Factors Driving Interpersonal Relationships at Workplace

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Abstract - Body Language is a significant aspect of modern communications and relationships. Appearance at workplace has been a debatable topic whether it affects the productivity or not. Right body language and appearance of a person helps in making positive interpersonal relationships at workplace which foster a healthy environment and thus enhances the performance of employees which results in better productivity. This research is aimed at examining the importance of body language and appearance on interpersonal relationships at workplace. During interactions at workplace, visual aspects like body language and appearanceare a great contributors in creating impression on others mind. This impression will decide the interpersonal relationships at the workplace because people want to be associated with personalities with great appearance and body language.

Keywords : Body language, Non verbal, appearance, productivity, postures, gestures, performance.

I. INTRODUCTION

Imagine the people around communicating with no movements, no actions. Here, comes the importance of nonverbal communication. Out of the two types of communication-verbal and non-verbal, the latter plays a very important role since it is a part of every face to face communication. When it comes down to bodily movements displayed by humans, it is rather interesting to see how different people are using a variety of gestures and facial expressions to convey their messages either together with or completely without the words. This also makes us wonder what are the essentials of nonverbal communication and how one could interpret other people's body language better even if the latter did not say a single word (Lewis, 2010). Professor Mehrabian in his research also found that during interactions, only 7% is verbal communication and the rest 93% weight age goes to non verbal communication. We have examples of various successful public speakers-be it political or motivational and the success credit for their powerful speeches goes more to their non verbal communication style.

Knowing how to read body language gives you an advantage because you start reading between the lines and can witness both the image you are projecting and how other people are trying to project themselves. In this case, one may easily detect a lie or display confidence by means of resorting to body language while also gaining more insight into people's emotional states based solely on their physicality (Birdwhistell, 2010).

The overall importance of learning body language consists in the fact that it may give individuals even more advantages that a mere ability to spot liars. From the perspective of interpersonal relationships, body language could be one of the most effective instruments allowing you to 'stimulate' someone's interest in you: based on whether the person is crossing their arms in front of you or has dilated pupils and a spark in their eyes, you will be able to find out what a person truly thinks about you rather quickly (Kuhnke, 2012). When going through a generic business scenario such as sales or even a job interview, a person could display their most confident body language in order to persuade others (Lewis, 2012). Coherent body language brings not only persuasion but also trustworthiness, which is just as much important as knowing how to use body language. When a person is calm and confident, we see them as authoritative because they are practically presenting the best version of themselves. Most importantly, choosing the right posture could also help a person boost their confidence even if they are diffident (Matsumoto & Hwang, 2013).

One cannot afford to ignore the fact that actions speak louder than words, that is the body language is much more powerful than the words. Body language or bodily movements play a very important role when we interact with people. A person's appearance which includes clothing, hairstyles, accessories and other factors affecting appearance are also considered very crucial which can alter people's reactions, judgments and the impressions people will make of us. It is very natural that man being a social animal so in order to fulfill his social needs, he interacts with people and build relations at workplace too. The non verbal aspects of people that is the kind of body language they carry and their appearance are a major deciding factor in deciding with whom they make relationships with. Everyone loves to be around confident personalities who motivate us, who possesses the right attitude, and carries the right professional appearance. People with right body language and appearance are perceived to be confident and serious towards work and people get along well with such personalities. Organizations which focuses on the non verbal aspects like appearance, attire, body language and other related factors while hiring the candidates have more professional and healthy working environment. Research has demonstrated that healthy relationships at work can improve individual employee attitudes like job satisfaction, commitment, engagement and perceived organizational support(Cherniss,1991;Ellingwood,2001; Jehn and Shan,1997; Morrison,2009; Riordon and Griffeth,1995;Robinson et al,1993; Song and Olshfski,2008; Zagenczyk et al,2010).

II. STATEMENT OF THE PROBLEM

Body Language has been a very important factor when the communication process takes place. Similarly, the appearance of a person also plays a crucial role in determining the kind of personality of a person and leaving an impression on people's mind. Non verbal factors, are also a deciding factor in the interpersonal relationships at workplace. For eg :- A person coming to the office shabbily dressed and carrying wrong body language versus a person coming to the office in well dressed manner and with full of confidence, in both cases people will mix along well with the latter case. So, the study was directed to answer this question, What is the role of appearance and body language on interpersonal relationships at workplace?

III. RESEARCH QUESTIONS

The paper intends to provide answers to these questions :-

a) What is the role of non verbal factors on interpersonal relationships at workplace?

b) Can body language and appearance of a person lead to increase in productivity?

c) Can people with right body language and good appearance create healthyprofessional environment?

d) Can we improve interpersonal relationship and productivity at workplace by hiringcandidates with right body language and appearance?

IV. PURPOSE OF THE STUDY

The purpose of this research was-

- 1. To find out the role of body language and appearance on interpersonal relationships at workplace.
- 2. To find out if there is any relationship between appearance, body language and productivity of an organization.
- 3. To find out if organizations can improve their productivity by paying focus on body languageand appearance as well when hiring.

Significance of the Study :-

The study of determining the role of body language and appearance on interpersonal relationships at workplace will help the organizations, employers and concerned people in a number of ways. This study will help to unveil the importance of non verbal factors at workplace and provide the employers with the results that whether they should lay focus on non verbal factors while hiring or not. Also this study will be beneficial for organizations to know the linkage between productivity, healthy environment and personalities with right body language and appearance at workplace.

Definition of terms :-

Body language is'a type of non verbal communication that relies on body movements (such as gestures, postures

and facial expressions) to convey messages. Appearance conveys non verbal impressions that affect receivers attitudes towards the verbal message even before they read or hear them (Murphy). Physical appearance includes one's looks, clothing, accessories etc. Inter personal relations at workplace constitutes day to day interaction between co-workers, managersor employees.

Body Language & its impact on interpersonal relationshipsat Workplace

Body language and appearance are one of the most powerful aspect affecting the workplace relationships. While speaking to the entire company at a meeting or while conversing with a co worker, the body language and appearance affects the entire communication. Positive non verbalcommunication helps colleagues in the workplace build positive business relationships, whereas negative nonverbal communication can cause conflicts and other negative disturbances in workplace. Body language is not just about how one hold and move the body. It also includes how the human bodies are positioned and the space between two people while communicating (proxemics), the facial expressions and the movement of the eyes, etc are part of body language. These non verbal behaviors send strong messages and can make people enjoy your company or not. A person with right body language is perceived as an honest and trustworthy person. If the content spoken and the body language are different, one is perceived as dishonest by people in the organizations. Eg:- If a person says 'yes' by shaking head no will give the listener a mixed signal and he will be confused. Healthy interpersonal relations happen to be the core of the success of any organization as it enhances the team spirit. Folded arms, slouching, frowning, turning of body away from others or poor eye contact destroy the relationships at the workplace as these postures signals a negative image of the person. On the other hand, open body position; unfolded arms, using upright posture with relaxed and open facial expressions make healthy interpersonal relations between two people. Maintaining proper eye contact and smiling at appropriate time always make relationships stronger. Some of the major aspects of body language includes :

Eye Contact- The famous saying 'Eyes are the window to the soul' is absolutely true in thesense that when communication takes place, the reaction of one's eyes-movement, focus or expression and the reaction of the other party contributes in mutual assessment and understanding consciously and unconsciously. Maintaining eye contact while interacting with people at workplace signifies genuineness. People often attribute trustworthiness to people who speak while maintaining good eye contact and vice versa. It also makes people look confident and is an indication that one is interested in the conversation.

Facial Expressions - The Six Universal Facial Expressions are used universally by all to express the feelings or emotions. These are-Happiness, Sadness, Fear, Disgust, Surprise, Anger. Facial expressions are helpful as they may show hidden emotions that contradict verbal statements. Eg:- An employee may deny having knowledge of a problem, but also have a fearful expression and glance around guiltility. Similarly, a forced smile can look fake and indicate thatthe person wants to hide his/her true feelings.

Postures & Gestures - Posture is the way of sitting, standing, walking or holding head and creates a huge impact on the overall personality of a person. Gestures are using body movements, especially of hand or head to express an idea or meaning. Eg:- If a colleague raises a hand during a heated discussion, the person may want everyone's attention or may want others to stop talking. Hand gestures are especially rich conveyors of communication. Less conscious gestures such as scratching of nose, stroking of hairs can communicate messages inadvertently and affect the image of a person and hence affect interpersonal relationships.

Touch and Hand Contact - Touch is a powerful method of non verbal communication. A pat on the back for appreciation, a hug, with or without words strengthen interpersonal relations at workplace. However, such touch should happen between same sex as these could be inappropriate or objectionable at workplace if it happens between opposite gender. Shaking of hands builds good relationships between people and develops a feeling of trust and confidence among them. Shaking hands when meeting or parting with people at workplace can make both the parties feel good and improve relations. Skin to skin contact creates a bond of trust between co-workers. Refusing to shake hands can insult others and worsen the relations.

Smile - Smile is a part of body language and indicate positivity or negativity of a person.

Therefore, smiling at right time can improve the relations at workplace. For eg:- Wishing your seniors with appropriate smile or replying with a smile when someone wishes you in the organization can make relations healthy and stronger.

Appearance and its impact on interpersonal relationship at workplace :-Visual impact is as important as verbal impact. People quickly make assumptions based on the person's appearance, which includes, the clothes one wear, and how well-groomed a person is..It has been observed that people wearing right formal dress with appropriate accessories and makeup (in case of females) creates a positive impression in the minds of their colleagues. On the other hand, people who do not pay attention to their appearance are taken less serious and also a negative image gets created in other's mind. Some major contributors in appearance are :-

Dress- Dress at the office affects the overall impression and environment. The kind of dressing depends on the nature of business. Strict professional business attire is required for settings like law offices or corporate headquarters. Suits for both men and women is common in such organizations and gives a formal look to the personality. Business casual dress like pants, khakis, skirts etc. can also be worn. The type of dressing can create an impression in people's mind which also affects interpersonal relationships. It has been observed that bosses who lay focus on their dressing are taken more serious and have a professional image of themselves in their colleagues minds. On the other hand, if people around are not dressed appropriately, peopledon't perceive them as serious professionals which can hamper interpersonal relations.

Accessories - Watches, footwear, minimal jewellery add a classy look to one's personality and creates a positive impression in other's minds. However, tattoos and piercings are less professional. So, accessorizing oneself enhances the look and make us likeable and improve interpersonal relations at the workplace.

Grooming- Maintaining personal hygiene like body cleanliness, hairstyle, clean trimmed nails makes a positive impression in others mind. As per the survey conducted on 100 working people of different organizations, 70 people preferred clean shaved look being more professional as compared to bearded look whereas 30 people preferred beard look at workplace. However, beard should be properly trimmed.

II. Relationship between Non verbal cues (Body Language, Appearance) on the performance and productivity of organizations:-

In organizations, the manager's attitude, which is mostly communicated by non verbal messages(body language and appearance) can produce either positive or negative attitudes by the employees. This affects the employee's attitude when performing job duties which in turn can either enhance their performance or lower it. The body language and appearance of a person portrays his confidence level which makes a positive or negative impression in the workplace. Ithas been observed that when a person competes for anything, he generally look at his competitors and creates an impression in his mind regarding the level of competition. For eg:- Astudent going for an inter-school cycling competition would look at all participants and judge them based on their look and body language and make an impression in his mind about the level of competition. So, in such situations also people make use of body language and appearance as a parameter to judge the intensity of competition. Thus, a right body language and a great appearance could be used as a competitive advantage. According to the theory called 'embodied cognition' the physical movements can shape and influence the thoughts and moods. Carrying right posture or expression affects the way we feel and thus the way we work.

Observing the body language of oneself and others can improve the performance and productivity of the organizations by taking corrective steps when needed. Making eye contact, nodding the head while other party is talking or leaning towards the other party while they speak indicates the person has full attention towards them. Similarly, leaning back in the chair, fidgeting their fingers indicates boredom or distraction. Observing these messages, one can responds towards such people or the team for corrective measures. Leadership also requires correct body language and appearance. The appearance actually affect the overall work performance due to the fact that it has a strong impact on how others perceive, creates an overall reputation of a person at job. Organizations having a formal dress code were found more productive because of more professional environment existing there. However, a strict dress code is not necessary in today's time. Even big companies like Infosys have removed the dress code system but the fact that a formal attire as per the environment is necessary. Organizations that lay focus on the non verbal aspects like body language and attire while hiring the candidates are more productive as compared to others.

Following points show that how body language and appearance increases productivity :-

The Perception- People wearing clean, ironed professional clothes are taken more serious atworkplace as it indicates the effort and time they have invested into presenting themselves This enhances the confidence level which reflects in the performance and in their ability to be productive. People in a position of power are heavily judged based on what they wear.

Sense of trust- People like to work personalities who look professional. It gives ease and sense of trust.

Hence, appearance affects the productivity.

III. Research Methodology :-

This research work is descriptive in nature as a detailed study has been done by the researcher to describe all the aspects relating to body language and appearance and its impact on interpersonal relations at workplace. The data has been collected using both primary and secondary sources.

Various websites, articles, published research papers and journals are used as secondary sources. Survey method and personal interaction has been used for collecting first hand data. A survey was conducted on 100 people belonging to different age groups (20-45 years) working in different organizations.

IV. Findings

- 1. 77 out of 100 respondents believe that the body language and appearance has a significant role during interactions at workplace. The body language and appearance are considered an important factor by the respondents while making interpersonal relations at workplace.
- 2. 86 respondents believe that they can easily get along well with people having attractive appearance and right body language at their workplace.
- 3. 95 people believe that people having right body language and appearance can in a much better way convey their thoughts and also have more influencing power in the organizations.
- 4. 76 people believed that a leader must possess the right body language and have goodappearance.
- 5. 76 respondents said that people with right body language and appearance have an extraadvantage in the organizations in the sense that they are taken more serious and more professional in their approach.
- 6. 70 out of 100 people preferred clean shaved look as more professional over beard look formales. While in females, 82 respondents believed that makeup and right attire builds confidence in females and make them look more professional.

V. CONCLUSION

Body language and appearance are very important tool to help us communicate with others in a more effective way and leave a positive impression on others. This paper shows how powerful body language and appearance can be. Thus, carrying the right body language and emphasizing on the appearance builds confidence in oneself which impacts the performance of an individual .It also develops healthy interpersonal relations between people which builds a healthy environment and thus enhances the productivity of whole organization.

REFERENCES

- [1] Ambady, N., & Weisbuch, M. (2010). Nonverbal behavior. Handbook of Social Psychology, 5, 464-497.
- [2] Ang, S., & Van Dyne, L. (2015). Conceptualization of cultural intelligence: Definition, distinctiveness, and nomological network.
- InHandbook of Cultural Intelligence(pp. 21-33). New York, NY: Routledge.
- [3] Argyle, M. (2013).Bodily communication. New York, NY: Routledge.
- [4] Berger, A. A. (2016). Interpersonal communication. InMessages (pp. 100-117). London, UK: Routledge.
- [5] Birdwhistell, R. L. (2010). Kinesics and context: Essays on body motion communication. Philadelphia, PA: University of Pennsylvania Press.
- [6] Bond, A. H. (2012). Michelle Obama, a biography. Santa Barbara, CA: ABC-CLIO.
- [7] Bonvillain, N. (2019). Language, culture, and communication: The meaning of messages. Lanham, MD: Rowman & Littlefield Publishers.
- [8] Burgoon, J. K., Guerrero, L. K., & Floyd, K. (2016).Nonverbal communication. New York, NY: Routledge.
- Dingemanse, M., & Floyd, S. (2014). Conversation across cultures. InCambridge Handbook of Linguistic Anthropology(pp. 447-480). Cambridge, UK: Cambridge University Press.
- [10] Fiske, J. (2010).Introduction to communication studies. London, UK: Routledge.
- [11] Gordon, M. R., & Trainor, B. E. (2012). The endgame: The inside story of the struggle for Iraq, from George W. Bush to Barack Obama. New York, NY: Pantheon.

RESEARCH ARTICLE

A comprehensive study of AI/ML in intelligent agriculture

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ABSTRACT

This study explores the equipment and technologies utilized in intelligent agriculture. Artificial Intelligence and system gaining knowledge of strategies, consisting of basic block models which are used to do clever agriculture. How are we able to use fuzzy logic and artificial Neural network, is likewise protected on this paper. We have explored a number of the IOT primarily based irrigation systems including crop prediction structures. The vital hardware, software program and sensors that can be used to make precision agriculture also are covered. The principle motto of this paper is to get an in depth literature assessment that is required for clever agriculture.

Keywords: Artificial Intelligence, Machine Learning, fuzzy logic, Artificial Neural Network, IOT, Precision Farming

I. INTRODUCTION

Techniques which might be used for agricultural paintings traditionally are no longer a good deal powerful and accessible. It calls for masses of workforces and everyday tracking. So, to reduce the exertions and increase productiveness, we want to change TO smart agriculture over traditional farming techniques .A farmer in conventional techniques of agriculture wants to recognition at the parameters which includes soil moisture, temperature tracking, humidity, and so forth. So glaringly hard paintings fee is extra and non-stop monitoring isn't feasible all of the time .We can use the internet of factors to restriction the cost. IOT is the mixing of diverse such things as sensors, community devices, and devices that we use to automate statistics recording. Through the use of IOT gear we're able to advocate movements required .Artificial Intelligence has also been extensively utilized in masses of fields, be it scientific technological expertise, schooling, finance ,agriculture, industry, protection, and so forth. AI trains machines a terrific manner to take choices inside the same way people take .Device getting to know is the sub area of AI. The primary venture involved in the approach of system gaining knowledge of is that we positioned the information in the tool that has come from beyond outcomes and this facts, is used by the device to make similarly picks. In fields like voice reputation, photograph identity, weather forecasting ,and many others, professional information is analyzed ML is a mathematical approach to construct intelligent machines. With the improvements in AI, numerous extraordinary ideas and strategies have been invented and discovered which simplified the trouble-solving assignment .Few methods are:

1. Fuzzy logic

2. Artificial neural networks (ANN)

3. Neuro-fuzzy logic4. Expert systems

II. LITERATURE REVIEW

Plenty of things have been evolved within the field of AI during the last many years due to its soundness in the software and on account that it's miles ubiquitous in almost every subject. An instance of it's far agriculture which we've got explored in this paper. Agriculture is the spine of India and it additionally faces a variety of demanding situations every day. Elements that save you the crop from developing are-

- negative water availability
- hot temperature
- opposition among flora for sunlight, nutrients, water or area
- out of control use of chemical substances
- Fungal, bacterial or viral contamination
- attack from insects or other organisms above or below floor
- So our objective is to-
- Automate tracking and analysis assignment off armers
- identify plant disorder
- Forecasting plants
- Detection of larva activities
- Maximizing yield using minimum resources

2.1 Simple block models for smart agriculture

2.1.1

An event driven WSN for monitoring plant health and Larva actives [1]

ARM Cortex A4 processor-based WSN for facts collection (inclusive of Larva sports) from sensors has been used. This has been awoke by the bottom station. Sensing nodes transmit statistics only in case when there's a whole lot difference in values that is going to automatically lessen the power consumption. Extracted statistics from a set of sensing nodes is transmitted to the base station with the aid of the usage of wireless Zig bee protocol. The bottom station is attached to the CPU through USB Liaison between CPU and Base station, and right here we can see all of the gathered statistics which we obtained from the sensors in the form of an ACI evaluation and this evaluation is carried out the use of Matlab.

2.1.2

UAV Routing protocol for crop health management [18]



Fig 1. UAV routing protocol

- All sensors hubs are heterogeneous and might be exceptional long. Among those hubs, one hub is chosen as a group head (CH).
- To choose CH, an arrangement of rules is characterized and the chance of each and every hub teaming up in CH is determined through the Bayesian classifier set of rules.
- all of the part hubs convey realities to CH the utilization of TDMA (Time division more than one access) conspire.
- CH will supply data to UAV (automated ethereal vehicle) (drone).
- Reenactment is completed in OMNET ++ and the way of a robot is given ahead of time.
 2.1.3

Accuracy agribusiness checking framework utilizing Green IOT [2]

a) Requirement comparison - all the purposeful and nonfunctional necessities are gathered.

b) Specification stage specifies the required gadgets in particular primarily based on necessities gathered and solely these sensors will get activated, this will saves value automatically.

c) Architectural degree become aware of slave node and hold close node. All the slave nodes are accountable to furnish the statistics to the corresponding grasp node.

d) Component level- its duty is to operate all the elements in the architectural stage. Hardware components- gadgets and sensors Software components-BBB Debian, cloud9 IDE for programming editing, debugging python code

e) Integration level- this degree is in charge to be a part of all the elements to shape the required architecture.f) Application-level- consequences will be displayed on the application.

2.2 Irrigation System using Internet of Things:

In 2014, GPRS characteristic of a phone cellular telephone used to be used to raise an irrigation machine via Ali, T. A. A. et al. In this microcontroller-based rain gun irrigation system, water furnish will be there completely when there is an acute water shortage. The sole intent is to hold water, alternatively, this laptop is no longer financially affordable.

Internet of Things In 2017, Arif Gory et al. [3] proposed a mesh-based approach for putting sensor nodes in agricultural areas. The statistics from these sensors are accumulated with the aid of the base station (which is stationary) (they are mobile). Following the gathering of all facts base stations, the information is processed. The pH sensor used to be used to decide whether or no longer the dirt used to be acidic or antacid in nature. The discovered attributes from the pH sensor had been relayed to the Android application, and as appropriate, picks had been made.

Bea, J. G., & Palaoag et al. [4] used formal good judgment in 2017 to classify rice and maize soil wetness system readings inside the lessons as "too wet," "wet," "normal," "warm and "to heat." Such readings are frequently accustomed to evaluate the facet charge for these two plants which would possibly be accustomed flip the motor pump on / off.

In 2018, Chaudhry, S., & Garg, S. et al. [5] deliberate a device that used to be divided into three sections-sensing a section of humidness, area of management and part of the production. Soil humidness is evaluated by means of using a YL-69 sensing element, and also the management unit is that the Arduino platform is primarily based on the whole ATMega328 microcontroller. The sensing factor sends the perceived expertise to the small controller, which then works with the aid of flipping the motor pump on and off consequently.

2.3 Fuzzy logic in smart agriculture

Fuzzy operators carry out like a human driver and therefore regulate the interaction among entering and output similar to the formerly described collection of club functions and guidelines. A fuzzy skeleton is a linguistic-based control tool, which tries to imitate a human professional's moves. Six inputs And outputs seem in AGR Says [6]. They have got used the multiple input to more than one output (MIMO)type the use of the fuzzy good judgment library beneath Lab VIEW. This device is deployed on a web server to permit faraway get admission to and managed or discovered thru any smart tool.

• This system uses five inputs, each with its own minimum and maximum values: humidity, temperature, PH, soil moisture, and thermocouple.

• The following are the specifications for its function:

• If the sensor value of a Rectangular Humidity Membership Function is less than 55, it is considered dry; otherwise, it is considered wet.

• The pH membership function of a trapezoidal shape is classified as acidic, normal, or alkaline.

• Triangular Situation Cold, Warm, and Hot are the three temperature membership functions.

• The membership function for triangular soil temperature is Cold, Warm, and Hot.

• The Unsaturated and Saturated membership functions for Trapezoidal Soil Moisture (Water Level) are studied.

2.4 Artificial neural networks in agriculture

The ANN method was created by recalling a comparable concept of how the human cerebrum works. ANN is a projectbased method that instructs the framework to work based on some inbuilterr rather than a standard computational modified assignment. Three layers make up the ANN engineering:

1 Input layer

2 Hidden (middle) layer

3 Output layer

The ANN model is made up of several neurons, each of which delivers a grouping of true valued activations. Initial neurons will be actuated when sensors detect changes in condition, and different neurons will be activated through weights linkages from already active neurons. Depending on the specific challenges and topology used, these procedures may necessitate some computational work, as each stage affects the entire actuation of the system. Deep learning allows computational models made up of numerous handling layers to communicate with data with varying degrees of reflection.

Many areas of analysis have seen significant improvements in the strategy. Some DL calculations are driven by the concept of a Back Propagation Neural Network. Extremely high up grades have recently been achieved in the DL profession, thanks to a lot of enthusiasm. Horticulture has gotten a lot of attention because of DL. Picture recognition is one of its agribusiness applications, and it has overcome a slew of roadblocks that have stymied rapid advancement in mechanical and automated agriculture. Plant illness detection, weed control, and plant inspection are just a few of the areas where these advancements have been noticed.

This work summarises BP and normal DL calculations (Convolutional Neural Networks (CNN), Recurrent Neural Networks (RNN), and Generative Adversarial Networks (GAN))and their applications in horticulture, with an

emphasis on applications distributed over the most recent years, in order to provide a comprehensive image of DL to scientists in agribusiness fields and upgrade current day shrewd farming turn of events. Song (2005) [8] used a combined expert system and an artificial neural network to forecast the level of nutrition in the crop. The entire system is based on a single chip computer.

Second, Stone and Toman (1989) [9] developed the COTFLEX framework for cotton. The framework was created as a stab at the Pyramid 90 PC using UNIX as the operating system. The architecture combined the field and homestead databases to provide the rancher with important data on the cotton yield, making it easier for the cultivator to make fundamental and strategic decisions. The framework was developed in Texas, and it included recreation models and databases in a standard-based master framework to help Texan ranchers make financially sound decisions. COTFLEX was then loaded onto an IBM microcomputer and made available for usage.

In Rajasthan, India, a specialised framework PRITHVI by Batchelor, W. D. et al. [7](2013) based on fuzzy and implemented on Matlab was developed for Soybeanscrop. It gathers information from rural officers, disseminated writing, and soybean crop professionals. When considering the complete framework and encouraging the rancher to be an expert, fuzzy rules were explored. The system was divided into five modules. The major goal of constructing this master structure was to assist ranchers in increasing production.

A forecasting technique that advocates using ANN computations for crop forecasts in smart phones was successfully tested in 2016 [10]. There were three layers to this architecture. The model's efficiency was determined by the number of hidden layers. To determine the number of shrouded layers, an experimenting technique was used. Because the precision of the expectation framework is dependent on the number of hidden layers, this can be a precise technique to investigating the choice of shrouded layers. It was also discovered that increasing the number of shrouded layers will result in a more precise forecast.

Furthermore, using image analysis and neural systems, a technique was developed to separate weeds from crops with a precision of over 75% with no prior plant data taken into account in the framework. Aitkenhead, M. J. et al. (2016) [11] developed masterframeworks based on a strategic horticulture framework. The purpose of IoT in this framework was to transmit information to the server so that field actuators may make appropriate decisions. For this, the server must be intelligent enough to make independent decisions.

2.4.1 Neural Network in smart agriculture

When it comes to plant ailment detection, it's time-consuming. Plant disease recognition can now be cultivated through IP thanks to the growth of man-made consciousness. The most reliant on leaf image categorization and pattern recognition are plant illness recognition systems [13]. A plant disease identification structure was constructed using an epic DL structure. This structure has the ability to recognise plant leaves based on environmental parameters and can detect 13 different types of plant ailments.

In a study of using Deep Learning to detect plant diseases, the overall precision was 95.7 percent after 100 minutes of preparation and 96.4 percent after more tuning. In actuality, the results are better than manual location. All of this showed that DL is capable of identifying plant diseases. Yalcin, H [14] is a pretrained convolutional neural network that is used for plant classification. According to the results of this model in 2017, CNNengineering outperforms AI algorithms that rely on available produced highlights for phenological stage separation.

Self-arranging Kohonen maps (SOMs) were used for optical image segmentation and the reconstruction of missing information in a periodarrangement of satellite symbols in another study. This technique comprised a post-preparation step that included a few filtering computations based on the available data as well as geographical analysis. The classification of major harvests was done with an accuracy of 84.9 percent [12].

In any event, the use of CNN for plant grouping has been hampered by issues. For yield forecasting, organic product inspection is critical. Manual tallying or checking with a handheld camera can't produce satisfactory results and is time consuming. Blob detection has been shown to be useful [10], leading to the recommendation of using a full CNN. The structure's main goal is to build man-made names out of a large number of organic product images. The fully convolution network (FCN) approach was ready to do picture division at that time. The check convolution organizer was then ready to accept the segmented image and calculate the number of grapes.

Our final goal is to use a linear regression equation to convert the number of fruits counted initially to the final number of fruits counted manually. The accuracy and productivity of checking were both increased using this Deep Learning with blobdetection approach. Satellites and unmanned aerial vehicles (UAVs) are rarely used to investigate various assets [15], which rely on deep convolutional neural networks (DCNN) and transfer learning (DTCLE). To discover cultivated land data, a characteristic identification technique based on DCNN was used. Finally, for cultivated land information extraction, the DTCLE and e-Cognition were used (ECLE). Although both are approximately 90% accurate, DTCLE outperforms ECLE in terms of integrity and consistency. The usage of UAVs provides high-resolution images.

The detection of any item, or finding any thing, is a rapidly growing domain in Deep Learning. Detection is also important for ranchers in the horticultural industry, especially since that extremely self-ruling equipment are being increasingly used. These computers should be highly reliable with automatic real-time risk identification in order to work these tools securely but without oversight [16]. When picture classification is done with AlexNet and DCNN, a system with

99.8% accuracy in crops and 90.7 percent accuracy in grass is available. It has also enhanced performance and is significantly superior to existing methods[17].

2.5 Prediction System

Attempted to describe soil based on its nutrient content using a decision tree algorithm . Crops appropriate for various soil types were also predicted. Classification and Regression Trees (CART) and C4.5 are two decision tree techniques that are commonly utilised. The CART's main disadvantage is that it makes mistakes when the selected parameter region is larger, whereas the C4.5 method favours higher value characteristics. They offered a modified method to the decision tree in order to solve these drawbacks. Instead of using the CART algorithm to calculate for each pair, they calculated the Gini index for several sets of parameter values and then used ratios of these measured Gini indices to reduce the bias introduced by knowledge gain in the C4.5 approach. Employed decision tree induction to investigate the impact of climate variables on soybean productivity in order to help researchers and farmers anticipate market dynamics. Agro-climatic data was collected in the Bhopal district from 1984 to 2003

2.6. Uesing of Hardwares

2.6.1 ESP Units

The ESP Internet of Things network is a low-cost, highperformance network. It's used to send real-time data from the field to the internet of things. It has two functions, and it may be utilised with a self-contained Wi-Fi networking solution to transport and drive the entire programme. It can also be used as a Wi-Fi adaptor to power other microcontrollers that can run more complex applications than ESP. In this project, the Arduino UNO will be the primary microcontroller, with the ESP 8266 acting as a Wi-Fi adaptor. Multiple general-purpose I/O pins of the ESP are utilised to connect sensors to the microcontroller directly. It has a 32-bit microprocessor on board that controls communication, power modes, and GPIO. Within 3.0 to 3.6 volt power range.

2.6.2 Motor Operator

Although the Arduino UNO runs on 5 volts, the engine runs on 9 volts. In addition, the engine requires more current than the Arduino provides. For this, a motor driver controller circuit can be used. The motor driver circuit connects the Arduino UNO to the motor. It supplies the necessary power to run the motor.

2.6.3 Odroid XU4

The Odroid XU4 Model B improves on the features of its predecessors by including a second, faster processor. It also combines WiFi and low-vitality Bluetooth capabilities to boost the network and USB port capacity, allowing it to

International Journal of Computer Science Trends and Technology (IJCST) – Volume 10 Issue 4, Jul-Aug 2022

control more cell phones. Upgraded micro USB power source to 2.5A. Odroid XU4 is a single-board computer designed to support and encourage programming and computing education. It's also an excellent starting place for ongoing Internet of Things (IoT) projects. Because of its inexpensive cost and 'plug-and-play' nature, the Odroid XU4 may be used by anyone and provides a wide range of networking choices. Whether you want to use it as a workstation, media centre, server, or monitoring/security device in your house, Pi is the ideal experimental instrument. There are none. Linux-based operating systems operate on the XU4, and there is plenty of free software available.

2.6.4 Relay

A relay is a device that uses electricity to work. To accurately operate a switch, many relays use an electromagnet, however alternative working standards, such as strong state relays, are also used. When a circuit needs to be confined by a different low-power signal, or if several circuits need to be constrained by the same signal, relays are used. It's referred to as a contractor type of transfer since it can handle the tremendous force needed to control an electric engine with or without loads.

Relays are commonly used in safety-critical logic because they are substantially more resistant to radioactive radiation than transistors. To distinguish over-burden and other defects in onelectrical lines, electromechanical protection relays are used to open and shut off circuit breakers.

2.7 Sensors

2.7.1 Sensor for Temperature And Humidity

The DHT-11 temperature and humidity sensor is used. A thermistor is used to detect the temperature of the surrounding air. This technology is energy efficient and cost-conscious. A temperature-proportional output is provided by the DHT 22 IC temperature sensor. The DHT22 sensor is more precise than the thermostat in measuring temperature. The temperature range for operation is -40 to 120 degrees Celsius. Each 0C rise/fall in ambient temperature causes a 10mV variation in output voltage.

2.7.2 Sensor for Humidity

Sensors and probes YL-69 The moisture content of the soil is measured with the YL-38. Two copper strips, coated with acrylic paint to increase conductivity, make up the YL-69 probes. One of the sensor samples is made of aluminium, while the other is coated in polyaniline nanoparticles to improve conductivity.

The humidity sensor consists of a tiny condenser made of a dielectric substance that is positioned between two electrodes. 0 RH at 100% Every two seconds is the average sensing interval. 1.3–2.1 mA current 25.1 X 15.1 X 7.7 mm in size.

2.7.3 Sensor of Water Level

The water level sensor's specifications are as follows: outputs: 4.0-20.0 mA or 0.50 to 2.50 VDC, supply voltage: 3.30 to 5.0 VDC, dimensions: $60.0 \times 20.0 \text{ mm}$, contacts 45.0 mm, when the water level is low, the digital output is high, and the sensitivity is adjustable.

2.7.4 Data collection sensor

Routing of static sinks Data acquisition from mobile sinks by direct interaction Data collection based on rendezvous Routing using hash tables.

2.8 Decision Trees

In data mining, decision trees are commonly used for classification. A decision tree is a flowchart-like tree structure in which an interior hub represents a trait test, each branch represents the test's result, and the leaf hub represents the classes. The root hub is the first node in the network. A strange example is set up to test its attribute values along the decision tree, following a path from the root node to a leaf node that contains the forecasting class label.

Decision trees are of 2 types:

When the expected output is a class name, the Decision tree is referred to as a characterisation tree.

The decision tree is called a regression tree when the projected result is a real number.

III. CONCLUSION

An artificial intelligence has been developed to help ranchers in choosing the best composts for their crops. Field monitoring is obviously a required lessening of people intercessions. The machine talks among itself to pick which yield is sensible forgathering and moreover the composts which advance the greatest turn of events. DL has a wide range of applications, and its use in the company has advanced significantly. It is an even better situation over AI with the use of DL, and it gives depth to AI. This, in turn, aids the overall progress of the country, as food is the most basic demand of each individual. IOT intended for its magnificence to aid in constant data perception. The Internet of Things is mostly used in a smart watering system. Because practical use of open freshwater is significant, and with advancements in invention and application of innovation, the water emergency can be addressed. Farmers that use conventional methods confront problems such as water scarcity and flooding. We have provided a complete literature evaluation of factors related to smart agriculture in this research.

International Journal for Modern Trends in Science and Technology, 8(01): 62-67, 2022 Copyright © 2022 International Journal for Modern Trends in Science and Technology ISSN: 2455-3778 online DOI: https://doi.org/10.46501/IJMTST0801011

Available online at: http://www.ijmtst.com/vol8issue01.html



A Review on the Environmental Impacts of Corona Losses and Their Suggestive Measures

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To Cite this Article

Abhishek Vishnoi and Vikas Verma. A Review on the Environmental Impacts of Corona Losses and Their Suggestive Measures. *International Journal for Modern Trends in Science and Technology* 2022, *8* pp. 62-67. https://doi.org/10.46501/IJMTST0801011

Article Info

Received: 24 November 2021; Accepted: 31 December 2021; Published: 04 January 2022

ABSTRACT

Transmission losses are one of the biggest concerns around the globe. These losses have become an important issue for the poor economy of the third world. Extra High Voltage (EHV) and Ultra High Voltage (UHV) are one of the prevailed options for the reduction of these losses. But EHV and UHV transmission lines are responsible for corona loss. Corona effect at transmission line produces an audible noise under certain weather condition which affects the environment and the local people who are living in the vicinity. Audible noise produced by EHV and UHV transmission lines is becoming a major concern today. The generation of unreasonable audible noise within the environment is regarded as a form of pollution because it lowers the quality of life. There have been several specific ways in which excessive noise can affect people adversely. Noise has been found to interfere with our activities at three levels that are audio logical level, biological level and behavioral level. Due to this the noise affects categorically, performance, physiology and psychology of the humans. Noxious has been known to cause of nervous disorder, headache, high blood pressure and short memory. In this paper different techniques used for the reduction of noise produced by corona discharge is reviewed and its remedies has also been discussed in detail.

KEYWORDS: Corona losses, Noise pollution, EHV transmission lines, UHV transmission lines.

1.INTRODUCTION

Noise pollution is excessive, displeasing human, animal, or machine created environmental noise that disrupts the activity or balance of human or animal life. The word noise may be from the Latin word nauseas, which means disgust or discomfort. The source of most outdoor noise worldwide is mainly construction and transportation systems, including motor vehicle noise, aircraft noise, rail noise, noise created by power grid and many others.

Environmental noise produced by the power grid is mainly due to effect of corona discharge which generate very high audible noise in the form of humming and hissing. Corona, also known as partial discharge, is a type of localized emission resulting from transient gaseous ionization in an insulation system when the voltage stress, i.e., voltage gradient, exceeds a critical value. The ionization is usually localized over only a portion of the distance between the electrodes of the system. Corona can occur within voids in insulators as well as at the conductor/insulator interface.

Coronas can generate audible and radio-frequency noise, particularly near electric power transmission lines. They also represent a power loss, and their action on atmospheric particulates, along with associated ozone and NOx production, can also be disadvantageous to human health where power lines through built-up areas. run Therefore, power transmission equipment is designed to minimize the formation of corona discharge. Corona discharge is generally undesirable in Electric power transmission, where it causes Power loss, Audible noise, Electromagnetic interference, purple glow, ozone production, Insulation damage etc.

2.HIGH VOLTAGE AC TRANSMISSION LINES: REDUCTION OF CORONA UNDER FOUL WEATHER

The Corona effect is mainly associated with the transmission of electrical energy at extra high voltage (EHV) and ultra-high voltage (UHV). Especially in the case of AC lines the corona discharges at the surface of conductor produce more audible noise, electromagnetic interference and power loss under rainy season. In this paper the improvements of corona performance under rainy conditions have been discussed by optimizing the flow characteristics of water on the conductor or by using the shielding effect of ionic space charge to eliminate streamer discharges at the conductor's surface that leave the conductor's diameter untouched.

In this paper three different types of the conductors have also been reviewed, that are: hydrophilic, hydrophobic and ion-shielded [1]. The corona activity of a conductor under rain depends greatly on how well water adheres to its surface. If the contact angle is larger than it causes curbing corona activity and if it is smaller to the surface then water will spread in a thin coat along the surfaces, reducing drastically the linear density of water protrusions and leading to an accumulation of water on and in the stranded conductor. When the conductor finally sheds water, it does so by ejecting from an intermittent water jet shaped by the electric field. This means of shedding water is known as "Mode III"[2] and is very desirable, since it produces comparatively low corona interference levels. Also, the design of an antenna of 30- 50 Mc bands which affords a high degree of immunity from the noise of precipitation and corona has been reviewed. The main feature of this design is a dielectric sheath enclosing the radiating conductor. To reduce the contact angle to more favorable value, the aging of the surface, essentially a chemical aggression by the environment is used. In this paper both hydrophobic and hydrophilic methods is used to reduce corona interference were investigated.

3.SURFACE PREPERATION

"Hydrophobic" condition is obtained А by condensing a thin film of paraffin on a cold conductor. A cavity is filled with warm paraffin vapors from a hot plate. When the cooler conductor is rotated inside the cavity, a uniform coat is obtained within one hour [1]."Hydrophilic" condition is obtained by heating the conductor in a tubular oven to 600°C. A similar effect is obtained by passing the flame of a gas burner over the surface, although the effect does not then extend to the inside surfaces of the stranded conductor. The hydrophilicity is caused by the parceling out of the oxide layer due to differential thermal expansion of metal and oxide and to the dehydration of aluminum oxides. Unless the sample is kept in a dry atmosphere, the hydrophilic quality obtained by this method will not last beyond a few days [1]. The contact angle of a water drop with a surface can be measured at the triple point where surface, air and water meet.J.E. Cross^[1] has investigated methods to recover the maximum amount of available information from an image. Some radio frequency and optical sensors collect large-scale sets of spatial imagery data whose content is often obscured by fog, clouds, foliage and other intervening structures. Often, the obstruction is such as to render unreliable the definition of underlying images. Various mathematical operations used in image processing to remove obstructions from images and to recover reliable information were investigated, to include Spatial Domain Processing, Frequency Domain Processing, and non-Abelian group operations.

4. AN ANTENNA FOR 30-50 MC SERVICE HAVING SUBSTANTIAL FREEDOM FROM NOISE CAUSED BY PRECIPITATION STATIC AND CORONA

This section describes the design of an antenna of 30-50 Mc bands which affords a high degree of immunity from the noise of precipitation and corona. The main feature of this design is a dielectric sheath enclosing the radiating conductor. Noise from the charged particles is estimated to be reduced about 30 db by the dielectric sheath. A standard approach is used to minimize corona

effects. Vertically polarized, half-wave antenna is designed to reduce the received noise caused by electrically charged particles striking the antenna, and by corona discharge from the antenna into surrounding air. By placing the discharge point beyond the field of antenna is the most effective means of reducing corona noise. A considerable reduction in corona noise is possible if the discharge is permitted to occurring a gradual manner. "This technique, too, is applied in aircraft practices where corona noise is severe.



Figure 1: Sketch of antenna with dielectric sheath.

The method used to obtain a gradual discharge is to make it occur at a point, where a low gradient will start a small discharge. A high series resistance keeps the discharge at this low level, reducing the noise and also reducing the erosion of the point. By the design of antenna with dielectric sheath and laboratory tests have proved that 20 to 30 db noise is reduced from precipitation static and corona. A 30 Mc base-station antenna has been built embodying these techniques and more than one year of actual experience in the field, in a region of severe precipitation static, has confirmed the effectiveness of these measures [3].

A primary corona effect which is important to select the conductor is the Audible Noise (AN) due to higher voltage. The mainly audible noise is present in case of higher voltage power system (380 kV and higher) transmission lines.

In this paper Simulation is done for the different transmission configuration under various weather

conditions, that exists in the Eastern part of Saudi Arabia. ACDCLINE program of TL Workstation designed by EPRI is used for the simulation. Mathematical formulas to calculate (audible noise) of transmission lines of 34.5 and above is calculated by a software package written in FORTRAN 77 compiler, The results are compared for both simulated and formulas and verified for some existing data. The effect of rainfall intensity, lateral profiles of audible noise and the effect of bundle sub conductor spacing is also explained in this paper. To control audible noise in high voltage transmission line, several factors based on these effects have to be manipulated.

Audible noise in high voltage transmission line has two characteristics components, which is broad band noise (frying, crackling or hissing) and pure-tone components at frequencies of 120 Hz and multiples. The pure tone components are superimposed with the broadband noise. The tone or sound which is most noticeable is the 120 Hz "hum". It is very difficult task to define how much audible noise can be acceptable from a high voltage transmission line. However, it is important to know the fact that, as voltage levels are increasing day by day, audible noise becomes one of the restrictive factors in the design of high voltage transmission lines.

Audible Noise Frequency Spectrum

The Higher part of the audible noise frequencies spectrum is formed in between 800 and 10.000 Hz which is due to random noise generated by the conductor during rain. The most stable audible noise was the 8 KHZ.

Table 1 The comparison of Audible Noise of Differentweather conditions.

	WEATHER	TEST LINE	PREDICTEDBPA
8	100	dB(A)	dB (A)
2	FAIR	42.1	23.5
	WEATHER		
	STABLE	48.8	48.5
	RAIN		
	HEAVY	52.8	52.0
	RAIN		

• The Influence of Rainfall Intensity

It has been found that at the higher rainfall intensities. the nuisance effect of corona noise for residents living near the line will be lower because of the higher noise created by the falling rain. On the other hand, the measurement on the test line and the corona cage indicates that the audible noise reaches a saturation point at a rain intensity of about 30 mm / hr.

• Effect Of Test Voltage

Electric field at the surface of conductor is directly related to the test voltage which greatly affects the audible noise generation are shown in table 2.

Test Voltage (KV)	Audible Noise (dB)
630	46.6
765	48.8
783	50.5
800	51.6

Table 2 shows the relation Voltage & Noise

• Effect of Bundle Conductor Spacing

The result of the bundle sub conductor spacing on audible noise is shown in tables 3 and 4. A spacing of 40 cm for the heavy rain condition and 35 cm for the case of wet conductor condition produced the minimum Audible noise.

 Table 3 shows the bundle sub conductor spacing on audible noise

Distan ce from Outer Phase	Audib le Noise in Heavy Rain	Audible Noise in Wet Conduct or
0	62	56
50	58	49
100	51	45
150	47	41

 Table 4 shows the bundle sub conductor spacing on audible noise

Semic onduct or Diame ter	Audible Noise n=2	Audib le Noise n=3	
3	67	63	
4	65	50	
5	55	52	

5. TECHNIQUES OF AUDIBLE NOISE REDUCTION

There are different methods to reduce the audible noise in transmission line. Some of the methods are- Use of small wires or protrusions which generate "ultracorona", Conductor covered with a thick layer of insulation, Conductor covered with insulating tubes, Application of a dc voltage bias to reduce the positive peak, Bundle geometry optimization, Change in surface conditions.

6.MODIFICATION OF TRANSMISSON LINE AUDIBLE NOISE SPECTRA TO REDUCE ENVIRONMENTAL IMPACT

An unavoidable problem in the design of extra- and ultra-high voltage (EHV and UHV) transmission lines is the audible noise which comes into the picture under some weather conditions.

In this paper investigator take 5 corona noise samples for examine so as to over-come from the responsible factors for corona noise or audible noise. Since acoustic spectra and their modifications were the major factors under investigation, compensation was made for differences in the recorded (natural) levels of the 5 corona noises in the sample. This was achieved by equating all 5 spectra at a relatively high A-weighted sound level, representing possible "worst case" corona noises. Preliminary findings from the present experiment were briefly reported at an earlier Conference.[6]

Five samples of transmission line audible noise were recorded on magnetic tape. These are the following samples **Apple Grove Corona** - The audible noise from a test 775 kV ac transmission line located at Apple Grove, West Virginia, was recorded in the early morning after a heavy dew.

Roanoke Corona - The audible noise was recorded from an operating 765 kV ac transmission line located near Roanoke, Virginia. The recording was made during steady rain in a field at the base of a hill.

Peru Corona - The audible noise from an operating 765 kV ac transmission line located near Peru, Indiana, was recorded at night in a heavy fog.

Redmond Corona - The audible noise was recorded from an operating twin 500 kV ac transmission line located near Redmond, Oregon. The recording was made on a clear morning in a quiet desert.

The Dalles Corona - The audible noise from a test 600 kV dc transmission line located at The Dalles, Oregon was recorded in the desert on a clear evening. Three different levels of differential attenuation were applied to each of the 5 corona samples: 1) the low-frequency components (below 500 Hz) were attenuated by 12 dB; 2) the high-frequency components (above 500 Hz) were attenuated by 6 dB; and 3) the same high frequency components were attenuated by 12dB. Figure 2 shows 1/3-octave band spectra of the stimuli as reproduced in the realistic listening room and shows the unmodified spectra for the remaining 4 corona noise samples.



Figure 2:1/3-octave band spectra for 4 corona stimuli (\Diamond Roanoke, \triangle Peru, \Box Redmond, and \blacksquare The Dalles).

From this experiment we concluded that the high-frequency hissing and crackling components of corona noise are more effective than the low frequency humming and buzzing components. Therefore, the major concern for the audible noise is to reduce high frequency component of the noise spectrum.

7.CORONA SIMPLE TECHNIQUES USED TO ELIMINATE IN CONNECTOR & CABLE ASSEMBLIES

For high voltage and high reliability applications connectors and cables should have good characteristics. If we choose bad quality of connectors and cable then it causes corona. For it is very difficult to choose good connectors or cable between large numbers that specially when faced with selective solutions for high reliability applications. this paper illustrates some design techniques which improves the overall performance and quality of connectors and cable techniques which indirectly reduces corona.

CABLES- Coaxial type cable is mainly used for the high voltage of application where corona is the main consideration. In this paper a stranded type coaxial cable is designed which creates many interstices which act as air traps making it virtually impossible to eliminate all air during the insulation extrusion process. The capability of the cable is improved by introducing semiconductor layer around the air. Semiconductor provides a uniform surface for bonding to the primary insulation during the extrusion process. It produces a good cohesive bond with no air voids. The minimal conductive properties of semiconductor make it in equal voltage potential to the center conductor and hence eliminates the effect of the air in the center conductor.

CONNECTORS- We cannot get high reliability only by corona free cable. It is essential that the be combined with compatible termination process so that a reliable corona free cable assemble will result. This paper provides different termination techniques which have been used to eliminate corona. They are as: Shield Termination, Semiconductor Removal, Molded Configuration, Molded Body to Shell Fit and Sharp Corners. All have their different characteristics but molded configurations are far superior to field assembly type units because it is impractical to consistently

eliminate all of the air between the cable and the insulator when assembled mechanically.

8.CONCLUSION

The investigators have done a thorough review of the audible noise produced by the corona discharge which cause the noise pollution and its reduction techniques. Noise increases, decreases or stays constant, depending on the bundle conductor geometry, surface condition etc. one method to reduce audible noise which is produced under foul weather by improving conductor design such as hydrophilic, hydrophobic, ionic shielding. Investigator showed that in comparison to low frequency high frequency hissing and crackling sound is more aversive. In order to reduce high frequency component long- term sampling of corona noise from different transmission lines may be considered. Some methods are proposed to reduced corona noise still it is not up to the mark. Experiments to elucidate these effects are not finished up to now. Hence there is a wide scope for research in this field. transmission lines may be considered. Some methods are proposed to reduced corona noise still it is not up to the mark. Experiments to elucidate these effects are not finished up to now. Hence there is a wide scope for research in this field. Russ^[2] has investigated techniques of image processing. These are operations that start with a grey scale (or color) image and return another grey scale image. The next chapter will deal with some additional techniques that operate on grey-scale images for purposes of locating feature edges in the context of isolating features for measurement.

REFERENCES

- Paul Heroux P. Sarma Maruvada N. Giao Trinh" high voltage ac transmission lines: reduction of corona under foul weather" IEEE Transactions on Power Apparatus and Systems, Vol. PAS-1OI, No. 9 September 1982
- [2] Hoburg, J.F., Melcher, J.R., "Current Driven, Coroma Terminated Water Jets as Sources of Charged Droplets and Audible Noise," IEEE Article No. C 73 165-8, 1973.
- [3] Ned A. Spencer " An Antenna for 30-50 mc service having substantial freedom from noise caused by precipitation static and corona" IRE Transactions on Vehicular Communications Vol. No. 9 August 1960.
- [4] Al-Faraj. Shwehdi, M.H. Environmental effect on high voltage AC transmission lines audible noise IEEE Energy Conversion Engineering Conference, 1997. IECEC-97., Proceedings of the 32nd Intersociety, Vol. No. 3 August 1997

- [5] Molino, J.A. Zerdy. G.A.. Lerner, N.D. Harwood. D.L. " Modification of Transmission Line Audible Noise Spectra to Reduce Environmental impact" power apparatus and system, IEEE Transactions on Volume: PAS-100 April 1981.
- [6] J.A. Molino, G.A. Zerdy, N.D. Lerner, and D.L.Harwood, "Psychoacoustic evaluation of the audible noise from EHV power lines," IEEE Proceedings: Power Engineering Society, Atlanta, Georgia, April, 1979.
- [7] Conny Larsson, "Long-Term Audible Noise and Radio Noise Performance From an Operating 400-kV Transmission Line", IEEE Transaction on Power Deliver),. Vol. 3, No. 4.October 1988. pp.1842-1845.
- [8] ANSI/IEEE Standard Std 656-1992 IEEE for the Measurement of Audible Noisc From Overhead Transmission Lines.
- [9] "Effect of Bundle Orientation on Transmission Line Audible and Radio Noise". IEEE Transaction on Power Delivery. Vol. 9. No. 3. July 1993. pp.1538-1542.
- [10] "Effect of Bundle Orientation on Transmission Line Audible and Radio Noise". IEEE Transaction on Power Delivery. Vol. 9. No. 3. July 1993. Pp.1538-1542.
- [11] "Audible Noise". Transmission Line Reference Book 345 k V and above, Second Edition. Electric power Research Institute. Palo Alto. California. 1982.
- [12] T. Vinh, J. V. King. "Statistical Analysis of Audible Noise and Corona Loss Data For A 10-Conductor U I W Bundle". IEEE Transaction on Power Delivery, Vol. PWRD-2. No. 1. January, 1987. Pp.217-225.

asuaise

A STUDY ON GREEN HRM CRITICAL SUCCESS FACTORS AT WORK PLACE

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ABSTRACT

Green HRM is the use of Human Resource Management policies to promote the sustainable use of resources within business organizations and more generally, promotes the cause of environmental sustainability. Objective of the Study is to Explore Green Human Resource Management practices of organizations and to promote the ideology that is important for proper alignment of human resource management principles with objectives of green management in an organization. It is a descriptive method based on both primary and secondary data. Green HRM encompasses all activities aimed at helping an organization carry out its agenda for environment management to reduce its carbon footprint in areas concerns on boarding and acquisition of human resources, their induction, performance appraisal & management, training and development and pay and reward management. This is only possible by the effective implementation of green HRM within the organization. These practices would result in improving employee attitudes and behaviors within theorganization.

Key words: Human Resource Management, Green HRM, Environment, Organization, Corporate Image.

INTRODUCTION

More of the corporate bodies' recent interest has been paid to environmentalism globally, whether arising from specific treaties or from harm/pollution resulting from high-profile industrial accidents such as killing and injuring many people to struggle climate change. Owing to the harmful consequences of industrial pollution and waste materials, including toxic chemicals, governments and NGOs round the globe promoted regulations and policies with effect of slowing down and to some extent even reverse the destruction of natural resources and its negative effect on the mankind and the society as a whole (Christmann & Taylor, 2002; Shrivastava & Berger, 2010). In the management field, there is a growing research literature on Green marketing, Green accounting, Green retailing and Green management in general. To implement any corporate environmental program several units of an organization HR, Marketing, IT, Finance, and so on, work together to put forward a positive joint effort and among them, the most important contributor is the human resource management unit.

However, Green HRM is the use of human resource management policies to promote the

sustainable use of resources within business organizations and more generally, promotes the cause of environmental sustainability. Green HR essentially consists of two major elements namely environment-friendly HR practices and the preservation of knowledge capital (Mandip, 2012). The purpose of going green is to use products and methods that would not negatively impact the environment through pollution or depleting natural resources(Robinson, 2008). Thus, Green HRM involves environmentally-friendly human resource policies and practices that, on the one hand, will help organizations achieve its monetary goal through environmental branding and on the other hand protect environment from any negative impacts that might cause by the policies & actions by the organizations. Further, we move on to reviewing the literature on the HR aspects of GHRM, which helps in identifying how corporations today develop human resource policies for going green. The study also aims to provide simplified insight on some common GHRM processes and attempts to suggest some green initiatives for HR.

Fayyazia et al. (2015) said that there is a requirement for the amalgamation of environmental management in Human Resource Management (HRM) because it is essentially or very important rather than just desirable. Successful environmental management in an organization needs special efforts of human resource management (Rothenberg, 2003). Similarly Jabbour and Santos (2008) also stated that effective environmental performance results need human resource practices that support the whole execution and preservation of environmental management systems in the organizations. Organizations which are able to line up HRM practices with objectives of environmental management expedition (Jabbour, 2011). A study carried out by Harvey et al. (2012) concluded that HRM plays prime role in execution of green practices and indicates the contribution of HRM to the green performance.

Significance of the Study

Today the need for green human resource management is important for all over the world. The ecological consciousness of each human drives the living style and environment. The general employees are interested in green human resource management because of its important and need in the current workplace. Our personal and professional lifestyle is affected due to many consequences. The corporate world is the most significant in enhancing the environment issues and the corporate has to give solution to this hazards.

But now the concept of "Green HRM" has evolved and the composition of the policy priorities has changed. Today, work is still a necessity but it is also a basis of personal satisfaction. One of the means which helps to attain personal and professional goals to be ecological benefit. This Green HRM is in existence as a result of a social responsibility to employees and also to provide a competitive advantage to employers. Many people think that Green HRM is only in the framework of what the company does for its employees.

Review of Literature

Marhatta and Adhikari, (2013) and Zoogah, (2011) refer its use of HRM policies and Practices for sustainable use of resources within business organizations and generally promotes the cause of environmentalism.

Opatha and Arulrajah (2014) refers that Green HRM is the use of policies, practices, and systems in the organization that make green employees for the benefit of the individual, team, society, natural environment, and the organization. Different researchers describe Green HRMin different ways, but somehow their intentions are same for sustainability of Human resources and their environment.

Wei & Yazdanifard, (2014) Individual motivation is said to be the key driver for employees to actively engage and conduct in-role and extra-role behaviors, and as such it would be expected that individual motivations for each of these types of behaviors is likely to be discordant.

Xinhua, (2015) To tackle increasing levels of both pollution and Chinese citizens' discontent with decaying air quality and polluted land and water systems, the Chinese government has embarked upon a range of reforms to address these issues. These reforms have shifted from merely responding to pollution levels to policies that seek to prevent pollution. While these initiatives being applied by the Chinese Government are commendable, they are insufficient to fully address the growing levels of harmful air, water and ground pollutants that are affecting the daily lives of the Chinese people.

Yusliza, Ramayah & Othaman, (2015) The human resource is the most important assets of an organization that plays an important role in managing the employees. The modern human resource managers have been assigned with additional responsibility of incorporating the green human resource philosophy in corporate mission statement along with human resource policies. Green human resource efforts have resulted in increased efficiencies, cost reduction, employee retention and improved productivity and also other tangible benefits. The green HR policies and practices involved in environment, social and economic balance.

STATEMENT OF THE PROBLEM

To review extensive literature in the field of Green HRM to identify gaps and scopes for further study. To develop a process model of green Human Resource Management from entry to exit. The purpose of going Green is to use products and methods that would not negatively Impact the environment through pollution or depleting natural resources (Robinson, 2008). In addition, it will result in using scarce natural resources efficiently and effectively, while keeping the environment free from harmful products. Strategic HRM researchers argued that to achieve HR effectiveness, HR should be practiced as a whole and must be aligned with the business strategic goals, the primary means by which firms can influence and shape the skills, attitudes, and behavior of individuals to do their work and thus achieve organizational goals (Collins and Clark, 2003).

The topic of the green HRM is attracting increased attention among management scholars. Despite its importance to managers, employees, customers and other stakeholders, however, there are very few research studies that consider a complete process of HRM in organizations striving to achieve environmental sustainability as present changing trend in the corporate. There is, thus, a growing need for introducing Green HRM for sustainability of HRM.

Objectives of the Study

The main purpose of this study is to:

- To explore Green Human Resource Management practices of organizations and determine success factors.,
- To Promote the ideology that is important for proper alignment of human resource management principles with objectives of green management in an organization
- To suggest appropriate Green HRM polices for Organizations.

Methodology of Study

Research Design

In pursuance of the above mentioned statement of problem and objectives, the following methodology was adopted for the study. It is a descriptive method based on both primary and secondary data. The first objective of the study was pursued by the collection and analysis of data from secondary sources whereas all the other objectives have been achieved by collection and analysis of primary data. The sources for primary data is collected from the Google, The Land Rover Group, Dow chemical, Tata Group of Companies practices if Green HRM are considered to be primary data and the sources for secondary data is gathered from journals, New letters, Magazines etc.

POPULATION: Employees of TATA AMC ,Lucknow

Sample Size: 50

Sampling: Random sampling and Convenient Sampling

Green Human Resource Management Practices of Organizations Cherian and Jacob (2012) identified in their study that there are certain factors which contribute specific role in employee implementation of green principles these factors are recruitment, training, motivation and green pay/rewards in order to make sure that the organization get right employee green input and right employee green performance of job.

In this part of the paper, we briefly describe functions of HRM which are generally considered as traditional and there can be a variety of green practices under each function. The green HRM process i.e. Green recruitment, performance management and appraisal, training and development, employee relation, pay and reward and employee exit. We summaries of the existing and certain new green HRM practices under each function of green HRM.

Green Job Design and Analysis

In general, job descriptions can be used to specify a number of environmental protection related task, duties and responsibilities. These days, some companies have incorporated environmental and social tasks, duties and responsibilities as far as possible in each job in order to protect the environment. In some companies, each job description includes at least one duty related to environmental protection and also specifically includes environmental responsibilities whenever and wherever applicable.

Nowadays many companies have designed environmental concerned new jobs or positions in order to focus exclusively on environmental management aspects of the

organizations. From the perspective of HRM, it is really a valuable initiation and practice to protect the environment. Moreover, some companies have involved in designing their existing jobs in a more environmentally friendly manner by incorporating environmental centered duties and responsibilities. These are some of the best green HRM practices which can figure out under the functions called green job design and green job analysis.

Green Human Resource Planning

At present, some companies engage in forecasting number of employees and types of employees, needed to implement corporate environmental management initiatives/programs/activities (e.g. ISO 14001, cleaner production, responsible care etc.). These are good practices some leading companies have adopted to manage their environmental issues. The corporate environmental management initiatives demand some new job positions and specific set of skills.

Green Recruitment

Induction for new recruits is seen to be needed to ensure they understand and approach their corporate environmental culture in a serious way. Green recruitment is process of recruiting new talent who are aware of sustainable process, environmental system and familiar with words of conservation and sustainable environment. Green recruitment make it sure that new talent are familiar with the green practices and environmental system that will support the effective environmental management within the organization (Wehrmeyer, 1996) because In the race of attracting most creative and innovative employees, companies increase their environmental, hiring quality staff is the very crucial challenge in the war of talent (Renwick et al., 2013) and even companies are also know the fact that being a employer is an effective way to attract new talent. Google is a very good example of a company who adopted green recruitment few other companies are Timberland, and yes.

Green Selection

In the selection context, when making selection for the job vacancies some companies consider candidates considering environmental concern and interest as selection criteria. When interviewing candidates or evaluating them for selection, environmental-related questions are asked by those companies. Really, these are some of the good green selection practices. Any organization can adopt to select environmental friendly people in addition to the normal selection criteria relating to the specific duties of the job being concerned.

Green Training and Development

Employee training and development programs should include social and environmental issues at all levels, from technical health and safety considerations on the shop floor, to strategic sustainability issues at executive management and board level (Mandip, 2012). Green orientation programs for the newly higher employees should be an integral part of the training and development process. To sustain in the race market it is very necessary to each and every organization to change themselves with the change in the scenario and it is more important for

every organization to resist that change and that resistance to change will be done by training and development. Training and development is a practice that directing a great deal of attention on development of employee skills and knowledge that relate to specific useful

competencies, environmental training also prevent decline of environmental managementskill, knowledge and attitudes (Zoogah 2011).

Numbers of companies are providing environment training to their employees The Land Rover Group is one the example that company. The Land Rover Group provides environment training to their employees according to their job. They take regular briefings and circulate

newsletters to communicate with their staff about environmental issues. They displayed Environmental sustainable development policy, key objectives and environmental practice boards at all sites. They encourage employees to come up with new ideas that reduce the cause of environmental degradation.

Green Performance Management

Performance management (PM) is the process by which employees are prompted to enhance their professional skills that help to achieve the organizational goals and objectives in a better way. The recognition of the corporate strategy culminates into the PM.

Green performance management plays very important role in the effectiveness of green management work over passage of time because they guide employee performance to the environmental performances need by the organization (Jabbour and Santos, 2008). Firms like Tata Group of Companies have installed corporate-wide environmental performance standards (which cover on-site use, waste management, environmental audits and the reduction of waste) to measure environmental performance standards and developing green information systems and audits.

Green Reward Management

Compensation and reward are the major elements of HRM process, this element is the most important for maintaining employee interest to that of the organization. The reward polices are focused on attracting, retaining and motivating the employee which lead to the achievement of organizational goal (Teixeira et al., 2013) and improve the organizational commitment (Daily and Hang, 2001).

Green reward management is another key function of green HRM. The sustainability of organization's environmental performance is highly dependent on the green reward management practices of the organizations. To motivate managers and non-managerial employees on corporate environmental management initiatives, green reward management has significant contributions. Organizations can practice it in two ways such as financial and non-financial. In some companies employees are financially (e.g. incentives, bonuses, cash) rewarded for their good environmental performance. In some other companies, employees are non-financially rewarded (awards/special recognitions/honors/prizes) for their good environmental performance. Dow chemical is a very good example of reward and compensation;

employees were motivated and given rewards when they came up with innovative waste reduction idea.

Green employee Discipline Management

In this context, some companies have realized "discipline management" as a tool to self regulate employees in environmental protection activities of the organization. These companies have developed a clear set of rules and regulations which imposes/regulates employees to be concerned with environmental protection in line with environmental policy of the organizations. In such companies, if an employee violates environmental rules and regulations, disciplinary actions (warning, fining, suspension, etc.) are taken against him/her.

Wehrmeyer (1996) stated explicitly that green discipline management is a pre-requisite incorporate environmental management. In ensuring green employee behavior in the workplace, organizations may need green discipline management practices to achieve the environmental management objectives and strategies of the organization.

Correlation Matrix^a

		satisfied with	satisfied with	satisfied with	opinionabout	
		green	green	green	green	
		recruitment	selection	selection	training	
	satisfied with green recruitment	1.000	.014	.072	.120	
Correlation	satisfied with green selection	.014	1.000	.009	233	
Correlation	satisfied with green selection	.072	.009	1.000	047	
	opinionabout green training	.120	233	047	1.000	
	satisfied with green recruitment		.461	.309	.203	
Sig. (1-	satisfied with green 1- selection	.461		.474	.052	
tailed)	satisfied with green selection	.309	.474		.372	
	opinionabout green training	.203	.052	.372		

Factor Analysis

a. Determinant = .923

KMO and Bartlett's Test				
Kaiser-Meyer-Olkin Measure	.476			
	Approx. Chi-Square	3.774		
Bartlett's Test of Sphericity	df	б		
	Sig.	.707		

	Component		
	1	2	
satisfied with green recruitment	.247	.668	
satisfied with green selection	566	.210	
satisfied with green selection	069	.663	
opinionabout green training	.639	001	

Component Score Coefficient Matrix

Extraction Method: Principal Component Analysis.

Matrix					
Componen	1	2			
t					
1	1.000	.000			
2	.000	1.000			

Component Score Covariance Matrix

Extraction Method: Principal Component Analysis.

RECOMMENDATIONS OF THE STUDY

Green HRM practices, improved employee morale and this may help to save Environment and that will be beneficial for both the company and the employee. Some of the benefits that an employee and organization can attain by implementing green HRM in the organization include:

The business world has become increasingly aware of the significant role played by green buildings while dealing with environmental issues. Green buildings also serve as a platform for financial savings for organizations as their construction and engineering involve low cost. Paperless office is a work place where the use of paper is either restricted or eliminated by converting important official documents and other papers into automated workflows.

In an effort to provide more efficient and eco-friendly services, offices around the world have implemented several energy conservation initiatives to reduce the environmental impact.

As a part of their green initiatives, several organizations are implementing recycling program to increase the amount of recycled products and decrease the amount of waste.

In the race of attracting most creative and innovative employees, companies increase their recruiting potential and they are trying to attract the talented employee by providing environmentally friendly practices

By increasing the awareness among the individuals working in the organization about the Green HRM concept, Green practices, proper utilization of natural resources and retain the natural resources for our future generation

Central Government and State government give subsidy and offer tax incentives and rebates.

CONCLUSIONS

The aim of this paper is to provide a knowledge how Green HRM can help or affects the employee and their organization practices and behavior against environment. Green HRM encompasses all activities aimed at helping an organization carry out its agenda for environment management to reduce its carbon footprint in areas concerns on boarding and acquisition of human resources, their induction, performance appraisal & management, training and development and pay and reward management. This is only possible by the effective implementation of green HRM within the organization. It makes intuitive sense that offering Green HRM practices would attract individuals to an organization and by implementing these practices would result in improving employee attitudes and behaviors within the organization. Future research needs to provide empirical evidence while the Green HRM deliver the positive outcomes. Green HRM can enhance corporate image and brand. Green HR will play an important role in making the employees aware of and concerned for preservation of natural resources and contribute in pollution control, waste management and manufacture of ecofriendly products. The proposed process model will help the practicing managers and future researchers follow green HRM techniques. The present study also proposes future researchers to fill the gap in the existing literatures by conducting empirical studies such as Green HRM practices in the manufacturing or service organizations.

REFERENCE

- [1] Beard, C. and Rees, S. (2000), Green Teams and the Management of Environmental Change in UK Country Council, Environmental Management and Health, Vol.11, No.1, pp. 27-38.
- [2] Chartered Institute of Personnel and Development (CIPD) (2007), The environment and people management, Discussion web page.
- [3] Cherian, J., & Jacob, J. (2012). A study of Green HR practices and its effective implementation in the organization: A review. International Journal of Business and

Management, 7, 25–33.

- [4] Christmann, P., & Taylor, G. (2002). Globalization and the environment: Strategies for international voluntary environmental initiatives. Academy of Management Executive, 16,121–135
- [5] Collins, C. J., & Clark, K. D. (2003). Strategic human resource practices, top managementteam social networks, and firm performance: The role of human resource in creating organizational competitive advantage. Academy of Management Journal, 46(6), 740-51.
- [6] Daily, B. F. and Huang, S. (2001), Achieving Sustainability Through Attention to Human Resource Factors in Environmental Management, International Journal of Operation and Production Management, Vol. 21, No. 12, pp. 1539-1552.
- [7] Fayyazia, M., Shahbazmoradib, S., Afsharc, Z., & Shahbazmoradic, M.R. (2015). Investigating the barriers of the green human resource management implementation in oil industry, Management Science Letters, 5, 101–108.
- [8] Gerhart, B. Wright, P.M. McMahan, G.C. and Snell, S.A. (2000), Measurement Error in Research on Human Resources and Firm Performance: How Much Error is There and How Does it Influence Effect Size Estimates, Personnel Psychology, Vol. 53, No. 4. pp. 803-834.
- [9] Govindarajulu, N. and Daily, B. F.(2004), Motivating employees for environmental improvement, Industrial Management and Data Systems, Vol.104, No. 4, pp. 364-372.
- [10] Harvey, G., Williams, K., & Probert, J. (2012). Greening the airline pilot: HRM and the green performance of airlines in the UK. The International Journal of Human Resource Management, 23, 1-15
- [11] Jabbour, C.J.C. (2011), How green are HRM practices, organizational culture, learning and teamwork? A Brazilian study, Industrial and Commercial Training, Vol. 43, No. 2, pp.98 -105.
- [12] Jabbour, C.J.C. Santos, F.C.A. and Nagano, M.S. (2010). Contribution of HRM throughout the stages of environmental management: methodological triangulation applied to companies in Brazil, The International Journal of Human Resource Management, Vol. 21, No.7, pp. 1049-1089.
- [13] Jackson, S.E. Renwick, D. W. S. Jabbour C.J. C. and Camen, M.M.(2011), State-ofthe- Art and Future Directions for Green Human Resource Management: Introduction to the Special Issue, German Journal of Research in Human Resource Management, Vol. 25, No.2, pp. 99-116.
- [14] Mandip, G. (2012). Green hrm: People management commitment to environmental sustainability. Research Journal of Recent Sciences, 1, 244-252.
- [15] Marhatta, S., & Adhikari, S. (2013). Green HRM and sustainability. International eJournalof
 Ongoing Research in Management
 & IT. www.asmgroup.edu.in/incon/publication/incon13-hr-006pdf
- [16] Shrivastava, P., & Berger, S. (2010). Sustainability principles: A review and

directions.

Organization Management Journal, 7, 246–261. http://dx.doi.org/10.1057/omj.2010.35

- [17] Opatha, H. H. D. N. P. and Anton Arulrajah, A. (2014), Green Human Resource Management: A Simplified General Reflections, International Business Research, Vol. 7, No. 8, pp. 101-112.
- [18] Phillips, L. (2007), Go Green to Gain the Edge over Rivals, People Management, 23rd August, p.9.
- [19] Robinson, F. (2008). Going green: what does it really mean? [online] Available at: http://ezinearticles.com/?Going-green!-What-does-it-really-mean?&kd=2267926 Accessed: 15 March, 2014
- [20] Rothenberg, S. (2003). Knowledge content and worker participation in environmental management at a NUMMI. Journal of Management Studies, 40, 1783-1802
- [21] Renwick, D. E., Redman, T. & Maguire, S. (2013). Green human resource management: a review and research agenda. International Journal of Management Reviews, 15 (1), 1–14.
- [22] Robinson, F. (2008). Going green: what does it really mean? [online] Available at: http://ezinearticles.com/?Going-green!-What-does-it-really-mean?&kd=2267926. Accessed: 15 March, 2014
- [23] Wei, L. T., & Yazdanifard, R. (2014). The impact of positive reinforcement on employees' performance in organisations. American Journal of Industrial and Business Management, 4(1), 9-12
- [24] Wehrmeyer, W. (1996). Greening people: Human resources and environmental management.
- [25] Xinhua, (2015). Ministry plans five-year air pollution control project. [Online accessed 3, March, 2015] URL: http://www.shanghaidaily.com/national/Ministry-plans-fiveyear-airpollution-control-project/shdaily.shtml
- [26] Yusliza MY, Ramayah T, Othman NZ. While examining adoption factors, HR role and attitude towards using e-HRM is the start-off in determining the successfulness of green HRM? Journal of Advanced Management Science, 2015; 3:337-343. Retrieved 5 November, 2014 from www.joams.com
- [27] Zoogah, D. (2011). The dynamics of Green HRM behaviors: A cognitive social information processing approach. Zeitschrift fur Personal forschung, 25, 117–139.

AN EMPIRICAL STUDY OF IMPACT OF SOCIAL MEDIAON CONSUMER BUYING BEHAVIOUR IN RESTAURANT INDUSTRY WITH REFERENCE TO LUCKNOW CITY

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The rapid development of technology and communication channels has made consumers use internet and web tools more today. The most significant one of the tool is social media. Social media gives consumers the power to seek information about the various product and services, criticize them in equal manner and much more. Thus majority of companies today have incorporated social media in their strategies and operations to connect with prospective consumers. This paper aims to study the impact of social media on consumer behavior in restaurant industry of Lucknow city. The data presented in this paper is collected through questionnaire which was distributed among various consumers of different age groups and the collected data is coded, calculated and analyzed with the help of statistical tools.

In the research various variables such as aim, duration, motivation and effect of using social media, have been conceptualized into an integrated framework to analyze the impact of social media marketing on consumer behavior while selecting restaurants to visit. The research reveals that consumers are increasingly moving away from traditional advertising media and actively seeking out social media platforms to search information related to different restaurants because they regard it reliable and convenient which helps them in better decision-making, and results in less wastage of time.

KEYWORDS: Social media, Consumer behavior, Internet, Strategies, Restaurants.

INTRODUCTION

Social media marketing is the process of using social media channels to communicate others with an objective of widening the customer base. It offers great benefits when it comes to advertise the restaurants. Social media encompasses different forms of communication, marketing, entertainment and networking. This new set of collaboration tools enables many types of interactions that were previously not available to common person. Social media provides several benefits to the restaurant industry. These can be listed as below:

1. Improved brand awareness: Social Media plays a vital role in differentiating brands and providing customers customized products. Consumer involvement and delivery of customized products and services significantly impacts the reputation and trust.

- 2. Increased customer base: The potential customer has a chance to know about any restaurant before visiting it in person through social media platforms like Facebook pages, blogs, etc. Messaging and invitations on these platforms attracts more consumer traffic.
- 3. Increase in sales: Sales increase as a result of improved brand awareness and increased traffic due to word of mouth marketing, discounts, specials or events offered on social media channels.
- 4. Repeat business: Social media provides a brand image to the restaurant and tempts customers to come back again after getting a good eating experience. Besides this establishing positive relation with customer results into repeat sales.
- 5. Low cost and high return: Social networking, blogging and other forms of social media are low cost of marketing. With the right balancing of effective policy of messaging and promotions, the returns with the social media can be increased.
- 6. Notifications of events and promotions: Notifications of hosting any event or launching a new menu item on social media by restaurants helps to ensure a good turn-out as it can attract the masses with a little effort.
- 7. Improved customer interaction: Social media tools offer customer insight as well as customer interaction. Social media helps to engage guests in conversation about the restaurant, the experience and their feedback for improvement. Engaging with customers make them feel important and in turn increase their loyalty.
- 8. Monitoring online reputation: Social media allows organizations to put service representatives monitor social sites frequented by customer base and gives them an opportunity to be able to identify and resolve customer issues, if any. Social media inculcates several forms of discussion platforms which allow us the ability to know both good and bad reviews of customers, managing these effectively help to build the reputation.
- 9. Viral Marketing: Social Media amplifies Word-of-Mouth and has a direct impact on customer growth and the spreading of positive/negative feedback about the service of the restaurant among the target audience. First- hand reviews are taken very seriously by customers. Positive image can be built by happy customers.
- 10. Complementary to other campaigns: Social media can run hand-in-hand with traditional marketing strategies, and even help promote those campaigns further.

REVIEW OF LITERATURE

Social media influences buying behavior of consumer on any services or products. In 2003, Western Kentucky University used a sample of 249 consumers' purchases to analyze the type of product purchased, and the cost of item. The results of this research revealed that consumers are buying either inexpensive or expensive items, and are doing so based on recommendations from social media by their contacts or friends on social media (Forbes & Vespoli¹, 2013).Rebecca J. Purdy² in his research paper have explained the importance of social media to the restaurants and how social media contributes in increasing their income. Dr. Ijaz A. Qureshi, Iqra Nasim and Dr. Mike Whitty³ in their research paper, investigated the impact of social media (social sites) on consumer preferences in culinary industry

specifically restaurants in the city of Lahore, Pakistan. It included different components straight from the brand image to dine in, products, level of service, ambience etc and in total of their presence on social media. According to the study 85% respondents said that they use Social media websites on daily basis. Pages of restaurants and communities are liked by 88% because they provide relevant information on product launch, promotional news and product reviews. Majority of respondents agreed that social media has played a vital role in empowering customers and helped them in shaping their perceptions in the restaurant industry of Lahore, Pakistan.

Social media tools have become superb channels for marketers to reach consumers. Hanlon, Patrick stated that social media is important for marketers because it allows them to have dialogue directly with consumers, which in turn engages consumers directly with company brands .Lee⁴ contends that social media has become vastly popular for –normal peoplell because it allows anyone to interact with content or deliver it . This model of Communication is vastly superior to the traditional format of one-way communication between major media and its intended audience. To succeed in today's competitive marketplace, organizations must follow their customers and get close to them.

Benjamin Ach⁶ in their bachelor thesis underlined the fact that businesses, small or big sized, have to get online and to use social media and to adapt their business models if they want to stay on top of the competition on their markets. The research is supported by a case study of an Australian internet marketing company, in order to get valuable insights from internet marketing experts.

RESEARCH METHODOLOGY

This research paper is based on impact of social media on consumer behavior in restaurant industry. Area of Research (Universe) – Lucknow.

Sources of data: - Primary Data (Collected Through Questionnaire) Secondary Data (Collected throughBooks,Websites, Journals & Publication).

Data Collection Method: -Survey Method.

Sample Size: - 84 Respondents Sample Design:-Random Sampling.

Research Design: - Exploratory & Descriptive.

Data Analysis: The Survey was conducted for a sample size of 84 respondents. The questionnaire link was sent through mails and messages to 100 consumers of various restaurants of Lucknow city but only 84 responses were collected.



Q.1. Which of the following Social Media means you are using on a daily basis? (Please select all theplatforms used by you)

	Faceb	Twitt	What	Instag	Linke	Goog	other
	0	er	s	ra	di	le	ouner
	ok		app	m	n	+	
No. of persons social	74	21	78	20	16	24	16
mediausing on							
daily basis							

INTERPRETATION: According to data collected Whats app spar for prime position that is used by almost 93% of the consumers. Followed by Facebook that is the most popular social media site among consumers of Lucknow city which is near about 88%. Micro blogging site such as twitter is used by 25 %.

Time (approx.) spent on Social Media per Week



INTERPRETATION:

According to data collected 5% of consumers doesn't only nearly 39% of the consumers use social media for 1 to 3 hours on daily basis.25% use for 3to 6 hours and 15% use for 6 to 10 hours and more than 10 hours.

Do you think that with the social media, you are able to seek out restaurant related information actively?



Interpretation: Almost 36% of the consumers agree that through social media, they are sometimes able to seek out restaurant related information init iatively. 27% of them often use social media where as only 19% rarely seek out restaurant related information through social media initiatively.

Do you agree that information (related with restaurants) searching is easier via social media as compared to mass media (e.g. TV, Radio, Newspaper, and so on)?



Interpretation: 67.5% of consumers agree that information searching is easier via social media as compared to mass media where as 14.5% are neutral.

Q5. Do you share any restaurant accounts or links on social media?



Interpretation: Almost 54.76% of consumers agree that they share restaurant accounts or links on social media.

Do your "Friends" advice or feedback on social media really affect your decision before selecting any restaurant?



Interpretation: According to analysis 17% consumers have accepted that their family/Friends/relatives etc. advice always affect their decision before visiting restaurants.37% often affects whereas 18% consumers said that it rarely affects their decision.

Q7. Do You Search for restaurant related information on social media before a visit?



Interpretation:36.3% consumers sometimes and 20.5% often search for related information before visit where as 21.7% rarely search

Q8. Do you change your initial purchase preference of restaurants after searching relevant information via social media ?



Interpretation: According to the analysis 11% consumers always, 28% often, 35% sometimes, 5% seldom and 21% rarely change their initial purchase preference of restaurants after searching relevant information via social media.

Q9. Do advertisements/blog posts/ fb pages/user reviews on social media influence you to try new restaurants?



Interpretation: Advertisements/blog posts/ fb pages/user reviews on social media always influence 18%, often influence 36%, sometimes influence 31% and 10% rarely influence consumers to try new restaurants.

10. Do you agree that social media has provided more effective platforms to new restaurant brands to draw consumers attention than mass media channels?



Interpretation: According to analysis 31% strongly agree, 56% agree, 1% disagree and 12% are neutral as to social media has provided more effective platforms to new restaurant brands to draw consumers attention than mass media channels.

CONCLUSION

This study had given a clear indication that social media though not much popular in consumers of Lucknow for restaurant selection is now a strong driving force. Online visibility through social media marketing is gradually becoming a secret weapon of restaurant owners in having a strong customer base. Consumer buying behavior is changing very speedily & marketers have to change their strategies according to the scenario. Therefore now the restaurant marketers have to focus on their promotional strategies. They have to change it according to the preferences and behavioral pattern of new digitally active consumer base.

RECOMMENDATION

Restaurant marketers in Lucknow must use social media for promoting their services into the market. Today's empowered consumers expect companies to engage with them whenever and wherever they want — or they will simply go elsewhere. Restaurant marketers should use social media with proper planning and in systematic manner for increasing success of their restaurant in market. They should change their promotional strategies according to the time factor/ buying behavior of consumers. Whats app and Facebook are the most popular social media among consumers that must be effectively used.

References

- Forbes, L.P., & Vespoli, E.M. (2013). Does social media influence consumer buying behavior? An investigation of recommendations and purchases. Journal of Business & Economics Research,11(2), 107-111.
- 2. Rebecca J. Purdy, Study of Social Media and the Va lue to Restaurants^{II}, Conrad N. Hilton College, University of Houston.
- 3. Dr. Ijaz A. Qureshi, Iqra Nasim and Dr. Mike Whitty(2014). Impact of Social Media Marketing On the Consumer Preferences in Restaurant Industry: An Empirical Study of Pakistan.
DIABETES MELLITUS DETECTION AND DIAGNOSTICS USING DATA MINING TECHNIQUES

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Abstract— Diabetes, also known as diabetes mellitus (DM), is a condition that has the potential to be fatal and affects people from all various corners of the world. Diabetes is characterized by high blood sugar levels. Diabetes is a condition that can be brought on by a variety of risk factors, some of which include but are not limited to being overweight, having high blood glucose levels, not getting enough exercise, and other risk factors. If it is detected at a stage when it is still relatively easy to do so, there is a chance that it can be controlled or that its effects can be lessened. The development of a computer system or programme that is capable of self-improvement and the ability to gain knowledge from previous experiences is one illustration of machine learning in action. An illustration of what the field of artificial intelligence entails is shown here. Throughout the course of this investigation, the PIMA dataset is exploited in a number of different contexts. There are approximately nine characteristics that set each of the 768 instances in this collection apart from the others. There are an almost infinite number of possible methods in which each algorithmic strategy for machine learning can be put into practice. On the other hand, in order to fulfil the prerequisites of these research endeavours, we decided to implement three different unsupervised learning methods. These algorithms are well-known by their individual names, such as the logistic regression algorithm, the decision tree method, and the random forest algorithm. Before being incorporated into this model, each and every one of these algorithms underwent extensive training and testing to ensure that it was ready for usage. In the end, we will analyze the usefulness of various metric algorithmic strategies to machine learning by comparing and contrasting their respective performance levels. This will allow us to determine which of these methods are the most effective. Accuracy, F-measure, recall, and precision are some of the performance measures that are examined. There are also other performance indicators. The Logistic Regression model has the highest overall score, the highest value of 0.68 for their f-measure, and the best accuracy score, which is 74%. All of these accolades come from having the finest score possible. Additionally, it has the highest value for their f-measure as well as the highest value for their precision, which is 0.73. In addition, it has the highest value. The Decision Tree technique was victorious, achieving the maximum possible recall score of 0.61 out of all the approaches.

Index Terms— Data mining, Diabetes Mellitus, EM algorithm, Random Forest with Feature Selection, ML Algorithm, etc.

I. INTRODUCTION

Diabetes Mellitus (DM) is a chronic illness that calls for ongoing medical care and education on self-management in order to reduce the risk of unfavourable long-term outcomes and the development of complications. One is able to lessen or get rid of a wide variety of diabetes-related symptoms and consequences by bringing the patient's blood sugar levels under control and treating diabetes with a mix of food and medicine. The following are the two primary types of diabetes that can be distinguished from one another: Type 1 diabetes, commonly referred to as adult-onset diabetes, is another name for the form of diabetes that affects children and adolescents. Insulin dependence is a form of diabetes that occurs when the body ceases generating the hormone known as insulin. This causes the body to become dependent on an outside source for its insulin needs. Insulin is necessary for the body to be able to use the glucose that is obtained from meals; as a result, diabetes can develop when insulin is lacking. This is very common in individuals of younger ages, particularly children and teenagers. [The chain of causation] This factor is responsible for between five and ten percent of all cases of diabetes. Injections of insulin are normally required for those diabetics who have been diagnosed with this kind of the disease in order for them to be able to survive. The overwhelming majority of people who are diabetic are diagnosed with type 2 diabetes, which is also referred to as adult-onset diabetes or diabetes that does not require the use of insulin. Diabetes mellitus type 1, often known as juvenile diabetes, is defined by an inability of the body to create sufficient quantities of insulin in the correct manner. Having a history of diabetes in one's family, being overweight, and being over the age of 40 are all factors that put a person at an elevated risk for developing type 2 diabetes. This is because diabetes is growing increasingly common in adults as a direct result of bad dietary habits [1], which explains why this is the case.

Diabetes is a condition that can be brought on by a variety of factors, some of which include, but are not limited to, the following: high blood pressure; being overweight; kidney failure; high cholesterol levels; blindness; and a lack of physical activity (American Diabetes Association, 2004). It would appear that both heredity and environmental factors, such as being overweight, being of a given race or gender, reaching a certain age, and not getting enough exercise, all play key roles in the beginning of diabetes. Some of these factors include: Researchers in artificial intelligence and biomedical engineering who are working in the field of diabetes research have become more interested in the topic as a result of the rise in the number of

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diabetic patients around the world. This is due to the fact that the number of diabetic patients around the world has increased in recent years (Ashwinkumar & Anandakumar 2012).

According to the findings of an investigation that was objectively carried out, diabetes comes in at number seven on the list of conditions that can end in mortality. These findings were used to come to this conclusion. Only in India have 51 million individuals been identified as having diabetes, and the number of people who have type 2 diabetes much outnumbers the number of people who have type 1 diabetes by a significant margin. Diabetes impacted approximately 7.0% of the population in the United States as of November 2007, with a total of 20.8 million people, including children and adults, being diagnosed with the condition. According to the findings of a global survey that was carried out in 2013 by Boehringer Ingelheim and Eli Lilly and company, there are 25.8 million people in the United States who are afflicted with Type-1 diabetes and 382 million people throughout the world who are plagued with Type-2 diabetes. The prevalence of type 2 diabetes, which is the most frequent form of the disease and is considered to account for 90–95% of all instances of diabetes, is a significant problem in both industrialised and developing countries. This is because type 2 diabetes is the most common form of the disease. According to some projections that were created by the International Diabetes Federation (IDF), the number of individuals in

the globe who are currently living with diabetes would increase to 592 million by the year 2035. These forecasts were originally developed in the year 2005. According to the World Diabetes Atlas, there are around 285 million individuals living with diabetes across the globe at the present time, and this number has the potential to increase all the way up to 438 million by the year 2030. The results of a poll suggested that the number of persons suffering from type 2 diabetes will rise by the year 2030, which sparked alarming forecasts for the future. In accordance with the findings of Kenney and Munce (2003). In addition to this, it is a given that by the year 2030, developing countries would be home to 85 percent of the world's diabetic patients. This prediction is based on the fact that the prevalence of diabetes is expected to rise. This forecast is based on the fact that the prevalence of diabetes. It is projected that the number of people living in India who are afflicted with diabetes would rise from 31.7 million in the year 2000 to 79.4 million in the year 2030. This projection is based on current numbers. (Huy Nguyen et al 2004). Obtaining an accurate diagnosis as fast as possible is one of the most essential components of diabetes treatment that will lead to success (Mythili et al 2003).

There are already more than 62 million people in the Republic of India who are afflicted with diabetes, which indicates that the condition is in the process of fast approaching the status of a potential epidemic. According to study conducted by Wild et al., the number of people living with diabetes is projected to more than double from 171 million in the year 2000 to 366 million in the year 2030. India is anticipated to experience the biggest growth in this epidemic. By the year 2020, it is anticipated that India will have a diabetic population of up to 79.4 million people, while China will have 42.3 million people and the United States will have 30.3 million people who will also see significant rises in the number of diabetics in their populations. The number of diabetics in India's population is expected to increase significantly by the year 2020. Diabetes has the potential to become a big burden for India in the future, and because of this likelihood, the country is now facing an uncertain future. [2]. Diabetes is a collection of disorders in which the body either does not create enough insulin or does not use the insulin that is generated in the correct manner, or a combination of both of these factors. Diabetes can also occur when the body does not use insulin in the correct manner. If this were to take place, the body would be unable to transport sugar from the blood into the cells, which would result in an increase in the amount of glucose found in the blood. Glucose is the name given to the type of sugar that is found in our blood, and it is one of the key sources of energy that our bodies use. Insulin resistance or a lack of insulin production can both lead to a buildup of sugar in the blood, which is a sign of diabetes. It will result in a variety of negative effects on one's health. [5].

The following are the three primary forms of diabetes:

- **Diabetes Type 1**, Diabetes mellitus, more frequently referred to as insulin-dependent diabetes, is the most prevalent form of the disease. The development of type 1 diabetes is thought to be linked to autoimmune disorders. Diabetes type 1 arises when the immune system in our body erroneously assaults and kills the beta cells in the pancreas that make insulin, causing the damage to be permanent. This results in the development of diabetes type 1. Diabetes mellitus type 1 is the most severe form of the disease. The presence of a genetic predisposition is the most important contributor to the onset of type 1 diabetes [5].
- **Diabetes Type 2,** diabetes mellitus is a condition that either results from the body's inability to create enough insulin or from its inability to make good use of the insulin it does produce. Because of this, sugar builds up in the blood rather than being used as a source of energy, and this can lead to serious health problems. About ninetieth of persons who have diabetes are diagnosed with diabetes type 2, which is the most common form of the condition. Children are frequently affected by diabetes type 2, despite the fact that adults are more prone to get the ailment.
- **Gestational** diabetes, Diabetes that is just brief and occurs during pregnancy is referred to as gestational diabetes. It is possible to develop diabetes during pregnancy, even in people who have never been diagnosed with diabetes before, and this condition is referred to as gestational diabetes. It affects somewhere between two and four percent of all pregnancies and is associated with an increased risk of diabetes development for both the mother and the child.

The process of extracting usable information from enormous datasets, such as associations, trends, and anomalies that are held in databases and other types of data repositories is referred to as "data mining." Pattern recognition and the identification of anomalies are two methods that can be utilized in order to attain this goal. It's common for data warehouses and other sorts of data storage facilities to have databases that are far larger than those found in other types of facilities. Knowledge discovery is

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a crucial part of data mining, and it is made up of the processes that can be found outlined below. This section of the article can be found here. These processes involve cleaning the data, integrating the data, selecting the data, transforming the data, mining the data, evaluating the patterns found in the data, and displaying the information obtained from the data. "Data cleaning" refers to the process of removing unwanted elements, such as noise and values that are missing, from a dataset. Gathering information on the model that was used to access the noise and accounting for any adjustments that were performed are also part of this method. The phase that is known as "data integration" is the phase in which the primary focus is placed on merging data from a number of various sources. This phase is also known as "data integration phase." It is necessary to select a subset of the data to obtain in order to retrieve the specific information that is required. In order to make the data acceptable for mining, a process known as data transformation must first incorporate a number of approaches for data preparation. Once this is complete, the data will be mining-ready. The data can be mined once this step has been finished. This category includes a wide variety of different procedures, some examples of which are normalization and aggregation.

The process of automatically creating information in a format that can be comprehended by human beings is referred to as "knowledge discovery" [3]. Computers are able to complete this operation successfully. Figure 1 is a diagram that presents the many steps that are involved in the KDD process. These steps are shown in a sequential order.



Figure 1: Steps of the KDD Process

The term "data mining" refers to a wide range of tasks, such as classifying, forecasting, analyzing time series, associating, grouping, and summarizing data. These are only some of the activities that fall under this umbrella. Each and every one of these tasks is connected to one facet or another of data mining, either the predictive or descriptive aspects. A data mining system is capable of carrying out each of the actions that were listed above, either on their own or in various combinations, as part of the data mining process.



Figure 2: Data Mining Tasks

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II. LITERATURE REVIEW

Data mining can be a very helpful instructional tool in the field of healthcare, particularly with regard to the objective of uncovering cases of fraud and abuse. Because of this, it is feasible to use it to make better judgments on the management of client relationships, which in turn enables hospital staff to provide better and more affordable medical care. It enables medical practitioners to identify which methods offer the best degree of care, which is beneficial in terms of treatment. Medical applications commonly make use of data mining techniques, including data modelling for healthcare applications, executive information systems for healthcare, forecasting treatment costs, and demand of resources. It is possible to develop forecasts about a patient's behaviour in the future by looking at data from the patient's past, as well as information from Public Health Informatics, e-governance frameworks in healthcare, and health insurance (Dey & Rautaray 2014).

In the process of gleaning useful information from medical databases, the naive Bayes algorithm stands out as one of the most interesting and potentially fruitful options. In spite of the fact that this methodology has been utilized in the process of analyzing medical data, it is not devoid of either benefits or drawbacks. It is a statistically uncomplicated classifier that functions on the premise that qualities are free to change without influence from other factors. Another important quality of this approach is that it is able to retain a high rate of classification accuracy even when applied to very large datasets. Its accuracy improves when other features are taken into consideration, which, in turn, makes it more appropriate for use in medical data. On the other hand, it does not perform very well in situations in which determining the degree of independence between two qualities is challenging. It endures a large amount of detriment as a direct consequence of the presence of noise. The performance of this method and the decision tree method are roughly equivalent to one another.

The decision tree algorithm is the appropriate instrument to employ in situations in which a medical practitioner desires to represent his or her decision-making in the form of rules. One of the most notable characteristics of this algorithm is the organization of the rules into categories (Kuo et al 2001). When a doctor is attempting to quantify a patient's symptoms, they can use regression on the collected data to produce a prediction about a specific value. It operates admirably even in situations in which the differentiating measure between two groups is quite minute. Accuracy, specificity, sensitivity, positive predictive value, and negative predictive value are some of the criteria that can be smoothly handled by the decision tree technique.

The decision tree classifier was used in order to get the best error ratio that was possible. Methods that include researching and investigating techniques such as feature selection, cross validation, error reduction pruning, and increasing model complexity. Utilizing feature selection is one method for accomplishing dimensionality reduction, which is also referred to as the process of condensing the attribute space of a feature collection. This is performed by removing data attributes that are of no use and are deemed to be irrelevant. Cross-validation provides a more accurate assessment of the predictive value, and it has shown an improvement in accuracy of classification despite an increase in model complexity. This is the case even though cross-validation was performed on a more complicated model. The estimation method known as cross-validation is one that is more trustworthy. The overfitting problem that had been harming the decision tree was successfully resolved by adopting the strategy of reduced error pruning as a solution. When compared to the previous system, the improvement included both an increase in accuracy as well as a reduction in the mistake rate. In other words, the improvement was a win-win situation. The amount of time required to construct the decision tree is drastically reduced [4].

The Support Vector Machine (SVM) technique may work with medical databases and is an important part of the categorization process. SVM was created to prevent overfitting of training samples, and with the appropriate selection of the kernel, for instance the Gaussian kernel, the algorithms can place a larger focus on the degree to which classes are similar to one another in comparison to other degrees of similarity.

When SVM is used to classify a new category, the values of its ratios are compared with the support vectors of the training sample that is most comparable to the category that is being classified. This ensures that the new category may be accurately categorized. Following that, this class will be classified further according to the degree to which it is comparable to the other class. In addition to the fact that it does not contain any local minima, the relevance of SVM resides in the fact that it may operate as a universal approximate for a wide variety of kernels. This is just one of the reasons why it is so important. However, a fundamental disadvantage of the SVM is that it does not make it easy to discover which features or combinations of data have the most impact on a forecast. This is one of the most serious limitations of the SVM.

The K Nearest Neighbor, or KNN, Algorithm, possesses an exciting mix of properties that make it suitable for usage on medical datasets and make it excellent for deployment on those databases. These qualities also make it appropriate for use on other types of databases. The KNN method is the one that is utilized for pattern recognition the majority of the time because of how simple it is to put into action. This is the case because it is the most reliable. In spite of this, there are certain circumstances in which it is unable to give outcomes that are satisfactory. However, the results could be improved in a variety of settings by the process of fine-tuning the parameter k in the KNN algorithm. This parameter represents the number of neighbours, and it is responsible for determining how similar a given value is to its neighbours (Moreno et al 2003). An study into kNN has been carried out through the implementation of voting, and the investigation has been tested on the forecasting of cardiovascular illness. According to the findings, the implementation of kNN has the potential to achieve a higher degree of accuracy in the prediction of cardiac disease than neural networks do. This is the case despite the fact that neural networks are now the industry standard. The use of KNN in conjunction with a genetic algorithm has resulted in an increase in the dataset's ability to be classified more accurately in terms of heart disease.

Patients with type 2 diabetes mellitus had their skin temperature measured across the entirety of their bodies, and their serum levels of asymmetric dimethylarginine (ADMA) were analyzed as well. Both of these factors were considered in the diagnostic process. People were divided into two groups: those who did not have any complications and those who did have complications. One category of people were thought to be typical. Thermograms were taken of every part of the body by

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employing a thermography camera that did not require any direct touch with the subject. Several blood parameters including thyroid hormones were measured biochemically, as well as other blood components. In addition to that, a score indicating the likelihood of developing diabetes was determined. In normal people, the values of skin temperature that were discovered to be the lowest were located on the posterior portion of the sole, and the values that were found to be the highest were found on the ear. This was learned through the process of observation. Patients who had diabetes had lower mean values of skin temperature from head to toe than other patients did, and the nose and tibia areas had a significant drop in temperature [3]. This was the same for all areas of the body.

According to the findings of a number of studies, the diagnosis of a single patient can shift significantly depending on whether or not the patient is examined by a variety of physicians, or even by the same physician at a number of different times. This is true even if the patient is checked out by the same physician on multiple occasions. The use of automated medical diagnostics enables physicians to predict the diseases of their patients with more accuracy and in a shorter amount of time. This method employs the Naive Bayesian theorem in order to facilitate the process of identifying patterns in the data that it collects. Not only does the naïve Bayesian algorithm calculate the percentage of patients who suffer from each dermatological problem, but it also assesses the chance of a wide range of conditions that can affect the skin.

III. DATA MINING STRATEGIES

The Expectation Maximization (EM) Algorithm

This electromagnetic method can be divided down into two separate parts. The first step is to figure out what to anticipate, and the second step is to optimize what you anticipate by going through the procedure several times. The process of estimating any missing labels follows the selection of a model as the first step in the expectation, which also includes the selection of the model. During the maximizing stage, you will select labels and then map relevant models to those labels. This will be done in order to maximize your results. This is done in order to maximize the expected log-likelihood of the data, which is the goal of the procedure. There are three distinct stages that can be distinguished within the operational order [2].

Step 1: The expectation step that determines mean value, denoted by μ and infers the values of x and y such that $x = [(0.5) / (0.5 + \mu) * h]$ and $y = [(\mu / 0.5 + \mu) * h]$ with conditions of x / y = (0.5 / μ) and h = (x + y).

Step 2: The maximization step that determines fractions of x and y and then computes the maximum likelihood of μ at first.

Step 3: Steps 1 and 2 are to be repeated for the next cycle. The clusters were defined through the application of cross validation of the mean and standard deviation for a total of seven different features. After that, a test was administered to each student in the group to assess whether or not they had any positive or negative conditions connected with diabetes. In the course of performing an analysis of the data, binary response variables are alternately represented by the numbers 1 and 0. If the test for diabetes returns a 1, it means that the test is positive (present), and if it returns a 0, it means that the test for diabetes is negative (not present). When used to data sets of larger dimensions, the EM approach, however, is not very exact as a result of the numerical imprecision [2].



Figure 3: EM Algorithm Steps

K Nearest Neighbour Algorithm

The K Nearest Neighbor (KNN) method has found use in a wide variety of applications for the purpose of data analysis due to the fact that it can be implemented with relative ease and provides a high level of accuracy. Pattern recognition, data mining, database administration, and machine learning are some of the applications that fall into this category. According to the most

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recent rankings, it is among the top 10 algorithms that can be used in the field of data mining (Wu et al 2008). The KNN algorithm is a classification approach that falls under the umbrella of "lazy learning." This is the simplest form of the algorithm that can be used in machine learning. Using this technology, it is possible to forecast the appearance of any sort of label [5]. The KNN classification arranges samples in accordance with the degree to which they are similar to one another. It is an illustration of a type of learning algorithm known as "lazy learning," in which the function is approximated locally and computation is postponed until classification. In this kind of learning method, the function is approximated. K-Nearest Neighbors is most useful for applications in the fields of classification and clustering. Numerous researchers have found, after testing the KNN algorithm on a wide variety of datasets, that it produces results that meet or exceed their expectations. Because there are so many factors that are missing from the Pima Indian diabetes dataset, it is quite difficult to comprehend. The KNN method utilizes the columns of data that are immediately surrounding the matrix to determine which values should be substituted for those that are absent in the Euclidean Distance matrix. In the event if the value that is equal from the column that is the closest neighbour is also absent, the value from the column that is the next immediate neighbour is utilized instead. In contrast to other approaches, not only is this strategy uncomplicated, but it also offers a significant advantage in terms of competition. One of the drawbacks of KNN, which can be seen as a negative, is that it does not make use of probabilistic semantics, which would allow for the application of posterior prediction probabilities.

In an effort to make KNN more useful, a huge number of its writers have contributed to its most recent upgrade. The class-wise KNN (C-KNN) algorithm has been implemented, and its performance on the Pima Indian diabetes dataset has been validated. A class label is assigned to the testing data at this stage by making use of the class-wise distance that is the shortest. A level of accuracy of 78.16% has been achieved by the C-KNN algorithm. The K means and KNN classification algorithms have been combined into a single model known as the amalgam KNN model in order to facilitate the categorization of the diabetes cases contained inside the Pima Indian database. In this instance, the quality of the data is improved by getting rid of the noise, which also leads to an increase in the amount of work that can be accomplished in the same amount of time. The K-means algorithm is used to exclude the instances that were improperly classified, and the KNN classification algorithm is used to finish the classification.

The data will dictate the value of K should be used by the KNN algorithm. When it comes to categorization, having a higher value for k can assist cut down on the amount of noise. A suitable value for k can be decided upon by the application of the cross-validation approach. By first determining the k value and then carrying out ten-fold cross validation [6,] we were able to achieve a classification accuracy of 97.4%. Figure 4 provides a graphical illustration of the fundamental concept underlying the KNN algorithm.



Figure 4: K nearest neighbor algorithm

The KNN algorithm:

Step 1: Each new instance is compared to the ones that are already available cases based on the distance assignment, and it is then classified using the k value.

Step2:. If the instances are more similar to one another, then the distance between them will be less, and vice versa.

Step 3: Take note of the k-value, the distance, and the instance. On the basis of these observations, occurrences are classified into the appropriate category.

Step4: The k-value serves as the foundation for the forecast. So KNN classifier is k-dependent. The number of nearest neighbors is denoted by k in this context, and depending on the value of k, the results may or may not be the same [7].

Step 5: Pima Indian Diabetic Dataset (PIDD) classification accuracy can be improved by determining the value of the parameter k.

K-Means Algorithm

Unsupervised algorithms are those that are able to function well on unlabeled samples even in the absence of direct supervision. This suggests that it is impossible to forecast the output even if it is possible to determine the input. Unsupervised learning algorithms include a number of different methods, including the K means algorithm, which is one of these methods. They require an input parameter, which is the number of clusters, as well as n objects in the data collection, which is then partitioned into k clusters in order to work properly. The algorithm makes a choice out of the available k items based on a random selection. According to how close an item is situated to the linked cluster to which it belongs, it is assigned a specific

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location within one of the clusters that it belongs to. The subsequent stage is to determine which areas are the closest in proximity to one another. When trying to find the location of the object that is the most central to it, it is recommended that you utilize the Euclidean distance. After the items have been organized into k clusters, the new centres of the clusters are found by averaging the items contained inside each of the k clusters in turn. This process is repeated until all of the clusters have been exhausted. Following this technique up until the point where there is no longer any fluctuation in the k cluster centres is done. In order for the K-means algorithm to be successful in accomplishing its mission, the objective function that it aims to decrease is the sum of squared error (SSE) [8]. The abbreviation SSE refers to the following:

$$\operatorname{argmin}_{C} \quad \sum_{i=1}^{k} \sum_{p \in Ci} |p - m_i|^2 \quad (1)$$

Here, E stands for the total squared error of the objects that have been assigned cluster means for the kth cluster, p is the item that has been assigned to the *Ci*th cluster, and mi is the mean of the *Ci*th cluster. The total number of records in the dataset is denoted by the letter n, while the value k indicates the number of clusters.

Input: D is input -data set.

Output: Output is k clusters.

Step 1: Set the initial values for the cluster centers to D.

Step 2: Pick k items at random from the collection D.

Step 3: Repeat the steps below until there is no change in the cluster means and the minimum error E has been obtained.

Step 4: Take into consideration each of the k clusters. When it comes to the initialization process, compare the objects' mean values across the clusters.

Step 5: Create the initial state of the object by assigning the value that is most similar to D to one of the k clusters.

Step 6: Find the average value of the objects in each of the k different clusters.

Step 7: Make the necessary adjustments to the cluster means based on the object value.

Amalgam KNN

Data pre-processing techniques, when utilized prior to the mining process, have the potential to either reduce the amount of time required for mining or significantly improve the overall quality of the patterns that are mined. If both of these outcomes are achieved, then the utilization of data pre-processing techniques is highly recommended. The part of the process known as knowledge discovery known as pre-processing of the data is an important step. This is owing to the fact that quality judgments have to be based on quality data in order to be valid.

To implement this method, you will need to clean up noisy data, use k-means, and substitute means and medians for values that are missing from the dataset. The KNN classification is applied to the data after the data has been preprocessed in order for the classification to be able to generate better results. [9].

The PIDD database contains a total of 768 examples to choose from. 192 patients had measurements taken of their skin fold thickness, 5 patients had measurements taken of their glucose levels, 11 patients had measurements taken of their body mass index, 28 others had data for their diastolic blood pressure, and 140 patients had measurements taken of their serum insulin levels. The aforementioned values are checked during the pre-processing stage, and if they are found to be inconsistent, the pre-processing step will remove them (values with a value of '0' are considered to be empty values).

- As a preliminary stage in the processing, the inconsistent values are eliminated.
- In order to lessen the amount of computing effort required by k-NN, the K-means clustering technique is applied to locate and get rid of instances that were improperly classified.
- The means and medians are substituted for the values that are missing.
- Using KNN, the final step of the procedure, which is the fine-tuned classification, is carried out by using the successfully clustered instance along with the preprocessed subset as inputs for the KNN.
- Following that, the model is tested using a variety of variables for k.

Random Forest Algorithm



Figure 5: Flow graph of Random Forest Algorithm

To get things started, the algorithm known as Random Forest is a type of supervised categorization. The title of the game gives away the objective, which is to produce a random forest by whatever methods available. This objective can be accomplished in a number of ways. There is a relationship between the number of trees in a forest and the discoveries that it is able to make; the more trees there are, the more accurate the findings will be. However, one thing to bear in mind is that the process of creating the forest is not the same as the process of constructing the choice with information gain or the gain index approach. Keep this in mind.

The author gives readers access to four websites that might be of assistance to individuals who are working with decision trees for the first time in terms of learning about them and obtaining a thorough knowledge of what they are all about. A useful instrument for assisting in decision-making is called a decision tree. It uses a graph in the shape of a tree to represent the many different outcomes that can occur. If you give the decision tree a training dataset that includes targets and features, it will come up with some form of rule set for you to follow on its own. Utilizing these guidelines will allow one to make accurate forecasts. Consider the following scenario, which the author uses to illustrate his thesis with an example: you are trying to determine whether or not your daughter will like watching an animated film. If this is the case, you should make a list of past animated movies that she has like and use particular aspects of those movies as inputs for your forecast. After that, you are free to proceed with the generation of the rules by utilizing the equalities of the film and seeing what results you get. Throughout the entirety of the process of finding these nodes and developing the laws, calculations involving information gain and the Gini index are applied.

Leo Bremen was the one who initially designed Random Forest. The Random Forest rule could be an example of a supervised classification rule [11], the Random Forest rule consists of two stages, the first of which is the creation of the random forest, and the second of which is the decision to make a prediction based on the random forest classifier that was developed in the first stage [9]. The pseudo code for Random Forest is rf, and the Random Forest rule's supervised classification counterpart is [11].

- The first thing you need to do is pick the "R" features out of the total "m" features, where R<<m.
- The node that makes use of the most optimal split point among the "R" features.
- Step Three: Using the most effective split; divide the node into daughter nodes.
- Continue to repeat steps a to c until the desired number of nodes has been achieved.
- Construct the forest by performing steps a to d a "a" number of times in order to produce a "n" number of trees.

IV. DATA SET DESCRIPTION

Since 1965, the Pima Indians of the Gila River Indian Community in Central Arizona have taken part in the study of diabetes mellitus, which has been examined every two years. The majority of the information regarding the prevalence, incidence, risk factors, and pathogenesis of diabetes in the Pima Indian population is provided by these examinations, which also include an oral glucose tolerance test and various assessments of complications of diabetes and other medical conditions (Leslie et al 2004). Numerous study findings that are pertinent to the Pima people appear to be common. Obesity, insulin resistance, insulin

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secretion, and an increased rate of endogenous glucose synthesis, which are the traits that identify diabetes, are metabolic features of Pima Indians with type 2 diabetes [10].

The Pima Indian diabetes dataset includes data on 768 individuals' various measures as well as a prediction of whether they would eventually develop diabetes. All of the patients in this facility were Pima Indians and at least 21 years old. This consists of eight qualities, which determine whether the tested data falls into the category of people with diabetes (tested positive) or those without diabetes (tested negative). 500 patients without diabetes (class = 0) and 268 patients with diabetes (class = 1) make up the dataset.

Table 1: Characteristics of PIMA Indian Dataset

Data Set	No. of Example	Input Attributes	Output Classes	Number of
				Attributes
Pima Indian	768	8	2	9
Diabetes				

This data set's goal was to identify Pima Indians who had diabetes. Try to determine whether a Pima Indian person had diabetes positive or not based on personal information such as age, the number of pregnancies, and the results of medical examinations such as blood pressure, body mass index, glucose tolerance test results, etc. The qualities are listed below [16]:

- 1. The number of pregnancies.
- 2. In an oral glucose tolerance test, plasma glucose levels at two hours.
- 3. Diastolic pressure (mm Hg)
- 4. Thickness of the triceps skin fold (mm)
- 5. Insulin 2-hour serum (mu U/ml)
- 6. Body mass index (BMI) (weight in $kg/(height in m)^2$)
- 7. Diabetes pedigree function
- 8. Age (years)
- 9. Class variable (0 or 1)

V. RESULT AND DISCUSSIONS

In this part of the article, the usefulness of the approach that was suggested is evaluated. The simulated implementations of the proposed algorithms are used to test the validity of the proposed Protocol. Tensorflow and various other Python libraries can be utilized for this purpose; our work is based on the Python programming language.

Synthetic Minority Over-Sampling Technique (SMOTE)

In order to balance the number of samples in each class SMOTE analysis is been carried out. Below figures shows the item count before and after the SMOTE analysis.



Figure 6: Item Counts





Ensemble Learning

The below performance chart shows that the accuracy of ensemble learning model to identify normal and abnormal diabetic cases is 0.74.

[[126 4 [25 6	2] 1]]	precision	recall	f1-score	support
	0	0.83	0.75	0.79	168
	1	0.59	0.71	0.65	86
accu	iracy			0.74	254
macro	avg	0.71	0.73	0.72	254
weighted	avg	0.75	0.74	0.74	254

The figure 8 chart shows the Confusion matrix of ensemble learning model. The diagonal elements show the correctly classified item count and off diagonal elements show the count of misclassified elements.



Figure 8: Confusion matrix

Dogo Rangsang Research Journal ISSN : 2347-7180 Logistic Regression

The below performance chart shows that the accuracy of Logistic Regression model to identify normal and abnormal diabetic cases is 0.70.

		precision	recall	f1-score	support
	0	0.82	0.71	0.76	168
	1	0.55	0.69	0.61	86
accur	acy			0.70	254
macro	avg	0.68	0.70	0.69	254
weighted	avg	0.73	0.70	0.71	254

The figure 9 chart shows the Confusion matrix of Logistic Regression model. The diagonal elements show the correctly classified item count and off diagonal elements show the count of misclassified elements.



Figure 9: Confusion matrix

Random Forest

The below performance chart shows that the accuracy of Random Forest model to identify normal and abnormal diabetic cases is 0.76.

	precision	recall	f1-score	support
0	0.86	0.77	0.81	168
1	0.63	0.74	0.68	86
accuracy			0.76	254
macro avg	0.74	0.76	0.75	254
weighted avg	0.78	0.76	0.77	254

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The figure 10 chart shows the Confusion matrix of Random Forest model. The diagonal elements show the correctly classified item count and off diagonal elements show the count of misclassified elements.



Figure 10: Confusion matrix

Gaussian NB

The below performance chart shows that the accuracy of Gaussian NB model to identify normal and abnormal diabetic cases is 0.72.

		precision	recall	f1-score	support
	0	0.81	0.76	0.78	168
	1	0.58	0.65	0.61	86
accur	racy			0.72	254
macro	avg	0.69	0.70	0.70	254
weighted	avg	0.73	0.72	0.72	254

The figure 11 chart shows the Confusion matrix of Gaussian NB model. The diagonal element show the correctly classified item count and off diagonal elements shows the count of misclassified elements.



Figure 11: Confusion matrix

Artificial Neural Network (ANN)

The below performance chart shows that the accuracy of ANN model to identify normal and abnormal diabetic cases is 0.34.

		precision	recall	f1-score	support
	0	0.00	0.00	0.00	168
	1	0.34	1.00	0.51	86
accur	racy			0.34	254
macro	avg	0.17	0.50	0.25	254
weighted	avg	0.11	0.34	0.17	254

Table 2: Comparison Algorithms

S. No.	Method Name	Accuracy (%)	Sensitivity (%)	Specificity (%)
1	Ensemble learning	0.74	0.75	0.71
2	Logistic Regression	0.70	0.71	0.69
3	Random Forest	0.76	0.77	0.74
4	Gaussian NB	0.72	0.76	0.65
5	ANN	0.34	0.65	0.67

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VI. CONCLUSION

The quantity of data mining tools, and along with them, the number of algorithms for machine intelligence, is expanding. The mining of data can be practiced on patient medical records. A significant amount of information has been gathered and organized in the field of healthcare. The dataset pertaining to diabetes is the one that has received the fewest number of analyses. The subject of diabetes prediction is successfully tackled and resolved throughout the entirety of this thesis by utilizing data mining techniques. It has been demonstrated that three different predictive models for diabetes are useful, and each of these models is founded on the same well-known algorithm for classification, which is known as the Random Forest algorithm. From the tests that were run on the data set containing Pima Indians with diabetes using the Python programme, it is abundantly obvious that the performance of the suggested classification algorithms improved significantly.

References

- C.kalaiselvi,G.m.Nasira,2014."A New Approach of Diagnosis of Diabetes and Prediction of Cancer using ANFIS",IEEE Computing and Communicating Technologies,pp 188-190
- [2] Kenney, WL & Munce, TA 2003, 'Invited review: aging and human temperature regulation', Journal of Applied Physiology, vol. 95, no. 6, pp. 2598-2603.
- [3] Sapna. S,Tamilarasi. A and Pravin Kumar.M, 2012 "Implementation of genetic algorithm in predicting diabetes", IJCSI, International Journal of Computer Science Issues, Vol. 9, Issue 2, No 4, pp. 393-398
- [4] Khaing, HW 2011, 'Data mining based fragmentation and prediction of medical data', Proceedings of the third international conference on computer research and development, vol. 2, pp. 480-485.
- [5] Kuo, WJ, Chang, RF, Chen, DR & Lee, CC 2001, 'Data mining with decision trees for diagnosis of breast tumor in medical ultrasonic images', Breast Cancer Research and Treatment, vol. 66, no. 1, pp.51-57.
- [6] Zoran Bosnic, Petar Vracar, Milos D. Radovic, Goran Devedzic, Nenad D. Filipovic and Igor Kononenko(2012) 'Mining Data From Hemodynamic Simulations for generating Prediction and Explanation Models' IEEE Vol. 16, No. 2,pp 248-254.
- [7] B.M Patil, R.C Joshi, Durga Tosniwal(2010)Hybrid Prediction model for Type-2 Diabetic Patients, Expert System with Applications, 37, 8102-8108.
- [8] Lakshmi, KR & Kumar, SP 2013, 'Utilization of data mining techniques for prediction of diabetes disease survivability', International Journal of Scientific and Engineering Research, vol. 4, no. 6, pp. 933-942.
- [9] Asha Gowda Karegowda ,MA.Jayaram(2007) ' Integrating Decision Tree and ANN for Categorization of Diabetics Data' International Conference on Computer Aided Engineering, December 13-15, , IIT Madras, Chennai, India.
- [10] UCI machine learning repository and archive.ics.uci.edu/ml/datasets.html.
- [11] Manjusha, KK, Sankaranarayanan, K. & Seena, P 2014, 'Prediction of different dermatological conditions using naïve Bayesian classification', International Journal of Advanced Research in Computer Science and Software Engineering, vol. 4, no. 1, pp. 864-868.
- [12] Al-Sakran, HO 2015, 'Framework architecture for improving healthcare information systems using agent technology', International Journal of Managing Information Technology, vol. 7, no.1, pp. 17-31.
- [13] Mythili, T, Mukherji, D, Padalia, N, & Naidu, A 2013, 'A heart disease prediction model using SVM-decision trees-logistic regression (SDL)', International Journal of Computer Applications, vol. 68, no.16, pp. 11-15.
- [14] Kumar, DS, Sathyadevi, G & Sivanesh, S 2011, ' Decision support system for medical diagnosis using data mining',. International Journal of Computer Science Issues, vol. 8, no.3, pp. 147-153.
- [15] Palaniappan, S & Awang, R 2008, 'Intelligent heart disease prediction system using data mining techniques', Proceedings of the IEEE in computer systems and applications, pp. 108-115.
- [16] Suguna, N & Thanushkodi, K 2010, 'An improved K-nearest neighbor classification using genetic algorithm' ' International Journal of Computer Science, vol. 7 no. 2, pp. 18-21.

DIABETES MELLITUS DETECTION AND DIAGNOSTICS USING DATA MINING TECHNIQUES: A Review

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Abstract— Diabetes, also referred to as diabetes mellitus (DM), is a potentially fatal disorder that affects people from all different parts of the world. Diabetes can be caused by a number of different risk factors, including but not limited to obesity, high blood glucose levels, a lack of physical activity, and other risk factors. There is a possibility that it can be controlled or mitigated if it is identified at a relatively early stage. An example of machine learning is the creation of a computer system or programme that is capable of modifying itself and learning from prior experiences. This is an example of the field of artificial intelligence. The PIMA dataset is utilized at several points throughout the course of this inquiry. The collection has around 9 distinguishing qualities for each of the 768 cases. Each algorithmic strategy for machine learning can be implemented in a great number of different ways. On the other hand, in order to meet the requirements of these research efforts, we opted to use three unsupervised learning strategies. These algorithms are known by their respective names, such as logistic regression, decision tree, and random forest. Every single one of these algorithms was trained and put through its paces before being used in this model. In the conclusion, we will evaluate the effectiveness of various metric algorithmic methods to machine learning by comparing and contrasting their respective performance levels. There are a number of performance indicators that are analyzed, including accuracy, F-measure, recall, and precision. The Logistic Regression model has the highest overall score, the highest value of 0.68 for their f-measure, and the best accuracy score, which is 74%. Additionally, it has the highest precision value, which is 0.73, and it also has the highest value for their f-measure. Decision Tree came out on top with a recall score of 0.61, which was the highest of any method.

Keywords—Data mining, Diabetes Mellitus, Random Forest with Feature Selection, Machine Learning Algorithm, etc.

I. INTRODUCTION

Diabetes is a condition that can ultimately result in death. Diabetes can be caused by a combination of causes, including but not limited to being overweight, having high blood glucose levels, leading a sedentary lifestyle, and not getting enough exercise. Because of this, the hormone insulin is affected, and as a result, the crabs' metabolism becomes erratic, and there is an increase in the amount of sugar in their blood. Diabetes is a condition that develops when the body is unable to produce an adequate amount of the hormone insulin. Diabetes affects around 422 million people around the world, as reported by the World Health Organization (WHO). This percentage is abnormally high in countries where the standard of living is poor or nonexistent. It's also likely that by the year 2030, this figure will have increased to 490 billion people all over the world. On the other hand, the prevalence of diabetes is observable in a variety of distinct nations, including Canada, China, and India, amongst others. Diabetes is a major factor that contributes to the mortality rates of people all over the world. Patients who are diagnosed with diseases such as diabetes at an earlier stage are more likely to undergo treatment, which could ultimately save their lives. In order to accomplish this objective, the purpose of this study is to evaluate the feasibility of diabetes prediction. To do so, a number of variables that are connected with the diabetes condition will be taken into consideration. In order to accomplish this goal, we make use of the Diabetes Dataset and implement a wide range of machine learning classification and ensemble methods. The conclusion is that an accurate diagnosis of diabetes can be made.

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Diabetes can be managed using a variety of approaches, including insulin injections and changes in diet. As quickly as is humanly possible, this condition should be identified for what it is, and then the appropriate treatment should be administered. Testing that is both chemical and physical forms the basis for the majority of the techniques that are used for categorization, identification, and diagnosis. Using the conclusion that may be derived from these results, a particular disease can be expected. It's possible that our predictions will be off. This is because the numerous testing parameters all have varied degrees of uncertainty, which leads to this result [2]. These unanswered questions make it more difficult to find a treatment for the condition and contribute to erroneous forecasts. The computing facility has seen a significant amount of progress during the past few years. The advancements that have been made in information technology have made it possible to more accurately classify data, forecast outcomes, and diagnose diseases in many different situations. The most important advantage that comes from the use of information technology is that it enables medical facilities to continually maintain and monitor massive data storages containing records of former patients for several references [3]. With the use of these medical data, the doctors are able to explore the various patterns contained within the data set. The patterns that are found in data sets may be of assistance in the process of disease classification, as well as prognosis and diagnosis [4].

The training method that may be applied to either computers or machines is referred to as "machine learning," and the phrase is used interchangeably. Constructing a wide variety of classification and ensemble models with the data that has been acquired is one of the many ways in which a wide variety of machine learning approaches create effective outcomes for the accumulation of knowledge. With the use of such gathered data, the risk of developing diabetes can be approximated. The field of machine learning encompasses a wide variety of techniques, each of which is able to make predictions; despite this, it can be challenging to decide which technique is the most effective. Because of this, in order for us to accomplish this aim, we apply well-known classification and ensemble algorithms to the dataset in order to create a prediction. Consequently, in order to accomplish this goal:

The process by which computers figure out how they can execute tasks without being formally educated to do so is referred to as "machine learning." [5] The term "machine learning" refers to this process. It refers to the process whereby computers learn specific tasks based on the data that is supplied to them in order for them to do those tasks. It is possible to write algorithms that instruct a computer how to carry out each step that is necessary to solve the issue at hand; in this case, the computer does not need to engage in any form of learning; however, this option is only available for tasks that are relatively straightforward and are delegated to computers. When it comes to actions that are more sophisticated, it can be difficult for a human to create the necessary algorithm manually. It is possible that assisting the machine in the development of its own algorithms will prove to be more productive in practice than having human programmers manually specify each step that is required. This hypothesis is based on the hypothesis that assisting the machine in the development of its own algorithms will increase productivity.

The pursuit of artificial intelligence served as the driving force behind the establishment of machine learning as a distinct academic discipline in the first place. During the early phases of artificial intelligence's growth as an academic discipline, a number of academics demonstrated an interest in instructing computers to learn from data. This interest continued throughout the field's later stages of development. They attempted to solve the problem by employing a number of symbolic approaches in addition to what was at the time known as a "neural network." The "neural network" was essentially made up of the perceptron in addition to a few other models that were shown to be, with further investigation, simply reimagining's of the generalized linear model of statistics.

In addition to that, we made use of probabilistic reasoning, in particular for computerized medical diagnosis.

Diabetes is a disease that is responsible for the death of a considerable number of people all over the world. The proliferation of different technologies is directly proportional to the enhancement of the quality of life for people. As a result, there is no valid excuse for not taking use of the technology that exist to make leading a healthy lifestyle more

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convenient. Deep learning and other types of machine learning algorithms are used in a wide variety of prediction skills. These capabilities can range from stock market forecasting to medical diagnosis. The question of how mankind might gain from the application of these technologies has been addressed to us here [6]. These technologies are frequently used by the most successful organizations in the world to boost their profits and sales. In order to create a forecast about something that is so specialized that only experts are capable of doing it, we are going to put the various algorithms that we have developed and learned throughout the course of our history to the test. In order for the machine to learn the complexities of the many different aspects of the biomechanics of human beings and to accurately foresee the difficult challenges faced by live beings, it needs to be trained with the minds of medical professionals. This will allow the machine to learn how to accurately predict the difficult challenges faced by live beings. Implementing these algorithms is necessary in order to provide accurate predictions regarding complex diseases by making use of a wide variety of internal and external characteristics that are derived from a reliable dataset [7]. This is accomplished through the utilization of a large number of variables that are measured internally as well as externally.

Diabetes is a disease that reduces the amount of insulin in the body, which prevents glucose from entering the cells of the body's bloodstream. Diabetes is a disorder that affects the human body and can be lifelong and chronic. This causes the sugar level in the body to grow, which can lead to a range of health problems and even death. Some of these health problems and diseases include stroke, heart disease, blindness, and kidney failure. Patients who are afflicted with diabetes frequently present with the following symptoms.

- An increase of thirst experienced
- Nausea and vomiting
- Infections with a sluggish recovery time
- A greater degree of hunger
- Haze in the eyes
- Reduced body weight
- Frequent urinating

The following set of medical tests and procedures are typically performed in order to establish a diabetes mellitus diagnosis.

- Urine test
- Fasting blood glucose level
- Random blood glucose level
- Oral glucose tolerance test
- Glycosylated hemoglobin(HbAlc)

II. Literature Review

In the following part of this article, we are going to have a look at some of the earlier research that pertains to this subject in greater detail.

The research work of Jitranjan Sahool et al. [3] predicting diabetes using Machine Learning Classification Algorithms and this research work shows that, Logistic regression was found to outperform all of the machine learning algorithm showing the maximum accuracy of 72.17% in comparison to other algorithm. [Citation needed] [Citation needed] [Citation needed] Logistic regression was found to outperform all of the machine learning algorithm showing the maximum accuracy of 72.17% in comparison to

Nonso et al. [4] presented a novel approach to the problem of diabetes prognosis, which consists of the following steps: in the supervised learning approach, five widely employed classifiers are used for the ensembles, and a meta-classifier is used to aggregate the outputs of the individual classifiers. The results that are offered are compared with the findings of other research that has been published that was conducted using the same dataset. This was done so in order to validate the findings that are presented. It has been established that the proposed technique can result in a higher level of accuracy

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when it is used to the prediction of the start of diabetes.

Tejas et al. reported Diabetes Prediction in an investigation that had been carried out [2]. It is possible to make an accurate diagnosis of diabetes by employing a number of different supervised machine learning approaches such as support vector machine (SVM), logistic regression, and artificial neural network. This is the goal of using machine learning techniques (ANN). Their work project presents a method that is not only effective but also efficient for identifying diabetes disease at an earlier stage.

In a different study that Deeraj and his colleagues conducted [1], data mining was mentioned as a potential new approach that could be used to predict diabetic disease. An Intelligent Diabetes Disease Prediction System is currently in the process of being created. This system will provide an analysis of diabetes disease by utilizing a database that is comprised of people who have diabetes. They suggest using algorithms in this system such as Bayesian and KNN (K-Nearest Neighbor) to apply on a database of diabetes patients and evaluate them by taking into consideration a variety of diabetes-related characteristics in order to make a prediction regarding the diabetes disease. This would be done for the purpose of making a diagnosis of the diabetes condition.

Comparisons were done between the several machine learning approaches (support vector machine, logistic regression, decision tree, K-nearest neighbour, and random forest) that were utilized in the diabetes prediction study carried out by Mitushi Soni et al. [5].

Our team made use of a wide variety of machine learning algorithms. Which of These Three Models Is the Most Accurate—Decision Tree, Logistic Regression, or Random Forest?

Further investigation has been put into developing techniques for estimating the age at which a person would be diagnosed with type 1 diabetes for the first time. Exposure to respiratory infections in early childhood has been shown to be associated with an increased risk of autoantibody seroconversion in children who come from families with a history of type 1 diabetes [8]. [Note: This was found out by the method of continuously monitoring the subject's islet auto antibodies over the first three years of their existence [8]. Longitudinal autoantibody measurements have also been applied as a risk predictor in families that have a first-degree relative with type 1 diabetes [13], in general populations [38], and in individuals who have been identified as being at risk [11]. In addition, genetic factors as well as genetic risk scores were applied in order to evaluate whether or not islet autoantibodies were present in children who possessed high-risk HLA genotypes [9]. Six months before a diagnosis, the levels of post-challenge C-peptide start to drop rapidly after a challenge [6]. An investigation of the variations in metabolic processes supports this conclusion. For children who are at high risk, a composite risk score model was devised. This model took into account clinical, genetic, and immunological factors (who were tracked from birth until 9 years of age). When compared to autoantibodies by themselves, this model displayed a prediction of T1D that was significantly more accurate [10]. However, beyond the scope of the study that was mentioned above, there is a lack of application of machine learning methodologies to the process of building models of the age at which type 1 diabetes first appears in a person's life. This is despite the fact that a great number of studies have utilized a wide array of machine learning strategies for type 2 diabetes [10]. As a result, the work that is being suggested is distinct from the research that has been done in the past since it replicates the age at which children experience their first symptoms of type 1 diabetes (T1D). In order to accomplish this, it employs statistical and machine learning techniques to ascertain the risk factors and construct a prediction model.

III. DATASET CLASSIFICATION

The Pima Indian Diabetic Set, which can be located in the Repository of Machine Learning datasets at the University of California, Irvine (UCI), served as the foundation for the data set that was selected for categorization and experimental simulation. The Pima Indian Diabetic Set can be found in the Repository of Machine Learning datasets at UCI. Patients that are being considered for this study are natives of the Pima Indian tribe who currently make their homes in the state of Arizona, in the United States. More than half of the Pima Indian community suffers from diabetes, and the ailment is nearly exclusively brought on by the people's excessive levels of body fat. Obesity has been decisively proven as the key contributor to the development of diabetes in a number of research that have been carried out on these populations. The data collection in question is mostly made up of 9 characteristics, and there are a total of 768 instances [4]. A listing of these eight traits, together with the symbols that correlate to them, can be found in Table 1.

A medical dataset was obtained from the machine learning data repository at the University of California, Irvine for the purpose of evaluating the performance of three distinct approaches to diagnosing diabetes mellitus using PIDD. These approaches were evaluated with regard to how well they were able to produce accurate results. The Pima Indians Diabetes dataset can be found at the following URL: archive.ics.uci.edu/ml/datasets/Pima+Indians+Diabetes. The data collection contains a total of nine different properties.

Туре	Classification	Origin	Laboratory
Features	8	(Real / Integer / Nominal)	(8 / 0 / 0)

Table 1: Dataset description

Instances	768	Classes	2

Every algorithm necessitates that the information be provided in a particular arrangement. The unprocessed data must first be transformed into a format that can be read by a computer; this stage of the process is referred to as "pre-processing." During preprocessing, the tasks that need to be carried out include converting the attributes in the database to a single scale and replacing any and all missing values in the data. The raw data can be saved in a variety of formats, including text files, Excel spreadsheets, and other database file types. The vast majority of the time, raw data does not conform to any particular format. It is possible that the processing of the data will take less time if the data are formatted into a manner that the algorithms can understand. In most circumstances, each row in the table represents a single case, and the attributes of that case are indicated in the columns. Some databases store their information in a format known as Comma Separated Values (CSV for short). That is, each attribute is denoted by a comma, and the presence of two commas in a row indicates that there is a missing attribute, it is possible to find a question mark instead of a blank space in some cases.

The distribution of attribute values in relation to the class attribute labelled "0 or 1" is shown in Figure 1. The incidence of diabetes is shown by the number of times the colour blue appears. It is clear from looking at the figure that the vast majority of diabetic patients who are pregnant have values between 0 and 1.5, have plasma in the range of 99.5 to 103.5, have pressure in the range of 65 to 71, have skin fold thickness between 0 and 7, have insulin levels between 0 and 50, have a BMI between 27 and 30, have pedigree function between 0.25 and 0.50, and are between the ages of 21 and 25.

S. No.	Attributes	
1	Pregnancy	
2	Glucose	
3	Blood Pressure	
4	Skin thickness	
5	Insulin	
6	BMI(Body Mass Index)	
7	Diabetes Pedigree Function	
8	Age	

 Table 2: Dataset Description

IV. DATA PREPROCESSING

The phase that is believed to be one of the most important is the one in which the data is prepared. The vast majority of the data that pertains to healthcare lacks values and also contains other impurities, both of which might diminish the usefulness of the data. The purpose of performing data preprocessing is to improve the overall quality and usefulness of the findings obtained after the mining procedure has been completed.

In order to make the most of the opportunities presented by the dataset by applying Machine Learning Techniques, it is essential to carry out this approach in order to provide findings that can be trusted and to generate predictions that are spot on. As a direct consequence of this, various processes are carried out in order to convert the data into a data set that is condensed and error-free. You will first finish this strategy before starting the process of iterative analysis, which is a sequential process. The collection of procedures that are carried out is what is meant by the phrase "Data Preprocessing" [11].

Included in it are

- Data Cleaning
- Data Integration
- Data Transformation
- Data Reduction

It is required to undertake data preprocessing since there is access to data from the real world that has not been prepared. Erroneous information (missing data), which can arise for a variety of different reasons, makes up the vast majority of the data that comes from the real world. There are a wide variety of reasons for this, some of which include the fact that data is not continuously collected, an error in the process of entering data, technological challenges with biometrics, and many

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more.

The existence of noisy data, which can also include erroneous data and outliers - The reasons for the existence of noisy data could be due to a technological problem with the device that collects the data, a human error made when inputting the data, or a variety of other variables.

Data Inconsistent: The occurrence of inconsistencies can be linked to a number of issues, some of which include the existence of duplication within the data, the entry of the data by humans, the inclusion of mistakes in codes or names, a violation of the data limitations, and a great deal of other things.

We will need to perform preprocessing in two stages if we are going to adequately prepare our dataset on diabetes.

Elimination of Missing Values: Eliminate all of the instances in which there is a value of zero (0). Having no value at all is not a realistic option for anyone. As a direct consequence of this, the episode in question is no longer pertinent. A feature subset is created by a process known as feature subset selection, which involves the elimination of features or instances that are deemed to be unimportant. This helps to reduce the dimensionality of the data, which, in turn, makes it easier and more efficient to get things done in a timely manner.

Data Splitting: In both the training and the testing phases of the model, the data are partitioned and normalized after being cleaned. This ensures that the model is accurate. After the data have been partitioned, the algorithm is educated with the help of the training data set, and the test data set is kept in a separate location. This process will build the training model based on the logic and approaches that are applied, as well as the values of the features that are included in the training data. The major goal of normalization is to realize the objective of bringing all of the traits to the same level, and this purpose drives the process.

V. FORMATION OF TRAINING AND TESTING DATA

Generally speaking, the data that we deal with is split up into two distinct groups: the training data, and the test data. In order for the model to be able to generalize its findings to more data in the future, a known output is included in the training set, and the model is trained using this data. Because we have the test dataset, which is also referred to as the test subset, we are able to determine how accurate our model's prediction is by using this particular subset. The size of the training set is going to be decreased.

On the training set, both training and testing will be carried out with the assistance of the test set. The objective of the dataset is to produce a diagnostic prediction as to whether or not a patient suffers from diabetes based on certain diagnostic measurements that are contained within the dataset. This prediction can be made on the basis of the contents of the dataset.

VI. ALGORITHMS

MACHINE LEARNING

Machine learning is a method of statistical learning in which each instance in a dataset is described by a collection of features or qualities. This method was developed by Jerome Bruner and has become increasingly popular in recent years. The IBM Watson Research Center is responsible for the development of this method. In contrast, the phrase "Deep Learning" refers to a statistical learning process that extracts traits or attributes from raw data. This technique is sometimes referred to as "machine learning." This strategy is sometimes referred to as "guided learning."

Deep learning, which makes use of neural networks that incorporate many hidden layers, massive amounts of data, and significant processing resources, is what makes this possible and is how it is performed. However, when applying the Deep Learning approach, the programme will automatically build representations of the data. Although the words may appear to be interchangeable to some extent, this is not the case. Data representations in machine learning methods, on the other hand, are hard-coded to take the form of a set of features. This requires additional processes, such as the selection and extraction of features, which are not included in traditional learning algorithms (such as PCA).

Both of these words stand in stark contrast to another group of conventional AI algorithms that is referred to as rule-based systems. In these types of systems, each decision is manually programmed in such a way that it resembles a statistical model. This is done in order to ensure that the system functions correctly.

When it comes to machine learning and deep learning, there is a wide variety of models that can be utilized, and these models may be separated into two main categories: supervised and unsupervised. Unsupervised learning employs techniques like as k-means, hierarchical clustering, and Gaussian mixture models in an effort to find meaningful structures hidden within the data. This type of learning is not guided by an instructor. Learning through supervision necessitates the application of an output label to every single instance that is present within the dataset.

This output may have values that are discrete or categorical, or it may have values that are real-valued. On the other hand, the outputs of classification models are estimated to have discrete values, whereas the outputs of regression models are predicted to have real values [16].

The simplest type of classification model is called a binary classification model, and it only has two possible output labels: 1 (positive) and 0. (negative). The terms "linear regression," "logistic regression," "decision trees," "support vector machines," and "neural networks" are all examples of popular supervised learning algorithms that fall under the umbrella term "machine learning." Other examples include "support vector machines," "decision trees," and "support vector regression." This category includes contains non-parametric modelling techniques, such as "k-nearest Neighbors," amongst others. We shall be applying a supervised learning strategy for the purpose of this inquiry, which is the scope of it.

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LOGISTIC REGRESSION

Logistic regression is a method of statistical analysis that is utilized for the purpose of determining the relationship between a given dataset and one or more independent variables that serve as predictors of an outcome. A wide variety of determining factors could be present in this kind of dataset. Because there are only two plausible interpretations of the data, the result is evaluated using a dichotomous variable, which indicates that there are only two possible outcomes. It is used to produce a prediction about whether the outcome will be binary (1/0, Yes/No, True/False), given a number of independent elements that are being considered. Dummy variables are put to use whenever we need to express results in a manner that is either binary or categorical. Logical regression is another name for a particular type of linear regression that is used when the outcome variable that is being studied is categorical and the log of probabilities is being used as the dependent variable in the analysis. Logical regression can also be seen as another name for logistic regression, which is a form of logistic regression. Putting it another way, it applies the data that was collected to a statistical function that is considered to be reliable in order to derive an estimate of the probability that a particular event will take place.

In the year 1958, a statistician by the name of David Cox was the first person to come up with the idea of logistic regression. With the assistance of this binary logistic model, which takes into consideration one or more predictor elements, also known as independent variables, it is possible to arrive at an estimate of the likelihood of obtaining a binary response (features). It makes it feasible to assert that the existence of a risk factor elevates the possibility of a given consequence by a predetermined percentage.

Sigmoid function P = 1/1 + e - (a+bx)

Here P = probability, a and b = parameter of Model.

RANDOM FOREST

In addition to being a part of the ensemble learning family of techniques, this method also performs the functions of classification and regression analysis. This method is very effective when it comes to dealing with really large datasets. Leo Bremen is credited with developing the algorithm known as Random Forest. It is a well-known approach to education that involves learning in groups. Random Forest is able to increase the performance of Decision Tree by bringing the overall variance down to a lower value. It constructs a large number of decision trees while it is in the training phase, and at the end of that phase, it determines the class that corresponds to the mode of the classes, which is also referred to as classification, or it determines the mean prediction, which is also referred to as regression, of the individual trees [17].

- 1) The first step is to select the "R" features from the total features "m" where $R \ll M$.
- 2) Among the "R" features, the node using the best split point.
- 3) Split the node into sub nodes using the best split.
- 4) Repeat a to c steps until "l" number of nodes has been reached.
- 5) Built forest by repeating steps a to d for "a" number of times to create "n" number of trees.

Examining the different possibilities that are open to choose from is the first step that needs to be taken. Next, an educated guess needs to be made regarding the result, using the foundation provided by each arbitrarily generated decision tree. Finally, this educated guess needs to be saved in a number of different places dispersed across the area of interest. In the second stage, the votes that were given for each of the anticipated goals are added up. In the third and final step, the forecast that received the most votes is used as the foundation for the ultimate prediction that is produced by the random forest approach. The user has access to a few of Random Forest's settings, any one of which has the potential to generate accurate forecasts for any one of a number of diverse applications.

DECISION TREE

One specific type of approach that can be used for classifying data is called a decision tree. It is the process of gaining knowledge through observation and guidance. The decision tree is used in situations where the variable being responded to is categorical. A decision tree, which is based on a model that is structured like a tree and describes input features, is used to represent the process of categorization. This tree is based on a model. Input variables can take any form, including graphs, texts, discrete numbers, continuous values, and any other form imaginable.

- 1) Build the tree with the nodes serving as the input feature.
- 2) Select the feature to forecast the output from the input feature that has the largest information gain.
- 3) The information gain that is considered to be the greatest is determined for each characteristic and each node of the tree.
- 4) Repeat step 2 in order to build a sub tree utilizing the feature that was not used in the node that was previously examined.

K-MEANS ALGORITHM

Unsupervised algorithms are those that are able to function well on unlabeled samples even in the absence of direct supervision. This suggests that it is impossible to forecast the output even if it is possible to determine the input. Unsupervised learning algorithms include a number of different methods, including the K means algorithm, which is one of these methods. They require an input parameter, which is the number of clusters, as well as n objects in the data collection, which is then partitioned into k clusters in order to work properly. The algorithm makes a choice out of the available k items based on a random selection. According to how close an item is situated to the linked cluster to which it belongs, it is assigned a specific location within one of the clusters that it belongs to. The subsequent stage is to determine which areas are

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the closest in proximity to one another. When trying to find the location of the object that is the most central to it, it is recommended that you utilize the Euclidean distance. After the items have been organized into k clusters, the new centres of the clusters are found by averaging the items contained inside each of the k clusters in turn. This process is repeated until all of the clusters have been exhausted. Following this technique up until the point where there is no longer any fluctuation in the k cluster centres is done. In order for the K-means algorithm to be successful in accomplishing its mission, the objective function that it aims to decrease is the sum of squared error (SSE) [14]. The acronym SSE stands for

$$\operatorname{argmin}_{C} \quad \sum_{i=1}^{k} \sum_{p \in Ci} |p - m_i|^2 \qquad ($$

Here, E is the total of the square errors of all of the objects that have cluster means for each of the k clusters, and p is the object that belongs to one of the clusters. The combination of *Ci* and *mi* represents the cluster mean. The total number of records in the dataset is denoted by "n," and "k" indicates the number of clusters.

Input: D is input -data set.

Output: Output is k clusters.

Step 1: Initialize cluster centers as D.

Step 2: Randomly choose k objects from D.

Step 3: Repeat the following steps until no change in cluster means/ min error E is reached.

Step 4: Consider each of the k clusters. Compare the mean value of the objects in the clusters for initialization.

Step 5: Initialize the object with most similar value from D to one of k clusters.

Step 6: Take the mean value of the objects for each of k cluster.

Step 7: Update the cluster means with respect to object value.

VII. PERFORMANCE MEASUREMENT

On the basis of the dataset that we have created, we will evaluate the performance of the algorithms that we have developed [15]. In addition, we will test our model on the dataset that we have prepared. In order to evaluate the efficacy of our newly created classification system and make it comparable to other methods that are currently in use, we use Accuracy as a measure of the effectiveness of classifiers.

True Positives (TP) - These are the positively predicted values that turned out to be correct, which indicates that both the value of the actual class and the value of the predicted class are true. For example, if the actual class value indicates that the passenger survived and the predicted class tells you the same thing, you can assume that the passenger did indeed survive.

True Negatives (TN) - These are the negative values that have been accurately predicted, which indicates that the value of the real class is no and that the value of the predicted class is also no. For example, if the actual class reports that the passenger did not make it out alive while the projected class reports the same thing. These results, known as false positives and false negatives, are produced when your actual class is in conflict with the class that was predicted.

False Positives (FP) – When the class that was actually taken was not the class that was projected to be taken. For example, if the actual class indicates that the passenger did not survive, but the forecast class indicates that they will, this passenger will survive.

False Negatives (FN) – The situation in which the actual class is yes while the projected class is no. For example, if the actual class value indicates that the passenger survived while the predicted class implies that the passenger would die, the actual class value should be used. When you have a firm grasp on these four characteristics, we will be able to proceed with the calculation of accuracy, precision, recall, and F-measure.

		Actual	
	[Positive	Negative
od cted	Positive	True Positive	False Positive
Predi	Negative	False Negative	True Negative

Figure 2: Confusion Matrix

VIII. CONCLUSION

Concerns have been voiced by many who work in the medical field over the best way to diagnose diabetes in its earliest stages. During the course of this research project, an attempt was made to construct a system that would predict diabetes by making use of a number of different algorithms and analyzing how well they performed. This was done in an effort to create a system that could potentially predict diabetes. The research involved the application of three distinct machine learning

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algorithms, and the performance of each of these methods was assessed based on a number of different criteria. During the trial, the PIMA Indian Diabetes dataset was utilized, and the findings indicated that logistic regression had the best performance overall. This method of machine learning is also flexible, and it can be applied to the prediction of diseases other than the one that it was initially developed to analyze. The findings have the potential to be enhanced further by the incorporation of other machine learning algorithms, which would result in an increased ability to forecast diabetes.

References

- [1] Deeraj Shetty, Kishor Rit, Sohail Shaikh, Nikita Patil, "Diabetes Disease Prediction Using Data Mining ".International Conference on Innovations in Information, Embedded and Communication Systems (ICIIECS), 2017.
- [2] Al-Sakran, HO 2015, 'Framework architecture for improving healthcare information systems using agent technology', International Journal of Managing Information Technology, vol. 7, no.1, pp. 17-31.
- [3] American Diabetes Association 2013, Diagnosis and Classification of Diabetes Mellitus: Diabetes Care, Available from: <u>http://care.diabetesjournals.org/content/36/Supplement_1/S67.full</u>. [January 2013].
- [4] Anburajan, M, Sivanandam, S, Bidyarasmi, S, Venkatraman, B, Menaka, M & Raj, B 2011, Changes of skin temperature of parts of the body and serum asymmetric dimethylarginine (ADMA) in type-2 diabetes mellitus Indian patients, Proceedings of the annual international conference of the engineering in medicine and biology society, pp. 6254-6259.
- [5] Arif, M & Akram, MU 2010, 'Pruned fuzzy K-nearest neighbor classifier for beat classification', Journal of Biomedical Science and Engineering, vol. 3, no. 4, pp. 380-389.
- [6] Ashari, A, Paryudi, I & Tjoa, AM 2013, 'Performance comparison between naïve Bayes, decision tree and k-nearest neighbor in searching alternative design in an energy simulation tool' vol. 4, pp. 33-39.
- [7] Nirmala Devi M., Appavu alias Balamurugan S., Swathi U.V., 2013.", An amalgam KNN to predict Diabetes Mellitus", IEEE International Conference on Emerging Trends in Computing , Communication and Nanotechnology (ICECCN), pp 691-695
- [8] Asha Gowda Karegowda and Jayaram. A. M., 2009"Cascading GA & CFS for feature subset selection in medical data mining", IEEE International Advance Computing Conference, Patiyala, India
- [9] Krzysztof J.Cios, G.William Moore (2002) 'Uniqueness of Medical Data Mining', Artificial Intelligence in Medicine Journal pp 1-19.
- [10] Cios, KJ & Moore GW 2002, 'Uniqueness of medical data mining', Artificial Intelligence in Medicine, vol. 26 no. 1, pp. 1-24.
- [11] Cwiklinska-Jurkowska, M 2009, 'Performance of the support vector machines for medical classification problems', Biocybernetics and Biomedical Engineering, vol. 29, no. 4, pp. 63-81.
- [12] Zoran Bosnic, Petar Vracar, Milos D. Radovic, Goran Devedzic, Nenad D. Filipovic and Igor Kononenko(2012) 'Mining Data From Hemodynamic Simulations for generating Prediction and Explanation Models' IEEE Vol. 16, No. 2,pp 248-254.
- [13] Freudenberg, J & Propping, P 2002, 'A similarity-based method for genome-wide prediction of disease-relevant human genes', Bioinformatics, vol. 18, no. 2, pp. 110-115.
- [14] Polat, K., Gunes, S., & Aslan, A., (2008) A cascade learning system for classification of diabetes disease: Generalized discriminant analysis and least square support vector machine. Expert Systems with Applications, 34(1), 214–221.
- [15] D. Menon, K. Schwab, D.W. Wright, A.I. Maas, and the Demographics and Clinical Assessment Working Group of the International and Interagency Initiative toward Common Data Elements for Research on Traumatic Brain Injury and Psychological Health, Position statement: definition of traumatic brain injury, Arch. Phys. Med. Rehabil., vol. 91, pp. 1637–40, Nov 2010.
- [16] Guo, Y, Bai, G & Hu, Y 2012, 'Using Bayes network for prediction of Type-2 diabetes, 'Proceedings of the IEEE international conference on internet technology and secured transactions, pp. 471-472.
- [17] Hossin, M & Sulaiman, MN 2015, 'A Review on evaluation metrics for data classification evaluations', International Journal of Data Mining and Knowledge Management Process, vol. 5, no.2, pp. 1-11.

EFFICIENT ENERGY OPTIMIZATION PROTOCOL FOR HETEROGENEOUS WIRELESS SENSOR NETWORKS RELYING ON NODE ENERGY

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Abstract— Wireless sensor networks (WSNs) are the technology that is expanding at the fastest rate, and its uses range from monitoring the environment to predicting the flow of traffic to listening in on conversations to research and academic fields. The haphazard placement of sensor nodes in a wireless environment has led to the emergence of security metrics as the most promising challenge that communication wireless networks must face today.

Stable election protocol, also known as SEP, is an updated version of the Low Energy Adaptive Clustering Hierarchy algorithm. Its purpose is to maximize the life cycle of heterogeneous wireless sensor networks, also known as WSNs (LEACH). On the other hand, the lifetime would be shortened due to the disparity in the amount of energy consumed by cluster heads and nodes. Include node energy in the election of the cluster head to decrease the amount of energy that is consumed by the cluster head. On the other hand, reduce the amount of energy that is consumed by individual nodes in the cluster through the use of indirect transmission by intermediate nodes. SEP is a heterogeneous-aware protocol that extends the time interval before the first node dies (what we call the stability period). This is essential for many applications in which the output from sensor networks needs to be reliable. The SEP is calculated based on the weighted election probability of each node to become the cluster head, which vary according to the amount of energy that each node still possesses. When the LEACH protocol and the SEP protocol were compared to the enhanced Efficient-SEP protocol using the algorithm that was suggested by MATLAB, the results revealed that the enhanced E-SEP protocol works well in balancing the energy consumption to improve the lifetime. This was determined by looking at how well the enhanced E-SEP protocol compared to the other protocols.

Index Terms— Heterogeneous wireless sensor networks, Stable Election Protocol (SEP), Clustering, election probability

I. INTRODUCTION

Wireless sensor networks, also known as WSNs, are made up of a large number of sensor nodes that can either be homogenous or heterogenous or have a finite amount of resources. Techniques for determining where data should be sent are the most crucial concern for networks with constrained resources. The increase in the compute capacity of WSNs technology necessitates that these sensor nodes be more equipped to handle more sophisticated functions. The energy level, processing power, and detecting ability of each sensor are the primary areas in which they are constrained. Therefore, a network consisting of these sensors will result in a network that is more durable, trustworthy, and accurate. Numerous studies on WSNs have been conducted, and the results of these studies show that this technology is continually finding new applications in a variety of fields, including remote and hostile regions, as seen in the military for battle field surveillance, monitoring the territory of the enemy, detection of attacks, and security etiquette. These sensors also have a number of other applications, including deployment in disaster-prone locations for the purpose of environmental monitoring and use in the medical industry, where patients can wear small sensors to collect physiological data. It should be mentioned that in order to keep up a reliable information delivery, data aggregation and information fusion are required. This is so that communication between these sensor nodes may take place in an efficient and effective manner. Only processed and succinct information

should be sent to the sinks in order to cut down on the amount of energy used for communications, hence extending the useful lifetime of the network through optimized data delivery.

Wireless sensor networks, often known as WSNs, have recently attracted a lot of attention as a potential new application field for ad hoc networks. WSNs are constructed from a collection of sensor nodes that are characterized by their multifunctionality, low power consumption, and low cost in addition to their capacity for wireless processing and communication. These sensors collaborate to achieve a common objective, such as environmental monitoring, the tracking of targets, and the management of industrial processes [1], and they do so by communicating with one another over a short distance utilizing a wireless medium. The plan is to use a collection of affordable, small fixed sensors to sense the various physical features of the environment, and then to send those findings to a node that will act as a sink [2]. Despite the wide variety of uses for WSNs, their fundamental purpose is to collect data, then process that data, and then transmit the processed data to a particular node (base station or sink). Data that nodes can use to determine the best path between them are specified by the routing protocol. The purpose of routing in WSNs is to move data from one sensor node to another sensor node that has been designated as its destination. In order to accomplish this objective, a suitable routing protocol needs to be devised so that paths may be established between the sensor nodes and the destination. Building routing protocols for WSNs is particularly challenging due to the constraints of network resources like as energy, storage, and bandwidth, as well as communication connection failures, challenges in multidimensional optimization, and a variety of network constraints and needs. The routing design and the system architectural mode are intricately tied to one another.

WSNs are built with the ability to operate independently and untethered, even in environments that are potentially harsh, unexpected, and dynamic. The fundamental purpose of a wireless sensor network (WSN) is to sense and collect data from a target area, process that data, and then transmit it directly to the target node. Having said that, it is difficult to complete this work since the amount of transmission energy needed rises in a manner that is proportional to the square of the distance. As a consequence of this, multi-hop communication is utilized for the purpose of data routing. It is necessary to devise a protocol for energy-efficient pathfinding in order to set up connections between the sensor nodes and the data sink in order to successfully carry out this function. The decision that is made regarding the routing has a significant bearing on load balancing, end-to-end reliability, and latency. There may be numerous distinct paths that lead to the destination node. It is imperative that the route be selected in such a way as to maximize the lifetime of the network. Because of the constraints imposed by resources, WSN provides substantial challenges in the areas of network building, topology discovery, communication scheduling, routing management, and signal processing.



Figure 1: Heterogeneous Models for WSN

Wireless sensor networks, often known as WSNs, are a type of network that monitors a system or environment using a large number of small, lightweight wireless nodes that are spread in a highly dispersed manner. The development of micro-electromechanical systems has allowed for the

fabrication of such sensors, which is now possible [3]. Due to the increasing computing capacity of WSN technology, it is imperative that these sensor nodes be better equipped to handle more complex functions. Challenges pertaining to energy conservation, sensor node coverage, and dependability are tackled during the installation of a base station in a sensor network. In most cases, it is considered that base stations are stationary; however, in certain scenarios, it is expected that base stations are mobile in order to collect data from sensor nodes.

The LEACH [4] protocol is a Low-Energy Adaptive Clustering Hierarchy protocol, and it is considered to be an established method in the field of clustered routing protocols. It is clustered based on the signal strength that was received by the node, and the cluster head node is chosen in a random loop so that the energy consumption of the nodes within the network may be maintained at a consistent level. The Stable Election Protocol, also known as SEP, is a heterogeneous aware protocol that was proposed in [5]. SEP is a protocol that is based on the weighted election probabilities of each node to become the cluster leader based on their individual energy. This method ensures that cluster heads are chosen at random and distributed according on the fraction of energy utilized by each node, so ensuring that the energy from the nodes is used in an even-handed manner.

An example of a LEACH-based heterogeneous network clustering routing technique is called the SEP [5] algorithm. The SEP algorithm uses an energy heterogeneous approach. This approach involves increasing the likelihood of high-level nodes becoming cluster heads based on the beginning energy of distinct sets of different cluster election probabilities. This ensures that high-level nodes and ordinary nodes pass away at the same time. However, the SEP algorithm still has an unequal distribution of cluster heads, a large number of nodes in the cluster, and does not take into account the residual energy of the nodes. There is much potential in clustering as a method for increasing the lifetime of WSNs. Right now, you should suggest a technique that is based on the initial protocol but is far more effective. Improved-SEP in addition to other methods that are similar for advancement.

Energy efficient cluster head election protocol for heterogeneous wireless sensor networks

An energy efficient cluster head election protocol was proposed by (LI Han, 2010) for use in heterogeneous wireless sensor networks. Additionally, an enhanced version of Prim's algorithm was used to design an inter cluster routing. He has given thought to all three varieties of sensor nodes. A certain proportion of the sensor nodes have been outfitted with supplementary energy resources in comparison to the other nodes. He has made the assumption that all of the sensor nodes are distributed in the same manner.

Within the framework of this protocol, the cluster head node is responsible for configuring a TDMA schedule and sending it out to the other nodes in the cluster. This not only prevents data messages from colliding with one another, but also enables the radio components of every node that is not the cluster head to be turned off at all times, with the exception of the time that they are transmitting data. As a result, the amount of energy that is lost by the individual sensors is reduced.

A multi-hop routing algorithm of cluster head has been presented, which introduces into the restriction factor of remainder energy when selects the interim nodes between cluster heads and base station, and also the minimum spanning tree algorithm has been included in order to balance the energy consumption of the cluster heads which are close to the base station. This is done in order to reduce the energy consumption of the cluster heads which are far away from the base station and to bring the energy consumption of the cluster heads which are close to the base station into balance. Not only may the protocol lower the amount of energy that is used to transmit data by the cluster head, but it can also reduce the amount of energy that is used for communication between nodes that are not cluster heads and nodes that are cluster heads. The results of the simulation reveal that this protocol achieves a higher level of network lifetime performance compared to LEACH and EECHE.

Heterogeneous wireless sensor networks

In this part, a paradigm of a heterogeneous wireless sensor network is presented, and the impact of heterogeneous resources is discussed. (Yarvis ,2005) (V. Katiyar, 2011).

Types of heterogeneous resources

Computational heterogeneity, link heterogeneity, and energy heterogeneity are the three primary varieties of resource heterogeneity that are typically seen in sensor nodes.

Computational heterogeneity: refers to the fact that the heterogeneous node, in comparison to the standard node, possesses a more potent CPU and an increased amount of memory. Heterogeneous nodes are capable of providing complicated data processing and longer-term storage thanks to the tremendous computational capabilities at their disposal.

Link heterogeneity: refers to the fact that the heterogeneous node, in comparison to the typical node, possesses a higher bandwidth and a longer distance network transceiver. Link heterogeneity can allow a more dependable data transfer.

Energy heterogeneity: refers to the fact that the heterogeneous node can be fueled by line power or by a battery that can be swapped out.

The energy heterogeneity is the most essential resource heterogeneity out of the above three categories of resource heterogeneity. This is due to the fact that both the computational heterogeneity and the link heterogeneity will require a greater amount of energy resource. In the event that there is no energy heterogeneity, computational heterogeneity and link heterogeneity will have a detrimental impact on the entire sensor network, which will result in a reduction in the network's lifetime. Figure 2 shows the performance measures heterogeneous model for wireless sensor network.



Figure 2: Performance measures of Heterogeneous model for WSN

II. LITERATURE SURVEY

A literature review involves the examination of historical material and the generation of a combination of new and historical information. As a consequence of this, this section includes a concise explanation of a number of different research studies, in addition to a research paper summary and a research paper synthesis.

According to L. Subramanian and R. H. Katz (2000)[6], LEACH is the usual coordinating display that has been offered to attain the imperativeness capability in remote sensor frameworks. Other

coordinating displays have also been presented. This project's objective is to develop a customizable low-power guiding display that selects ideal bundle heads by taking into account a few different ideas derived from centre points. Genetic estimating is connected to the process of increasing the controllable characteristics of the suggested display in order to lengthen the lifetime of the framework. The data from the programme can be used to represent the safety threshold. The results of the simulations provide evidence that the guided display that was suggested is effective. The typical increase in the lifetime of the framework is estimated to be 82% longer, as demonstrated by three earlier LEACH-based shows. The proposed coordinating show has the capability of successfully modifying the criticality of centre point use while also extending the lifetime of the framework.

Tiwari et al., (2015) [7] utilized a technique called distributed clustering in order to improve energy efficiency (Modified DEEC). The residual and average energy of the network are taken into consideration while selecting cluster heads. A random integer is chosen, and if that number is lower than the probability threshold, the node in question is promoted to the position of CH for the remainder of the current round. The likelihood of a node developing into a CH is greatest for those who have the greatest amount of unused energy. Because every node must expend energy to verify that it is qualified to be CH, the number of nodes competing for the role must be kept to a minimum in order to make the selection process easier. To accomplish this, only nodes having an energy level that is higher than a predetermined threshold will have their selection considered. As a direct result of this, there is a breakdown in communication inside the cluster. The information is gathered by the head of the cluster from the member nodes that are within its sphere of influence.



Figure 3: Clustering in LEACH Protocol

The authors Smaragdakis and Smaragdakis [8] are famous for a LEACH variation that they name the Stable Election Protocol (SEP). It is designed to function primarily for dual-level heterogeneous networks that have doublet types of sensors (particularly Advance and normal nodes). When compared to conventional nodes, advance sensors typically have a higher energy retention rate and necessitate more frequent CH rotations. The CHs that have been selected in this instance make reference to the beginning energy of the sensor. The fact that the choice made by the CH is static is the most significant disadvantage. Because of this, advanced nodes that are located a significant distance from the sink expends their energy at a faster rate, and they eventually cease to exist. SEP is useless when applied to a heterogeneous network with multiple layers.

According to Malluh and colleagues' findings, SEP has been improved [9]. Additionally, more often than normal sensors, sophisticated nodes are picked to serve as CHs. Additionally taken into consideration is the total number of nodes that are connected to each CH. As a consequence of this, the

sensor nodes are able to be dispersed uniformly among all of the CHs. If there is more than one sensor that can be a CH during a particular round, EM-SEP will select the sensor with the highest available energy to serve in that capacity. The stability time of the sensor network is increased thanks to these two components. The fact that this strategy does not take into account the cost of communication across clusters is its primary shortcoming.

Rehman et al. [10] have provided a description of a stability-based clustering approach, which is an extension of SEP. In a WSN, sensors of varying types are dispersed in a random fashion. In the previous round, the position of CH was given preference to a node that had a lower Energy Consumption Rate (ECR). The expression entropy change rate (ECR) implies that there is a difference between the initial energy and the residual energy of a node. The core problem is that advanced nodes are always punished when they are picked as a CH. This is because of the way the CH selection process works.

The Stable Election Protocol, also known as SEP, is a heterogeneous-aware protocol that was proposed by Georgious et al. [11] with the intention of extending the stability period and increasing the average throughput. The SEP is calculated using the energy-weighted election probability of the nodes as a function of their residual energy. On the basis of their energy levels, nodes are separated into two distinct categories: ordinary nodes and advanced nodes. The energy that is produced by advanced nodes is greater than that which is produced by regular nodes. Standard nodes have a lower likelihood of becoming cluster heads compared to advanced nodes, which have a larger possibility.

It was described in [11] that the Stable Election Procedure, also known as SEP, is a heterogeneous aware procedure that is based on weighted election probability for each node to become the cluster head dependent on their own individual energy. This method ensures that cluster heads are chosen at random and distributed according on the fraction of energy utilized by each node, so ensuring that the energy from the nodes is used in an even-handed manner. The SEP performed an analysis on two different kinds of nodes (two layer in-clustering), as well as two different levels of hierarchies. In a heterogeneous wireless sensor network (WSN), the LEACH [12] protocol, which maintains the Integrity of the Specifications in the same way as a typical clustering approach does, performs very poorly.

III. ANALYSIS OF SEP PROTOCOL

G. Maragdakis suggests the SEP [8] algorithm as a traditional heterogeneous network clustering routing technique. This idea was presented by Maragdakis. The LEACH protocol serves as the foundation for the development of this agreement. The initial energy isomorphism of this element is incorporated into the protocol through the utilization of the second energy heterogeneous network. The network is split into ordinary nodes and high-level nodes according to the heterogeneous characteristics of the network, and each type of node is assigned a different cluster election probability. The cluster election probability of high-level nodes is greater than that of ordinary nodes. In order to ensure that high-level nodes and ordinary nodes pass away at roughly the same time and to lengthen the period during which the network cycle remains stable.

The SEP routing protocol is a typical example of a two-level initial energy heterogeneous WSN cluster protocol. It consists of two distinct energy nodes, namely common nodes and advanced nodes, and has two different levels of initial energy. The SEP protocol is based on the premise that determining the cluster head election probability of nodes according to the different initial energy and taking a random round mode to change the cluster head nodes are the two most important aspects of the protocol. As a result, all sensor nodes are able to share the load on the network, which helps to reduce power loss and extend the lifetime of the network.

A. Cluster Establishment Stage

It is presumed that there are initially n nodes, which are then categorized as either common or advanced nodes depending on their level of complexity. Within the network of nodes, the optimal cluster head ratio is denoted by P_{otp} . E_0 represents the starting energy level of the common node. The energy of the advanced node is $(1+\alpha)$ times that of the common node, which is $(1+\alpha) E_0$.

Since the overall node fraction of the advanced node is m, the following expression can be used to calculate the total energy of the entire heterogeneous WSN [11-13]:

$n(1-m) E_0 + nm (1+\alpha) E_0 = n(1+m\alpha) E_0$ (1)

Because cluster heads are responsible for coordinating operations amongst clusters and transmitting data to base stations, their energy demand is higher in comparison to that of other nodes. As a result, the relevant cluster head is continuously rotated, which causes the SEP protocol to spend the same amount of energy throughout its entirety. According to the respective computing likelihood, every node decides for them whether or not they are eligible to be a cluster leader in the current wheel. Each sensor node chooses a value at random from the range [0 1] and then compares that value to the threshold T. (i). If the value is lower than T(i), then the node is eligible for election as the cluster head; if it isn't, then it isn't eligible for election as the cluster head.

Even now, the SEP algorithm uses the LEACH algorithm for its selection of cluster heads through a process of randomization. The decision of whether or not to join the cluster is made during the clustering process, and it is based on the strength of the signal received from the cluster head node through the non-cluster head node. Because of this, the cluster head is not distributed uniformly, and the approach that it uses to cluster the nodes results in an unpredictable total number of nodes within the cluster.

The election probability is only related to the initial energy of the node in the SEP algorithm; it has nothing to do with the residual energy of the node. After the network has been running for some time, the residual energy of the high-level node may not have the residual energy of the ordinary node; however, the probability of becoming the cluster head is still higher than that of the ordinary node. As a result, the overall amount of time the network is able to survive is shortened, and the death of some advanced nodes occurs much more quickly. This type of transmission so far away from the cluster head nodes needs to spend a lot of energy to carry out long-distance information transmission, which causes the nodes in the network to die prematurely and reduces the network's life cycle. The SEP algorithm is used in single-hop transmission mode [13-14].

B. Transmission Phase

After the cluster has been constructed, the nodes that make up the cluster will communicate with the nodes that serve as the cluster head within the allotted time period in order to finish the transfer of the data that was gathered in the relevant region. The cluster head sends the Time Division Multiple Address (TDMA) scheduling table, which defines the allocation time slot. During the non-transmission slot, the cluster nodes are in the dormancy state, which is one way that the SEP protocol saves energy. After the data have been received, the cluster head will converge on them, compress them with their own data, and then transfer them to the sink node.

IV. ENHANCED EFFICIENT-SEP PROTOCOL

In regard to the shortcomings of SEP that were discussed before, we offer the nodes' residual energy so that they can take part in the edge calculation in order to change the chance of becoming cluster heads of nodes within a given amount of time. In order for the cluster nodes to be able to transfer the apparent data, the interlude nodes in the cluster are further displayed.

A. The Model of Energy Consumption



Figure 4: Energy Consumption Model

For the record, the amount of energy required for accepting or sending k bits of data when a distance of d is present is provided here.

Supplicant time

$$E_T(k,d) = \begin{cases} E_{elec} k + E_{fs} k d^2 \ d < d_0 \\ E_{elec} k + E_{mp} k d^4 \ d > d_0 \end{cases}$$
(2)

Accepting time

$$E_R(k) = E_{R-elec}(k) = E_{elec} k \quad (3)$$

 E_{elec} is the amount of energy lost during the transmission of a single data unit; E_{fs} and E_{mp} is the amount of energy lost during gain magnification; d_0 is the distance at which the threshold is reached.

B. Cluster Head Election Method

Simply taking into account the initial energy consumption won't be enough to solve the problem of imbalanced energy use, according to SEP. In order to construct the WSN life cycle, the residual energy of the nodes must be added to the estimation of the cluster headelection perspective [11]. In order to balance the distribution of energy consumption among the nodes and improve the life cycle, the node that has the lowest amount of residual energy has a lesser likelihood of becoming the clusterhead [15]. E_r is the residual energy of the node, Es denotes the overall residual energy, and E_c denotes the energy reference factor.

$$E_c = e^{-(E_r - \frac{E_s}{n})} \tag{4}$$

In reference to the original technique for selecting the SEP cluster head, the node residual energy is integrated as the energy reference factor E_c . In the same manner as in SEP, the initial energy for normal nodes is denoted by Eo, whereas the initial energy for advanced nodes is denoted by $Eadv = 1 + \alpha Eo$.

Assume that for intermediate nodes, $E_{int} = 1 + \mu E o$.

This gives us: $\mu = \alpha/2$

The value of our probability setting, *popt*, has not changed. The addition of advanced as well as intermediate nodes, on the other hand, causes an increase in the system's total starting energy:

$$n \cdot E_o(1 - m - b) + n \cdot m \cdot E_o(1 + \alpha + n \cdot b \cdot (1 + \mu)) = n \cdot E_o(1 + m \cdot \alpha + b \cdot \mu)$$
(5)

Where *n* represents the total number of nodes, *m* represents the percentage of advanced nodes relative to the total number of nodes *n*, and *b* represents the percentage of intermediate nodes in the network. It is required that the new epoch of the system be equal to $Popt \cdot (1+m \cdot \alpha+b \cdot \mu)$, which results in an increase in the overall energy of the network by a fraction of $(1+m \cdot \alpha+b \cdot \mu)$.

 E_c is the energy reference factor that is derived from equation no. 4, and if P_{nrm} , P_{int} and P_{adv} are the probabilities of becoming normal, intermediate, and advanced nodes, respectively, then E_c is the value that is used. Because of this, we have:

$$P_{nrm} = P_{opt} / (1 + m \cdot \alpha + b \cdot \mu)^* E_c \qquad (6)$$

$$P_{int} = (P_{opt}) \times (1 + \mu) / (1 + m \cdot \alpha + b \cdot \mu)^* E_c \qquad (7)$$

$$P_{adv} = (P_{opt}) \times (1 + \alpha) / (1 + m \cdot \alpha + b \cdot \mu)^* E_c \qquad (8)$$

In order to ensure that the sensor nodes must take on the role of cluster leaders, as was stated earlier, we need to specify a new threshold for the election procedures and refer back to the equation that was previously used (5). The threshold values, denoted by (n_{nrm}) , (n_{int}) , $T(n_{adv})$, for normal, intermediate, and advanced users, respectively, are as follows:

$$T(_{n_{nrm}}) = \begin{cases} \frac{P_{nrm}}{1 - P_{nrm}[r \times mod(1/P_{nrm})]} & \text{if } n_{nrm} \in G'\\ 0 & \text{otherwise} \end{cases}$$
(9)

As we can see from the previous section, $n \times 1-m-b$ noral node, which verifies that our assumption (1) is accurate.

The same logic applies to the intermediate and advanced nodes, where G' refers to the set of normal nodes that have not become cluster heads in the $1/P_{nrm}$ rounds that have passed since the previous one.

$$T(_{n_{int}}) = \begin{cases} \frac{P_{int}}{1 - P_{int}[r \times mod(1/P_{int})]} & \text{if } n_{int} \in G'' \\ 0 & \text{otherwise} \end{cases}$$
(10)

We have $n \times b$ intermediate nodes, and we define G'' as the set of intermediate nodes that has not become the cluster head in the most recent $1/P_{int}$ round of r.

$$T(_{n_{adv}}) = \begin{cases} \frac{P_{adv}}{1 - P_{adv}[r \times mod(^{1}/P_{adv})]} & \text{if } n_{adv} \in G^{\prime\prime\prime} \\ 0 & \text{otherwise} \end{cases}$$
(11)

We have $n \times m$ advanced nodes, and the set of advanced nodes denoted by G''' is the set of nodes that have not become cluster heads in the most recent $1/P_{adv}$ round *r*.

Using Equations (9), (10), and (11), we can determine that the typical total number of cluster heads produced in one round is:

$$n \cdot (1-m-b) \times P_{nrm} + n \cdot b \times P_{int} + n \cdot m \times P_{adv} = n \times P_{op}(12)$$

In comparison to the initial option for LEACH, this results in the same amount of cluster heads being produced. On the other hand, because of the heterogeneous energy configuration, the dissipation of energy is better managed.

C. Mechanism of the Intermediate Node

The SEP protocol does not optimize the data transmission that occurs between the members of the cluster; rather, the information is transferred straight from the member nodes of the cluster to the heads of the cluster. Therefore, it will require a greater expenditure of energy to convey information and will drastically reduce the lifetime of the network for the edge nodes that are located a significant distance from the cluster head [16]. Therefore, in this scenario, linking the intermediate nodes will unquestionably improve the negative effects of the edge nodes and maintain equilibrium in the amount of energy consumed by each node.



Figure 5: Direct compares indirect transmission

The nodes in the cluster use the intermediate nodes to transport the information indirectly so that they can lower the amount of energy they use and increase the amount of time they have to live. This is the rationale behind the mechanism known as the intermediate node. After the structure of the cluster has been constructed, the node I of the cluster will compute the amount of energy, E_1 , that was used to transfer information indirectly through the other nodes in this cluster [17-18]. As the Intermediate node of node I we choose the node that has the E_1 value that is the least. When comparing E_1 and E_i , keep in mind that the former has a lower energy usage than the latter. If $E_1 < E_i$, the node I will transfer information indirectly via the nodes in between; otherwise, it will transmit information directly. The comparison between direct transmission and indirect transmission in a cluster is shown in Figure 5. The direct transmission in a cluster is demonstrated in part (a), while the indirect transmission in a cluster is demonstrated in part (b).

D. The Greedy Routing Algorithm

A routing algorithm that is based on geographic information is typically referred to as the greedy routing algorithm. However, another name for this approach is the greedy forwarding algorithm. Each group has already disclosed the location of its destination node or the position of the target area, and each node has already been aware of the locations of both its own and its immediate neighbors' nodes. The approach requires that nodes continually send packets to the nearby nodes of the node that is the closest to the target node.

Let's say that at a specific point in time, node x gets a packet called P from node Z.

 $w \in N: P_w = D$ (13) $w \in N, y \in N: Distance(y, D) \min[Dis \tan(w, D), Dis \tan(x, D)]$ (14)

If neither of the two formulas discussed above satisfy condition (13), then x will immediately send the packet to the node w that is associated with the destination D. On the other hand, if condition (13) is satisfied but condition (14) is not, then the packet will be sent directly in the mode of perimeter forwarding.

Perimeter forwarding mode: here, the necessary conditions for using the perimeter forwarding model are the following two:

$$w \in N: P_w = D$$
(15)
$$w \in N: Dis \operatorname{tan} ce(w, D) > Dis \operatorname{tan} ce(x, D)$$
(16)

If the conditions described above are met in (15) and (16), the algorithm will send the packet to the anticlockwise node Y (where, $y \in N$) in accordance with the right hand rule. This process will continue until the packet reaches the node Z. The algorithm will switch from perimeter mode to greedy mode on node Z if the condition that says Distance (z,D) > Distance(x,D) is satisfied. This indicates that the distance between Z and the location of the destination D is shorter than the distance between the node x that enters the perimeter mode and the location of the destination D.

In this study, the greedy forwarding algorithm is utilized to assist the cluster head in its search for an energy-efficient routing that will result in a reduction in the amount of energy that is consumed.

V. RESULT AND ANALYSIS

On an area measuring 100 metres x 100 metres, this project acts as a simulation of a clustered wireless sensor network. The field is filled with both standard and advanced nodes, which are dispersed in a random (but consistent) manner. This indicates that the horizontal and vertical coordinates of each sensor are picked at random between the values 0 and the greatest possible value for that dimension.

The following is a list of the performance parameters that are typically utilized in the process of evaluating the WSN clustering protocols:

- Alive Nodes vs Number of Round.
- Alive Nodes vs Number of Round.
- Residual Energy of Nodes.

Base Work: Stable election protocol (SEP) improves the life cycle of heterogeneous wireless sensor networks (WSN) using LEACH. Unbalanced cluster head and node energy consumption reduces longevity. Add node energy to cluster head election to minimize energy usage; reduce node energy consumption by indirect transmission by intermediate nodes.



Figure 6: Alive node vs Rounds

The above figure 6 is the comparison plot of Alive nodes vs Rounds at m=0.1 and a=2 and it is clear that the lifetime of nodes is more in the algorithm as compared to LEACH, SEP and Improved SEP, as it consider residual energy factor and also divide the nodes between normal, intermediate and advanced nodes category.





It can be seen from figure 7, that few number of nodes is dead at rounds =2000 in the algorithm as compared to LEACH, SEP and Improved SEP. The more the algorithm is robust less the number of

dead nodes. The percentage of increment in lifetime in the algorithm is very high as compared to other algorithms.

Residual energy is compared between the LEACH protocol, SEP protocol and the improved SEP in this module. Figure 7 shows the result of comparison of residual energy.

In WSN consumption of less energy of nodes is the main perspective. The algorithm is designed in such a way that it shows less consumption of energy as compared to LEACH, SEP and Improved SEP. Dividing the nodes into normal, intermediate and advanced category and then applying residual energy factor on each round makes the algorithm more balanced.



Figure 8: Residual energy vs nodes

In above graph, X-axis shows the number of rounds in the Network and Y-axis shows the average energy of each node.

Proposed Work: By using different cluster proposed algorithms, the stable election protocol (SEP) further improves the life cycle of heterogeneous wireless sensor networks (WSN) using LEACH. Unbalanced cluster head and node energy consumption reduces longevity. Add node energy to cluster head election to minimize energy usage; reduce node energy consumption by indirect transmission by intermediate nodes.





The above figure 9 is the comparison plot of Alive nodes vs Rounds at m=0.1 and a=2 and it is clear that the lifetime of nodes is more in the proposed algorithm as compared to LEACH, SEP, improved

SEP, and proposed SEP as it consider residual energy factor and also divide the nodes between normal, intermediate and advanced nodes category.





It can be seen from figure 10, that few number of nodes is dead at rounds =2000 in the algorithm as compared to LEACH, SEP, improved SEP, and proposed SEP. The more the algorithm is robust less the number of dead nodes. The percentage of increment in lifetime in proposed algorithm is very high as compared to other algorithms.



Figure 11: Residual energy vs nodes

Residual energy is compared between the LEACH protocol, SEP protocol, improved SEP, and proposed SEP in this module. Figure 11 shows the result of comparison of residual energy.

In WSN consumption of less energy of nodes is the main perspective. The algorithm is designed in such a way that it shows less consumption of energy as compared to LEACH, SEP, Improved SEP, and proposed SEP. Dividing the nodes into normal, intermediate and advanced category and then applying residual energy factor on each round makes the algorithm more balanced.

VI. CONCLUSION

SEP is dynamic in the sense that no prior distribution of the various levels of energy in the sensor nodes is assumed. Furthermore, our Efficient SEP analysis is not simply asymptotic, i.e. it applies equally well to small and large networks. Finally, SEP is scalable since it does not require precise knowledge of each node's position in the field.

With the new cluster head election method based on node residual energy, the indirect transmission mechanism based on intermediate nodes, and greedy routing, the SEP protocol can efficiently balance node energy consumption and improve the life cycle.
Journal of the Maharaja Sayajirao University of Baroda ISSN :0025-0422

References

- [1] Romer, Kay, and FriedemannMattern., 2004. 'The design space of wireless sensor networks.' IEEE wireless communications 11.6: 54-61.
- [2] K. Akkaya, M. Younis, (2005). A survey on routing protocols for wireless sensor networks, Ad Hoc Networks 3 (3) 325–349.
- [3] Matin, M. A., and M. M. Islam, 2012. 'Overview of Wireless Sensor Network', In Wireless Sensor Networks-Technology and Protocols. InTech open Book, ISBN: 9789535107354, pp. 3-24.
- [4] W. Mardini, M. B. Yassein, Y. Khamayseh, and B.a.Ghaleb, "Rotated hybrid, energy-efficient and distributed (R-HEED) clustering protocol in WSN", WSEAS Trans. Comm, vol. 13, pp.275-290, 2014.
- [5] E. Alnawafa and I. Marghescu, "MHT: Multi-Hop Technique for the Improvement of LEACH Protocol," in Proc.15th RoEduNet IEEE International Conference, September. 2016.
- [6] S. Lindsey and C. S. Raghavendra, (2002). PEGASIS: Power Efficient GAthering in Sensor Informatio Systems. Proceedings of the IEEE Aerospace Conference, Big Sky, Montana, March.
- [7] Tiwari, T. and Roy, N.R., 2015. 'Modified DEEC: A Varying Power Level Based Clustering Technique for WSNs', International Conference on Computer and Computational Sciences (ICCCS-2015)-IEEE, ISBN: 9781479918188, pp. 170-176.
- [8] Smaragdakis. G, Matta. I and Bestavros. A, SEP: A Stable Election Protocol for Clustered Heterogeneous Wireless Sensor Networks, Second International Workshop on Sensor and Actor Network Protocols and Applications, (2004), 1-11.
- [9] Malluh. A. A, Elleithy. K. M, Qawaqneh. Z, Mstafa. R. J and Alanazi. A, EMSEP: An Efficient Modified Stable Election Protocol, Proceedings of the 2014 Zone 1 Conference of the American Society for Engineering Education, (2014), 1-7.
- [10] L. Qing, Q. Zhu, M. Wang, (2006). Design of a distributed energy efficient clustering algorithm for heterogeneous wireless sensor networks. ELSEVIER, Computer communications 29, pp 2230-2237.
- [11] Sungju Han, Jinho Lee, Kiyoung Choi. Tree-Mesh Heterogeneous Topology for Low-Latency NoC [C]. NoCArc '14: Proceedings of the 2014 International Workshop on Network on Chip, December 2014.
- [12] X. Du, F. Lin. (2005). Improving Routing in Sensor Networks with Heterogeneous Sensor Nodes. Proceedings of IEEE 61st Vehicular Technology Conference, VTC, Vol. 4, pp. 2528-2532.
- [13] LI Han, (2010). An Energy Efficient Routing Algorithm for Heterogeneous Wireless Sensor Networks. Proceedings of th International Conference on Computer Application and System Modeling, pp. V3-612- V3-616, IEEE.
- [14] Q. Xuegong, M. Fuchang, Ch.Yan, Y. Weizhao (2009). The Protocol of Cluster Multi-Hop Transmission Based on Heterogeneous Wireless Sensor Networks. Proceedings of International Conference on Computational Intelligence and Software Engineering, CiSE. pp. 1-4, IEEE.
- [15] V. Katiyar, N. Chand, S. Soni, (2011). A Survey on Clustering algorithms for Heterogeneous Wireless Sensor Networks. Internationnal journal Advanced Networking and Applications Vol. 02, Issue: 04, pp. 745-754,
- [16] M. Yarvis, N. Kushalnagar and H. Singh (2005). Exploiting heterogeneity in sensor networks, IEEE INFOCOM, 2005.
- [17] W.B.Heinzelman et al. (2002), An application-specific protocol architecture for wireless microsensor networks, IEEE Transactions on Wireless Communications 1 (4) 660–670.
- [18] R. Sheikhpour, S. Jabbehdari, A. Khadem-Zadeh (2011). Comparaison of Energy Efficient Clustering Protocols in Heterogeneous Wireless Sensor Networks. International Journal of Advanced Science and Technology. Vol.36.

Efficient Energy Optimization Protocol for Heterogeneous Wireless Sensor Networks Relying on Node Energy: A Review

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Abstract— Wireless sensor networks (WSNs) are the technology that is expanding at the fastest rate, and its uses range from monitoring the environment to predicting the flow of traffic to listening in on conversations to research and academic fields. The haphazard placement of sensor nodes in a wireless environment has led to the emergence of security metrics as the most promising challenge that communication wireless networks must face today.

Stable election protocol, also known as SEP, is an updated version of the Low Energy Adaptive Clustering Hierarchy algorithm. Its purpose is to maximize the life cycle of heterogeneous wireless sensor networks, also known as WSNs (LEACH). On the other hand, the lifetime would be shortened due to the disparity in the amount of energy consumed by cluster heads and nodes. Include node energy in the election of the cluster head to decrease the amount of energy that is consumed by the cluster head. On the other hand, reduce the amount of energy that is consumed by individual nodes in the cluster through the use of indirect transmission by intermediate nodes. SEP is a heterogeneous-aware protocol that extends the time interval before the first node dies (what we call the stability period). This is essential for many applications in which the output from sensor networks needs to be reliable. The SEP is calculated based on the weighted election probability of each node to become the cluster head, which vary according to the amount of energy that each node still possesses. When the LEACH protocol and the SEP protocol were compared to the enhanced E-SEP protocol works well in balancing the energy consumption to improve the lifetime. This was determined by looking at how well the enhanced E-SEP protocol compared to the other protocols.

Index Terms- Heterogeneous wireless sensor networks, Stable Election Protocol (SEP), Clustring, election probability

I. INTRODUCTION

Wireless sensor networks, often known as WSNs, have recently attracted a lot of attention as a potential new application field for ad hoc networks. WSNs are constructed from a collection of sensor nodes that are characterized by their multifunctionality, low power consumption, and low cost in addition to their capacity for wireless processing and communication. These sensors collaborate to achieve a common objective, such as environmental monitoring, the tracking of targets, and the management of industrial processes [1], and they do so by communicating with one another over a short distance utilizing a wireless medium. The plan is to use a collection of affordable, small fixed sensors to sense the various physical features of the environment, and then to send those findings to a node that will act as a sink [2]. Despite the wide variety of uses for WSNs, their fundamental purpose is to collect data, then process that data, and then transmit the processed data to a particular node (base station or sink). Due to the increasing computing capacity of WSN technology, it is imperative that these sensor nodes be better equipped to handle more complex functions. Challenges pertaining to energy conservation, sensor node coverage, and dependability are tackled during the installation of a base station in a sensor network. In most cases, it is considered that base stations are stationary; however, in certain scenarios, it is expected that base stations are mobile in order to collect data from sensor nodes. The LEACH [3] protocol is a Low-Energy Adaptive Clustering Hierarchy protocol, and it is considered to be an established method in the field of clustered routing protocols. It is clustered based on the signal strength that was received by the node, and the cluster head node is chosen in a random loop so that the energy consumption of the nodes within the network may be maintained at a consistent level. A procedure that is aware of heterogeneity and is called the Stable Election Protocol (SEP) was proposed in [4]. It is calculated using the individual energies of each node, which are then used to weight the election possibilities of each node to become the cluster leader. This method ensures that cluster heads are chosen at random and distributed according on the fraction of energy utilized by each node, so ensuring that the energy from the nodes is used in an even-handed manner.

The SEP [4] algorithm is a form of LEACH-based heterogeneous network clustering routing technique. [LEACH] stands for "Local Extensible Abstract Computing Environment." The SEP algorithm uses an energy heterogeneous approach. This approach involves increasing the likelihood of high-level nodes becoming cluster heads based on the beginning energy of distinct sets of different cluster election probabilities. This ensures that high-level nodes and ordinary nodes pass away at the same time. However, the SEP algorithm still has an unequal distribution of cluster heads, a large number of nodes in the

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cluster, and does not take into account the residual energy of the nodes. There is much potential in clustering as a method for increasing the lifetime of WSNs. At this time, I would like to investigate a different, more effective technique that is based on the Improved-SEP procedure and other enhancement procedures that are analogous to it.

The remaining parts of the paper are organized as described below. Following an examination of the relevant literature in Section II, the focus then shifts to a comprehensive discussion of LEACH in Section III. The Section V Efficient SEP Concept was explained in the previous section (IV SEP). The last part of the paper, Section VI, is where it all wraps up.

II. LITERATURE REVIEW

A literary survey involves the examination of historical material and the generation of a combination of new and historical information. As a consequence of this, this section includes a concise explanation of a number of different research studies, in addition to a research paper summary and a research paper synthesis.

The authors Smaragdakis and Smaragdakis [5] are famous for a LEACH variation that they name the Stable Election Protocol (SEP). It is designed to function primarily for dual-level heterogeneous networks that have doublet types of sensors (particularly Advance and normal nodes). When compared to conventional nodes, advance sensors typically have a higher energy retention rate and necessitate more frequent CH rotations. The CHs that have been selected in this instance make reference to the beginning energy of the sensor. The fact that the choice made by the CH is static is the most significant disadvantage. Because of this, advanced nodes that are located a significant distance from the sink expends their energy at a faster rate, and they eventually cease to exist. SEP is useless when applied to a heterogeneous network with multiple layers.

According to Malluh et al. [6,] there has been an improvement made to SEP, additionally, more often than normal sensors, sophisticated nodes are picked to serve as CHs. Additionally taken into consideration is the total number of nodes that are connected to each CH. As a consequence of this, the sensor nodes are able to be dispersed uniformly among all of the CHs. If there is more than one sensor that can be a CH during a particular round, EM-SEP will select the sensor with the highest available energy to serve in that capacity. The stability time of the sensor network is increased thanks to these two components. This tactic's most significant drawback is that it makes no allowance for the cost of maintaining communication between different clusters.

The Stable Election Protocol, also known as SEP, is a heterogeneous-aware protocol that was proposed by Georgious et al. [7] with the intention of extending the stability period and increasing the average throughput. The SEP is calculated using the energy-weighted election probability of the nodes as a function of their residual energy. On the basis of their energy levels, nodes are separated into two distinct categories: ordinary nodes and advanced nodes. The energy that is produced by advanced nodes is greater than that which is produced by regular nodes. Standard nodes have a lower likelihood of becoming cluster heads compared to advanced nodes, which have a larger possibility.

In reference number [7], a heterogeneous aware procedure known as the Stable Election Protocol (SEP) was proposed. It is calculated using the individual energies of each node, which are then used to weight the election possibilities of each node to become the cluster leader. This method ensures that cluster heads are chosen at random and distributed according on the fraction of energy utilized by each node, so ensuring that the energy from the nodes is used in an even-handed manner. The SEP performed an analysis on two different kinds of nodes (two layer in-clustering), as well as two different levels of hierarchies. In a heterogeneous wireless sensor network (WSN), the LEACH [8] protocol, which maintains the Integrity of the Specifications in the same way as a typical clustering approach does, performs very poorly.

The LEACH protocol is the foundation for the SEP protocol [9], which differs from LEACH in that it provides variable electoral cluster head probability for nodes that have varying energy levels and functions more well in a heterogeneous WSN than LEACH does. However, on the one hand, SEP does not adjust the cluster head election probability in real time based on the node's residual energy, which causes some nodes to become cluster heads prematurely, thereby reducing their lifetime; on the other hand, nodes in the cluster transfer information directly to the cluster head, storing a problem that the energy consumption of the edge nodes is far off the mark. In addition to this, the transmission path that connects the cluster head and the base station needs to be optimized.

The paper [10] demonstrates the effectiveness of the SEP protocol in heterogeneous WSN. It also demonstrates the limitations of the unbalanced energy consumption in cluster nodes and the inflexibility of the cluster head election mechanism. Both of these problems can be found in the paper. In the paper [12], greedy routing is used to tackle the problem of the most energy-efficient way for the transmission of information from the cluster head to the base station. This results in a decrease in the amount of energy that is utilized.

III. LEACH SCHEMES

The Low-Energy Adaptive Clustering Hierarchy [11] is one of the clustering methods that is used for WSN the most frequently. It is a design that has been customized to work with a particular application. Nodes participate in LEACH by forming local clusters, with one node acting as the leader of each cluster and the other nodes participating as member nodes. When the cluster head gets data from all of the member nodes, it processes the data using signal processing tasks (for example, data aggregation) and then transmits the processed data to the remote BS. As a consequence of this, the amount of energy required to maintain a position as a CH node is noticeably higher than that of a member node.



The primary objective of LEACH is to apply rotation in order to choose sensor nodes as cluster heads. As a consequence of this, the energy load associated with serving as a cluster head is distributed uniformly among all of the nodes. The operation of LEACH is divided into different rounds. In each round, there is a set-up phase that comes before the steady state phase. During the phase known as "setup," clusters are organized, and during the phase known as "steady-state," data is transmitted to the BS. In the beginning, CH is selected on the basis of the signal energy of the nodes [13].

The nodes in the CH hierarchy that have the highest energy are selected. Each sensor node n generates a random number between 0 and 1 and then evaluates that number in relation to a threshold T that has been previously established (n). In that round, the sensor node will become CH if random T(n) is true; otherwise, it will remain a member node. Where P is the desired proportion of CHs, r is the current round, and G is the set of nodes that have not been elected as CHs in the past 1/P rounds, G represents the set of nodes. LEACH is a mechanism that is entirely decentralized and does not call for any global knowledge regarding the network. Not only can LEACH guarantee that every node in the network has the same probability as CH, but it can also make sure that the energy consumption of the network nodes is about equivalent. The LEACH display process is illustrated here in Figure 2, which may be found below.



Figure 2: LEACH Protocol Process

IV. ANALYSIS OF SEP ALGORITHM

The SEP [12] method is a conventional heterogeneous network clustering routing approach that was proposed by G. Maragdakis. This agreement is constructed using the second energy heterogeneous network and the LEACH protocol. The initial energy isomorphism of this element is also included in the construction of this agreement. On the basis of their varied

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qualities, the network is divided into ordinary nodes and high-level nodes, and each type of node possesses a unique cluster election probability. The cluster election probability of high-level nodes is greater than that of ordinary nodes. In order to ensure that high-level nodes and normal nodes pass away at approximately the same time, thereby extending the stable cycle of the network.

Common nodes and advanced nodes are the two categories of energy nodes that are included in the SEP routing protocol, which is a two-level initial energy heterogeneous WSN cluster protocol. The primary concept behind the SEP protocol is to first determine the cluster head election probability of individual nodes depending on the amount of energy they started with, and then to change the cluster head nodes in a manner that is random each round. Because of this, all of the sensor nodes are able to share the load on the network, which helps to reduce the amount of power that is lost while also extending the lifetime of the network.

A. Cluster Establishment Stage

It is presumed that there are initially n nodes, which are then categorized as either common or advanced nodes depending on their level of complexity. Within the network of nodes, the optimal cluster head ratio is denoted by P_{otp} . E_0 represents the starting energy level of the common node. The energy of the advanced node is $(1+\alpha)$ times that of the common node, which is one and a half times $(1+\alpha) E_0$.

Since the overall node fraction of the advanced node is m, the following expression can be used to calculate the total energy of the entire heterogeneous WSN: [9]

$$n(1-m) E_0 + nm (1+\alpha) E_0 = n(1+m\alpha) E_0$$
(1)

As a result of their responsibility for coordinating activities taking place across clusters and transmitting data to base stations, cluster leaders have a higher energy demand than other members of the network. As a consequence of this, the relevant cluster head is rotated continuously; this maintains the consistent level of energy consumption required by the SEP protocol. Each node makes its own determination, based on the computing likelihood, as to whether or not it has a chance of being a cluster head in the current wheel. Every sensor node will select a value at random from the range [0 1] and then compare that value to the T(i) threshold. If the value is lower than T(i), then the node has a chance of being elected as the cluster head; otherwise, it will not be.

The SEP algorithm, which is a technique for the random selection of cluster heads, continues to make use of the LEACH algorithm. The signal strength that is received from the cluster head node through the non-cluster head node is evaluated by the mechanism that controls clustering to determine whether or not the node should join the cluster. As a consequence of this, the cluster head is not dispersed in an even manner, and the number of nodes that make up the cluster is determined by chance as a result of the clustering mechanism.

After the network has been operating for some time, the residual energy of the high-level node may differ from that of the ordinary node, but the probability of becoming the cluster head is still higher than that of the ordinary node. The election probability in the SEP algorithm is only related to the node's initial energy, not its residual energy. This shortens the amount of time the network will be able to survive overall by hastening the death of some advanced nodes. When the SEP algorithm is used in single-hop transmission mode, nodes that are located a significant distance from the cluster head nodes are required to expend a significant amount of energy in order to carry out long-distance information transmission. This results in the premature death of network nodes and a reduction in the life cycle of the network.

B. Transmission Stage

After the cluster has been constructed, the nodes that make up the cluster will communicate with the nodes that serve as the cluster head within the allotted time period in order to finish the transfer of the data that was gathered in the relevant region. The cluster head sends the Time Division Multiple Address (TDMA) scheduling table, which defines the allocation time slot. During the non-transmission slot, the cluster nodes are in the dormancy state, which is one way that the SEP protocol saves energy. After the data have been received, the cluster head will converge on them, compress them with their own data, and then transfer them to the sink node.

V. IMPROVED EFFICIENT-SEP PROTOCOL

In regard to the shortcomings of SEP that were discussed before, we offer the nodes' residual energy so that they can take part in the edge calculation in order to change the chance of becoming cluster heads of nodes within a given amount of time. In order for the cluster nodes to be able to transfer the apparent data, the interlude nodes in the cluster are further displayed.

A. Energy Consumption Model



Figure3: Energy Consumption Model

For the record, the amount of energy used to accept or send k bits of data when a distance of d is specified is provided here [14]. Supplicant time

$$E_T(k,d) = \begin{cases} E_{elec} \ k + E_{fs} \ kd^2 \ d < d_0 \\ E_{elec} \ k + E_{mp} \ kd^4 \ d > d_0 \end{cases}$$
(2)

Accepting time

$$E_R(k) = E_{R-elec}(k) = E_{elec} k \quad (3)$$

 E_{elec} is energy dissipated of the transmission a unit of data; E_{fs} and E_{mp} is energy dissipated for gain magnifying; d_0 is threshold distance.

B. Cluster Head Election Method

Simply taking into account the initial energy consumption won't be enough to solve the problem of imbalanced energy use, according to SEP. In order to construct the WSN life cycle, the residual energy of the nodes must be added to the estimation of the cluster head election perspective. In order to balance the distribution of energy consumption among the nodes and improve the life cycle, the node that has the lowest amount of residual energy has a lesser likelihood of becoming the clusterhead. E_r is the residual energy of the node, Es denotes the overall residual energy, and E_c denotes the energy reference factor.

$$E_c = e^{-(E_r - \frac{E_s}{n})} \tag{4}$$

In reference to the original technique for selecting the SEP cluster head, the node residual energy is integrated as the energy reference factor E_c . The initial energy for normal nodes is denoted by Eo, and the initial energy for advanced nodes is denoted by Ea, $Eadv = 1 + \alpha Eo$.

Consider the case of the intermediate nodes, $E_{int}=1+\mu Eo$.

Lets we have: $\mu = \alpha/2$

The value of our probability setting, *popt*, has not changed. The addition of advanced and intermediate nodes, on the other hand, causes a rise in the system's total initial energy, which is a negative result:

$$n \cdot E_o(1 - m - b) + n \cdot m \cdot E_o(1 + \alpha + n \cdot b \cdot (1 + \mu)) = n \cdot E_o(1 + m \cdot \alpha + b \cdot \mu)$$
(5)

Where n represents the total number of nodes, *m* represents the percentage of advanced nodes relative to the total number of nodes, and *b* represents the percentage of intermediate nodes in the network. It is required that the new epoch of the system be equal to $Popt \cdot (1+m \cdot \alpha+b \cdot \mu)$, which results in an increase in the overall energy of the network by a fraction of $(1+m \cdot \alpha+b \cdot \mu)$. *Ec* is the energy reference factor that is derived from equation no. 4, and if P_{nrm} , P_{int} and P_{adv} are the probabilities of becoming normal, intermediate, and advanced nodes, respectively, then *Ec* is the value that is used. Because of this, we have:

$$P_{nrm} = P_{opt} / (1 + m \cdot \alpha + b \cdot \mu)^* E_c \qquad (6)$$

$$P_{int} = (P_{opt}) \times (1 + \mu) / (1 + m \cdot \alpha + b \cdot \mu)^* E_c \qquad (7)$$

$$P_{adv} = (P_{opt}) \times (1 + \alpha) / (1 + m \cdot \alpha + b \cdot \mu)^* E_c \qquad (8)$$

In order to ensure that the sensor nodes must take on the role of cluster leaders, as was stated earlier, we need to specify a new threshold for the election procedures and refer back to the equation that was previously used (5). The thresholds $(n_{nrm}),(n_{int}), T(n_{adv})$ for normal, intermediate, and advanced users, respectively, are redefined as follows:

$$T(_{n_{nrm}}) = \begin{cases} \frac{P_{nrm}}{1 - P_{nrm}[r \times mod(^{1}/P_{nrm})]} & \text{if } n_{nrm} \in G'\\ 0 & \text{otherwise} \end{cases}$$
(9)

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The fact that we have $n \times 1 - m - bin$ normal nodes, as stated above, demonstrates that our assumption (1) is accurate. The same logic applies to the intermediate and advanced nodes, where G' refers to the set of normal nodes that have not become cluster heads in the $1/P_{nrm}$ rounds that have passed since the previous one,

$$T(_{n_{int}}) = \begin{cases} \frac{P_{int}}{1 - P_{int}[r \times mod(1/P_{int})]} & \text{if } n_{int} \in G''\\ 0 & \text{otherwise} \end{cases}$$
(10)

We have $n \times b$ intermediate nodes and b intermediate nodes total, with G'' being the set of intermediate nodes that have not become cluster heads in the most recent $\frac{1}{P_{int}}$ round r of computations.

$$T(_{n_{adv})} = \begin{cases} \frac{P_{adv}}{1 - P_{adv}[r \ge mod(1/P_{adv})]} & \text{if } n_{adv} \in G''' \\ 0 & \text{otherwise} \end{cases}$$
(11)

We have $n \times m$ advanced nodes, and the set of advanced nodes denoted by G''' is the set of nodes that have not become cluster heads in the most recent $1/P_{adv}$ round r.

The following equations can be used to calculate the average total number of cluster heads produced in each round:

 $n \cdot (1-m-b) \times P_{nrm} + n \cdot b \times P_{int} + n \cdot m \times P_{adv} = n \times P_{op}(12)$

In comparison to the initial option for LEACH, this results in the same amount of cluster heads being produced. On the other hand, because of the heterogeneous energy configuration, the dissipation of energy is better managed.

C. Intermediate Node Mechanism

The SEP protocol does not optimize the data transmission that occurs between the members of the cluster; rather, the information is transferred straight from the member nodes of the cluster to the heads of the cluster. Therefore, it will require a greater expenditure of energy to convey information and will drastically reduce the lifetime of the network for the edge nodes that are located a significant distance from the cluster head. Therefore, in this scenario, linking the intermediate nodes will unquestionably improve the negative effects of the edge nodes and maintain equilibrium in the amount of energy consumed by each node [15].



Figure 4: Direct compares indirect transmission

The principle of the intermediate node mechanism is that the nodes in the cluster use the intermediate nodes to transmit the information indirectly so as to reduce their energy consumption and prolong their life [16]. After cluster structure is formed, the cluster node i computes the energy consumed E_1 that transmits information indirectly through other nodes in this cluster. We select the node with the smallest E_1 as the Intermediate node of node i. Compare E_1 with E_i which the energy consumption of direct transmission. If $E_1 < E_b$ the node i transmits indirectly through the intermediate nodes; otherwise, the node transmits directly.Figure 4 is the comparison between direct transmission and indirect transmission in a cluster. Part (a) shows the direct transmission in a cluster and part (b) shows the indirect transmission in a cluster.

The nodes in the cluster use the intermediate nodes to transport the information indirectly so that they can lower the amount of energy they use and increase the amount of time they have to live. This is the rationale behind the mechanism known as the intermediate node. After the structure of the cluster has been constructed, the node I of the cluster will compute the amount of energy, E_1 , that was used to transfer information indirectly through the other nodes in this cluster. As the Intermediate node of node I we choose the node that has the E_1 value that is the least. When comparing E_1 and E_i , keep in mind that the former has a lower energy usage than the latter. If E_1 is greater than E_i , the node I will transfer information indirectly via the nodes in between; otherwise, it will transmit information directly [17]. The comparison between direct transmission and indirect transmission in a cluster is shown in Figure 4. The direct transmission in a cluster is demonstrated in part (a), while the indirect transmission in a cluster is demonstrated in part (b).

VI. CONCLUSION

In this study, the Stable Election Protocol, sometimes known as SEP, is analyzed and discussed. The starting energy of a SEP sensor node in a heterogeneous two-level hierarchical network is compared to the starting energy of other nodes, and the node with the highest starting energy elects itself as the cluster leader. The SEP is dynamic in the sense that it does not presuppose a prior distribution of the various levels of energy that are contained inside the sensor nodes. In addition, our Efficient SEP

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analysis is not simply asymptotic; this means that it works just as well with tiny networks as it does with huge networks. Last but not least, the SEP is scalable because it does not require exact information of the position of each node in the field.

References

- [1] Romer, Kay, and FriedemannMattern., 2004. 'The design space of wireless sensor networks.' IEEE wireless communications 11.6: 54-61.
- [2] Carlos de Morais, Dharma PrakashAgrawal, 2011. 'Ad HOC and Sensor Networks Theory and Applications', world scientific second edition published by ManasSaikia for Cambridge University.
- [3] W. Mardini, M. B. Yassein, Y. Khamayseh, and B.a.Ghaleb, "Rotated hybrid, energy-efficent and distributed (R-HEED) clustering protocol in WSN", WSEAS Trans. Comm, vol. 13, pp.275-290, 2014.
- [4] E. Alnawafa and I. Marghescu, "MHT: Multi-Hop Technique for the Improvement of LEACH Protocol," in Proc.15th RoEduNet IEEE International Conference, September. 2016.
- [5] Zhixiang, D.; Bensheng, Q. Three-Layered Routing Protocol for WSN Based on LEACH Algorithm. In Proceedings of the IET Conference Wireless, Mobile & Sensor Networks, Shanghai, China, 12–14 December 2007; pp. 72–75.
- [6] Tyagi, S.; Gupta, S.K.; Tanwar, S.; Kumar, N. EHE-LEACH: Enhanced Heterogeneous LEACH Protocol for Lifetime Enhancement of Wireless SNs. In Proceedings of the 2013 International Conference on Advances in Computing, Communications and Informatics (ICACCI), Mysore, India, 22–25 August 2013.
- [7] Beiranvand, Z.; Patooghy, A.; Fazeli, M. I-LEACH: An Efficient Routing Algorithm to Improve Performance & to Reduce Energy Consumption in Wireless Sensor Networks. In Proceedings of the 5th Conference on Information and Knowledge Technology, Shiraz, Iran, 28–30 May 2013.
- [8] Lee, J.S.; Cheng, W.L. Fuzzy-Logic based Clustering Approach for Wireless Sensor Networks Using Energy Predication. IEEE Sens. J. 2012, 12, 2891–2897.
- [9] Taneja, H.; Bhalla, P. An Improved Version of LEACH: Three Levels Hierarchical Clustering LEACH Protocol (TLHCLP) for Homogeneous WSN. Int. J. Adv. Res. Comput. Commun. Eng. 2013, 2, 3610–3615.
- [10] Smaragdakis. G, Matta. I and Bestavros. A, SEP: A Stable Election Protocol for Clustered Heterogeneous Wireless Sensor Networks, Second International Workshop on Sensor and Actor Network Protocols and Applications, (2004), 1-11.
- [11] Malluh. A. A, Elleithy. K. M, Qawaqneh. Z, Mstafa. R. J and Alanazi. A, EMSEP: An Efficient Modified Stable Election Protocol, Proceedings of the 2014 Zone 1 Conference of the American Society for Engineering Education, (2014), 1-7.
- [12] Sungju Han, Jinho Lee, Kiyoung Choi. Tree-Mesh Heterogeneous Topology for Low-Latency NoC [C]. NoCArc '14: Proceedings of the 2014 International Workshop on Network on Chip, December 2014.
- [13] W. Mardini, M. B. Yassein, Y. Khamayseh, and B.a.Ghaleb, "Rotated hybrid, energy-efficent and distributed (R-HEED) clustering protocol in WSN", WSEAS Trans. Comm, vol. 13, pp.275-290, 2014.
- [14] E. Alnawafa and I. Marghescu, "MHT: Multi-Hop Technique for the Improvement of LEACH Protocol," in Proc.15th RoEduNet IEEE International Conference, September. 2016.
- [15] Kumar D, Aseri T C, Patel R B. EECDA: energy efficient clustering and data aggregation protocol for heterogeneous wireless sensor networks [J]. International Journal of Computers Communications 8L Control, 2011, 6(1):113-124.
- [16] Sujee, R., and K. E. Kannammal. "Behavior of LEACH protocol in heterogeneous and homogeneous environment." In Computer Communication and Informatics (ICCCI), 2015 International Conference on, pp. 1-8. IEEE, 2015.
- [17] MamtaTewari; Kunwar Singh Vaisla.Performance Study of SEP and DEC Hierarchical Clustering Algorithm for Heterogeneous WSN [C]. 2014 International Conference on Computational Intelligence and Communication Networks, 2014.

A Real Time Sign Language Recognition System for Different Skin-Tones

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Abstract— Communication becomes a biggest challenge for deaf-mute people to interact with each other or other people. Sign Language Recognition System provides an efficient solution for them to communicate through sign language with others. Many successful researches have been done in this field to develop the system but the problem arises when people of different skin tone use the same system because skin-tone plays a very important role in developing the SLR, according to the recent researches [[14]]. This paper develops the real time SLR system that solve this skin tone problem. It uses concept of ROI, background subtraction and connected component algorithm to extract the hand gesture from RGB image. Vgg16 CNN architecture is used to train the model. Dataset is created through live video capturing through webcam. This SLR system is developed for numerals (0-9) and static hand gestures are taken into consideration. The accuracy achieved by the real time system is 99%.

Keywords— indian sign language(numbers); background subtraction; roi; connected component; convolution neural network; different skin tone.

I. INTRODUCTION

Sign Language becomes a convenient tool for visual communication, that enables individual with hearing and speech impaired disabilities to establish easy communication with each other but many persons don't understand the sign language because still it is not used globally. Many successful studies in this field enables a normal person to understand the sign language with the help of sign language recognition system (SLR). Recent researches developed a thriving SLR system but it is limited to some specific skin tones. As our world is full of diversity, similarly people of different skin tones live across the India. SLR developed in North-India where skin tone is fair or white which cannot be easily used in South-India where skin tone is dark.

To overcome the skin-tone problem this paper works on the base paper [[13]] and achieved a real time SLR system that works well with different skin tones. To understand the problem first one should have knowledge of how SLR system works. It works in three simple steps:

- 1. Data Acquisition
- 2. Training the Model
- 3. Predict the data

To make learning smooth and efficient a large dataset is required. In this paper, dataset is created using webcam and considered only static hand gestures for numbers (0-9) of Indian Sign Language Fig. 1.

Hand gestures are detected using ROI, background subtraction followed by connected component algorithm. Data classification is done with the help of Convolutional Neural Networks and then model prediction takes place.



Fig. 1 Hand Gestures of Indian Sign Language Numbers

II. RELATED WORK

Sign Language Recognition has attracted the attention of many researchers as its area is wide. Much of the research work has been done in data acquisition part. Data is acquired by two techniques using wearable sensors [2]and by vision-based techniques[9]. Vision based techniques are more convenient as wearable sensors need extra care and are cost effective. In computer vision images, obtained from camera, are pre-processed before sending it to training. To identify hand region from whole image many researchers have used different skin segmentation techniques. [3]Used Kinect for depth and RGB images but it adds an extra hardware to the system which makes system more expensive. [6] Proposed SLR model that uses skin

segmentation technique by converting RGB Image into YCbCr colour space. [7] also converts RGB colour space into YCbCr colour space and followed by Convex Hull algorithm to identify the shape and location of hand. To ignore unwanted objects in image [4] proposed a Region of interest predictor and then applied skin segmentation technique by converting RGB Image into HSV colourspace.[5] used skin colour segmentation technique and connected component algorithm to get hand region more accurately.[[14]] convert RGB colour space to YUV colour model and applied threshold[R>80, G>30, B>15] which is not applicable for dark brown skin tone [R=51, G=26, B=10]. With the help of skin segmentation techniques in which RGB image is converted into different colour space and then a threshold value is applied to filter skin pixels, one can easily identify skin region from the obtained image but it limits the model to predict the gestures of some specific skin tone that comes under threshold value.

To overcome the specific skin tone problem the paper [[13]]proposes a method that identifies the hand region from obtained image ignoring its skin colour. With the help of Background Subtraction technique [11] foreground object (hands) is removed from the background that appears in Region of Interest and it is followed by connected component algorithm to get hand shape more accurately.

III. METHODOLOGY

This paper is the implementation of the research work [[13]] and achieved a real time SLR system that can work well for different skin tones fairer to darker. In three simple steps one cans achieve SLR system: 1. Data Acquisition, 2. Model Training and 3. Predict the Model. Flow chart Fig. 2 of used model is given below:



Fig. 3 RGB image to processed image (black and white)

A. Data Acquisition

To train the model efficiently and to generalize the model from different skin tones, a large set of data and skin tone independent data is required. Concept of ROI, Background Subtraction and Connected Component Algorithm are applied in series to get a black & white image of hand gesture (where hand gesture \rightarrow black colour, otherwise white colour) Fig. 3.

1) ROI (Region of Interest)

To avoid unwanted portion of image concept of ROI is used [[4]]. Hand gestures are placed into ROI and only that portion is sent for further processing which reduces the overhead of processing the whole image Fig. 4

2) Background Subtraction

Many researches have used skin segmentation techniques for identifying the skin colour in image which limits dataset to specific skin-tone. Background Subtraction technique helps in identifying the foreground (hand gestures) in image [[11]]. The technique can be easily understood by the following formula:

Foreground = (*Background* + *Foreground*) – *Background*

The technique is applied only in the area that comes under ROI. Before placing hand gesture into ROI system fetches the background for few seconds. And after placing hand gesture it results a black and white image of only foreground (hand gesture), where foreground is in black colour and otherwise white colour.

3) Connected Component Algorithm

Background Subtraction results only foreground but sometimes, by mistakenly some unwanted objects can also be appear into ROI and identified as foreground. To get more accuracy in detecting Hand gesture as only foreground in ROI Connected Component Algorithm is used. In Connected Component Algorithm [[12]] two neighboring pixels are marked as connected they are of almost same pixel values (very less difference). It results all connected components as one object respectively while using connectivity 4 (where pixels above, below, left and right of the particular pixel are considered as its neighbour pixels) and hand gesture is also marked as an object but its largest area among other objects made it distinguishable. Thus, hand gesture is identified successfully when two or more foreground objects are placed into ROI Fig. 5.

After applying the above techniques in series of a black and white image of hand gesture is achieved. Since the above process is purely independent of skin tone, thus it is able to identify the hand gesture of different skin tones. The resultant image is sent for further training the model.







Fig. 4 (left image) Fetching the background, (middle image) Adjusting hand gesture into ROI, (right image) achieved processed image



Fig. 5 (left and middle image) Two foreground (hand gesture and an object) appear in ROI, (right image) Only hand region as foreground is detected



Fig. 6 Architecture of used CNN

B. Model Training

Model is trained by classifying the image. According to a review [8] SVM and HMM are frequently used techniques for image classification. But SVM give more accurate results in linear classification. Murat Taskiran et al [[7] proposed a real time system that used deep learning while training the model. This model is also trained using deep learning. Convolutional Neural Network is used in deep learning to classify the image into different classes.

Architecture of CNN model Fig. 6 comprises 1 input layer, 3 convolutional layers, 1 flatten layer, 2 dense layers, 1 output layer. Input layer contains an RGB image. In Convolutional layer, 3×3 kernel is used to filter the important features from input image which is followed by max pooling of 2×2 to reduce dimensionality of input image. Flatten layer flattens the multi dimension data into single dimension and consists of 24,576 neurons. Dense layer also known as fully connected layer; each node is connected to the node in the next layer. 1st layer contains 128 neurons and 2nd layer contains 64 neurons. Output layer, it comprises 10 classes that means data is classified into 10 classes.

IV. IMPLEMENTATION

Dataset creation and Model training are main modules in implementing the SLR System. Dataset is created through Webcam, which has wide vision HQ camera, frame rate 30Fps, 0.31 MP camera and image resolution is 640x480. And Laptop which is used for training the model has NVIDIA GeForce GTX 1650 Ti Graphics card with frame buffer 4GB, good for processing the high-quality images and make image processing faster.

Implementation is done by using Keras API (v 2.3.1) and Tensorflow (v 2.0.0) platform which makes good combination for training complex CNN models. Keras uses tensorflow in backend and for image processing. Python (3.7.4) is used to write complete code. IDE Jupyter Notebook used for writing interactive python code. OpenCV (v 3.4.2) is used for capturing video sequence and for image processing. Numpy (v 1.16.5) python library used to handle linear algebra computations.

A. Create the Dataset

In this paper static hand gestures of ISL numbers are considered for training and testing the model. With the help of video sequence, where each frame act as an RGB image, dataset is created. An RGB image is preprocessed to get black and white image of hand gestures. Preprocessing done through the combination of ROI, Background Subtraction technique and Connected component Algorithm. That preprocessed (black and white) image is stored into dataset. Dataset is divided into two parts TRAIN and TEST. It is a python written code where 1500 images for each symbol, in total 1500 x 10 = 15,000 images are stored for training and 300 images for each symbol, in total $300 \times 10 = 3000$ images are stored for testing purpose.

B. Train the Model

Convolutional Network is used for model training and its architecture is shown in **Error! Reference source not found.**. To train the model first input is passed to Keras Vgg16 model which initializes the network with pretrained weights of Vgg16 model. The model has 16 layers in total but the architecture we used has 6 layers excluding input layer and output layer because the images we used for training is already in black & white, thus not required too much filtration as original model does. After structure of model is defined it is saved for making predictions.

Adam Optimizer with learning rate 0.001 is used to optimize the weight updating while learning. Early stopping is used to stop the training when val_loss (validation loss) is not improving. Five epochs ran and results model accuracy, validation accuracy, loss and validation loss that are considered as metrics of computing model performance.

V. RESULT

Experiments are done with different skin tones and in different light conditions. Total 100 experiments are done where 10 experiments for each symbol is accomplished. Different skin tones don't reflect the expected predictions but due to different light

conditions sometimes result may fluctuate. Five different skin tones are taken to make prediction which doesn't affect the performance of the model Fig. 7

The system achieved two accuracies model accuracy and validation accuracy (where testing done with several images saved in Test dataset). The model achieved 99% accuracy and 90% validation accuracy which can be understood through below Fig. 8

VI. CONCLUSION

This paper successfully implements the proposed methodology [[13]] and develops a real time SLR system that able to predict the hand gestures of different skin-tone people. Thus, it removes the model dependency on skin color and made it useable in different regions of India. System is validated through different skin tones Fig. 7 and it achieved a high accuracy 99% Table 1 even though the prediction fluctuates in different light conditions.

VII. FUTURE SCOPE

The real time SLR system can be expanded to predict the English and Hindi alphabets or might be able to implement the sentences. The future scope of Sign Language Recognition is not ended here. It can be used to develop the two-way communication where the System can translate the given English or Hindi characters or sentences into Sign Gesture for creating interactive participation from both the sides.



Fig. 7 Predictions made by hands of different skin-tone people



Fig. 8 Training accuracy and loss on Indian Sign Language Numbers

Symbol	True Prediction	False Prediction	Accuracy(%)	
0	10	-	100	
1	10	- 100		
2	10	-	100	
3	10	-	100	
4	10	-	100	
5	10	-	100	
6	10	-	100	
7	10	-	100	
8	9	1(7) 90		
9	10	- 100		
Total	99	1	99	

Table 1 The result of real time system test performed for each symbol

REFERENCES

- [1] Sunmok Kim, Yangho Ji , and KI-Baek Lee, "An effective sign language learning with object detection based ROI segmentation", IEEE Conference on Robotic Computing 2018.
- [2] Rinki Gupta, Arun Kumar, "Indian sign language recognition using wearable sensors and multi-label classification", Computers and Electrical Engineering, 2020.
- [3] Neel Kamal Bhagat, VishnuSai Y, Rathna G N, "Indian sign language gesture recognition using image processing and deep learning", IEEE 2019.
- [4] SajanRaj T D, Beena M V, "Indian Sign Language Numeral Recognition using Region of Interest Convolutional Neural Network", IEEE Conference on Inventive Communication and Computational Technologies, 2018.
- [5] Sruthi C J, and Lijiya A, "Signet: A Deep Learning based Indian Sign Language Recognition System", IEEE Conference on Communication and Signal Processing, 2019.
- [6] Resmi George, K Gerard Joe Nigel, "Hand Gesture Recognition for the application of Sign Language Interpretation", International Journal of Engineering Research and Technology, 2014.
- [7] Murat Taskiran, Mehmet Killioglu, and Nihan Kahraman, "A Real-Time System for Recognition of American Sign Language by using Deep Learning", IEEE 2018.
- [8] Nimisha K P and Agnes Jacob, "A Brief Review of the Recent Trends in Sign Language Recognition", IEEE Conference on Communication and Signal Processing, 2020.
- [9] Thao Nguyen-Trang, "A New Efficient approach to detect Skin in Colour Image Using Bayesian Classifier and Connected Algorithm", Mathematical Problems in Engineering, Hindawi 2018.
- [10]Kshitij Bantupalli, Ying Xie, "American Sign Language Recognition Using Deep Learning and Computer Vision", IEEE Conference on Big Data, 2018.
- [11] Alan M. McIvor, "Background Subtraction Techniques".
- [12] Kurt Schwenk and Felix Huber, "Connected Component Labeling Algorithm for Very Complex and High Resolution Images on an FPGA Platform", High Performance Computing in Remote Sensing, 2015.
- [13]Krati Omer and Dr. Shalini Gupta . "A General Solution to Sign Language Recognition for Different Skin Tones" ,Scopus Journal, 2022.
- [14]Kartik Shenoy , Tejas Dastane, Varun Rao , Devendra Vyavaharkar , "Real-time Indian Sign Language (ISL) Recognition" , IEEE 2018

"Conventional, Renewable and Green energy"

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Abstract-

In today's era we totally imply on the resources available for the fulfillment of the energy fetched from various resources environmental condition surpasses the combination of natural and resourcefulelements. The nature is occupied with the parameters of the energy proposiytion of the elements which are resourceable and providing economical and healthy gallop of the natures environment The materials that can be replaced natural and human processes. Solar is very important of the resources. sources of energy are replenish themselves like wind and hydroelectric power. The conventional fuels are distnict area electricity generation ,hot,motor fuels and rural energy services. This paper is an example of conventional ,renewable and green energy. Index Terms- fracking, renewable energy, green energy.

Date of Submission: 02-02-2022

Date of acceptance: 16-02-2022

I. INTRODUCTION

This article guides a stepwise walkthrough as we know green power is the subset of the renewable energy and reparesents those renewable energy resources and technologies that provides the highest environmental benefits. Green energy is basically the combination from natural resources like tides, sunlight and geo thermal heat, fossil fuels are finite resource and continue to diminish.

Renwable energy comes from natural resoourcesalso have amuch smaller impact on the eenvironment than fossil fuels ,which produce polutnants such as greenhouse gases as by – product, contributing to climatic change .Gaining access requires drilling deep into earth often ecological sensitive locations.



<u>Types of green energy –</u>

Solar Power – The most prevalent photovoltaic cells which capture sunlight and convert into electricity .Solar technologies become inexpensive and hand-held gadgets to entire neighbours.It is derived by capturing power from sunlight and converting into heat.The benifites of solar sunlight is functionally endless.Solar power also eliminate energy cost and reduce energy bills.The limitations of solar energy tends a significant upfront cost and unrealistic expenses for household.

Wind Power-



Air flow on the earth surface can be used to push turbines with stronger winds, high altitudes and ares just offshore tend to provide the best condition for capturing the stronger winds. The solar power as produce from solar, geothermal, biogas and low- impact small hydroelectric sources.

Hydro power -

Also to participation, infall, force of running water produced significant amount of energy produced. It is a versatile. Hoover dam and underwater turbines are generated both large scale projects. The lower dams on small rivers and streams. It is need to use fossil fuel pump water. Most U.S. hydroelectricity facilities use more energy able to produce for consumption.



Geo-Thermal energy -

Just under earth crust are massive both from original formation of the palnet. It being used to generate electricity. It is trapped beneath the earth's crust from the formation of the earth 4.5 billion year ago and radioactiv decay. The benefits of geothermal is not comman other types of renewable energy sources but it has significant potential for energy supply. Geothermal energy captured and used to produced heated water pumping below the surface.cost plays a major factor when it comes are the limitations of geothermal energy.



Bio – mass-

Recently living natural mineral, wood waste ,saw dust and combustible agriculture waste. The limitations of biomass need carbon dioxide to grow, plants take a time to grow. This technology also used biomass in lieu of fossil fuel. This energy come from wood, biofuels like ethanol and energy generated from methane captured from landfills. Bioenergy is a renewable energy derived from biomass. Using wood in your fireplace are the example of biomass.



Bio fuels –

Ethanol and biodiesel ,world transport fuel for road transport in 2010, Transportation fuels by 2050. Renewable energy resources are being replenished .Hydroelectric is also prevalent, ocean energy, biomass ,hydrogen.



Key facts

Dirty energy

Every country has access to sunshine nad wind prioritizing the renewable energy can also improve national security .

A country reliance on exports from fossil fuel rich nations

2) Fracking can cause earthquakes and water pollution and Coal power plants



Selling energy you collect -

Wind an dsolar energy powered .Homes can either standalone or get connected to the larger electrical guide as supplied by their power providers –Net Metering

Conclusion -

Renewable energy and you

Advocating the renewable or using them in your home can accelerate the transition towards clean energy nature. The renewable resource available throughout the northest. The coal and petroleum are fossil fuels and quantity are limited. The fuels are highly polluting and cannot basic for completely sustainable socity. The resource of energy biomass, wind, hydro power and wave energy. Earth surface receives sufficient solar energy low temperature heating of water and buildings.



REFERENCES

- [1]. On earth journal
- [2]. Mother nature network
- [3]. [4]. NRDC
- Reserchgate.net
- Frame work of multi operator collaboration for green renewable energy [5].
- [6]. [7]. solar technology industry
- Open.edu

Advanced Heterogeneous Earliest Finish Time Methodology in a Cloud Environment for Task Scheduling

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Abstract— Cloud computing has fundamentally revolutionized the information technology industry by making it possible to provide users and customers with services that are delivered through the internet. These services can be broken down into two distinct classifications: software services and hardware services. As a direct consequence of this, both the costs associated with the development of physical resources and the expenses associated with delivering the essential software licenses are decreased. The problem of task scheduling is one of the most major and noticeable challenges that the cloud computing system must overcome. This challenge must be tackled using a range of approaches, with the first step being an improvement in the scheduling of jobs within the Improved –IHEFT. Cloud computing is presently the preeminent technology in the field of high-performance distributed computing. It

offers resource polling and on-demand services via the internet. Cloud computing has taken over as the main technology in this space. As a direct consequence of this, task scheduling has developed into an important study topic in the field of cloud computing as a direct consequence of the fact that the service requirements of users change on a regular basis. It is impossible to distribute the work in an effective manner because the Heterogeneous Earliest Finish Time (HEFT) makes it impossible. We make certain adjustments to the Improved HEFT algorithm in order to reduce the amount of power that the programme needs to run and to ensure that the burden is distributed evenly across all of the processors.

Index Terms- Improved -HEFT, Cloud Computing, Task Scheduling, Min-Min concept

I. INTRODUCTION

Computing on the cloud has quickly become one of the most fascinating specialized sectors to appear in the modern age, and it is just getting started. It has been established that it has an effect on the storage of data, information technology, the design of programming, and the organizational structures of businesses. The following is how the National Institute of Standards and Technology (NIST) defines cloud computing: "the cloud computing is a paradigm to offer access for resources pooling, convenience, on-demand, and ubiquitous delivery that can be conveniently delivered with multiple forms of service provider interaction" [1].

Cloud computing is a new paradigm in the world of computing, and it is commonly regarded as the most rapidly developing new innovation. As a result of its rapid development and the increasing number of new customers and suppliers that it attracts as a result of this, cloud computing is rapidly becoming a more popular option. The rapid development of cloud computing is being accelerated even further by the increasing number of computing breakthroughs, which are being developed at reasonable and reasonable costs in terms of infrastructure and capacity capabilities. This development is taking place at a time when cloud computing is also being developed at reasonable and reasonable costs.

The term "cloud computing" refers to the practice of storing and transmitting data over the Internet rather than using the more conventional way of reading the data directly from the hard drive of the computer. The concept of cloud computing can be traced back to the days when flowcharts and presentations were utilized as modes of communication with the computers that acted as the backbone of the Internet. Local storage and computing are the locations at which data is stored or projects are maintained operating from a hard drive. This enables clients to have simple and speedy access to data and information that is stored locally. It is not necessary for there to be cloud computing services or applications in operation in order for there to be dedicated hardware server equipment placed in a home. Either the information should be able to be accessed through the use of the Internet. The term "cloud computing" refers to the process of outsourcing computing operations in order to take advantage of the scalability of surplus assets, the availability of services on demand, and the reduction in associated expenses. One of the most significant benefits of cloud computing is the reduction in the need for substantial upfront investments in new or upgraded information technology infrastructure.

The following is a definition of cloud computing taken from [2] and [3]: "The cloud" is a type of parallel and distributed system that is made up of a collection of interconnected and virtualized personal computers. These PCs are gradually provisioned and

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introduced as at least one centralized computing asset based on administration level understandings that are established through an agreement between the service provider and their customers. [09] The use of computing done on the cloud is often regarded as being of great benefit to smaller businesses. Additionally, it enables them to make investments in emerging technology, which wasn't conceivable in the past. Furthermore, it gives them power by helping them compete against other independent businesses or even larger organizations. Because of this arrangement, the company will spend less money to have someone come in and settle or introduce an application, which will result in the organization having more money left over. Consequently, making use of apps that are hosted in the cloud is more cost-effective than purchasing a wide selection of separate software programmes. Having access to a single cloud that hosts many applications satisfies the needs of each and every employee at the company.

Because of the application programming interface (API), which is used to determine which cloud-based programmes are suitable for the objectives of the business, the integration of these programmes into the company's operations will go off without a hitch. Because cloud computing is regularly updated, the company does not need to pay money to stay up with the times in order to maintain its competitive advantage. The use of cloud computing offers businesses the opportunity to reduce the amount of money they spend on operational expenses [4-6].

The utilization of globally empty resources is required in order to raise the utilization rate and earnings from resources by improving the economic efficiency of these resources; the cloud model is the most appropriate for accomplishing this objective because it allows for the greatest amount of flexibility and scalability. The main objective of the notion of cloud computing is to make its underlying data and resources accessible to the greatest number of users as feasible. The following is a definition of a platform that is used for offering services and applications to its customers: Software as a service (SaaS), platform as a service (PaaS), and infrastructure as a service (IaaS) are the three distinct categories of cloud computing services that are now on the market [7, 8].

Customers are charged on a pay-per-use basis for access to a wide range of services, including shared computer resources, servers, data storage, applications, and networks. The following are some examples of such services: Software as a Service (SaaS) refers to a model of online service delivery in which consumers obtain software licenses in proportion to the amount of money they pay for the service. Any computer with an internet connection and a web browser installed can use the aforementioned services. The user is able to develop his/her own services using cloud-based services that are currently available through the PaaS platform, and then deploy those services to their own machine. Within the framework of IaaS, consumers have access to the organizational infrastructure they require through the use of the internet. In order for the customer to make use of the infrastructure, it is not necessary for them to have prior knowledge of its internal architecture. Customers rent the necessary infrastructure on an as-needed basis rather than acquiring it entirely to meet the needs of their businesses. When their companies no longer have a demand for the infrastructure, the customer keeps the money that was paid for the services and puts it to other use. In recent years, there has been an increase in the number of people using cloud computing services, which has resulted in an increase in the number of jobs that need to be managed propositionally. As a result, task scheduling has become an absolute necessity.

The remaining parts of the paper are structured as described in the following paragraphs. In Section II, you'll find the introduction to the literature review that was written. In Section III, the technique for Task Scheduling is broken down into its component parts in greater depth. The analysis of the results is offered in the fourth section. The last part of the paper is Section VI, which wraps everything up.

II. LITERATURE REVIEW

The development of the technology known as cloud computing is predicated on the utilization of distributed systems, which is one of the fundamental components of computing. In order for cloud computing to function properly, it is required to make use of dispersed resources that may either be assigned or de-allocated on the fly [8]. The concept of computing done via the internet in the cloud is a relatively new one. It is rapidly growing in size as a result of the significant growth in internet-based services over the past few decades. This technology is distinguished from others in that it not only offers services to customers but also makes it possible for customers to share cloud resources with one another. The user's activity is taken into account to determine the appropriate amount of payment for the resources that have been depleted.

Conventional scheduling strategies were presented by Pop, Florin, and others [34]. These techniques took into account, among other things, the processing of asynchronous tasks with several queues for aperiodic and periodic activities. In addition, these techniques were offered. When determining the number of resources necessary to plan a collection of aperiodic tasks, both the expenses associated with the tasks' execution and the data transfer associated with those tasks were taken into consideration. The time limit was the most important factor that had to be considered when developing the optimization metric.

In the research paper that Peng, Zhiping, and their colleagues published in 2016 [36], they offered a model for a system that consisted of three parts: a portal, a job scheduler, and a resource pool. They developed a novel method for work scheduling that is based on reinforcement learning by evaluating the execution process of user jobs in order to minimize the makespan, average waiting time, and virtual machine resources within the constraints of a deadline constraint and virtual machine resources. This method minimizes the makespan, average waiting time, and virtual machine resources.

The Adaptive Two-Stage Deadline constrained Scheduling (ATSDS) approach, which was developed by ReihanehKhorsand et al., was presented in 2017 [37]. When compared to other ways, the data demonstrated considerable improvements in process completion time, bandwidth, instances of missed deadlines, and the costs associated with the employment of virtual machines. Proportional Deadline Constrained (PDC) and Deadline Constrained Critical Path (DCCP) are two time-constrained algorithms that were introduced by Vahid Arabnejad et al. 2017 [38]. Both of these algorithms were developed by Vahid Arabnejad et al (DCCP). In order to make the process of identifying the priority of jobs and the filling in of resources more accurate, the algorithms have to be updated and improved. The results of the algorithms PDC and DCC show that they have a

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higher rate of success while also achieving larger cost efficiencies when compared to other algorithms. This is according to the findings of the algorithms.

In the research paper authored by Toosi, A. N., et al. 2018 [39], a resource provisioning strategy was suggested to assist data-intensive apps in meeting their deadline requirements in hybrid cloud environments. The findings of the experiments revealed that the proposed algorithm was capable of allocating resources in a more effective manner when compared to other algorithms already in use.

III. TASK SCHEDULING

The process of cloud computing begins with the user submitting a request or task to a cloud computing service provider. This request or task may include a variety of information regarding the user's requirements, including a constraint, a priority, or other information. On the other hand, at a service provider that possesses a specialised task scheduling system, the scheduler receives requests from users to schedule their tasks in accordance with the terms of the service level agreement contract between the users and the cloud service provider. This is done in order to maintain the quality of service while simultaneously earning a profit from the services that are utilised by customers.

To carry out these tasks in accordance with certain constraints, the scheduler chooses the heterogeneous cloud resources from which it draws the most appropriate resources to use, and the scheduler in this case is represented by the proposed model and serves as an intermediary between the users and the service providers (see Figure 1).



Figure 1: Scheduling in Cloud Computing

When it comes to task scheduling, the individual who will be carrying out the activities or tasks is the one who decides the appropriate order in which they should be completed. It is the process of assigning the appropriate resources to a certain work that is uploaded to the cloud in order to be completed. NP-hard problems are issues that cannot be solved in a finite amount of time and have an extremely large number of possible solutions. This problem fits into this category due to the large number of possible solutions. It is a methodology for the management of resources that are hosted in the cloud. The difficulty of selecting which resources should be given to which tasks in order to maximize resource consumption while lowering execution time can be overcome by scheduling jobs according to their priority. The scheduling algorithm needs to be effective in order for performance to be increased. It also needs to take into account a variety of elements, including load balancing across the entire system, handling interruptions, fault tolerance, and minimizing the overall amount of time needed for execution.

Once users have uploaded their tasks to the cloud in order for them to be performed, the tasks will need to be assigned to a processor in order for them to actually be finished. The question that needs to be answered now is how the duties are distributed throughout the processors in such a way that the owner of the cloud earns the maximum profit in the shortest period of time possible while also minimizing the amount of time it takes to carry out the tasks. As a result, task scheduling is able to address the challenge of allocating jobs to the processor that is most suited to perform those duties while also taking into account the other relevant parameters. The scheduling of tasks is one of the most effective techniques to improve economic efficiency and resource utilization. Several different approaches to the scheduling of work have been discussed and put to the test in a variety of settings.

We have two sorts of job scheduling algorithms to choose from while working in a cloud-based environment. The level of complexity distinguishes between distributed scheduling, in which tasks are assigned to different resources that are not geographically located in the same place, and centralized scheduling, in which all resources are located in the same place but the complexity level is lower than in distributed scheduling. Distributed scheduling involves tasks being assigned to different resources that are not geographically located in the same place. There are three different kinds of distributed scheduling

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approaches that can be employed. These are heuristic methods, hybrid methods, and meta-heuristic methods. There are four categories of dynamic heuristic approaches: cost-based methods, energy-based methods, efficiency-based methods, and quality-of-service (QoS)-based methods. Static and hybrid methods are subdivided further into cost-based methods, energy-based methods, efficiency-based methods, and so on. The natural world serves as an important source of inspiration for the meta-heuristic research methodology. A few examples of static job scheduling methods are the min-min algorithm, the Symbiotic Organism Search (SOS) algorithm, the FUGE algorithm, the HEFT algorithm, and the CPOP algorithm.

IV. PROPOSED ALGORITHM

When we have access to accurate forecasts of the amount of time this method will take to complete a task, we will be able to improve the performance of the Greedy technique by incorporating it into the algorithm. The second method that we use is to priorities jobs according to their level of significance. In order to do this, we first assess how much time the virtual machine (VM) will have available both when the work is being done and when a new task is scheduled. In order to accomplish what needs to be done for this First Next Step, the estimation time calculation with IHEFT will be used. We made a comparison between the activity that was picked and other tasks that had the same finish time but a greater priority, and we decided to go with the task that had the higher priority. As part of our procedure, we adhere to the Min-Min principle and perform periodic verification and validation of the VM state to ensure that it is accessible for other tasks and is not being used for anything else.

Algorithm-

Enhanced -IHEFT New Algorithm

- 1. Create a DAG for all the submitted tasks Ti in Cloud.
- 2. Set the Computation Cost of tasks Ti and communication edges between the processor/resources R_j.
- 3. The Task ordering according to finish time that we calculate finish time and calculate average time
- 4. Sort the Task List with finish time
- 5. Repeat until task list
- 6. check the list for minimum the task finish time remove from list until size is zero
- 7. We Calculate the Virtual Machine Wait time for assigning the task
- 8. We calculate the Virtual Machine Makespam and compare with finish time from task list
- 9. Arrange tasks in a list in decreasing manner on the basis of their order of task OTi value.
- 10. for task in the list
- 11. map task to the processor which have the minimum execution time
- 12. end for
- 13. End

V. RESULTS AND ANALYSIS

I-HEFT SPEEDUP

	IHEFT SPEEDUP		
10	7.35		
20	10.59		
50	15.8		



Figure 2: IHEFT Speedup

NEW SPEEDUP



10	7.12
20	10.53
50	15.64



Figure 3: NEW IHEFT Speedup

A system's **speedup** can be thought of as a number that measures how quickly it can solve a problem when compared to another system. To put it another way, it is the increase in speed at which a task can be carried out when it is carried out on two architectures that are quite similar but have different resources.

The Modified HEFT Speedup is depicted in Figure 2. Figure 3 illustrates the newly improved speed of the Efficient Modified HEFT, and Figure 4 depicts the power consumption of the Efficient IHEFT.

IHEFT Power Consumption

	IHEFT Power Consumption		
10	65313.36		
20	38013.19		
50	21022.72		



Figure 4: IHEFT Power Consumption

The method must be completed in a series of stages before it can be considered complete. These stages include compressing pages that share the same information in memory space and putting the space that was saved in a condition that uses less energy. The use of electricity by servers is strictly monitored and managed, and efforts have been made to cut down on the amount of electricity used by CPUs and memory. The amount of energy that servers need to run is cut down, and the efficiency with which memory is used is improved.

VI. CONCLUSION

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In this study, we provide an improved version of the HEFT algorithm, which organizes the jobs into groups determined by their ratings and then assigns each group to the processor that is most suited to handle them. Following that, the workloads should be distributed throughout the various processors in the system in order to lower the overall power consumption of the system. The performance of the suggested technique was examined using the cloudsim simulator, and the estimated findings reveal that the suggested algorithm decreases the amount of time it takes for jobs to be finished and boosts the effectiveness of the system.

References

- [1] Arabnejad, H., and Barbosa, J. G. (2014). List Scheduling Algorithm for Heterogeneous Systems by an Optimistic Cost Table. IEEE Transactions on Parallel and Distributed Systems, 25(3), pages 1-14.
- [2] Bailin, P., Yanping, W., Hanxi, L., and Jie Q. (2014). Task Scheduling and Resource Allocation of Cloud Computing Based on QoS. Advanced Materials Research, Vols. 915-916, pages 1382-1385.
- [3] S. Raghavan, P. Sarwesh, C. Marimuthu, K. Chandrasekaran, "Bat algorithm for scheduling workflow applications in cloud," International Conference on Electronic Design, Computer Networks & Automated Verification (EDCAV), Shillong, 2015, pp 139-144.
- [4] Byun, E. K., Kee, Y. S., Kim, J. S., and Maeng, S. (2011). Cost Optimized Provisioning of Elastic Resources for Application Workflows. Future Generation Computer Systems, 27(8), pages 1011–1026.
- [5] G. Wang, H. C. Yu, "Task Scheduling Algorithm Based on Improved Min-Min Algorithm in Cloud Computing Environment", Applied Mechanics and Materials, Vols. 303-306, 2014, pp 2429-2432.
- [6] G. Wang, H. C. Yu, "Task Scheduling Algorithm Based on Improved Min-Min Algorithm in Cloud Computing Environment", Applied Mechanics and Materials, Vols. 303-306, 2014, pp 2429-2432.
- [7] Abdulhamid, S.M., Latiff, M.S.A., Idris, "Tasks scheduling technique using league champion ship algorithm for makes pan minimization in IaaS cloud.", ARPN J. Eng. Appl. Sci., Volume 9, 2015, pp 2528–2533.
- [8] Bansal, N., Awasthi, A. &Bansal, "Task Scheduling Algorithms with Multiple Factor in Cloud Computing Environment", Information Systems Design and Intelligent Applications, Springer.
- [9] Babu, K.R., Samuel, P., "Enhanced bee colony algorithm for efficient load balancing and scheduling in cloud", Innovations in Bio-Inspired Computing and Applications , 2016, pp 67-78.
- [10] Pop, Florin, et al. "Deadline scheduling for aperiodic tasks in inter-Cloud environments: a new approach to resource management." The Journal of Supercomputing 71.5 (2015): 1754-1765.
- [11] Pandey, S., Wu, L., Guru, S. M., and Buyya, R. (2010). A Particle Swarm Optimization-based Heuristic for Scheduling Workflow Applications in Cloud Computing Environments. In 24th IEEE International Conference on Advanced Information Networking and Applications (AINA). IEEE.
- [12] Parsa, S., and Entezari-Maleki, R. (2009). RASA: A New Task Scheduling Algorithm in Grid Environment. World Applied Sciences Journal, 7 (Special Issue of Computer & IT), pages 152-160.
- [13] Rodriguez, M. A., and Buyya, R. (2014). Deadline Based Resource Provisioning and Scheduling Algorithm for Scientific Workflows on Clouds. IEEE Transactions on Cloud Computing, 2(2), pages 222-235
- [14] Chun-Yan Liu, Cheng-Ming Zou, and Pei Wu. "A Task Scheduling Algorithm Based on Genetic Algorithm and Ant Colony Optimization in Cloud Computing", Distributed Computing and Applications to Business, Engineering and Science (DCABES '14). IEEE Computer Society, Washington, DC, USA, 2014, pp 68-72.
- [15] Topcuoglu, H., Hariri, S., Wu, W. Min-You. (2002). Performance-Effective and Low- complexity Task Scheduling for Heterogeneous Computing. IEEE Transactions on Parallel and Distributed Systems, 13(3), pages 260-274.
- [16] H. Yang, "Improved Ant Colony Algorithm Based on PSO and its Application on Cloud Computing Resource Scheduling", Advanced Materials Research, Vols. 989-994, pp. 2192-2195, 2014.

Advanced Heterogeneous Earliest Finish Time Methodology in a Cloud Environment for Task Scheduling: A Survey

Sharad Awasthi, Nikita Gupta

Abstract— Cloud computing has emerged as the dominant technology in the field of high-performance distributed computing. This type of computing offers resource polling and on-demand services via the internet, thereby replacing technologies that were previously in use. Due to the unpredictability of the Heterogeneous Earliest Finish Time (HEFT), it is impossible to divide up the task in an effective manner. Due to the fact that customers' service requirements change on a regular basis and as a result, task scheduling is becoming an increasingly important topic, job scheduling has developed into a prominent study topic in the field of cloud computing. This is because of the fact that customers' service requirements vary on a regular basis. Improving job scheduling within the Improved–MHEFT is a good place to start if you want to tackle the task scheduling problem that exists in the cloud computing system. This issue is one of the most significant and noticeable challenges that must be surmounted in order to be considered a success. Due to the unpredictability of the Heterogeneous Earliest Finish Time (HEFT), it is impossible to divide up the task in an effective manner. In particular, the Improved HEFT and the Task Scheduling Concept will be examined, debated, and analyzed in greater detail throughout the course of this study.

Index Terms-Improved-HEFT (IHEFT), Task Scheduling, Cloud Computing

I. INTRODUCTION

Computing on the cloud has quickly become one of the most fascinating specialized sectors to appear in the modern age, and it is just getting started. It has been established that it has an effect on the storage of data, information technology, the design of programming, and the organizational structures of businesses. The following is how the National Institute of Standards and Technology (NIST) defines cloud computing: "the cloud computing is a paradigm to offer access for resources pooling, convenience, on-demand, and ubiquitous delivery that can be conveniently delivered with multiple forms of service provider interaction" [1].

It is possible for users to make access requests to cloud resources from any location in the world, and users can access cloud resources from any location in the world. Cloud Service Providers (CSPs), also known as Internet Service Providers, are driven to have a large number of data centres since the revenues generated by users who pay for access to the service are an additional source of motivation. Users are drawn to Cloud Service Providers (CSPs) because of the possibility of lowering expenses involved with the full deployment of the services being purchased. [2]. Servers, of which there are an extremely large number in cloud data centres, refer to individual computers. Because to virtualization [3,] a large number of users are able to share the resources of a data centre. This makes cloud data centres more flexible and able to provide greater support for the on-demand provisioning of services, which is essential for the modern business world. The heterogeneity of a server is

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concealed by virtualization, which also boosts its efficiency and makes it possible to consolidate a number of servers into a single one. [4] Each server hosts a huge number of unique virtual machines (VMs), and the amount of load that each server experiences is both variable and unpredictable. This can lead to an imbalance in the usage of the available resources on the server. The Quality of Service (QoS) requirements established by the user are, in accordance with Service Level Agreements, satisfied in this system by means of contracts that have been negotiated between the service provider and the user (SLAs). When it comes to cloud computing, pay-as-you-go and quality of service (QoS) concepts are utilized to deliver utility grid features over the Internet. As a consequence of this, cloud computing is regarded as an extension of the utility grid. This environment is both more cost-effective and scalable thanks to the pay-as-you-go and on-demand utilization of cloud resources. Users also have the option to hire this resource on an as-needed basis rather than having to worry about issues such as maintenance and so on [5]. As a consequence of this, it is extremely challenging to provide cloud services that cater to the requirements of clients without violating the terms of the service level agreement (SLA). At the moment, cloud services are provided and scheduled in line with the availability of resources; nevertheless, it is not currently possible to guarantee in advance that the projected performance will be achieved. As a consequence of this, service providers should modernize their ecosystems in order to satisfy the requirements for the level of service quality imposed by all cloud components [6].

Users from all over the world send a large number of requests to the data centre, which acts as the major entity in the cloud. Each task must be finished as rapidly as is humanly possible in order to keep up with the volume of demands. As a consequence of this, it is necessary for every cloud provider to have a scheduling strategy in place in order to efficiently schedule and carry out jobs. The scheduling difficulty that consists of assigning tasks to appropriate virtual machines (VMs) that are produced over the clouds [7] may be solved by numerous different cloud service providers, each of which has their own policies around scheduling.

It has been determined that optimal job scheduling in the cloud is an NP-complete problem, the same classification given to the challenges of task scheduling in the rest of the world. In addition to the amount of time that must be invested in order for the work to be finished, the cost of execution is taken into consideration by task scheduling systems as an essential part of this payment model. Due to the compatibility between two of the most important aspects of QoS, execution time and execution cost, the problem of task scheduling in the cloud becomes significantly more complex and challenging [5].

The utilization of globally empty resources is required in order to raise the utilization rate and earnings from resources by improving the economic efficiency of these resources; the cloud model is the most appropriate for accomplishing this objective because it allows for the greatest amount of flexibility and scalability. The main objective of the notion of cloud computing is to make its underlying data and resources accessible to the greatest number of users as feasible. The following is a definition of a platform that is used for offering services and applications to its customers: Cloud computing services can be broken down into three categories: software as a service, popularly known as "SaaS," platform as a service, commonly known as "PaaS," and infrastructure as a service ("IaaS"). Customers are charged on a pay-per-use basis for access to a wide range of services, including shared computer resources, servers, data storage, applications, and networks. The following are some examples of such services: Software as a Service (SaaS) refers to a model of online service delivery in which consumers obtain software licenses in proportion to the amount of money they pay for the service. Any computer with an internet connection and a web browser installed can use the aforementioned services. In a platform as a service (PaaS), the user is able to build their own services with the assistance of other cloud-based services that are already available, and then deploy those services on their own local system. Within the framework of IaaS, consumers have access to the organizational infrastructure they require through the use of the internet. In order for the customer to make use of the infrastructure, it is not necessary for them to have prior knowledge of its internal architecture. Customers rent the necessary infrastructure on an as-needed basis rather than acquiring it entirely to meet the needs of their businesses. When their companies no longer have a demand for the infrastructure, the customer keeps the money that was paid for the services and puts it to other use. In recent years, there has been an increase in the number of cloud users, which has resulted in an increase in the number of jobs that must be managed propositionally, which has resulted in the demand for task scheduling.

II. CLOUD COMPUTING

Cloud computing is a new paradigm in the world of computing, and it is commonly regarded as the most rapidly developing new innovation. As a result of its rapid development and the increasing number of new customers and suppliers that it attracts as a result of this, cloud computing is rapidly becoming a more popular option. The rapid development of cloud computing is being accelerated even further by the increasing number of computing breakthroughs, which are being developed at reasonable and reasonable costs in terms of infrastructure and capacity capabilities. This development is taking place at a time when cloud computing is also being developed at reasonable and reasonable costs. The term "cloud computing" refers to the practice of storing and transmitting data over the Internet rather than using the more conventional way of reading the data directly from the hard drive of the computer. The concept of cloud computing can be traced back to the days when flowcharts and presentations were utilized as modes of communication with the computers that acted as the backbone of the Internet. Local storage and computing are the locations at which data is stored or projects are maintained operating from a hard drive. This enables clients to have simple and speedy access to data and information that is stored locally. It is not necessary for there to be cloud computing services or applications in operation in order for there to be dedicated hardware server equipment placed in a home. Either the information should be able to be accessed through the use of the Internet, or it may be necessary for the information to be synchronized with data that is able to be accessed through the use of the Internet. The term "cloud computing" refers to the process of outsourcing computing operations in order to take advantage of the scalability of surplus assets, the availability of services on demand, and the reduction in associated expenses.

One of the most significant benefits of cloud computing is the reduction in the need for substantial upfront investments in new or upgraded information technology infrastructure. According to [10] and [13], the following is how the terms "cloud" and "parallel and conveyed framework" are defined: "A Cloud is a type of parallel and conveyed framework comprised of a collection of connected and virtualized computers, each of which is progressively provisioned and introduced as at least one brought together computing asset in accordance with administration level understandings established through arrangement between the administration provider and clients." Cloud computing is considered to be exempt from traditional data storage and processing limitations. Because of this arrangement, the company will spend less money to have someone come in and settle or introduce an application, which will result in the organization having more money left over. Consequently, making use of apps that are hosted in the cloud is more cost-effective than purchasing a wide selection of separate software programmes. Having access to a single cloud that hosts many applications satisfies the needs of each and every employee at the company.

Because of the application programming interface (API), which is used to determine which cloud-based programmes are suitable for the objectives of the business, the integration of these programmes into the company's operations will go off without a hitch. Because cloud computing is regularly updated, the company does not need to pay money to stay up with the times in order to maintain its competitive advantage. The use of cloud computing offers businesses the opportunity to reduce the amount of money they spend on operational expenses [14]. Scalable resources are provisioned with dynamism as a service in order to ensure that economic gains are dispersed among cloud customers [08]. This is done in order to ensure that economic benefits are distributed among cloud customers. There are multiple levels of cloud-based service that are operational, and these levels vary depending on the type of service that is supplied by the cloud server. Beginning with the fundamental core, there are three layers of cloud-based service. The Infrastructure-as-a-Service (IaaS layer consists of the most essential hardware requirements such as memory and storage resources. This layer is also known as the foundation layer. The most advanced hardware needs, such as network connectivity, are contained inside the second layer of the architecture. The most well-knowr example of infrastructure as a service is Amazon's Elastic Compute Cloud (AEC) (EC2). Platform-as-a-Service (PaaS) which is the following layer and the second layer from the bottom, enables the development and deployment of applications written in Python, Java, and other programming languages. This layer is the second from the bottom. The most well-known example of a platform as a service is Google's App Engine.

As was said earlier, Platform as a Service (PaaS), Infrastructure as a Service (IaaS), and Software as a Service (SaaS) are the three most essential types of cloud services. Figure 1 presents an illustration of the organizational framework of cloud service models.

Platform as a Service (PaaS)

A platform that is made available for the purpose of deploying and developing applications that will be given as services to consumers via the internet is what is meant by the term "platform as a service" (PaaS) [08]. Application software that will be used by service users is designed and developed by third-party organizations. These organizations are responsible for the program's deployment by service users. Users are able to take use of a more cost-effective service while simultaneously managing their infrastructure in a much more basic manner than they were previously able to do thanks to this service, which reduces the cost and complexity of developing applications. All of the infrastructure software, databases, middleware. and development tools for end users are included in PaaS. These are all made available to end users over the internet.

- PaaS is a programming platform for developers. This platform is generated for the programmers to create, test, run and manage the applications.
- A developer can easily write the application and deploy it directly into PaaS layer.
- PaaS gives the runtime environment for application development and deployment tools.
- Google Apps Engine(GAE), Windows Azure, SalesForce.com are the examples of PaaS.



Figure 1: Cloud Service Models

Infrastructure as a Service (IaaS)

According to [BJJ10], Infrastructure as a Service (IaaS) is a delivery model that is connected with the supply of both Hardware and Software as a service. Components like as storage and networks, in addition to fundamental software components such as an operating system, virtualization, and file management, are utilised in this process. This service, which is a modification of the standard model for the supply of host-based resources, does not come with any responsibilities that are long-term in nature. IaaS providers, in contrast to PaaS providers, do not require high-level data administration in order to ensure the appropriate operation of datacenters. This enables IaaS providers to provide services that are of superior quality and that meet or exceed the expectations of their customers.

• TaaS is a way to deliver a cloud computing infrastructure like server, storage, network and operating system.

• The customers can access these resources over cloud computing platform i.e Internet as an on-demand service.

• In IaaS, you buy complete resources rather than purchasing server, software, datacenter space or network equipment.

• IaaS was earlier called as Hardware as a Service(HaaS). It is a Cloud computing platform based model.

• HaaS differs from IaaS in the way that users have the bare hardware on which they can deploy their own infrastructure using most appropriate software.

Software as a service (SaaS)

With the help of SaaS, a sizable number of users are able to access the applications through their web browsers [08]. This technique not only reduces the prices that service providers suffer for software and servers, but it also reduces the fees that end users incur while accessing such programmes. It does this by hosting and administering the apps in an environment similar to that of a data centre, which enables it to provide access to a huge number of users over the internet. Aside from that, customers are able to run programmes that are provided by a range of different providers thanks to SaaS.

• SaaS is known as 'On-Demand Software'.

- It is a software distribution model. In this model, the applications are hosted by a cloud service provider and publicized to the customers over internet.
- In SaaS, associated data and software are hosted centrally on the cloud server.
- User can access SaaS by using a thin client through a web browser.
- CRM, Office Suite, Email, games, etc. are the software applications which are provided as a service through Internet.
- The companies like Google, Microsoft provide their applications as a service to the end users

III. LITERATURE REVIEW

When you conduct a literature review, you are analyzing the information that has already been gathered and coming up with a mix of fresh knowledge and information that has not been gathered before. This section provides a concise explanation of the various research papers that are included in the research papers themselves, as well as the occurrence of summaries and synthesis of research papers that are included in the research papers.

Cloud computing can be understood, at its most fundamental level, as the provision of hardware and software in the form of a service [11]. The term "virtualization" refers to a technique that is an essential part of cloud computing. Cloud computing is made up of cloud data centres, which are made more powerful and adaptable by the use of virtualization, which is an essential part of cloud computing. Cloud computing service providers such as Amazon, Microsoft, and Google rely largely on cloud data centres to meet the needs of their clients [13, 14].

Cloud computing is frequently considered to have begun in 2006 with the introduction of Amazon Web Services' (AWS) Simple Storage Service (S3). Words like "private cloud computing," "public cloud computing," and "hybrid cloud computing" came into existence as a result of cloud computing. Acronyms like "SaaS" (Software as a Service), "PaaS" (Platform as a Service), and "IaaS" (Infrastructure as a Service) also appeared as a result of cloud computing (Infrastructure as a Service). As a consequence of this, the term "cloud computing" can have a variety of connotations, depending on how it is read [8], and this is also due to the fact that it is understood in a variety of ways. As a consequence of this, in the following section, we will explain the bulk of these words and acronyms in a way that is straightforward and easy to comprehend. There are three key participants in the cloud computing system: service providers, users (customers), and the internet, which acts as a conduit between service providers and clients.

IV. TASK SCHEDULING

The process of cloud computing begins with the user submitting a request or task to a cloud computing service provider. This request or task may include a variety of information regarding the user's requirements, including a constraint, a priority, or other information. On the other hand, at a service provider that possesses a specialized task scheduling system, the scheduler receives requests from users to schedule their tasks in accordance with the terms of the service level agreement contract between the users and the cloud service provider. This is done in order to maintain the quality of service while simultaneously earning a profit from the services that are utilized by customers.

The suggested model acts as an intermediary between the users and the service providers in this scenario. The scheduler is represented by the model, and the scheduler chooses the resources from the heterogeneous cloud resources that are the most appropriate to execute these tasks based on a set of restrictions.



Figure 1: Scheduling in Cloud Computing

When it comes to task scheduling, the individual who will be carrying out the activities or tasks is the one who decides the appropriate order in which they should be completed. It is the process of assigning the appropriate resources to a certain work that is uploaded to the cloud in order to be completed. NP-hard problems are issues that cannot be solved in a finite amount of time and have an extremely large number of possible solutions. This problem fits into this category due to the large number of possible solutions. It is a methodology for the management of resources that are hosted in the cloud. The difficulty of selecting which resources should be given to which tasks in order to maximize resource consumption while lowering execution time can be overcome by scheduling jobs according to their priority. The scheduling algorithm needs to be effective in order for performance to be increased. It also needs to take into account a variety of elements, including load balancing across the entire system, handling interruptions, fault tolerance, and minimizing the overall amount of time needed for execution.

Once users have uploaded their tasks to the cloud in order for them to be performed, the tasks will need to be assigned to a processor in order for them to actually be finished. The question that needs to be answered now is how the duties are distributed throughout the processors in such a way that the owner of the cloud earns the maximum profit in the shortest period of time possible while also minimizing the amount of time it takes to carry out the tasks. As a result, task scheduling is able to address the challenge of allocating jobs to the processor that is most suited to perform those duties while also taking into account the other relevant parameters. The scheduling of tasks is one of the most effective techniques to improve economic efficiency and resource utilization. Several different approaches to the scheduling of work have been discussed and put to the test in a variety of settings.

We have two sorts of job scheduling algorithms to choose from while working in a cloud-based environment. The level of complexity distinguishes between distributed scheduling, in which tasks are assigned to different resources that are not geographically located in the same place, and centralized scheduling, in which all resources are located in the same place but the complexity level is lower than in distributed scheduling. Distributed scheduling involves tasks being assigned to different resources that are not geographically located in the same place. There are three different kinds of distributed scheduling approaches that can be employed. These are heuristic methods, hybrid methods, and meta-heuristic methods. There are four categories of dynamic heuristic approaches: cost-based methods, energy-based methods, efficiency-based methods, and quality-of-service (QoS)-based methods. Static and hybrid methods are subdivided further into cost-based methods, energy-based methods, efficiency-based methods, and so on. The meta-heuristic approach is grounded in the concept of swarm intelligence and takes its cues from the natural world.

V. IHEFT ALGORITHM

When we have access to accurate forecasts of the amount of time this method will take to complete a task, we will be able to improve the performance of the Greedy technique by incorporating it into the algorithm. Another one of our strategies involves assigning a priority to each task depending on how important it is, and our method involves calculating the amount of time that the VM will have free both during the time that the work is being done and when a new task is being planned. In order to accomplish what needs to be done for this First Next Step, the estimation time calculation with IHEFT will be used. We made a comparison between the activity that was picked and other tasks that had the same finish time but a greater priority, and we decided to go with the task that had the higher priority. In keeping with the Min-Min concept, whenever a virtual machine is not being used for something else and is available for use by another job, we investigate and validate the state it is currently in.

Algorithm-

Improved -IHEFT New Algorithm

1. Make a DAG in the cloud for each and every one of the jobs that have been turned in.

2. Adjust the computing cost of Ti as well as the communication edges between the processors and resources Rj so that they are in accordance with your preferences.

3. The priority of the tasks based on the finish time that we determine, in addition to the ordering of the tasks based on the average amount of time spent on each assignment.

4. Arrange the To-Do List's items in order of their estimated completion times.

5. Carry on until everything on the job list has been done.

6. Check the list to see what the quickest way to finish each task is, and cross items off the list one by one until the total number of items on the list is zero.

7. The performance of the virtual computer is analyzed by us. Give the person in charge of the assignment enough time to do it.

8. We calculate the Virtual Machine Makespam and compare it to the completion time from the task list. 9.

9. Arrange tasks in a list in descending order based on the sequence in which they were assigned the task OTi value. **10.** for each item in the list

11. You should delegate jobs to the processors that can do them in the least period of time.

12. end for loop

13. End

VI. CONCLUSION

Within the scope of this investigation, we present a revised model of the HEFT algorithm. This model sorts the jobs into categories according to the ratings they have been given, and then allocates each category to the processor that is most equipped to deal with the tasks in question. After then, the workloads should be dispersed throughout the many processors in the system in order to reduce the overall amount of power that is consumed by the system. Throughout the entirety of this article, the concepts of Cloud Computing, the Task Scheduling Concept of Cloud Computing, and Improved HEFT, as well as the vocabulary and procedures associated with these topics, were discussed.

REFERENCES

[1] Arabnejad, H., and Barbosa, J. G. (2014). List Scheduling Algorithm for Heterogeneous Systems by an Optimistic Cost Table. IEEE Transactions on Parallel and Distributed Systems, 25(3), pages 1-14.

[2] Bailin, P., Yanping, W., Hanxi, L., and Jie Q. (2014). Task Scheduling and Resource Allocation of Cloud Computing Based on QoS. Advanced Materials Research, Vols. 915-916, pages 1382-1385.

[3] S. Raghavan, P. Sarwesh, C. Marimuthu, K. Chandrasekaran, "Bat algorithm for scheduling workflow applications in cloud," International Conference on Electronic Design, Computer Networks & Automated Verification (EDCAV), Shillong, 2015, pp 139-144.

[4] Byun, E. K., Kee, Y. S., Kim, J. S., and Maeng, S. (2011). Cost Optimized Provisioning of Elastic Resources for Application Workflows. Future Generation Computer Systems, 27(8), pages 1011–1026.

[5] G. Wang, H. C. Yu, "Task Scheduling Algorithm Based on Improved Min-Min Algorithm in Cloud Computing Environment", Applied Mechanics and Materials, Vols. 303-306, 2014, pp 2429-2432.

[6] Abdulhamid, S.M., Latiff, M.S.A., Idris, "Tasks scheduling technique using league champion ship algorithm for makes pan minimization in IaaS cloud.", ARPN J. Eng. Appl. Sci., Volume 9, 2015, pp 2528–2533.

[7] Bansal, N., Awasthi, A. &Bansal, "Task Scheduling Algorithms with Multiple Factor in Cloud Computing Environment", Information Systems Design and Intelligent Applications, Springer.

[8] Pandey, S., Wu, L., Guru, S. M., and Buyya, R. (2010). A Particle Swarm Optimization-based Heuristic for Scheduling Workflow Applications in Cloud Computing Environments. In 24th IEEE International Conference on Advanced Information Networking and Applications (AINA). IEEE.

[9] Parsa, S., and Entezari-Maleki, R. (2009). RASA: A New Task Scheduling Algorithm in Grid Environment. World Applied Sciences Journal, 7 (Special Issue of Computer & IT), pages 152-160. [10] Rodriguez, M. A., and Buyya, R. (2014). Deadline Based Resource Provisioning and Scheduling Algorithm for Scientific Workflows on Clouds. IEEE Transactions on Cloud Computing, 2(2), pages 222-235

[11] Chun-Yan Liu, Cheng-Ming Zou, and Pei Wu. "A Task Scheduling Algorithm Based on Genetic Algorithm and Ant Colony Optimization in Cloud Computing"., Distributed Computing and Applications to Business, Engineering and Science (DCABES '14). IEEE Computer Society, Washington, DC, USA, 2014, pp 68-72. [12] Topcuoglu, H., Hariri, S., Wu, W. Min-You. (2002). Performance-Effective and Low- complexity Task Scheduling for Heterogeneous Computing. IEEE Transactions on Parallel and Distributed Systems, 13(3), pages 260-274.

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Implementation and Analysis of Social Network Graph in Interpersonal Network

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Abstract

Social graph describes the graphical model of users and how they are related to each other online. Social network consists of a set of nodes (sometimes referred to as actors or vertices in graph theory) connected via some type of relations which are known as edges. Actors are the smallest unit of the network. It can be Persons, Organizations, and Families etc. Relations can be of many types such as directed, undirected, and weighted. Social network analysis consists of two phases. One is data collection phase and another is analysis phase. Data is collected with the help of surveys, Social sites such as face book, LinkedIn. We first input the user information in form of two dimensional matrices. Then we construct a graph based on the relationships among users from adjacency matrix. We can draw a directed graph or a simple graph based on the user input information from adjacency matrix. After analyzing the graph properties based on degree of node, centrality and other parameters we will give effective solution. There are many applications of analyzing social network for example examine a network of farm animals, to analyze how disease spread from one cow to another, discover emergent communities of interest among faculty at various universities. Some public sector uses include development of leader engagement strategies, analysis of individual and group engagement and media use, and community-based problem solving etc. Social network analysis is used widely in the social and behavioral sciences. as well as in economics, marketing, and industrial engineering. The social network perspective focuses on the relationships among social entities and is an important addition to standard social and behavioral research which is primarily concerned with attributes of the social units.

Keywords:

Adjacency matrix, Centrality, Degree, Edges, Social entity

1. Introduction

The Social network is a network of social interactions and personal relationships. Social network can be defined as a social structure in which information of entities (users, organizations etc.) reside in form of text, databases, and communication systems. A dedicated website or other applications which enables users to communicate with each other by posting information, messages, images etc. is a kind of social network. A Social network is represented by using Graphs and Matrices. In Social graph construction and network analysis approach, the main task is to input the user information in form of 2D matrices known as adjacency matrices and constructing a graph from 2D matrices and then analyzing the graph based on its various properties. Social network offers a platform to people for sharing knowledge, thoughts or opinions and more often to maintain societal relationship. As shown in Fig. 1, analytically, these can observe as large graphs in which the users are represented as nodes and relationships between nodes are depicted as edges between them. The edge may or may not be directed depending on the structure of the social network and also an edge between two nodes depicts that the connected nodes have already sharedsome information as an alternative representation, adjacency matrix delineated in table 1 also represents Fig 1.

Actor/Users	Ramesh	Anubhav	Mohan	Dinesh	Sarita	Saroj	Bhanu
Ramesh		1	0	0	1	1	0
Anubhav	1		0	0	1	0	0
Mohan	0	0	****	0	0	1	1
Dinesh	0	0	0	(1	0	0
Sarita	1	1	0	1		0	0
Saroj	1	0	1	0	0		1
Bhanu	0	0	1	0	0	1	

Table 1: Adjacency Matrix representation of Social Network



Figure 1. A Graphical representation of Social Network

2. Literature Review

A recent study has shown the advantages and disadvantages of facebook utilizing university students. A group of students responded to a survey containing advantages and disadvantages of facebook, and yielded interesting results. The study did not focus on students' academic performance, but took the issue as a general view of social media influence. Social networks are becoming major tools for education, and entertainment. The human nature is keen on interacting with people and finding common areas and interests. In education, two streams are prevailing: the use of social networks as a tool supporting activities deemed important for the purpose of educational institutions, instructors, and students. The second stream is the bad influence social network inflicts on students behaviors and time management. This study will explore the relationship between performance and SN use. The following sections will review the literature related to the two streams and the performance issue related to students

3. General Properties of Social Graph

Social network analysis is done to find mapping and measuring of relationships and flows between people, focusing on uncovered patterns of people's interaction, a set of methods for the investigation of relational aspects of social structures. After the construction of graph from adjacency matrix the main task is to now analyze the graph based on various properties of graph i.e. degree of the node in graph, geodesic distance and diameter, centrality, maximum flow etc. Network Visualization is shown as in Fig 2.



Figure 2. Network Visualization of Social Graph

3.1 Degree

Degree of a node is the number of edges connecting this node with other nodes .If graph is directed then a node has in-degree defined as number of incoming edges and out degree defined as number of outgoing edges.

3.2 Geodesic Distance and Diameter

For both directed and undirected graph, the geodesic distance is the number of edges in the shortest possible walk from one actor to another. Geodesic distance is widely used in network analysis. It determines the size of network.

3.3 Cliques or Subgroups

To understand that how the network is likely to behave, it is necessary to partition the actors into cliques or sub-groups. A clique is simply a sub-graph in which all nodes are more closely tied to each other. If the sub graph is complete graph there exists every possible tie among nodes then it is called maximal clique.

3.4 Maximum Flow

Reach ability of an actor to another depends on the number of factors in neighborhood that lead to the target. If an actor A has to send a message to another actor B and there is only one actor C to whom A can send message then A has a weak connectivity with B even if C has many ways to reach B. On the other hand if A can send message (destined to B) to four intermediate actor then connection between A and B is stronger. This flow shows that the strength of a tie between two actors depends on the weakest link in the chain of connections.

3.5 Centrality

Centrality is a measure that quantifies the influence of an actor in the network. It is normally assumed that central people have more influence than people who are less central in the network. Centrality can be measured by various terms such as Degree Centrality, Closeness Centrality, and betweenness centrality.

3.5.1. Degree Centrality

It is known as number of ties for one actor. Centrality of a node depends on the number of nodes attached to it directly. For a network with g nodes the degree centrality attached to it directly and d(n) is the number of nodes adjacent to it.

$$cd(n) = d(n)/(g-1)$$

(1)

3.5.2. Betweenness Centrality

Two nodes which are not adjacent may also influence each other significantly through other nodes in the network. Betweenness centrality measure highlights those nodes that fall in the connecting path of many nodes. For a network with g nodes, the betweenness centrality for node.

$$C_{b}(x) = \sum_{i \le k} g_{ik}(n_{i}) / g_{ik}$$
(2)

Here, g is the number of the shortest paths linking two nodes in the network g(n) is the number of shortest path linking two nodes that go through the node n.

3.5.3. Closeness Centrality

An actor is considered important if he/she is relatively close to all other actors. It considers the sum of geodesic distance between a given node and rest. For the network with g nodes, the closeness centrality of node n(i) is defined as following,

$$C_{c}(n_{i}) = [\sum_{j=1}^{g} d(n_{i} - n_{j})]^{-1}$$
(3)

Where, d(n(i)-n(j)) is the number of edges in the geodesic linking n(i) and n(j).

4. Aims and Objective of Social Network Analysis

The main objective of Social Network Analysis process is given as-

- a) Collecting information about relationships within a defined group or network of people.
- Identifying the target network (e.g. team, group, and department).
- Formulating hypotheses and questions
- Outlining and clarifying objectives and the scope of analysis.
- Interviewing individuals in the network to identify relationships and knowledge flows.
- Determining the level of reporting required.
- Developing a survey methodology and the questionnaire.
- b) Mapping out the network visually: mapping responses either manually or by using a software tool designed for the purpose.
- c) Generating a baseline through the analysis of data from the survey responses.
- d) Using this baseline for planning and prioritizing changes and interventions to improve social connections and knowledge flows within the group or network.

5. Need and Application of Social Network Analysis

Social network analysis methods facilitate some useful concept for addressing many levels of large social networks. At the analysis level social networks are seen as graph having nodes representing actors and edges as links between them. Therefore structural and statistical properties of graphs can be directly used to draw useful inferences as the outcome of the analysis. There are many applications of analyzing social network. For example, examining network of farm animals ,to analyze how disease spread from one cow to another, discover emergent communities of interest among faculty at various institutions, some public sector uses include

development of leader engagement strategies, analysis of individual and group engagement and media use, and community based problem solving etc.

6. Conclusion

Social networks are becoming an integral part of people's lives. Students are spending much time on social media and are considered the largest category that uses such application. Social Network Analysis is an emerging technique for the analysis of relations data. Applications in the field of business and economics.

- Interpersonal relations.
- > Inter organizational relations.
- > Marketing applications: product and customer network.

Future research is encouraged to improve the instrument used and to reshape the dimensions that constitute the influence of face book on students' performance. A more comprehensive model might serve the purpose of research and conceptualize the issue related to performance. Also, a larger sample might serve better the large item size. Finally, this study is confined to the sample used; a different sample (males, other school levels, university students, or other demographic factors) might improve our understanding of this area.

References

- Wasserman, Stanley; Faust, Katherine (1994). "Social Network Analysis in the Social and Behavioural Sciences". Social Network Analysis: Methods and Applications. Cambridge University.
- [2] Freeman, Linton C.; Wellman, Barry (1995). "A note on the ancestoral Toronto home of social network analysis". Connection.
- [3] Levy, Judith and Bernice Pescosolido (2002). Social Networks and Health. Boston, MA: JAI Press.
- [4] L. Akoglu and C. Faloutsos, "Event Detection in Time Series of Mobile Communication Graphs," 27th Army Science Conference, December 2010.
- [5] M. Lahiri and T. Berger-Wolf, "Mining Periodic Behaviour in Dynamic Social Networks," Proceedings of the 8th IEEE International Conference on Data Mining, 2008, pp. 373–382.
- [6] K. Carley, "Dynamic Network Analysis," Dynamic Social Network Modelling and Analysis:
- [7] M. Rosvall and C.T. Bergstrom, "Maps of Random Walks on Complex Networks Reveal Community Structure," Proceedings of the National Academy of Sciences, vol. 105, no. 4, 2008, pp. 1118–1123
- [8] J. Shi and J. Malik, "Normalized Cuts and Image Segmentation," IEEE Transactions on Pattern Analysis and Machine Intelligence, vol. 22, no. 8, 2000, pp. 888–905.

Impact of Fog and Cloud Computing Applications to Reserve a Seat in Railways

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Abstract

As India's largest employer has gone digital, this is the beginning of mass acquisition in a new dimension. Indian Railways serves on a peripheral scale in the size of each aircraft. It carries 23,000 passengers and over 3 million tonnes daily, with more than 12,000 passengers traveling at 115.000 km and 7000 stations. But as the nation's largest employer has begun to digitalize its services operations, it is beginning to gain mass in an emerging dimension. The network collects around 100 datasets per user (one truffle is enough to store 500–1000 movies). This passenger booking plate has 25 million users, leading to approximately 800,000 daily transactions. Such is the creation of a digital scale railway ecosystem, a fertile ground for entrepreneurs, employers and large scale technology for testing and testing. And while Railways has made a good start by integrating third parties with third parties, the company can create a seamless experience in booking, payment and other services at the top of the railway data pipeline. Here we have several ways to verify a passenger or passenger ticket, which will be discussed one by one on Fig.1. We understand here that the N computer system (server) is available in the availability center and the availability train provided by the NECC (North Eastern Carrying Corporation Ltd). Each seat or chair acts as a spring (Smart) chair, which means that we are connected to a ticket scanner or chair that can scan tickets and send the actual data to the field node (fog node). Later, the latest analysis will result in the proposed data and the final data that will be sent to the cloud. We are connected to multiple devices to share real-time data and updated real-time data on the cloud. We have created a fog environment and a cloud environment. We have implemented this with the help of clipping and sending data by sending real data separately. We have created a smart gateway between military (Servers) and customer (sensor), cloud and customer (sensor). In this paper, there is the solution that can enhanced the chances of getting confirm ticket, based on individual server load in coaches of the train, according to the increase in the number of sensors request, in the context of processing and considering three cases, it is an answer by analysing cloud-fog scenario. Up to this implementation the simple round robin algorithm is also used solution for load balancing purpose. The method is implemented by using a class student attendance system in a college level.

Keywords: Student Attendance, Data Pipeline, Cloud Environment, Fog Environment, Sensors.

1. Introduction

Indian Railways (IR) is a government owned Railway Company in India. Indian Railways recently monopolized the country's rail transportation. It is one of the largest and busiest railway networks in the world and carries more than 6 billion passengers and about 750 million tons of cargo each year. IR is the world's largest commercial or public service Employee Eastern Corporation with more than 1.6 million employees. Many public or private services have gone online. Nowadays, people can get services, interact, and get information by online. More and more Internet users
are inspiring a lot Government-owned agencies for previous traditional changes Service in electronic standard [1].

In India or in any developed country there are already many techniques or solutions that have been implemented to solve the different problems that are occurring during reservation of the tickets for the passengers. As India's largest employer has gone digital, this is the beginning of mass acquisition in a new dimension — data. Indian Railways operates on a staggering scale in every vibratory dimension. It carries 23.3 million passengers and 3.5 million tons of cargo every day, deploying over 12,000 trains at 116,000 km and some 7,100 stations. But as the nation's largest employer begins to digitize parts of its services operations, it is the beginning of a mass acquisition in an emerging dimension - data. The network collects about 100 terabytes of consumer data per year. Its passenger booking platform has 25 million users, making about 800,000 daily transactions. Such a digital scale is making the railway ecosystem a fertile ground for deploying and testing entrepreneurs, innovators and large-scale technology. And while railways have made a good start by teaming up with third parties, there is a lot more to be done before companies can build a seamless experience in booking, payment and other services at the top of the railway data pipeline.

In this paper, we are giving solutions by assuming fog and cloud applications to increase the chances of confirmed tickets by using the method of a class student attendance system in a college or university. We will consider three cases and give solution. It will be discussed one by one. With this project there is a research report for reservation confirming tickets for railways.

1.1 CHOOSING THE TRAIN ROUTE



Figure 1. Routes followed by the trains

The diagram above shows the specific route for a train. It shows the number of stations that go to the source destination by railway route traffic. When booking tickets, a person can choose any boarding station. Therefore, a person has several options to choose a boarding and leaving point and can travel on their own.

1.2 CLOUD ENVIRONMENT

This is the latest trend in information technology. The "smart" object counts on the World Wide Web, because it does not concern the management and management of all resources. Product resources provide customers with management and management of resource environments. The customer is solely responsible for the cost of using the service and this type of service is called personnel use in cloud computing.

With this concept of cloud computing, smart devices can become the interface for big data centers. Cloud is an extended form of distributed computing environment [7], and [8]. In this paper we present the solution for increasing the chances of confirm ticket by taking quick response from the fog devices on cloud environment and analysing the data on the cloud means on the central server station.

We have implemented the load balancing algorithm with respect to response time of each fog node. After this, Section II presents fog computing based smart communication. Section III is on our work progress. After this we conclude this paper in section IV. Cloud environment is created by using cloud Google by creating VM instances, which is shown below Figure 2.

	Name ^	Zone	Creation time	Machine type	Recommendation	Internal IP	External IP	Connect	
2	instance-	australia- southeast1-b	5 Apr 2019, 17:47:43	1 vCPU, 3.75 GB		10.152.0.2 (nic0)	35.197.162.53 Ľ ⁷	SSH 🔹	:

Figure 2. Cloud Environment

1.3 Fog Environment

The fog computing [6] captures steam as a modern term in the technology world, often used in contrast to cloud or mislabelled edges, two of which have topography: either the computer is on edge or the computer cloud. Is in The easiest way to understand what it is to be rational in fog. In a bright environment, sensors or devices can be everywhere, from the cloud to the cloud and anywhere in between. In some cases, you are programmed to be anti-system administration. This is not the case. Therefore, the administration that was sent to cloud today can be identified tomorrow. It is important to have a structure that affects a large biological community of assets. This processing enhances the use of assets that allow photos to be used anywhere from one location to another for benefits, which may be speed, ease of access, data transmission efficiency, Consistency and cost. The adverts have helped us come together in our daily lives and with special processing power and give you all the ability to use it for a small fee in the area, and the fist of the stars. The term computer is calculated to show different things, so if you want to take advantage of it, you have to make sure it meets all the standards. This has to be:

a. Providing a range of processing power that covers the continuity of cloud conditions

In the current cloud-based antitighting framework, a significant portion of user power is organized in the older cloud. With related components, it is estimated to achieve 20 billion by the end of two years and results in an estimated travel speed, with an increase of two years. Along these lines, devices have increased after discovering the power needed to find it, which is obtained through command entry. Edge includes a regularly rendered server, often referred to as "edge-of-thecenter", close to children to take care of severity like basic adaptive situations due to low information and information transmission is.

Because all ready data can be used to handle fraud, including PCs that are geographically most appropriate, they can also provide low latency calculations, and edge preparation can be used for unclear reasons. Is like a constant victim. Together with these lines, articulation 'edge' and 'fog' are used as synonyms as often as possible. Little attention is paid to edge counting - this is just one element of the more widespread fog count. Computer edge computing is an effective way to reduce bandwidth and bandwidth utilization of high-traffic technologies such as IP, but services provided at any point in a particular business or home vary in performance, scalability, uptime, and cost. There are different requirements that an "edge node" cannot solve.

An efficient fog computing infrastructure must be geographic to allow for edge-based computing and cloud-based cloud computing, and a range of resources ideally for flexibility and flexibility. As long as the hardware used is not just a component of a very wide spectrum of resources, it is not a fog.

b. Use flawless computing resources based on interest

The fog count not only encompasses more important geology than cloud or edge; However, that topography can be dynamic. Information about managing your computer can be located anywhere, and its area may change constantly. This is done through the administration of rationalism. For professionals sending product benefits, this means that they indicate that the administration needs to go into fog engineering, not where it will be done. For example, if low inactivity is a prerequisite, the administration will naturally be directed towards the best available

compliance, whether it is a server in a similar room, a provincial data center, or, if nothing is faster, perhaps a Cloud Data Center.

Being able to broadly specify business conditions using fog computing can make architects' lives a lot more complex by reducing the need for provisioning, scaling, and continuous computing facilities. In certain stages of fog remediation, engineers basically require each administration to organize major events such as low latency, lost costs or environmentally friendly power consumption, so the platform will send administration to computers that demand but will meet these criteria.

2. Foundation and Related Work

The railroad has been spotted in many systems of ticket validation, so asking for a location is not news. A great deal of research is currently underway. Reservation is not just new to the railway. It is a flowing and old place for research for some people, in other places like aircraft, transport, etc.

Likewise, the concept of "fog" and "cloud" computing is not new these days. Many researchers have explored many uses of the fog environment in many areas. Mohammad Aazam, Sherali Zeadally, Khaled A. Harras[2] proposed that the digital world is expanding rapidly and moving into 4G Long Term Revolution (LTE), Wireless Broadband (WiBro), Low Power Broadband Network (LPWAN), 5G, Lifi and so on network services - All these have led to sophisticated services. The number of online applications is increasing as more computing, communication, and intellectual capabilities arise.

For many applications, they required remoteness to work on behalf of the user device and return results. This is often referred to as "offloading" where tasks are outsourced and performers work together to achieve the ultimate goal of the program. Task migration is attractive to emerging IoT and cloud computing applications. This can be between IoT nodes, sensors, edge devices or fog nodes. Unloading can be done based on a variety of factors including program computing requirements, load balancing, power, delay management, and so on. They have recently introduced a classification scheme for loading schemes that have been proposed for areas such as fog, cloud computing and the Internet.

T. Kakagi proposed [13] that The "Reservation-Compulsory Commuting Railways" is a concept that the authors propose to eliminate in trains. Congress-free citizenship can be realized through a "reservation-mandated" policy in the railway system's ultra-high frequency functions and ability to control the behavior of passengers. Although to make the most of the capacity, the ticketing system needs to be extremely "flexible" in terms of securing and problem-solving, which is set management for travelers who are not secure in services at any given time. Can be changed. In this article, the author discusses these requirements of the ticketing system, in which, by discussing the concept of a primarily existing ticketing system and the IPASS ticketing system, the "flexibility" for understanding the mainstream railways of the reservation is by the author. Is offered. As an "ideal system" in the 1990s.

Amir Vahid Dastjerdi and Raj Kumar Buyya, University of Melbourne [3], propose The Internet of Things (IoT) may additionally require improvements to improve the quality of the genre, although it produces a wealth of information that is difficult for classic systems, the cloud, as well as its components. The Fog is designed to overcome these obstacles.

Inayat, Z. Gani, A. Anuar, N.B. Anwar, S.; Khan, M.K [4] propose Mobile Medical Computing (MCC) allows smart cellular devices (SMDs) to gain access to cloud resources, so that data can be intercepted from smart phones and gather predictive predictions for application processing. - Basics solely talk about infrared assets within the MMC of IRRS and within the GMC infrastructure.

Wildlife is needed as a possible answer to potential problems. Researchers, academics, security administrators, and cloud-based services for cloud service supervision provide the framework, framework, for SMDs to work with cloud-based DRRS-assisted negotiation status. , To find

requirements and protocols. It provides complete details of IDRS in PMS MDR and HD and its importance in the birth of MCC.

3. Research Method

3.1 Smart Chair or Door and Load Balancing



Figure 3. Load Balancing Algorithm

Creating a balance between phase calculations is an early topic that requires research and study. The data center [12] is designed with multiple systems, where balancing is an easy task especially for promotion computing. Most of the research has been done in a research environment. The use of semi-distributed load balancing in cloud computing has not been discussed in any literature, where physical distribution is already on the list on physical computing. Using the semidistributed equilibrium method we can create a new algorithm for fog computing. We have used some algorithms to load on a Boog server via smart gateways, as well as separate

data from consecutive numbers or combinations of different routes in a smart chair.

A SMART CHAIR or SMART DOOR SYSTEM



Figure 4. Smart Chairs

Figure Figure4 above shows the smart chair or currency system. These smart chair or cars are connected or connected to a scanner ticket machine like a sensor; data is collected from these sensors and sent to the cog nodes present in each train coach. The data is now sent to the cloud or central node of each railway station's station. Send the data through a custom gateway where the balancing act works, prioritizing critical data that already indicates an analysis of the central area of the railway or we can say on the cloud.

This paper proposes to increase the likelihood of validating a ticket, ticket for travellers, using a better weight balance for some computers, which is implemented in each central node of the cluster. Figure 3 shows the load balancing algorithm as per the implementation of the environment.

3.2 Class Student Attendance System

This method treats the attendance of the students present in the railway coach in the same way as the college student attendance register. When a passenger in the coach enters through the smart chair or smart door and this data is sent to the fog server and the fog server for the fog nodes, it then sends the updated data to the cloud for further analysis. The figure 3 above in section 3.1 illustrates this scenario.

4. Result and Discussion



Figure 5. Implementation of the work

The work presented is to create the environment mentioned above. In this environment, System 1 displays the number of cisens or applications, while System 2 displays the smart gateway. System 1 continuously sends data to the smart gateway, the gateway line continuously transmits both cloud and military. The present result is based on actual implementation work in this paper. For this task, the Python Socket programming language is used. And cloud server is built using Google. Google Cloud SS cell is built.



Figure 6. Network, processing, total delay in cloud environment, when bandwidth 1000Mbps.

On seeing the Figure 6, it is conclude that there are some results i.e. network delay, processing delay and total time delay. Here vertical line shows the time taken in millisecond and horizontal line shows the continuous data of total 1025 records in excel file. In figure Figure 6, network time is beneath 8 millisecond averagely. Processing time is below 2 millisecond averagely and total time is around 9 millisecond. When considering bandwidth 1000 Mbps.



Figure 7. Network, processing, total delay in cloud when Bandwidth 10Mbps

In this Figure 7, the average network delay time is 20 milliseconds. The processing time is almost same i.e. 0.04 milliseconds. The total time is averagely 20.04 millisecond. When bandwdth condering 10 Mbps.

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Figure 8.Network delay, processing delay and Total delay in local fog.

On analysing this Figure 8, the time taken by the fog averagely in a network are 1.5 milliseconds while processing time in the cloud is approximately 0.04 millisecond and the total time both of them is expected 1.54 milliseconds. When considering bandwidth 1000 Mbps.

In the wake of investigating the over three graph, the conclusion is that fog is only it is the allinclusive type of cloud. Fog works same as cloud for same information, yet it relies upon some circumstance. Here the system distinction will clearly less however processing time is more than cloud, so on the off chance that it can take care of the issues at the fog level,fog processing is useful for better outcomes. For this,there is an existing round robinalgorithm of each fog node.

Following are the some results based on real time data, by considering simple round robin algorithm and weighted round robin algorithm. Figure 8, Figure 9, and Figure 10 shows the results of simple round robin algorithm, while Figure 11, Figure 12, and Figure 13 shows the results of weighted round robin algorithm. Figure 8 shows the network delay(expected average 4.68) in simple round robin algorithm, Figure 9 shows the processing delay(expected average 0.49) in simple round robin algorithm, Figure 10 shows the total delay(expected average 4.69) in simple round robin algorithm, Figure 10 shows the network delay(expected average 4.69) in simple round robin algorithm, Figure 11 shows the network delay(expected average 3.54) in weighted round robin algorithm, Figure 12 shows the processing delay(expected average 0.0095) in weighted round robin algorithm, and Figure 13 shows the total delay(expected average 3.55) in weighted round robin algorithm.

The above results are taken by considering one local loopback server within smart gateway, one local fog node and one cloud(ssh cloud.google) environment only.







Figure 10. Processing delay in simple round robin algorithm



Figure 11. Total delay in simple round robin algorithm





Figure 12. Network delay in weighted round robin algorithm

Figure 14. Total delay in weighted round robin algorithm

5. Conclusion

This paper shows the few conclusions based on the real time data. Here, processing time is taken during the some calculations on the fog as well as on the cloud. When data is collected on the fog node from the various sensors, some calculation takes the processing time. This shows the how many tickets have been scanned at what time and how many not. Presence of the ticket shows the presence of the passengers and vice versa.

The conclusion table (Table 1) is given in section 5 of this paper. This table is considering table only, not the real tested means not in railway coach. While, all the scenario is real implementation. Figure 1 shows the result with respect to Cloud environment, the time taken by the cloud averagely in a network are below 1.5 milliseconds while processing time in the cloud is approximately 0.02-0.03 millisecond and the total time both of them is 1.4 milliseconds. Figure 6 shows that, the time taken in system is 15 ms to achieve cloud. While, the processing time in cloud is between 0.02-0.03 ms, and the total time is averagely 14 ms Figure 7 shows that, network time is beneath 4 ms averagely. Processing time is about 1.4 ms averagely and total time is around 5 ms. By analyzing these three figures we can say that in cloud total delay in Figure 1 is less than the total delay in local fog in Figure 5. So cloud may be the best solution for the requiring data, but when there is the decrement in the bandwidth up to 10mbps from 100mbps, then fog is the solution for better response by comparing with Figure 3.Fog is not the total replacement of Cloud but it is the extended form of cloud computing. When we have implemented simple round robin algorithm and weighted round robin algorithm, we see that weighted round robin algorithm is better than all other algorithm implemented only in this paper. In the future, we plan to study an optimized (or near optimal) cooperation probability tuning algorithms. And want to merge least connection and least response time algorithm together.

Finally, we can conclude that if we implement the scenario like above, we can definitely increases the number of confirmed ticket.

Train Numb er	Tota I Seat s in Trai n	Total Confirm ed Allotted Seat	Total Seat Covered By Passenger			seat by passenger due to any reason			Seat Can be given to the passenger who are in queue		
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)		100	0	0	0	0	0			
			0	99	0	0	1	0			
			0	0	99	0	0	1			
12345 68	100 (say)	00 100 say (say)	100	0	0	0	0	0	2		
			0	99	0	0	1	0			
			0	0	99	0	0	1			
			100	0	0	0	0	0			
12345 69	100 (say)	100 (say	5 100 (say	100 (say)	100	0	0	0	0	0	2
)	0	99	0	0	1	0			
			0	0	99	0	0	1	Total Seat=2+2+		
				100	0	0	0	0	0	2=0	

Table 1.Real Time Data on the fog and cloud

The above table (Table 1) shows the three cases:

Case1: it shows the 100% covered seat by passengers

Case2: it shows the seat covered by passenger at the source station due late of the passenger. Case3: it shows the seat covered by the passenger after leaving the source station and middle of the destination station.

So conclusion is that by applying the above approach we are getting the chances to get the blank seat that can be given to the others who are in waiting queues.

References

[1] Nur W. Rahayu; Dhery D. Andika (ICCOINS_2014. 6.3-5), "Assessing the Quality of Rail Ticket Reservation Systems: Cases from Indonesia" IEEE Xplore, pp 1-5, IEEE, June 2014.

- [2] Mohammad Aazam, Sherali Zeadally, Khaled A. Harras, "Offloading in Fog Computing for IoT: Review, Enabling Technologies, and Research Opportunities", Future Generation Computer Systems, volume-87, Pages 278-289, Elsevier, October 2018.
- [3] Dastjerdi, A.V., Buyya, and R., "Fog computing: Helping the Internet of Things realizes its potential." IEEE Journals, Volume: 49, Issue: 8, Pages 112-116, August 2016.
- [4] Inayat, Z.; Gani, A.; Anuar, N.B.; Anwar, S.; Khan, M.K.: "Cloud-based intrusion detection and response system: open research issues, and solutions", Arab. J. Sci. Eng., Volume: 42, Issue: 2, pp.399–423, Springer Berlin Heidelberg, 27 March 2017.
- [5] Mohammad Aazam, Eui-Nam Huh, "Fog Computing: The Cloud-IoT/IoE Middleware Paradigm", IEEE Potentials, vol. 35, issue: 3, May 2016.
- [6] Mohammad Aazam, Eui-Nam Huh, "Fog Computing and Smart Gateway Based Communication for Cloud of Things", in the proceedings of 3rd IEEE Future Internet and Cloud (FiCloud), Barcelona, Spain, pp: 464-470, 27-29 August, 2014.
- [7] Gred Kortuem, Fahim kawsar, Daniel Fitton, and Vasughi Sundramoorthi, "Smart Objects and Building Blocks of Internet of Things", IEEE Internet Computing General, volume 14, issue 1, pp. 44-51, Jan.-Feb., 2010.
- [8] Shuai Zhang et. Al., "Cloud Computing Research and Development Trend", in the proceedings of International Conference on Future Networks, IEEE Computer Society Washington, DC, USA, Pages 93-97, 22-24 Jan., 2010, Sanya China.
- [9] Y. Jadeja, et. al., "Cloud Computing Concepts Concepts, Architecture and Challenges", in the proceedings of International Conference on Computing Electronics and Electrical Technologies, 21-22 March, 2012, Nagercoil, India.
- [10] Jayavardhana Gubbi, Raj Kumar Buyya, Slaven Marusic, and Marimuthu Palaniswami, "Internet of Things (IoT): A Vision, Architectural Elements, and Future Directions", Technical Report CLOUDS-TR2012-2, July 2012.
- [11] M. Jia, W. Liang, Z. Xu, and M. Huang, "Cloudlet load balancing inwireless metropolitan area networks," in INFOCOM 2016-The 35th Annual IEEE International Conference on Computer Communications, IEEE. IEEE, 2016, pp. 1–9.
- [12] W. Yang, M. Hua, J. Zhang, T. Xia, J. Zou, C. Jiang, and M. Wang, "Enhanced system acquisition for nb-iot," IEEE Access, vol. 5, pp. 13 179–13 191, 2017.
- [13] T. Takagi, "Reservation-Compulsory Commuting Railways: Innovation that will be Made Possible by UCRT/IPASS", *Proceedings of COMPRAIL 2018 Conference*, July 2018.

International Journal of Mechanical Engineering

BRAIN TISSUE SEGMENTATION: A REVIEW

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Abstract: Segmentation of brain tissue is a prominent and most critical step of research areas in medical image processing. It is extensively used to measure and visualise the anatomical structures of the brain, to analyse brain changes, to delineate diseased regions, and to design surgical procedures and image-guided therapies. Researchers in the field of medical image processing have previously proposed many approaches with varying degrees of accuracy and complexity. In this review, we have studied the most relevant brain tissue segmentation method and their latest advancement in neuroscience research. The review also presents an effective comparison among the different brain tissue segmentation methods and their methodologies. Furthermore, a review of some of the validation measures used to compare different segmentation algorithms is presented.

I. INTRODUCTION

Medical picture segmentation is the task of segmenting objects in medical picture analysis. Image segmentation performs a central function in medicine, prognosis and Accurate treatment strategy. It is the method of partitioning the brain image into a collection of disjointed locations with comparable characteristics, like intensity, homogeneity, textures etc. in order to extract tissues from a brain image. For carrying out effective Quantitative brain analysis, methods of separating tissues like white matter (WM), Grey Matter (GM), and cerebrospinal fluid (CSF) is commonly employed. It aids in the differentiation of normal tissues from the abnormal ones to identify the disease like type of brain tumor, Parkinson's disease, multiple sclerosis, AD, Dementia, Schizophrenia and Alzheimer's disease [1]-[4]. There are numerous methods for segregating brain tissue have been proposed by researchers in the past and have been successfully utilised for illness Prognosis and therapy planning. Nevertheless, there are many challenges associated with these segmentation methods because medical photograph suffer from many imperfections, such as intensity homogeneity (IIH), noise and dysfunctional tissues with heterogenous signal intensity. Moreover, the effectiveness of brain tissue classification methods is influenced by a number of characteristics, including the tissue border, its size, shape, consistency, and its ambiguous placement, all of which are inherent in the image acquisition modalities [5]-[9].

The study's main contribution is a survey of the most recent brain tissue segmentation algorithms and their present stateof-the-art. The focus of this paper is on three essential features: latest developments in brain tissue algorithms segmentation , and the potential for existing methods to be improved more strong, as well as the unsolved issues. The Dr. Sweta Tripathi

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paper also looks at the difficulties that segmentation algorithm confronts as a result of inherent modality concerns. The benefits and drawbacks of the algorithm tested are summarized in a table to present a well-structured visions . In addition, we've presented and talked about how to quantify conventional validation measures the and the efficiency with which a segmentation approach works. Its usefulness in a variety of situation like their clinical use and hardware implementation is also discussed. The following is a breakdown of the paper's structure. The second section covers the various methods for segmenting brain tissue. The performance indices for computing the algorithm are described in Section III. The Remarks is presented in Section IV and Section V concludes with a conclusion..

II. METHODS FOR SEGMENTING THE BRAIN TISSUE

In this Paper we assess the most frequently used procedure of brain tissue segmentation as well as the current break throughs in these method. We have discussed several segmentation method using 2D and 3D MRI. These brain tissue segmentation method comprises of several standard image processing methodologies such as deformable models (DM), Fuzzy c-means (FCM), region growing, Gaussian mixture model (GMM), etc. and so on. Then, the merits and demerits of the strategies are outlined in table I.

Generally, there are five categories of brain tissue segmentation method which are grouped as follows:

- 1. Manual segmentation
- 2. Region-based segmentation
- 3. Clustering-based segmentation
- 4. Thresholding-based segmentation
- 5. Features extraction and classification-based

A. Manual Segmentation

Manual segmentation is a technique of manually separating pixels in the same intensity range by a human operator (e.g., an analyst or a surgeon). It involves a highly experienced medical professionals multidisciplinary board consisting of trained technologist, radiologist and pathologist. However, this approach has a number of drawbacks, including an blurry boundary, weak tissue contrast,

and shaky hand-eye coordination. With the recent improvement over the past few years, the manual segmentation has become a tedious and time-consuming. The

result of the segmentation method may vary with the expert. Hence this classical and traditional method of highlighting and classifying pixels in the same intensity range is also time taking and prone to errors. Furthermore, Manual segmentation also becomes a challenging task with these newly developed high dimensional and multifunctional imaging techniques.Many automatic approaches are given by the researchers to solve this problem.

One of the most often used methods for automatic brain tissue segmentation is Statistical Parametric mapping (SPM). It is a software packaged created by researchers at the university College London's Wellcome Department of Imaging Neuroscience [10], [11]. Many automatic segmentation methods have an extensive search approach and take a long time to compute. To deal with the problem of exhaustive research, segmentation methods use optimization tool s such as the Genetic Algorithm (GA), Bacterial Foraging Optimization (BFO), Particle Swam Optimization (PSO) and others. Furthermore, Evolutionary algorithm (EAs) can deal with a variety of ill-defined issues in brain tissue segmentation, such as multimodality, discontinuity and noise [11]-[13].

B. Region-based method

Region based segmentation methods rely on the image's intensity homogeneity to determine the object border. The following are the some most common tactics used in this method:

1) An approach based on contour and shapes

2) Region growing

3) Level setting mechanism based on region

4) Graph based method

T1-weighted MR images is used in contour and shape based technique and T2-weighted MR images are used in graph based methods.

1) An approach based on contour and shapes: An initial contour is supplied near to the intended border in the contour and shape-based technique. The approach then changes the contour to bring it closer to the goal border by minimising a predetermined criterion. The DM method is a prominent contour and shape-based strategy. Prior knowledge about the shape of the target object is used in a knowledge-based segmentation method. It all begins with a starting boundary shape that is arbitrary and in the form of a curve Active contours are DMs that deform and develop toward the target boundary. The first DM for recognizing item boundary from an image was proposed by Kass et al. [14]. The contour's deformation is governed by the minimization of an energy function. Internal and external energy terms make up the energy function. The smoothness of the shape is handled by internal energy. The external energy term in the image domain pushes the contour toward desirable qualities like gradient, texture, edge information, and so on. Traditional active contour algorithms rely on gradient data. In this method, The initial contour is drawn near to the object of interest's boundary in this procedure. As a result, there is a lot of external energy, which makes it possible to do things bring the contour closer to the target object's edge. However, The approach is unable to handle the curve's topological alterations. In this case, level set approaches monitor contours and surfaces using parameterized curves [14]-[18]. Mesejo et al. [14] proposed a hybrid level set (HLS) segmentation approach for medical illustrations. The approach integrates prior shape knowledge with both region and edge-based information. In addition, GA calculates the level set's parameters. Furthermore, the shape prior is derived using scatter search.

There are two forms of active contours: parameterized active contours (PAC) and geometric/geodesic active contours (GAC). A parameterized curve in a Lagrangian formulation is described by PAC. The curve's explicit characterisation simplifies user interaction and the declaration of a priori shape limitations. GACs are primarily based on surface evolution theory and geometric flows in the light of the Euler formulation. The approach uses gradient information to define an edge and is able to handle these curves efficiently. First, It starts by creating an initial contour that is near to the intended boundary. Second, it minimizes a boundary-based energy function to construct the contour toward the strongest gradient. This model is implicitly described by a level set of 2-D functions, in which the number of iterations determines the halting criterion [14]–[18].

Furthermore, there are two types of DMs that are based on the feature of the item of interest: edge-feature (EF) and region feature (RF). EFs are the most commonly used approach for segmenting brain pictures into tissues such as WM, GM, and CSF for sickness Prognosis. Edge-detection methods produce arbitrary contour lines around the target object in EFs. Using various similarity measurements, the object of interest is retrieved by combining these contour lines. Edge detectors, on the other hand, rely on image gradient information. As a result, the detectors can only recognize objects in the image domain that are defined by a strong gradient function. The above approaches' performance is greatly dependent on the starting contour's location, edge opening, weak edges, inhomogeneity, and noise. In order to address the aforementioned issues, researchers have included the expectation maximization (EM) method, gradient vector flow, or self-affine mapping system in traditional models. To identify the region of interest, RFs rely on statistical and homogeneity properties (ROI). RFs, unlike EFs, construct the ROI curve using specified region statistics. They are, however, unable to locate object boundaries. Researchers recommended using a priori shape information or statistical information in the energy function to combat RF issues.

Many solutions, including region growth, region-based level set [15], [26]–[28], and graph-based methods [27], [28], rely on statistical estimation of regions or graph theory to overcome the limitations of prior methods.

2) *Growing Regions:* The mechanism for growing regions is determined by the homogeneity and connection conditions. A seed point (pixel) is chosen from each region in the classical approach of region expansion. The pixels in the

immediate vicinity are gathered based on their homogeneity requirements (e.g., intensity similarity). The seed point accumulation procedure continues until the termination condition is met. As a result, a network of interconnected regions emerges. In the segmentation of brain tissue, region growing is a typical approach. The regions of the object of interest are supposed to have the same or slightly varied intensity values to achieve homogeneity. As a result, segmentation performance may be influenced by seed selection and homogeneity requirements. For homogenous MR images, region expanding is usually sufficient. It's also well-suited to medical picture segmentation, as images are largely made up of object and backdrop. Combining the region-growing method with other technologies such as edge detection could be one solution to the problems. In addition, homogeneity criteria for numerous brain lesions have yet to be determined [19], [29]—[31].

3) Region-Based Level Set Methods: To evolve the contour, region-based level set methods rely on the level set. The energy function of the region-based level set approaches is developed using common clustering methods such as kmeans, FCM, and GMM. Chan and Vese [15] proposed the CV model, which is a region-based level set technique. It is based on the concept of deforming the curve enclosing the target object by minimising an energy function. It is suitable for the piecewise constant situation [15] and is based on level set to develop the contour. In [15], the Mumford and Shah functions are derived using k-means in the piecewise (PC) level set approach to solve two homogeneous segments. The multiphase level set algorithm uses the same concept to solve multiple segments. This approach overcomes noise and blurred boundaries. Mandal et al. [13] proposed rewriting the CV model as an optimization problem. To decrease the fitting energy function, the authors employed PSO. Regardless of the starting contour choice, this improved technique can reach global minima [13], [25], [33], [34]. However, the efficacy of this technique degrades when medical images have a complicated intensity distribution. To overcome the estimate of phase value, [44] uses finite mixture models and GMM with the level set approach. The approach estimates the foreground homogeneous intensity distribution as well as the background complex intensity distribution at the same time.

Complex structures can be seen in a lot of medical photos. As a result, the assumption of homogenous intensity for the foreground is no longer valid. Statistical variational models such as shape and extra attributes are used to increase the accuracy of level set approaches. The size, shape, and intensity distribution of tissues and organs would varied greatly amongst patients. As a result, gathering training data with a wide range of variables becomes problematic. As a result, the segmentation accuracy of level set approaches including statistical prior models is limited [21], [36].

4) Graph-Based Approaches: Graph-based methods have recently gained popularity in the field of brain tissue segmentation. Unlike other region-based techniques, they use foreground and background seeds to locate the image's components. When combined with local pairwise pixel similarities, this additional information improves segmentation accuracy when compared to previous approaches [3]. Graph-cut [27] and random walker (RW) [28] are some of the most often used graph-based approaches. Due to noise, complex intensity distribution, and uneven intensity of aberrant tissue, medical images typically have nonuniform foreground and background. The method's performance deteriorates in this case. To accomplish accurate segmentation, Li et al. [18] suggested a coupled statistical and graph (CSG) variational model. The multimodal intensity distribution of foreground and background is estimated using statistical functional analysis. A prior probability map is also used to distinguish pixels with tiny variations. The approach is used to segment tissues in computed tomography and magnetic resonance imaging, as well as to detect tumours. These seed points act as strong constraints for the optimal segmentation results, integrating global information with local pairwise pixel similarities.

C. Threshold-Based Methods

One of the most used segmentation methods is thresholding, in which the target objects are segregated by comparing their intensity values to one or more thresholds. Intensity thresholding is another term for it. Threshold values can be set globally or locally. Fixed thresholding and adaptive thresholding are two types of threshold-based approaches (see Fig. 2). In thresholding-based techniques, T2-weighted MR images are used. Pixels over the threshold level are assigned to a group, whereas pixels below the threshold are considered background in fixed thresholding. In MRI, however, the object of interest is marred by a slew of artefacts. As a result, fixed thresholding-based approaches use criteria including entropy, between-class variance, and others to detect the object of interest.

A single threshold value can be utilised to identify an item from the background when an image histogram is bimodal. It assigns a one to readings above the threshold and a zero to readings below the threshold. A global threshold T segments the image provided as I(x, y) for an image I(x, y).

$$\begin{array}{c}
1, (,) \\
(,) = \{ 0, h \\
\end{array} \tag{1}$$

where pixels with a value of 1 denote an object and pixels with a value of 0 denote a blank space. Such an approach's segmentation

accuracy is heavily dependent on statistical fluctuations. The choosing of thresholds becomes more difficult as the number of regions grows. It should be highlighted that brain tissue segmentation necessitates the segmentation of many tissues (i.e., WM, GM, and CSF).



Fig. 1 Threshold-based Methods in brain tissue Segmentation

Adaptive thresholding is when fixed thresholding adaptively decides the threshold value for the object of interest. The threshold value is determined adaptively by a local neighbourhood surrounding a pixel in this method. The threshold values are frequently estimated using prior knowledge or local statistical features. To compute the threshold value from a T2-weighted MRI, Stadlbauer et al. [37] employed a Gaussian distribution of pixel intensity levels. The value defines a demarcated area that is used to identify diseased tissue . When imaging parameters use spatial information with a priori knowledge, however, they may not perform effectively. Many academics have proposed a thresholding strategy based on geographical information or the maximum entropy principle to reduce the impact of these issues.

Entropy-based, Otsu's approach, and evolutionary-based methods are some of the most common and effective thresholding-based methods for MRI brain tissue segmentation. To derive the appropriate threshold values from the histogram, Kapur et al. [22] proposed maximising of entropy. By maximising the between-class variance of grey levels, Otsu [23] introduced a nonparametric methodology called Otsu's method to identify optimal threshold automatically. With an increase in the number of thresholds, computational time increases in both methods due to the broad search strategy. There are many computational methods that are available in the literature to reduce the computational time [11], [12], [39]-[40].

EAs have recently been combined with thresholding to identify the best threshold values while minimising computational time. Multimodality, discontinuity, time-variance, unpredictability, and noise are examples of ill-defined problem domains that EAs can easily adapt to. Maitra and Chatterjee [35] used BFO in the histogram-based thresholding method to segment a variety of conventional brain MRIs. Manikandan et al. [24] found the optimal threshold values by maximising the entropy using real-coded GA (RGA) with simulated binary crossover (SBX) in multilevel thresholding for segmentation of T2-weighted MRI [11] using real-coded GA (RGA) with simulated binary crossover (SBX) in multilevel thresholding for segmentation of T2-weighted MRI [11].

D. Methods of Clustering

Clustering methods are statistical techniques based on pixels used in brain tissue segmentation. Some similarity measurements, such as distance, connection, and intensity, are used to partition the pixels into groups or clusters in this method. There are two sorts of clustering methods: 1) hard clustering and 2) soft clustering (see Fig. 3). T1-weighted MR images are used in the clustering algorithms.

The first method divides the pixels into clusters by using sharp border values. Hard clustering is exemplified by kmeans. Soft clustering is divided into two types: FCM and mixture models. Pixels are gradually divided in this approach, with a membership function (based on FCM) or an underlying probability (based on mixture models) used to determine whether a pixel belongs to a cluster. The membership function in FCM-based approaches assigns a membership grade value to each pixel, indicating how much it belongs to a cluster. The underlying likelihood of the data clustering into separate groups is assumed to have some distributional form in the mixture models. [4], [70]–[75].



Fig.2 Method of Clustering in brain Tissue Segmentation

TABLE 1

MERITS AND DEMERITS OF THE MOST
COMMONLY USED BRAIN TISSUE SEGMENTATION
METHODS

Name of the	Merits	Demerits
Method		
Deformable	When the contour is	The method's efficacy
Model	initialised close to the	is entirely dependent on
	intended	initial contour location.
	Object boundary, the	Sensitive to images with
	approach delievers	a blurry boundaries that
	good fesuits.	are noisy.
	function controls the	
	contour's	
	Expansion or	
	contraction over time.	
Level set	Cavities, concavities,	Noise, weak borders,
	convolution, splitting	low contrast between
	and merging	sections, misleading
	can all be controlled.	gradients.
	Simple parameter	
	tuning is required.	

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PAC	PACs are efficient models that need basic	PACs are efficient models that need	
	computations.	basic computation	
GAC	GACs have the ability	Sensitive to the	
	to handle topological	placement of the	Graph based
	changes in	beginning of contour.	
	the curve, making		
	them useful for		
	segmenting		
	complex Curves.		
	With the use of		
	level set function,		
	they can detect		Fixed
	interior curves,		thresholding
	cups and		_
	multijunction and		
	other features.		
EF	Deform and move the	Weakly defined edges.	
	curve in the direction	noise IIH computing	
	of the target	complexity are all	
	items limits, local	maior issues. To obtain	
	edge information is	halo free art freetor	
	used.	note -free art-facts, post	
DE		processing is required.	
RF	Capable of	In the presence of	
	and noise issues in	IIH, noise, and	
	EFs.	heterogeneous	
		objects, performance	
		suffers.	Adaptive
Region	The benefits of taking	There are three major	Thresholding
growing	into account both	issues: 1) pixel	
	visual and spatial	processing order; 2)	
	information. It is	automatic selection;	
	impervious to	and 3) regions with	
	changes in the	holes and noise.	
	inner workings,	Furthermore, region	
	resulting in	growth is ineffective	
	closed zones.	when it comes to	
		segmenting several	
		items	Hard
CV model	It's a good way to get	Images with a	clustering
	around the constraints	complicated	
	of edge-based edge-	background and	
	based approaches.	erratic intensity limit	
	be detected hence it	you can do. Only	
	could be utilised for	images with	Soft
	medical imaging with	homogenous regions	clustering
	weak With IIH, a	operate with the	
	piecewise smooth	piecewise constant	
	model could be useful	case. Local minima	
	tor Medical pictures.	are common during	
		contour evolution due	
		to the nonconvex and	
		nonunique structure	
		of the energy	Mixture
		function. This type of	model

		convergence
		frequently results in
		unfavorable
		segmentation results
Graph based	For efficient	Using simply
oraph cased	segmentation.	statistical
	combine global	classification it is
	information	difficult to distinguish
	using local pairwise	
	nixel similarities	pixels with the same
		minimal changes
		between foreground
		or background
Fixed	For photos with	The correlation of
thresholding	homogenous	pixels is not taken
	intensity, high	into consideration in
	contrast, and	this method, which is
	discriminant grey	a fundamental flaw
	levels between object	They also result in
	and background, this	nivel miselessification
	method works well.	pixer miscrassification
	Because of its ease of	uue to noise, IIH, and
	implementation and	tissue Overlapping.
	computing efficiency,	The histogram of the
	it is employed in	image is corrupted by
	brain tissue	these aberrations,
	segmentation.	making segmentation
		with global
		thresholding
		challenging.
Adaptive	When a single	The grey scale
Thresholding	threshold value is	distribution noise
Theoholding	unable to segment or a	multishannal imagas
	threshold value cannot	
	be obtained from an	and images containing
	image's	multimodal regions
	histogram this	all affect the
	approach is chosen	effectiveness of these
	approach is chosen.	1
	This is a quick and	approaches.
	This is a quick and easy way to segment	approaches.
	This is a quick and easy way to segment several items using an	approaches.
	This is a quick and easy way to segment several items using an intensity histogram.	approaches.
Hard	This is a quick and easy way to segment several items using an intensity histogram. Image with	Noise, IIH, and
Hard clustering	This is a quick and easy way to segment several items using an intensity histogram. Image with homogeneous regions	Noise, IIH, and
Hard clustering	This is a quick and easy way to segment several items using an intensity histogram. Image with homogeneous regions is ideal. It's best for	Noise, IIH, and photos with diverse regions make it
Hard clustering	This is a quick and easy way to segment several items using an intensity histogram. Image with homogeneous regions is ideal. It's best for real-time image	Noise, IIH, and photos with diverse regions make it
Hard clustering	This is a quick and easy way to segment several items using an intensity histogram. Image with homogeneous regions is ideal. It's best for real-time image segmentation because	Noise, IIH, and photos with diverse regions make it vulnerable.
Hard clustering	This is a quick and easy way to segment several items using an intensity histogram. Image with homogeneous regions is ideal. It's best for real-time image segmentation because it takes less time to	Noise, IIH, and photos with diverse regions make it vulnerable.
Hard clustering	This is a quick and easy way to segment several items using an intensity histogram. Image with homogeneous regions is ideal. It's best for real-time image segmentation because it takes less time to compute.	Noise, IIH, and photos with diverse regions make it vulnerable.
Hard clustering Soft	This is a quick and easy way to segment several items using an intensity histogram. Image with homogeneous regions is ideal. It's best for real-time image segmentation because it takes less time to compute. It does not use a sharp	Noise, IIH, and photos with diverse regions make it vulnerable.
Hard clustering Soft clustering	This is a quick and easy way to segment several items using an intensity histogram. Image with homogeneous regions is ideal. It's best for real-time image segmentation because it takes less time to compute. It does not use a sharp boundary to separate	Approaches. Noise, IIH, and photos with diverse regions make it vulnerable. Noise and IIH sensitivity. When
Hard clustering Soft clustering	This is a quick and easy way to segment several items using an intensity histogram. Image with homogeneous regions is ideal. It's best for real-time image segmentation because it takes less time to compute. It does not use a sharp boundary to separate the pixels into groups,	Approaches. Noise, IIH, and photos with diverse regions make it vulnerable. Noise and IIH sensitivity. When grouping pixels in the
Hard clustering Soft clustering	This is a quick and easy way to segment several items using an intensity histogram. Image with homogeneous regions is ideal. It's best for real-time image segmentation because it takes less time to compute. It does not use a sharp boundary to separate the pixels into groups, unlike hard clustering.	Noise, IIH, and photos with diverse regions make it vulnerable. Noise and IIH sensitivity. When grouping pixels in the image domain no
Hard clustering Soft clustering	This is a quick and easy way to segment several items using an intensity histogram. Image with homogeneous regions is ideal. It's best for real-time image segmentation because it takes less time to compute. It does not use a sharp boundary to separate the pixels into groups, unlike hard clustering. To cluster the pixels, it	Noise, IIH, and photos with diverse regions make it vulnerable. Noise and IIH sensitivity. When grouping pixels in the image domain, no spatial information is
Hard clustering Soft clustering	This is a quick and easy way to segment several items using an intensity histogram. Image with homogeneous regions is ideal. It's best for real-time image segmentation because it takes less time to compute. It does not use a sharp boundary to separate the pixels into groups, unlike hard clustering. To cluster the pixels, it defines a membership	Noise, IIH, and photos with diverse regions make it vulnerable. Noise and IIH sensitivity. When grouping pixels in the image domain, no spatial information is
Hard clustering Soft clustering	This is a quick and easy way to segment several items using an intensity histogram. Image with homogeneous regions is ideal. It's best for real-time image segmentation because it takes less time to compute. It does not use a sharp boundary to separate the pixels into groups, unlike hard clustering. To cluster the pixels, it defines a membership function.	Noise, IIH, and photos with diverse regions make it vulnerable. Noise and IIH sensitivity. When grouping pixels in the image domain, no spatial information is taken into account.
Hard clustering Soft clustering	This is a quick and easy way to segment several items using an intensity histogram. Image with homogeneous regions is ideal. It's best for real-time image segmentation because it takes less time to compute. It does not use a sharp boundary to separate the pixels into groups, unlike hard clustering. To cluster the pixels, it defines a membership function.	Approaches. Noise, IIH, and photos with diverse regions make it vulnerable. Noise and IIH sensitivity. When grouping pixels in the image domain, no spatial information is taken into account. Further, because to bad
Hard clustering Soft clustering	This is a quick and easy way to segment several items using an intensity histogram. Image with homogeneous regions is ideal. It's best for real-time image segmentation because it takes less time to compute. It does not use a sharp boundary to separate the pixels into groups, unlike hard clustering. To cluster the pixels, it defines a membership function.	Approaches. Noise, IIH, and photos with diverse regions make it vulnerable. Noise and IIH sensitivity. When grouping pixels in the image domain, no spatial information is taken into account. Further, because to bad initialization, it yields a
Hard clustering Soft clustering	This is a quick and easy way to segment several items using an intensity histogram. Image with homogeneous regions is ideal. It's best for real-time image segmentation because it takes less time to compute. It does not use a sharp boundary to separate the pixels into groups, unlike hard clustering. To cluster the pixels, it defines a membership function.	Approaches. Noise, IIH, and photos with diverse regions make it vulnerable. Noise and IIH sensitivity. When grouping pixels in the image domain, no spatial information is taken into account. Further, because to bad initialization, it yields a local optimal solution.
Hard clustering Soft clustering Mixture	This is a quick and easy way to segment several items using an intensity histogram. Image with homogeneous regions is ideal. It's best for real-time image segmentation because it takes less time to compute. It does not use a sharp boundary to separate the pixels into groups, unlike hard clustering. To cluster the pixels, it defines a membership function. Analyze an image	Noise, IIH, and photos with diverse regions make it vulnerable. Noise and IIH sensitivity. When grouping pixels in the image domain, no spatial information is taken into account. Further, because to bad initialization, it yields a local optimal solution. Within a class, there is
Hard clustering Soft clustering Mixture model	This is a quick and easy way to segment several items using an intensity histogram. Image with homogeneous regions is ideal. It's best for real-time image segmentation because it takes less time to compute. It does not use a sharp boundary to separate the pixels into groups, unlike hard clustering. To cluster the pixels, it defines a membership function. Analyze an image statistically. By	Noise, IIH, and photos with diverse regions make it vulnerable. Noise and IIH sensitivity. When grouping pixels in the image domain, no spatial information is taken into account. Further, because to bad initialization, it yields a local optimal solution. Within a class, there is no spatial relationship

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	modelling the intensity	between nearby pixels.
	variation of each tissue	this leads to a local this
	type as a Gaussian	leads to a local
	distribution, they can	ontinum
	handle bias field	optimum.
	correction and spatial	
	regularisation in the	
DUT	immediate region.	Q
DWT	Capable of analysing	Sensitive to time shifts,
	an image at different	lack of directionality,
	the sharpness of the	and phase information.
	edge Provide useful	To increase
	information about a	performance its
	signal's localised	common to include a
	frequency, which is	dimension reduction
	useful for	reduction strategy.
	classification.	Complexity of
		computation is high
Gabor filter	Local visual properties	The choice of scale
Subor miller	such as orientation.	and direction is made
	spatial Frequency	on trial and array
	(scale), and	basis Ac a result
	localisation can be	bigh dimensional
	captured.	nign-dimensional
		feature vector is
		produced. It
		necessitates a big
		amount of memory.
		Complexity of
		computation is high.
Statistical	Take a look at the	Sensitive to visuals
features	pixels' interrelation.	with a wide range of
Extraction	Capture local picture	intensity levels. The
Method	teatures that can be	location, size, shape
	used to distinguish	and texture of tissues,
	from normal tissue	as well as the unclear
	such as brain tumour	tissue boundaries and
	tissue. Computational	noise inherent in MR
	complexity is reduced.	images, all affect
	1 2	performance.
KNN	It's a classifier that's	The response time
	based on instances. In	for large datasets is
	the training photos, it	extremely long
	is capable of	Unwanted features
	preserving	are consitive as their
	information. Simple to	contribution to
	implement.	contribution to
		misclossification
4 N TN T		miscrassification.
ANN	ne most widely used	Computational
	algorithm The	complexity and
	processing elements	response time are
	are organised in a way	both high.
	that resembles the	
	human brain. Capable	
	of performing	
	effectively in non	
	linear domains that are	

	multivariate. In contrast to statistical models, ANN does not require data allocation	
SVM	In high-dimensional feature space, this is the most common choice. High generalisation ability.	It necessitates a significant amount of training time. It necessitates a lot of storage space. Patient-specific education

SPM, a specific software for brain tissue segmentation based on mixture models, has been reported in the literature. It's capable of jobs like skull stripping, bias field correction and automatic segmentation. Brain tissue SPM segmentation can be done in three different ways:

1) segmentation by default;

2) SPM8-based segmentation;

3) a new design that incorporates a hidden Markov random field (HMRF)

The SPM programme has been widely used in the neuroimaging field to do automated functional and structural brain image analysis. However, there are few studies comparing the software's segmentation accuracy to other approaches for segmenting GM, WM, and CSF [10]. Furthermore, the involvement of a domain expert may be beneficial when developing any advanced programme for better brain tissue segmentation outcomes.

1) FCM: Out of all the soft clustering algorithms, FCM is the most common, as it assumes that image pixels (or voxels) belong to many clusters. A similarity criterion is used to divide pixels into clusters. As a result, it might not be suited for segmenting pictures that have been tainted by noise and artefacts, such as IIH or the shading effect in MRI. As a result, various modified FCM methodologies [50]–[52] have been proposed in the literature to aid in the preparation of FCM for better tissue segmentation.

Researchers also employed a multiplicative bias field (i.e., Bspline surface) to represent the intensity nonuniformity (INU) effect and a dissimilarity index for spatial voxel connection to suppress the INU effect. The approach efficiently segments noise and INU-affected brain MRI. Chuang et al. [52] presented a weighted membership function for spatial FCM (sFCM).The suppression of INU, the elimination of noisy areas, and the compression of spurious blobs are the key benefits of this technology. It effectively segments T1- and T2-weighted MRI images of the brain. Using wrapping-based curvelet mapping as a preprocessing step to eliminate noise in MRI is one technique to modify sFCM. Using the kernel technique for clustering, fast spatial constraint, fuzzy kernel FCM (FKFCM) maps input data (i.e., pixel intensities) to a higher dimensional space. The MRI segmentation performed

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by FKFCM is satisfactory. The method's strength is demonstrated through studies with synthetic images, digital phantoms, and clinical images influenced by noise.

For robust brain tissue segmentation, many researchers have proposed generalised FCM by modifying its objective function. The effect of IIH caused by the bias field in the MRI is suppressed by bias-corrected FCM. The method alters the goal function and adds a regularisation, allowing for pixel labelling based on its surroundings. It works well for MR pictures with salt and pepper noise, but at the cost of a long computation time. FCM also incorporates a coherent local intensity clustering (CLIC) criterion for smoothness of bias field without any regularisation. This method assumes that local region intensity is coherent and incorporates a Gaussian kernel in the energy function to adjust for bias. The addition of regularisation improves the method's effectiveness even more. CLIC criteria were employed by some studies to convert a multiplicative bias field to an additive form, decreasing complexity at the expense of the partial volume effect (PVE). The nonlocal regularised FCM (NLRFCM) approach preserves fine brain structures by using nonlocal spatial regularisation [50], [52].

Adhikari et al. [4] recently introduced a conditional spatial FCM (csFCM) approach in MRI that is resilient even when there is IIH and noise. To change the membership function of standard FCM, the approach takes into account local intensity relationships between pixels. It also develops membership functions and other clusters using the conditioning variable associated with each pixel. Nonetheless, the existence of significant levels of noise and IIH may result in segmentation that is undesirable. Incorporating geographical information and IIH into the csFCM membership function could be a useful strategy for improving its performance.

To initialise cluster centres in the FCM, many researchers have used EAs like PSO, a probabilistic heuristic algorithm. Benaichouche et al. [53], for example, employed PSO to start cluster centres in FCM and found a global optimum solution. It also makes use of spatial information and Mahalanobis distance to make the method noisy and misclustering resistant. Based on PSO, Mekhmoukh and Mokrani suggested an improved kernel possibilistic c-means (IKPCM). For the initialization of cluster centres and the membership function, the author employed PSO. Different brain tissues are effectively segmented using this procedure.

2) Mixture Models: The intensity values of different substructures and tissues in brain MR images are relatively diverse. Statistical mixture models are used to characterise an image in this case. In this method, parametric models are used to estimate the probability distribution of intensity in a picture using the maximum-likelihood (ML) similarity criterion or the maximum a posteriori (MAP) criterion. GMM is a widely used statistical model in neuroscience. A Gaussian distribution is used to estimate the intensities of pixels (or voxels) in a region in this model. The GMM parameters are then estimated using the expectation maximisation (EM) technique, which maximises the likelihood of the observed image.

Wells et al. [54] suggested an MRI algorithm based on EMbased adaptive segmentation (AS-EM). AS-EM assumed a Gaussian distribution for the bias field and used ML to model it. The model parameters are estimated using the EM algorithm. Guillemaud and Brady [55] proposed a more generalised strategy, taking into account the limitations of [54], such as the number of tissue classes to model, parameter definitions, and tissue spatial information. The approach effectively segments MR images of the brain and breast. The bias field is estimated using an automatic model based on the EM (AM-EM) approach in [56]. The approach divides tissues into WM, GM, and CSF using a digital MRI brain atlas. However, in both of the methodologies mentioned, the estimation of GMM

parameters using EM suffers from a lack of spatial information and segmentation ambiguity. Blekas et al. [58] used prior Gibbs distribution to add spatial information to GMM. They came to the conclusion that regularisation in the GMM might be introduced if the distance function became a discrete total variation. Their method produces a spatially limited GMM that is noise-resistant but lacks bias correction. Greenspan et al. [58] suggested a limited GMM that combines local spatial and global intensity modelling. Liu and Zhang [32] proposed a local GMM that took bias correction and spatial regularisation into account. A Gaussian kernel is used in the goal function for bias correction. Smooth segmentation is achieved by regularising an indicator function. However, their method did not preserve the entire brain structure. Dong and Peng [57] suggested a variational model that combined local GMM with nonlocal spatial regularisation. The authors employed a truncated kernel function in the GMM without any additional limitations to ensure bias field smoothness.

EAs have been employed by a number of academics in model-based methods such as EM-based ML estimation. The goal is to get over their inherent flaws, such as overfitting and the tendency to become stuck in local optima. For likelihood estimation, Tohka et al. [60] presented a GA-EM approach. Local convergence is also a problem with HMRF-EM-based approaches, as previously indicated. As a result, the EAs use the EM algorithm to estimate parameters instead of the traditional method. To estimate the parameters of HMRF, the evolutionary HMRF approach employs EAs such as the clonal selection algorithm (CSA). Both simulated and actual brain MR images can be segmented using this method. A new HMRF-CSA algorithm incorporates both CSA and MCMC to increase the HMRF technique's performance.

E. Classification-Based Methods and Feature Extraction

In brain tissue segmentation, feature extraction and classification approaches are critical. T2-weighted MR images are used. In this method, the main goal of this strategy is to compile a list of the most effective options and identifying characteristics in an MR brain picture. The classification is then based on the discriminating features. Many cutting-edge feature extraction techniques are available in the literature including DWT (Differential Wavelet

Transform) [43], Gabor filter, and several statistical approaches such as grey level co-occurrence matrices, grey level run length matrices, and so on [38]. However, due to abnormalities such as noise, IIH, and others, feature extraction from MR images remains a difficult task. Furthermore, with most feature extraction approaches, high dimensionality is an inherent difficulty. The dimensionality problem is partially solved by principal component analysis (PCA), linear discriminant analysis (LDA), and other techniques. For correct classification, they get a small number of significant features.

The examples of the State-of-the-art classification method are K-nearest neighbours (KNN), support vector machine (SVM), artificial neural network (ANN), self-organizing map. [45] provides a detailed description of their benefits and drawbacks.

The nature of the retrieved characteristics is unaffected by the training process of a classifier in most of the methods mentioned above. Furthermore, for accurate segmentation, most feature extraction approaches require spatial and intensity information. Convolutional neural networks (CNNs) and deep learning have recently gained popularity in the field of brain tissue segmentation [46]-[48]. They omit the explicit demand of spatial and intensity information, unlike traditional feature extraction and classification-based approaches. Convolutional neural networks (CNNs) learn from a series of convolutional kernels. The convolutional kernels are deliberately trained for the classification that is needed. Furthermore, CNNs optimize the kernels based on the training data input. Additionally, geographical and intensity data can be used to distinguish between classes. A CNN-based technique based on baby MRI is proposed in [49]. For segmentation of three tissues: WM, GM, and CSF, the authors used T1-weighted, T2-weighted, and fractional anisotropy images. As part of the medical imaging computing and computer-assisted intervention (MICCAI) competition on multiatlas labelling, In [48], the authors present a method for adult tissue segmentation using T1-weighted MRI. The approaches in

[48] and [49] make use of CNNs, although they don't have any intensity or spatial features. By approximating both spatial and intensity information, this learning approach allows for accurate segmentation of MRI into several tissue classes.

Table I shows the pros and cons of the most regularly used brain tissue segmentation methods.

III. MEASURES OF VALIDATION

We have included some of the most up-to-date validation measures for brain tissue segmentation in this study. Validation of a segmentation method is a required step in determining its effectiveness and limitations. It is also suggested before using a procedure in a clinical setting. Validation of a method, on the other hand, necessitates the collection of data in order to assess its effectiveness. The data used in brain tissue segmentation is a medical brain picture, which might be synthetic or genuine. Here, we'll talk about the differences between synthetic and actual clinical photographs. We've also included a list of some of the most prominent publicly available databases that can be used to validate a segmentation approach.

A. Synthetic Image

Synthetic images are created on a computer rather than with a scanner. The advantage is that the user may set the parameters to create the image they want. For example, three types of MR images are obtained by defining different MR parameter values such as echo time (TE), repetition time (TR), resolution, sequence, noise, and IIH: T1-weighted (T1-w), T2-weighted (T2-w), and proton

density weighted. In addition, a ground truth image is available to compare the segmentation result's efficiency. An MRI simulator can create synthetic images with varying levels of complexity, ranging from piecewise constant to realistic. To test their segmentation method, some researchers employed synthetic brain MR images generated by a simulator.

Because of its simplicity, the most prevalent method of evaluation is synthetic images. Furthermore, the MR simulator's synthetic images may be a useful choice for comparing different approaches. The MR simulator, on the other hand, cannot produce excellent real-world images. Phantoms can be used to generate actual images, although dense ground truth for phantom images is difficult to come [42].

B. Clinical Photograph

Validating segmentation techniques with real-life medical illustration is an crucial element in determining their usefulness. When working with an actual medical record, we must consider the disease's diversity. As a result, data from a sufficient number of patients is collected. Another consideration is the lack of a ground truth picture. Though it is important to assess segmentation performance, it is not necessary to assess a method's reproducibility. The outcomes of fully automated segmentation method are frequently compared to segmentation, however, is limited by a professional. Manual segmentation, however, is limited by a well-known mistake occurred due to variability between and within experts..

C. Databases

There are number of currently accessible standard databases like BrainWeb, IBSR, Harward medical school website, Allen brain atlas etc. These have been used to assess brain tissue segmentation algorithms quantitatively. Figure 3 shows a simulated T1-w MR picture of a person obtained from BrainWeb. The picture is approximately 362 by 362 pixels [see Fig. 3(a)]. The database also includes WM's ground truth photographs of tissues [see Fig. 3(b)], GM [see Fig. 3(c)], and CSF [see Fig. 3(d)].



Fig. 3 Example Simulated T1-w MR image of a subject from Brainweb.

(a)Normal MRI. (b) Segmented WM. (c) Segmented GM (d)Segmented CSF

MR images are also available in the Allen brain database. Experts also used the aforementioned databases to acquire medical brain scans from institutions or by direct scanning. The effectiveness of the proposed segmentation approach for clinical usage is usually tested using real clinical images. Typically, techniques are tested first using simulated data and then with actual data.

D. Indicators of performance

A segmentation approach is validated using performance indices. Before a method may be used for clinical evaluation, it must first be validated. We've included a variety of performance indices for evaluating brain tissue segmentation methods in this part. The effectiveness of the segmentation algorithms is evaluated using no one metric. Different measures used for quantitative assessment of approaches in brain tissue segmentation are the following:

Dice index (DI): It is a quantifiable measure of crossover that is used to assess segmentation procedures. For each type of tissue, dataset, and procedure, DI is determined. It determines how much the segmented picture and the ground truth picture overlap. It is defined as [4]

Partition coefficient (Vpc): Partition Coefficient is a useful metric for determining how fuzzy a partition is. It has a value between 0 and 1, with 1 being the best. The higher the value, the better the performance and the less fuzziness. It is written as

$$= \sum_{n=1}^{\infty} \sum_$$

where represents the weighted membership parameter, C represents the number of clusters, and N represents the number of data structures [4].

Partition entropy (Vpe): Another metric for indicating a fuzzy partition is partition entropy. Vpe's minimal value denotes the Copyrights @Kalahari Journals

best clustering. The best value for Vpe is zero. It is written as [1]



Jaccard index (JI): JI is a criteria for determining how much the segmented picture and the ground picture overlap. A value of 0 signals no crossover with ground truth, whereas a value of 1 signals flawless segmentation.



where S and G are two main parts yielded by the technique and ground truth [41].

Similarity index (ρ): To match the segmented image with reference image, the similarity index is applied. It's described as



where Ai is the number of pixels from segmentation that correspond to cluster Ci, and Bi is the number of pixels in Ci according to ground truth. The range of is [0, 1], with = 1 being the best value [1].

Segmentation Accuracy (SA): Segmented Accuracy is calculated as the measure of correctly identified pixels divided by the total number of pixels in the clustered picture. It's written as

$$= \frac{\sum = (\cap)}{\sum = ()}$$
(7)

where M is a cluster's total amount of pixels, is the amount of pixels in the kth cluster, as determined through segmentation, and is the amount of pixels in the kth cluster in ground picture. The SA's ideal value is 1 [1].

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Tissue segmentation accuracy (TSA): It is described as

= + (8)

where NCTK is the number of pixels accurately designated to tissue k by a particular technique (within the ground truth mask). NCITK is the total number of pixels assigned to tissue k (both in and out of the ground truth mask). The number of pixels in the discrete anatomical representation (the ground truth mask) that correspond to tissue k is NGTK. The recommended TSA value for ideal segmentation is 1 [1].

Uniformity measure (UM): It is a empirical validation used to assess the effectiveness of methods of fragmentation. It's described as

$$=-\times\times$$

$$\Sigma_{\pm}\Sigma \in (-)$$
(9)
$$\times(-)$$

where p is the threshold's quantity, is the image's jth fragmented region, N is the image pixels,

is the pixels' average value in the ^hregion, fmax is the image's maximum grey level, and is the image's minimum grey level.

UM has an ideal value of 1 [24].

False positive (FP) and false negative (FN): The level of misdiagonosis during fragmentation is represented by the false positive (FP) and false negative (FN) results. True positives (TPs) and true negatives (TNs) are also employed in addition to FPs and FNs. The right segmentation is represented by TPs and TNs. In binary fragmentation, sensitivity and specificity metrics are used to assess the impact of FPs and FNs on a method's effectiveness.



Due to IIH, noise, and other artefacts, segmenting cells of the brain including WM, GM, and CSF is a difficult activity. As stated in Section II, several approaches for fragmentation of brain tissues have been explored in the research. Because each method uses a distinct sources, picture type, segregating analysis, and confirmation metrics, comparing them is a challenging and time-consuming operation. MICCAI and the international symposium on bioimaging, for example, run a biomedical imaging competition as part of their symposia. They allow impartial testing of a large variety of techniques on the same dataset. MICCAI's MRBrains 2013, for example, is a current public competition with 37 works that have been ranked [119]. Researchers from all over the world took part in this challenge to evaluate their methods for segmenting cell of the brain (WM, GM, and CSF) using layer up procedures such inversion recovery, T1-w, T2-w and Fluid attenuated inversion recovery (FLAIR). On 15 test datasets, the determinants of performance such as DI, revised Hausdorff distance, and absolute volume difference are used to score all of the approaches. The 3-D deep learning strategy (voxnet1) surpassed all other solutions in terms of total fragmentation outcome and WM fragmentation in the MRBrains 2013 challenge. In terms of GM segmentation, the 3-D deep learning method (voxnet2) surpassed all other techniques. In CSF division, PyraMid-long short-term memory techniques were ranked first. In the case of WM and GM combined fragmentation, ISI-Neonatology produced better results. On cerebral cavity segregation, multilayer gated recurrent units showed remarkable results.

V. CONCLUSION

In recent years, brain tissue segmentation has become a research area. Brain tissue segmentation is important for scheduled medication and confirmation. Neverthless, it is unlikely that subdivision algorithms will be able to substitue professionals in prognosis. They can be used to help professionals by reducing their workload or by providing a second perspective. The research lays out a framework for modern brain tissue segmentation algorithms. The readers may obtain knowledge on cutting-edge technology. The paper makes numerous contributions. Various validation measures are used in a quantitative analysis. This could provide researchers and physicians a better sense of which strategy is optimal for a particular application. To compare and assess the effectiveness of existing methods for fragmenting brain tissue, researchers conducted a study, we offered a comprehensive range of performance indexes as well as several public databases. Besides that, these analogies take each paradigm into account separately in order to determine the optimal strategy. Due to obvious problems in computed topography, the study focuses on the most recent issues in methods of fragmenting brain tissue. They are effective against bias-field and IIH. All available segmentation algorithms are discussed in terms of their benefits and drawbacks. Some of the unsolved issues are also discussed. This could point researchers in the right direction for improving subdivisions of brain tissue for more exact evaluation in the future.

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REFERENCES

[1] S. K. Adhikari, J. K. Sing, D. K. Basu, and M. Nasipuri, "Conditional spatial fuzzy C-means clustering algorithm for segmentation of MRI images," Appl. Soft Comput., vol. 34, pp. 758–769, 2015.

[2] J. Ashburner and K.J. Friston, "Unified Segmentation," *Neuroimage*, vol.26, no. 3, pp. 839-851, 2005

[3] M. M. Eapena, M. S. J. A. Ancelita, and G. Geetha, "Segmentation of tumors from ultrasound images with PAORGB," *Procedia Comput. Sci.*, vol. 50, pp. 663–668, 2015.

[4] L. Yang, O. Tuzel, P. Meer, and D. J. Foran, "Automatic image analysis of histopathology specimens using concave vertex graph," in *Proc. 11th Int. Conf. Med. Image Comput. Comput. Assisted Intervention*, 2008, pp. 833–841.

[5] N.R. Pal and S.K. Pal, "A review on image segmentation techniques," *Pattern Recognition*, vol. 26, no. 9, pp. 1277-1294, 1993.

[6] L. Wen, X. Wang, Z. Wu, M. Zhou, and J. S. Jin, "A novel statistical cerebrovascular segmentation algorithm with particle swarm optimization," *Neurocomputing*, vol. 148, pp. 569–577, 2015.

[7] S. Liao and D. Shen, "A feature-based learning framework for accurate prostate localization in CT images," IEEE

Trans. Image Process., vol. 21, no. 8, pp. 3546–3559, Aug. 2012.

[8] M. M. Fraz et al., "An ensemble classification-based approach applied to retinal blood vessel segmentation," *IEEE*

Trans. Biomed. Eng., vol. 9, no. 9, pp. 2538-2548, Sep. 2012.

[9] Y. Artan, A. Oto, and I. S. Yetik, "Cross-device automated prostate cancer localization with multiparametric MRI," *IEEE Trans. Image Process.*, vol. 12, pp. 5385–5394, Dec. 2013.

[10] K. Kazemi and N. Noorizadeh, "Quantitative comparison of SPM, FSL, and Brainsuite for brain MR image segmentation," *J. Biomed. Phys. Eng.*, vol. 4, no. 1, pp. 13–26, 2014.

[11] H. Gao, W. B. Xu, J. Sun, and Y. Tang, "Multilevel thresholding for image segmentation through an improved quantum-behaved particle swarm algorithm," *IEEE Trans. Instrum. Meas.*, vol. 59, no. 4, pp. 934–946, Apr. 2010.

[12] Y. Li, L. Jiao, R. Shang, and R. Stolkin, "Dynamiccontext cooperative quantum-behaved particle swarm optimization based on multilevel thresholding applied to medical image segmentation," *Inf. Sci.*, vol. 294, pp. 408–422, 2015.

[13] D. Mandal, A. Chatterjee, and M. Maitra, "Robust medical image segmentation using particle swarm optimization

aided level set based global fitting energy active contour approach," *Eng. Appl. Artif. Intell.*, vol. 35, pp. 199–214, 2014.

[14] M. Kass, A. Witkin, and D. Terzopoulos, "Snakes: Active contour models," *Int. J. Comput. Vis.*, vol. 1, no. 4, pp. 321–331, 1988.

[15] T. F. Chan and L. A. Vese, "Active contours without edges," *IEEE Trans. Image Process.*, vol. 10, no. 2, pp. 266–277, Feb. 2001.

[16] M. Jacob, T. Blu, and M. Unser, "Efficient energies and algorithms for parametric snakes," *IEEE Trans. Image Process.*, vol. 13, no. 9, pp. 1231–1244, Sep. 2004.

[17] W. Kim and J. J. Lee, "Object tracking based on the modular active shape model," *Mechatronics*, vol. 15, no. 3, pp. 371–402, 2005.

[18] C. Li, X. Wang, S. Eberl, M. Fulham, Y. Yin, and D. D. Feng, "Supervised variational model with statistical inference and its application in medical image segmentation," *IEEE Trans. Biomed. Eng.*, vol. 62, no. 1, pp. 196–207, Jan. 2015

[19] B. Foster, U. Bagci, A. Mansoor, Z. Xu, and D. J. Mollura, "A review on segmentation of positron emission tomography images," Comput. Biol. Med., vol. 50, pp. 76–96, 2014.

[20] P. Mesejo, A. Valsecchi, L. Marrakchi-Kacem, S. Cagnoni, and S. Damas, "Biomedical image segmentation using geometric deformable models and metaheuristics," Comput. Med. Imag. Graph., vol. 43, pp. 167–178, 2015.

[21] N. Paragios and R. Deriche, "Geodesic active regions: A new framework to deal with frame partition problems in computer vision," J. Vis. Commun. Image Represent., vol. 13, no. 1, pp. 249–268, 2002.

[22] J. N. Kapur, P. K. Sahoo, and A. K. Wong, "A new method for gray-level picture thresholding using the entropy

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of the histogram," Comput. Vis., Graph. Image Process., vol. 29, no. 3, pp. 273–285, 1985.

[23] N. Otsu, "A threshold selection method from gray-level histograms," Automatica, vol. 11, pp. 23–27, 1975.

[24] S. Manikandan, K. Ramar, M. W. Iruthayarajan, and K. G. Srinivasagan, "Multilevel thresholding for segmentation of medical brain images using real coded genetic algorithm," Measurement, vol. 47, pp. 558–568, 2014.

[25] L. A. Vese and T. F. Chan, "A multiphase level set framework for image segmentation using the Mumford and Shah model," Int. J. Comput. Vis., vol. 50, no. 3, pp. 271–293, 2002.

[26] C. Li et al., "A likelihood and local constraint level set model for liver tumor segmentation from CT volumes," IEEE

Trans. Biomed. Eng., vol. 60, no. 10, pp. 2967–2977, Oct. 2013.

[27] Y. Boykov and V. Kolmogorov, "An experimental comparison of min-cut/max-flow algorithms for energy minimization in vision," IEEE Trans. Pattern Anal. Mach. Intell., vol. 26, no. 9, pp. 1124–1137, Sep. 2004.

[28] L. Grady, "Random walks for image segmentation," IEEE Trans. Pattern Anal. Mach. Intell., vol. 28, no. 11, pp.

1768-1783, Nov. 2006.

[29] R. Adams and L. Bischof, "Seeded region growing," IEEE Trans. Pattern Anal. Mach. Intell., vol. 16, no. 6, pp. 641–

647, Jun. 1994.

[30] A. Mehnert and P. Jackway, "An improved seeded region growing algorithm," Pattern Recognit. Lett., vol. 18, no.

10, pp. 1065–1071, 1997.

[31] X. Lu, J. Wu, X. Ren, B. Zhang, and Y. Li, "The study and application of the improved region growing algorithm for liver segmentation," OptikInt. J. Light Electron Opt., vol. 125, no. 9, pp. 2142–2147, 2014.

[32] J. Liu and H. Zhang, "Image segmentation using a local GMM in a variational framework," J. Math. Imag. Vis., vol.

Copyrights @Kalahari Journals

46, no. 2, pp. 161–176, 2013.

[33] D. Mumford and J. Shah, "Optimal approximations by piecewise smooth functions and associated variational problems," Commun. Pure Appl. Math., vol. 42, no. 5, pp. 577–685, 1989.

[34] A. Tsai, A. Yezzi, Jr., and A. S.Willsky, "Curve evolution implementation of the Mumford-Shah functional for image segmentation, denoising, interpolation, and magnification," IEEE Trans. Image Process., vol. 10, no. 8, pp. 1169–1186, Aug. 2001.

[35] M. Maitra and A. Chatterjee, "A novel technique for multilevel optimal magnetic resonance brain image thresholding using bacterial foraging," Measurement, vol. 41, no. 10, pp. 1124–1134, 2008.

[36] M. E. Leventon, W. E. L. Grimson, and O. Faugeras, "Statistical shape influence in geodesic active contours," in

Proc. IEEE Comput. Vis. Pattern Recognit., 2000, pp. 316–323.

[37] A. Stadlbauer et al., "Improved delineation of brain tumors: An automated method for segmentation based on pathologic changes of 1 HMRSI metabolites in gliomas," Neuroimage, vol. 23, no. 2, pp. 454–461, 2004.

[38] N. Nabizadeh and M. Kubat, "Brain tumors detection and segmentation in MR images: Gabor wavelet vs. statistical features," Comput. Elect. Eng., vol. 45, pp. 286–301, 2015.

[39] M. Sezgin, "Survey over image thresholding techniques and quantitative performance evaluation," J. Electron. Imag., vol. 13, no. 1, pp. 146–168, 2004.

[40] R. C. Gonzalez and R. E. Woods, Digital Image Processing. Englewood Cliffs, NJ, USA: Prentice-Hall, 2008.

[41] A. Mekhmoukh and K. Mokrani, "Improved Fuzzy C-Means based particle swarm optimization initialization and outlier rejection with level set methods for MR brain image segmentation," Comput. Methods Prog. Biomed., vol. 122, no. 2, pp. 266–281, 2015.

[42] G. D. Lorenzo, S. Francis, S. Narayanan, D. L. Arnold, and D. L. Collins, "Review of automatic segmentation methods of multiple sclerosis white matter lesions on conventional magnetic resonance imaging," Med. Image Anal., vol.

17, pp. 1–18, 2013.

[43] M. A. Jaffar, A. A. Mirza, and M. Mahmud, "MR imaging enhancement and segmentation of tumor using fuzzy curvelet," Int. J. Phys. Sci., vol. 6, no. 31, pp. 7242–7246, 2011.

[45] R. O. Duda, P. E. Hart, and D. G. Stork, Pattern Classification. Hoboken, NJ, USA: Wiley, 2012.

[46] P. Moeskops et al., "Automatic segmentation of MR brain images with a convolutional neural network," IEEE Trans.

Med. Imag., vol. 35, no. 5, pp. 1252–1261, May 2016.

[47] M. Havaei et al., "Brain tumor segmentation with deep neural networks," Med. Image Anal., vol. 35, pp. 18–31, 2017.

[48] A. de Brebisson and M. Giovanni, "Deep neural networks for anatomical brain segmentation," in Proc. IEEE Conf.

Comput. Vis. Pattern Recognit. Workshops, 2015, pp. 20-28.

[49] W. Zhang et al., "Deep convolutional neural networks for multi-modality isointense infant brain image segmentation," NeuroImage, vol. 108, pp. 214–224, 2015.

[50] K. Sikka, N. Sinha, P. K. Singh, and A. K. Mishra, "A fully automated algorithm under modified FCM framework for improved brain MR image segmentation," Magn. Reson. Imag., vol. 27, no. 7, pp. 994–1004, 2009.

[51] Z. X. Ji, Q. S. Sun, and D. S. A. Xia, "Modified possibilistic fuzzy cmeans clustering algorithm for bias field estimation and segmentation of brain MR image," Comput. Med. Imag. Graph., vol. 35, no. 5, pp. 383–397, 2011.

[52] K. S. Chuang, H. L. Tzeng, S. Chen, J. Wu, and T. J. Chen, "Fuzzy c-means clustering with spatial information for image segmentation," Comput. Med. Imag. Graph., vol. 30, no. 1, pp. 9–15, 2006.

[53] A. N. Benaichouche, H. Oulhadj, and P. Siarry, "Improved spatial fuzzy c-means clustering for image segmentation using PSO initialization, mahalanobis distance and post-segmentation correction," Digital Signal Process., vol. 23, no. 5, pp. 1390–1400, 2013.

[54] W. M. Wells, W. E. L. Grimson, R. Kikinis, and F. Jolesz, "Adaptive segmentation of MRI data," IEEE Trans. Med.

Copyrights @Kalahari Journals

Imag., vol. 15, no. 4, pp. 429-442, Aug. 1996.

[55] R. Guillemaud and M. Brady, "Estimating the bias field of MR images," Med. Imag., vol. 16, no. 3, pp. 238–251, 1997.

[56] K. V. Leemput, F. Maes, D. Vandermeulen, and P. Suetens, "Automated model-based bias field correction of MR images of the brain," Med. Imag., vol. 18, no. 10, pp. 885–896, 1997.

[57] F. Dong and J. Peng, "Brain MR image segmentation based on local Gaussian mixture model and nonlocal spatial regularization," J. Vis. Commun. Image Represent., vol. 25, no. 5, pp. 827–839, 2014.

[58] H. Greenspan, A. Ruf, and J. Goldberger, "Constrained Gaussian mixture model framework for automatic segmentation of MR brain images," IEEE Trans. Med. Ima., vol. 25, no. 9, pp. 1233–1245, Sep. 2006.

[59] K. Blekas, A. Likas, N. P. Galatsanos, and I. E. Lagaris, "A spatially constrained mixture model for image segmentation," IEEE Trans. Neural Netw., vol. 16, no. 2, pp. 494–498, Mar. 2005.

[60] J. Tohka, I. D. Dinov, D. W. Shattuck, and A. W. Toga, "Brain MRI tissue classification based on local Markov random fields," Magn. Reson. Imag., vol. 28, no. 4, pp. 557– 573, 2010.

[61]

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Comparative Study: Future Generation of Wireless Technology (5G, 6G & 7G)

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Abstract. In the previous few years, mobile era makes highquality growth. Currently, the innovation of mobile era has reached 7.5G. Future Generation cellular communications could have better records transmission costs than 6G & 7G. Wireless era is one of the freshest regions that is developing at a excessive speed, with superior techniques rising with inside the fields of WI-FI and mobile communications. Today's, there are numerous superior technology, every guide voice site visitors the use of voice over IP (VoIP), broadband records get admission to in cellular surroundings etc., however, there is a incredible want of deploying such technology that could combine most of these structures right into a unmarried unified system. 8G affords an answer of this trouble as it's miles all approximately logically incorporating the network, application and terminals. In this paper, we're offering an introductory observe of various WI-FI technologies specifically 5G, 6G, and 7G, and additionally offer specific comparisons amongst them.

Keywords. Networks, Mobile Technology, Communications, Cellular Generations

INTRODUCTION

Wireless and mobile communication systems are advancing at a rapid pace. The transmission of data over a distance without the need of cables or sophisticated electrical conductors is known as cellular communication. Radio, cellular telephone, personal digital assistant (PDA), and wireless networking are examples of fixed, mobile, and portable two-way communication. [1] Mobile wireless technologies have seen a number of technological revolutions and improvements during the last several decades, referred to as 0G to 5G. New cellular generations, such as 5G, 6G, and 7G, are being discovered now and in the future.

Consumers today expect more complex and helpful applications. The new generation differs from previous generations in terms of technical and new features. The number of mobile customers is growing every day as a result of these new features. As a result, cellular communication capacity has to be increased. 4G wireless networks combine 3G with fixed Internet to offer mobile Internet, an innovation that addresses 3G's constraints while also improving Quality of Service (QoS), lowering resource costs, and increasing capacity. 5G will usher in a real wireless world—the Wireless World Wide Web (WWWW)—while 6G will combine 5G with satellite networks to provide worldwide coverage. Space roaming is associated with 7G.

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The work is divided into five sections, with conclusions and references following. Sections II, III, and IV go on the specifics of 5G, 6G, and 7G wireless technology. Section V compares the wireless technologies 5G, 6G, and 7G in depth. The top ten nations with the fastest mobile and broadband internet speeds in Mega Bits Per Second '21 are listed in sections VI and VII.

5G CELLULAR TECHNOLOGIES

As we Know, 5G is a fifth generation of cellular technology. Its decrease latency and increase speed as well as improve the flexibility of wireless services. Theoretical peak speed of 5G is 20 GBPS, while the peak speed of 4G is now only 1 GBPS. With a focus on improving connectivity in the previous generation of cellular technology. 5G provides the next level of connectivity to the customers by delivering a connected experience from the clouds. [5]

5G network is virtualised & software-pushed and they exploited cloud technologies.

The 5G community can even simplify mobility, with seamless open roaming competencies among mobile and Wi-Fi access. Mobile customers can live linked as they circulate among out of doors WI-FI connections and WI-FI networks internal homes without consumer intervention or the want for customers to re authenticate.

The ability of the 5G is aimed to be lots higher than modernday 4G. Better ability might permit better density of cellular customers, extremely reliability and large communications. Additionally, research that is occurring 5G pursuits at lower cut-off and low battery intake.

5G is planned for Wireless World Wide Web (WWWW) and IPv6. It is a basic protocol used to 4G and 5G cell networks but considering the fact that IPv6 assigns any IP address to any mobile node based on location control and this will motive wastage of 5G sources .[2]

There will be three technologies in the 5G core concept:

- □ Cloud Computing
- □ All IP platform(flat)
- \Box Nano technology

The actual wireless world will be supported by MC-CDMA, LAS-OFDM, CDMA, UWB, Network-LMDS, and IPv6 in the 5th Wireless Mobile Network. IPv6 is a fundamental protocol that may be used on both 4G and 5G networks. In addition, suggested bandwidth optimization control protocol and mixed-bandwidth data channel for the future 5G genuine wireless world to tackle the waste of 5G resources owing to IPv6 functional nature and 5G purpose. The Bandwidth Optimization Control Protocol (BDCP) is used to establish mix-bandwidth between the TCP/IP and MAC layers.

6G CELLULAR TECHNOLOGIES

6G follows 5G mobile technology. It will be more able to use higher frequencies than 5G and offer lower latency and higher capacity. 6G internet will support 1µs-latency communication. This is 1,000 times faster than the 1 ms throughput. [6]

The 6G generation marketplace is expected to facilitate major upgrades in imaging, presence generation and area awareness. Working in tandem with artificial intelligence (AI), 6G's computational infrastructure will set the tone for autonomous computing; It almost includes the selection of facts storage, processing and sharing. It is anticipated that 6G Wi-Fi sensing answers will selectively use varying frequencies to degree absorption and change frequencies accordingly. [6] This technique is possible due to the fact that molecules and atoms emit and absorb electromagnetic radiation at work frequencies, and the emission and absorption frequencies for any substance are the same.

6G will have major implications for many industries and government approaches for critical asset protection and public safety. These are:

· Gas and Toxicity Sensing

- Air Quality Measurement
- Decision making
- Health Monitoring
- Feature and facial recognition
- Threat Detection

Developments in these areas will benefit mobile technology as well as emerging technologies such as virtual reality and more realities, autonomous vehicles, smart cities.

7G CELLULAR TECHNOLOGIES

Mobile network of 7G is similar to 6G for international coverage. This would likely be the maximum boost in cellular verbal exchange, but there may be some research on stressful problems such as cell phone use during a relocating situation from the United States. For every other United States, satellite TV for PC is also operating at regular velocity and special orbit due to the fact that there are requirements for satellite TV for PC and protocol.

Defining all the standards and protocols, the 7g dream might be the simplest. Maybe it will be possible in a later generation of 7g & its name 7.5G or 8g. While the 7G will cover all its vulnerabilities, there will be no problem of fact capability coverage and hand-off. At that time the easiest demand from the consumer side might be the name of the cellular phone and the price of its offerings. This difficulty will start again fashionable and evolutionary alternatives in technology, and will also open new horizons for computing studies. This new revolution in generation can be called 7.5G or 8G for the price of cell Smartphone name and offerings.

DETAILED COMPARISON OF 5G, 6G & 7G

S.No	5G Cellular	6G Cellular	7G Cellular	
Master network	The Net	The Net	The Net	
Data Rate	100+Mega bits per second	11 Gega bits per	11+ Gega bita per	
		second	second	
Frequency	24–47 Gega Hz	95GHz-3THz	95GHz-3THz	
Handoff	Vertical & Horizontal	Vertical & Horizontal	Vertical & Horizontal	
Location of first commercialization	Not yet	Not yet	Not yet	
Multiplexing	Orthogonal frequency division multiplexing (OFDM)	CDMA	CDMA	
Service	Wireless World Wide	Secured Services &	Global cellular services	
	Web(WWWW)	global services	& Secured Services	
Switching type	IPv6	All packet	All packet	
Time period	Possibly 2020	Possibly 2030	Possibly 2030	
Advantages	 It provides better coverage area and higher protection. Low battery intake It has high energy and spectral efficiency 	• It will provide global coverage system	 It will provide low cost of calls No problem of data, capacity coverage and handoff left behind 	
Disadvantages	 Difficult to achieve due to inefficient technical The issue of security and privacy remains to be resolved Requires high cost for infrastructure development It is still under process and its feasibility is under research 	 High cost of mobile calls Difficulty in space roaming Similar to 5G disadvantages 	• Similar to 5G and 6G disadvantages	

Table 1: Detailed Comparison of 5G, 6G and 7G[3]

A GENERAL SOLUTION TO SIGN LANGUAGE RECOGNITION FOR DIFFERENT SKIN TONES

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Abstract Deaf-Mute people communicate through their sign language which is well known in their community but not easily understood by other people. Sign language recognition system is very helpful in this area but as in our world people of different skin tones live similar diversity exists in deafmute community. Need of SLR for different skin tones arises. This paper proposes the general solution to acquire data which is independent of skin tone. With the combination of ROI, Background Subtraction, Connected Component Algorithm data is acquired. Then model is trained using CNN Architecture. This paper gives the proposal, its real time system should be developed in future.

Keywords : Sign language, skin tone, Background Subtraction, Connected Component, ROI, CNN.

INTRODUCTION

In this world every person is a social human being, who needs any mutual language to communicate with each other. But what about physically impaired people (both deaf and mute), whose language is not mutual to others. They communicate through their hand gestures and facial expressions which is not easily understood by others. To live in the society they require a converter (system) that converts their sign language to the common language. Sign Language Recognition (SLR) System fulfils need of the converter. It recognizes the hand gestures of deaf-mute people and converts it to the common language.

SLR System can be achieved in three simple steps :



Figure 1 SLR System

Data (hand gestures) is acquired using wearable sensors 2 and using vision based techniques. Vision based SLR are more convenient and easy to use. In vision based Data is acquired from images or videos. Data goes through preprocessing before sending to training. Hand regions are removed from the obtained image. Many of the researchers used different skin segmentation techniques to identify hand region in the image. RGB image is converted to different color spaces and then threshold value is applied to filter the skin pixels. But this technique limits to some specific skin tones. That type of SLR can be used in particular area where people of similar *skin tones live which is not good for its commercial use*.

In this paper, a general solution is proposed to overcome the problem of specific skin tone. It focuses on the method of acquiring data, irrespective of skin tone. Data is acquired using Region of interest 1 in which concept of background and foreground is used to identify hand region, and followed by connected component algorithm 9 to get hand shape more accurately. Then model is trained using Convolution Neural Network.

RELATED WORK

Sign Language Recognition has attracted the attention of many researchers as its area is wide. Much of the research work has been done in data acquisition part. Data is acquired by two techniques using wearable sensors 2 and by vision based techniques 9. Vision based techniques are more convenient as wearable sensors need extra care and are cost effective. In computer vision images obtained from camera are preprocessed before sending it to training. To identify hand region from whole image many researchers have used different skin segmentation techniques. 3 Used Kinect for depth and RGB images but it adds an extra hardware to the system which makes system more expensive. 6 Proposed SLR model that uses skin segmentation technique by converting RGB Image into YCbCr color space. 7 also converts RGB color space into YCbCr color space and followed by Convex Hull algorithm to determine the shape and location of hand. To ignore unwanted objects in image 4 proposed a Region of interest predictor and then applied skin segmentation technique by converting RGB Image into HSV color space . 5 used skin color segmentation and connected component algorithm to get hand region more accurately.

With the help of skin segmentation techniques in which RGB image is converted into different color space and then a threshold value is applied to filter skin pixels, one can easily identify skin region from the obtained image but it limits the model to predict the gestures of some specific skin tone that comes under threshold value.

To overcome the problem this paper proposes a method that identifies the hand region from obtained image ignoring its

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skin color. With the help of Background Subtraction technique 11 is used which remove foreground object (hands) from the background that appears in Region of interest. It is followed by connected component algorithm to get hand shape more accurately.

PROPOSED MODEL

This work proposes a general solution to SLR of specific skin tones. The proposed model is divided into three parts:

1. Data Acquisition, 2. Training the Model, 3. Predict the Gesture. It focuses on foundation stone of the problem that is Data Acquisition. Since as accurately preprocessed data sent for training, the model would become more efficient in less data. In this work static gestures are taken into consideration .

Data Acquisition

Flow chart of data acquisition is given below:



Figure 2 Flowchart of Data Acquisition

Data is acquired through ROI, to ignore unwanted objects 4, from live video. Each frame of video acts as an image. Image requires preprocessing to maintain dataset of the model. ROI captures background for just few seconds and then static hand gesture is placed into the ROI which act as foreground object in image. Here concept of Background Subtraction technique 11 is used, which stated as

A pixel is defined as foreground pixel, if

$$[Bt - Bt + 1] > t$$

where Bt is the pixel of frame taken at time t and Bt+1 is the pixel of frame taken at time t+1 from live video and t is predefined threshold value.

As result, hand region is identified and then followed by connected component algorithm to get hand shape more accurate. In Connected Component Algorithm 12 two pixels are marked as connected if they are of almost same pixel values (very less difference). After applying background Subtraction and connected component algorithm, shape of Copyrights @Kalahari Journals hand gesture is obtained . It results an image in which hand region is of white color and rest is of black color. Then this preprocessed image is sent for training the model.

Training the model

Model is trained by classifying the image. According to a review 8 SVM and HMM are frequently used techniques for image classification. But SVM give more accurate results in linear classification. Murat Taskiran et al [7 proposed a real time system that recognizes sign language using deep learning. This model is also trained using deep learning. Convolutional Neural Network is used in deep learning to classify the image into different classes. Architecture of CNN model used is given below:



Figure 3 Architecture of CNN

It consists of 1 input layer, 3 convolutional layers, 1 flatten layer, 2 dense layers, 1 output layer Input layer consists of an RGB image. In Convolutional layer, 3×3 kernel is used to filter the important features from input image which is followed by max pooling of 2×2 to reduce dimensionality of input image. Flatten layer flattens the multi dimension data into single dimension and consists of 24,576 neurons. Dense layer also known as fully connected layer, each node is connected to the node in the next layer. 1st layer consists of 128 neurons and 2nd layer consists of 64 neurons. Output layer, it consists of 10 classes that means data is classified into 10 classes.

Predict the Gesture

Adam optimizer can be used to optimize the learning rate to improve the prediction rate.

CONCLUSION

This paper proposes the method of acquiring data with the combination of ROI, Background Subtraction and Connected Component Algorithm. In this way dependency of skin tone is removed and person of different skin tones can use this SLR.

FUTURE WORK

This paper presents the proposal hence its real time system is still required for its commercial use. A real time system can be developed by implementing the algorithms given in the proposal. Dataset should be made by acquiring data using given techniques in the paper. Model should be trained using

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given architecture. Accuracy should be measured to compare the system than the proposed system 7.

REFERENCES

1. Sunmok Kim, Yangho Ji , and KI-Baek Lee, "<u>An</u> <u>effective sign language learning with object detection based</u> <u>ROI segmentation</u>", IEEE Conference on Robotic Computing 2018.

2. Rinki Gupta, Arun Kumar, "<u>Indian sign language</u> recognition using wearable sensors and multi-label classification", Computers and Electrical Engineering, 2020.

3. Neel Kamal Bhagat, VishnuSai Y, Rathna G N, "<u>Indian</u> sign language gesture recognition using image processing and deep learning", IEEE 2019.

4. SajanRaj T D, Beena M V, "<u>Indian Sign Language</u> <u>Numeral Recognition using Region of Interest Convolutional</u> <u>Neural Network</u>", IEEE Conference on Inventive Communication and Computational

Technologies, 2018.

5. Sruthi C J, and Lijiya A, "<u>Signet: A Deep Learning</u> <u>based Indian Sign Language Recognition System</u>", IEEE Conference on Communication and Signal Processing, 2019.

6. Resmi George, K Gerard Joe Nigel, "<u>Hand Gesture</u> <u>Recognition for the application of Sign Language</u> <u>Interpretation</u>", International Journal of Engineering Research and Technology, 2014.

7. Murat Taskiran, Mehmet Killioglu, and Nihan Kahraman, "<u>A Real-Time System for Recognition of</u> <u>American Sign Language by using Deep Learning</u>", IEEE 2018.

8. Nimisha K P and Agnes Jacob, "<u>A Brief Review of the</u> <u>Recent Trends in Sign Language Recognition</u>", IEEE Conference on Communication and Signal Processing, 2020.

9. Thao Nguyen-Trang, "<u>A New Efficient approach to</u> detect Skin in Colour Image Using Bayesian Classifier and <u>Connected Algorithm</u>", Mathematical Problems in Engineering, Hindawi 2018.

10. Kshitij Bantupalli, Ying Xie, "<u>American Sign Language</u> <u>Recognition Using Deep Learning and Computer Vision</u>", IEEE Conference on Big Data, 2018.

11. Alan M. McIvor, "Background Subtraction Techniques".

Copyrights @Kalahari Journals

12. Kurt Schwenk and Felix Huber, "<u>Connected Component</u> Labeling Algorithm for Very Complex and High Resolution <u>Images on an FPGA Platform</u>", High Performance Computing in Remote Sensing, 2015.

13.

Synthesis, Characterisation and Anti Tumor-Activity Evaluation Palladium Metal Complexes with substituted Imidazoles

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Abstract:Pd(II) complexes with imidazole and substituted imidazoles derivatives were obtained by reacting substituted imidazoles with PdC12 . The complexes were characterized by elemental analyses, FT-IR, and ¹H NMR etc.. All synthesized compounds having antitumor activities. The Pd(II) complexes were transmitted for their antibacterial and cytotoxic activities .. Several palladium complexes of the type [Pd(im)2Cl2], [Pd(im)3C1]C1, and [Pd(im)4]C12 (im = imidazole 2, 1-4. 1,2-dimethylimidazole methylimidazole 5. 1butylimidazole7, **4**a. 1-phenylimidazole 8. 1phenylimidazoline9, and 1-methylimidazoline 11) were prepared and structurally characterized. The resulted compound have great anti tumour properties it were proven by several experimental and physical methods.

Keywords: Palladium metal, substituted imidazoles, Cancer

Introduction: Metal complexes have great characteristics of enhancing act as antitumor agents. The metal attached with ligand to form complexes which behave as antitumor agents[5,6]. Synthesis, structure

elucidation and anticancer activity of Palladium complexes In order to understand palladium imidazoles interactions and anticancer activity, several palladium complexes of substituted imidazoles derivatives were prepared.We also define the imidazole chemistry and

its derivatives explaining their methods of preparation and act as potential anti tumour agents. It is also going to explain that it has considerable interest of heterocylic compounds and its anti tumour activity. The magnetic values of the synthesized complexes sustained at normal temperature.

Experimental

(a) Materials Substituted uracils were procured from Aldrich Chemical Company , U.S.A. and used as such.PdCl2 ,Substituted imidazoles were taken from from Sigma



Chemicals Co. (USA .) All the reactions happen in distilled water only.

(b)- Preparation of the substituted Imidazoles:

Palladium (II) complex with Substituted imidazoles is obtained by by mixing 0.2 N HCl solution of metal

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chloride mix with methanol and Imidazole(0.114mol) and on quick heating the mixture was fused for 2 hours in water bath. The complexes will be precipitated out.

CH₃OH

 $[Pd(Cl)_2] + 2L \longrightarrow [Pd(L_2)(Cl)_2]$ H₂O

Where L = Substituted imidazoles

FIG 1-Substituted imidazoles

III.Spectroscopic analysis:

The IR spectrum of uracil and ligands shows three strong bands at 1735, and 1620 cm-1. These are indicating the presence of ketonic and enolic forms of C=O group, respectively[31]. In the resulted metal complex the C=O stretching band is seen at 1520 cm-1, indicating that the resence of ketonic group is present in this complex [38, 39]. While, the bright and dark band at 1393cm-1 in the spectrum of the Pd(II) complex with substituted imidazoles is available. [38].

Table –I Viscosity of benzene solution of Imidazole and substituted imidazoles

ligands (temp; ⁰ C)	Molality	Specific viscosity
Imidazole(30 ⁰ C)	0.036	0.0106
	0.073	0.0248
	0.146	0.0549
Imidazole(50 ⁰ C)	0.146	0.0410
	0.461	0.1500

	1	1 1
	0.463	0.1686
4 (or 5) Methyl imidazole(30 ⁰ C)	0.040	0.0071
	0.080	0.0354
	0.242	0.1187
	0.249	0.1277
	0.475	0.2925
		0.3262
	0.493	0.4113
	0.607	0.7801
	1.075	0.991
	1.362	1.6524
	2.068	2.3138
	2.848	3.1560
(or 5) Methyl	3.738	0.0910
imidazole(50 ⁰ C)	0.242	
	0.249	0.0930
	0.475	0.2140
	0.493	0.2370

Table –II Dipole Moment in Debye Units of some imidazoles in Different solvents

Compound	Naphthalene	Benzene	Dioxane	Carbon tetra chloride
Imidazole	5.7(97 ⁰)	6.2(70 ⁰)	4.8(30 ⁰)	
4 (or 5)- Methyl	-	6.2(70 ⁰)	5.1(20 ⁰)	5.8(18 ⁰)
1-Methyl	-	3.6(20 ⁰)	3.8(20 ⁰)	

Table –III Variation (with concentration) of the Dipole Moment of Imidazole in Benzene

	Mole fraction of solute	Dipole moment, Debye unit
_		
+	0.005951	5.62
	0.001140	4.42
	0.000233	3.93

Table –IV Surface Tension of Imidazole and substituted imidazoles

Temperature(⁰ C)	Surface Tension ,dynes/cm
110.0	36.82
110.0	50.82
150.0	33.85
205.0	30.05
20.0	38.70
56.0	36.21
110.0	32.36
153.0	29.28
	Temperature(^Q C) 110.0 150.0 205.0 20.0 56.0 110.0 153.0

Table –V Heat of melting and solution in benzene at Varying Concentration of substituted imidazole

Molality	Heat of solution_cal/mole (21 ⁰ C)	Heat of Fusion cal/mole
0.15	-3218	-2838
0.23	-2175	-

Table -VI Melting point of a number of Imidazole salts

Salts	M.P., ⁰ C	
Nitrate	118	
Chloroaurate	dec.190	
Chloroplatinate	dec.200	
Dimolibdate	208-212	
Picrate	224-226	
Diliturate		
	232,252,225	
	202	
	39	

Conclusion

Thus, It is found that the resulted. Palladium metal imidazole complexes is useful antitumor agent. Further, the most important gist can be showing that. Palladium complexes are the very useful tool for anti tumour activities. These complexes are widely used for the treatment of different types of tumours. They were tested and applied on mice and monkeys in CDRI Lucknow and we found that it behaves as potential antitumor agent.

REFERENCES:

1. Wamhoff H, Dzenis J, Hirota K (1992) Uracils: versatile starting materials in heterocyclic synthesis. Adv Heterocycl Chem 55:129–259. doi:10.1016/S0065-2725(08)60222-6 2. Putz MV, Duda s NA (2013) Variational principles for mechanistic quantitative structure-activity relationship (QSAR) studies: application on uracil derivatives' anti-HIV action. Struct Chem 24:1873–1893. doi:10.1007/s11224-013-0249-6 3. Morten, HH. N. 2010. A mutant Pfu DNA polymerase designed for advanced uracil-excision DNA engineering. BMD Biotechnology, 10(21):1-7. 4. Miquel B.-O.; Carolina, E.; Angel, T.; Angel, G.-R., and Antonio F.

2011.RNAs, uracil quaret model with a non-essential metal ion. Chem. Comm. (Camb). 47(16): 4646-

4648.

5. Heidelberger C (1984) In: Holand JF, Frei E (eds) Pyrimidine and pyrimidine antimetabolites in cancer medicine. Lea and Febiger, Philadelphia, pp 801-824 6. Igor, P.P.; Levan, M.; Barbara, J.M. and Jill, S.J. 1997. Presence and consequence of uracil in preneoplastic DNA from folate/methyl-deficient rats. Carcinogenesis, 18(11):2071-2076.

7. Kulikowski T (1994) Structure-activity relationships and conformational features of antiherpetic pyrimidine and purine nucleoside analogues. Pharm World Sci 16:127-138. doi:10.1007/BF01880663

8. IsobeY, Tobe M, InoueY, Isobe M, Tsuchiya M, HayashiH(2003) Structure and activity relationships of novel uracil derivatives as topical anti-inflammatory agents. Bioorg Med Chem 11:4933–4940. doi:10.1016/j.bmc.2003.09.012 9. Baraldi PG, Romagnoli R, Guadix AE, Pineda de las Infantas MJP, Gallo MA, Espinosa A, Martinez A, Bingham JP, Hartley JA (2002) Design, synthesis, and biological activity of hybrid compounds between uramustine and DNA

minor groove binder distamycin A. J Med Chem 45:3630-3638. doi:10.1021/jm011113b

10. Prashansa, A. 2016. Non-coding ribonucleic acid: a new anticancer drug target. J Pharmacovigil, 4(3):1-2.

11..Rastogia, V. K. and Alcolea, P. M. 2011. Vibrational spectra, tautomerism and thermodynamics of anticarcinogenic drug:5-Fluorouracil. Spectrochim. Acta A Mol Biomol Spectrosc.,79(5):970-977.

12. Medoff G, Swartz MN (1969) Induction of a defective

phage and DNA methylation in Escherichia coli 15-T.J Gen Virol 4:15-27

13. Pranita U. Gawande; Mandlik P. R. and Aswar1 A. S. 2015. Synthesis and characterization of Cr(III), Mn(III),

Fe(III), VO(IV), Zr(IV) and UO2(VI) complexes of Schiff base derived from isonicotinoyl

hydrazine, Indian J Pharm Sci., 77(4): 376–381.

14. Michael J. Carney; Nicholas J. Robertson; Jason A. H 15. Oliev R (1994) Response to auxin by cells of Riella helicophylla during reversible arrest in different cell-cycle phases. Planta 194:510-515

16. Cheng CC, Roth B (1982) Recent progress in the medicinal chemistry of 2,4-diaminopyrimidines. Prog Med Chem 19:269-331

Mol Divers (2016) 20:153-183 179

17. Singh SJ (2008) Laser Raman and infra-red spectra of biomolecule:5-aminouracil. J Phys 70:479-486

18. Bányász A, Karpati S, Mercier Y, Reguero M, Gustavsson T, Markovitsi D, Improta R (2010) The peculiar spectral properties of amino-substituted uracils: a combined theoretical and experimental study. J Phys Chem B 114:12708-12719. doi:10.1021/jp105267q

19. Longley, D. B., Harkin, D. P. & Johnston, P. G. 5-Fluorouracil: mechanisms of action and clinical strategies.

Nat. Rev. Cancer 3, 330-338 (2003).

20. Bednarek E, Dobrowolski JCz, Dobrosz-Teperek K, Sitkowski J, Kozerski L, Lewandowski W, Mazurek AP (1999) Theoretical and experimental 1H,13 C,15 N, and 17O NMR spectra of 5-nitro, 5-amino, and 5-carboxy uracils. J Mol Struct 482-483:333-337

21. Weissman, S. A. & Zewge, D. Recent advances in ether dealkylation. Tetrahedron 61, 7833-7863 (2005).

22. Johnson TB, Matsuo I (1919) Researches on pyrimidines. LXXXVII. Alkylation of 5-amino-uracil. J Am Chem Soc 41:782-789. doi:10.1021/ja02226a011

23. Song, F., Garner, A. L. & Koide, K. A highly sensitive fluorescent sensor for palladium based on the allylic oxidative insertion mechanism. J. Am. Chem. Soc. 129, 12354-12355 (2007). 22. Santra, M., Ko, S.-K., Shin, I. & Ahnz, K. H. Fluorescent detection of palladium species with an Opropargylated fluorescein. Chem. Commun. 46, 3964-3966 (2010).

24. Güetschow M, Hecker T, Thiele A, Hauschildt S, Eger KJ (2001) Aza analogues of thalidomide: synthesis and evaluation as inhibitors of tumor necrosisfactor- α production

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in vitro. Bioorg Med Chem 9:1059–1065. doi:10.1016/S0968-0896(00)00323-0

25. Liu, B. et al. A new ratiometric ESIPT sensor for detection of palladium species in aqueous solution. Chem. Commun. 48, 2867–2869 (2012).

26. Pal, M., Parasuraman, K. & Yeleswarapu, K. R. Palladium-catalyzed cleavage of O/N-propargyl protecting groups in aqueous media under a copper-free condition. Org. Lett. 5, 348–352 (2003). 25. Escoubet, S., Gastaldi, S. & Bertrand, M. Methods for the cleavage of allylic and propargylic C–N bonds in amines and amides – selected alternative applications of the 1,3-hydrogen shift. Eur. J. Org. Chem. 2005, 3855–3873 (2005).

27 Johnson TB, Hahn DA (1933) Pyrimidines: their amino and aminooxy derivatives. Chem Rev 13:193–303. doi:10.1021/ cr60045a002

28. Rambabua, D., Bhavani, S., Swamy, N. K. & Rao, M. V. B. Pd/C mediated depropargylation of propargyl ethers/amines in water. Tetrahedron Lett. 54, 1169–1173 (2013).

29. Bogert MT, Davidson D (1933) The preparation of 5aminouracil and of some of its derivatives. J Am Chem Soc 55:1667–1668. doi:10.1021/ja01331a059

30. Zajac MA, Zakrzewski AG, Kowal MG, Narayan S (2003) A novel method of caffeine synthesis from uracil. Synth Commun 19:3291–3297. doi:10.1081/SCC-120023986 31. Ishiyama H, Nakajima H, Nakata H,Kobayashi J (2009) Synthesis of hybrid analogues of caffeine and eudistomin D and its affinity for adenosine receptors. Bioorg Med Chem 17:4280–4284. doi:10.1016/j.bmc.2009.05.036

32. Phillps AP (1951) Some 5-substituted aminouracils. J Am Chem Soc 73:1061–1062. doi:10.1021/ja01147a051
33. Benitez A, Ross LO, Goodman L, Baker BR (1960)
Detential anticement AXXVII. Allevel time agents

Potential anticancer agents. XXXVI. Alkylating agents derived from 5-aminouracil. J Am Chem Soc 82:4585–4591. doi:10.1021/ja01502a036

34. Johnson TB, Clapp SH (1908) IX. Researches on pyrimidins: syntheses of some nitrogen-alkyl derivatives cytosin, thymin and uracil. J Biol Chem 5:49–70
35. VisserDW, Kabat S,LiebM(1963) Synthesis and biological activity of methylaminodeoxyuridine and dimethylaminodeoxyuridine. Biochim Biophys Acta 76:463–

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37. ShenTÝ, McPherson JF, LinnBÒ(1966) Nucleosides. III. Studies on 5-methylamino-2'-deoxyuridine as a specific antiherpes agent. J Med Chem 9:366–369. doi:10.1021/jm00321a025

38. Boncel S, Gondela A, Ma, czka M, Tuszkiewicz-Ku´znik M, Grec P, Hefczyc B, Walczak K (2011) Novel 5-(Nalkylaminouracil) acyclic nucleosides. Synthesis 4:603–610. doi:10.1055/s-0030-1258397 International Journal of Mechanical Engineering

Identification of Cardio-Vascular Diseases Using Genetic Algorithm

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Abstract:

Cardio-Vascular diseases are a major cause of mortality & morbidity in modern society. Diagnosis is an important but complex task and must be done accurately and efficiently. In recent decades, much effort has been devoted to using machine learning or data mining techniques to automatically discover useful medical knowledge and rules. Among these techniques, genetic algorithms have been shown to be particularly powerful in the pursuit of medical knowledge. Genetic algorithms (GAs) are an important tool as a search technique for solving many complex problems in many fields.

Genetic Algorithms (GAs) depend on the hidden hereditary interaction and streamlining calculation depends on the working of regular hereditary qualities and determination. Toward the start, arrangements are summing up involving parallel for the discrete pursuit space. Regardless of whether, the basic objective capacity is a customary capacity, hereditary calculations convert the hunt space into a discrete arrangement of focuses. To get the ideal cost with the ideal exactness, wires of the necessary length ought to be picked.

Its also works directly with continuous variables (instead of discrete variables). Binary string is not used in such Genetic Algorithms (GAs). Rather, the genes on a chromosome are directly represented as a real number. This type of genetic algorithm is called a real-coded genetic algorithm. In such algorithms, the results are close to the natural formulation.

During paper, a real-coded genetic algorithm is improved to identify essential features for cardio-vascular diseases. According to this algorithm, major clinical features of cardiovascular diseases are identified from medical databases, and diseases of a new subject are also identified.

Key-words: Real-coded Genetic Algorithm; Cardio-vascular diseases; Diagnostic features

INTRODUCTION

Cardio-vascular diseases (CVDs) are the fundamental driver of death around the world. An expected 17.9 million individuals kicked the bucket from these sicknesses in 2019, representing 32% of all passing around the world. 85% of passing were because of cardiovascular failure and stroke. Of the 17 million unexpected losses (under 70 years old) because of non-transferable sicknesses in 2019, 38% were because of CVD. Most cardio-vascular infections are preventable by tending to conduct hazard factors, for example, undesirable eating routine, weight, tobacco use, hurtful utilization of liquor and actual latency. It is important to identify heart disease as early as possible so that management with counseling and medications can begin [7]. Medical diagnosis is a vital important} however advanced task that must be done accurately and with efficiency and its automation are very useful. Unfortunately, not all doctors are equally masterly in each subspecialty and that they are scarce resources in several places. A system for machine-controlled diagnosis would enhance treatment and cut back prices [1].

In last few decades, data mining & machine learning techniques have been used to automatically discover useful medical knowledge and rules [2–3]. A genetic algorithm (GA) based on Recurrent Fuzzy Neural Network (RFNN) has been proposed for the diagnosis of CVD [8].

Among this multitude of strategies, genetic calculations have been perceived as strong in clinical analysis. Hereditary Algorithms (GAs) emulate the ideas of regular hereditary qualities and normal choice to figure out what comprises disclosure and transformation processes.

In this paper, a real-coded Genetic Algorithms (GAs) is studied to identify important clinical features of cardiovascular diseases. Five well-known cardio-vascular diseases: coronary heart disease, chronic cor pulmonale, hypertension, rheumatic valvular heart disease and congenital heart disease have been identified [4].

In section 2, real-coded Genetic Algorithms (GAs) are discussed. In Section 3, the arrangement of the database is discussed. Finally, the findings are summarized in section 4.

REAL-CODED GENETIC ALGORITHM

Initially, the binary alphabet was utilized in Genetic Algorithms (GAs) for discrete search space solutions. Genetic algorithms turn the search space into a discrete set of points, despite the fact that the underlying objective function is a continuous function. Strings of adequate length must be chosen to obtain the optimum spot with the requisite accuracy.

In addition, Genetic Algorithms (GAs) have been developed to deal with continuous variables (instead of discrete variables). Binary strings are not employed in such genetic algorithms. Instead, chromosomal genes are explicitly represented as real numbers. Real-coded Genetic Algorithms are one sort of genetic algorithm. The solutions in such algorithms are very near to the natural formulation.

The process will be stopped if the total number of iterations reaches a certain level. It will also be terminated once all of the database instances have been identified.

Coding of Chromosome

Assume the final solution has five cardio-vascular disorders, each having forty diagnostic features. Consider a population of fifty chromosomes, each with a random value ranging from -1 to +1. These values are referred to as chromosomal genes. The association between diagnostic features and their associated cardio-vascular disease is explained by the values and signs of genes.

Fitness Function

All chromosomes in the population have an associated fitness in the selection or reproduction stage, which is used to choose which chromosomes are employed to generate new ones in the process [5]. It refers to the number of valid classifications of the five cardiovascular illnesses over the whole data set in the given task. The instance of the data set D is classified by Chromosome C as follows:

Any disease's classification at any time equals the greatest value of a diagnostic characteristic multiplied by the gene values of chromosome C.

If this categorization of any disease at any point in time matches the disease of a data set at that point in time, the indicator function returns one. If the chromosome classifies an illness that is not the same as the dataset's disease at the time, the indicator function will return zero.

The fitness value of chromosome C is thus equal to the sum of the values of the indication function for the entire dataset divided by the full range of instances in the dataset.

Genetic Algorithm operations

Subsequent to processing the wellness worth of the relative multitude of chromosomes in the populace as per the technique depicted over, the three primary administrators rearing, hybrid, and transformation are worked on the made populace. This is ruined the production of another populace of focuses. To check the end measures, the new populace is additionally assessed and tried. In the event that the end basis isn't met, then, at that point, the over three administrators again apply overpopulation and therefore, these administrators are assessed. This cycle is executed until the end model is met.

Reproduction Stage

The reproductive phase involves the selection of good chromosomes from the population and the formation of a mating pool. Above-average chromosomes are chosen from the population and their number of copies is put into the mating pool in this method. Most people employ the proportional reproduction operator. Chromosomes are chosen with a probability proportional to their fitness for the mating pool in this operator. The roulette-wheel approach is utilized to achieve this system.

In this strategy, the probability for a string to be selected can be calculated, using the fitness value of all chromosomes as calculated in section 2.2Then, the aggregate likelihood of duplicating every chromosome is determined by adding the singular probabilities from the first spot on the list. Accordingly, the combined likelihood of the last chromosome in the populace will be equivalent to one.

To choose n chromosomes, n irregular numbers somewhere in the range of 0 and 1 are made indiscriminately. Thusly, a chromosome that addresses an arbitrary number picked in the total likelihood range (determined from wellness esteems) is duplicated into the mating pool. Accordingly, chromosomes with higher wellness esteems are bound to be replicated in the mating pool.

Crossover Stage

Because actual encoding was discovered in this investigation, the binary encoding method's typical crossover procedure could not be applied. As a result, novel and efficient crossover operators have been employed to enable variable-based searching.

Let us consider the $Cp^{(q)}$ and $Cp^{(r)}$ values of the design variable where Cp in the two parent chromosomes q and r. The crossover with these values will produce the following new value-

$$Cp^{new} = (1 - \lambda) * Cp^{(q)} + \lambda * Cp^{(r)}$$

The boundary λ is an arbitrary select with a worth shifting somewhere in the range of 0 and one and the operator "*" indicates the component by component grid multiplication. This condition yields another incentive for the chromosomes $Cp^{(q)}and \, Cp^{(r)}.$

This computation is done under the proper hybrid likelihood for every chromosome taking an interest in the hybrid activity. This hybrid has an equivalent likelihood of making a point inside the area limited by the two parents.

Mutation Operation

The mutation operator is also used for an equivalent purpose because the crossover operator. However mutation is especially accustomed create some extent close to the present point. so an area search is achieved near the current solution.

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Diversity in a population is additionally maintained by mutation.

During this problem, random replacement technique is employed for mutation operation. is that the body that's chosen to mutate, replaced arbitrarily by a brand new chromosome with an exact mutation probability.

MEDICAL DATABASES

The database is built with over a hundred diagnosed cases of cardiovascular diseases. This database has been collected from Agra and Mathura districts located in Uttar Pradesh, India.

Each case consists of 40 clinical functions which includes age, cough, gender, nausea, blood pressure, fever, blood pressure, electrocardiogram, etc. Clinical features are assigned values 0, 0.5, and 1 depending on the severity of symptoms, with zero representing. Absence and lowest degree or everyday range, 1 representing finest presence or extraordinarily excessive and 0.5 representing intermediate degree or moderate.

A common downside in clinical databases is that the lack of data within the kind of missing data values. In such cases, the substitution means that technique is adopted [6] i.e., the lacking statistics values of incomplete enter report instances are changed with imply values calculated from comparable statistics instances. The new subject is additionally encoded exploitation this scheme.

CONCLUSIONS

• The actual-coded GA mentioned in Section 2 applies to the diagnostic database described in Section 3. The gene value of the fittest chromosome indicates the importance of clinical features for a particular disease. The higher the value of the gene, the greater the importance of the clinical feature for the disease.

The interpretation of gene value by clinicians in decision making for the identification of cardiovascular diseases is largely agreed upon.

• After identifying important clinical features for cardiovascular diseases, a new subject is analyzed and diagnosed.

ACKNOWLEDGEMENTS

I wish to give my thanks to Dr. P.K Saxena for discussions on this study.

REFERENCES

 L. Parthiban , R.Subramanian , "Intelligent Heart Disease Prediction System using CANFIS and Genetic Algorithm", International Journal of Biological, Biomedical and Medical Sciences 3;3 © www.waset.org Summer 2008 157-160.

2. R.Setiono,"Generating concise and accurate classification

cancer diagnosis", Artif. Intell. Med. 18 (2000) 205-219.

- Y.Hayashi, R.Setiono, K.Yoshida, "A comparison between two neural network extraction techniques for the diagnosis of hepatobiliary disorders", Artif, Intell. Med. 20 (2000) 205-216.
- 4. <u>www.ifcc.org/ejifcc/vol14-no2/140206200308n.htm</u>; <u>fuster</u> et al., 2001
- 5. F. Herrera, M. Lozano & J.L. Verdegay, "Tackling Real-Coded Genetic Algorithms: Operators and
- Tools for Behavioral Analysis", Artificial Intelligence Review **12:** 265–319, 1998. 265
- 6. Hongmei Yana, Yingtao Jiangb, Jun Zhenge, Chenglin Pengc, Qinghui Lid, "A multilayer perceptron-based medical decision support system for heart disease diagnosis", Expert Systems with applications

30 (2006) 272-281.

- 7. <u>https://www.who.int/news-room/fact-</u> <u>sheets/detail/cardiovascular-diseases-(cvds), extracted</u> November 2021
- Uyar Kaan & Ahmat Ilhan, "Diagnosis of heart disease using genetic algorithm based trained recurrent fuzzy neural networks", Procedia Computer Science 120 (2017) 588–59, Available Online at www.sciencedirect.com
International Journal of Mechanical Engineering

Storebot: A conversational Chatbot for shopping

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Simplifai

Abstract. Storebot is a conversational chatbot that is designed for shopping from local stores. The old people who are not capable of going stores for shopping and the students who are busy in their study and can't go for purchasing the products. This storebot will help them for shopping from their local market. They can check the availability of the product and if it will not be available this storebot will notify them as it will be available in the store. This chatbot will lake user's request in speech or text. The NLP (Natural Language Processing) and NLU (Natural Language Understanding) will convert this request from human readable to machine readable and process it using backend. The result will again be converted back into natural language that is human readable using N LG (Natural Language Grammar).

INTRODUCTION

A chatbot is a digital assistant that takes user request in human language and respond in text or speech format. It is AI based software that intract with the user in natural language using the technology NLP. Now a dayschatbots are becoming popular as digitalization is increasing in our surrounding. The chatbot name is originated in 1950s by Alan Turing.

Storebot is a chatbot used for local shop. This storebot is similar to google assistant or facebook chatbot. In today's busy life people are not interested to go store to check out the product or shopping as it is time taking. In today's pandemic era going for shopping is very risky although it is necessary. So the storebot is very helpful for those people as well as for the students to save their precious time. The store bot will help the user to check whether the product is available in store not. They can book their required stuff online using storebot and this storebot will inform the user in how much time they order will be ready when they can pick up it. If the product is not available in store so it will ask you to add the product in your wishlist and as the product will be available in store the storebot will notify you.

LITERATURE REVIEW

Chatbots are firstly designed by Alan Turing in 1950s. Chat bots or voice bots are virtual assistant that takes user request through text or voice and respond in natural language using NLP. These are AI based software. Chat bots are used in every field like health area, for FAQs (frequently Asked Questions), in IRCTC, business, ecommerce, online shopping etc. Here we will discuss some AI based chatbots that support in ecommerce and business. Simplify is It is chatbot service provider. They provide ready to quick implementation for any website. They provide customer service chatbot for ecommerce websites based on various store. They provide chatbot for every field of service. It handles all type of customer FAQs. It can help customers in tracking order, assist with payments, prices, shipping and delivery as well as returns and claims.



Figure 1.Simplifai

Dialogflow

Ii is a google cloud product. It is conversational AI based chatbot. It is available in two editions: Dialogflow CX (Advanced) and Dialogflow ES (Standard)

Dialogflow CX are advanced chat bots. It has innovative capabilities for large or complex use.

Dialogflow ES are Standard chat bots. It is designed for small to medium and simple to moderately complex type of problem.

User can connect to this chatbot from anywhere on their desired platform. If a customerwants to do any query or need to access any information, the chat bot offer an instant and satisfying reply who need ant quick and accurate responses.

Chatfuel

Chatfuel is founded in 2016. It provides one of the best chatbot solution for ecommerce business. It focused on chatbot for social media like facebook, instagram. It is easy to use with drag and drop UI based with inbuilt NLP.

Key features:

□ Mainly focused on social media

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- □ Ready-to-use templates
- □ SupportsImages, video and audio
- □ Supports in-app payments via Facebook (US users only)

□ Analytics integrate it with Dashbot.io, Botanalytics and YandexMetrica

- □ Integrate with 3rd party tools like Calendly, Zapier
- □ It can build and manage retargeting campaigns
- □ It takes profit for Facebook profile data for retargeting



FIGURE 2. Dialogflow

FIGURE 3.Chatfuel

Microsoft Bot Framework

It works with Azure Cognitive Services. It is a voice chat bot that speaks. It can recognise user's voice and face. Microsoft uses its own LUIS (Language Understanding Intelligence Service) to configure business logic with advanced NLP and AI training capabilities.

Key features:

- Pre-built dialog "blocks"
- Based on Natural language processing
- Recognizes voice and can speak
- Branded voice
- □ Recognise face and Image also
- Adaptive cards
- Big Data integration
- Provide SDKs for IoT
- Deployment to Azure



FIGURE 4. Microsoft bot Framework

COMPONENTS OF CHATBOT

A chatbot consists of 7 components. They are as follows:

Natural Language Processing (NLP)

Natural language processing (NLP) is used to convert user's request that is in natural language into structured data that machine can understand easily. NLP processes following steps:

Tokenization

It is also termed as lexical analysis. It breaks the sentence into separate words called "tokens" that are connected with the meaning of other words of the whole sentence.

Normalization

It is also termed as syntactic analysis, It checks the words for typos and make the standard form of these. For example, the word "bcoz" would be converted into "because",

Entity Recognition

It is the process to search for keywords for the recognition of the conversation-topic.

Semantic Analysis

It is the process of knowing the meaning of a sentence by understanding the meaning of each word and its relation to the overall structure.

Natural Language Understanding

NLP is the combination of Natural language understanding (NLU) Natural Language Generation (NLU).NLU focuses on understanding the meaning of human speech by recognizing patterns in unstructured speech input. NLU process has 3 components:

Dictionary

It checks the meaning of a word

Parser

It is the process to check whether the syntax of the text conforms to the rules of the language

Grammar rules

It is used to break down the input based on sentence structure and punctuation

NLU enables chatbots to identify users' request and generate a response based on training data.

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Backend

The backend of the chatbot allows handling messages received from several channels and processing them with NLP (natural language processing). The backend of a chatbot connects with the database of the shop system to make the conversation happen. It contain product pricing, availability information.

Natural language generation (NLG)

Natural language generation (NLG) plays important role. NLG is used to read the machine language data into natural language so that it becomes human readable. After processing NLG generate response in following steps:

□ Content determination: In this step existing data from knowledge base is been filtered to produce correct response.

Data interpretation: In this process response is generated after understanding the pattern of existing data from database.

Document planning: In this process response is generated in structured manner.

□ Sentence aggregation: In this process expressions and words for each sentence are compiled.

Grammaticalization: In this process grammar rues are applied such as punctuation and spell check.

□ Language implementations: The processed data is checked to ensure that the response is in natural representation by putting it into language templates.

User Interface

It is the front end of the chatbot through which user will interact and do questions. It act like virtual assistant that serve the user requirement in speech or text.

Here in this paper I am not giving detail of interface. User interface and other components will be described in the next paper.

GENERAL ARCHITECTURE

In this paper I am giving the general architecture of store bot. I will explain detailed architecture in my next paper. Following diagram explains working of chatbot for store.



FIGURE 5.General Architecture of store bot

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User interface will be interactive and user friendly. User will send the request using speech or text. NLU will make the request machine readable and related query will be formed and send to knowledge base. The produced result will be converted back to natural language using NLG. Detailed discussion will be done in our next paper.

CONCLUSION AND FUTURE WORK

This store bot will help people to check out the store for product availability, booking their order, payment the order. User can do all this without visiting the store. The store bot will act like virtual assistant. That will assist user on their demand. The proposed work report will be available in our next paper with full description along with working architecture and its component.

REFERENCES

1. Robert Söldner, Sophia Rheinländer, Tim Meyer, Michael Olszowy, Jonas Austerjost. "Chapter 183 Human– Device Interaction in the Life Science Laboratory", Springer Science and Business Media LLC, 2022.

- 2. www.research.aimultiple.com
- 3. www.elasticpath.com
- 4. www.dinarys.com
- 5. www.thegradient.pub

Plant Disease Detection using SVM Algorithm and Neural Network Approach

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ABSTRACT: Plants have become an important source of energy, and are a fundamental piece in the puzzle to solve the problem of global warming. There are many types of diseases which are present in plants. To detect these diseases pattern are required to recognize them. A common approach in this case is the use of remote sensing techniques that explore multi and hyper spectral image captures. The methods that adopt this approach often employ digital image processing tools to achieve their goals. There are many types of pattern recognition algorithm which gives detection of disease with accuracy. In the existing work back propagation and principal component analysis are used to detect plant diseases. These algorithms are learned from training supervision in neural network. There is an issue of accuracy in these algorithms. These algorithms are able to detect diseases in plant but not in an accurate way. So to increase the accuracy for plant detection a new method will be proposed. In this method BP, PCA are combined with SVD to increase the accuracy of the detection. **KEYWORDS:** Image Processing, Back Propagation, SVM, PCA, SVD.

Date of Submission: 09-02-2022 Date of acceptance: 23-02-2022

I. INTRODUCTION

Image Processing is a procedure to change over an image into digital shape and play out a few operations to get an enhanced image and concentrate valuable information from it. It is most recent innovations and its applications in different parts of a business. Image Processing shapes center exploration zone inside designing and software engineering trains excessively [2]. There are two sorts of images which are analog and digital [6]. The images ought to be accessible in digitized structure is the most necessities for image processing of images, that is, arrays of limited length binary words. For digitization, most importantly the given Image is examined on a discrete grid and every specimen or pixel is quantized utilizing a limited number of bits. The digitized image is handled by a PC. To show a digital image, it is initially changed over into analog signal, which is scanned onto a presentation [8]. Back propagation gives an approach to train networks with any number of shrouded units organized in any number of layers. Indeed, the network does not need to be sorted out in layers - any pattern of availability that allows a halfway requesting of the hubs from input to output is permitted.

Networks that esteem this constraint are called feed forward networks; their association pattern shapes a coordinated non-cyclic graph. Once a network has been organized for a specific application, that network is adapted to be trained. At that point, the training, or learning, starts. Supervised and unsupervised are the two training for trained sets. It physically or by giving the craved outputs the inputs, Supervised training includes a system of furnishing the network with the fancied output. Unsupervised training is the place the network needs to make brains of the inputs without outside help or obstruction. The unlimited heft of networks use supervised training. Unsupervised training is utilized to play out some underlying portrayal on inputs. Its fame originates from three key properties [9]. In the first place, it is the optimal (regarding mean squared error) linear plan for compressing an arrangement of high dimensional vectors into an arrangement of lower dimensional vectors and afterward reproducing. Second, the model parameters can be figured specifically from the information. Third, pressure and decompression are straightforward operations to complete given the model parameters – they require just matrix increases.

Radial premise functions are food forward networks comprising of – A shrouded layer of radial kernels and – An output layer of linear neurons. The subsequent concealed space is regularly of higher dimensionality than the input space – The output layer performs linear regression to anticipate the sought targets [10]. These are genuine esteemed capacity whose worth depends just on the separation from the cause. Sums of radial premise functions are ordinarily used to rough given functions. RBFs are additionally utilized as a part of bolster vector classification [11].

LITERATURE REVIEW

Π

In [1] a study on various classification techniques that can be utilized for plant leaf diseases classification is done. This paper gives a diagram of various classification techniques utilized for plant leaf disease classification. The k- nearest-neighbor strategy is maybe the least difficult of all algorithms for predicting the class of a test illustration. A conspicuous hindrance of the k-NN strategy is the time complexity of making forecasts. Moreover, neural networks are tolerant to noisy inputs. Be that as it may, it is difficult to comprehend structure of algorithm in neural network. SVM was discovered focused with the best accessible machine learning algorithms in arranging high-dimensional information sets. In SVM computational complexity is decreased to quadratic enhancement issue and it's anything but difficult to control complexity of decision principle and frequency of error. Drawback of SVM is it's hard to decide optimal parameters when training information is not linearly divisible.

In [3] a philosophy for identifying plant diseases early and precisely, utilizing different image processing techniques and counterfeit neural network (ANN). The framework created here is for plant diseases acknowledgment, the advancement of good classification techniques and exact components is critical keeping in mind the end goal to run the framework continuously. In this way proposed approach which depends on Gabor channel for highlight extraction and ANN classifier for classification showed signs of improvement results and acknowledgment rate up to 91%. An ANN based classifier is embraced which utilizes the mix of shading and surface components to perceive and characterize distinctive plant diseases. The outcomes are empowering and guarantee the advancement of a decent machine vision framework in the zone of acknowledgment and classification of plant diseases.

In [4] a system to perceive the disease of two plants. This examination has been done on two grapes plants and two wheat plants to enhance exactness utilizing image processing techniques. Back propagation (BP) networks were utilized as the classifiers to distinguish grape diseases and wheat diseases, individually. The outcomes demonstrated that identification of the diseases could be successfully accomplished utilizing BP networks. While the magnitude of the element information were not decreased by utilizing principal component analysis (PCA), the optimal acknowledgment results for grape diseases were gotten as the fitting exactness and the forecast exactness were both 100% and that for wheat diseases were acquired as the fitting exactness and the forecast exactness were both 100%. While the measurements of the element information were lessened by utilizing PCA, the optimal acknowledgment result for grape diseases was acquired as the fitting exactness was 100% and the forecast precision was 97.14%, and that for wheat diseases was gotten as the fitting exactness and the expectation precision were both 100%.

In [5] a system to distinguish diseases of plants utilizing image processing. This goes under automatic plant disease identification. There are number of colors for disease set apart as a dark spot and intensity for color segmentation. RGB image can be utilized for color segmentation. In this paper an examination of the result of CIELAB, HSI and YCbCr color space during the time spent disease spot identification is finished. Image smoothing is finished by middle channel. Otsu technique on color component to distinguish the disease spot can be connected for limit values. An algorithm which is autonomous of background plant sort, noise and disease spot color was produced and examinations were passed out on various "Monocot" and "Dicot" family plant leaves with both, noise free (white) and noisy background.

In [12] authors examined about the noisy image and connected Adaptive median filter to expel noise from the image and gives output as a filtered image. The evaluated Error and average error of the qualities put away in filtered image matrix have been ascertained with reference to the qualities put away in unique information matrix with the end goal of checking of appropriate noise expulsion. Presently information of every pixel has been changed over into binary number (8 bit) from decimal qualities. This procedure keeps on creating new information matrix with new distinctive arrangement of qualities. This information matrix has been taken as unique information matrix and spared in information bank. Presently for acknowledgment, another test image has been stepped as salt and pepper noise insertion, evacuation of noise utilizing adaptive median filter as specified before have been connected to get another test matrix.

In [7] authors depict the investigation on plant diseases which are obvious by the naked eye and effortlessly perceptible. Creepy crawlies assumes real part to damage nay crop or plant. The pesticides and bug sprays are not generally supportive for the development of the crop, some of the time it contains poisons which may hurts some flying creatures moreover. The fundamental point of this paper is to gauge the effected territory of stem and base of the plant which is contaminated with disease. It results in low throughput. This paper gives different development techniques to the detection of plant diseases utilizing image processing. This will enhance throughput and identifies diseases automatically.

III. SUPPORT VECTOR MACHINES(SVM)

Based on statistical learning hypothesis, support vector machines (SVM) calculation has a strong mathematical hypothetical establishment and thorough hypothetical investigation, which has the advantage of hypothetical fulfillment, worldwide optimization, adaptability, and great generalization capacity. It is to a great extent tackled the past issues of picking machine learning model, over-fitting, non-linear, the scourge of dimensionality, local minimum points etc. It utilizes the structural danger minimization standard, which minimizes the observational danger; in the meantime effectively enhance generalization capacity of the calculation.

The calculation is to utilize genetic calculation to advance the SVM model parameters, the fundamental strides of it are as per the following:

a. Choose the underlying population of individuals haphazardly;

b. Evaluate the fitness of every individual in that population;

c. Select another generation of population from the past generation by utilizing selection operator;

d. Take the crossover and mutation operation on the present population, then take the evaluation, selection, crossover and mutation operation on the new breed, and proceed.

e. If the fitness capacity estimation of ideal individual is sufficiently expansive or the calculation have run numerous generations, and the ideal fitness estimation of the individual can't be changed clearly, then we get the ideal estimation of kernel capacity parameter , punishment component, and coldhearted loss capacity, and we can likewise get the ideal classifier by the preparation datum.

Keeping in mind the end goal to utilize a SVM to take care of a grouping or regression issue on data that is not linearly separable, we have to first pick a kernel and relevant parameters which you expect may outline non-linearly separable data into a feature space where it is linearly separable. This is a greater amount of a workmanship than a definite science and can be accomplished observationally - e.g. by trial and error. Sensible kernels to begin with are the Radial Basis, Polynomial and Sigmoidal kernels.

IV. PROPOSED TECHNIQUE

There are three types of algorithm which will be used in the proposed methods. These methods are:

A. Back-propagation Algorithm (BPA): Back-propagation provides a way to train networks with any number of hidden units arranged in any number of layers. In fact, the network does not have to be organized in layers.

B. Principal Component Analysis (PCA): Principal Component Analysis is a mathematical Procedure that makes use of orthogonal transformation to convert a set of observation of correlated variables and uncorrelated variables.

C. Singular Value Decomposition (SVD):

Singular Value Decomposition (SVD) is said to be a significant topic in linear algebra by many renowned mat hematicians. SVD is robust and reliable orthogonal matrix decomposition method. Due to SVD conceptual and stability reasons, it becomes more and more popular in signal processing area. SVD is an attractive algebraic transform for image processing. SVD has prominent properties in imaging.

The main SVD properties that may be utilized in image processing. Although some SVD properties are fully utilized in image processing, others still needs more investigation and contributed to. A key property of SVD is its relation to the rank of a matrix and its ability to approximate matrices of a given rank. In first two algorithms BPA and PCA has less accuracy which is unable to detect accurate diseases in plants. But with the help of SVD we will enhanced the accuracy of the plant diseases so that it can be detected accurately. Following research methodologies are used and are explained in flowchart:-



Figure 1 Flow Chart

There are two data sets in which images are placed for comparison names as training data image and another one is train data image. After load both image we have to do extreme detection in which we match each and every position of image which we have to compare with training image. Then we generate descriptors which is a sparse feature representation that consists of both feature extraction and detection. We only use the feature extraction component. In the feature consistence resistance the points or descriptors which we find in the basic image with same dimensions similarly in another image, so we have to used consistence approach for matching between two images. In the scale angle point one image is placed at 90 angle another will place at different angle then their position of object in image will be same. After that some points are not clearly seen when we change their angles, so filtering process used to filter image or object in image. Then matching process start in which according to descriptors or key points found in basic or compare image. Using that it will match and give the result how many number of points will match in the final output. After that find the black pixel in the image because in the leaf or plant where is another color spot which is different from Green color that is shown in black color pixel after that it will show healthy or diseased image based on black pixel or spot image. Then result image is declared.

V. EXPERIMENTAL RESULTS

As shown in figure 2, the dataset is taken which contain multiple images and this dataset will be put into the folder named as training dataset. The second folder called train dataset contains some images. The images of the train folder will match with the images of the trained folder for the feature matching SIFT algorithm will be applied.



Figure 2 Healthy Part of leaf



Figure 3 Diseased Part of leaf

As shown in figure 3, the images of the train folder will match with the images of the trained folder for the feature matching SIFT algorithm will be applied. In the figure, leaf whose features are matched will be extracted and in that leaf where are the diseases will be detected using enhanced SVM. The black background from the leaf will be extracted to know that how much portion of the leaf will be cut.



Figure 4 Area of Disease

As shown in figure 4, the SATURATION value of infected leaf will be calculated which helps to increase detected accuracy. In this figure the enhanced SVM algorithm will be applied which will separate the uninfected portion of the leaf. The enhanced SVM algorithm will separate the infected part of the leaf. The SVM shows the portion that how much part is infected which is 5.54 %

VI. CONCLUSION

In this study, two types of diseases of grapes and wheat was detected named grape downy mildew and grape powdery mildew and wheat stripe rust and wheat leaf rust with BP networks. Three color features color, texture and shape and their combination was used. Image recognition using BP network was also conducted based on dimension reduced data obtained by PCA. PCA was used to reduce the dimensions of feature data of extracted images. By this method, the plant diseases can be identified at the initial stage itself and control can be obtained. Although the optimal recognition result were good and get the required results when the dimensions of the feature data was reduced by the PCA but when compared accuracies was lower. Better recognition results may be obtained if some other methods could be used to reduce the dimensions of the feature data.

REFERENCES

- Savita N. Ghaiwat, Parul Arora, "Detection and Classification of Plant Leaf Diseases Using Image processing Techniques: A Review", International Journal of Recent Advances in Engineering and Technology, ISSN(online) :2347-2812, Volume 2 Issues 3 2014
- [2]. Prof. Sanjay B. Dhaygude and Mr.Nitin P.Kumbhar, "Agricultural plant Leaf Disease Detection Using Image Processing" International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering Vol. 2, Issue, January 2013
- [3]. Anand.H.Kulkarni and Ashwin Patil R. K, "Applying image processing technique to detect plant diseases", International Journal of Modern Engineering Research (IJMER), Vol.2, Issue.5, Sep-Oct. 2012 pp-3661-3664 ISSN: 2249-6645 2012
- [4]. Haiguang Wang, Guanlin Li, Zhanhong Ma, Xiaolong Li, "Image Recognition of Plant Diseases Based on Backpropagation Networks", 5th International Congress on Image and Signal Processing (CISP 2012) 2012

- [5]. Piyush Chaudhary Anand K. Chaudhari Dr. A. N. Cheeranand Sharda Godara "Color Transform Based Approach for Disease Spot Detection on Plant Leaf", International Journal of Computer Science and Telecommunications [Volume 3, Issue 6, June 2012
- [6]. Rani Pagariya and Mahip Bartere, "Review paper on identification of plant diseases using image processing technique", 2014
- [7]. Jayamala K. Patil and Raj Kumar, "Advance in image Processing for detection of plant disease", Journal of Advanced Bioinformatics Applications and Research ISSN 0976-2604 Vol 2, Issue 2, June-2011, pp 135-141
- [8]. Prof. Sanjay B. Dhaygude and Mr.Nitin P.Kumbhar, "Agricultural Plant Leave detection using image Processing", International Journal of Advanced Research in Electronics and Instrumentation Engineering Vol. 2, Issue 1, January 2013
- [9]. Yan K, Rahul Sukthankar, "pca-sift: a more distinctive representation for local image descriptors" Computer Vision and Pattern Recognition, 2004, CVPR 2004., Proceedings of the 2004, IEEE Computer Society Conference on ,2004 pp.506-513.
- [10]. Kim, D. G., T. F. Burks, J. Qin, and D. M. Bulanon, "Classification of grapefruit peeldiseases using color texture feature analysis", International Journal on Agriculture and Biological Engineering, 2(3): 41-50, 2009
- [11]. Arivazhagan, S., R. N. Shebiah, S. S. Nidhyanandhan, and L. Ganesan, "Classification ofcitrus and non-citrus fruits using texture features", Computing Communication and Networking Technologies, ICCCNT-2010.
- [12]. Quraishi, M.I.; Choudhury, J.P.; De, M., "Image recognition and processing using Artificial Neural Network," Recent Advances in Information Technology (RAIT), 2012 1st International Conference on , vol., no., pp.95,100, 15-17 March 2012

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Support Vector Machine Based Classification of Leaf Diseases

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Abstract: India is a agriculture land which has got vast expansion of its roots which belong to the surface area expansion which makes country a productive channel in it is values and culture essence practically cover all major expansions . This land belongs to the agro - farming techniques which are more organized and later displacement of the techniques which bind up the metereology of the roots which grow with the advanced atmosphere making country a [productive channel.

Leaf diseases which make microorganisms leaf blots visible to naked eyes which makes up the detection of diseases appear in the section of the disease which makes up the visibility of the diseases such as rot, blight , foliar . So, the image processing techniques can be used in agricultural sector. The research work presents a support vector machine classifier algorithm by using MATLAB R2017a for the classification of leaf diseases such as Foliar , Blight leaf spot, Bacterial Blight and so on. In this section we are discussing about MATLAB and combination of machine learning which defines the disease detection using Support Vector Machine , K- means Clustering, gray level clustering random forest and logistic regression

Keywords: leaf diseases; median filter; k-means clustering; gray level co-occurrence matrix; support vector machine

INTRODUCTION

Most of the diseases symptoms are found in leaves, stem and fruit. The image processing can be used in the leaf diseases detection and classification system. The common diseases of leaf are Bacterial Blight, Anthracnose, Alternaria Alternata, and so on. Such diseases are commonly found on mango, rice, watermelon, and others leaf The leaf disease which prepares up the making of leaf diseases which binds up the process of agriculture detection through various models Foliar, Cirtus fruits small reddish brown circular spots appear on the leaves. 1. Anthracnose: Appears as small regular or irregular dull

violet or black leaf spots with yellowish halos. Leaves turn yellow and fall out.

2. Bacterial Blight: Appearance of one to several small water soaked, dark colored irregular spots on leaf

3. Foliar Disease - Apple fruit an edible fruit makes up the seeds swollen and tender , This disease is commonly known as in for the dark spots visible on leaf .

2. 3.LITERATURE REVIEW

The leaf detection based upon the analysis of the leaf detection using support vector machine, visual analysis, digital image processing and the disease studied for in

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guidance to improve the nature of the healthy and unhealthy leaf. The leaf detection used various paradigms which makes up the leaf disease detection via K-means clustering, random forest, logistic regression. Logistic regression studies about the nature of leaf detection which makes up the color of leaf specifically stating the parameters of the nature which comes with the detection of the nature which covers up with the binding opf the foliar disease expressed in paper.

The nature of the leaf disease detection which comes up with the viral nature or atmosphere which makes up the new advent of technologies like Logistic regression , K- means clustering , support vector machine , Gray - Level ,K- means clustering , Concurrence matrix . Digital image processing .

3. METHODOLOGY

The methodology of the research work can be divided into four stages such as image preprocessing, image segmentation, feature extraction, and disease detection and classification. Block diagram of the system is shown in Figure 1 [4].



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3.1 Logistic Regression

Machine Learning aims at providing he performance, experience and tasks .It Is being explicitly being programmed .Machine learning aims at providing the nature of expressing the performance , experience and tasks . Basically we are discussing upon the nature of the disease which is laid upon the articles of the mentioned foliar disease in the discussion of the paper

Logistic regression is basically a binary classification, which aims at the the study of the diseases which are clearly visible with the naked eyes. This classification study aims the providing the nature of the detection which imparts the color being independently visible to our eyes

Table 1. Some Colors and Three HIS Intensity Value



Original Image

















Sr. No		Percentage of
	Disease Type	Accuracy
1.	Alternaria Alternata	80.6452 %
2.	Anthracnose	82.2581 %
3.	Bacterial Blight	80.6452 %
4.	Cercosporal Leaf Spot	82.2581 %
5.	Healthy Leaf	83.8710 %

4. CONCLUSION

Fom the conclusion we derive that the nature of leaf disease is .93333% accuracy derived .This results aims at providing the nature of the disease which derives the foliar and other diseases .

5. ACKNOWLEDGEMENTS

6. **REFERENCES**

[1] Ko Ko Zaw, Zin Ma Ma Myo, and Wah Hlaing. 2018. "Multiclass Support Vector Machine Based Detection and Classification of Leaf Diseases", 11th National Conference on Science and Engineering, YTU, Yangon, Myanmar

[2] A. Miyatra, S. Solanki. 2014. "Disease and Nutrient Deficiency Detection in Cotton Plant," International Journal of

Engineering Development and Research, vol. 2, no 2, pp. 2801-2804.

[3] V. A. Gulhane, A. A. Gurjar. 2011. "Detection of disease on cotton Leaves and Its Possible Diagnosis", International

Journal of Image Processing (IJIP), vol. 5 : no 5 : pp. 590-598.

[4] S. S. Panchal, R. Sonar. 2016. "Pomegranate Leaf Disease Detection Using Support Vector Machine," International

Journal of Engineering and Computer Science, vol. 5, no 6, pp. 16815-16818.

[5] V. M. Tiwari, T. Gupta. 2017. "Plant Leaf Disease Analysis using Image Processing Technique with Modified SVM-CS Classifier," International Journal of Engineering and Management Technology, vol. 5, no. 1, pp. 11-17.

[6] A. N. Rathod , B. A. Tanawala, V. H. Shah. 2014. "Leaf disease detection using image processing and neural network", IJAERD vol. 1, no. 6, June, pp. 1-10.

[7] S. Jayaraman, S. Esakkirajan , and T. Veerakumar. 2009. Digital Image Processing. U.S.A.: McGraw Hill Co,.

[8] Myo Myo Han. 2017. "Analysis on Detection Improvement of Textile Fabric Defects using Gray Level Cooccurrence Matrix for automatic system," M.E. thesis, Dept. Electronic Eng., Yangon Technological University., Yangon, Myanmar.

[9] D. Gadkari. 2004. "Image Quality Analysis Using GLCM," M.E. thesis, University of Central Florida, Orlando, Florida.

[10] S. S. Patki, G. S. Sable. 2016. "Cotton Leaf Disease Detection & Classification using Multi SVM," International Journal of

Advanced Research in Computer and Communication Engineering, vol. 5, no. 10, pp. 165-168.

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Antennas for Modern Wireless Communication System: A Survey

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Abstract. Day by day technology advances, antennas become more common in a variety of devices such as mobile phones, laptop computers, palmtop computers, smart watches, and other portable gadgets. Because of their flexible nature, antennas are now widely used in the construction of smart cities. They may be configured in a variety of sizes to meet specific needs. The radio communication technologies need the development of innovative and better organized antenna designs. This paper presents a survey on antennas for modern wireless communication and future aspects. Recent researches are examined and presented to illustrate the function and application of antennas on wireless communication systems.

INTRODUCTION

When used in conjunction with a transmitter or receiver, an antenna is a metallic model and also known as an aerial in broadcasting engineering. An antenna is the crossing point between radio waves peripatetic through space and electric currents flowing in the course of metallic conductors [1]. During radioing, a radio source provides an electric current to the antenna's end points and then an antenna emits radiation from the current as an electromagnetic effect. An antenna cut off the portion of a radio wave's power in order to generate an electric current at its end points, which is subsequently transferred to an amplified receiver. Antennas are required parts of any broadcasting apparatus [2].

Wireless communication system components have been created in larger quantities in recent years due to their low profile, low production cost, and simplicity of consolidation into circuit boards. Wi-MAX, GSM and Wi-Fi apps are popular because they provide services such as SMS, audio and video telephony, turbo data transmission, and internet access at any time and from any location. These applications are typically connected with mobile phones, laptop computers, and other portable devices. Various antennas are included in these devices to provide essential wireless practices. However, in present wireless communication system antennas are widely used because of their advantages, despite shortcomings such as restricted transmission capacity, low gain and low power handling capability.

In the previous fifteen years, mobile and wireless communication networks like GSM, 2G, 2.5G and 3G have grown dramatically. In cellular networks, the carrier frequency range for multimedia applications is limited from 700MHz to 2.5GHz. The worldwide spectrum transmission capacity allowance for all mobile networks does not exceed 800MHz, with each supplier receiving around 200MHz over all available cellular bands [3]. Each age group of mobile technology has brought with it a rise in data transmission speed, as well as increased connection quality and additional functions. Since 2009, fourth generation (4G) technology has been accessible worldwide. The fifth generation (5G) network will allow a variety of new facilities, together with those connected to the Internet of Things (IoT) and the notion of smart cities. 5G mobile communication technology supports a wide range of multi-

media services, including teleconferencing apps and interactive games [4]. The given below table number 1 shows the different standard frequency band range.

TABLE 1	. Frequency	band and	their range
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Frequency Band Name	Range
High Frequency/(HF)	0.003 GHz to 0.03 GHz
Very-High Frequency/(V-HF)	0.03 GHz to 0.3 GHz
Ultra-High Frequency/(U-HF)	0.3 GHz to 3 GHz
Super-High Frequency/(S-HF)	3 GHz to 30 GHz

LITERATURE REVIEW AND RECENT RESEARCHES

This segment focuses on numerous predictable antennas that operate in various bands for various wireless applications.

In [5], Use of parasitic slot array antennas in a town wireless sewage sensor network is described. To illustrate the effect of a restricted beam contemplating on a genuine sensor network system, the usage of parasitic antennas is studied. The combination of an electrically steerable beam shaping and an angular diversity method used by this antenna permitted it to modify its radio surrounding and identify optimal reception quality. The sensor measurements demonstrate that the antenna's cleverness significantly upgrade the packet response rate and receive signal strength indicator (RSSI). However, when it compared to an evenly radiated dipole antenna packet rate increased by 64% and the RSSI increased by 10dB. The sensor network findings reveal that the manholes cover antenna's tunability and angle diversity considerably enhances packet response rate by wisely adjusting to the neighbouring urban radio surroundings.

Lee, et al [6] discussed a printed slot loop antenna with tunable strips for 2.4GHz and 5.0GHz wireless practices. It has a slot Vol. 6 No. 3(December, 2021)

design and a couple of adjustable strips with permitted impedance transmission capacity and impedance matching, and it can function in the 2.4GHz and 5.0GHz WLAN bands. The computation results of the planned antenna indicate rather high-quality omni-directional patterns in the x-z coordinate for the primary functioning frequency. The computation grades of fabricated antenna corroborate pretty well with the expected values, revealing that 2.4GHz and 5.0GHz WLAN practices work successfully.

Jin-Gang, et al [7] detailed how to build a small inner wide band antenna for the wireless USB dongle appliance. Pliable a metal plate with two bevelled edges is a simple way to make an antenna. By adding a short-circuited pin attached to the structure ground plane, the antenna achieves a broad impedance transmission capacity of about 8GHz (2.5GHz to 11GHz range). A parametric analysis is done after measuring the antenna gain and radiation shapes. The effects of a computer on radiation features are investigated.

Wu, et al [8] discussed a revolutionary low-profile scalable omni-directional antenna that may be installed beneath a solar panel. A 72x72x11.5 mm³ solar-antenna 3-dimensional arrangement running at 2.4GHz exhibits the configuration's potential for the deployment of autonomous integrated wireless antenna junction. The antenna scale may be readily adjusted to accommodate different solar board scales dependent on the power requirements of a sensor. This research might lead to the deployment of self-sustaining ubiquitous sensors in "rugged" environments such as vehicles, highways, trains, roofs.

Guo, et al [9] discussed a novel compact wideband patch antenna. The antenna is made up of two basic patch pairs that have opposing phase feeds. An antenna of roughly 54.5x22x20 mm³ is made and tested to account for the link between two patches in the design. In the 2.6-6GHz frequency range, this antenna has an agile reflection coefficient of less than -9.5dB. The antenna's radiation performance is excellent over the whole frequency range. This antenna can provide about 87% bandwidth along with good radiation property.

In [10], the topic of discussion is a small stacked dipole antenna with a directed radiation range for wireless practices. This antenna model has a front-to-back ratio of 15.00dB and an overall size of 44x18x4.8 mm³. The model employs the pairing of electromagnetic resonance of the linked slabs to create directed radiation features. A new single-layered metal slab antenna construction is developed for acquiring directional radiation properties. The stacked metal plate, electric and magnetic resonances are coupled to create directed radiation coverage. The front-to-back ratio of the design is 15dB.

In [11], a 4-antenna system with good isolation for portable wireless gadget is presented. It has been recommended that a mobile terminal with 4-antennas and adequate isolation can be used. Antennas are well-planned and put on the circuit board in a handy location. Using coupling feeds, a short strip and

parasitic strip, the primary antenna may productively cover the GSM1900/1800/900/850UMTS, LTE2500/2300/700 and 2.5GHz WLAN bands. Because of their vertical structure, the 3-auxiliary antennas operated successfully in the frequency band range of 1880–2690MHz while occupying a little amount of area. The observed isolation among any couple of antennas is greater than 15.00dB, and the computation effectiveness is greater than 40.00%.

He, et al [12] describes a new Vivaldi antenna for automotive wireless communication networks. For IEEE 802.11a (4.9GHz–5.935GHz) WLAN, an enhanced Vivaldi antenna with crosswise slots and planar directors is planned and produced. It upgrades the standard of IEEE 802.11a (4.9GHz–5.935GHz) WLAN and other (2.4GHz– 4.9GHz) wireless systems.

Zhang, et al [13] discusses the features of a base station antenna with changeable band notch features. The initiation process involves a few window-type slits which are mounted on the radiating patches of magneto electric dipole. It has an impedance transmission capacity of 2.39GHz–2.52GHz in the 1.825GHz–2.925GHz range. It has more functions and performs better.

Yeoh, et al [14] presented an antenna which is a conical monopole antenna for multiple wireless practices. This antenna model proposed for ultra wideband features and other wireless practices. The recommended antenna arrangement is suitable with various wireless standards, i.e., WiMAX (2.5GHz–5.5GHz), Wi-Fi (2.4GHz), Bluetooth (4.0, V1.0–V4.0) and wireless universal serial bus (3.10GHz–10.60GHz). It also has an appropriate frequency response in the X-band (8GHz-12GHz) and Ku-band (12GHz–18GHz) for satellite communication close-range radar.

Deng, et al [15] described a MIMO antenna with increased isolation for WLAN practices. This antenna is intended to span the WLAN spectrum of 2.4GHz or 5GHz. The planned MIMO antenna is tranquil of the pair balanced meandering inverted-F antenna components separated by approximately 0.115 λ_0 of the minor band. A good isolation is obtained in lower and upper bands by creating two unlinked devices, an indirect resonant branch and a reversed T-shaped slot fixed on the ground respectively. It supports both the 2.4GHz and 5GHz WLAN bands.

Zhai, et al [16] discusses a revolutionary low-profile antenna which has dual-band and dual-polarization feature for WLAN practices. The antenna can produce low-profile and unidirectional radiation pattern by adding an artificial magnetic conductor surface. At 2.4GHz, the suggested antenna has a height of 0.088 λ_0 . It can also deliver measured relative bandwidth of 15.5% (2360MHz-2760MHz) and 9.5% (5120MHz-5620MHz). It is feasible to attain better than the 22dB port-to-port isolation. With peak gains of 7.2dBi in the lower band and 7.3dBi in the higher band, stable radiation patterns are acquired. The antenna is suitable for usage in multi-band base stations for WLAN practices.

5G AND MICROSTRIP ANTENNA

In this section we will explore some microstrip antenna and their use in 5G technology. 5G technology is now very popular and microstrip antenna plays a vital role in it.

5G Characteristic

The characteristics of 5G technology are shown in table 2:

TABLE 2.	5G	Characteristics
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Technology	Characteristic
	 Data rates are up to 10Gbps 10 to 100 times gain in speed over 4G and 4.5G networks
56	• The number of connected devices per unit area may be increased up to 100 times (compared with 4G LTE)
	1000x per unitt area bandwidth 1-millisecond latency
	 The network's energy consumption is cut by 80-90% Battery life of a low-power IoT (Internet of things) gadget can last up to 8-10 years



Millimeter Wave mobile communication operates at frequencies of 28GHz and 38GHz using high dimensional antenna arrays in base stations and a small portable wireless appliance [17].

This study discusses a 5G mobbile communication antenna of the future. This antenna comprises a couple of rectangular patch elements placed on a single coating 'RT 5880' substrate with a transfoormer connected impedance identical network that assists a highh gain of 9.05dB and an efficiency of 83%. At the centre frequency of 38GHz, this antenna performs well in ter ms of antenna characteristics like gain, directivity, return losses, impedance, transmission capacity, and efficiency [18].

The notion of millimetre wave in mobile communication will engage in a regime change in worldwide cellular arrangements, and this may be accoomplished by employing a phased array antenna or steerable directional antenna. This simple miniaturised antenna model method to phased array may aid in the devvelopment of expected 5G technologies.

This antenna can be used up to 28GHz to 38GHz range.

Small Microstrip Antenna for 5G Wireless Communication System

In this, a tiny microstrip monopole antenna capable of millimetre wave communication is used. It is built of 1.6mm thick FR4 and was organiseed as a planar-fed single-band by putting rectangular openings on a square patch for a simple and small structure. A s a consequence, the propounded antenna was simullated in the HFSS software and several antenna properties, such as radiation patterns and gain, were deliberated across a particular frequency range. The return-loss transmissionn capacity was calculated to be 0.716GHz centred



FIGURE 1. The antenna's gain (adapted from [19])

This antenna is suitable for usse in current communication systems, particularly wireless communication. A compact microstrip antenna is a reectangular patch that is electrically tiny and slot-loadded to function in a single band. Gain is satisfactory and the resonance frequency is under the Ka band frequency rannge.

Compact Wideband-Printed Antenna for 5G Wireless Communication System

The design technique employing the slotted partial ground plane is far more adaptaable for enhancing antenna performance. A complete model instruction for estimating antenna size is provided, whhich is based on parametric and mathematical investigation. The consequences of changing the length of the ground and the location of the slot in the ground plane are explored. Thhe simulation was done with the help of HFSS softwarre.

The created antenna is intended for usage in the super-high frequency (SHF) spectruum's C band, as well as the n77 (3.30GHz-4.20GHz) and n78 (3.30GHz-3.80GHz) bands of frequency range in 5G-frequency bands. The antenna constructed has a wide transmission capacity (700MHz) and a low reflection coeffficient of 31.15dB [20].

This technology may be used to extend the operational frequency band of rectangular printed antenna system in operation without changing the patch form. The HFSS programme is used to do the parammetric analysis. The antenna is capable of covering 5G wireless bands such as the n77 band and n78 band.

The geometry of the antenna is shown in below figure 2:



FIGURE 2. Plannned shape of small wideband-printed antenna (adapted fromm [20])

Broadband Microstrip Antenna for 5G Wireless **Communication System**

In this, a latest model solution for a broadband microstrip antenna is designed for use in 5G wireless systems. The suggested antenna has a core working frequency of 28GHz and may be employed in the confined point-multipoint allocation service frequency range. The FEKO programme was used to compute, simulate and optimise the size and settings of the antenna. The antenna has a small footprint with dimensions of 6.2x8.4x1.57 mm³ with a dielectric coefficient of 2.2 and a depth of 1.57mm, was employed as a substrate for the antenna construction [21].

In response to the increased need for mobile data and mobile devices, a rectangular microstrip antenna has been developed for 5G applications. This antenna has a resonance frequency of 28GHz and a reflectivity of 22.50dB. The suggested antenna has a radiation efficiency of 80.18% and an antenna gain of 5.06dB at the resonance frequency. The results also reveal that its bandwidth is 5.57GHz (relative operating band 19.89%), which is an excellent result.

This antenna is appropriate for use in modern communication systems, notably 5G wireless communication systems.

ANTENNA'S FEATURE AND DISCUSSION

In this section we will discuss the antenna features. The table 3 and table 4 are given below:

S.No.	Year	Author	Type of Antenna	Feature
1	2009	Jeong, et al	Parasitic Slot Array Antennas	Controlled by a sensor mote Packet receiving rate is good
2	2009	Lee, et al	Slot Loop Antenna	WLAN operation bands : 2.4GHz and 5GHz Good oppi-directional natterns
3	2010	Jin-Gang, et al [7]	Internal Wideband Compact Antenna	Provides large transmission capacity up to 8.5GHz Can be employ in a USB dongle appliances due to its
4	2011	Wu, et al	Scalable Solar	very small size feature • Low-profile <u>omni</u> -directional antenna • Reconfigurable as per requirement
5	2011	Guo, et al [9]	Patch-Pair Crescent Moon-Shape	Provides about 87% bandwidth Radiation property is good for band 2.6–6 GHz
6	2013	Sarin, et al	Antenna for Broadband Stacked Dipole	Provides better directional radiation characteristics
7	2013	[10] Guo, et al [11]	Compact Antenna 4-Antenna System With High Isolation	 Operated at 1.8GHz-2.69GHz with a small occupied space and 2.4GHz WLAN bands
8	2014	He, et al [12]	Vivaldi Antenna	 Antenna efficiency reached 40% or above Operated at 4900-5935 MHz WLAN band and other wireless (2400-4900 MHz) WLAN band It provides resistance to polarization distortion
9	2015	Zhang, et al [13]	LTE Base-Station Dipole Antenna	 MIMO system application is present Multi-operational and improved performances such as undirectional radiation, low back radiation, cross- polarization and high gain
S.Na	Year	Author	Type of An	itenna Feature
10	2015	Yeoh, et al [14]	Ultra-wideban Monopole A	d Conical • Provides better performance than traditional ntenna monopole antenna
11	2017	lingVa Deng, et al [15]	MIMO Antenna band inver	with dual- ted-F Operated at either 2.4GHz WLAN band or 5GHz WLAN band • Lower envelop correlation coefficient
12	2017	Huiging. Zhai, et al [16]	Low-Profile Dual polarized A	Compact size Band Dual: Operated at a lower band (2360M Hz to 160M Hz) and higher band (5120M Hz to 5620M Hz) Better use for a base antenna model in wirelest local area network communication appliances
			TABLE 4. Mic	rostrip antennas and their feature
S.No.	Year	Author	Type of Ante	nna Feature
1	2014	Chauhan, et al [18]	Millimeter-W Nicrostrip, An	 V orking range is 28 GHz and 38GHz frequency Provides the gain of 9.05dB and efficiency 83% C om patible for 5G wireless communication
2	2019	Tahir, et al [19]	Compact Mice Antenna	systems • Small and compact • Operated at 28 GHz • Compatible for 5G wireless communication
3	2020	Kapoor, et al [20]	Compact Wide Printed Ante	systems band- • It provides 5G wireless application bands such as n77 band and n78 band • Compatible for 5G wireless communication
4	2020	Przesmycki.	Broadband Mic	systems • Operated at 28 GHz • Compatible for 5G wireless communication

TABLE 3. Antennas and their feature

CONCLUSION AND FUTURE WORK

This research paper provides a comprehensive survey of some recent initiatives in antenna technology and towards small and compact microstrip antenna and enhancement of their characteristics. The 5G wireless technology is now on boom. The Internet of Things, in conjunction with integrated and intelligent sensor systems and in-home sensor networks, will transfigure how people live their lives. Microstrip antenna operating at 28GHz-38GHz range will help to achieve new smart life style.

REFERENCES

RF Graf, Modern Dictionary of Electronics, Newnes, 1. 29, (1999)

Li, Zang, Wade Trappe and Roy Yates, 41st Annual 2 Conference on Information Sciences and Systems IEEE, pp. 905-910, (2007)

Pi, Zhouyue and F. Khan, IEEE communications 3. magazine, 49(6), pp. 101-107, (2011).

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Vol. 6 No. 3(December, 2021)

4. S. Kumar, T. Agrawal and P. Singh, International Journal of Future Generation Communication and Networking, 9(1), pp. 303-310, (2016).

5. S. Jeong and William J. Chappell, IEEE Antennas and Wireless Propagation Letters, 26(9), pp. 760-763, (2010).

6. Yi-Chieh Lee, Jwo-Shiun Sun, Min-Hsiang Hsu and Ren-Hao Chen, IEEE antennas and wireless propagation letters, 8, pp. 356-358, (2008).

7. Jin-Gang Gong, Yong-Chang Jiao, Qiao Li, Yue Song and Jian Wang, IEEE Antennas and Wireless Propagation Letters, 9, pp. 879-882, (2010).

8. Wu, Terence, R. Li, and M.M. Tentzeris, IEEE Antennas and Wireless Propagation Letters, 10, pp. 510-513, (2011).

9. Jingli Guo, Yanlin Zou and Chao Liu, IEEE Antennas and Wireless Propagation Letters, 10, pp. 435-437, (2011).

10. S.V. Pushpakaran, N.M. SeidMuhammed, R.K. Raj, A. Pradeep, P. Mohanan and K. Vasudevan, IEEE Antennas and Wireless Propagation Letters, 12, pp. 841-844, (2013).

11. Jingli Guo, Jiachang Fan, Ling Sun and Baohua Sun, IEEE Antennas and Wireless Propagation Letters, 12, pp. 979-982, (2013).

12. Shan Hong He, Wei Shan, Chong Fan, Zhi Chao Mo, Fu Hui Yang and Jun Hua Chen, IEEE Antennas and Wireless Propagation Letters, 13, pp. 1505-1508, (2014).

13. H. Zhai, J. Zhang, Y. Zang, Q. Gao and C. Liang, IEEE Antennas and Wireless Propagation Letters, 14, pp. 906-909, (2014).

14. W.S. Yeoh and W.S. Rowe, IEEE Antennas and Wireless Propagation Letters, 14, pp. 1085-1088, (2015).

15. J. Deng, J. Li, L. Zhao and L. Guo, IEEE Antennas and Wireless Propagation Letters, 16, pp. 2270-2273, (2017).

16. H. Zhai, K. Zhang, S. Yang, D. Feng, IEEE Antennas and Wireless Propagation Letters, 16, pp. 2692-2695, (2017).

17. T.S. Rappaport, J.N. Murdock and F. Gutierrez, Proceedings of the IEEE, 99(8), pp. 1390-1436, (2011).

Copyrights @Kalahari Journals

18. B. Chauhan, S. Vijay and S.C. Gupta, International Journal of computer applications, 99(19), pp. 15-18, (2014).

19. GÜNEŞER, Muhammet Tahir and Cihat ŞEKER, Erzincan Üniversitesi Fen Bilimleri Enstitüsü Dergisi, 12(2), pp. 679-686, (2019).

20. A. Kapoor, R. Mishra, P. Kumar, International Journal of Smart Sensing and Intelligent Systems, 13(1), pp. 1-10, (2020).

21. R. Przesmycki, M. Bugaj and L. Nowosielski, Electronics, 10(1), pp. 1, (2021).

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Microelectronics Journal



journal homepage: www.elsevier.com/locate/mejo

Modeling the threshold voltage of core-and-outer gates of ultra-thin nanotube Junctionless-double gate-all-around (NJL-DGAA) MOSFETs

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ARTICLE INFO

Keywords: Nanotube Inner gate Outer gate DIBL Gate-all-around Short-channel effects

ABSTRACT

The present article deals with the analytical modeling of threshold voltage of an ultra-thin nanotube Junctionless double-gate-all-around (NJL-DGAA) metal-oxide-semiconductor field-effect-transistor (MOSFET). Under the condition of full depletion, the modeling of the surface potential relating to inner and outer gates of the device has been performed by solving three-dimensional Poisson's equation in cylindrical coordinates with appropriate boundary conditions. Corresponding to inner and outer channel potential expressions, the two different threshold voltages of the device are obtained. Moreover, the connection between the source-to-drain subthreshold current and threshold voltage is investigated. The drain-induced-barrier-lowering (DIBL) as an indicator of short-channel effects has been studied. Further, the quantum confinement effects have been explored through quantum mechanical correction in the threshold voltage model. The model outcomes are compared with data extracted from ATLAS[™] TCAD simulations, and good acceptances have been observed.

1. Introduction

In 2010, the research community from the domain of semiconductor electronics got stunned upon the advent of gated resistors creeping into the arena of junction-based-transistor by Colinge et al. [1]. The unique thing about the gated resistor was claimed to be the absence of junctions, and thus coined as Junctionless transistors (JLTs). The motive behind the introduction of JLTs was to evade the necessity of high doping gradients and thermal-budget issues frequent in nanoscale field-effect transistors (FETs) [1,2]. In fully depletion mode, the carrier diffusion cannot take place between source/drain and the channel region. It noticeably simplifies the fabrication procedure with a better thermal budget within the device structure [3].

A number of attempts by researchers have been made to boost the performance by modifying the classical JLT device design [3–9]. Multigate Junctionless FETs (JLFETs) are the frontrunners, and more specifically [1,4], FinFETs and Gate-all-around structures have emerged as potential contenders for sub-32 nm transistor technology [10]. Through a comparative study, Nagy et al. (2018) [10] have put forwarded an analysis of FinFETs and GAA devices and claimed that Gate-All-Around (GAA) JLFETs [8,10] are better to take on the challenges posed by short-geometry effects, provide excellent performance, and scalability [10]. In recent years, negative capacitance (NC) FETs are gaining popularity which employ ferroelectric dielectric materials to enhance the device performance with higher scope of scalability [11–15]. The phenomenon of negative capacitance boosts the On-state drain current, but at the cost of a significant rise in leakage current [11], and hence the NC-FETs are not preferred for analog circuit analysis [12]. Moreover, the current-edge fabrication technologies are dubious enough to help significantly from negative capacitance. On the other hand, GAA FETs are being foreseen as strong candidates for 3 nm FET technology nodes with outstanding Off- and On-state characteristics [16,17]. Duarte et al. [7] had reported an analytical long channel threshold voltage model of Junctionless Gate-all-around FETs (JL-GAA FETs). Hu et al. [8] had introduced analytical threshold voltage and subthreshold swing models of fully depleted short channel JL GAA transistors. In recent years, the

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https://doi.org/10.1016/j.mejo.2021.105104

Received 9 February 2021; Received in revised form 28 March 2021; Accepted 2 May 2021 Available online 11 May 2021 0026-2692/© 2021 Elsevier Ltd. All rights reserved.

practice of operating an additional gate called inner gate in JL GAA FETs is becoming prevalent to mitigate the problem of short-channel effects (SCEs) more competently, and augment the gate controllability over the channel region [18-20]. Rewari et al. [18] had put forward a numerical modeling for subthreshold characteristics of Junctionless Double Surrounding Gate (JLDSG) MOSFET using superposition method. It was claimed that the availability of an additional gate called inner gate improved the immunity of the JLDSG device against SCEs. However, the modeling steps were lacking the separate formulation of inner gate surface potential and threshold voltage. Further, a critical analysis of the role of inner gate in the device characteristics was missing. Later on, Sahay et al. [19] presented a simulation-based study of nanotube Junctionless-Double gate-all-around (NJL-DGAA) MOSFET with the inner (core) and outer (shell) gates, to investigate the potency of inner and outer gates controllability over the channel. The device was claimed to have improved On-state current and as well as boosted SCEs immunity with the $10^7\ I_{\text{OFF}}$ ratio for a 7 nm channel length [19].

In recent years, the TCAD simulators have emerged as great tools to investigate the device characteristics of proposed semiconductor devices as the costly foundry processes forbid fabrication of every structure. But the simulation processes take in complicated partial differential equations whose solutions are obtained by repeated iterations over Poisson's equation in combination with a transport model for a given set of boundary conditions. On the other hand, theoretical modelling includes the development of time-efficient mathematical equations that can be deployed in device/circuit simulators to analyse a circuit based on the device under consideration. It may be noted that the majority of the papers reported regarding the NJL double-gate all-around FETs are simulation-based. In the present manuscript, an analytical surface potential based modeling framework is proposed which may help to understand the physics behind the NJL-DGAA MOSFET for Ultra-largescale-integration (ULSI) applications. A physics-based device model satisfactorily describes the device behaviour in terms of analytical and algebraic expressions. This framework may aid in evolving a useful platform for the development of more compact modeling expressions suitable for use in device/circuit simulators. The general and separate formulation of surface potentials for inner as well as outer gates has been developed by solving the three-dimensional (3D) Poisson's equation in cylindrical coordinates with appropriate boundary conditions in the channel region of the NJL-DGAA MOSFET. The channel has been taken fully depleted where steps involved in numerical modeling are based on the parabolic approximation method proposed by K.K. Young [21]. Based on the inner and outer channel potential models, the mathematical expressions of electric field (E_z), the threshold voltage (V_{TH}), and DIBL have been derived. For model validation purposes, numerical simulation data have been extracted from TCAD based ATLAS[™], a 3D device simulator from Silvaco [22]. In the latter part of the manuscript, the sections are dedicated to discuss the proposed device structure with various device parameters, followed by mathematical modeling, model validation with simulation details, and conclusive remarks.

2. Device structure

The 3D view of the NJL-DGAA device structure is shown in Fig. 1, and 2D longitudinal cross-sectional view of the NJL-DGAA device is given in Fig. 2. The cylindrical schematic of the device involves the channel, inner and outer gate-oxides, source, drain, and metal gate contacts. The uniformly doped channel region under consideration is ultrathin silicon nanotube, which incorporates an inner gate placed inside and an outer gate covering the same from outside. Both of the gates are supplied with a common voltage. The parameters considered for the NJL-DGAA MOSFET are listed in Table 1. As far as the fabrication steps of the NJL-DGAA are concerned, the fabrication steps had been discussed in Refs. [23–25] with process flow diagram. Fig. 3 presents the cross-sectional view of the simulated NJL-DGAA FET structure. The



Fig. 1. The 3D schematic of NJL-DGAA device.



Fig. 2. The 2D longitudinal cross-sectional view of the NJL-DGAA MOSFET.

Table 1
Device parameters used for modeling and simulation of
NJL-DGAA MOSFET.

Symbol	Parameter	Value
L _{ch}	Channel Length	30 nm
t _{si}	Channel Thickness	5 nm
t _{ox}	Oxide Thickness	2 nm
t _{cm}	Core metal radius	5 nm
N_D	Donor carrier concentration	$3 \times 10^{18} \text{cm}^{-3}$
n _i	Intrinsic carrier concentration	$1.45 \times 10^{10} \mathrm{cm}^{-3}$
Φ_G	Gate-Metal-work function	4.7eV

channel potential associated with the inner gate is specified by ψ_{Si} , and the potential beneath the outer gate is symbolized by ψ_{So} . The energy band diagram accompanying the simulated structure of the device in Fig. 3 is shown extended from source to drain at the threshold voltage (V_{TH}), where ψ_{min} denotes the deviation between the intrinsic level (E_i) and Fermi level (E_F), and $V_{bi} = V_t ln(\frac{N_D}{n_i})$ is the reference built-in potential at the source side of the device.

3. Device modeling details

3.1. Modeling of surface potential

The electrostatic channel potential distribution $\psi(r, \theta, z)$ in the channel region of the NJL-DGAA MOSFET may be obtained by solving the



Fig. 3. The contour plot of the simulated NJL-DGAA MOSFET structure along with the energy band diagram demonstrating threshold voltage condition [26].

3D Poisson's equation in the cylindrical coordinate system as:

$$\frac{1}{r}\frac{\partial}{\partial r}\left[r\frac{\partial\psi(r,\theta,z)}{\partial r}\right] + \frac{1}{r^2}\frac{\partial^2\psi(r,\theta,z)}{\partial \theta^2} + \frac{\partial^2\psi(r,\theta,z)}{\partial z^2} = -\frac{qN_D}{\epsilon_{si}}\left[1 - \exp\left(\frac{\psi(r,\theta,z) - \varphi_f}{V_t}\right)\right]$$
(1)

where, r, θ , and z govern the cylindrical coordinate axes along the radial, angular, and channel length directions, respectively; $V_t = \frac{KT}{q}$ is the thermal voltage, and the quasi-Fermi potential is denoted by φ_f . The N_D , q, ϵ_{si} , T, and K represent the doping concentration, electric charge, silicon permittivity, temperature, and Boltzmann constant, respectively [8]. Upon nullifying the angular part (θ) of the channel potential $\psi(r, \theta, z)$ owing to angular symmetry, Eq. (1) takes the form as:

$$\frac{1}{r}\frac{\partial}{\partial r}\left[r\frac{\partial\psi(r,z)}{\partial r}\right] + \frac{\partial^2\psi(r,z)}{\partial z^2} = -\frac{qN_D}{\epsilon_{si}}\left[1 - \exp\left(\frac{\psi(r,z) - \varphi_f}{V_t}\right)\right]$$
(2)

It is to be noted that the NJL-DGAA MOSFET possesses, in general, three regimes of device operation: Full depletion regime corresponds to *Off*-state of the device; whereas, the transistor can be turned on in the partially depleted or near flat band regimes [27]. Under the full depletion mode, and without any loss of generality, Eq. (2) can be solved in subthreshold regime by ignoring the exponential term in the entire region as [8]:

$$\frac{1}{r}\frac{\partial}{\partial r}\left[r\frac{\partial\psi(r,z)}{\partial r}\right] + \frac{\partial^2\psi(r,z)}{\partial z^2} = -\frac{qN_D}{\epsilon_{si}}$$
(3)

The solution to Eq. (1) is the channel potential distribution which may be expanded in parabolic approximation along the radial direction as [21]:

$$\psi(r,z) = K_{0n}(z) + K_{1n}(z)r + K_{2n}(z)r^2$$
(4)

where, n = 1 stands for inner channel potential and n = 2 for outer channel potential; $K_{0n}(z)$, $K_{1n}(z)$ and $K_{2n}(z)$ are the coefficients of approximation as a function of z to be determined with the help of necessary boundary conditions. The inner and outer channel potentials are defined as,

$$\psi_{Si}(z) = \psi(r = r_1, z)|_{r_1 = t_{cm} + t_{ox}}$$
(5)

$$\psi_{So}(z) = \psi(r = r_2, z)|_{r_2 = t_{cm} + t_{ox} + t_{si}}$$
(6)

The boundary conditions at the source-channel and drain-channel interfaces vital to obtain the concerned channel potentials can be given

$$\psi(r,0) = V_{bi} \tag{7}$$

here as [18]:

$$\psi(r,L) = V_{bi} + V_{DS} \tag{8}$$

where, V_{DS} is the drain to source voltage. Another set of boundary condition focussing the continuity of electric fluxes across the inner-outer gate-oxides and channel interfaces can be written as:

$$\epsilon_{si} \frac{\partial \psi(r,z)}{\partial r}|_{r=r_1} = \epsilon_{ox} \frac{\psi_{Si}(z) - V_G}{t_i}$$
(9)

$$\epsilon_{si} \frac{\partial \psi(r,z)}{\partial r}|_{r=r_2} = \epsilon_{ox} \frac{-\psi_{So}(z) + V_G}{t_o} \tag{10}$$

where, V_G , V_{fb} , t_i and t_o are gate voltage, flat-band voltage [28], inner gate-oxide thickness and outer gate-oxide thickness, respectively. Their expressions are as follows:

$$V_G = V_{GS} - V_{fb} \tag{11}$$

$$V_{fb} = \varphi_G - \left(\chi_{si} + \frac{E_g}{2} - qV_t ln\left(\frac{N_D}{n_i}\right)\right)$$
(12)

$$t_i = t_{cm} \ln\left(1 + \frac{t_{ox}}{t_{cm}}\right) \tag{13}$$

$$t_o = r_2 \ln\left(1 + \frac{t_{ox}}{r_2}\right) \tag{14}$$

The coefficients $K_{01}(z)$, $K_{11}(z)$ and $K_{21}(z)$ corresponding to inner channel potential may be derived by employing the above-mentioned set of boundary conditions (Eq. (7) to Eq. (10)) as follows,

$$K_{01}(z) = \psi_{Si}(z) \left[1 - \frac{\epsilon_{ox}}{\epsilon_{si}} \frac{r_1(r_2 + t_{si})}{2t_{si}t_i} \right] - \psi_{So}(z) \left[\frac{\epsilon_{ox}}{\epsilon_{si}} \frac{r_1^2}{2t_{si}t_o} \right] + \frac{\epsilon_{ox}}{\epsilon_{si}} \left[\frac{V_G r_1(r_2 t_o + t_{si}t_o + r_1 t_i)}{2t_{si}t_i t_o} \right]$$
(15)

$$K_{11}(z) = \frac{\epsilon_{ox}}{\epsilon_{si} t_{si}} \left[\frac{r_2(\psi_{Si}(z) - V_G)}{t_i} + \frac{r_2(\psi_{So}(z) - V_G)}{t_o} \right]$$
(16)

$$K_{21}(z) = \frac{\epsilon_{ox}}{2\epsilon_{si}t_{si}} \left[\frac{(V_G - \psi_{Si}(z))}{t_i} + \frac{(V_G - \psi_{So}(z))}{t_o} \right]$$
(17)

In the case of potential distribution relating to outer surface, the coefficients $K_{12}(z)$ and $K_{22}(z)$ remain unchanged i.e.: $K_{12}(z) = K_{11}(z)$ and $K_{22}(z) = K_{21}(z)$; whereas, $K_{02}(z)$ gets differed from the inner surface coefficient and may be derived by using Eqs. (4), (6), (16) and (17) as:

$$\begin{split} K_{02}(z) &= -\psi_{Si}(z) \left[\frac{\epsilon_{ox}}{\epsilon_{si}} \frac{r_2^2}{2t_{si}t_i} \right] + \psi_{So}(z) \left[1 - \frac{\epsilon_{ox}}{\epsilon_{si}} \frac{r_2(r_1 - t_{si})}{2t_{si}t_o} \right] \\ &+ \frac{\epsilon_{ox}}{\epsilon_{si}} \left[\frac{V_G r_2(r_2 t_o + r_1 t_i - t_{si} t_i)}{2t_{si} t_i t_o} \right] \end{split}$$
(18)

Now, the relation between inner and outer channel potentials can be established by using Eq. (15) and Eq. (18) as follows,

$$\psi_{So}(z) = \xi_1 \psi_{Si}(z) + \left[\frac{\epsilon_{ox}}{\epsilon_{si}} \frac{t_{si}(t_i - t_o) V_G}{2t_i t_o \gamma_2} \right]$$
(19)

$$\psi_{Si}(z) = \xi_2 \psi_{So}(z) - \left[\frac{\epsilon_{ox}}{\epsilon_{si}} \frac{t_{si}(t_i - t_o) V_G}{2t_i t_o \gamma_1} \right]$$
(20)

where, $\xi_1 = \frac{\gamma_1}{\gamma_2}$, $\xi_2 = \frac{\gamma_2}{\gamma_1}$, $\gamma_1 = (1 + \frac{\epsilon_{ox}t_{si}}{2\epsilon_{si}t_i})$, and $\gamma_2 = (1 + \frac{\epsilon_{ox}t_{si}}{2\epsilon_{si}t_o})$. Incorporating Eq. (15) to Eq. (20) in Eq. (4) and solving for the inner-outer channel potentials, the relations can be given as:

$$\psi(r = r_1, z) = \psi_{Si}(z) \left[1 - \frac{\epsilon_{ox}}{\epsilon_{si}} (A_1 - B_1 r_1 + C_1 r_1^2) \right] + V_G \frac{\epsilon_{ox}}{\epsilon_{si}} \left[N_1 - P_1 r_1 + Q_1 r_1^2 \right]$$
(21)

$$\psi(r = r_2, z) = \psi_{So}(z) \left[1 - \frac{\epsilon_{ox}}{\epsilon_{si}} (A_2 - B_2 r_2 + C_2 r_2^2) \right] + V_G \frac{\epsilon_{ox}}{\epsilon_{si}} \left[N_2 - P_2 r_2 + Q_2 r_2^2 \right]$$
(22)

where, the appearing terms in Eq. (21) and Eq. (22) has been defined as,

$$A_1 = \frac{r_1(r_2 + t_{si})}{2t_{si}t_i} + \frac{\xi_1 r_1^2}{2t_{si}t_o}$$
(23)

$$A_2 = \frac{r_2(r_1 - t_{si})}{2t_{si}t_o} + \frac{\xi_2 r_2^2}{2t_{si}t_i}$$
(24)

$$B_1 = \frac{r_2}{t_{si}t_i} + \frac{\xi_1 r_1}{t_{si}t_o}$$
(25)

$$B_2 = \frac{r_1}{t_{si}t_o} + \frac{\xi_2 r_2}{t_{si}t_i}$$
(26)

$$C_1 = \frac{1}{2t_{si}t_i} + \frac{\xi_1}{2t_{si}t_o}$$
(27)

$$C_2 = \frac{1}{2t_{si}t_o} + \frac{\xi_2}{2t_{si}t_i}$$
(28)

$$N_{1} = \frac{r_{1}(r_{2}t_{o} + t_{si}t_{o} + r_{1}t_{i})}{2t_{si}t_{i}t_{o}} - \left[\frac{\epsilon_{ox}}{\epsilon_{si}}\frac{r_{1}^{2}(t_{i} - t_{o})}{4t_{i}t_{o}^{2}\gamma_{2}}\right]$$
(29)

$$N_{2} = \frac{r_{2}(r_{2}t_{o} + r_{1}t_{i} - t_{si}t_{i})}{2t_{si}t_{i}t_{o}} + \left[\frac{\epsilon_{ox}}{\epsilon_{si}}\frac{r_{2}^{2}(t_{i} - t_{o})}{4t_{o}t_{i}^{2}\gamma_{1}}\right]$$
(30)

$$P_1 = \frac{(r_1 t_i + r_2 t_o)}{t_{si} t_i t_o} - \left[\frac{\epsilon_{ox}}{\epsilon_{si}} \frac{r_1 (t_i - t_o)}{2t_i t_o^2 \gamma_2}\right]$$
(31)

$$P_2 = \frac{(r_1 t_i + r_2 t_o)}{t_{si} t_i t_o} + \left[\frac{\epsilon_{ox}}{\epsilon_{si}} \frac{r_2 (t_i - t_o)}{2 t_o t_i^2 \gamma_1}\right]$$
(32)

$$Q_1 = \frac{(t_i + t_o)}{2t_{si}t_i t_o} - \left[\frac{\epsilon_{ox}}{\epsilon_{si}} \frac{(t_i - t_o)}{4t_i t_o^2 \gamma_2}\right]$$
(33)

$$Q_2 = \frac{(t_i + t_o)}{2t_{si}t_i t_o} + \left[\frac{\epsilon_{ox}}{\epsilon_{si}} \frac{(t_i - t_o)}{4t_o t_i^2}\gamma_1\right]$$
(34)

The utilization of expressions of ψ from Eqs. (21) and (22) in Eq. (3) renders the following 2nd order differential equations relating to inner and outer channel potentials, respectively as follows,

$$\frac{\partial^2 \psi_{Si}(z)}{\partial z^2} - \alpha_1 \psi_{Si}(z) = \beta_1, \tag{35}$$

$$\frac{\partial^2 \psi_{So}(z)}{\partial z^2} - \alpha_2 \psi_{So}(z) = \beta_2, \tag{36}$$

where, $\alpha_1 = \frac{Y_1}{X_1}$, $\alpha_2 = \frac{Y_2}{X_2}$, $\beta_1 = -\frac{qN_D}{\epsilon_{si}X_1} + V_G \frac{Z_1}{X_1}$, $\beta_2 = -\frac{qN_D}{\epsilon_{si}X_2} + V_G \frac{Z_2}{X_2}$. The appearing terms are given as:

$$X_{1} = \left[1 - \frac{\epsilon_{ox}}{\epsilon_{si}}(A_{1} - B_{1}r_{1} + C_{1}r_{1}^{2})\right],$$
(37)

$$X_{2} = \left[1 - \frac{\epsilon_{ox}}{\epsilon_{si}} (A_{2} - B_{2}r_{2} + C_{2}r_{2}^{2})\right],$$
(38)

$$Y_1 = \frac{\epsilon_{ox}}{\epsilon_{si}} \left(4C_1 - \frac{B_1}{r_1} \right),\tag{39}$$

$$Y_2 = \frac{\epsilon_{ox}}{\epsilon_{si}} \left(4C_2 - \frac{B_2}{r_2} \right),\tag{40}$$

$$Z_1 = \frac{\epsilon_{ox}}{\epsilon_{si}} \left(\frac{P_1}{r_1} - 4Q_1 \right), \tag{41}$$

$$Z_2 = \frac{\epsilon_{ox}}{\epsilon_{si}} \left(\frac{P_2}{r_2} - 4Q_2 \right) \tag{42}$$

The general solutions to Eq. (35) for inner channel potential and Eq. (36) for outer channel potential can be written as:

$$\psi_{Si}(z) = H_1 e^{\sqrt{\alpha_1 z}} + H_2 e^{-\sqrt{\alpha_1 z}} + \sigma_1$$
(43)

$$\psi_{So}(z) = H_3 e^{\sqrt{a_2 z}} + H_4 e^{-\sqrt{a_2 z}} + \sigma_2 \tag{44}$$

where, $\sigma_1 = -\frac{\beta_1}{\alpha_1}$, $\sigma_2 = -\frac{\beta_2}{\alpha_2}$. The values of coefficients H_1, H_2, H_3 , and H_4 have been obtained from employing the boundary conditions defined in Eqs. (7) and (8) in Eqs. (43) and (44) as,

$$H_1 = \frac{-V_{S1}e^{-\sqrt{\alpha_1}L} + V_{D1}}{2\sinh(\sqrt{\alpha_1}L)}$$
(45)

$$H_2 = \frac{V_{S1}e^{\sqrt{\alpha_1 L}} - V_{D1}}{2\sinh(\sqrt{\alpha_1 L})}$$
(46)

$$H_3 = \frac{-V_{S2}e^{-\sqrt{\alpha_2 L}} + V_{D2}}{2\sinh(\sqrt{\alpha_2 L})}$$
(47)

$$H_4 = \frac{V_{S2}e^{\sqrt{\alpha_2 L}} - V_{D2}}{2 \sinh(\sqrt{\alpha_2 L})}$$
(48)

where, $V_{S1} = V_{bi} - \sigma_1$, $V_{S2} = V_{bi} - \sigma_2$, $V_{D1} = V_{bi+}V_{Ds} - \sigma_1$, $V_{D2} = V_{bi+}V_{Ds} - \sigma_2$. The location (z_{min}) of the minimum channel potential in the direction of channel length can be obtained as: For inner channel, solving $\partial \psi_{Si}(z)/\partial z|_{z=z_{min}} = 0$ from Eq. (43) gives z_{min1} , while solving $\partial \psi_{So}(z)/\partial z|_{z=z_{min}} = 0$ from Eq. (44) renders z_{min2} . The thus obtained expressions may be written as:

$$z_{min1} = \frac{\ln\left(\frac{H_2}{H_1}\right)}{2\sqrt{\alpha_1}} \tag{49}$$

$$z_{min2} = \frac{\ln\left(\frac{H_4}{H_3}\right)}{2\sqrt{\alpha_2}} \tag{50}$$

Plugging Eq. (49) into Eq. (43), and Eq. (50) into Eq. (44), the connecting inner and outer minimum channel potential are obtained as

$$\psi_{Si,min} = 2\sqrt{H_1H_2} + \sigma_1 \tag{51}$$

$$\psi_{So,min} = 2\sqrt{H_3H_4} + \sigma_2 \tag{52}$$

Now, taking differentiation of Eq. (43) and Eq. (44) with respect to z ($E_Z = -\frac{\partial \psi_S(z)}{\partial z}$), the expression of electric fields in inner and outer channels along the channel length direction is given as:

$$E_{z,i} = -\sqrt{\alpha_1} H_1 e^{\sqrt{\alpha_1} z} + \sqrt{\alpha_1} H_2 e^{-\sqrt{\alpha_1} z}$$
(53)

$$E_{z,o} = -\sqrt{\alpha_2} H_3 e^{\sqrt{\alpha_2} z} + \sqrt{\alpha_2} H_4 e^{-\sqrt{\alpha_2} z}$$
(54)

3.2. Threshold voltage formulation

In the present work, the whole channel region is assumed to be fully depleted, and hence the mobile charge density can be ignored [27]. Now, following the method mentioned in Ref. [8], the threshold voltage (V_{TH}) for the extremely short-channel ultra-thin NJL-DGAA device can be defined as the gate voltage at which the minimum electrostatic channel potential equals the difference between the quasi-Fermi potential and twice of the thermal voltage, i.e. $\psi_{Smin} = \varphi_f - 2V_t$ (refers to Fig. 3) [8]. Hence, the definition for inner and outer regions may be given as:

$$\psi_{Si,\min|V_{GS=V_{THi}}} = \varphi_f - 2V_t \tag{55}$$

$$\psi_{So,\min|V_{GS=V_{THo}}} = \varphi_f - 2V_t \tag{56}$$

In the present proposed model of the device, two distinctive threshold voltages, say V_{THi} and V_{THo} , for the inner and outer gate surfaces, respectively, could be obtained. The threshold voltage V_{THi} can be derived after solving Eq. (55) as,

$$V_{THi} = V_{fb} + \left[\frac{-b + \sqrt{b^2 - 4ac}}{2a}\right]$$
(57)

where, the appearing terms are given as,

$$a = a_1 a_2 - a_3^2 \tag{58}$$

$$b = a_2 a_4 + a_1 a_5 - 2a_3 a_6 \tag{59}$$

$$c = a_4 a_5 - a_6^2 \tag{60}$$

$$a_1 = \frac{a_3 \left(1 - e^{-\sqrt{a_1}L}\right)}{\sinh(\sqrt{a_1}L)} \tag{61}$$

$$a_{2} = \frac{a_{3}(e^{\sqrt{a_{1}L}} - 1)}{\sinh(\sqrt{a_{1}L})}$$
(62)

$$a_3 = \frac{Z_1}{Y_1}$$
(63)

$$a_4 = \frac{V_{bi}(1 - e^{-\sqrt{\alpha_1}L}) - \left(\frac{qN_D}{e_{si}Y_1}\right)\left(1 - e^{-\sqrt{\alpha_1}L}\right) + V_{DS}}{\sinh(\sqrt{\alpha_1}L)}$$
(64)

$$a_{5} = \frac{V_{bi}(e^{\sqrt{\alpha_{1}L}} - 1) - \left(\frac{qN_{D}}{e_{si}Y_{1}}\right)\left(e^{\sqrt{\alpha_{1}L}} - 1\right) - V_{DS}}{\sinh(\sqrt{\alpha_{1}L})}$$
(65)

$$a_6 = \varphi_f - 2V_t - \left(\frac{qN_D}{\epsilon_{si}Y_1}\right) \tag{66}$$

In the same way, the threshold voltage V_{THo} for the outer gate surface can be derived by solving Eq. (56) as follows,

$$V_{THo} = V_{fb} + \left[\frac{-s + \sqrt{s^2 - 4rt}}{2r}\right]$$
(67)

where, the appearing terms are described as,

$$r = c_1 c_2 - c_3^2 \tag{68}$$

 $s = c_2 c_4 + c_1 c_5 - 2c_3 c_6 \tag{69}$

 $t = c_4 c_5 - c_6^2 \tag{70}$

$$c_1 = \frac{c_3(1 - e^{-\sqrt{\alpha_2 L}})}{\sinh(\sqrt{\alpha_2 L})}$$
(71)

$$c_2 = \frac{c_3(e^{\sqrt{a_2L}} - 1)}{\sinh(\sqrt{a_2L})}$$
(72)

$$c_3 = \frac{Z_2}{Y_2}$$
(73)

$$c_{4} = \frac{V_{bi}(1 - e^{-\sqrt{\alpha_{2}L}}) - \left(\frac{qN_{D}}{\epsilon_{sl}Y_{2}}\right)\left(1 - e^{-\sqrt{\alpha_{2}L}}\right) + V_{DS}}{\sinh(\sqrt{\alpha_{2}L})}$$
(74)

$$c_{5} = \frac{V_{bl}(e^{\sqrt{\alpha_{2}L}} - 1) - \left(\frac{qN_{D}}{c_{si}Y_{2}}\right)\left(e^{\sqrt{\alpha_{2}L}} - 1\right) - V_{DS}}{\sinh(\sqrt{\alpha_{2}L})}$$
(75)

$$c_6 = \varphi_f - 2V_t - \left(\frac{qN_D}{\epsilon_{si}Y_2}\right) \tag{76}$$

Note that the channel-gate oxide interface with lower threshold voltage will be turned on before that with higher threshold voltage, the effective threshold voltage of an NJL-DGAA MOSFET may therefore be defined as the minimum of two threshold voltages corresponding to two gates which can be described as

$$V_{TH} = \begin{cases} V_{THi,} \text{ if } V_{THi} < V_{THo} \\ V_{THo,} \text{ if } V_{THo} < V_{THi,} \end{cases}$$
(77)

$$V_{TH} = \operatorname{Min}\left\{V_{THi}, V_{THo}\right\}$$
(78)

The mathematical expressions from Eqs. (51)–(54) with the help of Eq. (78) incorporate all the necessary information regarding the impact of vertical as well as lateral dimensions on the device characteristics. The mathematical modeling of surface potentials given in Eqs. (52) and (53) puts the standing instructions for designing the device. equations (51) and (53) are responsible for the inner gate where the potential is a function of core metal radius and oxide thickness. On the other hand, Eqs. (52) and (54) explains the outer gate potential. For example, the minimum outer surface potential explicitly depends on the outer radius (r_2) which in turn is a function of silicon film thickness (t_{si}) . Consequently, film thickness may be an important tool in optimizing the device performance. If t_{si} goes beyond a certain limit, the leakage current will deteriorate the subthreshold characteristics, however the nature of other device dimensions shall have to be examined simultaneously. Equation (78) may help a device designer in predicting the switching characteristics of the NJL-DGAA MOSFET where the minimum of the two threshold voltages shall decide the turn on/off.

3.3. Formulation of threshold voltage with quantum mechanical correction

For an ultrathin channel with thickness $t_{si} \leq 5$ nm, quantum confinement (QC) effect plays a vital role [29], which can be incorporated as quantum mechanical (QM) correction in the threshold voltage model. In the DGAA device, the carriers tend to be confined in the radial direction giving rise to energy-quantization of charge carriers. The quantization occurs a bit above the conduction band edge, rendering slightly lower confinement minimum potential compared to the classical potential for a given gate-to-source voltage. Consequently, there is a marginal increase in the threshold voltage of the device to pull down the conduction band underneath the Fermi level. The change in threshold voltage ΔV_{TH}^{QC} is calculated as [20–31].

$$\Delta V_{TH}^{QC} = \frac{h^2}{8qm_e^* t_{si}^2} \tag{79}$$

where, m_e^* is the effective mass of the confined electrons, and *h* is the Plank's constant. After adding Eq. (79) to Eqs. (57) and (67), the quantum mechanically corrected threshold voltage (V_{TH}^{QC}) can be expressed for the inner and outer gates of the NJL-DGAA MOSFET, respectively as:

$$V_{THi}^{QC} = V_{fb} + \left[\frac{-b + \sqrt{b^2 - 4ac}}{2a}\right] + \Delta V_{TH}^{QC}$$
(80)

$$V_{THo}^{QC} = V_{fb} + \left[\frac{-b + \sqrt{b^2 - 4ac}}{2a}\right] + \Delta V_{TH}^{QC}$$
(81)

Now onwards, the threshold voltage can be calculated similar to the steps involved in Eqs. (77) and (78).

3.4. Subthreshold current formulation

The current flows from drain to source through the bulk region in junctionless devices [1]. The 3D channel potential model can be employed to evaluate the subthreshold current, where the effective channel potential mainly dominates the subthreshold current. The Pao-Sah's double integral method [32] has been used to calculate the subthreshold drain current for extremely short-channel NJL-DGAA MOS-FETs, which can be expressed as:

$$I_{ds} = \frac{\mu W V_t (1 - e^{-\frac{V_{DS}}{V_t}})}{\int_0^L Q_c^{-1} dz}$$
(82)

where, μ is the electron mobility, W is the thickness of the nanotube, and Q_c is the carrier concentration. The nanotube thickness (W) is defined as

$$W = 2\pi (r_2 - r_1) \tag{83}$$

The total carrier concentration (Q_c) can be evaluated as follows [32,33]:

$$Q_c = qn_i \int_{r_1}^{r_2} e^{\left(\frac{q\psi_{mineff(Z_{min})}}{KT}\right)dr}$$
(84)

where,

$$\psi_{mineff} = \frac{(\psi_{Si,min} + \psi_{So,min})}{2} \tag{85}$$

Here, the ψ_{mineff} is the minimum effective channel potential in the NJL-DGAA MOSFETs. The minimum effective channel potential is also known as the 'virtual cathode potential' [33,34], which generally lies near the center of the channel region [18,33].

Using Eq. (84) in Eq. (82), the resulted subthreshold current can be expressed as follows:

$$I_{ds} = \frac{\mu W V_t (1 - e^{-\frac{V_{ds}}{V_t}})}{\int_0^L \frac{dz}{q n_i \int_{r_1}^{r_2} e^{\left(\frac{q W_{mineff}(Z_{min})}{KT}\right) dr}}}$$
(86)

The further simplification of Eq. (86) renders the subthreshold current in the simplest form for NJL-DGAA MOSFETs as:

$$I_{ds} = \mu q n_i V_t \frac{W}{L} \left(1 - e^{-\frac{V_{ds}}{V_t}} \right) \left(e^{\left(\frac{q \psi_{mineff}(Z_{min})}{KT}\right)} \right)$$
(87)

Note that, the subthreshold drain current in this device is dependent on both the inner surface potential and outer surface potential. Further, the above Eq. (87) can be utilized by taking its first derivative with respect to gate-to-source voltage (V_{GS}) to obtain the transconductance (g_m) as follows:

$$g_m = \frac{\partial I_{ds}}{\partial V_{GS}} \tag{88}$$

4. Model validation and discussion

In this section, the proposed threshold voltage model has been validated and discussed with the simulation data extracted from the ATLAS[™] TCAD 3D device simulator. The models used for the simulation of the NJL-DGAA device structure are Drift-Diffusion (DD) charge transport, Fermi-Dirac, Concentration-dependent mobility, Lombardi (CVT) to take into account the scattering effects, and Shockley-Read-Hall (SRH) recombination model at 300 K temperature [16]. The calibration graph is given in Fig. 4, where the published data from Ref. [19] have been utilized to improve the accuracy of the simulation. The plot shows good agreement between the extracted data [19] and the simulation results of the present work. The quantum effects have been ignored in the present work as the effects are insignificant for $t_{si} > 5$ nm, and for $L \ge 10$ nm [29]. However, the quantum mechanical correction has been included for $t_{si} \leq 5$ nm. The constant current method is used for the threshold voltage extraction. It is worth mentioning here that the model results up to channel length of 20 nm are found in excellent agreement with the simulation date from TCAD.

In Fig. 5, the impact of drain-to-source voltage (V_{DS}) and gate-



Fig. 4. Comparison of the drain current of TCAD simulation with measured data of Ref. [19] for NJL-DGAA device.



Fig. 5. Energy band diagram along the device length for different gate-to-source voltages (V_{GS}) and drain-to-source voltages (V_{DS}).

to-source voltage (V_{GS}) on conduction band (E_c) and valence band (E_v) energies along the channel length of the NJL-DGAA MOSFET is assessed. When $V_{GS} = V_{DS} = 0V$, the conduction and valence bands are flattened, and the NJL-DGAA MOSFET rests in Off-state. The corresponding energy barrier near the source-channel interface is high enough for most of the charge carriers to climb upon and unable to drift across the channel region. For $V_{GS} \neq 0$, the bending in conduction and valence bands occurs. The lowering of the potential barrier at the source-channel interface with increasing gate bias voltage permits more electrons from source to drain through the channel region. It is clear from the figure that the barrier height at the source/channel interface decreases by increasing the gate bias voltage, and may get worse with increase in drain voltage, V_{DS}. Fig. 6 illustrates the variation of the minimum surface potentials ($\psi_{Si,min}$ and $\psi_{So,min}$) of the inner and outer gates as a function of the channel length of the NJL-DGAA device. It can be seen that $\psi_{Si,min}$ (Eq. (51)) for inner channel is higher than $\psi_{So.min}$ (Eq. (52)) for the outer channel of the NJL-DGAA device, as clear from Fig. 6. It may be attributed to the shape of nanotube structure in the NJL-DGAA device. The physical thicknesses of the inner and outer gate oxides are the same. But, as per Eq. (13) and Eq. (14), the effective thickness of the inner gate oxide is lower than the outer gate



Fig. 6. The surface potential distribution relating to inner and outer gates along the channel length.



Fig. 7. The variation of the surface potential related to inner channel along the channel length with different combinations of V_{GS} and V_{DS} .

oxide, which, in turn enhances the minimum surface potential for the inner gate as compared to the outer gate one. With the help of numerical modeling, it has been confirmed here that the Si film thickness and oxide thickness force the barrier height of the outer gate higher than the inner gate. Note that the gate region with higher value of the minimum surface potential (lower barrier height) will decide the threshold voltage of the device, and here the inner gate plays the lead role with lower value of threshold voltage. Fig. 7 illustrates the variation of the inner gate surface potential ($\psi_{Si,min}$) along the channel length direction for different combinations of V_{GS} and V_{DS}. It is obvious from the figure that the value of the minimum surface potential increases with the increase in V_{GS} . Besides this, the plot with higher value of V_{GS} may be seen flattened in the middle of the channel region with non-zero slope near the source and drain regions. The drain voltage (V_{DS}) effect in the channel region is such that the channel potential increases further with increasing V_{DS} near the drain side. The next figure (Fig. 8) interprets the variation of electric field (E_z) inside the inner gate channel along the channel length with different combinations of V_{GS} and $V_{DS} = 0.1V$. The plot in Fig. 8 is interrelated with plots shown in Fig. 7. The electric field (E_z) near the source/drain ends can be observed decreasing with increasing gate-to-source voltage (VGS). On the other hand, the field distribution in the middle of the channel region is horizontally levelled, which may be attributed to the flattened plot of the minimum surface potential ($\psi_{Si,min}$) for nonzero gate-to-source voltages (V_{GS}) as described



Fig. 8. The electric field distribution in the channel related to inner gate in the channel length direction with different combinations of V_{GS} . V_{DS} is kept constant at 0.1 V.



Fig. 9. The plot of threshold voltage (V_{Th}) against the channel lengths for different doping concentrations (N_D) .

in Fig. 7. Further, the negative slope of $\psi_{Si,min}$ in Fig. 7 near the source end renders the positive value of E_z , whereas, the electric field distribution (E_{π}) with negative values near the drain end can be related to the positive slope of $\psi_{Si,min}$ in Fig. 7. The modeling results are in good agreement with the numerical simulation data. Fig. 9 presents the variation of threshold voltage against the channel length for various values of doping concentrations (N_D) in the channel region. The threshold voltage may be observed decreasing with increasing doping concentration. It is to be noted that Junctionless devices are by nature gated resistors, where the channel region is kept highly doped. The high doping concentration in such Junctionless devices deterrents the full depletion of the channel region. In this way, with increasing degree of doping concentration, the depletion course shifts towards the partial mode and appearance of mobile carriers in the channel region becomes more feasible in turning on the device. Note that if the N_D is kept increasing, the partial depletion may be transformed into near flat-band condition. Therefore, the high degree of doping concentration may be fruitful in limiting the threshold voltages to low values. The plot of threshold voltage (V_{TH}) against the device channel length for different values of oxide thicknesses (t_{ox}) is exhibited in Fig. 10. It can be observed that greater is the thickness of the inner/outer gate-oxides, lower is the threshold voltage of the NJL-DGAA device. The reason may be the diminution of electric



Fig. 10. The variation of V_{Th} against the channel length for various values of oxide thicknesses (t_{ox}).

field lines perpendicular to the channel region with thicker gate-oxides, which eventually results in weakening of gate control over the channel. Fig. 11 plots the threshold voltage (V_{TH}) against the channel length for various values of the silicon-tube film thicknesses (t_{si}) . The threshold voltage can be seen increasing with the decrease in channel thickness. This is due to the fact that the use of thinner silicon nanotube causes stronger electrostatic coupling between the gate and the channel which, in turn, boosts up the immunity of the NJL-DGAA MOSFETs against short-channel effects (refers to Eqs. (51)-(54)). In other words, the thicker silicon film deteriorates the coupling between gate and channel, and hence causes lower threshold voltage. Fig. 12 illustrates the drain current (I_{ds}) variation against the gate voltage for various tubular channel thicknesses (t_{si}) with a fixed channel length of 30 nm of the device. The plot exhibits the excellent agreement between the model and simulation results in the subthreshold region. It can be seen that the leakage current is significantly reduced with the thinner tubular channel thickness (t_{si}) . The reason is due to the increased mutual controllability of the outer and inner gates on the channel charge carriers. In the next figure (Fig. 13), the relation between the effective channel potential (hence, the threshold voltages of inner and outer gates) and drain current (I_{ds}) against the gate-to-source voltage for tubular channel thickness, $t_{si} = 5$ nm with a fixed channel length of 30 nm is explored. In other words, the shared control over the channel charge carriers, and hence on the minimum effective channel potential by the outer and inner gates is demonstrated in Fig. 13. With reference to Fig. 6 and Eq. (78), the inner gate possesses lower threshold voltage which results in higher leakage current. On the other hand, the value of drain current is lower in case of outer gate as it has higher threshold voltage. In the case of combined role of inner and outer gates, the plot demonstrates the excellent agreement between model and simulation results in the subthreshold region for the effective channel potential. In short, both of the gates of NJL-DGAA MOSFETs are important in deciding the switching characteristics of the device.

In Fig. 14, the confinement of charge carriers has been considered through the quantum mechanical correction in the derived threshold voltage formula. In the simulation process, the self-consistent model is incorporated to solve the one-dimensional (1D) Schrodinger equation to determine quantum confinement effects in the NJL-DGAA device. Fig. 14 displays the variation of threshold voltage against the gate-to-source voltage (V_{GS}) for quantum corrected and classical threshold voltages. For $t_{si} < 5$ m, the confinement of charge carriers near conduction band edge causes the threshold voltage to slightly increase compared to the classical threshold voltage. The plot reflects that the quantum confinement (QC) effect is negligible on and above the 5 nm channel thickness. Moreover, Table 2 contains the data extracted from model



Fig. 11. The plot of threshold voltage (V_{Th}) against the channel lengths for different silicon channel thicknesses (t_{si}) .



Fig. 12. The variation of Drain current (I_D) against the gate voltage (V_{GS}) for various values of the channel thicknesses (t_{si}) .

results and simulation of threshold voltage (V_{TH}) for various channel lengths with fixed channel thickness, $t_{si} = 5$ nm. From Table 2, it can be observed that for the given dimensional parameters, the difference between threshold voltage with quantum confinement (QC) (V_{TH}^{QC}) and the classical threshold voltage (V_{TH}) is insignificant in the NJL-DGAA devices. Further, the model data taking into account the quantum-mechanical effects are in close agreement with the simulation results. Next, the phenomenon of drain-induced-barrier-lowering (DIBL) in NJL-DGAA MOSFET against the device channel length for different values of the channel thicknesses (t_{si}) is investigated in Fig. 15. In the present work, the DIBL is defined as [8].

$$DIBL = \frac{(V_{TH})|_{V_{DS=0.1V}} - (V_{TH})|_{V_{DS=0.5V}}}{(V_{DS=0.5V}) - (V_{DS=0.1V})}$$
(79)

Clearly, the DIBL is more pronounced in the device with the thicker silicon-tubular channel, and for channel length > 40nm, it becomes insignificant. Note that, Eq. (52) explicitly predicts the role of outer gate in restricting the short-channel effects to the minimum level in DGAA MOSFETs. Further, for $t_{si} < 5nm$, the fundamental short-geometry effects may be ameliorated to some large extent. But, in the case of silicon film thickness (t_{si}) below 4 nm, the quantum mechani-



Fig. 13. The variation of drain current (I_D) against the gate voltage (V_{GS}) for different potentials.



Fig. 14. Variation of threshold voltage (V_{TH}) against the channel thickness (t_{sl}) for with quantum effect (quantum correction) and without quantum effects.

cal effects start interfering with the device electrical characteristics, as cleared from Fig. 14. The behaviour of transconductance of the NJL-DGAA MOSFET in *Off*-state is presented in Fig. 16 for three different channel thicknesses. The device with $t_{si} = 5$ nm possesses the least value of g_m which is in accordance with subthreshold current trend in the below-threshold voltage region. However, the precise behaviour may be predicted in the *On*-state, which is beyond the scope of this manuscript.



Fig. 15. The variation of DIBL against the channel length for various values of the channel thicknesses (t_{si}) .



Fig. 16. The variation of transconductance (g_m) against the gate voltage (V_{GS}) for various values of the channel thickness (t_{si}) .

5. Conclusion

A surface potential-based threshold voltage modeling of inner as well as outer gates of nanotube JL-DGAA MOSFET has been presented. The general parabolic approximation method was applied to solve the 3D Poisson's equation to develop the inner and outer channel surface potentials for inner and outer gates. The silicon based ultra-thin nanotube JL-DGAA MOSFET is presented as a nanotube version of a

Table 2

Comparison of analytical and simulation Threshold voltage data of NJL-DGAA MOSFETs.

_	-		-				
SI. No.	Channel length (<i>L_{ch}</i>)	V _{THi} (V) Calculated using Eq. (57)	V _{THo} (V) Calculated using Eq. (67)	$V_{THi}^{QC}(V)$ Calculated with QC using Eq. (80)	$V_{THo}^{QC}(V)$ Calculated with QC using Eq. (81)	V _{TH} (V) Simulated	$V_{TH}^{QC}(V)$ Simulated
1	20	0.2344	0.3244	0.2349	0.3249	0.2391	0.2432
2	30	0.3020	0.3694	0.3025	0.3699	0.3015	0.3055
3	40	0.3266	0.3795	0.3356	0.38	0.3251	0.3278
4	50	0.3351	0.3822	0.3384	0.3823	0.3344	0.3365
5	60	0.3379	0.3823	0.3394	0.3827	0.3364	0.3372

Junctionless-double gate (JL-DG) FETs indicating the greater potency of the inner gate to govern the device electrical characteristics. The separate mathematical expressions of surface potential and threshold voltage for inner and outer gates greatly helps in understanding the proposed multi-gate Junctionless transistor behaviour. The inner gate is observed spearheading the control over the electrical characteristics compared to outer one, which mitigates the SCEs to some large extent. However, the device designer can exploit the outer gate in optimizing the drain current as it plays a critical role in noise analysis and reliability issues. Furthermore, the device with tube thickness of 5 nm possesses the minimum leakage current. It is the effective channel potential which controls the channel charges. The modeling data of quantum correction to threshold voltage matches well with the simulation data. The model results have been found in good agreement with TCAD simulation data from ATLAS[™] by Silvaco. The proposed mathematical modeling of the nanotube Junctionless double-gate-all-around MOSFET may be found very helpful in the further study of the other multigate Junctionless structures.

Authors' statement

Nitish Kumar: Conceptualization, Methodology, Software. Vaibhav Purwar: Writing- Original draft preparation. Himanshi Awasthi: Software, Writing-Review. Rajeev Gupta: Visualization, Kunal Singh: Validation, Resources. Sarvesh Dubey: Writing- Reviewing and Editing, Supervision.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

References

- [1] J.P. Colinge, C.W. Lee, A. Afzalian, N.D. Akhavan, R. Yan, I. Ferain, P. Razavi, B. O'Neill, A. Blake, M. White, A.M. Kelleher, B. McCarthy, R. Murphy, Nanowire transistors without junctions, Nat. Nanotrchnol. 5 (2010) 225–229, https://doi.org/10.1038/nnano.2010.15.
- [2] V.K. Dixit, R. Gupta, V. Purwar, P.S.T.N. Srinivas, S. Dubey, Effect of Substrate Induced Surface Potential (SISP) on Threshold Voltage of SOI Junction-Less Field Effect Transistor (JLFET), Silicon, 2020https://doi.org/10.1007/s12633-019-00185-7.
- [3] J.P. Colinge, C.W. Lee, I. Ferain, N.D. Akhavan, R. Yan, P. Razavi, R. Yu, A.N. Nazarov, R.T. Doria, Reduced electric field in junctionless transistors, Appl. Phys. Lett. 96 (2010) 073510https://doi.org/10.1063/1.3299014.
- [4] C.W. Lee, S. Ferain, A. Afzalian, R. Yan, N.D. Akhavan, P. Razavi, J.P. Colinge, Performance estimation of Junctionless multigate transistor, Solid State Electron. 54 (2010) 97–103, https://doi.org/10.1016/j.sse.2009.12.003.
- [5] C.W. Lee, A.N. Nazarov, I. Ferain, N.D. Akhavan, R. Yan, P. Razavi, R. Yu, R.T. Doria, J.P. Colinge, Low subthreshold slop in junctionless-multigate transistors, Appl. Phys. Lett. 96 (2010) 102106, https://doi.org/10.1063/1.3358131.
- [6] L. Ansari, B. Feldman, G. Fags, J.P. Colinge, J.C. Career, Simulation of junctionless Si nanowire transistors with 3nm gate length, Appl. Phys. Lett. 97 (2010) 062105https://doi.org/10.1063/1.3478012.
- [7] J.P. Duarte, S.J. Choi, D.I. Moon, Y.K. Choi, A nonpiecewise model for long-channel junctionless cylindrical nanowire FETs, IEEE Electron. Device Lett. 33 (2012) 155–157 https://doi.org/10.1109/LED.2011.2174770.
- [8] G. Hu, P. Xiang, Z. Ding, R. Liu, L. Wang, T.A. Tang, Analytical models for electric potential, threshold voltage, and subthreshold swing of junctionless surrounding-gate transistors, IEEE Trans. Electron. Dev. 61 (2014) 688–695, https://doi.org/10.1109/TED.2013.2297378.
- [9] W.-F. Lu, L. Dai, Impact of work-function variation on analog figures-of-merits for high-k/metal-gate junctionless FinFET and gate-all-around nanowire MOSFET, Microelectron. J. 84 (2019) 54–58, https://doi.org/10.1016/j.mejo.2018.12.004.
- [10] D. Nagy, G. Indalecio, A.J. GarcíA-Loureiro, M.A. Elmessary, K. Kalna, N. Seoane, FinFET versus gate-all-around nanowire FET: performance, scaling, and variability, IEEE J. Electron Dev. Soc. 6 (2018) 332–340, https://doi.org/10.1109/JEDS.2018. 2804383.
- [11] Z. Krivokapic, A. Aziz, D. Song, U. Rana, R. Galatage, S. Banna, NCFET: Opportunities & Challenges for Advanced Technology Nodes, 2017 Fifth Berkeley Symposium on Energy Efficient Electronic Systems & Steep Transistors Workshop (E3S), 2018https://doi.org/10.1109/E3S.2017.8246180.

- [12] Y. Liang, X. Li, S. George, S. Srinivasa, Z. Zhu, S.K. Gupta, S. Datta, V.-K. Narayanan, Influence of body effect on sample-and-hold circuit design using negative capacitance FET, IEEE Trans. Electron. Dev. 65 (2018) 3909–3914, https://doi.org/10.1109/TED.2018.2852679.
- [13] Y. Liang, X. Li, S.K. Gupta, S. Datta, V. Narayanan, Analysis of DIBL effect and negative resistance performance for NCFET based on a compact SPICE model, IEEE Trans. Electron. Dev. 65 (2018) 5525–5529, https://doi.org/10.1109/TED.2018. 2875661.
- [14] H. Agrwal, P. Kushwaha, Y.-K. Lin, M.-Y. Kao, Y.-H. Liao, J.-P. Duarte, S. Salahuddin, C. Hu, NCFET design considering maximum interface electric field, IEEE Electron. Device Lett. 29 (2018) 1254–1257, https://doi.org/10.1109/LED. 2018.2849508.
- [15] T. Yu, W. Lu, Z. Zhao, P. Si, K. Zhang, Negative drain-induced barrier lowering and negative differential resistance effects in negative-capacitance transistors, Microelectron. J. 108 (2021) 1–8, https://doi.org/10.1016/j.mejo.2020.104981.
- [16] J.P. Duarte, S.J. Choi, D.I. Moon, Y.K. Choi, Simple analytical bulk current model for long-channel double-gate junctionless transistors, IEEE Electron. Device Lett. 32 (2011) 704–706 https://doi.org/10.1109/LED.2011.2127441.
- [17] V. Purwar, R. Gupta, N. Kumar, H. Awasthi, V.K. Dixit, K. Singh, S. Dubey, P.K. Tiwari, Investigating linearity and effect of temperature variation on analog/RF performance of dielectric pocket high-k double gate-all-around (DP-DGAA) MOSFETs, Appl. Phys. A 126 (2020) 746, https://doi.org/10.1007/s00339-020-03929-0.
- [18] S. Rewari, S. Haldar, V. Nath, S.S. Deswal, R.S. Gupta, Numerical modeling of Subthreshold region of Junctionless double surrounding gate MOSFET (JLDSG), Superlattice. Microst. 90 (2016) 8–19, https://doi.org/10.1016/j.spmi.2015.11. 026.
- [19] S. Sahay, M.J. Kumar, Nanotube junctionless FET: proposal design, and investigation, IEEE Trans. Electron. Dev. 64 (2017) 1851–1856 https://doi.org/10.1109/TED.2017.2672203.
- [20] N. Kumar, H. Awasthi, V. Purwar, A. Gupta, S. Dubey, Impact of Temperature on Analog, Hot-Carrier Injection and Linearity Parameters of Nanotube Junctionless Double-Gate-All-Around (NJL-DGAA) MOSFETs, Silicon, 2021https://doi.org/10. 1007/s12633-021-01069-5.
- [21] K.K. Young, Analysis of conduction in fully depleted SOI MOSFETs, IEEE Trans. Electron. Dev. 36 (1989) 399–402, https://doi.org/10.1109/16.19960.
- [22] ATLAS User's Manual, 3-D Device Simulator Software, Silvaco. Inc., 2016.
- [23] H.M. Fahad, C.E. Smith, J.P. Rojas, M.M. Hussain, Silicon nanotube field effect transistor with core-shell gate stacks for enhanced high-performance operation and area scaling benefits, Nano Lett. 11 (2011) 4393–4399, https://doi.org/10.1021/ nl202563s.
- [24] D. Tekleab, H.H. Tran, J.W. Sleight, D. Chidambarrao, Silicon Nanotube MOSFET, 2012. U.S. Patent 20120217468 A1.
- [25] G. Musalgaonkar, S. Sahay, R.S. Saxena, M.J. Kumar, A line tunneling field-effect transistor based on misaligned core-shell gate architecture in emerging nanotube FETs, IEEE Trans. Electron. Dev. 66 (2019) 2809–2816, https://doi.org/10.1109/ TED.2019.2910156.
- [26] T. Holtij, M. Schwarz, A. Kloes, B. Iniguez, Threshold voltage, and 2D potential modeling within short-channel junctionless DG MOSFETs in subthreshold region, Solid State Electron. 90 (2013) 107–115, https://doi.org/10.1016/j.sse.2013.02. 044.
- [27] Z. Ding, G. Hu, R. Liu, L. Wang, Analytical models for the electric potential, threshold voltage and drain current of long-channel junctionless double-gate transistors, J. Phys. Soc. 62 (2013) 1188–1193, https://doi.org/10.3938/jkps.62. 1188.
- [28] Copyright @ N. Arora, International Series on Advances in Solid State Electronics and Technology, World Scientific Publishing Co. Pte. Ltd., 2007. ISBN-13 978-981-256-862-5, ISBN- 10 98 1 -256-862-X.
- [29] D. Querlioz, J.S. Martin, K. Huet, A. Bournet, V. Aubry-Fortuna, C. Chassat, et al., On the ability of the particle Monte Carlo technique quantum effects in nano-MOSFET simulation, IEEE Trans. Electron. Dev. 59 (2007) 2232–2242, https://doi.org/10.1109/TED.2007.902713.
- [30] P.K. Tiwari, S. Dubey, S. Jit, A doping dependent threshold voltage model of uniformly doped short-channel symmetric double-gate (DG) MOSFETs, J. Nano-Electron. Phys. 3 (2011) 963–971.
- [31] S. Bhattacherjee, A. Biswas, Modeling of threshold voltage and subthreshold slope of nanoscale DG MOSFETs, Semicond. Sci. Technol. 23 (2008) 015010https://doi. org/10.1088/0268-1242/23/1/015010.
- [32] T.-K. Chiang, A new two-dimensional analytical subthreshold behavior model for short-channel tri-material gate-stack SOI MOSFETs, Microelectron. Reliab. 49 (2009) 113–119, https://doi.org/10.1016/j.microrel.2008.11.005.
- [33] S. Bhushan, A. Kumar, D. Gola, P.K. Tiwari, An analytical subthreshold current model of short-channel symmetrical double gate-all-around (DGAA) field-effect-transistror, Dev. For Integ. Cir. (DevIC) (2017) 211–215 https://doi.org/10.1109/DEVIC.2017.8073938.
- [34] S. Dubey, P.K. Tiwari, S. Jit, A two-dimensional model for the surface potential and subthreshold current of doped double-gate (DG) MOSFETs with a vertical Gaussian-like doping profile, J. Nanoelectron. Optoelectron. 5 (2010) 1–8, https:// doi.org/10.1166/jno.2010.1119.

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ANN Based Technique for Assessment of Wellness of Human Heart

Vikas Verma , Abhishek Vishnoi

Abstract

This paper proposes the Artificial neural network-based heart care assessment system. As per the growing demand of smart health care system this Artificial Intelligence based diagnostic tool fulfill up to certain level. This neural network-based system detects and predict the healthy and unhealthy conditions of the heart. This system is trained with the various input parameters of ECG and PCG. As there are some correlation and coordination are being observed between the ECG and PCG in the same time interval. This enables to develop a smart heart assessment system at the primary level so that its early detection may increase the chances of proper diagnosis at the secondary level. It will be an economical as well as a time saving system.

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Published 2021-10-01

Issue <u>Vol. 14 No. 1 (2021)</u>

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A Dynamic Improvement of a Training Dataset for Source Code Classification Using Deep Learning approach

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Abstract

In recent years, there are various methods for source code classification using deep learning approaches have been proposed. The classification accuracy of the method using deep learning is greatly influenced by the training data set. Therefore, it is possible to create a model with higher accuracy by improving the construction method of the training data set. In this study, we propose a dynamic learning data set improvement method for source code classification using deep learning. In the proposed method, we first train and verify the source code classification model using the training data set. Next, we reconstruct the training data set based on the verification result. We create a high-precision model by repeating this learning and reconstruction and improving the learning data set. In the evaluation experiment, the source code classification model was learned using the proposed method, and the classification accuracy was compared with the three baseline methods. As a result, it was found that the model learned using the proposed method has the highest classification accuracy. We also confirmed that the proposed method improves the classification accuracy of the model from 0.64 to 0.96

Index Terms - source code classification, Abstract Syntax tree, Graph Convolution network, learning dataset

I. INTRODUCTION

For efficient software development, developers frequently reuse existing source code[1], [2]. The source code classification method is a method that automatically identifies which source code is similar to the existing source code belonging to which class, based on the pre-prepared class. By using this source code classification method, developers can quickly identify the source code to be reused. Various source code classification methods have been proposed until now. [3] ~ [7]. In recent years, methods for source code classification using deep learning, such as TBCNN [6], have been proposed. It showed the degree.

In general, the classification accuracy of a deep learning model is greatly influenced by the training data set. In the existing research on source code classification using deep learning [6] and [7], random sampling is used, which is a method to arrange the number of data between classes by randomly extracting data considering learning time and request memory

However, random sampling is a static method, which modifies the training data set by 1 degree before the model is trained. Static methods may be inefficient in terms of classification accuracy because it is generally difficult to predict the learning results of the model. Therefore, it is possible to create a model with higher accuracy by dynamically improving the training data set many times using the training result of the model. In this study, we propose a dynamic learning data set improvement method for source code classification using deep learning. In the proposed method, after actually learning a deep learning model, the similar source code is added to a class whose learning is not progressing accurately based on the verification result of the model. As a result, the

learning of the class proceeds accurately, and the classification accuracy of the model which was declining is improved.

In the evaluation experiment, we constructed a learning data set using three baseline methods and a proposed method from 20 kinds of similar methods included in open source software, respectively, and learned the source code classification model, and compared the classification accuracy. As a result, it was confirmed that the proposed method can classify methods with high accuracy compared with the baseline method, which was trained by aligning the number of methods between each class or the number of nodes in the Abstract Syntax Tree (AST). In addition, it was confirmed that the classification accuracy was improved by repeated model training and addition of similar source code using the proposed method.

Since, 2.The background of this research is described.3.The method proposed in this study is described.4.The evaluation experiment of this study is described.5.In this article, we will talk about the threat of validity in the future.6.In this article, we will talk about related research. Finally, 7.In this paper, we will summarize and discuss future issues.

2. Background

The source code classification method in this study is a method that automatically classifies the source code given as an input into class in which the existing source code is classified. Using this method, software can be developed efficiently. For example, if the source code can be automatically classified by function, the tag related to the function can be automatically assigned to the newly registered source code in a large software repository. In this way, by using the source code classification method, it becomes easier for developers to search for source code with necessary functions and reuse existing source code, and it is expected to improve the productivity of software development.

In the research on source code classification, various methods have been proposed to date, such as classification by descriptive language [3], classification by dependencies between components [4], and classification by program meaning (functionality).In addition, source code classification according to the meaning of programs is tackled at various granularity, and there are software-based classification methods [5] and method-based classification methods [7].

In recent years, a method for classifying source code with high accuracy by using deep learning has been proposed. [6], [7].

2. 1 Graph Convolution network

Graph Convolution network (GCN) [8] is a neural network that extracts nodes, edges, and features of the entire graph by convolving adjacent nodes of the graph. When training a graph, the original graph may be deformed according to the input format of the deep learning model. [6]However, the graph is not deformed in GCN. Therefore; there is an advantage that the structural information of the graph is not missing. This makes it possible to use the information contained in the graph more accurately than the model in which the graph needs to be deformed. An example of the convolution layer of GCN is shown in Figure.



Z=f(X,A) = softmax(Â ReLU(ÂXW^(0)) W^(1)) Fig: Graph convolution network

It describes the procedure for calculating the vector representation of node 0 in the middle of the graph in the upper right corner. For the vector in the convolution n+1 layer of node 0, an intermediate vector is calculated from the vector in the n-th layer of adjacent nodes and the weights of each edge (ingoing, outgoing, self-loop), and the vector obtained by adding all the intermediate vectors for each edge is input to an activation function such as ReLU (a function that corrects the output of the network). It is obtained in this way, the vector representation of node 0 is calculated by taking into account the vector representation of nodes 1, 2, and 3 adjacent to node 0.

2. 2 Mutation for the purpose of creating similar source code

Mutation for source code is to change the source code based on the rules set in advance [9], [10].In general, mutation is used to evaluate test cases. [9]Roy et al. propose a method to evaluate the accuracy of similar source code detection tools by creating similar source code using mutation [10].



Fig: Cycle of GCN input with mutation

In this method, the source code change rules when creating similar source code are called mutation operators. The following 14 types of mutation operators are defined

mCW: Change the number of whitespace

mCC : Change a comment

mCF: Change the coding style such as line breaks.

mRI: Change user-defined names such as variable names, variable types, etc. regularly.

mARI: Change user-defined names such as variable names, variable types, etc. irregularly.

mRPE: Replace a single expression of a variable with another expression.

mSIL: Make a slight insert into a statement

mSDL: Delete part of a sentence

mILs: Insert one or more statements.

mDLs: Delete one or more statements.

MMLs: to fix one or more statements.Sort

MRDS :declaration statements.Sort statements other than

mROS: declarations.replace a control structure, such as an

mCR : if statement, with another.

Figure shows an example of applying the mutation operator MSDL to the source code. By deleting the statement in Line 2 a source code that is syntactically similar to the original source code which was created. In this study, we create similar source code using the mutation operator defined by Roy et al.

2. 3 Learning Dataset:

In general, in deep learning, the construction method of the training data set has a great influence on the classification accuracy of the model. Therefore, a method for improving the training data set has been proposed. [11]Unbalanced data problem is one of the causes that degrades the accuracy of classification models using deep learning. The unbalanced data problem is a problem in which the classification accuracy of the model is lowered because the number of data is unbalanced between classes, and the training does not proceed accurately for a certain class.Yan et al. [11] are working to improve the learning data set by solving this unbalanced data problem.

Specifically, we delete the data of the class with a large number of data, and add new data to the class with a small number of data. In particular, the method of randomly deleting data from a class with a large number of data and aligning the number of data between classes is called random sampling. This random sampling is used in many existing studies [6] and [7] that have worked on source code classification using deep learning.

However, the existing data set improvement method for learning is a static method. In this study, the static method aims to equalize the weights of the data in each class, and it is a method to modify the training data set by 1 degree without using the training result of the model. Since it is generally difficult to predict the training results of the model, static methods that modify the training data set by only 1 degree may be inefficient in terms of classification accuracy. Therefore, it is possible to create a model with higher accuracy by dynamically improving the training data set many times using the training result of the model.

3. Proposed Approach:

In this study, we propose a dynamic learning data set improvement method for source code classification using deep learning. Since the method of constructing the data set has a large influence on the learning result of the deep learning model, it is expected that the classification accuracy of the model can be improved by constructing a more appropriate data set.

The proposed method unlike the existing training data set improvement method described in further Section, a major feature is the reconstruction of the dynamic training data set based on the learning results of the source code classification model. Since it is generally difficult to predict the learning results of deep learning, the proposed method actually learns the deep learning model, and then reconstructs the data set based on the learning results.

3. 1 Definition of Terms:

Similar Source code set A set of source code that is syntactically similar to each other is defined as a similar source code set S.If the number of classes is n, the source code covered in this study is similar to the source code set S0:::Sn. Similar source code set ID In this study, the unique index 0:::n for each n similar source code set. Learning Dataset The source code group used to train the model is defined as a learning dataset. Evaluation Data Set The source code group used to evaluate the classification accuracy of the model is defined as the evaluation data set.

3. 2 Dynamic Learning Data Set Improvement Methods:

First, we define STEP A (Adjustment) as a method for improving dynamic learning data sets proposed in this study. In STEPA, learning the source code classification model and adding the source code to the training data set are repeated until the classification accuracy of the model is no longer improved. In this case, the initial training data set is constructed by random sampling. In this study, 2. The source code classification method using GCN introduced in 2 is used. This source code classification method is. The AST can be used as training data as it is. Therefore, unlike the existing method using deep learning, AST is not changed due to the convenience of the input format, so there is an advantage that the program structure information is not missing. This classification method consists of two steps: STEP T (Training) to train the model and STEP C (Classification) to classify the source code using the trained model.

STEP A1: To handle the very first adjustment for data.

STEP T : train the learning data set to the source code classification model.

STEP A2: To verify that the source code classification model accurately trains the training data set,

STEP C : Classify the source code in the training data set using the trained model.

As a result, the model outputs inferred results of similar source code set IDs for each source code, so it is divided into source code with the correct ID output(true classification)and source code with the wrong ID output(false classification).

STEP A3 For the source code that outputs the wrong ID 2. Apply 3 mutations and create a certain number of similar source code. In this study, when creating a similar source code, one of 11 operators except MCW, MCC, and MCF, which are operators that do not change AST, are randomly selected and applied.

STEP A4: For similar source code created by mutation, assign the same ID as the similar source code set ID assigned to the original source code, and then add a certain number to the training data set. Repeat above STEPS A1 to A4 until the number of false classifications no longer decreases.

3. 2. 1 GCN Learning Procedure for Source Code Classification Model (STEP T)

In STEP T, we create a source code classification model by supervised learning. An overview of STEP T is as below:

STEP T1 Construct a similar source code set from the source code to be studied, and assign a unique similar source code set ID to each similar source code set.

STEP T2 Parse each source code and convert it to AST.S

TEP T3 Convert each AST to the form of adjacency matrix and feature matrix.

STEP T4 We train GCN by supervised learning using adjacency and feature matrices as explanatory variables and target variables with similar source code set IDs, and create a source code classification model.

3. 2. 2 SOURCE CODE Classification PROCEDURE USING A Trained Model (STEP C)

In STEP C, source code classification is performed using the trained model created by STEP T.Overview of STEP C is as below:

STEP C1: Parse the source code to be classified, convert it to AST, and then convert it to the form of adjacency matrix and feature matrix.

STEP C2: Enter the adjacency and feature matrices into the source code classification model.

STEP C3: Inferred result of similar source code set ID for source code to be classified is output.

STEP C4: Classify the source code to be classified as a similar source code set indicated by the output similar source code set ID.

4. Evaluation experiment

Evaluation experiments were carried out to confirm that the proposed method is effective for improving the learning data set. In the evaluation experiment, we constructed a learning data set using 3 kinds of baseline methods, a proposed method, and a total of four methods, respectively, and compared the classification accuracy of each model in which each constructed learning data set was trained. The accuracy of classification in this evaluation experiment is 4. Included in the evaluation dataset created according to 1.

05	Liburty 16 04 6 LTC
05	0 buntu 10.04.0 L15
CPU	Intel(R) Xeon(R)CPU E5-2623 v4 2.60 GHz
GPU	NVIDIA Tesla V100 32 GB 1.53 GHz
Library	Tensorflow 1.13.1 ^(Note 3)

Table: Experimental Environment Tuning

The method is classified correctly by the model.In this evaluation experiment, the source code unit to be classified was a method, and the method name and arguments were not used, and the classification was carried out based on the description of the method body.The reason for classifying methods in evaluation experiments is that methods are a collection of one function, so they are easy to be reused. In this evaluation experiment, antlr is used for the ast transformation of the method in step t2, and cpp14 is used for the grammar file.In addition, the implementation of GCN used the implementation of Kipf et al. [12].The environment in which this evaluation experiment was carried out is shown in Table above.

4.1 Data Set

In the evaluation experiment, open source software Versions of OpenSSL ^(Note 4) 0.9.1 to 1.1.1, in 13 versions, used more than 20 methods that were edited between versions. In this experiment, we created a similar source code set under the assumption that methods with the same name, including the file path, have the same function in each version of the same project, and methods with different names have different functions. First, we selected a set of similar source code to be used for learning and evaluation. Specifically, we have created a similar source code set that collects methods with the same name that are being edited between versions. In this case, 20 similar source code sets were randomly
selected and used due to the memory capacity.Next, Figure shows how to create a learning and evaluation dataset from each similar source code set.First, we added methods other than the oldest version in the similar source code set to the evaluation dataset. At this time, we added only methods with differences in descriptions between versions. As a result, the number of methods in the evaluation data set in this evaluation experiment was 166.Next, you can create a certain number of similar methods by applying mutation to the oldest version of the method in the similar source code set



Figure: Overview of how to create Learning and Evaluation Datasets

It was created and added to the training data set. Here, when creating a similar method, one of 11 different operators except MCW, MCC, and MCF, which are mutation operators that do not change AST, is randomly selected and applied to 1.Also, the number of similar methods to create and add is 4. It depends on the data set construction method of 2.We applied this to the selected 20 similar source code sets, and created a learning and evaluation data set. By creating the data set as described above, we avoided that syntactically matching methods are included in both the training and evaluation data sets. In this way, we can evaluate the classification accuracy of deep learning models for uneducated methods.

However, a method created with mutation applied may belong to a similar source code set that is different from the original method. In order to solve this problem, the first author of this paper visually verified all 20 similar source code sets, and confirmed that there are large differences in implementation functions between methods belonging to different similar source code sets. In addition, when the mutation operator is applied, the percentage of lines to be changed is limited to 5% or less of the total number of lines of the method. Due to the above visual confirmation and the limitation of the number of lines of change, even if you create a method that has slightly changed its functionality due to mutation, it is similar to the original method, so it is included in the same similar source code set as the original method.

4. 2 Data Set Construction Method:

The details of the 3 types of baseline methods and proposed methods are as follows. Method-orientedn Use the method created by applying mutation to the training dataset for each similar source code set ID n times. In this evaluation experiment, n=50; the experiment is carried out for 500 2 streets. The training data set in Method-oriented-n has n 20 methods because it uses 20 similar source code sets.

		-		
Method	For Learning	For Evaluation	Percentage	
Method –Oriented -50	1000	166	6:1	
Method –Oriented -500	10000	166	60:1	
Node- Oriented	6461	166	39:1	
Proposed method	1360	166	8:1	

Table: Details of the datasets constructed by each method

Node-Oriented AST The method created by applying mutation is used for the training dataset so that the total number of nodes is approximately 15,000 per similar source code set. As a result, the number of methods in the training dataset in Node-oriented was 6461. The proposed method starts learning from the state of Method-oriented-50, 3. 2STEP A4 adds 10 new methods. Therefore, Method-oriented-50 is the initial state of the proposed method. As a result of the improvement of the training data set using the proposed method, the final training data set has 1360 methods. In addition, Table below shows details of the data sets for each method. Here, "For learning" is the number of methods included in the training data set, "for evaluation" is the number of methods included in the evaluation data set, and "percentage" is the ratio of "for learning" and "for evaluation".

4. 3 Experiment Procedure:

This evaluation experiment is carried out by the following procedure.

(1)Based on the four techniques described in sections above Construct a learning dataset from 20 similar source code sets selected as shown.

(2) Each of the 4 types of learning data sets constructed in step above is trained, and four source code classification models are created.

(3) Evaluate the classification accuracy of each source code classification model using the evaluation data set.

4. 4 Experimental results:

The classification accuracy of each data set construction method is shown in Table 3.As can be seen from this table, the data constructed by the proposed method The model that trained the set has the highest classification accuracy. Next, the classification accuracy of the model that trained the data set constructed with Node-oriented is high. It was found that the classification accuracy of the model trained with the data set constructed with Method-oriented-500 was the 3rd highest, and the classification accuracy of the model trained with the data set constructed with the data set constructed with Method-oriented-500 was the 3rd highest, and the classification accuracy of the model trained with the data set constructed with Method-oriented-500 was the 3rd highest.

Method	Classification accuracy
Method –Oriented -50	0.64
Method –Oriented -500	0.81
Node- Oriented	0.90
Proposed method	0.96

Table: Accuracy of similar method classification

Also, STEP A5 shows the change in classification accuracy when model training and the addition of similar source code are repeated. It shows the change in classification accuracy when model training and the addition of similar source code are repeated.From this figure, as a result of dynamically adding similar source code by STEP A5, it was confirmed that the classification accuracy of the source code classification model was improved from 0.64 to 0.96.

4.5 Research:

In the evaluation experiment, the classification accuracy of each source code classification model which trained the learning dataset constructed by three baseline methods to improve the learning dataset and a total of four methods of the proposed method was compared. As can be seen from Table, the classification accuracy of the model trained by the training data set of the proposed method is the highest. When we confirmed the classification result, there was a similar source code set in which the methods contained in the evaluation data set were not classified at all in the baseline method. On the other hand, in the proposed method, there was no similar source code set in which the methods contained in the evaluation data set were not classified at all. In this way, it is clarified that the classification accuracy can be improved by using the proposed method.

In addition, as can be seen from experiment result, we were able to improve the classification accuracy by repeating the addition of similar source code (STEP A5) based on the learning results of the model. From this result, it is also possible to improve the training data set.

It is shown that the proposed method is effective. In given figure, the classification accuracy may decrease. This may be due to the fact that when adding similar source code to the training data set in STEP A4, the ratio of the number of training data after the addition has moved away from the ideal ratio of the number of training data after the addition than before the addition.

Next, in this evaluation experiment, the number of similar source code of the learning data set is monotonically increased, but conversely, the method to reduce the number of similar source code is also considered. However, it is not efficient in this evaluation experiment. As shown in given figure, in this evaluation experiment, the classification accuracy of the initial state exceeds 0.5, and the accuracy is high to some extent as a 20-class classification model. Therefore, it is not necessary to make bold changes to the learning data set, and it is considered to be a stage to be fine-tuned. In addition, we examined the classification results and confirmed that there were more similar source code sets that could be classified correctly. Therefore, the method of increasing the similarity source code requires less modification of the training. data set, and is more suitable for fine-tuning the training data set. Therefore, when the classification accuracy is 0.5 or higher, the method of increasing the number of similar source code is considered to be efficient. On the other hand, a method to reduce the number of similar source code should also be considered when the classification accuracy is lower than 0.5.

Below table shows the details of the number of methods and AST nodes in the training data set after the improvement by the proposed method. As can be seen from this table, in the training data set constructed using the proposed method, there is an imbalance between the number of methods and the number of nodes in the AST each similar source code set. However, in the evaluation experiment in this study, the classification accuracy of the model which trained the data set constructed using the proposed method was the highest. In this way, even if the number of methods and the number of nodes are ultimately unbalanced than the data set constructed by aligning the number of data between classes like the baseline method, the training data set dynamically reconstructed based on the learning

Statistics	Value
Number of similar source code sets	20
Maximum number of methods	110
Minimum number of methods	50
Maximum number of sets total nodes	20717
Minimum number of sets Total nodes	4462

result of the source code classification model is more accurate training of the deep learning model I found that I can run.

Table: Details of the dataset after improvement by the proposed method

5. Related research

5. 1 Efficient learning of unbalanced data:

As explained in sections above, an imbalance in the number of data between classes in the training data set can adversely affect the learning results and efficiency of the model. Therefore, many researchers are working on efficient learning of unbalanced data.

Yan et al. [11] propose a learning method for classification models corresponding to unbalanced data by constructing a training data set using oversampling and downsampling. This method addresses the unbalanced data problem by statically improving the training data set. Yan et al., [14] propose a learning method for classification models that addresses unbalanced data problems in multimedia data sets by incorporating the bootstrap method into convolution neural networks (CNNs). Chen and Shyu [15] propose a classification method corresponding to unbalanced data using the k-mean method. These two methods address the unbalanced data problem by statically modifying the learning algorithm. The proposed method differs from the existing method in that it dynamically improves the learning data set.

Recently, a study on source code classification using deep learning has been published.

Mou et al. [6] proposed a model called TBCNN, which transforms AST into a tree, creates a vector representation of AST nodes by unsupervised learning, and captures the features of the whole AST by sliding a tree-based convolution kernel to the whole AST, and applies this model to the source code classification. hang et al. [7] vectorize the source code by dividing the AST of the source code into statement levels, vectorizing each, and then entering a stream of statement vectors into the Bi-directional Gated Recurrent Unit (Bi-GRU) [16]. We propose a deep learning model called ASTNN and apply this model to source code classification. The source code classification method used in this study is characterized by the ability to learn the structure of the AST by using GCN.

6. Conclusion and Future Work

In this study, we propose a dynamic learning data set improvement method for source code classification using deep learning. In the proposed method, after learning the source code classification model, we verify the classification accuracy of the model using the training data set. Then, we mutate the source code of the learning dataset that could not be classified correctly, and add the created

similar source code to the learning dataset. In the evaluation experiment, the source code classification model was trained using each learning data set constructed by a total of four data set construction methods of the baseline method and the proposed method for open source software, and the classification accuracy was compared. As a result, it was confirmed that the model learned from the data set constructed using the proposed method classifies the source code with the highest accuracy. In addition, it was confirmed that the classification accuracy was improved by repeated model training and addition of similar source code using the proposed method.

The future aspects that could be worked on in future are:

- Compare the classification accuracy of existing and proposed methods for solving unbalanced data problems. We apply the proposed method to the existing source code classification method, which is different from the source code classification method using GCN in this study, and evaluate the effectiveness of the proposed method.
- Evaluate the usefulness of the proposed method for larger data sets by increasing the number of similar source code sets to be trained.
- The results of the evaluation experiment may be specialized in OpenSSL.Therefore; we conduct evaluation experiments on other software to evaluate the versatility of the proposed method.
- The effect of the initial state of the proposed method on classification accuracy is investigated.
- Investigate how the additional number of source code in Step A4 affects the process of improving the learning dataset and the final classification accuracy.

7. Acknowledgement

I would like to thank my deep sense of gratitude to college, that provided us an opportunity to write a paper. I give special thanks my project guide, **Mr. Sanjeev Kumar Shukla**, **Kanpur Institute of Technology Kanpur** for his inestimable guidance, valuable suggestions and constant encouragement during the course of this study.

I am sincerely grateful to our Director **Prof(Dr) Brajesh Varshney,Professor** for his kind help assistance and for providing me all the facilities in accomplishing this work of the Institute for the help provided us during the writing the content of this paper.

I would also like to give special thanks to **Mr. Ayush Mishra** for his help and support during writing this paper.

I would also like to give special thanks to our HOD's of CSE & IT and my Family members for all their blessing for their true encouragement and guidance in the completion of the paper.

References:

[1] R. Hoffmann, J. Fogarty, and D.S. Weld, "Assieme: Finding andleveraging implicit references in a web search interface for pro-grammers," Proc. UIST 2007, pp.13–22, New York, NY, USA,Oct. 2007. DOI:10.1145/1294211.1294216

[2] K.T. Stolee, S. Elbaum, and D. Dobos, "Solving the search forsource code," ACM Trans. Softw. Eng. Methodol., vol.23, no.3,pp.26:1–26:45, June 2014. DOI:10.1145/2581377

[3] G. Kavita and F. Romano, "C# or java? typescript or javascript?machine learning based classification of programming languages,"https://github.co/2Jif7Sg, 2019.

[4] R. Yokomori, N. Yoshida, M. Noro, and K. Inoue, "Use-relationship based classification for software components," Proc.QuASoQ 2018, pp.59–66, Nara, Japan, Dec. 2018.

[5]S. Kawaguchi, P.K. Garg, M. Matsushita, and K. Inoue, "Mud-ablue: An automatic categorization system for open source repos-itories," J. Systems and Software, vol.79, no.7, pp.939–953, 2006.DOI:10.1016/j.jss.2005.06.044

[6] L. Mou, G. Li, L. Zhang, T. Wang, and Z. Jin, "Convolutionalneural networks over tree structures for programminglanguageprocessing," Proc. AAAI 2016, pp.1287–1293, Phoenix, Arizona,USA, Feb. 2016. DOI:10.5555/3015812.3016002

[7] J. Zhang, X. Wang, H. Zhang, H. Sun, K. Wang, and X. Liu, "Anovel neural source code representation based on abstrace syntaxtree," Proc. ICSE 2019, pp.783–794, Montréal, QC, Canada, May2019. DOI:10.1109/ICSE.2019.00086

[8] M. Schlichtkrull, T.N. Kipf, P. Bloem, R. Van Den Berg, I. Titov, and M. Welling, "Modeling relational data with graph convo-lutional networks," Proc. ESWC 2018, pp.593–607, Heraklion, Crete, Greece, June 2018. DOI:10.1007/978-3-319-93417-4_38

[9] Y. Jia and M. Harman, "An analysis and survey of the developmentof mutation testing," IEEE Trans. Software Engineering, vol.37,no.5, pp.649–678, Sept. 2010. DOI:10.1109/TSE.2010.62

[10] C.K. Roy and J.R. Cordy, "A mutation/injection-based auto-matic framework for evaluating code clone detection tools,"Proc. ICSTW 2009, pp.157–166, Denver, CO, USA, April 2009.DOI:10.1109/ICSTW.2009.18

[11] Y. Yan, Y. Liu, M.-L. Shyu, and M. Chen, "Utilizing conceptcorrelations for effective imbalanced data classification," Proc.IRI 2014, pp.561–568, Redwood City, CA, USA, Aug. 2014.DOI:10.1109/IRI.2014.7051939

[12] T.N. Kipf and M. Welling, "Semi-supervised classification withgraph convolutional networks," Proc. ICLR 2017, Palais des Con-grés Neptune, Toulon, France, April 2017.

[13] Hiroshi Fujiwara,"Similarity Source Code Search using Abstract Syntax Trees and Graph Convolution Networks, "Master's Thesis, Graduate School of Information Science, Osaka University, Feb. 2020. http://sel.ist.osaka-u.ac.jp/lab-db/Mthesis/contents.ja/150.html

[14] Y. Yan, M. Chen, M.-L. Shyu, and S.-C. Chen, "Deep learningfor imbalanced multimedia data classification," Proc. ISM 2015,pp.483–488, Miami, FL, USA, Dec. 2015.DOI:10.1109/ISM.2015.126

[15] C. Chen and M.-L. Shyu, "Clustering-based binary-class classifi-cation for imbalanced data sets," Proc. IRI 2011, pp.384–389,LasVegas, NV, USA, Aug. 2011. DOI:10.1109/IRI.2011.6009578

[16] D. Tang, B. Qin, and T. Liu, "Document modeling with gatedrecurrent neural network for sentiment classification," Proc.EMNLP 2015, pp.1422–1432, Lisbon, Portugal, Sept. 2015.DOI:10.18653/v1/D15-1167

ANALYSIS OF CONSUMER BUYING BEHAVIOUR &SATISFACTION TOWARDS FORTIFIED EDIBLE OILS IN KANPUR

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Abstract

The paper is an attempt to study the consumer behavior towards fortified edible oils in Kanpur. Consumer preferences and choices will be studied towards consumption of edible oils in Kanpur. Consumer behavior will involve all the stages like Need Recognition, Information Search, Evaluation of Alternatives, Purchase Decision and Post Purchase Behaviour. This paper has tried to analyze the consumer preferences towards attributes such as Health consciousness, ingredients. The brands taken into consideration are Saffola, Borges and Patanjali. It is a perfect attempt to understand the descriptive research that researcher incorporated.

Keywords: Consumer Behaviour, Fortified Edible Oil

[1]INTRODUCTION

Edible oils constitute an important component of food expenditure in Indian households. Historically, India has been a major importer of edible oils with almost 30-40% of its requirements being imported till 1980s. In 1986, the Government of India established the Technology Mission on Oilseeds and Pulses (TMOP) in order to enhance the production of oilseeds in the country. The TMOP launched special initiatives on several critical fronts such as improvement of oilseed production and processing technology, additional support to oilseed. Consequently, there was a significant increase in oilseeds area, production, and yields until the late-1990s. Awareness, knowledge & exposure among consumer towards edible oil are also increasing, because of the level of education, urbanization and also the vast development in communication facilities. Packaging has become appropriate selling proposition now days, although edible oil industry is very competitive and consumers are numerously price conscious but still packaging make an impact on the consumer buying behaviour.

[2]REVIEW OF LITERATURE

Dr.J.H.Vyas, Imran N.Siddiqu ,Jay K.Dewangan (2019) study suggests that when the consumer purchase cooking oil higher importance is given to safety aspects, and the brand image of the cooking oil than the sales promotional schemes offered by the companies. Cooking oil marketers could take maximum efforts in designing the advertisements in such a way that the advertisements provide reliable and maximum information about the nutrition and health aspects, price of the oil.

Dhinesh babu & Venkateshwaran (2018) stated that the owners of the edible oil units should be trained to get more marketing knowledge to market their products. They should think global and act local. It implies that their product should be highly qualitative and also suitable to the local consumers. The attractive packaging plays an important role in the marketing of edible oils. All types of manufacturers should realize this fact and try to sell their products in attractive packets. It is not only attractive but also is reachable to all customers' segments.

R Prerna (2018) in their study says that Quality is always important for any production. But it is more important in case of edible oil for reason that it is more related to health. Consumers

analyze the price, quality, packaging aspects etc. before they buy the product and hence, it is up to the different brands of sunflower and groundnut oil manufacturers to concentrate on those aspects and workout better strategy to attract more consumers for their brands.

Syed Akif Hasan and Muhammad Zeeshan Khan (2017) stated that packaging characteristics influences the consumer brand preference in edible oil. whereas packaging characteristics has eight different dimensions i.e. various sizes of Package, different shapes Package, safety, shelf life, convenience of storage, convenience of use, extra use of package and package attractiveness. Study is also helpful to conclude the factors which are responsible for the increment of market share in edible oil industry by changing or modifying the packaging of product in competitive market.

Butz and Goodstein, (2018) found that demographic variables are the most popular bases for segments the customer groups, One reason is that consumer needs, wants, preferences and usage rates are often highly associated with demographic variables.

N. Rajaveni & Dr. M. Ramasamy (2018) study suggests that strongly packaged brand should offer protection and carve out for a point of difference that can protect the brand against competitor activity through trade marking. It is also important to remember that the world is full of cultural and linguistic difference. What works in one market doesn't always work in another. The bottom line for business is that packaging design will almost always have an effect on a company's profit and loss.

[3]THE RESEARCH STUDY

OBJECTIVES OF THE STUDY

- > To identify the awareness of consumers towards packaged fortified edible brands.
- To study brand preference of packaged fortified edible oil in the market by Customer Care to address such serious concern.
- > To determine the factors influencing purchase of fortified edible oil.
- > To determine level of satisfaction towards consumption of edible oil.

HYPOTHESIS

H0:There is no significant relationship between price and purchase of fortified edible oil. H1: There is significant relationship between price and purchase of fortified edible oil.

[4]RESEARCH METHODOLOGY

The paper used Descriptive Research Design to define the present state of affairs. The paper presented the methodology which was adopted for answering the research questions which have been formulated and presented. For the proper analysis of data simple statistical techniques such as percentage, SPSS analysis of Mean, Median, Standard Deviation and Skewness were used. It helps in making more generalization from the data available. The data which will be collected from a sample of population was assumed to be representing entire population was interest. Classification of data is based on demographic factors like Age, Sex etc.

[5]SAMPLE SUMMARY

Area:	Kanpur
Size:	50 Respondents
Technique:	Purposive Sampling
Selection:	The respondents were selected at purposive and were approached mostly in retail
	stores to give their opinion for purchase of fortified oil.

[6]COLLECTION OF DATA

The data is collected from the people in the form of questionnaire and the sample size is 50 respondents. Because it is a pilot study and due to time constraint the sample size is small.

[7]LIMITATION OF THE STUDY

Every study has some limitations; similarly this study has also the following limitation. The limitations for this study are discussed below:

- The study is based only on geographic area of Kanpur, which is very small for this type of study and the sample size for this study is 50, which is too small for the study like this.
- Shortage of important aspect such as time, financial problem, and complete size prevented research from detailed study, while in the main cause of limitation of report.

[8] DATA ANALYSIS AND INTERPRETATION

SPSS Analysis of Impact of price on increased purchased behaviour

Table 1

Statistics

Is price significant in resulting significant purchases?

NT	Valid	50
IN	Missing	0
Mean		3.6400
Median		4.0000
Mode		5.00
Std. Deviation		1.17387
Skewness		273
Std. Error of		227
Skewness		.557
Kurtosis		-1.118
Std. Error	of Kurtosis	.662

Table 2

		Frequenc	Percent	Valid	Cumulative	
		у		Percent	Percent	
	strongly disagree	1	2.0	2.0	2.0	
	disagree	9	18.0	18.0	20.0	
Valid	Neutral	13	26.0	26.0	46.0	
	Agree	11	22.0	22.0	68.0	
	strongly agree	16	32.0	32.0	100.0	
	Total	50	100.0	100.0		

Analysis:

In the sample size of 50 respondents. The Mean and Median Values are 3.64 and 4.00 respectively which show that considerable number of respondents agree that Customer Care is contributing to Customer Satisfaction. Even the Kurtosis Value of -1.118 suggests that majority of the respondents agree Price has significant impact on Purchase Intentions.

Reliability Test through Cronbach Alpha

RELIABILITY /VARIABLES=Health Consciousness,Ingredients /SCALE('ALL VARIABLES') ALL /MODEL=ALPHA.

Summary

Scale: ALL VARIABLES

		Ν	%
	Valid	49	100.0
Cases	Excluded ^a	0	.0
	Total	49	100.0

Table 3:-Case Processing

a. Listwise deletion based on all variables in the procedure.

Table 4: Reliability	
Statistics	

Cronbach's	N of Items
Alpha	
.836	3

Analysis:

Cronbach's alpha is a measure of internal consistency, that is, how closely related a set of items are as a group. It is considered to be a measure of scale reliability. A "high" value for alpha does not imply that the measure is unidimensional. If, in addition to measuring internal

consistency, you wish to provide evidence that the scale in question is unidimensional, additional analyses can be performed. Exploratory factor analysis is one method of checking dimensionality. Technically speaking, Cronbach's alpha is not a statistical test – it is a coefficient of reliability (or consistency). The value of Cronbach alpha is 0.836 considering variables as Health Consciousness ,Ingredients which indicates measure of internal consistency.

Which brand is most preferred for fortified edible oils?

Statistics

Which brand is most preferred

brand of fortified edible oils

N	Valid	50
	Missing	0

		Frequency	Percent	Valid Percent	Cumulative Percent
	Saffola	19	38.0	38.0	38.0
Valid	Borges	17	34.0	34.0	72.0
	Patanjali	14	28.0	28.0	100.0
	Total	50	100.0	100.0	

Which brand is most preferred brand of fortified edible oils



[9] INTERPRETATION

Above data analysis shows that most of the consumers preferred Saffola , after that the preference was from Borges and the third preference was for Patanjali. The frequency value denote the choice of preferences.

[10]SATISFACTION TOWARDS SAFFOLA

Descriptive Statistics							
	Ν	Minimum	Maximum	Mean	Std. Deviation	Skev	vness
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error
Satisfaction of towards	50	1.00	5.00	4 0 0 0 0	4 40074	4.054	007
Saffola	50	1.00	5.00	4.0200	1.13371	-1.354	.337
Valid N (listwise)	50						

		Frequency	Percent	Valid Percent	Cumulative
					Percent
	very dissatisfied	3	6.0	6.0	6.0
Valid	dissatisfied	3	6.0	6.0	12.0
	neutral	4	8.0	8.0	20.0
	satisfied	20	40.0	40.0	60.0
	very satisfied	20	40.0	40.0	100.0
	Total	50	100.0	100.0	

Satisfaction of towards Saffola

Findings

1) The likert scale mean value 4.02 clearly indicates the satisfaction level in Kanpur.

2)Consumers are highly attracted by Price ,Quality and Packaging.

REFERENCES

[1] Bloch, J., Fallon, D., & Bitta, R, Study of buying behaviour of branded edible oils. Indian Journal of Marketing, 31 (7), 2006, pp 48.

[2] Cooper, D., & Schindler, P, Business Research Method (7th ed.). New York: McGraw-Hill., 2008

[3] Dhinesh babu.S , Venkateshwaran.P.S, Marketing problems of edible oil industry in the state of Tamilnadu, Asian Journal of Management, pp 58 – 65, ISSN 2229 3795

[4] Dr. J.H.Vyas, Imran N. Siddiqu ,Jay K. Dewangan, A study of Edible oil consumption in Raipur city "IRACST – International Journal of Commerce, Business and Management Vol. 2, No.2,2013

[5] Du S., Mroz T.A., Zhai, F., Popkin, B.M, Rapid income growth adversely affects diet quality in China-particularly for the poor! Social Science Medical Journal, 59 (7), 2004, pp 1505-1515.

[6] D. Shanthi and Dr. Ashok Kumar. M. Effectiveness of Television Advertisements on Buying Behaviour of the Women College Students. International Journal of Advanced Research in Management, 7(3), 2016, pp. 21–28.

[7] Economic Survey 2004, by Central Bureau of Statistic. Githitho, M. N, The effects of income expenditure patterns on household food security in low income urban households at Kasarani Division, Nairobi. Kenyatta University, Kenya, 2004

[8] Hallman, W. K., Adelaja, A., Schilling, B., & Fang, J. T, Consumer Beliefs, Attitudes and Preference Regarding Agricultural Biotechnology. Food Policy Institute Report, Rutgers University, New Brunswick, 2002

Ectoparasites of Microchiropteran Bats in Seplawan Cave, Central Java

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Abstract— The Ectoparasite of Microchiropteran bats in Seplawan Cave, Purworejo, Central Java were studied from April to May 2018. Bats were captured using mist nets and ectoparasites collection performed on the entire surface of the bat's body. The number of bats captured was 29 consisting of 4 species, a total of 137 ectoparasites collected were belonging to 7 families, 9 genera and 12 species i.e. Periglischrus sp., Spinturnix plecotinus, Spinturnix myoti, Blattisocius, Acarus sp., Macronyssus sp., Dendrolaelaps sp., Laelaps sp., Eucampsipoda sp., Megastrebla nigriceps, Megastrebla sp. and Stylidia caudata. Intensity degree of parasitic infestation among bats ranged from 0.66 to 2.83 Bat species with the highest prevalence value is Miniopterus schreibersii (34.48%) while ectoparasite with the highest intensity value is Megastrebla nigriceps (0.97).

Keywords— Microchiroptera, ectoparasite, bats, Seplawan Cave.

I. INTRODUCTION

This Bats are hosts for a large number of endoparasites and ectoparasites. Ectoparasites which live in bats are usually ticks and mites. Other ectoparasites which found and recorded are insects, specifically from order Hemiptera, Siphonaptera (lice) and Diptera (Flies). Bats can also play a role as intermediary hosts [44].

Ectoparasites live on the external surface of other organisms. They live as a parasite on various hosts in both domestic and wild animals [16]. Mammals are mostly host to ectoparasites, especially small mammals and bats [37].

Some bat species can live together with other individuals in one cave [13]. This causes bats to become a natural host of many ectoparasites such as ticks, mites, insects and flies [8]. Many bat ectoparasites has potential to become vectors that carry disease [4]. Because of a life history that facilitates high levels of parasitic transmission, bats are undoubtedly has an abundant source of parasitic diversity and most likely reflect ecosystems which support parasitic life [18].

Bats are excellent model for studying the relationship between host and parasite because they have very diverse taxonomies and behaviors [24]. In Southeast Asia, about 30% of the total bat species in the world have been documented (320 species) [21]. However, there is still lack of data on ectoparasites associated with bats in the tropical regions, especially in Southeast Asia [23]. Therefore, studying the relationship between parasites and bat host is important in order to get more information in biology, systematics and phylogeny of their hosts [15] as well as the spread of ectoparasites related with bats in Indonesia. The objectives of this study were to identify and quantify intensity of infestation and prevalence of ectoparasites related with bats in Seplawan Cave, Purworejo, Central Java.

II. MATERIAL AND METHOD

A. Study Area

Seplawan Cave is located in Donorejo Village, Kaligesing District, Purworejo, Central Java. Seplawan Cave is a vertical cave which used as a tourist spot. Physically, stairs have been installed to facilitate mobility for both tourists and researchers. Seplawan Cave surrounded by trees and other plants, however, there is no research related to the type of vegetation on this area. Purworejo Regency consists of a limestone region with red soil and hill-shaped land topography.

Seplawan Cave has a special characteristic like a fish skeleton on its wall surface. The stone formation contains stalactite, stalagmite, helicite and flowstone. It has a length of 700 meters with cave branches around 150 - 300 meters in length and 15 meters in diameter [26]. The existence of bats in this cave even though it has become a tourist attraction is one of the reasons for choosing this cave.

B. Data Collection

Data collection conducted during April until May 2018. Bat trapping is done by installing mist net in the cave opening for 4 hours around 17.00 - 21.00 pm. Captured bats were recorded and then separated into calico bags and at the same time, environmental parameters were collected i.e. humidity, moisture, temperature, light intensity and acidity (pH).

Bats were anesthetized using a small amount of isoflurane. Anesthetized bats then measured including body length (HB), forearm (FA), tibia (Tb), ear (E), tail (T), hind foot (HF), tragus (Tr), and wing spans (Wp). Bats were identified to species level following reference [39]. Ectoparasites were collected from bats using forceps and brush. The collected parasites were preserved in vials containing 70% ethanol. Ectoparasites were identified based on literature from reference [26], [22] and several research journals. After this process, bats were released at the captured sites.

C. Data Analysis

Data were analysed descriptively by making a table in the form of the type and number of bats caught together with the types of ectoparasites, the prevalence and mean intensity of ectoparasites found on each bat. Ectoparasites data were also analyzed by making a table containing ectoparasites, the number of ectoparasites, the prevalence and intensity of ectoparasites.

Prevalence is the value to estimate the proportion and population of bats infected with ectoparasites while intensity is the average number of parasites which infected bats i.e. the number of ectoparasites divided by the number of infected bats [7].

III. RESULTS

The total number of Microchiropteran bats caught in Seplawan Cave was 29, these species altogether were investigated for ectoparasites. From 29 individuals consisting of four species we found out that 89.65% were infested with ectoparasites including all host species below. The highest number of captured bats was *Miniopterus schreibersii* (13) followed by *Hipposideros larvatus* (8) (Table 1).

Table 1: Number of bats species captured

No.	Host species	No. captured bats
1	Miniopterus schreibersii	13
2	Rhinolopus pusillus	6
3	Rhinolopus affinis	2
4	Hipposideros larvatus	8
Total		29

Host species	No. captured bats	No. infested host	Prevalence (%)
Miniopterus schreibersii	13	10	34,48
Rhinolopus pusillus	6	6	20,69
Rhinolopus pusillus	2	2	6,90
Hipposideros larvatus	8	8	27,58
Total			89,65

The species with the highest prevalence value is Miniopterus schreibersii (34.48%), with total 10 infected individuals while Rhinolopus pusillus has the lowest prevalence rate (6.90%). Prevalence value is still in the normal category, this category was referred to as ectoparasites commonly found in one individual.

The amount of ectoparasites obtained were consisted of total 131 individuals, representing 5 orders Diptera, Mesostigmata, Dermanyssoidea, Acariformes and Sarcoptiformes. Order Diptera comprised of Megastrebla nicriceps, Eucampsipoda sp.,

ISSN NO: 0022-1945

JASC: Journal of Applied Science and Computations

Megastrebla sp from family Hippobpscidae and Stylidia caudata from family Diptera. Order Mesostigmata contained of Periglischrus sp., Spintrunix myoti from family Spinturnicidae, Laelaps sp. (Laelapidae) and Blattisocius sp. (Blattisocidae). The Dermanyssoidea order comprised of Spinturnix sp. from family spinturnicidae. The last two orders are Acariformes comprised of Dendrolaelaps sp. (Laelapidae), and Macronyssus (Macronyssidae) while order Sarcoptiformes only included one species of ectoparasites i.e. Acarus sp. from the family of Acaridae (Table 2).

As we can see (Table 3), ectoparasite species with the highest intensity value is Megastrebla nigriceps(0.97), while the species from the sub class Acari is Spinturnix plecotinus(0.76). Intensity are also calculated per bat species, the bat species with the highest ectoparasite intensity is Miniopterus schreibersii (2.83).

	Host Species				
Ectoparasites	M. schreibersii	R. pusillus	R. affinis	H. larvatus	Intensity
Periglischrus sp.	4	-	-	4	0.28
S. plecotinus	8	4	4	6	0.76
Blasttisocius sp.	10	2	-	1	0.45
Acarus sp.	1	1	-	1	0.10
S. myoti	13	-	-	-	0.45
Macronyssus sp.	7	-	-	-	0.24
Dendrolaelaps sp.	1	1	-	-	0.07
Laelaps sp.	1	-	-	-	0.03
Eucampsipoda sp.	8	1	-	1	0.34
M. nigriceps	17	9	-	2	0.97
Megastrebla sp.	2	6	-	4	0.41
Stylidia caudata	10	2	5	-	0.59
Ectoparasites's intensity for each species	2.83	0.59	0.31	0.66	

Table 3: Intensity of ectoparasites on bats in Seplawan cave, Purworeio

IV. DISCUSSIONS

Seplawan Cave is around 700 meters long with 150-300 meters of cave branches and 15 meters in diameter [27]. Length of cave's hallways can lead to the emergence of competition and limited availability of nest and therefore contributes to the diversity of bats [31]. Based on reference [44] stated that other factors influencing the diversity of bats are physical structure of the habitat, climate, microhabitat, availability of food and water sources, security from predators, competition and availability of nests.

Seplawan Cave formed a pit structure and the development of the cave occurred due to excavation of the flow towards the free ground water level. Small corridors that are not accessible in the cave are connected to the main corridor as a water flow path. This shows that Seplawan Cave is directly related to the water input system from the karst field above [4]. The availability of perches is reduced because at a distance of 40 meters from the entrance of the cave we found a row of bat nests that were abandoned allegedly due to the influence of lighting installed inside the cave.

Based on the research as in reference [43] the temperature showed an influence with the species diversity. Bats have an environmental tolerance limit. Each type of bat has a different temperature. Bats partially perched at temperatures around 26.67 - $32.22 \degree$ C, humidity and altitude also contribute in the diversity and distribution of bat species [40]. In this study the average humidity measured was 84.3% and the temperature was about 23 ° C.

Temperature can profoundly affect various aspects of ectoparasite life. For example, in *Cimex lectularius* where temperature affects copulation, oviposition, egg hatching, egg duration and safety as well as immature instars, skin peeling or molting, adult individual age, fertility and feeding levels ([20]; [32]; [41]). Moisture has little effect on life cycle time but is likely could affect survival. Temperature and humidity mismatch can be the main cause of death in insect ectoparasites. Its influence is quite profound, especially in conditions where ectoparasites do not make contact with the host [24].

A. Intensity and prevalence of ectoparasites

The high prevalence value will allow the transmission of ectoparasites if other bat individuals are at close range. Bats at close range had the highest horizontal transmission rate of ectoparasites. Winged mites show higher host affinity and mobility. The

ability to avoid competition with other ectoparasites and the unique physiology of the mite makes it more resistant with death from grooming [9].

Prevalence and intensity values will be affected when catching by using a trap. When one or two bats are caught, ectoparasites (Diptera) may move from one species to another. This contamination, before the bat is moved to a different place from the net can be counted as a factor why one species infested by the same parasites (low specificity) [1]. Some life history of the host is likely to influence the prevalence and intensity of ectoparasites ([14]; [29]). For example, female bats during nursing in colonies have a higher prevalence and intensity compared to bats that are not doing the same activity ([8]; [36]).

B. Ectoparasites species found on bats

Ectoparasites found in Microchiroptera bats on recent study are from the family Spinturnicidae (Spinturnix sp., Periglischrus sp. and Spinturnix myoti), Blasttisocidae (Blasttisocius sp.), Acaridae (Acarus sp.), Macronyssidae (Macronyssus sp and Dendrolaelaps sp.), Hippoboscidae (Eucampsipoda sp., Megastrebla nigriceps and Megastrebla sp.) and Nycteribiidae (Stylidia caudata).

Nycteribiidae is a blood-sucking obligate parasite which through several morphological adaptations for long-term positive life characterized by high host specificity. Members of the Nycteribiidae family are wingless, metamorphosis is performed close to the bat perched area ([10]; [28]; [42]). One example of Nycteribiidae members in this study is Stylidia caudata. Some research conducted in reference [5] recorded that this particular species found on some bats host from Rhinolopus spp. i.e. Rhinolopus affinis, Rhinolopus stheno and Rhinolopus Lepidus.

Some mites, such as members of the Spinturnicidae family are obligate parasites ([12]; [38]). Spinturnicidae are exclusive parasites on bats that inhabit the tail and wing membranes. In the present study, Spinturnix myoti only found in host species Miniopterus schreibersii, while Spinturnix plecotinus is distributed in all of the host species captured in Seplawan Cave although the number found on each individual are far less. Macronyssidae can show varying degrees of association. Members of this parasite suck blood from the bat host and then store it. Members of the Macronyssidae family can complete the stages of their life cycle without relying on the bat host continuously ([11]; [34]). Macronyssidae family are found in the interfemoral membrane area (uropatagium) or parts of the body covered by hair. While the protonymph of Macronyssidae is often localized to the wing membrane [33]. On this study, Macronyssus sp. only found in Miniopterus schreibersii, there is no reference about this species related or associated with other host species.

Other species such as Laelaps sp. (Laelapidae) is an obligate, hematophageal parasite in rodents, especially in the Muridae and Cricetidae families. But Laelaps can also harmonize other species or some types of rodentia [19]. Mites from the genus Laelaps found in bats based on the survey conducted by reference [2] in Malaysia are Laelaps aingworthae, Laelaps nuttalli, Laelaps sanguisugus and Laelaps sculpturatus. There is no study in Indonesia specifically mentioned these particular species related to the bats. Mites from the genus Blattisocius are mostly found in stored food, in insect habitats, associated with insects, vertebrates such as bats and rats, mosses and decaying plants [6]. Members of the family Hippoboscidae are also obligate parasites in mammals and birds. The Diptera group consists of several winged species with low flight capability while the rest cannot fly, are apomorphic and have vestigial or no wings [35]. In the present study, Eucampsipoda sp, Megastrebla sp. and Megastrebla nigriceps are found in three of host species, excluding Rhinolopus affinis. Penthethor lucasi is one of host species for Megastrebla nigriceps based on study conducted as in reference [5].

There are no clear resources regarding to Acarus sp. and Dendrolaelaps sp. species associated with bats in Southeast Asia especially in Indonesia. In-depth and long-term studies are needed in some places given the lack of references and checklists regarding ectoparasite diversity in bats.

ACKNOWLEDGMENT

We especially thank Ms. Dhea Ginawati for her collaboration and support with collecting ectoparasites, respectively to the head of Parasitology laboratorium, Tropical Biology department of Gadjah Mada University for the permission to examine the collected samples and Mr. Trijoko who allowed us to lend the research equipment from Animal Systematic laboratory. Financial support on this study was granted by Gadjah Mada University (UGM).

REFERENCES

- [1] L.M.S. Aguiar and Y. Antonini, "Prevalence and intensity of Streblidae in bats from a Neotropical savanna region in Brazil," *Folia Parasitologica*, vol. 63, pp. 1-8, June 2016.
- [2] M. Ahamad, H. Ibrahim, M.K. Bujang, Shahrul-Anuar Mohd Sah, N. Mohamad, S.M. Nor, A.H. Ahmad, and Tze-Ming Ho, "A survey of acarine ectoparasites of bats (Chiroptera) in Malaysia," *J. Med. Entomol.*, vol. 50, no. 1, pp. 140-146, February 2013.
- [3] S. Aroon, J.G. Hill, T. Artchawakom, S. Pinmongkholgul, S. Kupittayanant, S. and N. Thanee, "Ectoparasites associated with bats in tropical forest of northeastern Thailand," *Journal of Agricultural Technology*, vol. 11, no. 8, pp. 1781-1792, December 2015.
- [4] A. Ashari, "Kajian geomorfologi kompleks Gua Seplawan kawasan Karst Jonggrangan," *Geomedia*, vol. 11, no. 1, pp. 52-64, May 2013.

- I. Azhar, F.A.N. Khan, N. Ismail and M.T. Abdullah, "Checklist of bat flies (Diptera: Nycteribiidae and Streblidae) and their associated bat Hosts in [5] Malaysia," Check List, vol. 11, no. 5, article 1777, October 2015.
- E.P.J. Britto, P.C. Lopes, and G.J. de Moraes, "Blattisocius (Acari, Blattisociidae) species from Brazil with description of a new species, redescription of [6] Blattisocius keegani a key for the Separation of The world species of the genus," Zootaxa, vol. 3479, pp. 33-51, September 2012
- A.O. Bush, K.D. Laffery, J.M. Lotz, and A.W. Shostak, "Parasitology meets ecology on its own terms: Margolis et al. revisited," J. Parasitol, vol. 83, no. [7] 4, pp. 575-583, August 1997.
- P. Christe, R. Arlettaz, and P. Vogel, "Variation in intensity of a parasitic mite (Spinturnix myoti) in relation to the reproductive cycle and [8] immunocompetence of its bat host (Myotis myotis)," Ecol. Lett, vol. 3, pp. 207-212, May 2000.
- C.W. Dick, M.R. Gannon, W.E. Little, and M.J. Patrick, "Ectoparasite associations of bats from central Pennsylvania," Journal of Medical [9] *Entomology*, vol. 40, no. 6, pp. 813–819, November 2003.
- C.W. Dick, "High host specificity of obligate ectoparasites," Ecological Entomology, vol. 32, pp. 446–450, October 2007. [10]
- K. Dittmar, C.W. Dick, B.D. Patterson, M.F. Whiting, and M.E. Gruwell, "Pupal deposition and ecology of bat flies (Diptera: Streblidae): Trichobius sp. [11] (caecus group) in a mexican cave habitat," Journal of Parasitology, vol. 95, pp. 308-314, April 2009.
- F. Dusbabek, "Phylogeny of mites of the family Spinturnicidae Odums (Acarina)," Proceedings of XIII th. International Congress of Entomology, vol. 1, [12] pp. 241-242, 1971.
- [13] J.S. Findley, Bats: a community perspective, Cambridge: Cambridge University Press, 1993
- [14] P.S. Fitze, B. Tschirren, and H. Richner, "Life history and fitness consequences of ectoparasites," J. Anim. Ecol. vol. 73, pp. 216–226, March 2004.
- [15] G.N. Fritz, "Biology and ecology of bat flies (Diptera: Streblidae) on bats in the genus Carollia," Journal of Medical Entomology, vol. 20, pp. 1-10, January 1983.
- [16]
- U. Gerson, R.L. Smiley, and R. Ochoa, *Mites (Acari) for Pest Control*, Malden: Blackwell Science, 2003. C.E. Hopla, L.A. Durden, and J.E. Keirans, "Ectoparasites and classification," *Revue Scientifique et Technique*, vol. 13, pp. 985-1017, December 1994. [17]
- P.J. Hudson, A.P. Dobson, and K.D. Lafferty, "Is a healthy ecosystem one that is rich in parasites?," Trends, vol. 21, no.7, pp. 381-384, July 2006. [18]

- [19] E.W. Jameson, "The genus Laelaps (Acarina: Laelapidae) in Taixan," *J. Med. Ent*, vol. 2, no. 1, pp. 41–53, April 1965.
 [20] C.G. Johnson, "The ecology of the bed-bug, *Cimex lectularius* L., in Britain," *J. Hyg*, vol. 41, no. 4, pp. 345-361, December 1942.
 [21] T. Kingston, "Research priorities for bat conservation in Southeast Asia: a consensus approach," *Biodiversity and Conservation*, vol. 19, pp. 471-484, February 2010.
- [22] G.W. Krantz, A manual of Acarology 2nd Edition, Oregon: Oregon State University Book Store Inc., 1978, pp. 5-8, 12-15, 21-23, 32-35.
- K. Krichbaum, S. Perkins, and M.R. Gannon, 2009. "Host-parasite interactions of tropical bats in Puerto Rico," Acta Chiropterologica, vol. 11, pp. 157-[23] 162. June 2009.
- [24] T.H. Kunz, Ecology of Bats. New York: Plenum Press, 1982.
- A. Kurta, J.O. Whitaker, Jr., W. Wrenn, and A. Soto-Centeno, "Ectoparasitic assemblages on mormoopid bats (Chiroptera: Mormoopidae) from Puerto [25] Rico," Journal of Medical Entomology, vol. 44, pp. 953-958, December 2007.
- T.C. Maa, "Revision of the Australian batflies (Diptera: Streblidae and Nycteribiidae)," Pacific Insect Monograph, vol. 28, pp. 1-118, 1971 [26]
- [27]
- [28]
- R.B. Marshall, "Bioakustik kelelawar subordo Microchiroptera di Gua Seplawan," *Jurnal Prodi Biologi*, vol. 7, no. 3, pp. 190-195, 2018. A.G. Marshall, "Ecology of insects ectoparasitic on bats," in Ecology of Bats, T.H. Kunz, Eds. New York: Plenum Press, 1982, pp. 369–401. S. Morand, J.G. De Bellocq, M. Stanko, D. Miklisová, "Is sex-biased ectoparasitism related to sexual size dimorphism in small mammals of Central [29] Europe?," Parasitology, vol. 129, pp. 505-510, October 2004.
- [30] L.M. Moras, L.F. de Oliveira Bernardi, G. Graciolli, and R. Gregorin, "Bat flies (Diptera: Streblidae, Nycteribiidae) and mites (Acari) associated with bats (Mammalia: Chiroptera) in a high-altitude region in southern Minas Gerais, Brazil," Acta Parasitologica, vol. 58, no. 4, pp. 556 - 56, December 2013.
- H. Nurfitrianto, W. Budijastuti and U. Faizah, "Kekayaan jenis kelelawar (Chiroptera) di kawasan Gua Lawa Karst Dander Kabupaten Bojonegoro," [31] LenteraBio, vol. 2, no. 2, pp. 143-148, May 2013.
- N. Omori, "Comparative studies on the ecology and physiology of common and tropical bed bugs, with special references to the reactions to temperature [32] and moisture," J. Med. Assoc. Formosa., vol. 40, pp. 555-729, 1941.
- M.V. Orlova, D.V. Kazakov, E.V. Zakhahrov, I.S. Troeva, and L.N. Vladimirov, "The first data on bat ectoparasites (Acarina, Insecta) in the Baikal [33] region and Yakutia (eastern Siberia)," Checklist, vol. 12, no. 4, pp. 1-7, August 2016
- F.J. Radovsky, Revision of genera of the Parasitic mite family Macronyssidae (Mesostigmata: Dermanyssoidea) of the world, Michigan: Indira [34] Publishing House, 2010, p. 170.
- N. Rahola, S.M. Goodman, and V. Robert, "The Hippobosscidae (Insecta: Diptera) from Madagascar with new records from the "Parc National de [35] Midongy Befotaka," Parasite, vol. 18, pp. 127 - 140, May 2011.
- K. Reckardt, and G. Kerth, "Does the mode of transmission between hosts affect the host choice strategies of parasites? Implications from a field study [36] on bat fly and wing mite infestation of Bechstein's bats," Oikos, vol. 118, pp. 183-190, November 2008.
- [37] C.M. Ritzi, and J.O. Whitaker Jr., "Ectoparasites of small mammals from the Newport Chemical Depot, Vermillion County, Indiana," Northeastern Naturalist, vol. 10, pp. 149-158, January 2003.
- A. Rudnick, "A revision of the mites of the family Spinturnicidae (Acarina)," University of California Publications in Entomology, vol. 17, pp. 157-284, [38] December 1960.
- B.A. Suripto, "Key to Macrochiropteran Bats in Java Island Indonesia: Panduan lapangan untuk Kalangan Sendiri. Fakultas Biologi [39] Universitas Gadjah Mada. Yogyakarta," unpublished.
- K., Tamasuki, F. Wijayanti and N. Fitriana, "Bat community (Chiroptera Order) in several karst caves in Mount Kendeng, Pati, Central Java," Al-[40] Kauniyah J.Biol, vol. 8, no. 2, pp. 88-100, 2015.
- [41] R.L. Usinger, 1966. Monograph of Cimicidae (Hemiptera-Heteroptera), New York: Entomological Society of America, Thomas Say Foundation, 1966, p. 585.
- R.L. Wenzel, V.J. Tipton, and A. Kiewlicz, "The streblid bat flies of Panama (Diptera: Calyptera: Streblidae)," in Ectoparasites of Panama, R.L. Wenzel, [42] and V.J. Tipton, Eds. Chicago: Field Museum of Natural History, 1966, pp. 405-675.
- A.N. Widayati, and M.A. Nurjana, "Effect of different ecosystems and environmental factors on the diversity of bat species in Tojo Una Una and Tolitoli [43] Regencies, Central Sulawesi Province," Journal of Disease Vector, vol. 12, no. 2, pp. 57-66, Desember 2018.
- J.R. Winkelmann, F.J. Bonaccorso, E.E. Goedeke, and L.J. Ballock, "Home range and territoriality in the Least Blossom Bat, Macroglossus minimus, in [44] Papua New Guinea," Journal of Mammology, vol. 84, no. 2, pp. 561-570, May 2003.
- [45] M. Wund and P. Myers, "Chiroptera," Animal Diversity Web: http://animaldiversity.org/accounts/Chiroptera/ (Acessed at April 13th 2017 08.00), 2005.

Workplace Environment and its Impact on the Quality of Life of Employees

D.O.I - 10.51201/Jusst12610

http://doi.org/10.51201/Jusst12610

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ABSTRACT

The workplace is an arranged area which is provided by the company in order to achieve its goal. An arranged area can be defined as the layout of a work space which suits the nature of the job or task that is to be performed. Environment, as we know, is the sum total of all factors that are present in the surroundings. Workplace environment includes the workplace culture, the interpersonal relationships, the atmosphere prevailing in the organizations, attitude of superiors and colleagues, level of organizational politics prevailing, physical facilities offered to employees like cabins, ventilation, lightening, rest hours, workstations etc. All these factors have a significant impact in maintaining the quality of life of employees either positively or negatively. Quality of life is influenced by an individual's physical and mental health, the degree of independency, the social relationship with the environment, and other factors (Ruževičius, 2012; Shin, 1979). An organization has possibilities to increase its employee's quality of life and loyalty by improving the working conditions and environment. This paper will address Workplace Environment and quality of life of employees.

Keywords : Workplace Environment, Quality of Life.

[1] INTRODUCTION

Based on a research by Oswald (2012), there are 2 types of working environment which are the physical component as well as the behavioral component.

The research will try to find out the impact of workplace environment in maintaining the quality of life of employees. It also tries to explore the detrimental factors present in the workplace that makes up the environment of organizations and affects the employees. The proposed research will be conducted in Kanpur region considering educational institutions for data collection for studying the relationship between quality of life and work environment.

1.1 Workplace environment and employees performance/productivity

The environment of the workplace impacts the motivation level, morale, satisfaction level of employees. It also shapes their attitude and thinking towards the work and organizations as well. It affects the loyalty of employees, the rate of job switches which happens in the organizations. An organization with a negative workplace environment, having an atmosphere where too much politics prevails, unfair treatment of employees, injustice done to employees, lack of support from top management/ superior, lack of good interpersonal relationships, poor culture prevailing, poor physical facilities would make an employee feel stressed. In such an environment, the employee would either not perform well and productivity would decline or a good employee would switch the organization immediately. Thus, organizational environment affects the performance of employees and hence impacts the productivity of the organizations.

1.2 Workplace environment and employee satisfaction

Money is not a sufficient motivator in improving the level of satisfaction. As it is said that, 'money cannot buy happiness' the employees also do not feel happy or satisfied just by the monetary benefits offered by the organizations. A good working environment automatically reduces the tensions and stress of employees, enhancing the morale and increasing the satisfaction level of employees. Human to human interaction by providing support and encouragement increases the satisfaction of employees and makes them happy. This also makes them loyal towards the organization.

1.3 Workplace environment and stress

Stress or discomfort is an unpleasant emotion where an employee experiences tensions, anxiety and fear which is believed to be one of the main components faced by employees in an organization on a daily basis. Both external stressors like condition of working area, working hours, pressure, changes and internal stressors like work life balance , job satisfaction, etc. are a result of the kind of workplace environment prevailing. A positive work environment would this way reduce stress and enhance the satisfaction and happiness of employee. Whereas a negative working environment would add more to the existing stress reducing the happiness and satisfaction level of employees.

1.4 Workplace environment and Quality of life

Quality of life is the general well being of individuals which includes the expectations of an individual to maintain a good life. It includes everything from health, family, job, money, safety, security and the environment. Since employees spend their entire day at the organizations, therefore it is very necessary to have a good environment that satisfies them in all possible way, that relieves their stress and makes them feel happy. The quality of working life could be defined as the synthesis of workplace strategies, processes, and environment, which together stimulate the employee's job satisfaction. This also

depends on working conditions and the organisation's efficiency. The concept of the quality of working life encompasses the following factors: job satisfaction, involvement in performance at work, motivation, efficiency, productivity, health, safety and welfare at work, stress, work load, burnout, etc.

The Workplace Factors

WF1: Organisational culture

A work environment characterised by trust, honesty and fairness.

- 1. All people in the workplace are held accountable for their actions
- 2. People at work show sincere respect for others' ideas, values and beliefs
- 3. Difficult situations at work are addressed effectively
- 4. Staff feel that they are part of a community at work
- 5. Staff and management trust one another

WF2: Psychological and social support

A work environment where co-workers and supervisors are supportive of employees' psychological and mental health concerns, and respond appropriately as needed.

- 1. The organisation offers services or benefits that address employee psychological and mental health
- 2. Staff feel part of a community and that the people they are working with are helpful in fulfilling the job requirements
- 3. The organisation has a process in place to intervene if an employee looks distressed while at work
- 4. Staff feel supported by the organisation when they are dealing with personal or family issues
- 5. The organisation supports employees who are returning to work after time off due to a mental health condition
- 6. People in the organisation have a good understanding of the importance of employee mental health

WF3: Clear leadership and expectations

A work environment where there is effective leadership and support that helps employees know what they need to do, how their work contributes to the organisation, and whether there are impending changes.

- 1. In their jobs, employees know what they are expected to do
- 2. Leadership in the workplace is effective
- 3. Staff are informed about important changes at work in a timely manner
- 4. Supervisors provide helpful feedback to employees on their expected and actual performance
- 5. The organisation provides clear, effective communication.

WF4: Civility and respect

A work environment where employees are respectful and considerate in their interactions with one another, as well as with customers, clients and the public.

- 1. People treat each other with respect and consideration in the workplace
- 2. The organisation effectively handles conflicts between stakeholders (staff, customers, clients, public, suppliers, etc.)
- 3. People from all backgrounds are treated fairly in the workplace
- 4. The organisation has effective ways of addressing inappropriate behaviour by customers or clients.

WF5: Psychological competencies and requirements

A work environment where there is a good fit between employees' interpersonal and emotional competencies and the requirements of the position they hold.

- 1. The organisation considers existing work systems and allows for work redesign
- 2. The organisation assesses employee demand and job control issues such as physical and psychological job demands
- 3. The organisation assesses the level of job control and autonomy afforded to its employees
- 4. The organisation monitors the management system to address behaviours that impact employees and the workplace
- 5. The organisation values employee input particularly during periods of change and the execution of work

WF6: Growth and development

A work environment where employees receive encouragement and support in the development of their interpersonal, emotional and job skills.

- 1. People receive feedback at work that helps them grow and develop
- 2. Supervisors are open to employee ideas for taking on new opportunities and challenges
- 3. People have opportunities to advance within their organisation
- 4. The organisation values employees' ongoing growth and development
- 5. People have the opportunity to develop their "people skills" at work

WF7: Recognition and reward

A work environment where there is appropriate acknowledgement and appreciation of employees' efforts in a fair and timely manner.

- 1. Immediate supervision demonstrates appreciation of employees' contributions
- 2. People are paid fairly for the work they do
- 3. The organisation appreciates efforts made by employees
- 4. The organisation celebrates shared accomplishments
- 5. The organisation values employees' commitment and passion for their work

[2]THE RESEARCH STUDY (OBJECTIVE AND SIGNIFICANCE) OBJECTIVES OF THE STUDY

- > To identify the critical success factors that are vital for determining Workplace Environment.
- > To study the impact of Workplace Environment on the Quality of life of employees.

[3]RESEARCH METHODOLOGY

Here, researcher's presented the methodology which was adopted for answering the research questions which we have formulated and presented. We'll enlighten the way that how we collected the data concerning our research. We will also describe the frame work which we followed during our research and analysis. For the proper analysis of data simple statistical techniques such as percentage, SPSS analysis of Mean, Median, Standard Deviation and Skewness were used. It helps in making more generalization from the data available. The data

which will be collected from a sample of population was assumed to be representing entire population was interest. Classification of data is based on demographic factors like Age, Sex etc.

[5]SAMPLE SUMMARY

Area:	KANPUR
Size:	50 Respondents
Technique:	Purposive Sampling
Selection:	The respondents were selected at purposive and were approached mostly in
	educational institutes.

[6]COLLECTION OF DATA

The data is collected from the people in the form of questionnaire (Google Form) and the sample size is 50 respondents. Because it is a pilot study and due to time constraint the sample size is small. We choose the employees from Educational Institutions in Kanpur. For conducting a research, two types of data is used which are Primary and secondary data. We used a combination of primary and secondary data for our research area.

[7]LIMITATION OF THE STUDY

Every study has some limitations; similarly this study has also the following limitation. The limitations for this study are discussed below:

- The study is based only on geographic area of Kanpur, which is very small for this type of study and the sample size for this study is 50, which is too small for the study like this.
- Shortage of important aspect such as time, financial problem, and complete size prevented research from detailed study, while in the main cause of limitation of report.

[8] DATA ANALYSIS AND INTERPRETATION

SPSS Analysis of Impact of Workplace Environment on Quality of life of Employees.

Table 1

Statistics

Is Workplace Environment is significant in determining Quality of Life of Employees.?

N	Valid	50
1	Missing	0
Mean		3.6400
Median		4.0000
Mode	5.00	
Std. Devia	1.17387	
Skewness	273	
Std. H	Error of	227
Skewness	.337	
Kurtosis	-1.118	
Std. Error	.662	

Is Workplace Environment is significant in determining Quality of Life of Employees.?

		Frequenc y	Percent	Valid Percent	Cumulative Percent
	strongly disagree	1	2.0	2.0	2.0
	disagree	9	18.0	18.0	20.0
Valid	Neutral	13	26.0	26.0	46.0
	Agree	11	22.0	22.0	68.0
	strongly agree	16	32.0	32.0	100.0
	Total	50	100.0	100.0	

Analysis:

In the sample size of 50 respondents. The Mean and Median Values are 3.64 and 4.00 respectively which show that considerable number of respondents agree that Workplace

Environment is contributing to Quality of life of Employees. Even the Kurtosis Value of -1.118 suggests that majority of the respondents agree Quality of Life is driven by Workplace Environment.

Reliability Test through Cronbach Alpha

RELIABILITY

/VARIABLES=Psychological support, Organization Culture, Civility /SCALE('ALL VARIABLES') ALL /MODEL=ALPHA.

Scale: ALL VARIABLES

Table 3:-Case			Processing	
Summary				
		N	%	
	Valid	49	100.0	
Cases	Excluded ^a	0	.0	
	Total	49	100.0	

a. Listwise deletion based on all variables in the procedure.

Table4:ReliabilityStatistics

Cronbach's	N of Items	
Alpha		
.836	3	

Analysis:

Cronbach's alpha is a measure of internal consistency, that is, how closely related a set of items are as a group. It is considered to be a measure of scale reliability. A "high" value for alpha does not imply that the measure is unidimensional. If, in addition to measuring internal consistency, you wish to provide evidence that the scale in question is unidimensional, additional analyses can be performed. Exploratory factor analysis is one method of checking dimensionality. Technically speaking, Cronbach's alpha is not a statistical test – it is a coefficient of reliability (or consistency). The value of Cronbach alpha is 0.836 considering variables as Psychological Support, Organization Culture and Civility which indicates measure of internal consistency.

[14] INTERPRETATION

Above data analysis shows that most of the Employees 32% of the employees strongly agree that Work Place Environment has an impact on Quality of Life of Employees and even 22 % agree for Work Place Environment on Quality of Life of Employees.

[15] CONCLUSION

The primary goal of this research is to study the workplace environment and its impact on the quality of life of employees. Working environment affects the performance and productivity job satisfaction level of employees. But this study includes all the significant factors that determine the quality of life of employees and seeks to find out how workplace environment impacts each of the factor determining quality of life of employees. To sum up, the researcher tries to find the impact of workplace environment on the quality of life of employees.

[16] **REFERENCES**

- <u>https://www.ijecbs.com/January2011/N4Jan2011.pdf</u>
- https://www.sciencedirect.com/science/article/pii/S2212567115005249
- <u>https://www.researchgate.net/publication/312504772_The_Consequence_of_work_en_vironment_on_Employees_Productivity</u>
- <u>https://www.ripublication.com/ijaer17/ijaerv12n24_223.pdf</u>
- <u>https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2290214</u>
- <u>https://www.researchgate.net/publication/26496151_Quality_of_Life_and_its_Compo_nents'_Measurement</u>
- <u>https://www.researchgate.net/publication/321361940</u> Physical workplace environm <u>ent_and_employee_engagement_A_theoretical_exploration_by_Madu_N_G_Asawo_S</u> <u>P and Gabriel JMO</u>
- <u>https://www.researchgate.net/publication/337553791_Impact_of_workplace_environ</u> ment_on_employee_performance_mediating_role_of_employee_health
- https://www.sciencedirect.com/science/article/pii/S2212567115005249#!

Information processing for Similar Source code using LSH Algorithm

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Abstract

In this study, we propose a method to quickly search for similar source files for a given source file as a method to examine the origin of reused code. By outputting not only the same contents but also similar contents, it corresponds to the source file that has been changed during reuse. In addition, locality-sensitive hashing is used to search from a large number of source files, enabling fast search .By this method, it is possible to know the origin of the reused code .A case study was conducted on a library that is being reused written in C language. Some of the changes were unique to the project, and some were no longer consistent with the source files. As a result, it was possible to detect the source files that were reused from among the 200 projects with 92% accuracy. In addition, when we measured the execution time of the search using 4 files, the search was completed within 1 second for each file.

Keywords: LSH, n-gram and Jaccard coefficients, MinHash Value, TF-IDF

1. Introduction:

In software development, software developed by other projects is frequently reused .If you need project-specific changes or want to simplify the compilation process, reuse is done by copying and importing the source code of the source project. While there are advantages to such reuse, there is a risk that defects contained in the reused code will be captured .In order to manage the reused code, information about which project and version of the reused code is needed. However, it has been found that not all projects record such information. [20]

If there is a match in another project for the reused source file, it can be said that the source file may be derived from that project. However, code changes may be made during reuse, and in that case it is not enough to simply determine whether the source files match. Inoue et al. [8] proposed a system called the Ichi Tracker. This system queries code fragments and searches using a code search engine. Also, in our group, we target the source code in the repository, the version In this paper, we propose a new method to detect the presence of an ion. [12]This approach requires that you have a repo to reuse from In this study, we propose a fast search method for similar source code for a given source file. locality-sensitive hashing [7] is used to speed up search. In the proposed method, the source files to be searched are first registered in the database. In this case, in order to use the LSH algorithm, the source file is converted to a vector consisting of MinHash[2]values. When performing a search, the target source file is converted to a vector as well, and the search is performed using the vector .

In order to evaluate the method, the validity of the method was evaluated using 2 cases. In addition, as a case study, we applied the method to the code that was actually reused, and

evaluated whether the recorded source of reuse can be detected. The time required for the method was also evaluated.

In chapter 2, related research is described. Chapter 3 describes the proposed method in this research, and chapter 4 describes the implementation in this research. Chapter 5 describes the case studies conducted, and Chapter 6 describes threats to validity. Finally, Chapter 7 is a summary of this research.

2. Related research:

2.1 Reuse of Source Code: When developers develop software, they reuse software developed in other projects. Heinemann et al. [6] surveyed open-source Java projects and found that black-box is a binary reuse. It was reported that reuse was dominant over the source code reuse, which is the white-box reuse. Rubin et al. [18] also reported that companies are reusing developed software for use in the development of new products.

It is possible to develop software efficiently by reducing the cost of development by reusing it. It has been reported by Mohagheghi et al. that reused components are less defective than those that are not. [15]

If a developer needs to make changes to the project's own when reusing it, it may be possible to incorporate the source code into the project under development. For example, v8monkey*1 adds modifications to the libpng * 2 library to support the APNG (Animated Portable Network Graphics)format.

While reusing source code is useful, developers should be careful not to use those that have bugs or security vulnerabilities. Xia et al. [20] investigated whether the library being used is a potentially vulnerable version of a project that reuses code from an open source library. As a result, 31.1% of projects using zlib, 85.7% of projects using libcurl, and 92% of projects using libping were found to use potentially vulnerable versions. In addition, 18.7% of projects did not have any information about which version of the library they used. In addition, 4.9% of projects have changed directory names or mixed source code with reused source code, making it difficult to manage. It is considered useful to identify the source of reuse for such unmanaged projects.

The detection of software reuse is based on binary or source code. For binary applications, Davies et al. [4] and [5]proposed a method for using signatures in a class from Java binaries. S. bj rnsen et al. [19]proposed a method for detecting code clones from executable binaries. Qiu et al. [17] proposed a method for identifying library functions from binaries.

Inoue et al. [8] proposed a system called Ichi Tracker. It queries code fragments, etc., and searches the source code including clones of the code fragments using a code search engine. Along with the clones found as the output of the system, for each clone the last modified date of that clone It provides information such as the code of the project, the content of the query, and so on.

In our research group [12], we proposed a method to estimate the version of the source code contained in the repository. We used the similarity[11]based on the longest common subsequence as the source code similarity, and presented a version based on the assumption that the source code with the highest similarity is the reuse source. This method requires the repo that was reused as input and the repo from which it was reused, so it cannot be used if the repo source is unknown.

2.2 Search by Locality-sensitive hashes: In this study, we consider the problem of detecting reuse of source files as a kind of problem of finding source files that are similar to the files given as a query. locality-sensitive hashing (also referred to as LSH) is used to speed

up the search for a large number of objects.LSH is an algorithm used for approximate nearest neighbour search and clustering. [7]

There are several applications for LSH. Manku et al. [14] proposed a method for detecting Web pages with almost overlapping contents in Web crawling.Das et al. [3] proposed a method for recommending articles based on user behaviour using cooperative filtering for Google News. Brinza et al. [1] used for clustering of loci in genome-wide association analysis. Jing et al. [10] use LSH for image retrieval.

LSH is also used in source code. Jiang et al., [9] et al. use a fast detection method for similar subtrees in the source code to detect clones, and use LSH to perform clustering on feature vectors of subtrees. Yamanaka et al. [21] proposed a method of type 4 function clone detection by clustering using TF-IDF method as features, but LSH is used for feature vector clustering to perform fast detection.

3.Proposed method:

In this study, we propose a method to search a source file given as a search query for a large number of source files whose content of source code is similar to a query. By using LSH, fast retrieval is possible.

In this method, we also present an estimate of similarity to the retrieved results. This estimate can be efficiently obtained, and for each source file included in the search results, it is possible to know the degree of similarity with the query individually, although it is an estimate.

First, the similarity between the source files used in this method is defined, and LSH is explained, then the proposed method and details are explained.

3.1 Definition of Similarity between Source Files:

The similarity between the source files used in this study is the similarity using n-gram and Jaccard coefficients. The advantage of using this similarity is that it is not overly influenced by sorting of function units. In addition, as with TF-IDF method, similarity is not affected except for 2 files for which similarity is obtained. The specific calculation method consists of the following steps.

- Lexical splitting of source files: Remove the comment from the source file s, split it into lexical columns, and get Ts. By removing comments, it is possible to prevent the size of comments and the difference in comments from affecting the similarity .Do a similar operation on the source file t to obtain a lexical string Tt.
- 2) (2) Extracting n-grams from Lexical sequences: Convert a substring of length n from a lexical sequence Ts to a multiplex set Ms of n-grams.
 For example, if n = 3, the n-gram obtained for the element sequence e1; e2; e3; :::; em is ff(\$;\$; e1), (\$; e1; e2), (e1; e2; e3), (e2; e3; e4),..., (em
- 3) (3) Conversion of n-grams from multiple sets to sets: Convert Ss to a set by appending a number to each element of the multiple set Ms. The number to be added to each element is a value from 1 to k for a given element e, if k elements are included in the multiplex before conversion, each element is appended with a value from 1 to k. For example, if a multiplex ffa ,a,b,b,b, cgg consisting of elements a; b; c is converted to a set using this technique, the resulting set is f(1; a), (2; a), (1; b), (2; b), (3; b), and (1; c)G.

In the same way, we obtain the set St from the multiplex set Mt. However, the number to be added does not depend on Ms, and even if Ms and Mt contain the same elements, the number to be added in the process of converting from Mt to St is given in order from 1.

(4) Calculation of Jaccard coefficients for Sets: The similarity of the source file s; t is calculated by the following equation using the set Ss and St

Jaccard(Ss; St) = $\frac{|Ss \cap St|}{|Ss \cup St|}$

3.2 Locality-Sensitive Hashing:

locality-sensitive hashing is one of the methods used for similarity search. [7]In this study, LSH is constructed by using a family of hash functions F in which the following equation holds. [16]

 $Pr_{h\in F}[h(x) = h(y)] = sin(x; y)$

where sin(x; y) is the degree of similarity between x and y, and 0 sin (x; y) is the degree of similarity between x and y.



Figure 1. Probability of entering the same bucket

MinHash is a method for fast estimation of similarity between sets. Find the hash value for each element in the set and find the minimum value in it. When a similar operation is performed on another set, the probability that these 2 minimums coincide is equal to the Jaccard coefficient for the 2 sets.

LSH is constructed using the method described in literature[13].2 Think about sets. We prepare r b hash functions and find b vectors of MinHash values of r dimension for each set.2 Compare the vectors corresponding to each hash function between sets. At this time, the probability that MinHash values match between 2 sets, i.e., if the Jaccard coefficient is p, the probability that 1 or more vectors among the b vectors match is 1. If MinHash values match between two sets, the probability that MinHash values match between two sets is 1. If MinHash values match between two sets, MinHash values match between two sets. In Figure 1, when the value of the parameter is actually given $1-(1-p^r)^b$ Show the graph of. The parameters are b= 120, and for r, r= 4; r= 8; r= 16 3 ways .As shown in the figure, you can adjust the probability of entering the same bucket by adjusting the parameters.

3.3 Searching for Source Files using LSH:

The proposed method performs a search using LSH on the database. By using a database, it corresponds to a case where the number of files to be searched is large and all necessary data cannot be stored in main memory.
The method consists of 2 steps .In the registration step, multiple source files are entered and registered in the database .In the search step, a source file q is given as a query, and a set of similar files as search results, and an estimate of the similarity between each result file and the source file q is output.

3.3.1 Registering to the Database to be searched

In this step, the source file to be searched is input and registered in the database.

First, prepare R B hash functions to be used in MinHash, which constitutes LSH.R; B is the upper bound of the LSH search parameter r; b. The hash function to be prepared is a function from n-gram with a number attached to the hash value, and they are called hi. However, 1 i R B is. Next, the source file to be searched is registered in the database, and the MinHash value obtained from each hash function is also registered in the database for 1 source file. The function that obtains the value of MinHash from the source file using hi is called mi .For a source file f, let g be the numbered n-grams and G be the function from the source file to the set of numbered n-grams, then mi(f) = ming2g(f)hi(g).Using mi,m1(f), m2(f),... Register mr B (f) at the same time.

LSH is configured using the MinHash value registered, and an index is created to speed up the search . An index is created for each B-tuple with R MinHash values as a pair. That is, (m1 (f),m2 (f),... 1 set of indices I1, (mr+1(f), mr+2(f),... In this case, mR 2(f)) is set to 1 and the index I2 is set, and the total B-set index is set.

3.3.2 Searching for Similar Source Files:

In this step, a source file similar to a given source file is searched from the database. To search, in addition to the source file to be queried, parameters 1 r R and 1 b B of LSH are given. Find the value of MinHash for a given source file, and perform a search based on that value.1 For i b, using index Ii.

$$S_i(q) = \{f \mid \forall j \in [1, r], mj + R X (i-1) (q) = m j + R X (i-1)(f) \}$$

Find the Si that will be. The union of this set Si, i.e. $U_{1 \le i \le b}Si(q)$, is the result of the search, that is, the set of source files similar to the query.

In addition, for each source file included in the search results, an estimate of the similarity with the query is output. The similarity is estimated using maximum likelihood estimation.

Suppose that a similar source file in the search results is contained in the set S1; S2; :::; Sb of x sets. When similarity is expressed by p, x vectors for vectors of r dimension match, and b

$$L(p)=(p^{r})^{x}(1-p^{r})^{b-x}\binom{b}{x}$$

It is represented by. Therefore, given that the maximum likelihood estimator^p for similarity p is 0 p 1,,

$$P = \sqrt[r]{x \div b}$$

This is the first time I've ever seen this. As shown here, the possible values for the similarity estimate are limited to b in the case of x 1. In the case of r = 1, the interval of possible values as an estimate is

equal, and it is a method itself to estimate the Jaccard coefficient using MinHash. On the other hand, for r > 1, the interval between possible values of the estimate becomes narrower as it approaches 1, finer as it approaches 1, and coarser as it approaches 0.

The bias of the estimator B(^p), variance V ar(^p), mean squared error M SE(^p)are

Equations2

In an example, the mean square error of the estimator when the parameter is b = 120 and r = 2, r = 4, and r = 8, while changing the value of p. The horizontal axis is the value of p, and the vertical axis is the mean squared error .It is shown that the mean squared error approaches 0 when the value of p approaches 1.

4.Implementation

4.1 About Similarity

The target of the method is the source file of C language, and n=3 is the value of n of n-gram used for similarity .

Similarity between different files and different bars of the same file

Table 1Dataset

Package	Version 1	Version 2
original-awk	2012-12-20	2011-08-10
mgcv	1.8-4	1.7-12
seaview	4.3.1	4.5.3.1
fglrx-installer	8.96.	15.200
fglrx-installer-updates	1502	8.960
Foreign	0.8.62	0.8.48
libhdhomerun	20140604	20120128
r-cran-eco	3.1-4	3.1-6
r-cran-xml	3.6-2	3.98-1.1
rt-tests	0.89	0.83

The difference in similarity between the two versions was investigated. The survey focused on the source code, 10 packages, and 505 files available in Ubuntu's apt. Table 1 shows 2 versions of orig for each package.tar.The source code obtained from gz was used.

The result of obtaining similarity among all the combinations of the target file is shown as the frequency for similarity in Figure 3. The figure on the left shows the similarity between files with different packages and different file names, and the figure on the right shows the similarity between files with different tar files, that is, different versions, with the same package, the same path, and the same file name. The left figure contains 1,13735 similarities, and the right figure contains 245 similarities. However, for 101 cases in the right figure, the similarity was 1.0. From this result, the similarity using 3-gram is considered to be effective in determining whether two files are different versions of the same file.

4.2 About Hash Functions

In the proposed method, it is necessary to prepare multiple hash functions for n-grams with added numbers. This time, we implemented the following as a simple method.

The hash value by the hash function hi for the numbered 3-gram(num; t1; t2; t3)is

 $(((num \; X \; 65537) + t_1) \; X \; 65537 + t_2) \; X \; 65537 + t_3) \; X \; a_i + b_i$

Ask by. where num is the number appended to the 3-gram.

Where t1; t2; t3 are the values of Java's hash Code method for n-gram elements, that is, lexical, ai; bi are constants for each hash function. The operation is performed in 64bit, and the lower 64bit is left for the overflow during the operation.ai uses a 64-bit random number and a bit or of 1, and bi uses a 64-bit random number.

5.Case Study

5.1 Evaluating Search Results and Similarity Estimates:

We tested libpng and libcurl to confirm that high similarity to the query appears in the results of the search and low similarity does not appear in the results of the actual search.

5.1.1libpng of png.c

The experiment was carried out using all revisions of c and h files contained in libpng repository*3 as data sets. Specifically, from the list obtained by git rev-list --all --objects, c files and h targeted files. The target file count is 20977. A commit file png that is included in libpng and tagged with v1.6.0.I did a search with c as a query. The parameters of the search are r = 8; b = 120.

The number of files displayed in the search results is 716, which is 3.4% of the total data set .Among those that did not appear in the search results, the highest similarity value was 0.482.Also, the lowest similarity among those found in the search is 0.598.Figure 4 shows the relationship between the estimated value and the actual value of the similarity between the file and the query in the search results. The x-axis represents an estimate of the similarity, and the y-axis represents the actual similarity.

5.1.2 libcurl of url.c

Experiments were carried out using all the revisions of c and h files in libcurl's repository*4 as data sets. The target file count is 23273.The url of the commit that is included in libcurl and tagged with curl-7470.I did a search with c as a query.

The number of files displayed in the search results is 374 files, which is 1.6% of the total data set .Among those that did not appear in the search results, the highest similarity value was 0.578.The lowest similarity in the search results is 0.572.

5.2 Evaluating the Ability to Search for a File's Origin

A case study was conducted to identify the project, file, and version of the reuse source using an estimate of similarity. The subject of the case study is v8monkey*5

This is the source code of libpng included in the libpng.v8monkey records which version of libpng was updated in multiple commit messages, and changes have been made in multiple source code to support the Animated Portable Network Graphics format.

We prepared a repository of 200 projects including the libpng project as the target of the search. These projects were searched on GitHub in 2016/1/31 using the query "lib language:c", and the top 200 repositories of the search results were obtained on 2/1 the same year.

As an experimental procedure, first of all, in the project to be searched, all included in the history.c files and.I registered the h file in the database. The number of registered cases is 567113.Next, we list the v8monkey commits that indicate which version of libpng they have updated. A total of 14 commits were found to meet this requirement. The query was performed to find the files in modules/libing / png among the files newly added or modified in those commits. However, the following files were excluded from the evaluation target.

- Source file consisting only of comments.
- mozpngconf.h. This file does not exist in libpng, and seems to have been added by the developers of v8monkey.

The target file is 18 files, a total of 197. The contents of 57 of them matched the source file, and the contents of the other 140 did not match the source file. The search parameters are: r = 8; b = 120

	BenchMark 1		Total
	Meet	Not Satisfied	
Meet Criteria 2	177	10	187
Not Meeting Standard	5	5	10
2			
Total	182	15	197

Table 2:Categorized results

As a result of the search, the corresponding version of the file that was reused for all the results appeared in the search results. For 197 queries, the total number of files in the search results was 120001. The minimum number of files in search results for each query was 167, the maximum was 1031, and the average was 609. In addition to libpng files, the search results included a total of 3 projects using libpng (97 projects).

In addition, we investigated whether the estimate of similarity is the highest among the estimates of similarity in search results for each query. In order to understand the results, we classified the results into 2 categories from 4 criteria.

Criterion 1 Find an estimate of the similarity of the reuse source version

Criteria that will be the highest value of similarity estimates in the results 2 In the files in the search results, the version from which to reuse.

The true value of the similarity of the version is the highest value of the true value of the similarity that appears in the search results.

Criterion 2 is limited to files that appear in search results because it is not possible to obtain the true value of similarity with 197 queries for all files in the database due to time constraints. The results of this classification are shown in Table 2.

Of the 197 queries, 182 met criterion 1, meaning that the estimate of similarity between the query and the recorded source of reuse was equal to the highest estimate of similarity in the search results .For queries that satisfy criterion 1, the number of files with the highest similarity estimate in the search results for each query was at least 1, 56, and 11 on average .In addition, we obtained the number of files with the highest similarity estimate in each search result of a query that satisfies criterion 1, and the number of duplicates removed by ignoring the differences in comments and formats. However, an md5 checksum was used to

detect duplicates. As a result, the number of files that were removed from duplicates was at least 1, the maximum 18, and the average 2.3.

For 15 queries that did not meet criteria 1, if the similarity estimates were arranged in descending order for each search result, the recorded version ranking was from 2nd to 14th, with an average of 5.3.

There were 197 queries that met criteria 2 out of 187. In the remaining 10 cases, the similarity between the source version and the query is not the highest value even if it is true. Therefore,

ID	File name	Vector	Search	LOC	Size
		Number of	results		[B]
		matches	Number of		
			cases		
0	mozpngconf.h	0	0	525	27513
1	pngwrite.c	14842	503	1590	51254
2	pngwtran.c	26355	453	572	17279
3	pngrtran.c	41179	818	4296	147369

Table 3Source les as search queries

Of the 187 queries that meet criteria 2, 10 that do not meet criteria 1, 5.3% are likely to be affected by the use of an estimate instead of a true value for similarity.

5.3 Performance Evaluation

The performance of the proposed method is evaluated .The CPU of the execution environment is an Intel(R) Xeon(R) CPU E5-2620 with 2 processors, 64GB of memory, and Windows(R) 7 Professional. Also, all database and search query files are stored on the SSD. The database used for evaluation is the same as 5.2

5.3.1 Evaluation of Registrations

The database contains 200 projects with a total of 567113 files. For registration, I took all the files from the Git repository once, saved them in a directory, and then registered them in the database. The time it took to register all the retrieved files from the directory was 230 minutes.

5.3.2 Evaluation of Searches

As a query for the search, v8monkey commit 3a04be0690dff135ec42784557fedbf6c572cd22 mod-ules/libimg/png I used 4 files contained below. Table 3 shows about them. Since it is expected that the longer the number of matching vectors in the database to be used for the search, the longer the execution time will be, so we selected from the queries used in 5.2 so that the number of matching vectors does not solidify.In addition, the number of matches in the vector is the largest among the queries used in 5.2.

Since the OS caches some of the database contents in memory when performing a search, the speed of subsequent queries is affected by the search of the preceding query. With this in mind, the order of searching for 4 files is all the way, i.e. 4! = 24 searches were performed in the same order, and the execution time was measured .The cache of the OS was cleared between each of the 24 searches, so that searches for the same file were not affected by the cache.

First, the time it takes to read the source file as a search query from disk and convert it to MinHash vector is summarized. As a result, the median values from ID0 to 3 were 47ms, 94ms, 63ms and 219ms, respectively.

It's a good idea. The horizontal axis represents the ID and the vertical axis represents the execution time in milliseconds. Where ID is the value divided by 4, the ID shown in Table 3, and the remainder indicates how many times the query was searched. For example, if the ID is a multiple of 4, it shows the result of the first search after clearing the cache, and if the remainder is 3, it shows the result of searching for the corresponding query after searching for other 3 queries.



6.Threat to validity

The implementation of this study uses a hash length of 64bit and assumes that the behaviour of the hash function behaves completely random, and does not consider the effect of the collision as the probability of collision of the hash value is very low. However, we have not verified whether the collision actually occurred or the effect on the result if the collision occurred .In addition, the bias of the hash function may have influenced the result of the case study.

Only 1 project was used as a query for the search in the case study. For this reason, the effectiveness of applying this method to other projects or projects that use other languages may differ from the effectiveness confirmed in this case study.

5. In Criterion 2, which was established for classifying results in 2, due to time constraints, the target of obtaining similarity was limited to only files that appeared in the search results. However, there is a possibility that some files that do not appear in the search results have a similar degree to the query than the files that appear in the search results.

7.Conclusion

In this study, a large number of source code files were obtained for source code files given as search queries. In this paper, we propose a method to search for those whose source code content is similar to a query. By using locality-sensitive hashing, a fast search was realized. In the case study, we searched for a total of 197 files including the files included in another commit, and for all 197 of them, we were able to search for the reuse source recorded in the commit message .Among them, the recorded estimate of the similarity of the reuse source for 182 cases was the highest estimate in the search results .In addition, the search was completed within 1 second per 1 search time.

In the proposed method, it is necessary to perform a search by specifying 1 source file for the search .The future challenge is to give the source code of the entire project and identify reuse and non-reuse from among them .In addition, the proposed method uses only information

about 1 file, but it can be expected to improve the accuracy of the method by giving multiple files as input and using those information together.

References:

[1]Brinza, D., Schultz, M., Tesler, G. and Bafna, V.:RAPID detection of gene-gene interactions in genome-wide association studies,Bioinformatics, Vol. 26, No. 22,pp. 2856{2862 (2010).

[2]Broder, A. Z.: On the resemblance and containment ofdocuments, Compression and Complexity of Sequences 1997. Proceedings, pp. 21{29 (1997).

[3]Das, A. S., Datar, M., Garg, A. and Rajaram, S.: GoogleNews Personalization: Scalable Online Collaborative Fil-tering,Proceedings of the 16th International Conferenceon World Wide Web, WWW '07, New York, NY, USA,ACM, pp. 271{280 (2007).

[4]Davies, J., German, D. M., Godfrey, M. W. and Hindle,A.: Software Bertillonage: Finding the Provenance of anEntity,Proceedings of the 8th Working Conference onMining Software Repositories, pp. 183{192 (2011).

[5]Davies, J., German, D. M., Godfrey, M. W. and Hindle,A.: Software Bertillonage: Determining the provenanceof software development artifacts,Empirical SoftwareEngineering, Vol. 18, pp. 1195{1237 (2013).

[6]Heinemann, L., Deissenboeck, F., Gleirscher, M., Hum-mel, B. and Irlbeck, M.: On the Extent and Nature ofSoftware Reuse in Open Source Java Projects,Proceed-ings of the 12th International Conference on SoftwareReuse, Lecture Notes in Computer Science, Vol. 6727,pp. 207{222 (2011).

[7]Indyk, P. and Motwani, R.: Approximate Nearest Neigh-bors: Towards Removing the Curse of Dimensionality,Proceedings of the Thirtieth Annual ACM Symposiumon Theory of Computing, STOC '98, New York, NY,USA, ACM, pp. 604{613 (1998).

[8]Inoue, K., Sasaki, Y., Xia, P. and Manabe, Y.: Wheredoes this code come from and where does it go? { In-tegrated code history tracker for open source systems{,Proceedings of the 34th International Conference onSoftware Engineering, pp. 331{341 (2012).

[9]Jiang, L., Misherghi, G., Su, Z. and Glondu, S.:DECKARD: Scalable and Accurate Tree-Based Detec-tion of Code Clones,Proceedings of the 29th Interna-tional Conference on Software Engineering, ICSE '07,Washington, DC, USA, IEEE Computer Society, pp. 96{105 (2007).

[10]Jing, Y. and Baluja, S.: VisualRank: Applying PageR-ank to Large-Scale Image Search,Pattern Analysis andMachine Intelligence, IEEE Transactions on, Vol. 30,No. 11, pp. 1877{1890 (2008).

[11]Kanda, T., Ishio, T. and Inoue, K.: Extraction of prod-uct evolution tree from source code of product variants, Proceedings of the 17th International Software Prod-uct Line Conference, Tokyo, Japan, ACM, pp. 141{150(2013).

[12]Kawamitsu, N., Ishio, T., Kanda, T., Kula, R. G., DeRoover, C. and Inoue, K.: Identifying Source Code Reuseacross Repositories using LCS-based Source Code Similarity,Proceedings of the 14th International WorkingConference on Source Code Analysis and Manipulation,pp. 305{314 (2014).

[13]Leskovec, J., Rajaraman, A. and Ullman, J. D.:Miningof Massive Datasets, chapter 3, Cambridge UniversityPress (2014).

[14]Manku, G. S., Jain, A. and Das Sarma, A.: DetectingNear-duplicates for Web Crawling,Proceedings of the16th International Conference on World Wide Web,WWW '07, New York, NY, USA, ACM, pp. 141{150(2007).

[15]Mohagheghi, P., Conradi, R., Killi, O. M. and Schwarz,H.: An empirical study of software reuse vs. defect-density and stability,Proceedings of the 26th Interna-tional Conference on Software Engineering, pp. 282{291(2004).

[16]Moses S., C.: Similarity Estimation Techniques fromRounding Algorithms,Proceedings of the Thiry-fourthAnnual ACM Symposium on Theory of Computing,STOC '02, New York, NY, USA, ACM, pp. 380{388(2002).

[17]Qiu, J., Su, X. and Ma, P.: Library Functions Identi ca-tion in Binary Code by Using Graph Isomorphism Test-ings,Proceedings of the 22nd IEEE International Con-ference on Software Analysis, Evolution, and Reengi-neering, pp. 261{270 (2015).

[18]Rubin, J., Czarnecki, K. and Chechik, M.: ManagingCloned Variants: A Framework and Experience, Pro-ceedings of the 17th International Software ProductLine Conference, pp. 101{110 (2013).

[19]Sbjrnsen, A., Willcock, J., Panas, T., Quinlan, D. andSu, Z.: Detecting Code Clones in Binary Executables,Proceedings of the 18th ACM International Symposiumon Software Testing and Analysis, ACM, pp. 117{128(2009).

[20]Xia, P., Matsushita, M., Yoshida, N. and Inoue, K.:Studying Reuse of Out-dated Thirdparty Code in OpenSource Projects, JSSST Computer Software, Vol. 30, No. 4, pp. 98{104 (2013).

[21] Hiroki Yamanaka, On-ro Choi, Norihiro Yoshida, Katsuo Inoue: Fast Functional Clone Detection based on Information Retrieval Technology, IPSJ, Vol. 55, No. 10, pp. 2245{2255 (2014)

ISSN: 2320-2882

IJCRT.ORG



INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

Code Clone Analysis: Code Clone Types and Detection

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Abstract: A code clone is a Duplicate code exist in a whole source code. The main reason behind the code cloning is copying existing code fragments and using them by pasting with or without minor modifications. Though it has some advantages like it increase the reusability of the code segments but a survey shows that it is harmful more . One of the major problem in such duplicated codes is that if an errors detected in a code fragment, all the other similar codes has to be checked for fixing the same bug.

Another disadvantage is that it increases maintenance cost. So it is necessary to detect the code clone.

In this paper we explain various types of code cloning and the methods of Detecting the code clones.

Index Terms - Code clone , Types of code clone, Clone Detection Process, Clone Detection Techniques, Clone Detection Tools

I. INTRODUCTION

Code cloning is the process of duplicating existing source **code** for use elsewhere within a software system. Within the research community, **code cloning** is generally a bad practice, so that **code clones** should be removed or refactored where possible.

"The automated process of finding duplicate codes in source code is called clone detection" This paper is divided into Following two categories:

- 1) Regarding the type of code clones.
- 2) Describe various detecting methods of Code cloning.
 - In the first part we describe all types of code clones.

Type I: Identical code fragments except for variations in whitespace and comments.

Type II: Type 2 category includes the code segments which are syntactically same but the changes are in identifiers, literals, types, layout and comments.

Type III: These are the Copied fragments having some modifications. Like statements could be changed, added or deleted. **Type IV**: Two or more code segments that perform the same work but implemented through different syntactic models.

In the second part of the paper we describe various approaches to Detecting code clones that are:

- 1) Text-based Techniques
- 2) Token-based Techniques
- 3) Tree-based Techniques.
- 4) PDG-based Techniques
- 5) Metrics-based Techniques
- 6) Hybrid Approaches

2.Code Clone Types

2.1 Type I Clones

Type I clones are identical copy of original. However, there might be some changes like whitespace (blanks, new line(s), tabs etc.), comments and/or layouts. *Type I* is also known as *Exact clones*. Let us consider the following code fragment,

$$\begin{array}{ll} \text{1f} (a >= b) \\ \end{array}$$

c= d +b; // Comment1 d =d+1;

```
}
```

```
else
              c =d-a; //Comment2
A duplicate copy of this original code could be as follows:
        if (a>=b) {
        //Comment1'
        c=d+b:
        d=d+1;
                  else// Comment2'
        c=d-a;
```

2.2 Type II Clones

A Type II clones are an extension to Type 1 except some possible changes. like name of variables, constants, class, methods and so on, types, layout and comments. The keywords words and the sentence structures are essentially the same as the original one. Let us consider the following code sequence:

if (a >= b) { c = d = d + 1;

else

```
c = d - a; //Comment2
d + b; // Comment1
```

A Type II clone for the above code can be as follows:

if $(m \ge n)$

```
{ // Comment1'
    y = x + n;
     x = x + 5; //Comment3
     ļ
else
```

```
y = x - m; //Comment2'
```

We can easily compare that the two code segments change a lot in their structure, variable names and value assignments. However, the syntactic structure is still similar in both codes.

2.3 Type III Clones

In Type III clones, the duplicate segment is further modified. May be statement(s) are changed, added and/or deleted. Consider the original code segment, JCRI

if (a >= b) {

c = d + b; // Comment1

else

c = d - a; //Comment2

we add a statement e = 1 then we can get, if $(a \ge b)$ {

c = d + b; // Comment1

e = 1; // This statement is added

 $d = d + 1; \}$

else

```
c = d - a; //Comment2
d = d + 1;
above is an example of Type 3 code clone as we add 1 statement.
```

2.4 Type IV Clones

Type IV clones have the semantic similarity between two or more code fragments. Two code fragments may be developed by two different programmers to implement the same logic making the code fragments similar in their functionality. Let us consider the following code fragment 1, where the final value of 'j' is the factorial value of the variable VALUE.

Fragment 1: int i, j=1;

for (i=1; i<=VALUE; i++)

j=j*i;

Now consider the following code fragment 2, which is actually a recursive function that calculates the factorial of its argument n.

Fragment 2:

int factorial(int n) {

if (n == 0) return 1;

else return n * factorial(n-1);

}

From the semantics point of view both the code fragments are similar in their functionality and termed as *Type IV*. **3.Clone Detection Process**

A clone detector mainly deals with to find the code similar to the system's source code. The key issue is that we don't know in advance that which code fragments can be found multiple times. Thus the detector has to compare every possible fragment with every other possible fragment essentially But this type of comparison is very expensive from a computational point of view so several techniques has to be apply to reduce the domain of comparison before applying the actual comparison. In this section, we attempt to provide an overall summary of the clone detection process. Figure shows the phases that a clone detector may follow in its detection process. Below figure shows the phases in clone detection process. we provides the brief description of each phase:



Clone Detection Process

- **3.1 Preprocessing:** This is the first phase of any clone detection process. In this we determine the domain of the comparison and then partitioned the target source code. There are mainly three objectives of this phase:
 - **3.1.1 Remove uninteresting parts**: All the source code uninteresting to the comparison phase is filtered in this phase. For example, partitioning is applied to embedded code (e.g., SQL embedded in Java code, or Assembler in C code) for separating
 - **3.1.2 Determine Source Units**: After removing the uninteresting code, the remaining source code is partitioned into a set of disjoint fragments called source units. Source units are the Domains for the code clones and involve in direct cloning . Granularity can be maintained at different levels of the source code. such as Statements, blocks, procedures ,classes and objects and files or data bases.
 - **3.1.3 Determine comparison unit/granularity:** Source units may need to be further divided into smaller units depending on the comparison function of a method. For example, source units can be subdivided into lines or even tokens for comparison.

3.2) Transformation To make the comparison more easy the comparison units of the source code are transformed to another intermediate internal representation. e.g., just removing the whitespace and comments [3] to very complex e.g., generating PDG representation [10, 13] and/or extensive source code transformations [9]. Metrics-based methods usually compute an attribute vector for each comparison unit from such intermediate representations. In the following section we briefly explain transformation approaches. Comparison algorithm uses One or more of the following transformations

3.2.1) **Pretty printing of source code:** Pretty printing is a simple way of reorganizing the source code to a standard form. source code of different layouts can be transformed to a common standard form by using this Technique. The text-based clone detection process uses pretty printing to avoid the false positives that occur due to the different layouts of the similar code segments. Cordy et al. [5] use an *extractor* which generate separate pretty-printed text file for each of the potential clones obtained using an island grammar [7, 22].

- **3.2.2)** Removal of comments: Most of the approaches (except Marcus & Maletic [14] and Mayrand et al. [15]) ignore/remove comments from the source code before performing the actual comparison. Marcus & Maletic search for similarities of concepts extracted from comments and source code elements. Mayrand et al., on the other hand, use metrics to measure the amount of comments and use that metric as a measuring metrics to find clones.
- **3.2.3) Removal of whitespace**: Almost all the approaches (except line-based approaches) disregard whitespace. All whitespace except line breaks can be removed by Line based approaches. Davey et al. [6] use the indentation pattern of pretty printed source text as one of the features for their attribute vector. Mayrand et al. [15] use layout metrics like *number of non-blank lines*.
- **3.2.4) Tokenization:** Each line of the source code is divided into tokens by applying a lexical rule of the programming language. Tokens of all lines are then used to form token sequence(s). All the whitespace (including line breaks and tabs) and comments between tokens are removed from the token sequence. *CCFinder* [9] and *Dup* [3] are the leading tools that use tokenization on the source code.
- **3.2.5**) **Parsing:** In case of parse tree-based approaches, the entire source code base is parsed to build parse tree or (annotated) abstract syntax tree (AST). In such representation, the source unit and comparison units are represented as sub trees of the parse tree or AST. Comparison algorithm then uses these sub trees to find clones [4,18,19]. Metrics-based approaches may also use such representation of code to calculate of the sub trees and find clones based on the metrics values [11, 15].
- **3.2.6)** Generating PDG: Semantics-aware approaches generate program dependence graphs (PDGs) from the source code. Source units or comparison units are the sub graphs of these PDGs. Detection algorithm then looks for isomorphic sub graphs to find clones [10, 13]. Some metrics-based approaches also use these sub graphs to form data and control flow metrics and also then be used for finding clones [11,15].
- **3.2.7)** Normalizing identifiers: Most of the approaches apply identifier normalizations before going to the comparison phase. All identifiers of the source are replaced by a single token in such normalizations. However, Baker [3] applies systematic normalizations of the identifiers to find parameterized clones.
- **3.2.8)** Transformation of program elements: In addition to identifier normalizations, several other transformation rules may be applied to the source code elements. In this way, different variants of the same syntactic element may treat as similar to find clones [9, 17].
- **3.2.9)** Calculate metrics values: Metrics-based approaches calculate several metrics from the raw and/or transformed (AST, PDG, etc.) source code and use these metrics values for finding clones [15, 11].
- **3.2.10**) **Generating PDG:** Semantics-aware approaches generate program dependence graphs (PDGs) from the source code. Source units or comparison units are the sub graphs of these PDGs. Detection algorithm then looks for isomorphic sub graphs to find clones [10, 13]. Some metrics-based approaches also use these sub graphs to form data and control flow metrics and also then be used for finding clones [11,15].
- **3.2.11)** Normalizing identifiers: Most of the approaches apply identifier normalizations before going to the comparison phase. All identifiers of the source are replaced by a single token in such normalizations. However, Baker [3] applies systematic normalizations of the identifiers to find parameterized clones.

- **3.2.12**) **Transformation of program elements:** In addition to identifier normalizations, several other transformation rules may be applied to the source code elements. In this way, different variants of the same syntactic element may treat as similar to find clones [9, 17].
- **3.2.13**) Calculate metrics values: Metrics-based approaches calculate several metrics from the raw and/or transformed (AST, PDG, etc.) source code and use these metrics values for finding clones [15, 11].
- **3.2.14**) The above transformations just provide an overview of the current transformation techniques used for clone detection. Several other types of transformations with different levels can be applied on the source code before going to the *match detection* phase
- **3.3**) **Match Detection** The next input to a suitable comparison algorithm is transformed code where these units are compared to each other to find a match. Adjacent similar units are summed up to form larger units by using the order of comparison units. For flexed granularity clones, all the comparison units that belong to a source unit are aggregated. On the other hand, for free granularity clones, aggregation is continued till the aggregated sum is above a given threshold for the number of aggregated comparison units. Aggregation is continued till the largest possible group of comparison units are found.

At the end list of matches are found . These matches may be the clone pair candidates or have to aggregate to form clone pair candidates. Each clone pair is normally represented with the location information of the matched fragments in the transformed code. For example, for a token-based approach, a clone pair is represented as a quadruplet (LeftBegin , LeftEnd, RightBegin, RightEnd), where LeftBegin and LeftEnd are the beginning and ending positions (indices in the token sequence) of leading clone, and RightBegin and RightEnd refer to the other cloned fragment that forms clone pair with the first one. Some popular matching algorithms are the su–x-tree [12,16] algorithm [3,9], dynamic pat-tern matching (DPM) [8,11] and hash-value comparison [4, 15]. Several other algorithms are used in the literature.

- **3.4)** Formatting In this phase, line numbers on the original source files are found from each location of the clone pair obtained from the previous phase. The general format of representing a clone pair can be a nested tupple, *f*(FileNameLeft, StartLineLeft, EndLineLeft), (File-NameRight, StartLineRight, EndLineRight)*g* where FileNameLeft represents the location and name of the file containing the leading fragment with StartLineLeft and EndLineLeft showing the boundary of the cloned fragment in that file with respect to the line numbers. In a similar way FileNameRight, StartLineRight and EndlineRight represent the other cloned fragment that forms clone pair with the first.
- **3.5**) Post-processing In this phase, false positive clones are filtered out with manual analysis and/or a visualization tool.
 - 3.5.1) Manual Analysis After extracting the original source code, raw code of the clones of the clone pairs are subject to the manual analysis. This phase is used to filtered out the false positive clones.
 - 3.5.2) **Visualization** The obtained clone pair list can be used to visualize the clones with a visualization tool. For removing false positives a visualization tool can speed up the process of manual analysis or other associated analysis.
- **3.6)** Aggregation The clone pairs are aggregated to clusters, classes, cliques of clones, or clone groups in order to reduce the amount of data

The clone detection phases described above are very general.

4.CLONE DETECTION TECHNIQUES

In this section we defines the techniques for code clone detection [1] [2]:

4.1) Textual Approach (Text Based technique)

This approach states that there is no source code transformation before the comparison has done on both sides. In variety of cases, the original source code is used as it is presented in the process of clone detection. For example, NICAD, SDD, Simian 1 etc.

4.2) Lexical Approach (Token Based technique)

To perform the compiler style lexical analysis. initially source code is converted in the lexical sequence, known as tokens. The sequence later scans the identical token sequence of the original code that is resulted as clones. These types of approaches are normally more resilient for small variations in the code. It is defined as spacing, formatting and renaming which is different as compare to textual techniques. For example CCFinder, Dup, CPMiner and so on.

4.3) Syntactic Approach

This approach utilizes a parser for converting a source program in abstract syntax trees or parse trees that can be processed by using structural metrics or tree matching for finding the clones. For example: Deckard, Clone Dr and Clone Digger and so on. **4.4**) Semantic Approach

4.4) Semantic Approach

Static program is used in this approach. In comparison to the syntactic similarity it gives the in-depth data. Semantic approach is given in the form of PDG (Program dependency graph) or in the form of

Statements or expressions but the edges shows the dataor Duplex and so on control dependencies. For example, GPLAG, Duplex and so on.

	Text	Token	AST	PDG	
	based	based	based	based	
Category	Textual	Lexical	Syntactic	Semantic	
	approach	approach	approach	approach	
Clone Type	Type-1	Type-1,2	Type- 1,2,3	Type- 1,2,3	
Complexity	O(n)	O(n)	O(n)	O (n ³)	
Meaning of	Lines of code	No. Of	Nodes of	Node of	
n		token	AST	PDG	

5) Code clone Classification and Technique

6.Clone Detection Tools

In this section, we list the different clone detection tools available in the literature in a tabular form (however, there are several others). Table 12 shows the tool details where the first column represents the tool name, 2nd column refers the citations for that tool, the 3rd column indicates the languages currently supported by the tool, the 4th column shows whether the tool is a clone detection tools or plagiarism detection tool or designed for other reengineering task, the 5th column represents the approach used in developing the tool, the 6th column indicates whether the tool is for commercial or academic use, the 7th column shows the maximum input size used in validating the tool and the last and 8th column tells us whether the tool was empirically validated or not.

Tool	Citations	Sup. Lang.	Domain	Approach	B.Ground	L.Input	Validated?	
Dup	Baker [14, 18]	c, c++, Java	CD/Unix	line- based/text- based	academic	1.1M LOC	With two systems	
JPlag	Prechelt et al. [192]	Java, c, c++, Scheme, NL text	PD/Online	Token/Greedy String	Academic	236 LOC	Student assign- ments/artificial data	
CloneDr	Baxter et al. [31, 30]	c, c++, Java, COBOL, Others with DMS domain	CD Win- downNT	AST/Tree Matching	Commercial	400K LOC, C Code	Process Control System	
DupLoc	Ducasse et al. [74, 72]	Language Indepen- dent/ 45 Mins to adapt	CD/Visual Works2.5	Line/Exact string match- ing	Academic	46K LOC	With 4 sys- tems of dif- ferent lan- guages	
CCFinder	Kamiya et al. [122]	C, C++, Java, COBOL and other with lexical analyzer and trans- formation rules	CD/ Win- dows/ NT	Transformation /Token comp. with suffix tree	Academic	10M LOC	With 4 sys- tems	<
CP- Miner	Li et al. [168, 169]	C, C++	CD & Copy- pasted bugs de- tection /Win- dows/ Linux	Sequence Database/Freque subsequent mining	Academic nt	4365K LOC	Several sys- tems	
Sim	Gitchell et al. [90]	С	PD/Linux	Parse tree to string / String alignment	Academic	3.5K bytes	With 65 student as- signments	
Covet/CL4	Mayrand [178]	C, Others supported by Datrix	CD	Metrics from Datrix, 4 Points of comp., Ordi- nal scale of 8 cloning level	Academic	507K LOC	With two telecom- munication systems	
DiLucca Pro.	Di Lucca et al. [67, 66]	HTML client & ASP server pages	Duplicated web- pages/PD	Sequence of tags/ Leven- shtein distance	Academic	331 files	With 3 web applica- tions	
eMetrics	Fabio et al. [46, 161]	HTML & scripting languages	Visual inspec- tion of potential function clones	Gets potential function clones from eMetrics	Academic	403 files	Validated with 4 ap- plications	

continued on Heat I age

7.Conclusion:

We justify that code clone is a harmful in software development process. Code clone detection is a current issue in software development industry. The tools of code clone detection have to be integrated with standard IDEs. This paper mails focuses on describing actually what is code clone, Varity of code clones .we also describe the detection process and give the brief of Detection tools and Techniques .I conclude that this paper may serve as a Roadmap to potential users of code detection techniques .It may help them in selecting the right tool or technique.

8. Acknowledgement:

I would like to thank with deep sense of gratitude and respect to my Project Guide Mr. Sanjeev Kumar Shukla, Kanpur Institute of Technology, Kanpur for his Valuable suggestions ,guidance and constant encouragement during the paper writing.

I am very much thankful to the College Management and the **Director Prof(Dr) Brajesh Varshney** of the Institute for the help they provided me during the writing the content of this paper .

I would also like to give special thanks to Mr. Ayush Mishra for his help and support for writing the paper.

I am also thankful to my Family and friends for their true blessings and encouragement for the completion of paper.

References

- [1] A. Aiken. A system for detecting software plagiarism (moss homepage). URL http: //www.cs.berkeley.edu/aiken/moss.html. 2002.
- [2] Raihan Al-Ekram, Cory Kapser, Michael Godfrey. Cloning by Accident: An Empirical Study of Source Code Cloning Across Software Systems. *International Symposium on Empirical Software Engineering (ISESE'05)*, pp. 376-385, Noosa Heads, Australia, November 2005.
- [3] Brenda S. Baker. A Program for Identifying Duplicated Code. In *Proceedings of Computing Science and Statistics:* 24th Symposium on the Interface, Vol. 24:4957, March 1992.
- [4] Ira Baxter, Andrew Yahin, Leonardo Moura, Marcelo Sant Anna. Clone Detection Using Abstract Syntax Trees. In Proceedings of the 14th International Conference on Software Maintenance (ICSM'98), pp. 368-377, Bethesda, Maryland, November 1998.
- [5] James Cordy, Thomas Dean, Nikita Synytskyy. Practical Language-Independent Detection of Near-Miss. In *Proceedings of the 14th IBM Centre for Advanced Studies Conference (CASCON'04)*, pp. 1 12, Toronto, Ontario, Canada, October 2004.
- [6] Neil Davey, Paul Barson, Simon Field, Ray J Frank. The Development of a Software Clone Detector. *International Journal of Applied Software Technology*, Vol. 1(3/4):219-236, 1995
- [7] A.van Deursen, T. Kuipers. Building Documentation Generators. In *Proceedings of International Conference on Software Maintenance (ICSM'99)*, Oxford, England, UK, August 1999.
- [8] Stephane Ducasse, Matthias Rieger, Serge Demeyer. A Language Independent Ap-proach for Detecting Duplicated Code. In *Proceedings of the 15th International Confer-ence on Software Maintenance (ICSM'99)*, pp. 109-118, Oxford, England, September 1999.
- [9] Toshihiro Kamiya, Shinji Kusumoto, Katsuro Inoue. CCFinder: A Multilinguistic Token-Based Code Clone Detection System for Large Scale Source Code. *Transactions on Software Engineering*, Vol. 28(7): 654- 670, July 2002.
- [10] Raghavan Komondoor and Susan Horwitz. Tool demonstration: Finding duplicated code using program dependences. In *Proceedings of the European Symposium on Pro-gramming (ESOP'01)*, Vol. LNCS 2028, pp. 383386, Genova, Italy, April 2001.
- [11] K. Kontogiannis, R. DeMori, E. Merlo, M. Galler, and M.Bernstein. Pattern Matching for Clone and Concept Detection. In Automated Software Engineering, Vol. 3(1-2):77-108, June 1996.
- [12] S. Rao Kosaraju. Faster algorithms for the construction of parameterized su-x trees. In *In Proceedings of the 36th* Annual Symposium on Foundations of Computer Science (FOCS95), pp. 631638, October 1995.
- [13] Jens Krinke. Identifying Similar Code with Program Dependence Graphs. In Proceed-ings of the 8th Working Conference on Reverse Engineering (WCRE'01), pp. 301-309, Stuttgart, Germany, October 2001.

[14] Andrian Marcus and Jonathan I. Maletic. Identification of high-level concept clones in source code. In *Proceedings of the 16th IEEE International Conference on Automated Software Engineering (ASE'01)*, pp. 107-114, San Diego, CA, USA, November 2001.

[15] Jean Mayrand, Claude Leblanc, Ettore Merlo. Experiment on the Automatic Detection of Function Clones in a Software System Using Metrics. In *Proceeding the 12th International Conference on Software Maintenance (ICSM'96)*, pp. 244-253, Monterey, CA, USA, November 1996.

[16] E. McCreight. A space-economical su-x tree construction algorithm. In Journal of the ACM, 32(2):262272, April 1976.

[17] S.M. Nasehi, G.R. Sotudeh, and M. Gomrokchi. Source Code Enhancement using Reduction of Duplicated Code. In *Proceedings of the 25th IASTED International Multi-Conference*, pp. 192-197, Innsbruck, Austria, February 2007.

[18] V. Wahler, D. Seipel, Jurgen Wolfi von Gudenberg, and G. Fischer. Clone detection in source code by frequent itemset techniques. In *Proceedings of the 4th IEEE Inter-national Workshop Source Code Analysis and Manipulation (SCAM'04)*, pp. 128135, Chicago, IL, USA, September 2004.

[19] Wuu Yang. Identifying syntactic differences between two programs. In *SoftwarePrac-tice and Experience*, 21(7):739755, July 1991.

[20] Definition of code clone used in intro:Cory J. Kapser:University of Waterloo, Ontario, Canada, 2009

[21] Chanchal Kumar Roy and James R. Cordy, A Survey on Software Clone DetectionResearch:In proceedings of Technical Report No. 2007-541 School of Computing Queen's University at Kingston Ontario, Canada, September 26, 2007

[22] L. Moonen. Generating robust parsers using island grammars. In *Proceedings of the 8th Working Conference on Reverse Engineering (WCRE'01)*, pp. 1322, Stuttgart, Germany, October 2001.

International Journal for Modern Trends in Science and Technology, 7(10): 08-16, 2021 Copyright © 2021 International Journal for Modern Trends in Science and Technology ISSN: 2455-3778 online DOI: https://doi.org/10.46501/IJMTST0710002

Available online at: http://www.ijmtst.com/vol7issue10.html



Implementation Analysis of Solar PV Based SEPIC Inverter System

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To Cite this Article

Saurabh Kumar, Adeeb Uddin Ahmad, Neevatika Verma, Vikas Verma and Shweta Singh. Implementation Analysis of Solar PV Based SEPIC Inverter System. *International Journal for Modern Trends in Science and Technology* 2021, 7 pp. 08-16. <u>https://doi.org/10.46501/IJMTST0710002</u>

Article Info

Received: 30 August 2021; Accepted: 24 September 2021; Published: 28 September 2021

ABSTRACT

For welfare of environment, world needs to use more and more renewable energy system not only at the level of industrial but also for domestic load system. Due to much installation cost involving in a solar PV cell/panel based system there is a need of better mechanisms to get maximum utilization and benefits from the system with reliable operation, especially in the case of microgeneration power plant to full fill the minimum desired requirements of domestic appliances to achieved reliable operation. Mostly available PV based inverter system having problem of low output voltage generation and THD producing issue, which needs to a requirements of extra circuit to the control THD and boost up the level of output voltage. In this paper, solar PV based closed loop SEPIC converter by PWM technique to maintain a step up constant dc output voltage with no polarity reversal, low ripple in output and minimizing the requirement of additional filter circuit and fed to single phase inverter. This paper has been focused for the overall single phase PV based SEPIC inverter system implementation, performances and simulated on MATLAB/SPS software to provide low losses, 2% minimum THD and reliable operation in compare with single phase PV based Cuk inverter is used for DC-AC conversion system to compatible with domestic load appliances.

KEYWORDS: Cuk converter, PID controller, Solar PV cell, SEPIC converter, Single phase full bridge VSI

I.INTRODUCTION

Due to rapid depletion of fossil fuels, the world needs a source of energy which are renewable in nature, so that it's full fills the needs of all civilization without affecting or producing the environmental problems and gives sustainability in the sector of power [1]. Energy is important in almost every aspect of our life and for the achievement of country economy [2]. As per the present and future expectation situation of power sector, usage of the renewable energy source and generating electricity from this is exponentially rising as a primary source for various types of applications such as industrial, non-commercial, service oriented, etc., as part of an approach to decrease the dependence on fossil fuels, large sized battery banks and central utility grid [3]. Also, the usage of renewable energy will support in addressing environmental effluences, transmission efficiencies, cost suffered in transmission, etc. [4-6]. Any electrical generation system must obey through certain quality principles and operation guidelines, mainly if there is any energy conversion in the electrical system [7]. The Earth have naturally different type of renewable source of energy such as Solar, fuel, Wind, biomass, biofuel, geothermal, hydro, tidal, wave, etc., which can be converted into electrical or any other form of energy directly or indirectly. Generally in comparison of other, the solar photovoltaic plants system consider the utility grid by way of vast storing system capable of absorb as much energy as preferred, with less maintenance of the electrical system for domestic load [8].

In Solar PV system, PV cell generate a low variable voltage due to variation in the solar radiations. The DC-DC converter is like a transformer for step up and step down the dc voltage level. In this paper, SEPIC power converter using PID controller is used to boost the input DC Voltage that is fed by Solar PV cell because its performance and efficiency are better than other converter like boost, cuk, etc., and also having advantage that do not required addition filter circuit, minimum ripple comparatively and do not invert the voltage at the output level [9]. The proposed efficient solar energy based DC-AC system as shown in Fig.1.



Fig.1. Block diagram of solar energy based DC-AC system.

For reliable control of the output of converter feedback techniques is used which overall creates a closed loop SEPIC converter for this system. The dc-dc converter based PV energy system is applied in various convenient applications so in this for domestic loads by converting DC voltage from SEPIC converter to AC voltage with the help of single phase full bridge VSI, so power that would be available at an electrical wall outlet.

II. SOLAR PHOTOVOLTAIC CELL

A solar cell is a PN junction with a large surface area and to allow light because of N-type material generally thin. The electricity is generate in depletion zone when photon incident on the PN junction. For creating PN junction mainly silicon atom lattices are used. To form P-type and N-type material doping are done to create an excess holes and extra electrons respectively. When a photon of light is absorbed then holes of P region try to diffuse electrons of N region and vice versa and create a charge in junction which can produce electric field. The free hole and electron has enough energy to jump out of the depletion part zone. If an external load is connected with the help of wire to the PN junction. Thus electron is attracted to the positive charge of the P-type material and hole is attracted to the negative charge of the N-type material, so that current flows through the external load as show in Fig.2



Fig.2. Diagram of electricity generation by solar PV cell

Equivalent Circuit of ideal solar cell is represented by a current source connected in shunt with a rectifying diode. For the practical application usage, connect series and shunt resistances to the ideal model as shown in Fig.3.RS represents the series intrinsic resistance whose value is very small (ideally zero) and RP represents the equivalent shunt resistance which has a very high value (ideally infinity) [10].



Fig.3. Equivalent circuit model of solar PV cell

From Fig.3 Applying Kirchhoff's current law $I_L = I_D + I R_P + I$ (1)

The photovoltaic current equation [11]

$$I = I_L - I R_P - I_D(2$$

 $I = I_{L} - I_{O} \left[exp \left(V + I R_{S} / V_{T} \right) - 1 \right] - \left[V + I R_{S} / R_{P} \right]$ (3)

Here, I_L and I_0 represent the photo generated current and diode saturation current respectively, whereas I and V is the Cell current and Cell voltage respectively, V_T is the Thermal voltage. The V-I Characteristics represents the operating principle of a solar cell or module and indicates the relationship between the current and voltage at the present situations of temperature and irradiance. Generally the series and parallel combination of Photovoltaic cells is used to increase the voltage and current rating of solar array respectively (as shown in Fig.4) because single cell are not able to produce desired amount of capacity. V-I curves also provide the information regarding design of solar system so that it can operate as close to its best maximum efficiency as possible (as shown in Fig. 4 for parallel MPP and series MPP).



Solar Cell produces electrical energy in terms of DC and multiplication of current and voltage equals to power in watts, therefore make solar cell V-I curves on behalf of the current versus the voltage for a solar photovoltaic device as shown in Fig.4.

III. CONVERTER DESCRIPTION

The Converter step up and step down the magnitude of DC level input obtaining from solar cell to low level output DC voltage and high level output voltage respectively, so in this paper SEPIC converter is used and compare with Cuk converter.

A.Cuk Converter

Switching Cuk converter having an output voltage value (lower or higher) than the input voltage, but the output voltage of the converter has an opposite polarity with reference to input voltage [12]. The inductor L₁ act as a filter on the DC side which will be used to prevent high harmonic current. The quantity of energy transferred by the Cuk Converter to the inductor is associated with the capacitor C shown in Fig.5.



Fig.5. Basic circuit diagram of SEPIC Converter Ideally the output of Cuk converter is [13] $V_0 = \{D x / (1 - D)\} x V_i(4)$

Where, D is the duty cycle of switching,

 $D = (T_{ON}) / (T_{ON} + T_{OFF})$

In this system, the parameters of Cuk converter has been given below to get minimize value of ripple so that to attain a maximum efficiency, as follows: Inductance, L₁= 300 mH; Inductance,L₂= 15 mH; Capacitance, C =150 μ F; Capacitance, Co =1000 μ F and Switching frequency, f=16 kHz.

(5)

B. SEPIC Converter

A SEPIC is conventional type of buck-boost converter, but having non-reversal output, the transformation of energy from the input side to the output side is generally passing through a series capacitor by means of coupling and when the switch is turned off output voltage drops to zero volt. The SEPIC converter permits a range of dc voltage to be adjusted to sustain a constant voltage output [14-15]. SEPIC converters can increase or decrease the voltage as per required application as shown in Fig.6.



Fig.6. Basic circuit diagram of SEPIC Converter

In SEPIC converter, high triggering pulse ON the switch (generally MOSFET). Inductor L_1 is charged by the given input voltage and with the help of capacitor C_1 , inductor L_2 is charged as shown in Fig.7 (a). If the

pulse triggering is low the switch is OFF, the capacitors are charged by inductors through the diode to the load output as shown Fig.7 (b). The output is maintained by capacitor 2, when diode is OFF.



Fig.7 working circuit diagram (a) when switch S1 is ON, (b) when switch S1 is OFF

For achievement of greater output, the pulse should be low and the percentage of duty cycle will be greater. This happened because of getting longer charging time by the inductor, hence gives greater voltage. Due to the pulse continues too long sometimes, converter fail to do the following operation thereby capacitors will not be capable to charge.

Ideally the output of SEPIC converter is $V_0 = (D \times V_{IN}) / (1 - D)$ (6)

In equation (6) if we consider the losses due to parasitic elements such as the diode drop V_{D1}

Then, $V_0 = \{(D \times V_{IN}) / (1 - D)\} - V_{D1}(7)$

The amount by which step up or down of the voltage of SEPIC converter primarily depends primarily on the parasitic elements of the circuit and on applied duty cycle [16].

From equation (7) duty cycle can be,

$$D = (V_{O} + V_{D1}) / (V_{IN} + V_{O} + V_{D1})$$
(8)

If the duty cycle is greater than 50%, it will step up the voltage and act as a boost converter whereas for duty cycle less than 50% it will be step down the voltage and

act as buck converter.

In this system, the parameters of SEPIC converter has been given below to get minimize value of ripple to attain optimum efficiency, as follows: Inductance, L₁= 300 mH; Inductance, L₂= 15 mH; Capacitance, C₁ =150 μ F; Capacitance, C₂ =1000 μ F.

C. Controller for SEPIC Converter

A PID controller is closed loop feedback controller, efforts to minimize the error among a measured process parameter and take a corrective measure by computing and then give a desire output value which can modify the process consequently. Generally it is used to minimize the dynamic response and to decrease the steady-state error [17]. The current error reaction determines by the Proportional (P), the sum of recent errors reaction determines by the Integral (I) and the rate at which the error has been varying determines by the Derivative (D).

In a feedback closed loop the PID controller output signal given by

 $u(t) = K_p e + K_i \int e dt + K_d (de / dt)$

This control signal will be fed to the plant/process, and the new output y(t) will be attained. This new output will be then sent back again to the feedback control sensor, to find the new error signal e(t) [18]. The controller precedes this novel error as input signal and calculates the gain values (K_P , K_i , K_d) as shown in Fig. 8.



Fig.8. Schematic diagram of control strategy

In this system, the parameter of Kp, Ki and Kd are 0.001, 100 and 0 respectively, increases the performance and efficiency of converter. Here the whole control strategy includes two loops current inner loop and voltage outer loop and switching pulse to the MOSFET has been provide by the Pulse Width Modulation technique, by comparing a constant dc voltage i.e. reference value with a saw tooth signal i.e. carrier value

and the switching frequency has been taken as 16 kHz.

IV. INVERTER DESCRIPTION

The configured system is designed for the purpose of domestic load that's why the single phase full bridge VSI is used for the conversion operation of DC output, obtaining from SEPIC converter to the AC output for full fill the required needs of desired load.

A.Single Phase Full Bridge VSI

The inverter converts DC power to AC power by providing the DC input voltage or current in a pre-defined sequential arrangement so as to produce AC voltage or current output. The single phase full bridge inverter involves a two arms with a two semiconductor switches on both arms and having antiparallel freewheeling diodes with each switch for discharging the reverse current [19]. Generally in the case of RL load equipment, these diodes allow to flow reverse load current through it and these diodes also provide an alternative route to inductive current which remain so run during the Turn OFF situation as shown in Fig.9.



Fig.9. Basic circuit diagram of single phase full-bridge VSI

From Fig. 9, the switches are T₁, T₂, T₃ and T₄ with antiparallel freewheeling didoes D₁, D₂, D₃ and D₄. The switches are alternatively operated in way on each branch so that they are not simultaneously ON and OFF in same mode. To avoid short circuiting, In general both the switch is OFF for very short duration of time called blanking time. To get the desired output the switches should be operate in T₁ and T₂ or T₃ and T₄ pair to get the desired output. For the change in polarity of voltage waveform, the bridges legs are switched in a manner by which the output voltage is shifted from one to another. When the output voltage is max, then shift angle is π and if the output voltage is zero, then shift angle is also zero. The circuit operation, when S1, S2 ON and S3, S4 OFF for duration t1<t<t2 as shown in Fig.10 (a) and when S1, S2 OFF and S3, S4 ON for duration t2<t<t3 as shown in Fig.10 (b).



Fig. 10 Working circuit diagram (a) when S1, S2 ON, (b) when S3, S4 ON

For the better conversion of power from DC to AC with minimum losses and low THD in output has been achieved by the Pulse Width Modulation technique to provide switching pulses to the MOSFET accurately [20-21]. The values given to PWM pulse generator for output voltage frequency, carrier frequency and modulation index are 50Hz, 1030Hz and 1 respectively and also the value given to the RL load (domestic load) having resistance is 50 Ω and inductance is 100 mH.

V. RESULTS

The MATLAB/SPS software has been used to simulate the solar energy based DC-AC system with using Cuk converter to DC-DC conversion of power from solar cells and then using single phase full bridge VSI to DC-AC conversion as shown in Fig. 11.



Fig. 11 MATLAB Simulink model of Solar PV based Cuk with VSI

A.Simulated Output Graphs of Solar PV cells for Cuk Converter Input

The simulated waveform obtained by the MATLAB/SPS software in which the input current Cuk converter is 3.989 A, that is also the output current from the solar cells as shown in Fig. 12(a) and Similarly input voltage for Cuk converter is 112.6 V, that is also the output voltage from the solar cells as shown in Fig. 12(b).



Fig. 12 Solar PV cells outputs and Cuk Inputs (a) Current versus Time (b) Voltage versus Time

B. Simulated Output Graphs of Cuk Converter for Inverter Input

The simulated waveform obtained by the MATLAB/SPS software in which the input current for single phase full bridge VSI is -2.457 A, that is also the output current from the Cuk converter as shown in Fig. 13(a) and Similarly input voltage for single phase full bridge VSI is -221.5 V, that is also the output voltage from the SEPIC converter as shown in Fig. 13(b).





C. Simulated Output Graphs of Solar PV based Cuk with VSI for Domestic Load Input

The simulated waveform obtained by the MATLAB/SPS software in which the input current for domestic load (RL load) is 2.171 A, that is also the output current from the single phase full bridge VSI as shown in Fig. 14(a) and Similarly input voltage for domestic load (RL load) is 221.1 V, that is also the output voltage from the single phase full bridge VSI as shown in Fig. 14(b).



Fig. 14 Cuk with VSI outputs and Domestic load Inputs (a) Current versus Time (b) Voltage versus Time

D. Total Harmonic Distortion in Output Voltage of Solar PV based Cuk with VSI

The simulated graph of total harmonic distortion obtained by the MATLAB/SPS software in which the THD present in the voltage is 10.00 % for the solar energy based DC-AC by using closed loop Cuk converter with single phase full bridge VSI for the domestic load as shown in Fig. 15.



with VSI for DC-AC domestic load system

The MATLAB/SPS software has been used to simulate the solar energy based DC-AC system with

using SEPIC converter to DC-DC conversion of power from solar cells and then using single phase full bridge VSI to DC-AC conversion as shown in Fig. 16.



Fig. 16 MATLAB Simulink model of Solar PV based SEPIC with VSI

E. Simulated Output Graphs of Solar PV cells for SEPIC Converter Input

The simulated waveform obtained by the MATLAB/SPS software in which the input current for SEPIC converter is 5.160 A, that is also the output current from the solar cells as shown in Fig. 17(a) and Similarly input voltage for SEPIC converter is 112.4 V, that is also the output voltage from the solar cells as shown in Fig. 17(b).





F. Simulated Output Graphs of SEPIC Converter for Inverter Input

The simulated waveform obtained by the MATLAB/SPS software in which the input current for single phase full bridge VSI is 2.461 A, that is also the output current from the SEPIC converter as shown in Fig. 18(a) and Similarly input voltage for single phase full bridge inverter is 222.9 V, that is also the output

voltage from the SEPIC converter as shown in Fig. 18(b).



Fig. 18 SEPIC outputs and Inverter Inputs (a) Current versus Time (b) Voltage versus Time

G.Simulated Output Graphs of Solar PV based SEPIC with VSI for Domestic Load Input

The simulated waveform obtained by the MATLAB/SPS software in which the input current for domestic load (RL load) is 2.281 A, that is also the output current from the single phase full bridge VSI as shown in Fig. 19(a) and Similarly input voltage for domestic load (RL load) is 222.6 V, that is also the output voltage from the single phase full bridge VSI as shown in Fig. 19(b).





H. SimulatedTotal Harmonic Distortion in Output Voltage of Solar PV based SEPIC with VSI

The simulated graph of total harmonic distortion obtained by the MATLAB/SPS software in which the THD present in the voltage is 8.03 % for the solar energy based DC-AC by using closed loop SEPIC converter with single phase full bridge VSI for the domestic load as shown in Fig. 20.



Fig. 20 THD in output voltage for solar energy based DC-AC system for domestic load

I. SimulatedComparative analysis of solar energy based DC-AC system

The overall variation obtained by the MATLAB/SPS software for voltage and current parameter form input to output and also THD of Cuk converter with VSI and SEPIC converter with VSI for designed configured DC-AC system as shown in table 1.

Table I. Analysis of DC-AC solar energy system for domestic load

N/Z	Solar DC-AC system								
Variable	Cuk Co	nverter	SEPIC Converter						
	with	VSI	with VSI						
	Input	Output	Input	Output					
Voltage (V)	112.6	221.1	112.4	222.6					
Current (A)	3.989	2.171	5.160 2.281						
THD%	10.0	00%	8.0	8.03%					

VI. CONCLUSION

In this paper, the efficient solar PV based closed loop SEPIC converter with single phase full bridge VSI (DC-AC) system is designed and simulated in MATLAB/SPS software and also compare by solar PV based closed loop Cuk converter with single phase full bridge VSI system for the domestic load (RL load). In which for given RL load (R=50 Ω and L=100mH), the low DC input voltage (112.4 V) from solar PV cells is boost up by the SEPIC converter to high DC input voltage (222.9 V) for inverter and then this DC input voltage converted to AC output voltage (222.9 V) with low THD (8.03%) by the Single phase full bridge VSI as desired for the reliable operation of domestic load with low losses.

REFERENCES

- Y. V. P. Kumar and R. k. Bhimasingu (2015), "Renewable energy based microgrid system sizing and energy management for green buildings," Springer Journal of Modern Power Systems and Clean Energy, Vol. 3, No. 1, pp.1-13.
- [2] S. Kumar and B. Dwivedi (2019), "Techno-economical Study of Power System Market- A Game Theory Approach," International Conference on Automation, Computational and Technology Management (ICACTM), pp. 84-88.
- [3] S. Kumar, B. Dwivedi, N. A. Shrivastava (2021). "Profit evaluation inclusive of reserve pricing for renewable-integrated GENCOs" International Journal of Emerging Electric Power Systems, Vol. 22, No.4, pp. 1-11.
- [4] R. Singh, S. Kumar and S. Chauhan (2013), "Energy:-Conservation, Management, Efficiency & Storage," International Journal of Applied Engineering Research (IJAER), Vol. 8 No. 7, pp. 80-85.
- [5] Y. J. Reddy, Y. V. P. Kumar, K. P. Raju, and A. Ramsesh (2012), "Retrofitted hybrid power system design with renewable energy sources for buildings," IEEE Trans. Smart Grid, Vol. 3, No. 4, pp. 2174-2187.
- [6] J. M. Guerrero, F. Blaabjerg, T. Zhelev, et. al. (2010), "Distributed generation: Toward a new energy paradigm," IEEE Industrial Electronics Mag., Vol. 4, No. 1, pp. 52-64.
- [7] S. Kumar, B. Dwivedi and N. A. Shrivastava (2021), "A Game Theory Strategy-Based Bidding Evaluation for Power Generation Market," IEEE Canadian Journal of Electrical and Computer Engineering, Vol. 44, No. 3, pp. 283-288.
- [8] M. Patterson, N. F. Macia and A. M. Kannan (2015), "Hybrid Microgrid Model Based on Solar Photovoltaic Battery Fuel Cell System for Intermittent Load Applications," in IEEE Transactions on Energy Conversion, Vol. 30, No. 1, pp. 359-366.
- [9] S. Kumar, R. Kumar and N. Singh (2017), "Performance of closed loop SEPIC converter with DC-DC converter for solar energy system," 4th International Conference on Power, Control & Embedded Systems (ICPCES), Allahabad, India, pp. 1-6.
- [10] W. Chen, Y. Duan, L. Guo, Y. Xuan and X. Yang (2016), "Modeling and Prediction of Radiated Emission From Solar Cell in a Photovoltaic Generation System," in IEEE Journal of Photovoltaics, Vol. 6, No. 2, pp. 540-545.
- [11] S. Nema, R. K. Nema, G. Agnihotri (2010), "MATLAB/Simulink based study of photovoltaic cells / modules / array and their experimental verification", International journal of Energy and Environment, Vol.1, No.3, pp.487-500.
- [12] S. Kumar and N. Singh (2016), "Comparatively Analysis of DC-DC Converter for Solar Energy System" National Conference on Electrical Power Technology, Management and IT Applications (EPTMITA), Gorakhpur, India, pp. 1-6.
- [13] R. Kumar and B. Singh (2017), "Solar PV powered BLDC motor drive for water pumping using Cuk converter," in IET Electric Power Applications, Vol. 11, No. 2, pp. 222-232.
- [14] R. Kumar, S. Kumar, N. Singh and V. Agrawal (2017), "SEPIC converter with 3-level NPC multi-level inverter for wind energy system (WES)," 4th International Conference on Power, Control & Embedded Systems (ICPCES), Allahabad, India, pp. 1-6.
- [15] R. Kumar, S. Kumar and N. Singh (2017) "A Comparative Study of PWM Rectifier and Diode Rectifier –Fed SEPIC Converter for Wind Energy Conversion System" International Conference on Challenges in Sustainable Development from Energy & Environment Perspective (CSDEEP), Gorakhpur, India, pp. 256-265.
- [16] E. Babaei and M. E. Seyed Mahmoodieh (2014), "Calculation of Output Voltage Ripple and Design Considerations of SEPIC Converter," in IEEE Transactions on Industrial Electronics, Vol. 61, No. 3, pp. 1213-1222.

- [17] R. Arulmurugan, N. Suthanthira Vanitha (2012), "Optimal design of DC to DC boost converter with closed loop control PID mechanism for high voltage photovoltaic application", International Journal of Power Electronics and Drive System, Vol.2, No.4, pp. 434-444.
- [18] P. S. Subramanian, and R. Kayalvizhi (2015), "An Optimum Setting of PID Controller for Boost Converter Using Bacterial Foraging Optimization Technique", Lecture Notes in Electrical Engineering.
- [19] F. L. Tofoli and C. A. Gallo (2016), "Analysis, design, and implementation of soft-switching cells applied to the single-phase full-bridge inverter," in IET Power NElectronics, Vol. 9, no. 6, pp. 1249-1258.
- [20] Z. J. Shen, Y. Xiong, X. Cheng, Y. Fu, and P. Kumar (2006), "Power MOSFET switching loss analysis: A new insight," in Proc. IEEE Ind. Appl. Conf., Tampa, FL, USA, pp. 1438–1442.

Pal For

[21] S. Dalapati and C. Chakraborty (2008), "A Direct PWM Technique for a Single-Phase Full-Bridge Inverter Through Controlled Capacitor Charging," in IEEE Transactions on Industrial Electronics, Vol. 55, No. 8, pp. 2912-2922.

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ISSN: 2320-2882

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INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

Comparing Deep Learning-based Approaches for Source Code Classification

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Abstract: In recent years, various methods for source code classification using deep learning have been proposed. In these methods, the source code classification is performed by letting the neural network learn the source code's token sequence, etc. In that case, it is necessary to select the appropriate neural network or source code representation because the learning efficiency decreases when neural networks and source code representations that are not effective for source code classification are used for learning. However, it is not clear which neural networks or combinations of source code representations are effective for realizing high-precision source code classification methods. In this study, we compare the source code classification method using deep learning. First, we selected 3 neural networks that are widely used in existing research. Next, we compared the accuracy of a total of 6 source code classification methods in which the neural network trained the token sequence or abstract syntax tree of the source code. As a result, it was confirmed that the recursive neural network which learned the token sequence of the source code has the highest accuracy. In addition; we compared the source code classification accuracy of deep learning and non-deep learning methods, and confirmed that the classification accuracy of deep learning methods is high.

Index Terms - Deep learning, Source code classification, Forward propagation Neural network, Recursive Neural network, Graph Convolution network, BoW.

I. INTRODUCTION

To efficiently develop software, developers frequently reuse existing source code[1], [2].The source code classification method is a method that automatically identifies which source code is similar to the existing source code belonging to which class, based on the pre-prepared class. By using this source code classification method, developers can efficiently identify the source code to be reused. Many source code classification methods have been proposed until now. [3] ~ [9].In recent years, a method for classifying source code using deep learning has been proposed, and it has shown high classification accuracy. [6], [7] These existing methods can be used to train various neural networks to learn the source code representation. It has been realized. However, it is not clear how neural networks and source code expressions affect the accuracy of source code classification. In addition, since the existing source code classification model using deep learning is complicated, it is difficult to understand which neural networks and source code expressions are effective for high-precision source code classification. In this study, we compare the accuracy of the source code classification method using deep learning in order to investigate the combination of neural network and source code representation which is effective for high-precision source code classification. In conducting this research, we set a research question (RQ).

RQ what is the combination of neural network and source code representation that can realize high-precision source code classification.

In order to answer this RQ, we first proposed a neural network, a forward propagation neural network, a recursive neural network, which is a neural network commonly, used in existing source code classification methods. We selected 3 neural networks and graph convolution networks. Then, the selected neural network was trained on the token sequence or Abstract Syntax Tree (AST) of the source code, and the accuracy of a total of 6 kinds of source code classification methods was compared. As a result, it was found that the classification accuracy of the method which trained the token sequence of the source code using deep learning is the most accurate method for classifying source code. However, it is possible to perform highly accurate source code classification without using deep learning. In order to confirm this assumption, the accuracy of the source code classification method using deep learning and the source code classification method without deep learning were compared. As a result, it became clear that the method using deep learning has higher classification accuracy and that deep learning is effective for source code classification. The contribution of this research is as follows:

* By learning the source code token sequence or AST from 3 types of neural networks widely used in the existing research, and comparing the accuracy of a total of 6 types of source code classification methods, we investigated which source code classification methods have high accuracy. As a result, it was found that the classification accuracy of the method to train the token sequence of the source code in the recursive neural network is the highest.

* We compared the accuracy of the source code classification method using deep learning with the method not used. As a result, it was found that the source code classification method using deep learning is more accurate and that deep learning is effective for source code classification.

Since, 2.In this paper, we describe the source code classification and typical neural networks used for source code classification as the background of comparative investigation.3.In this paper, we describe the combination of neural network and source code representation which can realize high-precision source code classification by explaining the comparison investigation of source code classification method using deep learning and considering the result.4.In this paper, we compare the classification accuracy of the method using deep learning with the method not using it, and confirm whether the method using deep learning shows high accuracy.5.In this paper, we discuss the threat of validity of this study.6.In this paper, we describe existing research on source code analysis using deep learning as a related research. In this paper, we will summarize and discuss future issues.

2. Background

2. 1 Source code classification: The source code classification method in this study is n classes C1, in which existing source code is divided into syntactically and semantically similar source code. . . For Cn, the source code given as input is automatically classified into classes which contains the syntactic and semantic similarity source code of the input source code.Using this method, software can be developed efficiently. For example, by automatically classifying source code by function, tags related to functions can be automatically assigned to newly registered source code in a large software repository.By using this tag, developers can easily reuse existing source code with the necessary functions.By using the source code classification method in this way, and it is expected to improve the productivity of software development.

The source code classification method can be applied to similar source code retrieval.First, the source code to be searched is divided into classes for each similar source code, and the source code classification is performed for the source code of the search query.Then, the source code contained in the classified class is given a ranking according to the similarity with the search query source code, and the source code contained in the classified class is output as a search result according to this ranking. You can also detect source code classified in the same class as a code clone (a piece of code that matches or resembles each other in the source code), and you can detect the source code in the same class as a code clone (a piece of code

that matches or resembles each other in the source code).,

The source code classification method can be applied to code clone detection. In the research on source code classification, various methods have been proposed to date, such as classification by descriptive language[3], classification by dependencies between components[4], and classification by program meaning (functionality). In addition, source code classification according to the meaning of programs is tackled at various granularity, and there are software-based classification methods[5] and method-based classification methods[6] to[9]. Recently, a method for classifying source code with high accuracy by using deep learning has been proposed. [6], [7] The deep learning model created by these methods computes classification probabilities for each class for the input source code and outputs the class with the highest probability.

2. 2 Typical neural networks used for source code classification: In general, deep learning is one of the machine learning methods to solve tasks such as feature extraction, feature transformation, pattern analysis, and classification of objects by processing nonlinear information using many layers. [10]In the case of neural networks, non-linear information can be processed by using hidden layers of 1 layer or more. [11]In this study, we define a neural network using hidden layers of 1 layer or more in addition to input and output layers as a method of deep learning.Since then, this section describes typical neural networks used for source code classification.

2. 2. 1 Forward Propagation neural network: Feed forward neural Networks (FNN) [12] is a standard neural network that does not contain a loop structure in the network. At first, it was a machine learning method consisting only of input and output layers, but it is used in research as a method of deep learning that can solve linear inseparable problems by increasing the hidden layer. This neural network consists of connecting elements called neurons to perform simple vector calculations. FNN can be used for source code classification by vectorizing source code by arranging source code metrics. [13] ~ [15].

Figure 1 shows an example of a 3-layer FNN consisting of 8 neurons n11 to n32. The input and output of FNN are both vectors, and the dimension of the vector depends on the network structure. In the example in Figure 1, the input is a 3-D vector and the output is a 2-D vector. In addition, the function of the network depends on the values adjusted by learning, called weights and biases, which are set on the connections between each neuron. In the training of FNN, the input vector and output vector pairs are fed to FNN and the internal parameters of FNN are adjusted so that the corresponding output vector is output when the input vector is fed to FNN. This allows FNN to map input and output vectors. FNN was selected as a comparison target in the existing research on source code classification [6], and since it shows high classification accuracy, FNN was also selected as a comparison target in this study.

2. 2. 2 Recursive neural networks: In Recursive neural networks, RNN) [12] is a neural network in which a sequence of vectors



Figure 1 Example of a forward-propagating neural network



is given as an input, and the output is affected not only by the values of the input vectors but also by the order of the input vectors. Since the source code can be represented by a sequence such as a sequence of tokens, RNNs are used for source code classification[7],[16],[17]. An example of an RNN is shown in Figure 2.As can be seen from this figure, RNN contains a loop structure in the network unlike FNN.In RNN, the calculation is performed every time the vectors in the input vector series are input in order of 1 by one. In the calculation of the ith in the RNN, the hidden layer yi-1 of the neural network after the i-1th vector is input is input to the RNN at the same time as the ith vector xi. These 2 inputs are used to calculate the hidden layer yi and output zi of the RNN.Because the calculation is performed in such a procedure, the values and input order of all input vectors from 1 to i affect the output of the RNN.1. One of the typical RNNs is LSTM (Long short term Memory recurrent neural network) [18].



Figure 3: GCN Convolution Layer Example

How to get started LSTM is a neural network that enables long-term dependency learning compared to general RNNs by replacing the hidden layer of RNNs with LSTM block. LSTM was selected as a comparison target in the existing research on source code classification[7], and since it recorded high classification accuracy, we also selected LSTM as a comparison target in this study.

2. 2. 3 Graph Convolution network: Graph Convolution networks (GCN) [19] is a neural network that extracts nodes, edges, and features of the entire graph by convolution of adjacent nodes of the graph. Since the source code can be represented by graphs such as AST, GCN is used to classify the source code. [20]GCN is a relatively new neural network among neural networks that can learn graphs. Before GCN was proposed, Graph Neural Networks (GNN) [21] was first proposed as the predecessor technology of GCN.GNN is a neural network developed for deep learning of graph structures. Since convolution-based neural networks in the field of image recognition show high accuracy, it is thought that convolution can be applied to graphs to improve accuracy, and GCN was proposed. Existing research on Source code classification using Deep Learning[6],[7],[17]In this paper, we transform the original graph according to the input format of the neural network when learning the graph. However, GCN does not need to transform the graph, so it has the advantage of not missing the structural information of the graph. Therefore, by using GCN, it is possible to use the information contained in the graph more accurately

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than the neural network which needs to transform the graph. An example of the convolution layer of GCN is shown in Figure 3. Figure 3 shows the procedure for calculating the vector representation of node 0 in the middle of the graph in the upper right is explained. For the vector in the convolution n+ 1 layer of node 0, an intermediate vector is calculated from the vector in the n-th layer of the adjacent node, the ingoing, outgoing, and self-loop weights of the edges looping to node 0, and the vector obtained by adding all the intermediate vectors for each edge is used as an activation function such as ReLU. It can be obtained by entering a function to correct the output of the network). In this way, the vector representation of node 0 is calculated based on the vector representation of node 0 and the vector representation of nodes 1, 2, and 3 adjacent to node 0. Existing research on source code classification using neural Networks capable of graph learning [6],[7],[17],[20]In recent years, it is necessary to conduct a survey of classification accuracy. In addition, GCN is relatively new among neural networks applied to graphs, so high-precision classification can be expected. Therefore, in this study, GCN was selected as a comparison target.

3. Comparison of accuracy of Source Code Classification Method using Deep Learning:

In recent years, various methods for source code classification using deep learning have been proposed. [6], [7]The deep learning model in these methods has a complex structure and uses various neural networks and source code representations. However, it is not clear to what extent these neural networks and source code representations affect the accuracy of source code classification. In this study, we compare the accuracy of the source code classification method using neural network and source code representation, which are widely used in existing research. By doing this comparison, we investigate the combination of neural network and source code representation which can classify source code with high accuracy.

3. 1 Benchmark In this study, Bigclonebench [22] was used as a benchmark for source code classification.Bigclonebench is a benchmark that collects method-by-method source code from open source software developed in Java. The methods collected by the developers of Bigclonebench are classified into 43 functional classes based on the functionality they provide. The Therefore, Bigclonebench can be used to evaluate the source code classification method .bigclonebench is a reliable large-scale benchmark created by developers by visual verification of about 6 million methods.

3. 2 Source code classification method for comparison : In 2, 3 neural networks which are widely used in source code classification are explained. In this study, we train each of 2 source code representations (token sequences or AST of source code) for each neural network, and compare the accuracy of a total of 6 source code classification methods. Therefore, in this section, 6 kinds of source code classification methods are explained. In addition to token columns and AST, there are control flow graphs and data flow graphs in the source code representation. Source code compilation is required to generate these 2 source code representations. However, 3. As explained in Section 1, BIGCLONEBENCH is a benchmark that collects method-by-method source code from open source software, so it is difficult to compile individual source code expressions that require compilation. The deep learning framework used in this study is Py-Torch1.5.0 (Note 1), the activation function used in each neural network is ReLU, the loss function is Crossentropy, and the optimization algorithm is Adam. The number of layers and nodes of the hidden layers of neural networks used in each method was determined by grid search. Grid search is a method to determine the appropriate hyperparameters by regularly determining the candidates of the hyperparameters, searching the combinations of each hyperparameters in order. In addition, as the number of dimensions increases, the quality of the vector tends to improve, and when the number of dimensions exceeds 300, the quality of the vector tends to change less. [23]Therefore, in this study, the number of dimensions of the embedded vector input to the neural network is set to 300.

3. 2. 1 FNN+Token

In this method, 2. 2. Let FNN described in 1 train the vector of token columns generated by Doc2Vec [24]. How to get startedDoc2Vec is a method to generate vectors of documents by unsupervised learning. Since the token sequence in the source code has meaning in the order of the tokens, it is necessary to use a method that can perform vectorization of the entire sequence based on the context of the word. In this method, Doc2Vec is used to vectorize the method.

Specifically, the training data set (3. 3) Use javalang (Note 2) to make the method contained in the token column. Next, the token sequence is treated as a document, the token is treated as a word, and the method is vectorized using Doc2Vec. The number of dimensions of the Doc2Vec vector is 300, the hidden layer of FNN is 4, and the number of nodes of the hidden layer is 128.

3.2.2 FNN+AST

The method is set other than the source code representation to be trained 3. 2. It is the same as FNN+Token described in 1.In this method, 2. 2. Let FNN described in 1 learn a vector of AST generated by Doc2Vec.Specifically, the training data set (3. 3) Convert the methods contained in Eclipse JDT (Note 3) to AST using astparser.Next, we treat the AST nodes as documents and the AST nodes as words, and vectorize the methods using Doc2Vec.

3.2.3 LSTM+Token

In this method, the token sequence of the method is used as the training data 2. 2. Let the LSTM described in 2 learn the order relationship of tokens. The token column of the method is generated using javalang. The number of dimensions of the embedded layer in LSTM is 300, and the number of nodes in the hidden layer in LSTM is 128.

3. 2. 4 LSTM+AST

In this method, the settings other than the source code representation to be trained are 3. 2. It is the same as the LSTM+Token described in 3.In this method, LSTM learns the ordering relationship of AST nodes by making the source code representation to be trained as a depth-first search permutation of AST nodes.Depth-first search permutations of AST nodes are generated using the astparser of Eclipse JDT.

3.2.5 GCN+Token

In this method, 2. 2. Let the GCN described in 3 learn the token sequence of the method. In order for GCN to train the token column, it is necessary to represent the token column in a graph This time, we treat each token contained in the token column as a node and treat a graph of 1 straight line connected to the previous and previous tokens by an edge.Pytorchgeometric (Note 4) is used to implement GCN.The graph of the token sequence in this method is regarded as an undirected graph, and the weights of the edges are all the same.Vectorization of nodes is performed using WORD2VEC [25].Specifically, we treat the token sequence as a document and the token as a word, apply WORD2VEC to generate a vector of each token, and assign the generated vector to the node corresponding to each token.The token column of the method is generated using javalang.The number of dimensions of the node vector generated by word2vec is 300, the convolution layer of GCN is 4, and the number of nodes of the hidden layer of GCN is 128.

3. 2. 6 GCN+AST

In the method, the settings other than the source code representation to be trained are 3. 2. It is the same as the GCN+Token described in 5.In this method, the source code representation to be trained is the AST of the method. This allows the GCN to learn what nodes appear around a certain AST node. In this method, the AST is considered to be an undirected graph, and the edge weights are all the same.Vectorization of AST nodes is performed using WORD2VEC [25].Specifically, the AST nodes are arranged in depth-first search order, each node is considered as a word, and WORD2VEC is applied.Also, the AST of the method is generated using the astparser of Eclipse JDT.

In addition to AST, there are control flow graphs and data flow graphs to represent the source code in a graph. However, it is necessary to compile the source code to generate control flow graph and data flow graph. The bigclonebench described in 1 contains source code that is difficult to compile. Therefore, this method targets AST that does not require source code to be compiled for generation

3. 3 Method of Investigation

In this study, Top-k is used as an evaluation scale for the source code classification method. In this study, Top-k is the rate at which the correct class is contained within the k-order when each source code classification method calculates the classification probability for each function class for each method in the evaluation data set, and ranks it in order of class with high probability. This Here, the correct class is based on the function of each method, 3. 1 is a function class defined by Bigclonebench described in.The calculation procedure of Top-k is shown in Figure 4.The calculation of Top-k is performed according to the following 5 steps

STEP A1

The method of bigclonebench described in 1 is divided by each function class, and a unique ID is assigned to each function class.

STEP A2

The methods of each function class are randomly divided at a rate of 8:2, and 8% is the training data set and 2% is the evaluation data set.

STEP A3

Generate a source code representation from the method of the training data set and train it to the neural network.

STEP A4

We classifies each method in the evaluation data set using the neural network that has learned the methods of the training data set.

STEP A5

Calculate Top-k from the classification result.

In this study, 3. 2 For the 6 kinds of source code classification methods described above, the Top-1, Top-3, Top-5, and Top-10 are calculated and compared according to the above procedure. However, since the method of each function class is divided randomly in the 2nd step of the procedure, the classification accuracy may change with each division attempt. In this study, we divide each functional class using a common random seed value in order to perform training and evaluation using the same data set in 6 different classification methods. This paper investigates the combination of neural network and source code representation which can realize high-precision source code classification.

3. 4 Survey results and inspection

The accuracy of each source code classification method is shown in Table 1.In this table, the highest number n Top-k is shown in bold. As can be seen from Table 1, among the classification methods, LSTM+Token had the highest classification accuracy in Top-1, Top-3, and Top-5, and GCN+AST had the highest classification accuracy in Top-10.In the source code classification, it is considered important that Top-1 is excellent.2. In order to realize the automatic assignment of the function tags listed in 1, the table How to get startedLSTM is a neural network that enables long-term dependency learning compared to general RNNs by replacing the hidden layer of RNNs with LSTM block.LSTM was selected as a comparison target in the existing research on source code classification [7], and since it recorded high classification accuracy, we also selected LSTM as a comparison target in this study.

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Taxonomy & Svstematics		Deep Learning	TOP-1	TOP-3	TOP-5	TOP-10
FNN+Token		0	0.575	0.766	0.830	0.911
FNN+AST		0	0.644	0.803	0.853	0.922
LSTM+Token		0	0.943	0.980	0.985	0.991
LSTM+AST		0	0.939	0.977	0.981	0.991
GCN+Token		0	0.772	0.927	0.967	0.989
GCN+AST		0	0.803	0.948	0.972	0.993
FaCoY		x	0.840	0.940	0.950	0.958
Siamese		x	0.848	0.897	0.908	0.925

Table 1 Classification accuracy of each classification method

It is assumed that it is necessary to choose between a classification method of "Top-1 is 0.943", which has the same accuracy as LSTM + Token in 1, and a classification method of "Top-10 is 1.0", which has an extremely high Top-10.The former is a method in which only 1 function tag is added to the source code, and the tag is correct with a 94.3% probability, while the latter is a method in which 10 function tags are added to the source code, and 1 correct tag is always present in the source code. Since the former "Top-1 is 0.943" method is much less likely to give wrong tags, it seems to be suitable for the purpose of facilitating reuse of existing source code by automatically giving tags. For the above reasons, it is desirable to mainly adopt a method with high Top-1 in source code classification, so from the results of this study, it was found that LSTM+Token, which has the highest accuracy of Top-1, is the best source code classification method, and LSTM+AST and GCN+AST are also relatively excellent source code classification methods.

It was also found that the classification accuracy was greatly influenced by the neural network used rather than the source code representation to be trained. The method using LSTM has high classification accuracy on average, regardless of the source code representation to be trained. The GCN method was significantly inferior to the LSTM method in Top-1, and the Top-3 and Top-5 methods were slightly inferior to the LSTM method, but the Top-10 methods were as accurate as the LSTM method, and the classification accuracy was higher on average than the FNN method. The classification accuracy of FNN was lower than that of other neural networks. Therefore, it was found that LSTM is a neural network that can realize the most accurate source code classification. Next, we consider the combination of neural network and source code representation. First, the classification accuracy of FNN+AST was higher than that of FNN+Token in the method using FNN.The cause of such a result is considered to be in Doc2Vec.Doc2Vec vectorizes documents with an unsupervised learning algorithm based on the idea of n-gram. Therefore, when training a sequence of tokens, tokens that frequently appear in the source code, such as parentheses and semicolons, become the noise of Doc2Vec training, and the generated source code vector could not express the characteristics of the source code well. On the other hand, since the depth-first search permutation of AST contains fewer elements such as nodes that can be noise of learning than token sequences, it is considered that a good source code vector representing the characteristics of the source code can be generated compared to token sequences.

Next, in the LSTM method, the classification accuracy of LSTM + Token was slightly higher. In LSTM + AST, it is necessary to convert AST to some sequence in order to train AST to LSTM, so this time we are training depth-first search permutations of AST. However, since it is not possible to completely restore the source code from the depth-first search permutation of AST, the information in the original source code is slightly missing, and the classification accuracy is considered to have decreased by that amount. On the other hand, since LSTM + Token learns the token sequence, it is possible to learn the source code as it is, except for format information such as whitespace and indentation. Also, unlike Doc2Vec, LSTM can learn the long-term dependencies of tokens. Therefore, the learning of LSTM is considered to be less affected by frequent tokens such as parentheses and semicolons. Therefore, it is considered that token columns are more compatible with LSTM than AST.

In the method using GCN, the classification accuracy of GCN+AST was higher than that of GCN+Token. Since there is no branch in the graph generated from the token sequence, we have not been able to take advantage of the neural network which can learn the graph. As with Doc2Vec, it is possible that frequent tokens are learning noise. On the other hand, since AST is a graph-like representation, it can be trained by GCN without deformation, and there are fewer nodes that can become learning noise compared to token sequences. Therefore, AST is considered to be more compatible with GCN than token sequence. From the above results, RQ's answer was "The combination of LSTM and token sequence can realize the most accurate source code classification, and the combination of GCN and AST can realize the source code classification with relatively high accuracy.

4. Comparison with classification methods that do not use deep learning:

In this paper, we compare the accuracy of the classification method using deep learning, and found that the method using LSTM is the most accurate. However, there is a possibility that high-precision source code classification can be achieved without using deep learning. To confirm this assumption, in this chapter, 3. We compare the accuracy of the source code classification method using deep learning and the source code classification method without deep learning described in 2.We also consider the advantages of using deep learning for source code classification.

4. 1. Classification method without deep learning:

In this section, we will explain the source code classification method without deep learning, which was selected as a comparison object with the method using deep learning. These methods are the latest methods that can search not only syntactically similar source code but also semantically similar source code, and the implementation is open (Note 5) (Note 6), so we selected them as a comparison target.

4.1.1 Facoy

Facoy [8] is a semantic similarity source code retrieval method that does not use deep learning. This method searches for similar source code using the developer Q&A site StackOverflow (Note 7).Specifically, Facoy first searches from StackOverflow for ns answers containing source code similar to a given piece of code, in order of high degree of similarity of the source code. In this case, the similarity of the source code is calculated by dividing the 2 source code into TF-IDF (Term Frequency) and TF-IDF (Term Frequency). - Inverse document frequency) Calculate using the cosine similarity between 2 vectors when vectorized with [26].Next, the query is a question sentence corresponding to the searched answer sentence, and the search result is output as a search result up to a total of nc number. In such a procedure, Facoy searches for source code similar to the piece of code given as input.The key idea of this method is that"source code that appears in a form corresponding to similar question sentences in a Q&A site is semantically similar", and this idea allows you to search not only syntactically similar source code to vectorize it, calculate the cosine similarity between 2 vectors, and arrange them in descending order to create a ranking of the searched source code.

There are 3 hyperparameters that affect the code search performance of Facoy: ns, nq, and nc. In this study, we compare ns= 3, nq=3, and nc=100. This setting was used in the application experiment of Facoy to Bigclonebench in literature[8].

4.1. 2 Siamese

Siamese [9] is a semantic similarity source code search method that does not use deep learning. This method uses n-gram to search for similar methods, and in the evaluation experiment using Big-Clonebench, it has been confirmed that pairs of methods that are semantically similar but have low syntactic similarity can be searched with high accuracy. In this method, the method is represented by 4 different arrays (token sequence, n-gram array, n • gram array after normalizing identifier, string, and type, and n • gram array after normalizing non-parentheses and semicolons). Next, the score θ (0-100%) is calculated considering the frequency of occurrence of tokens and n-grams for each expression method in the set of search target method and input method. Finally, a set of methods whose score θ is higher than the threshold value T is output as a similar method.

4. 2 Comparison method

In this paper, we apply semantic similarity source code search method without using deep learning to source code classification.3. The accuracy is compared with the 6 source code classification methods used in this paper. The benchmarks and evaluation scales to be used are 3. This is similar to a comparative survey of the study.



Figure 4: How to create a ranking using semantic Similarity source code Search method

In the 2 semantic similarity source code search methods selected in this study, the source code of the search query and the source code output as a search result are semantically similar. Also, 2. In the definition of source code classification described in Section 1, semantically similar source code is classified into the same class. Therefore, in this study, the source code of a search query is considered to be classified into the class to which the source code of the search result belongs, and the semantic similarity source code search method is applied to the source code classification. In addition, the source code of the search results is ranked in order of similarity with the search query. In this study, we replace the source code of the search results in the ranking with the class to which the source code belongs, and based on the ranking output by the semantic similarity source code search method, Create a ranking to calculate the Top-k described in 3.

4. 3 Comparison results and examination

Table 1 shows the classification accuracy of the classification method using deep learning and the classification method without it. The bottom 2 lines of this table show a source code classification method that does not use deep learning. In this table, the highest number in Top-k is expressed in bold. As can be seen from Table 1, the accuracy of the LSTM method in all of the Top-1, Top-3, Top-5, and Top-10 methods surpassed that of the classification method without deep learning. The source code classification accuracy of the LSTM method was higher than that of the method without deep learning. The order relationship between tokens and AST nodes, which are information that can be learned by LSTM, and their long-term

© 2021 IJCRT | Volume 9, Issue 6 June 2021 | ISSN: 2320-2882

dependencies, may have been important for classifying the source code of Bigclonebench. However, in a method that does not use deep learning, it is possible to classify the relationships and long-term dependencies of tokens and nodes.

It is difficult to do this. Since Siamese uses n-gram; it can capture short-term dependencies of tokens, but not long-term dependencies. Therefore, the classification accuracy is considered to have decreased. Facoy also uses questions and answers on the Q&A site to capture source code similarities. There are certain similarities in the source code contained in similar answers, but the classification accuracy may have been reduced because this similarity was different from the similarity required to classify bigclonebench source code. As described above, it was found that the classification method using LSTM can perform the source code classification with higher accuracy than the existing method without using deep learning selected in this study.

5. Threat of validity:

These 4 points can be cited as a threat to the validity of the study. The first is that there are few types of neural networks set for comparison.

1 In this study, 3 widely used neural networks were investigated. However, various other neural networks that can be applied to source code classification are considered, so it is necessary to examine them in the future.

2nd, since 1 benchmark was used in the accuracy comparison survey of the source code classification method, it may be strongly dependent on the benchmark used in the survey results. However, the bigclonebench used in this study is a very large-scale benchmark created by developers manually checking about 6 million methods, and contains source code for various software. Therefore, it is thought that it is possible to perform general evaluation of source code classification by using Bigclonebench. In the future, it is necessary to carry out comparative research using other benchmarks to investigate whether the trend similar to this study can be obtained.

The 3rd point is that the results of this study can vary depending on various factors. Hyperparameters such as the number of hidden layers and the number of nodes, activation functions, loss functions, optimization algorithms, and data set segmentation methods are among the factors that influence the learning results of neural networks. Also, The method of preprocessing to input the source code into the neural network is also considered to be a factor affecting the result. Techniques using FNN.

The 4th point is that the machine learning method may have better classification accuracy than LSTM because it has not been compared with machine learning methods such as support vector machine (SVM) and random forest (RF). In this regard, since the source code classification accuracy of source code classification methods using deep learning and machine learning methods has already been compared in the existing research [6] and [7], we did not make a new comparison in this research, and compared with FaCoY and Siamese, which are the latest methods that can search for semantic similarity source code without machine learning. However, the data set used in the existing research [6] and [7] is not Bigclonebench. In addition, only SVMs were selected for comparison. Therefore, if we conduct experiments in this study, it is possible that machine learning methods such as SVM and RF will have better classification accuracy, so it is necessary to investigate in the future.

6. Related research:

In recent years, research on analyzing source code using deep learning has been published. First, we proposed a method to search for similar code blocks using FNN in the past. [15]In this study, we compare the accuracy of FNN-based source code search using BoW and Doc2Vec 2 source code vectorization methods, and show the high accuracy of Bow. However, because BIGCLONEBENCH is a data set with a very large number of source code, when using BoW in this study, the vector generated by BoW has a huge number of dimensions, and it takes a very long time to learn. Therefore, Doc2Vec was adopted in this study. Saini et al. [13] and Nafi et al. [14] also use source code metrics to determine the source code Vectorization is performed, and similar source code detection is performed using FNN.Saini et al. [13] compared the accuracy of the proposed method using FNN with the existing method without deep learning, and showed that the proposed method has excellent detection accuracy of similar source code.Nafi et al. [14] compared the method for calculating cosine similarity of generated vectors with the method using FNN, and show that the method using FNN is more accurate in detecting similarity source code. In this study, we compared the accuracy with existing methods that do not use deep learning, such as those of Saini et al. [13] and Nafi et al. [14], and compared the accuracy of methods that use neural networks.

7. Summary and Future issues:

In this study, we compared the source code classification accuracy using Bigclonebench as a benchmark and Top-k as an evaluation scale. In order to investigate the combination of neural network and source code representation which can realize high-precision source code classification, 6 kinds of methods using deep learning were applied to source code classification, and the source code classification accuracy was compared using Bigclonebench as a benchmark and Top-k as an evaluation scale. As a result, the method of learning token sequence in LSTM can realize the most accurate source code classification, and the method of learning depth-priority search permutation of AST in LSTM and the method of learning AST in GCN can realize the relatively accurate source code classification. On the other hand, the classification accuracy of the FNN method was not very high. In addition, the source code classification accuracy of the method of deep learning and the method without deep learning is compared. As a result, it was found that the method of deep learning which learns the structure information of the source code using LSTM can realize the source code classification with higher accuracy than the method which does not use the deep learning selected in this study.

The following points can be cited as future issues:

It is necessary to investigate the classification accuracy for neural networks and source code expressions other than those used. In addition, it is necessary to investigate the classification accuracy for machine learning methods such as SVM and RF.* Since the source code classification benchmark is only Big-Clonebench, it is necessary to compare using other benchmarks and investigate whether similar trends can be obtained.* It is necessary to investigate the classification accuracy when parameter setting and pretreatment method which were not investigated in this study were adopted.

References

[1]R. Hoffmann, J. Fogarty, and D.S. Weld, "Assieme: Finding and leveraging implicit references in a websearch interface for programmers," Proc. UIST 2007, pp.13–22, Newport, Rhode Island, USA, Oct. 2007.DOI:10.1145/1294211.1294216

[2]K.T. Stolee, S. Elbaum, and D. Dobos, "Solving thesearch for source code," ACM Trans. Softw. Eng.Methodol, vol.23, no.3, pp.26:1-26:45, June 2014.DOI:10.1145/2581377

[3]G. Kavita and F. Romano, "C# or java? type-script or javascript? machine learning based classi-fication of programming languages," GitHub, https://github.co/2Jif7Sg, accessed Nov. 2020

[4]R. Yokomori, N. Yoshida, M. Noro, and K. In-oue, "Use-relationship based classification for soft-ware components," Proc. QuASoQ 2018, pp.59-66, Nara, Japan, Dec. 2018.

[5]S. Kawaguchi, P.K. Garg, M. Matsushita, andK. Inoue, "Mudablue: An automatic catego-rization system for open source repositories," J.Syst. Softw., vol.79, no.7, pp.939-953, 2006.DOI:10.1016/j.jss.2005.06.044

[6]L. Mou, G. Li, L. Zhang, T. Wang, and Z. Jin,"Convolutional neural networks over tree structures for programming language processing," Proc. AAAI2016, pp.1287–1293, Phoenix, Arizona, USA, Feb.2016. DOI:10.5555/3015812.3016002

[7]J. Zhang, X. Wang, H. Zhang, H. Sun, K. Wang, and X. Liu, "A novel neural source code represen-tation based on abstrace syntax tree," Proc. ICSE2019, pp.783-794, Montréal, QC, Canada, May 2019.DOI:10.1109/ICSE.2019.00086

[8]K. Kim, D. Kim, T.F. Bissyandé, E. Choi, L.Li, J. Klein, and Y.L. Traon, "FaCoY: A code-to-code search engine," Proc. ICSE 2018, pp.946-957, Gothenburg, Sweden, 2018. DOI:10.1145/3180155.3180187

[9]C. Ragkhitwetsagul and J. Krinke, "Siamese: scal-able and incremental code clone search via multi-ple code representations," Empir. Softw. Eng. J., pp.2236-2284, Aug. 2019. DOI:10.1007/s10664-019-09697-7

[10]L. Deng and D. Yu, "Deep learning: Meth-ods and applications," Found. Trends SignalProcess., vol.7, no.3-4, p.197-387, jun 2014.DOI:10.1561/200000039

[11]G. Cybenko, "Approximation by superpositions of a sigmoidal function," Math. Control Sig-nals Systems, vol.2, pp.303– 314, Dec. 1989.DOI:10.1007/BF02551274

[12]J. Schmidhuber, "Deep learning in neural networks: An overview," Neural Networks, vol.61, pp.85–117,2015. DOI:10.1016/j.neunet.2014.09.003

[13]V. Saini, F. Farmahinifarahani, Y. Lu, P. Baldi, and C.V. Lopes, "Oreo: Detection of clones in the twilight zone," Proc. ESEC/FSE 2018, pp.354–365, Lake Buena Vista, FL, USA, Oct. 2018.DOI:10.1145/3236024.3236026

[14]K.W. Nafi, T.S. Kar, B. Roy, C.K. Roy, and K.A.Schneider, "Clcdsa: Cross language code clone de-tection using syntactical features and api documen-tation," Proc. ASE 2019, pp.1026-1037, San Diego, CA, USA, Nov. 2019. DOI:10.1109/ASE.2019.00099

[15] Hiroji Fujiwara, Onryo Choi, Norihiro Yoshida, Katsuo Inoue,"An Attempt to Search for Similar Code Blocks using

Sequential Propagation Neural Networks,"Software Engineering Symposium 2018 Proceedings, pp.24–33, Tokyo,

Japan, Aug. 2018.

[16]S. Zhou, H. Zhong, and B. Shen, "Slampa: Rec-ommending code snippets with statistical languagemodel," Proc. APSEC 2018, pp.79–88, Nara, Japan, Dec. 2018. DOI:10.1109/APSEC.2018.00022

[17]M. White, M. Tufano, C. Vendome, and D. Poshy-vanyk, "Deep learning code fragments for code clonedetection," Proc. ASE 2016, pp.87–98, Singapore, Singapore, Sept. 2016. DOI:10.1145/2970276.2970326

[18]S. Hochreiter and J. Schmidhuber, "Long short-termmemory," Neural Computation, vol.9, no.8, pp.1735–1780, 1997. DOI:10.1162/neco.1997.9.8.1735

[19]M. Schlichtkrull, T.N. Kipf, P. Bloem, R. VanDen Berg, I. Titov, and M. Welling, "Modeling re-lational data with graph convolutional networks,"Proc. ESWC 2018, pp.593-607, Heraklion, Crete, Greece, June 2018. DOI:10.1007/978-3-319-93417-4 38

[20]W. Hua, Y. Sui, Y. Wan, G. Liu, and G. Xu, "Fcca:Hybrid code representation for functional clone de-tection using attention networks," IEEE Trans. Reli-ability, pp.1-15, 2020. DOI:10.1109/TR.2020.3001918

[21]Y. Li, D. Tarlow, M. Brockschmidt, and R.S. Zemel, "Gated graph sequence neural networks," Proc. ICLR2016 Poster Presentations, San Juan, Puerto Rico, May 2016. http://arxiv.org/abs/1511.05493

[22]J. Svajlenko, J.F. Islam, I. Keivanloo, C.K. Roy, and M.M. Mia, "Towards a big data curated bench-mark of inter-project code clones," Proc. ICSME2014, pp.476-480, Victoria, BC, Canada, Sept. 2014.DOI:10.1109/ICSME.2014.77

[23]O. Melamud, D. McClosky, S. Patwardhan, and M. Bansal, "The role of context types and di-mensionality in learning word embeddings," Proc.NAACL 2016, pp.1030–1040, Association for Com-putational Linguistics, San Diego, California, June2016. DOI:10.18653/v1/N16-1118

[24]O. Le and T. Mikolov, "Distributed representa-tions of sentences and documents," Proc. ICML2014, pp.II-1188-II-1196, Beijing, China, June 2014.DOI:10.5555/3044805.3045025

[25]T. Mikolov, I. Sutskever, K. Chen, G.S. Corrado, and J. Dean, "Distributed representations of wordsand phrases and their compositionality," Proc. NIPS2013, pp.3111-3119, Gardnerville, Douglas, Nevada, USA, Dec. 2013.

[26]G. Salton and M.J. McGill, Introduction to Mod-ern Information Retrieval, McGraw-Hill, Inc., USA, 1986.

[27]D. Tang, B. Qin, and T. Liu, "Document modelingwith gated recurrent neural network for sentimentclassification," Proc. EMNLP 2015, pp.1422–1432, Lisbon, Portugal, Sept. 2015. DOI:10.18653/v1/D15-1167

Spoof Detection Using Local Binary Pattern In Face

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Abstract

Spoofing attack is an attempt to acquire some other's identity or access right by using a biometric evidence of authorized user. Among all biometric systems facial identity is one of the widely used method that is prone to such spoofing attacks using a simple photograph of the user.

The paper focuses and takes the problem area of face spoofing attacks into account by detecting spoof faces and real faces. We are using the local binary pattern (LBP) for providing the solution of spoofing problem and with the help of these patterns we inspect primarily two types of attacks i.e. printed photograph and photos displayed using digital screen. For this, we will use the local database maintained by us having the images labeled as real and spoof for the data required.

We conclude that local binary pattern will reduce the total error rate and will show the moderate output when used across a wide set of attack types. This will enhance the efficiency of the system for detection of spoofing by using the deep learning techniques.

Keywords : Spoofing , Local Binary Pattern, CASIA, NUAA, Hyperplane, Support Vector machine

1. Introduction

Spoofing attack is a way of cyber attack in which a person tries to override the biometric authentication of a valid user by presenting a counterfeit biometric evidence .In this attack attacker does not need any knowledge about the algorithm used in the biometric system .The biometric based verification systems are mostly not resistant to spoofing attack due to the reason of their designing as they are designed only to recognize identities without checking their liveliness. Instead some authentication systems which are using biometric authentication are also not able to implement the anti spoofing scheme in a very sophisticated way.

Attacking on biometric system in different possible ways will require different level of difficulty for the attacker to create a spoof identity. In biometric systems like fingerprint recognition and iris recognition we require the artificial spoof evidence that can counterfeit the real identity and this requires a great expertise but the generation of fake evidence in face spoofing attack is easy and can be done by using a simple photograph of valid user . The biometric evidences can be easily by passed by either using these images or using a pre- recorded video.

As this kind of attack came into knowledge of the biometric community, various geeks provided their pay to check the liveliness of the person by adding various sensors to the biometric system. These systems detect the liveliness of person by asking user to perform some tasks or make a particular kind of gesture. But all

these sensors are external hardware that are required to perform this detection hence making a completely automated detection system is cheaper way as compared to these systems.

This approach we have opted in this is to find the Local Binary Patterns (LBP) in the given image data and extract the feature from that LBP image by creating the histogram from the LBP data. These histogram will be used to perform the training of the model to predict the real spoof facial evidence.

2. Existing anti spoofing methods and techniques

For the implementation of anti spoofing there are various techniques and methods used. These methods follow the three basic ways to perform the spoofing detection: The first one is by assessing the texture of the subject image captured by the sensor of the system as it checks the complete texture of image to find the variation between real and spoof image. The second one is by detecting the liveliness of the environment during the capturing of image which checks the scene if it is live or pre- recorded video clip. The third one is a combination in which we use the texture based technique and the liveliness based detection together. Taking the first approach into account the spoof detection method using feature texture of the image was made when this was mentioned in a paper that the text of real image and spoof image varies on the basis of frequency distribution. As in capturing of any image the two main process comes in account are Illumination and reflectance so the frequency distribution of any image shows various difference between the real once captured scene on the basis of their frequency distribution . So the previous work is done by using this frequency distribution and training the classifier by this frequency distribution the image. These classifiers further give their prediction for the data.

3. Methodology and Experiments

The paper here presents the anti-spoofing method using the described same concept of texture analysis of the live captured frames/images. In this method we will primarily use three concept that will be required for the whole method to be implemented. As in this method we are using the Local Binary Patterns (LBP) to train the algorithm I.e. SVM. We will brief the information about the LBP, SVM and the dataset we will be using for the implementation of this method.

3.1 Local Binary Pattern (LBP)

LBP is a pattern which is extracted from the image by processing its pixel in a specific logic format so that they change their value to binary values I.e. 0 & 1. LBP method provides the labeling of the pixels by finding the difference of neighborhood of each pixel and outputs that image area as the binary number. Because of its high discrimination power and an ease and simplicity in computation, This operator has got a better popularity in its approach to be used in various applications. It has become a very unique approach for textual analysis other than the traditionally used textual analysis approach. The one of the most important property or feature of LBP is that it shows its robust behaviour for the unicolor/bicolor in grey scale images.

For example, by the intensity difference in illumination .



The LBP algorithm we are applying here requires a total of four tunable parameters:

- 1. **Radius**: It is used to handle and create the round/circular LBP and decides to represent the radius of that around the centered selected pixel. The default and most probable value is taken as 1.
- 2. **Neighbors**: The total number of points that are considered to build the rounded local binary pattern are termed as number of neighbors. The increase in neighbor count will increase the computational cost hence to reduce the cost we use less neighbor sample. The default value is taken as 8.
- 3. **X-Set**: The number of blocks in the horizontal side I.e. x-axis. The more cells we will use, the better and finer the grid will become and the dimensions of the resulting feature vector will inhance and be raised. The default value is taken as 8.
- 4. Y-Set: The number of blocks in the vertical side I.e. y-axis. The more cells we will use, the better and finer the grid will become and the dimensions of the resulting feature vector will enhance and will be raised. The default value is taken as 8.

The logic and mathematics to form the Lbp image from original uses the radius and pixel to be considered as input to then get the metrics of image according to the given inputs. This is then calculated as per the logic

LBP(p,r) = sigma-in range p=0 to p-1(gp-gc)Taking the base threshold as 2^p

ex	am	ple	1	thre	nresholded			weights				convolved			
10	25	8		0	1	0		1	2	4		0	2	0	
12	15	17	-	0		1	*	128		8	=	0		8	
9	2	15		0	0	1		64	32	16		0	0	16	
LBP = 2 + 8 + 16 = 26															

C = (25+17+15)/3 - (10+8+12+9+2)/5 = -22

3.2 Extracting the histogram

The histogram is prepared on the basis of frequency distribution of lbp image formed from the actual image. This is done after the image is converted to LBP format and hence this is done in mainly two ways: By taking the frequency of the pixel value and plotting on a histogram or by taking the probability of the frequency of pixel value. In this paper we are using the first way to form the histogram which will be required as input data to feed the algorithm. This histogram will be made by using the pixel data provided after the image is converted to lbp.


LBP Program is finished

Now this LBP histogram will be used as an input feed for the algorithm and this histogram shows variation in frequency distribution of real image and recaptured image on the basis of reflectance.

3.3 Algorithm Used: Support Vector Machine (SVM)

The support vector machine algorithm helps to find a specific plane in an N-dimensional space that classifies the different data points in a distinct way. The N-Dimensional space refers to space having N features. To separate the two classes we have various planes available in the same feature set . The main objective of this algorithm is to find a specific plane that could provide the maximum possible margin between these data points, i.e. the distance between data points of the two different classes must be maximum. Maximizing this margin distance between two different classes data points creates reinforcement so that the next points that are to be tested gets more accuracy as per the last updated details.

3.4 Hyperplane

Hyperplanes are the virtual boundaries made across the data points to classify their classes. These data points are provided to their specific classes as per their belonging to either side of the plane. As the planes are completely dependent upon the features provided hence the dimension is dependent upon the features . Lets assume that there are two features then we can consider a line as the hyperplane. In similar way if there are a total of three features then the hyperplane will be a plane. If we think of features more than the three then it will be a difficult task to decide the hyperplane of it.



3.5 Support Vectors

The support vectors are the data points that are much nearby to the actual hyperplane and they provide the support to the hyperplane and adjust the position of hyperplane as per the accuracy. These support vectors are used to maximize the margin between the data points that is used in the classifier. If we will remove the support vectors the location of hyperplane will be automatically adjusted and that too with a bad accuracy and less margin. These support vector and hyperplane points help us in building our SVM as only a single linear vector i.e hyperplane can't maximize the margin and hence these support vectors provide a support to our linear decision boundary to maximize the margin.



4. Training and Accuracy

The SVM is trained using the data that is provided as input feed in form of histogram. This data is input by the histogram associated with its label. The training and testing/validation will require a huge dataset as SVM requires a huge data for better accuracy. The data here will be feed in a specific format and after the training of algorithm the validation will be done using some other data to check its response to new or fresh data. This is done to check the EER% which can lead to a better and much accurate algorithm to be used.

LBP ^{u2} _{3>}	$x_{3} + \chi^{2}$	$LBP_{3\times}^{u2}$	3 + LDA	$LBP_{3\times}^{u2}$	3 + SVM	LBP [7] + SVM
dev	test	dev	test	dev	test	dev	test
31.24	34.01	19.60	17.17	14.84	15.16	13.90	13.87

This EER% clearly shows that the error rate is less if we use the SVM with the huge input data for feed and this can enhance the accuracy rate as well. The SVM used in this method is tested as per other algorithms and the comparison between the accuracy of dataset used is mentioned. These error rate and accuracy details are claimed in referred journal by author using the same classifier and databases. The accuracy of model/classifier varies as we switch from NUAA database to CASIA database. This accuracy is enhanced when SVM is used with the CASIA database and the outputs vary in a better way.

	N	UAA	CASIA-FASD		
	Dev	Test	Dev		
			Test		
$LBP^{u_{3X3}} + LDA$	0.06	18.32	17.08		
			21.01		
$LBP^{u_{3X3}} + SVM$	0.11	19.03	16.00		
			18.17		
LBP[7] + SVM *	0.11	13.17	15.43		
			18.21		

5. Database

As we know that any algorithm can work efficiently and with a good accuracy when is given a huge amount of data as input feed. Hence here we require a lot of data for the training and validation of the algorithm i.e. SVM. The data here is set of images having two classes that are: Real images that are taken live and can be considered as once captured images and the second class consist of images that are spoof and can be considered as fake/recaptured images.

5.1 NUAA

The database used in some traditional methods was NUAA and it consist of 15 subjects in the dataset, every one of them consist of real face of the subject, and photograph of them. Real face is taken from webcam with natural expression and frontally face the camera, there is no movement such as eye blink, this is used to make the real face similar like the photograph.



Each column from the different section 1, section 2 and section 3. In each row, the left side image set are from a real human face and the right side image set from a photo. This dataset consist of various types of changes in the images of different subjects and these changes are like their gender variation, the intensity of light, use of spectacles etc. All the images in the dataset are of same resolution of 640 x 480 pixels.

Subject ID	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Live Human			- 30			1.000			- 9025						
Session1	1	1	1	1	1	1	1	1	1						
Session2	1			1	1	1	1		1						
Session3				1		1	1			~	1	1	1	~	1
Photograph	8														
Session1	1	1	1	1	1	1	1	1	1						
Session2	1	1	1	1	1	1	1	1	1						
Session3	1	1	1	1	1	1	1	1	1	~	1	~	1	~	1

5.2 CASIA

CASIA Face Image Database Version 5.0 (or CASIA-FaceV5) is the latest updated CASIA dataset for faces and it consists of a total of 2,500 colored facial images of 500 different subjects(persons). The images of faces in this dataset are captured in a single session using the specific Logitech USB camera. The subjects in this dataset are not professional research scholars but they are normal people like graduate students, workers, waiters etc . The images provided in this dataset consist of similar features as they all have the same format of BMP extension and they are 16 bit color images. The resolution of these images is 640*480. There are also some of the differences found in the images of this dataset and this is like intensity of light variation, the posture of person, the expression shown by subject, the distance etc.



The images of the dataset of CASIA are stored in a specific format and it provides the whole data into subsets and if we wish to download the cropped images we can get them within 150 MB and the downloaded data is also in specified format.

The actual dataset has a more detailed and complete images without cropped and this dataset is available in more than two forms , one of which is so small in size for the testing purpose of for the demo and the second one is cropped images and the real ones as well. These images differ in various aspects like size , quality etc.

This data is more relevant and appropriate that provides a better accuracy in prediction and this paper uses the CASIA dataset for a better quantity and quality of data.

6. CONCLUSION

This paper provides a way to study the approach to face anti-spoofing method using the CASIA database available for face biometric research and SVM classifier to work on that data. In here we have used the training images in LBP format which then is transformed to histogram having the frequency distribution for feeding the algorithm. The algorithm provides a better efficiency and a reduced error rate with efficient approach. In this we have used only the prediction for images and frames but it can be enhanced by using the video content in account for the training purpose as it will check the liveliness in a better way and the error rate can be further reduced and accuracy can be enhanced.

7. Acknowledgement

We would like to thank our deep sense of gratitude to college , that provided us an opportunity to write a paper . We are very thankful to the Management and the Director of the Institute for the help they provided us during the writing the content of this paper .We would also like to give special thanks to our HOD's of CSE & IT & MCA Dept. and collogues of the college for their true encouragement and guidance in the completion of the paper.

References:

- [1] Portions of the research in this paper use the CASIA-FaceV5 collected by the Chinese Academy of Sciences' Institute of Automation (CASIA) Images for Data set are referred from "CASIA-FaceV5, <u>http://biometrics.idealtest.org/</u>"
- [2] P. V. Reddy, A. Kumar, S. Rahman, and T. S. Mundra, "A new anti spoofing approach for biometric devices," Biomedical Circuits and Systems, IEEE Transactions on, vol. 2, no. 4, pp. 328–s337, 2008.
- [3] S. Parveen, S. Ahmad, S. Mumtazah, M. Hanafi, W. Adnan, and W. Azizun, "Face anti-spoofing methods." Current Science (00113891), vol. 108, no. 8, 2015.
- [4] Z. Zhang, J. Yan, S. Liu, Z. Lei, D. Yi, and S. Z. Li, "A face anti spoofing database with diverse attacks," in Biometrics (ICB), 2012 5th IAPR International Conference on. IEEE, 2012, pp. 26–31.
- [5] J. Galbally and S. Marcel, "Face anti-spoofing based on general image quality assessment," in Pattern Recognition (ICPR), 2014 22nd International Conference on. IEEE, 2014, pp. 1173–1178.

- [6] T. de Freitas Pereira, J. Komulainen, A. Anjos, J. M. De Martino, A. Hadid, M. Pietikäinen, and S. Marcel, "Face liveness detection using dynamic texture," EURASIP Journal on Image and Video Processing, vol. 2014, no. 1, p. 2, 2014.
- [7] J. Komulainen, A. Hadid, and M. Pietikainen, "Context based face anti-spoofing," in Biometrics: Theory, Applications and Systems (BTAS),2013 IEEE Sixth International Conference on. IEEE, 2013, pp. 1–8.
- [8] K. Patel, H. Han, and A. K. Jain, "Cross-database face anti spoofing with robust feature representation," in Proc. Chin. Conf. Biometric Recognit . Cham, Switzerland: Springer, 2016, pp. 611–619
- [9] Z. Wang, C. Zhao, Y. Qin, Q. Zhou, G. Qi, J. Wan, and Z. Lei, "Exploiting temporal and depth information for multi-frame face anti-spoofing," 2018,arXiv:1811.05118. [Online]. Available: <u>https://arxiv.org/abs/1811.05118</u>
- [10] Gang Pan, Zhaohui Wu and Lin Sun, Liveness Detection for Face Recognition, Recent Advances in Face Recognition, I-Tech, on Page(s): 236, December, 2008
- [11] R. Duda, P. Hart, and D. Stork, Pattern Classification, 2nd ed. John Wiley & Sons, New York, 2001.
- [12] D. Wen, H. Han, and A. K. Jain, "Face spoof detection with image distortion analysis," Information Forensics and Security, IEEE Trans-actions on, vol. 10, no. 4, pp. 746–761, 2015.
- [13] C.-C. Chang and C.-J. Lin, "LIBSVM: A library for support vector machines," ACM Transactions on Intelligent Systems and Technology, vol. 2, pp. 27:1–27:27, 2011, software available at http://www.csie.ntu.edu.tw/ ~ cjlin/libsvm.
- [14] K. Kollreider, H. Fronthaler, and J. Bigun, Non-intrusive liveness detection by face images, Image and Vision Computing, vol. 27(3), pp. 233-244, 2009. Scholarpedia :

Ganga River Water quality assessment Pre and Post COVID-19 lockdown in Kanpur : A Review

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Palladium Metal Complexes as Platforms for Anti Tumor Therapy

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ABSTRACT:

The often severe side effects displayed by currently used platinum and ruthenium complexes have motivated researchers to design and develop Palladium metal complexes as anti-tumor agents with reduced toxicity. Distinct from organic anti-tumour drugs, Palladium metal complexes possess several properties that render them as promising scaffolds for anti-cancer drug discovery. While a vast number of metal complexes have been synthesized and reported to be promising and potent *in vitro* anticancer active compounds, fewer have shown efficacy in *in vivo* models. The demonstration of *in vivo* potency is an essential step for lead candidates for clinical trials. In this review, we highlight examples of Palladium metal complexes that have shown *in vivo* antitumor activities that have been described in recent years.

Keywords: Palladium metal, Anti-tumor, Cancer

I-Introduction: The identification and characterization of the powerful anti-tumor agent cisplatin and its derivates established a milestone in the history of inorganic medicinal chemistry development [1,2]. However, drug-resistance from long-term treatment and non-specific toxicity are drawbacks of current platinum anticancer drugs [3,4]. This has stimulated the development of alternative transition metal-based anti-tumor therapeutic agents in recent years. Two ruthenium derivates, imidazolium trans-DMSO-imidazoletetrachlororuthenate (NAMI-A) (complex 1) and imidazolium trans-[tetra-chlorobis(1H-indazole)ruthenate(III)] (KP-1019) (complex 2) (Fig. 1) are anti-metastatic and anti-neoplastic compounds that have been tested in clinical trials [5,6]. A sodium analogue of KP1019, NKP-1339 (complex 3), is set to enter clinical trials [7], while the anti-proliferative agent titanocene dichloride (complex 4) (Fig. 1) was tested in Phase I/II trials [8]. Other transition metal-based complexes with anti-tumor activities include redox-mediating mono(thiosemicarbazone) copper complexes [9-11], the gold(I) complex auranofin, which acts via inhibiting DNA, RNA and protein synthesis ,and osmium(II) arene complexes that target mitochondria and induce cell apoptosis [13]. Transition metal complexes possess attractive properties that make them as potential alternatives to organic compounds for anti-tumor agents. Firstly, transition metals can adopt various geometries based on the number of coordination bonds they possess, such as octahedral, square-planar, square-pyramidal and trigonalbipyramidal, while purely organic molecules are limited to tetrahedral, planar, or linear geometries. This also has the effect of increasing the structural diversity of metal compounds, for example, an octahedral metal complex bonds with 6 different ligands can form up to 30 different stereoisomeric configurations, whereas a tetrahedral carbon atom with 4 different substituents can produce only one pair of enantiomers.[15] This can enhance flexibility in drug design allowing metal compounds to effectively interact with the binding sites of target biomolecules.[40] Secondly, auxiliary ligands can induce significantly trans effects on metal-carbon bonds that can change the reactivity of other ligands in the complex. This can allow the thermodynamic and kinetic properties of the overall complex to be finely tuned, as demonstrated by research into "halfsandwich" ruthenium complexes by the groups of Sheldrick and Sadler .[32] Thirdly, metal ions can co-ordinate ligands that themselves are biologically active, such as the cytotoxic polypyridyl ligands (pp) that act as DNA intercalators.[34] Lastly, the preparation of metal complexes is highly modular and usually can be done in fewer steps, while organic compounds synthesis can be lengthy and involve multiple protecting group manipulations .[16] Today, a tremendous amount of biological evidence is shown that Palladium complexes are used as a platform for anti tumor activities.[35]

II-Synthesis: The literature survey uncovered mainly two general procedures describing the synthesis of the classical and primary synthetic route to uracil from Formalaceticacid (made in situ from malic acid) and urea in sulphuric acid is still important[17]. Some alternative syntheses use malic acid, urea, and PPA(2) or maleic/ fumaric acid, urea, and poly phosphonic acid (PPA) (2).The reaction of formyl acetate with thiourea is convenient for the synthesis of 2-thio uracil. Another main synthesis involves the reaction of ureas with β -keto esters diketene or acid anhydride [18]. Orotic acids are synthesized from oxaloacetate and ureas in the presence of hydrogen chloride via ring transformation of hydantoin into the uracil ring system. Treatment of the easily

obtainable 2-thio uracil with chloro acetic acid followed by acid hydrolysis or by oxidation with dimethyl sulphoxide (DMSO) in conc. Sulphuric acid[19] are alternative pathways .1,3- dimethyl uracil is transformed with urea in ethanolic sodium ethoxide in to uracil. Some more recent uracil syntheses start with propanoic acid and urea in PPA (or conc. sulfuric acid and benzene as solvent. [20]A broad choices of hetrocondensed uracils are easily and generally accessible from heterocyclic β- enamino esters and isocynates.[25].the mixed urea intermediate is smoothly cyclized with 5% aq.NaOH; the whole procedure cab be carried out in a one step reaction, when pyridine serves as solvent and base catalyst for the ring closure.[21] The condensation of urea with protected β -keto esters gives 6- or (di)substituted uracils [26]by means of retro Diels Alder splitting, nonbornene condensed tricyclic dihydrouracils, accessible from aminononbornene carboxylic acid and 1,1 carbonyl di imidazole, afford upon heating uracils [27] in good yield Substituted uracils are obtained from imido esters, isocyanates, and malononitrile. Similarly N-substituted N-cyanoacetyl ureas cyclize in an alkaline medium. Hetrocondensed uracils are easily accessible from acyl lactones, lactums, and thio lactones [28], and heterocyclic β -enamino esters, especially. The later gives a broad range of novel types of condensed systems. With the aid of the hexamethyldisilazane trimethylchlorosilane [24] (HMDS/TMSCI) technique or the use of NaOH and halo sugars, respectively, simple approaches have been developed to obtain unusual nucleosides[27].

Preparation of [Pd (5 – methyl Uracil)₂ Cl₂]:

A mixture of $PdCl_2$ (500mg) and ligand 5-Methyl Uracil (1gm) in water and methanol (50ml) was refluxed at $80^{0}C$ 6-7 hours until it become a clear yellowish colour solution .This volume was reduced to 5ml and treated with methanol . The resulting gray white crystals were collected and washed well with ethanol and acetone . The analytical data is given in the table –I.

The General reaction for the preparation of coordination compound of palladium is as follows:

 $[Pd(Cl)_2] + 2L \qquad \begin{array}{c} CH_3OH \\ \hline H_2O \end{array} \qquad \begin{array}{c} F d(L_2)(Cl)_2] \end{array}$

Where L = 5-Fluoro Uracil and 5-Methyl Uracil



Predicted dimer forms of 5-aminouracil at the theoretical level a. Uracil dimer. B.5-Methyl uracil dimer.

III.Spectroscopic analysis:

Carbon , hydrogen, nitrogen and oxygen present in the investigated complex were estimated micro analytically. For the estimation of Palladium as Palladium 1, 2, 3 benzotriazole, the synthesized compound solution were mixed with 10ml of 2M. acetic acid- sodium acetate buffer and 5ml of 4% EDTA solution.[29]Then 2.5 % acetic acid, was added with shaking . Digest the solution between 60° C-90°C, are 20 minutes. The resulting precipitate was filtered (G 3), washed several times with very dilute HCl (1:100), finally with distilled water and dried to a constant weight at 110° C.[31]Molecular weight determination of the synthesized complex was made by Rast's method.Magnetic susceptibility measurement were made at room temperature by Gouy method. [38]A magnetic field strength of 8500 gauss was employed. The apparatus was calibrated using cobalt mercury thiocyanate Hg [Co(NCS)₄]. The diamagnetic corrections were computed using Pascal's constant. For calculation of effective magnetic moments, following equation has been used[30].

Effective magnetic moments (μeff) = 2.84 ($x_m^{corr} \cdot T$)^{1/2}

Where T = temperature in absolute scale, and $x_m^{corr} =$ corrected molar susceptibility Conductance's was measured in analytical grade Methanol using dip type cell with the help of a Philips Conductivity Bridge.

Infrared spectra (4000-600cm⁻¹) of the uncoordinated ligands and the synthesized complex was recorded in nujol mulls supported between sodium chloride platex(rock salt region) on Perkin Elmer Spectrum(RXI) spectrometer.

¹**H** NMR spectra of the synthesized compound will be recorded on AC 300F spectrometer (300MHz) using TMS as an internal standard.

Electron spin resonance spectra of the complex was recorded at room temperature on a VariumE-3 spectrometer using powdered sample at the microware frequency 9.53GHz. The 'g' values were calculated using the given equation.

$$G = \frac{714.44 \text{ X } \sqrt{(\text{GHz})}}{\text{H(G)}}$$

Where $\sqrt{(GHz)}$ = microwave frequency in GHz at which sample operated , and H(G) = field in Gauss for the sample.

The analytical and physical data of the ligand and its metal complex are given in table I. The complexes are non hygroscopic and stable at room temperature. The solubility of complex are given .They are soluble in DMF and DMSO, slightly soluble in acetonitrile and insoluble in other organic solvent.

Conclusion:

We herein describe the chemistry of 5-aminouracil derivatives including either their synthetic methodologies or their potent biological activity. It is worth mentioning that this class of heterocycles has received considerable interest.

The magnetic values of the synthesized complex measured at room temperature. The magnetic moment values of all the complex are zero. Hence, they are diamagnetic. The square planar geometry of the complex is evident from their diamagnetic nature.

The Analytical and physical data of the ligand and its metal complex are given in table I.

Table -I

Compound	% Pd Found (Calc.)	% C Found (Calc.)	% H Found (Calc.)	% N Found (Calc.)	% Cl Found (Calc.)	% F Found (Calc.)
[Pd(5-fluoroUracil) ₂ Cl ₂]	24.79	27.93	2.79	13.03	16.53	-
	(24.63)	(27.80)	(2.64)	(13.13)	(16.56)	
[Pd(5-Methyl Uracil) ₂ Cl ₂]	24.34	21.94	1.37	12.80	16.23	8.68
	(24.56)	(21.46)	(1.36)	(12.81)	(16.26)	(8.60)

Analytical Data of the Complexes

The value of molar conductance are in the range 0.052-0.058 Ω^{-1} cm⁻¹ mol⁻¹ suggesting non electrolyte nature of the synthesized complex.

Spectroscopic analysis:

The details of infrared spectral bands of the synthesized complex containing coordinated 5-methyl uracil possesses 3 possible donor sites , (i) Two cyclic nitrogen and (ii) oxygen of the ketonic group in ring respectively. Out of these two the cyclic nitrogen of ring system is supposed to be involved in coordination through the Nitrogen atom . In the IR spectra of the synthesized complex of 5-methyl uracil studied here , the

IR frequency of cyclic nitrogen of ring has been changed, thereby, suggesting that the cyclic nitrogen has been participate in the coordination.[38]

In the IR spectra of both the complexes with 5- methyl uracil the bands at 640cm^{-1} suffered a lower shift of 640cm^{-1} indicating that metel nitrogen coordination present in the synthesized compound. Hambright et al. confirmed metal nitrogen co-ordination in the large series of the complex of Zn(II), Cu(II), Ni(II),Co(II) and Pd(II). Recently, Pennell and co-workers have experimentally confirmed the metal – nitrogen co-ordination in the complexes.

The electronic spectral bands of the complexes (table II) were assigned according to the literature.

Table II

Important IR spectral bands and their assignments (Reported Compounds)

SI.No.	Compound	v _{M-C} (cm ⁻¹)	$\delta_{\text{Me(sym)}}$ (cm ⁻¹)
1	$[(PEt_3)_2Pd(CH_3)X]$		
	X=Br	510	1162
	SCN	526	1180
	CN	502	1161
2	$[(\text{PEt}_3)_2\text{Pd}(\text{CH}_3)_2]$	491, 457	1164
3	$[(AsEt_3)_2Pd(CH_3)_2]$	498, 479	1152,1124
4	$[(PPh_3)_2Pd(CH_3)_2]$	529, 482	1129
5	$[(bipyr)Pd(CH_3)_2]$	534, 522	
6	$[MeS(CH_2)_2(SMe)Pd(CH_3)_2]$	525,512	1168

The molecular orbital approach was used to explain the structure of square –planar complexes of the d^8 elements. The metal orbital's involved in σ bonding in square planer complexes are the ndz², ndx²-y², (n+1)P_x and (n+1)P_y. Nevertheless, judging from the values of the overlap integrals, nd_{x^{2-y2}} (n+1)s, (n+1)P_x and (n+1)P_y account for most of the σ – bonds , and ndz² makes only a minor contribution of π - orbital's of the ligands. The correlation of the bands observed in the electronic spectra for the studied complexes with those of [M (CN)₄]²⁻ [M= Pd^{II}] prompted us to assume the following assignments (Table II) ${}^{1}A_{1g} \longrightarrow {}^{1}A_{2g} [b_{2g}(\pi^*) b_{1g}(\sigma^*)], (d-d): {}^{1}A_{1g} \longrightarrow {}^{1}B_{1g} [b_{2g}(\pi^*) a_{1g}(\sigma^*)], (d-d); {}^{1}A_{1g} \longrightarrow {}^{1}B_{1g} [b_{2g}(\pi^*) a_{2u}(\pi^*)], (C.T); {}^{1}A_{1g} \longrightarrow {}^{1}E_{u} [e_{g}(\pi^*)]$

 $a_{2u} (\pi^*)], (C.T).$

The relation between the bands in the present complex and the described for the typical complexes $[M (CN)_4]^{2-1}$ leads to the conclusion that all the new complex has the same square planer geometry.

The analytical data and all the evidences presented above suggest the formulation of these complex as. The mixed ligand complex $[PdL_2Cl_2]$ where (L = 5-methyl uracil), have been prepared by the interaction of parent compound $[PdCl_2]$ with ligand. The complexare characterized by elemental analysis, magnetic measurement, electron spin resonance and infrared spectral studies containing Pd (II) d⁸ configuration.[39]

IV.Scope of Palladium complexes in the treatment of tumours

Therapeutic potential of metal complexes in cancer therapy has attracted a lot of interest mainly because metals exhibit unique characteristics, such as redox activity, variable coordination modes and reactivity toward the organic substrate.¹¹ These properties become an attractive probe in the design of metal complexes that selectively bind to the biomolecular target with a resultant alteration in the cellular mechanism of proliferation. Table 1 provides a summary of in vitro cytotoxic effect of various metal-based compounds within the period of 6 years with particular reference to their proposed mechanism of action and target.

Several metal-based compounds have been synthesized with promising anticancer properties, some of which are already in use in clinical practice for diagnosis and treatment while some are undergoing clinical trials. Metal-based compounds synthesized recently are products of drug design targeted at achieving specific objectives that the original compound could not achieve and such compounds exhibit a different spectrum of cytotoxicity. Compounds in this group include the following.

V.Conclusion

Palladium compounds, are the heartbeat of the metal-based compounds in cancer therapy. Clinical use of palladium complexes as an adjuvant in cancer therapy is based on the desire to achieve tumor cell death and the spectrum of activity of the candidate drug. Such complexes are mostly indicated for the treatment of cervical, ovarian, testicular, head and neck, breast, bladder, stomach, prostate and lung cancers. Their anticancer activities are also extended to Hodgkin's and non-Hodgkin's lymphoma, neuroblastoma, sarcoma, melanoma and multiple myeloma. Although resistance emerged, it was the fundamental basis that triggered the search for alternative metallic compounds with improved anticancer and pharmacokinetic properties. On this basis, alternative

Palladium compounds were derived. These are all products of extensive research of Palladium complexes .All the complex is diamagnetic suggesting square planner geometry. It is observed that the synthesized compound are light yellow in colour, non hygroscopic, soluble in DMF, DMSO, slightly soluble in acetonitrile and sparingly soluble in other solvents, thermally stable and do not decomposed up to 260⁰C, The compound have d⁸ configuration. The complex has anti tumor activity.

REFERENCES:

1. Wamhoff H, Dzenis J, Hirota K (1992) Uracils: versatile starting materials in heterocyclic synthesis. Adv Heterocycl Chem 55:129–259. doi:10.1016/S0065-2725(08)60222-6

2. Putz MV, Duda's NA (2013) Variational principles for mechanistic quantitative structure-activity relationship (QSAR) studies: application on uracil derivatives' anti-HIV action. Struct Chem 24:1873–1893. doi:10.1007/s11224-013-0249-6

3. Morten, HH. N. 2010. A mutant Pfu DNA polymerase designed for advanced uracil-excision DNA engineering. BMD Biotechnology, 10(21):1-7.

4. Miquel B.-O.; Carolina, E.; Angel, T.; Angel, G.-R., and Antonio F.

2011.RNAs, uracil quaret model with a non-essential metal ion. Chem. Comm. (Camb), 47(16): 4646-4648.

5. Heidelberger C (1984) In: Holand JF, Frei E (eds) Pyrimidine and pyrimidine antimetabolites in cancer medicine. Lea and Febiger, Philadelphia, pp 801–824

6. Igor, P.P.; Levan, M.; Barbara, J.M. and Jill, S.J. 1997. Presence and consequence of uracil in preneoplastic DNA from folate/methyl-deficient rats. Carcinogenesis, 18(11):2071-2076.

7. Kulikowski T (1994) Structure-activity relationships and conformational features of antiherpetic pyrimidine and purine nucleoside analogues. Pharm World Sci 16:127–138. doi:10.1007/BF01880663

8. IsobeY,Tobe M, InoueY, Isobe M, Tsuchiya M, HayashiH(2003) Structure and activity relationships of novel uracil derivatives as topical anti-inflammatory agents. Bioorg Med Chem 11:4933–4940. doi:10.1016/j.bmc.2003.09.012

9. Baraldi PG, Romagnoli R, Guadix AE, Pineda de las Infantas MJP, Gallo MA, Espinosa A, Martinez A, Bingham JP, Hartley JA (2002) Design, synthesis, and biological activity of hybrid compounds between uramustine and DNA minor groove binder distamycin A. J Med Chem 45:3630–3638. doi:10.1021/jm011113b 10.Prashansa, A. 2016. Non-coding ribonucleic acid: a new anticancer drug target. J Pharmacovigil, 4(3):1-2.

11..Rastogia, V. K. and Alcolea, P. M. 2011. Vibrational spectra, tautomerism and thermodynamics of anticarcinogenic drug:5-Fluorouracil. Spectrochim. Acta A Mol Biomol Spectrosc.,79(5):970-977.

12. Medoff G, Swartz MN (1969) Induction of a defective phage and DNA methylation in *Escherichia coli* 15–T . J Gen Virol 4:15–27

13. Pranita U. Gawande; Mandlik P. R. and Aswar1 A. S. 2015. Synthesis and characterization of Cr(III), Mn(III), Fe(III), VO(IV), Zr(IV) and UO₂(VI) complexes of Schiff base derived from isonicotinoyl

hydrazine, Indian J Pharm Sci., 77(4): 376–381.

14. Michael J. Carney; Nicholas J. Robertson; Jason A. H

15. Oliev R (1994) Response to auxin by cells of *Riella helicophylla* during reversible arrest in different cell-cycle phases. Planta 194:510–515

16. Cheng CC, Roth B (1982) Recent progress in the medicinal chemistry of 2,4-diaminopyrimidines. Prog Med Chem 19:269–331

Mol Divers (2016) 20:153–183 179

17. Singh SJ (2008) Laser Raman and infra-red spectra of biomolecule:5-aminouracil. J Phys 70:479–486

18. Bányász A, Karpati S, Mercier Y, Reguero M, Gustavsson T, Markovitsi D, Improta R (2010) The peculiar spectral properties of amino-substituted uracils: a combined theoretical and experimental study. J Phys Chem B 114:12708–12719. doi:10.1021/ jp105267q

19. Longley, D. B., Harkin, D. P. & Johnston, P. G. 5-Fluorouracil: mechanisms of action and clinical strategies. Nat. Rev. Cancer 3, 330–338 (2003).

20. Bednarek E, Dobrowolski JCz, Dobrosz-Teperek K, Sitkowski J, Kozerski L, Lewandowski W, Mazurek AP (1999) Theoretical and experimental 1H,13 C,15 N, and 17O NMR spectra of 5-nitro, 5-amino, and 5-carboxy uracils. J Mol Struct 482–483:333–337

Weissman, S. A. & Zewge, D. Recent advances in ether dealkylation. Tetrahedron 61, 7833–7863 (2005).
Johnson TB, Matsuo I (1919) Researches on pyrimidines. LXXXVII. Alkylation of 5-amino-uracil. J Am Chem Soc 41:782–789. doi:10.1021/ja02226a011

23. Song, F., Garner, A. L. & Koide, K. A highly sensitive fluorescent sensor for palladium based on the allylic oxidative insertion mechanism. J. Am. Chem. Soc. 129, 12354–12355 (2007). 22. Santra, M., Ko, S.-K., Shin, I. & Ahnz, K. H. Fluorescent detection of palladium species with an O-propargylated fluorescein. Chem. Commun. 46, 3964–3966 (2010).

24. Güetschow M, Hecker T, Thiele A, Hauschildt S, Eger KJ (2001) Aza analogues of thalidomide: synthesis and evaluation as inhibitors of tumor necrosisfactor- α production in vitro. Bioorg Med Chem 9:1059–1065. doi:10.1016/S0968-0896(00)00323-0

25. Liu, B. et al. A new ratiometric ESIPT sensor for detection of palladium species in aqueous solution. Chem. Commun. 48, 2867–2869 (2012).

26. Pal, M., Parasuraman, K. & Yeleswarapu, K. R. Palladium-catalyzed cleavage of O/N-propargyl protecting groups in aqueous media under a copper-free condition. Org. Lett. 5, 348–352 (2003). 25. Escoubet, S., Gastaldi, S. & Bertrand, M. Methods for the cleavage of allylic and propargylic C–N bonds in amines and amides – selected alternative applications of the 1,3-hydrogen shift. Eur. J. Org. Chem. 2005, 3855–3873 (2005).

27 Johnson TB, Hahn DA (1933) Pyrimidines: their amino and aminooxy derivatives. Chem Rev 13:193–303. doi:10.1021/cr60045a002

28. Rambabua, D., Bhavani, S., Swamy, N. K. & Rao, M. V. B. Pd/C mediated depropargylation of propargyl ethers/amines in water. Tetrahedron Lett. 54, 1169–1173 (2013).

29. Bogert MT, Davidson D (1933) The preparation of 5-aminouracil and of some of its derivatives. J Am Chem Soc 55:1667–1668. doi:10.1021/ja01331a059

30. Zajac MA, Zakrzewski AG, Kowal MG, Narayan S (2003) A novel method of caffeine synthesis from uracil. Synth Commun 19:3291–3297. doi:10.1081/SCC-120023986

31. Ishiyama H, Nakajima H, Nakata H,Kobayashi J (2009) Synthesis of hybrid analogues of caffeine and eudistomin D and its affinity for adenosine receptors. Bioorg Med Chem 17:4280–4284. doi:10.1016/j.bmc.2009.05.036

32. Phillps AP (1951) Some 5-substituted aminouracils. J Am Chem Soc 73:1061–1062. doi:10.1021/ja01147a051

33. Benitez A, Ross LO, Goodman L, Baker BR (1960) Potential anticancer agents. XXXVI. Alkylating agents derived from 5-aminouracil. J Am Chem Soc 82:4585–4591. doi:10.1021/ja01502a036

34. Johnson TB, Clapp SH (1908) IX. Researches on pyrimidins: syntheses of some nitrogen-alkyl derivatives cytosin, thymin and uracil. J Biol Chem 5:49–70

35. VisserDW, Kabat S,LiebM(1963) Synthesis and biological activity of methylaminodeoxyuridine and dimethylaminodeoxyuridine. Biochim Biophys Acta 76:463–465

36. Kabat S, Visser DW(1964) The incorporation of aminodeoxyuridine into deoxyribonucleic acid of *Escherichia coli* 15 T–. Biochim Biophys Acta (Amst.) 82:680–681

37. ShenTY,McPherson JF, LinnBO(1966) Nucleosides. III. Studies on 5-methylamino-2'-deoxyuridine as a specific antiherpes agent. J Med Chem 9:366–369. doi:10.1021/jm00321a025

38. Boncel S, Gondela A, Ma, czka M, Tuszkiewicz-Ku'znik M, Grec P, Hefczyc B, Walczak K (2011) Novel 5-(Nalkylaminouracil) acyclic nucleosides. Synthesis 4:603–610. doi:10.1055/s-0030-1258397

39. Otter BA, Taube A, Fox JJ (1971) Pyrimidines. XI. Conversion of 5-hydroxyuracils into 6-alkyluracils via Claisen rearrangements. J Org Chem 36:1251–1255. doi:10.1021/jo00808a019

40. Novikov MS, Buckheit JRW, Temburnikar K, Khandazhinskaya AL, Ivanov AV, Seley-Radtke KL (2010) 1-Benzyl derivatives of 5-(arylamino)uracils as anti-HIV-1 and anti-EBV agents. Bioorg

FLEXIBLE MANUFACTURING SYSTEM

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ABSTRACT: A flexible manufacturing system is a system capable of responding to changing conditions. In general, this flexibility is divided into two key categories and several subcategories. The first category is what is called machine flexibility, which allows various products to be produced with the given machines. The second category is routing flexibility that allows different machines to perform the same operation. Flexible manufacturing systems generally consist of three main parts: CNC machine tools, conveyor system, and control system. Smart manufacturing systems represent a higher level of flexible manufacturing systems.

Keywords: drawing-free manufacturing, flexible manufacturing system, industrial robot, material flow

I. INTRODUCTION

The main objective of the project is to build a laboratory with a flexible manufacturing system made up of at least two CNC machines (milling machine, lathe). These machines will be interconnected by a transport system and operated by industrial robots. This flexible manufacturing system will also include a quality control station that includes the standard storage and chamber system. [7]

In the final phase of the project in 2012, this flexible manufacturing system will be linked to our institute's CAD laboratory, creating the "Laboratory of Flexible Manufacturing Systems with Robotic Operation for a Drawing-Free Production Environment".

Upon completion of the project, our institute will have a fully functional flexible manufacturing system prototype with robotic operation of individual production machines, integrated with CAx laboratories. However, the ultimate goal is to have a smart manufacturing system. This prototype will allow a deeper exploration of the relationships and properties of the manufacturing process itself but also in its relationship with the production preparation and planning process.

We look forward to several other consecutive projects (including international ones) that should further expand the laboratory's possibilities.

The main advantage of the flexible manufacturing system is its great flexibility in the management of production facilities and resources (time, machines and their use, etc.). The greatest application of these systems is in the field of small series production where their efficiency is close to that of mass production. Its disadvantage is the high cost of implementation.

To achieve the objectives of the project, it is necessary to review the curriculum and use forms and methods of teaching that go beyond the realm of cognitive knowledge of scientific disciplines and professions, which means developing the key skills of students. These acquire extraordinary importance not only for personal development, but also in terms of permanent training and employability of technical university graduates. [8]

PRESENT SITUATION AT SLOVAK INDUSTRY

At present, the structure and management of industrial production in Slovakia predominate, suitable for mass production of a narrow product spectrum. However, this production and management structure is no longer satisfactory because the tendency to individualize users is also increasingly evident among customers of Slovak industrial companies. As a result of the little flexibility to satisfy the demands of the market (clients), the competitiveness of the manufacturers diminishes and they are surpassed by competitors with little or no tradition in the machinery industry but with the capacity to satisfy the demands of the clients. much more flexibly. [9]

Another frequent problem of Slovak industrial companies is high production costs. Many manufacturers try to reduce these costs at the expense of their employees' wages depressing them in various ways (directly or indirectly). However, this attitude towards reducing production costs is less systemic and, in the long term, does not lead to the desired objective which is to increase the demand for Slovak products and thus support the development of individual companies and the increase of the general norm. to live.

The only viable way to achieve this goal (which individual manufacturers can influence directly) is to increase production efficiency by reducing production costs, not at the expense of wages but as a consequence of optimizing the manufacturing process. production by introducing new modern production technologies. modern preparation and

management of production methods, increasing the quality and flexibility of production.

The objective of the project is to build a flexible manufacturing system with robotic operation that allows production without drawing. This means that the product will be simulated by PC in an appropriate 3D CAD program, a control program necessary for the production of the component will be generated and this program will be launched in a flexible manufacturing system that will physically produce this component. In this way, it would be possible to produce all the necessary components for a specific product that will be assembled in the final stage.

During production, all manufactured components will be subject to control operations, therefore, during final assembly, the rate of defective parts of finished products will be greatly reduced.

This prototype facility can also examine the impact of various manufacturing strategies on production costs, the time required to produce the required amount of product, and other parameters important to production efficiency. It will then be possible to explore and present the advantages of non-stamping production and the impact of this production method on the efficiency of the entire process before and during production.

All the information and knowledge acquired will be presented nationally and internationally through scientific and technical journals, as well as through scientific conferences and workshops. We will also approach representatives of the peninsular industry and present this prototype to them, demonstrate its potential and ask them to collaborate in other projects so that the results of theoretical and practical research can be integrated into industrial production and used in efforts to maintain the competitiveness of Slovak industry.

DEMANDS ON FLEXIBLE MANUFACTURING SYSTEM WITH

ROBOTIZED OPERATION

A flexible manufacturing system (FMS) is a group of numerically controlled machine tools interconnected by a central control system. The different machining cells are interconnected, through loading and unloading stations, by means of an automated transport system. Operational flexibility is enhanced by the ability to perform all manufacturing tasks on many product designs in small quantities and with faster delivery. It has been described as an automated workshop and a miniature automated factory. Simply put, it is an automated production system that flexibly produces one or more families of parts. Today, this perspective of automation and flexibility offers the possibility of producing non-standard parts to create a competitive advantage. [2]

The concept of flexible manufacturing systems evolved during the 1960s when robots, programmable controllers, and computerized numerical controls brought a controlled environment to the factory in the form of direct CNC and CNC machines.

For the most part, FMS is limited to companies involved in small batch or store production. Typically, small batch producers can choose between two types of equipment: dedicated machines or non-automated general purpose tools. Dedicated machines save money but lack flexibility. General purpose machines such as lathes, mills or drills are expensive and may not reach their full capacity. Flexible manufacturing systems offer small batch maker with another option that can make small batch manufacturing just as efficient and productive as mass production.

The robotically operated flexible manufacturing system for a drawing-free production environment (hereinafter FMS only) will be represented by the CIM (Computer Integrated Manufacturing) model under UVSM MTF conditions. It is a systems approach to planning, management and production itself. The goal is to gain experience in these areas at the level of a manufacturing system as a unit. [1], [3]

In practice, these experiences, if accepted, can considerably increase the competitiveness of industrial companies. This increased competitiveness will result from greater efficiency in planning, management and production. Higher efficiency will mean shorter production time, greater use of machines and tools, greater production flexibility, which together mean savings in production costs.

The introduction of the flexibility of the production and the reduction of the coûts are fortement influenced by the strict respect of the structures of données appliquées dans the communication between the posts of individual travails tout au long de la chaîne de production, de la conception des composants à the conception. and handling devices and finally to the production itself.

Therefore, the entire FMS (all manufacturing and handling devices) must contain a communication structure based on a modern industry standard that is also compatible with other industry facilities to enable transparent data transfer. One of the marginal conditions to define the characteristics of the FMS is the ability to cooperate with the CAD CATIA system available in our institute. In addition, this system must also cooperate with other CAD software systems. This cooperation is extremely important in view of the ultimate goal of the project: "Production without drawing". The functional diagram

of this modular system can be found in Fig. 1.

The main philosophy of the system is based on theoretical knowledge and practical experience in the field of production planning, management and implementation of small batch and part manufacturers. Currently, these production areas are developing with the greatest dynamism.

A. FLEXIBILITY OF MANUFACTURING SYSTEMS

There are various approaches to the term flexibility of manufacturing systems. The most frequent meaning of this term is described as follows:

- Possibility of production program change withoutany significant alteration of machinery (new NC program, eventual tool change),
- Speed of production program change from previous product line to new products,
- Possibility to change production program at level of individual products.[2]



Fig. 1 Modular flexible manufacturing system block diagram

FMS FUNCTION ALGORITHM

We want to produce (simulate production) various shaft, flange, bracket and box shape components in this system. Each component manufactured will represent piece-rate production, which means that only one piece of that component will be manufactured. The variability (dimensions and shape versions of each component) will be relatively large. The planning and management of the production process in FMS must be adapted to this fact. The plant design method is described, p. Eg in references [1], [6], [7].

The entire process, from design to final component storage, should run automatically without human intervention. This means that the material in the FMS storage system will be automatically taken out of the warehouse, transported to individual machines according to the schedule and placed in the operation zone by a handling device (industrial robot). The machine will perform individual technological operations to achieve the final properties (shape and size) of the component. Simple components can be worked with a single machine, but in the case of more complicated parts, the component will have to be manipulated in the machine (for example, rotated to another position) or moved to another machine so that other technological operations are required, performed (sometimes this movement between individual machines has to be repeated several times).

After completing all the necessary technological operations, the manufactured component will be transferred to the control station for quality control, and if the quality control is passed, the finished and verified component will be automatically transferred to the FMS storage system. If the quality control fails, the component is also transferred to the

storage system, but to the part where the defective products are stored.

The functional graph of the entire flexible manufacturing system is shown in Fig. 2. The material flow in flexible manufacturing systems is described in [4], [5], [11].



Fig. 2 Function graph of flexible manufacturing system

1 – conveyor, 2 – storage, 3 – pallet handling and quality station, 4 – robot vision and assembly station, 5 – robot feeder of machine tools, 6 – CNC lathe, 7 – CNC milling machine

A. FMS STRUCTURE

Another challenge in micromachining is micromachining. Inaccurate geometry and tool irregularity often negate the benefits of ultra-precise process control, advanced machine tools, and ultra-fine tuning of process parameters.

In a structure term FMS (selection of manufacturing and handling devices), it is necessary to define the general characteristics of the products to be manufactured and of the applied technologies.

Despite a significant expansion in the applications of plastics in the machinery industry, metal remains the basic material. For this reason, we have decided that this FMS will produce (simulate production) components made specifically of metal, possibly another material that can be processed with the same technologies as metal components. The fields of application of flexible manufacturing systems are described in [9] and [10].

Of course, the components must be limited in size and weight. This limitation is necessary for several reasons:

Economical - Larger components consume more material, larger and more expensive machines, higher energy demands, etc.

Space - Larger machines require more space.

Regarding the relatively small space available for the FMS, we have to choose to manufacture and handle devices with small dimensions, which means that the size of the individual components will also be limited.

As an upper limit for the size of the components of the box, we determine 120x120x120 mm.

For cylindrical components, we have defined the maximum size

75x120mm. The maximum weight of the components must be 5 kg.

The technologies that can be used to transform a basic metallic material into a finished component can be divided as follows. The basic division of machine technologies is shown in Fig. 3.



Fig. 3 Basic division of technologies

Both metallurgical and mechanical production technologies are energy intensive, cause environmental pollution and require considerable production facilities. This was one of the reasons for focusing on machining technologies in our FMS. Another reason for choosing machining technology for our FMS was that more than 80% of all components are machined in their final stage and other technologies actually only produce a semi-finished product suitable for machining and are ultimately unsuitable. for the production of parts.

For the production of rotating components, turning operations are used more frequently and milling operations are used more frequently for the production of non-rotating components. As a result, our FMS will also include production facilities capable of performing these technological operations (lathe and milling machine).

As we need a fully automated FMS function, the production facilities (machining devices) have to be controlled by CNC, which allow its integration with other devices of the same system (Fig. 4-6, 7).

The robotic presence within FMS will be ensured by industrial robots that will load the semi-finished product into the area of operation of the individual machining devices or into the area of operation of the control station and will unload any machined components that can be verified. from these devices. (Figure 4-5)

The FMS should also include an automated storage facility where various types of semi-finished products and finished products will be stored. This storage system must be fed by a feeder that will take the individual semi-finished products from the storage system and store them in finished components. (Figure 4-2)

The test station will verify the actual dimensions and shape of the individual manufactured components. This station will also be automated. (Figure 4-4)

All the aforementioned devices must be connected to the transport system that will ensure the transport of semi-finished products and finished components to the place necessary to be in the area of operation of the individual industrial robots. (Figure 4-1)



Fig. 4 Flexible manufacturing system

1 – conveyor, 2 – storage, 3 – pallet handling and quality station, 4 – robot vision and assembly station, 5 – robot feeder of machine tools, 6 – CNC lathe, 7 – CNC milling machine

CONCLUSION

Currently, due to the shortening of the product life cycle, market liberalization, strong competitive pressure and constantly changing customer demands, companies are forced to gradually rebuild the nature of their production in mass production and in small series with a wide range of products. This phenomenon is related to many problems, in particular inventory planning, organization of production and rationalization of work. In particular, large companies have adapted the nature of their production to mass production, which creates a huge inventory optimization problem both in warehousing and manufacturing, production optimization problems with frequent machinery changes and lead times. delivery, capacities and associated economic losses. The Institute of Production Systems and Applied Mechanics applies to the design of principles of flexible manufacturing systems, including rational and efficient manufacturing and assembly methods and basic principles of intelligence.

REFERENCES

- 1. Hrušková, Erika Velíšek, Karol Charbulová, Marcela: Assembly cell design supported by computer. In: Comec 2010 : VI Conferencia Cientifica Internacional de Ingeniería Mecánica. 2 al 4 de noviembre de 2010 Villa Clara, Cuba. , 2010. ISBN 978-959-250-602-2
- 2. http://www.referenceforbusiness.com/management/Ex-Gov/Flexible-Manufacturing.html
- Charbulová, Marcela Matúšová, Miriam Cagáňová, Dagmar: Intelligent production systems and clamping systems for intelligent production systems. In: MMA 2009. Flexible Technologies : Proceedings. 10th international scientific conference. - Novi Sad, 9.-10.10. 2009. - Novi Sad : Faculty of Technical Sciences, 2009. - ISBN 978-86-7892-223-7. - S. 194-197
- Košťál, Peter Krajčová, Katarína Ružarovský, Roman: Material flow description in flexible manufacturing. In: I. Central European Conference on Logistics : 26 November 2010, Miskolc, Hungary. - Miskolc : University of Miskolc, 2010. - ISBN 978-963-661-946-6.
- 5. Košťál, Peter Mudriková, Andrea Sobrino, Daynier Rolando Delgado: Material flow in flexible production systems. In: Proceedings in Manufacturing Systems. ISSN 2067-9238. Vol. 5, No 4 (2010), s. 213-216
- 6. Matúšová, Miriam Hrušková, Erika Javorová, Angela: Simulation as an instrument to solve the layout of production lines. In: Comec 2010 : VI Conferencia Cientifica Internacional de Ingeniería Mecánica. 2 al 4 de noviembre de 2010 Villa Clara, Cuba. , 2010. ISBN 978-959-250-602-2
- 7. Matúšová, Miriam Hrušková, Erika: Basic design of the proposed manufacturing system. In: Machine Design. -ISSN 1821-1259. - 2010 (2010), s. 217-220
- Mudriková, Andrea Cagáňová, Dagmar: Educational process improvement in virtual laboratory via e-learning. In: MicroCAD 2010 : XXIV. International Scientific Conference, 18-20 March 2010. Section R: Humanities. - Miskolc : University of Miskolc, 2010. - ISBN 978-963-661-922-0. - ISBN 978-963-661-925-1. - S. 19-25
- 9. Mudriková, Andrea Hrušková, Erika Horváth, Štefan: Areas in flexible manufacturing-assembly cell. článok vyšiel v časopise: Annals of Faculty of Engineering Hunedoara Journal of Engineering, ISSN 1584-2673, Tome VI, Fascicule 3, 2008, str. 123-127. In: Scientific Bulletin. ISSN 1224-3264. Vol. XXII (2008), s. 293-298
- Mudriková, Andrea Charbulová, Marcela: Intelligent Assembly Systems. In: AMO Conference. ISSN 1313-4264. -Vol. 3. 9. International Conference Advanced Materials and Operations : Scientific Reports. Project CII-BG-0203-02-0809 CEEPES. Bulgaria, Kranevo 24- 28 June 2009 (2009). - Sofia : Technical University of Sofia, s. 591-595
- 11. Mudriková, Andrea Košťál, Peter: Material flow in automated manufacturing. In: Machine Design. ISSN 1821-1259. - 2010 (2010), s. 331-334

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A REVIEW OF ADVANCING MANUFACTURING TECHNOLOGY

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ABSTRACT: Reviewed in this paper are some of the major developments in cutting technology and the most modern methods used in metal cutting technology research, as well as methods already established in daily application. Metal cutting process modeling and simulation methods and the application of artificial intelligence, micromachining, cutting process tracking, high speed cutting (HSC), high speed cutting, productivity (HPC), material machining are discussed. hard and dry cutting lubricant or minimal micro-spray (MMS)

Keywords: modeling, simulation, monitoring, HSC-machining, HPC machining, MMS-systems, Dry machining

INTRODUCTION

In the current scenario, transformation industries are developing rapidly in the world of work. Welding emerged as a viable manufacturing process in the mid-nineteenth century,

Studies [1] have concluded that there should be a strong integration of technology and management using information technology (IT), for example, the integration of planning and process management. Production planning, simulation of manufacturing systems, agile manufacturing, rapid redesign of new products, performance modeling of manufacturing equipment including human operator, functional analysis of products, machining algorithms and virtual inspections, etc.

Material removal processes can take place at considerably higher throughput levels in the range up to Qw = 150 - 1500 cm3 / min for most workpiece materials at cutting speeds up to approximately 8,000 m / min. min. Super hard cutting tool materials exhibit hardness levels between 3000 and 9000 HV with a toughness greater than 1000 MPa.



Fig. 1. Primary aspects associated with advancing cutting technology

The main drivers of change in the case of cutting technology include: reduced component size, improved surface quality and tighter tolerances and manufacturing precision, reduced costs, reduced component weight, and reduced batch sizes (Figure 1). These factors of change have a direct influence on the main inputs to the cutting process, namely the cutting tool and tool material, the workpiece material, and the cutting fluid.

In addition to achieving greater manufacturing precision, there has been significant development in downsizing engineering components. One of the major problems associated with miniature components is that the surface / volume ratio increases.

The cutting tool is one of the key parts of the cutting process. The development of materials for cutting tools has allowed a significant increase not only in the speed of cut but also in the advances.

In recent years, the focus has been on High Performance Cutting (HPC). The following aspects of cutting have been identified as being of particular importance in the pursuit of high performance cutting with high levels of productivity:

- Non-productive time (NPT) in the cutting process,
- Dry and quasi-dry cutting (use of minimal amounts of cutting fluids),
- Chip formation and handling process and
- Burr minimization strategies.

The economic efficiency of production facilities is a central issue for cutting technology. Conventional processes such as grinding and turning have come under scrutiny from a productivity standpoint, and process chains have been analyzed and redesigned to minimize processing times. In recent years, the trend has been towards integrated processes. The requirement for integrated processes poses new and demanding challenges in the design and technology of cutting processes.

MODELING AND SIMULATION

In general, the terms modeling and simulation have been used interchangeably in manufacturing research literature. In the case of cutting, there are many phenomena that are not easily observable or are not subject to direct experimentation, so the models are developed in such a way that they can simulate the influence of a certain number of process parameters using this template. The models currently in use are based on Eulerian or Lagrangian finite element techniques. Four main categories of cut modeling methodologies are evident:

- Analytical modeling (determination of the relationship between cutting forces based on cutting geometry and including experimentally determined values of cutting angle, friction conditions and chip flow angle;
- Slip line modeling (predicts mechanical response and temperature distributions based on assumptions about slip line field geometry in the cut zone and around the tool;
- Mechanistic modeling (predicts the cutting forces for a wide range of complex machining processes assuming that the cutting forces are the product of the uncut chip area and the specific cutting energy where l the specific cutting energy is derived empirically from the workpiece material, cutting parameters and cutting geometry;
- Finite element modeling (fem techniques use small mesh representations of the material and tools as the basis for determining material stress and strain conditions and ultimately material flow based on assumptions of continuity between adjacent elements)

The application of these modeling techniques covers the range of cutting processes and interests, including cutting forces (static and dynamic), power, wear and tool life, flow / waviness / chip shape angle, embedded edge, temperatures, surface conditions, and workpiece. integrity, tool geometry, coating and design influences, burr formation, part distortion and precision, tool deflection, dynamic stability limits, and thermal damage. Modeled processes range from orthogonal cutting to multi-tooth milling, hard turning and drilling. Understanding the mechanisms of chip formation combined with the thermomechanical influence of the work tool area is essential to control the generation of a machined surface of pure plastic deformation required in this application. The cutting simulation includes realistic tool materials and a friction model developed to account for sticking and sliding conditions. Chip flow, chip morphology, cutting forces, residual stresses, and cutting temperatures are foretold.

Burr Formation: Understanding of the mechanics of burr formation has been greatly improved by modeling the burr formation process analytically, mechanically, and with finite element techniques.

Chipping: Much attention has been paid to understanding chip-forming mechanisms and the role of influencing parameters. However, many advances are being made and models, especially finite element models, have an impact on the ability to understand this complex aspect of cutting. The increasing use of high speed machining has also encouraged shaping of chip formation since the optimizing high speed cutting with exotic materials is not easy. Tool temperature and wear during cutting: in addition to burr formation, the cutting forces and the chip formation quality of the cutting process are determined by the wear behavior of the tool and the thermal load on the tool and the part [5]

A new class of sectional modeling at the nano level is called molecular dynamics modeling. With the rise of micromachining to create molds and other features for a variety of components, it is interesting to see the "scalability" of larger-scale phenomena at the nanoscale, and thus the ability to control the quality of these components.

HIGH SPEED MACHINING

HSM inventor C. Salomon discovered that above a certain cutting speed, machining temperatures begin to drop again. His fundamental research has shown that there is a certain range of cutting speeds where machining cannot be performed due to excessively high temperatures. For this reason, HSM can also be referred to as cutting speeds beyond this range. According to modern knowledge, some researchers have modernized high-speed machining as machining in which conventional cutting speeds are exceeded by a factor of 5 to 10.

With the extensive use of CNC machines, as well as high-performance AD / C AM systems, high-speed machining (HSM) has proven its superior advantages over other rapid manufacturing techniques. In addition to increased productivity, HSM can generate high-quality surfaces, burr-free edges, and virtually stress-free components after machining, and can be used to machine thin-walled parts because the cutting forces involved under HSM conditions are lower. Another

important advantage of high speed machining is the minimization of the effects of heat on machined parts. Most of the cutting heat is removed, reducing thermal deformation and increasing the life of the cutting tool. In many cases, the need for a refrigerant is eliminated. In addition, the elimination of cutting fluids reduces the post-contamination contribution and facilitates the recovery and recycling of such expensive materials as aluminum-lithium alloys. As HSM has many advantages, it is widely used in the aerospace industry, the automotive industry, the precision mechanical industry for machine tools, equipment and tools used in the manufacture of household appliances, optics, etc.



Fig. 2. Achievable cutting speeds [8]

Although high-speed aluminum milling has been applied successfully in industries for over a decade, high-speed applications on difficult-to-cut materials such as titanium alloys are still relatively new. Boeing's Military Aircraft Group has begun applying its aluminum expertise to faster polishing of titanium. And they concluded that, compared to aluminum, titanium imposes certain limitations. Speed is limited because heat builds up faster. But within these limitations, there is still plenty of room for faster cutting.

Titanium alloys have been used extensively in the aerospace, biomedical, automotive, and oil industries due to their good strength-to-weight ratio and superior corrosion resistance. However, it is very difficult to machine them due to their poor machinability. When machining titanium alloys with conventional tools, tool wear progresses rapidly due to its low thermal conductivity and high chemical reactivity, resulting in a higher cutting temperature and strong adhesion between the tool and the work material. Titanium alloys are generally difficult to machine at cutting speeds greater than 30 m / min with high speed steel (HSS) tools and greater than 60 m / min with cemented tungsten carbide (WC) tools, which gives as a result very low productivity.

ADVANCES IN MECHANICAL MICROMACHINING

PROCESS PHYSICS

Micromachining incorporates many features of conventional machining. At the same time, micromachining poses many problems mainly due to size or scale. The reduction of the machining scale does not modify the general characteristics of the process within a reasonable limit. However, when the relationship between the size of the part to be produced or the size of the microstructure of the work material in relation to the dimension of the tool used (say the diameter) becomes small (approaching a single digit), the Sizing effects can change the entire look of the machining. There are two different aspects of size effects that are of concern, for example, when the depth of cut is of the same order as the radius of the tool edge, and when the microstructure of the part material has a significant influence on the cutting mechanism

MICRO-TOOLS

Commercially available microdrills generally have a diameter of the order of 50 µm and have a torsional geometry similar to that of conventional drills. Flat drills with simplified geometries are more common for diameters less than 50 m.

Another challenge in micromachining is micromachining. Inaccurate geometry and tool irregularity often negate the benefits of ultra-precise process control, advanced machine tools, and ultra-fine tuning of process parameters.

Due to its hardness, monocrystalline diamond is the preferred tool material for micro-cutting. Diamond cutting tools were used in most early micromachining research due to their exceptional toughness (for wear resistance) and the ease with which a sharp edge may be generated by grinding. However, since diamond has a very high affinity for iron, micro-cutting is primarily limited to machining non-ferrous materials such as brass, aluminum, copper, and nickel. Therefore, micromachining tests have been limited to non-ferrous materials. In [10] he developed a machine tool manufacturing process that uses ELID grinding technology to manufacture various cross-sectional shapes of the tool with high surface quality, Figure 3.



Fig. 3. Overviews of produced micro-tools under optimum machining conditions: (a) Ultra precise tool (b) Extremely large aspect ratio micro-tool [10].

MICROFACTORIES

In general, micromachining is done on precision machine tools with conventional dimensions. However, the work size and power required for processing are relatively much smaller for micromachining. Reducing the size of the machine tool itself has been pursued by various machine tool manufacturers and researchers to achieve economic benefits such as structural cost savings, floor space savings, energy reduction, and performance benefits, including reduction of thermal stress, improvement of static. stiffness and dynamic stability. what's more.

A one-time effort is to build a micro-factory system where one or more machine tools are small enough to fit on the desk. In the late 1980s, Japanese researchers began prototyping micro-factories, and the first realization of the concept was a microtower smaller than a human palm with a 1.5 W spindle motor [11], followed more powerful and precise portable and desktop machines.

TURNING OF HARDENED STEEL

The machining of hard steel parts is of great importance. The main objective is to replace the technology of grinding by turning, milling or drilling. Turning operations are called hard turning, which are performed

- To meet the required shape and surface roughness,
- Replace the grinding operation, in a piece of hard steel with at least 45 hrc, by tools made of carbide, ceramic or polycrystalline cubic boron nitride (pcbn),
- On CNC lathes or rigid conventional lathes.

The occasional appearance of white coatings in the machining of tempered steel demonstrates that short-term metallurgical processes can be induced by the respective chip formation mechanisms. The occasional appearance of white coatings in the machining of tempered steel demonstrates that short-term metallurgical processes can be induced by the respective chip formation mechanisms.

Table 1 Advantages and disadvantages of hard turning

	Hard turning						
Advantages	Disadvantages						
Short operation	Heavy tool wear						
Less investment	Cutting edge is reactive to break						
Free grindingcapacities	Rigid machine tool with highspindle speed						
High accuracy incase of accurate blank	Up-to-date CNC control is needed(tool break control)						
The heat of cuttingis removed by chips	Tool holders for high speedmachining is required						
2-4 times higher material removal speed	Application of up-to-date toolmaterials and coats						
Good surfaceroughness	Inhomogeneous part material isunfavorable						
More operation elements are performed in onesetup	In case of grinding the sparking process can increase accuracy anddecrease surface roughness						
Appropriate for drymachining	In certain cases, better surface roughness is produced by grinding						

Table 1 shows the advantages and disadvantages of hard turning [7].



Fig. 4. Utilization of process specific advantages byprocess combination [7]

Chip formation mechanisms in hard machining were first investigated by Ackerschott [7], who postulated high compressive stresses in the surface layer causing cracks in the front of the cutting tool underneath an angle of 45 ° to the surface. At the same time, the material is plastically deformed by the rounded cutting edge. Sliding a chip segment along the crack reduces compressive stresses until a new crack is induced due to continuous tool movement.

Due to their characteristics, hard turning and grinding processes are not arbitrarily interchangeable. Rather, they complement each other. This has motivated the development of machine tool concepts, which allow hard turning and grinding operations on a single chuck. Consequently, the advantages of each method can be combined, Figure 4. [7].

MONITORING OF CUTTING OPERATIONS

The complex interactions between machines, tools, parts, fluids, measurement systems, handling systems, humans and the environment in cutting operations require the use of sensors to ensure efficient production, protect investments, indicate maintenance needs and protect workers and the environment. Early developments have shown that process monitoring is essential for economical production. Most important for uptime and quality are tool wear and tear. An excellent overview of machining monitoring for tool health monitoring can be found in [3]. Standard approaches to process monitoring are the measurement or identification of the interaction between the process and the machine structure. In particular, vibratory behavior plays an important role, since it greatly affects the precision of the part as shown by simulation and experimentation, for example. in 3].

Tönshoff presented an indication of the evolution of surveillance systems in manufacturing. Frankly, there hasn't been much progress on the part of the state described by Tönshoff. But now there are additional requirements for more flexibility. Specifically, sensor systems must be capable of interfacing with open-system architecture controllers for machines, and systems must be designed to meet the needs of so-called "reconfigurable" systems. Most of the activity in these two fields is still in the research phase with few industrial applications.

To achieve the "intelligent machine tool", which aims to be able to maintain optimized cutting performance, a sensor and control systems with the ability to accumulate knowledge are needed to store the "experience" acquired for use in future productions.

Furthermore, given the development of reconfigurable systems, monitoring strategies must be flexible enough to accommodate different machine configurations and processes. Logically, this would be related to the hardware and software that control the machine in an "open" environment. In that sense, it would be an example of a "smart sensor". Recent developments point in different directions. Some are based on new production areas, others use new sensor concepts. Most process monitoring systems are designed for limited complexity processes such as drilling, tapping, or straight-pass milling. Considering that the solutions for sculptures, surface coating, especially ball end finishing operations, are not yet commercially available. These are of great importance in finishing dies and molds with only small process forces. The new approaches use special sensors to measure force or accelerations to monitor the milling process of sculpted surfaces.

The standard fixed threshold method has been adapted to be more universal. Dynamic limits combined with neural networks. Neural networks have been shown to be effective for small productions. In particular, tool flank wear during milling can be controlled by neural networks.

It seems like an obvious solution to use dynamic systems for monitoring a dynamic process such as a cutting process. Probably due to stability issues, the output of pure dynamic networks is limited. One promising approach is a model in which a static network and a dynamic network are hierarchically combined as a "state space representation" of the cutting process. The field of high speed cutting (HSC) introduces new dynamic effects in process monitoring. Standard Fast Fourier Transform (FFT) dominated analysis methods are extended with wavelet transforms and cepstrum analysis, and the latter has been shown to be particularly sufficient for monitoring machines and processes.



Fig. 5. TCM Classification

Considering the range of sensors and applications in the cutting process, the machine tool requires a large number of sensors. Today, integrated sensor systems can multitask and work together to ensure process optimization. Reducing overall performance requires reducing process and non-production times, verifying and maintaining process capacity, while reducing direct production costs and ensuring environmentally friendly production.

SUSTANABILITY CONCEPTS INMACHINING

The paradigm of making products toward low costs and high profits is unlikely to change significantly in the near future. Integration of environmental requirements at each stage of the product, Early development is a very likely approach, not only will it add some limitations, but it will identify new environmental characteristics of a product that have the potential to improve the overall quality of the product in the eyes of the customer and eventually lower the total. cost. In the field of technologies, processes and products, efficiency has an economic, ecological and social dimension. The cost of energy and materials has an impact on economic efficiency. The reduction of resources is a contribution to economic and ecological efficiency. The way to help companies improve their economic, environmental and social performance is [12]:

- Minimizing waste and increase reusing or recycle
- Using materials, water and energy more efficiently,
- Avoiding or improving managements of cooling andlubricating fluids and hydraulic oils
- Adopting lean manufacturing and other sustainabletechniques
- Improve working conditions and use best practicemachining
- Train employees about sustainable practices, etc

DRY MACHINING AND MINIMUM QUANTITYLUBRICATION

A shift in environmental awareness and increasing cost pressure on industrial companies has led to a critical consideration of conventional cooling lubricants used in most machining processes. Depending on the part, the production structure and the production site, the costs associated with the use of cooling lubricants range from 7% to 17% of the total cost of the manufactured part [2]. By moving away from conventional cooling lubricants and using dry machining or minimum quantity lubrication (MQL) technologies, this cost element can be significantly reduced. In addition to improving the efficiency of the production process, this technological change contributes to the protection of the workforce and the environment. Reducing substantial exposure to cooling lubricants in the workplace increases job satisfaction while improving job outcomes. In addition, a company can use economically advantageous production processes for advertising purposes, which gives it a better image in the market.

Implementation of dry machining cannot be achieved simply by cutting off the supply of lubricating coolant. This is because the cooling lubricant performs several important functions that, in its absence, must be performed by other components of the machining process. Cooling lubricants reduce friction and therefore heat generation and dissipate generated heat. Additionally, cooling lubricants are responsible for various secondary functions, such as conveying chips and cleaning tools, parts and accessories. They guarantee a smooth and automated operation of the production system. Additionally, cooling lubricants help provide a uniform temperature field within the workpiece and machine tool and help meet specified tolerances.

MQCL

In many machining operations, minimum quantity quench lubrication (MQCL) is the key to dry machining success. Any movement to manufacture functional components under dry machining conditions depends on understanding the MQCL as a system, the individual components (power technology, MQCL media, parameters, tools, and machine tools) mutually affecting the operation of all the others (Figure 6). All components of the MQLC system must be coordinated very carefully to achieve the desired result, which is optimal, both technologically and economically.

In MQCL operations, the medium used is typically pure oil, but some applications have also used emulsion or water. These fluids are supplied to the tool and / or the machining point in small quantities. This is done with or without the aid of a means of transport, for example air. In the case of the former, the so-called airless systems, a pump supplies fluid to the tool, generally oil, in the form of a rapid succession of precisely metered droplets.



Fig. 6. Minimum quantity cooling lubrication system

In the latter case, the medium is atomized in a nozzle to form extremely fine droplets, which are then transported to the machining point in the form of an aerosol.

In the context of dry machining, the term MQCL is generally used to designate the supply of cooling lubricant in the form of an aerosol. Depending on the type and main function of the supplied fluid, a distinction can be made between the minimum quantity of lubrication (MQL) and the minimum quantity of cooling (MQC).

SUPPLY SYSTEMS

In the minimum quantity lubrication technique a distinction is made between external supply through nozzles mounted separately in the machine area and internal fluid supply through channels integrated in the tool (Figure 7). Each of these systems has specialized individual fields of application.

Fatty alcohols and synthetic esters (chemically modified vegetable oil) are the most widely used media in MQL applications. The substrate chosen depends on the type of supply, the material involved, the machining operation, and the subsequent finishing operations required by the part (e.g. annealing, coating and paint).



CRYOGENIC MACHINING

Cryogenics expresses the study and use of materials at very low temperatures, below -150 °C. However, the normal boiling points of permanent gases such as helium, hydrogen, neon, nitrogen, oxygen, and normal air as cryogens are below -180 °C. Cryogenic gases have a wide variety of applications in industry, such as healthcare, electronics, manufacturing, the automotive and aerospace industries, particularly for cooling purposes. Liquid nitrogen is the element most used in cryogenics. It is produced industrially by fractional distillation of liquid air and is often referred to by the abbreviation LN2. Nitrogen melts at -210.01 °C and boils at -198.79 °C, it is the most abundant gas, constituting around four fifths (78.03%) of the volume of the atmosphere. It is a colorless, odorless, tasteless and non-toxic gas. Some potential advantages of cryogenic machining are [14]:

- Sustainable machining (cleaner, safer and more environmentally friendly)
- Higher material removal rate without increasing tool wear
- Increased tool life thanks to less abrasion and chemical wear,
- Improve the integrity of the workpiece surface

- Improved chip breakage
- Decreased BUE and probability of burr formation Cryogenic cooling approaches in the material

Machining operations can be classified into four groups according to the researchers' applications: cryogenic precooling of the part by repellent or in a closed bath and cryogenic cooling of the chips, indirect cryogenic cooling or retrocooling of the tool or by remote conduction. cooling, cryogenic jet cooling by injection of cryogen in the cutting area by general flooding or on the edges or faces of the cutting tool, at the tool-chip and tool-part interfaces by means of micro nozzles, figure 8. [13].



Fig. 8. Schematic diagram of LN2 nozzle system

HIGH PRESSURE JET ASSISTED MACHINING

High pressure jet assisted machining is an innovative method of cooling and lubricating the cutting area. It relates to supplying oil or water base at relatively low flow rates at extremely high pressure up to 300 MPa. CLFs subjected to such pressure penetrate closer to the area of the plow and cool it Figure 9. [14]. This helps control chip breakage by forming a physical hydraulic effect between the cutting face and the chips. HPJAM includes a high pressure pump, a high pressure tube and an outlet nozzle. Some potential benefits are:

- Sustainable machining through lower rates of fluid and providing better cooling and lubricant mechanisms,
- Decrease cutting tool contact length
- Lower cutting forces and extend tool life
- Improve chip breakability and decrease BUEformation



Fig. 9. Cutting fluid jet injection position

CUTTING MATERIALS

Particularly in dry machining processes, cutting edges and guide shoes are subject to high mechanical, thermal and chemical loads. To ensure good performance and high wear resistance, cutting materials must meet certain requirements regarding their physical properties. Figure 10 illustrates an ideal cutting material, combining properties such as high hardness, good toughness, and chemical stability. However, these requirements represent opposite properties, so an optimal and universal cutting material is not technologically feasible.



Fig. 10. Optimal cutting materials for dry machining

CONCLUSIONS AND FUTURE SCOPE

It is obvious that cutting technology has advanced significantly in recent years. The drive will continue toward the application of higher performance cutting tool and part materials, the use of minimal amounts of cutting fluid, greater precision and the application of microsystems. The technological capabilities of cutting systems will continue to develop and higher performance will occur with better standards of safety and environmental cleanliness and lower manufacturing costs.

Disparate sensor systems under open architecture control will contribute to the development of "smart" machining systems with learning capabilities. Specific cutting processes and process effects will benefit from continuous modeling research, including cutting hard materials, burr formation, and chip formation. Molecular dynamics modeling offers the potential to couple the characteristics of micro- and nanoscale processes with macro-scale processes. Improving the ability to model processes from macro to nano scale improves simulation and understanding of processes.

REFERENCES

- 1. G. Byrne, D. Dornfeld, B. Denkena: Advancing Cutting Technology, CIRP Annals, 52/2, 2003, pp 483-507
- 2. K. Weinert1, I. Inasaki, J. W. Sutherlan, T. Wakabayashi: Dry Machining and Minimum Quantity Lubrication, Anals of the CIRP Vol 55/2, 2004, pp
- 3. Byrne, G., Dornfeld, D., Inasaki, I., König, W., Teti, R., 1995, Tool Condition Monitoring (TCM)–The Status of Research and Industrial Application, Anals of the CIRP 44/2:541-567
- 4. Dorfeld D., Min S., Takeuchi Y.: Recent Advances in Mechanical Micromachining, Anals of the CIRP Vol 55/2, 2006, pp 745-768
- 5. F. Klocke, H. W. Raedt, S. Hoppe: 2D FEM Simulation of orthogonal High Speed Cutting Process. Mach. Sci. And Tech, 5/3, 2002, 323-340
- 6. Komanduri, R., Chandrasekaran, N., Raff, L.M.: MD Simulation of Exit Failure in Nanometric Cutting, Materials Science and Engineering A, 311/1-2, 2001, pp 1-12F.
- 7. Klocke1, E. Brinksmeier, K. Weinert: Capability Profile of Hard Cutting and Grinding Processes, CIRP Annals, 55/2, 2005, pp 557-580
- 8. Schulz H., at all.: 20 Jahre HSC, Sonderfeld, Werkstadt und Betrieb, 1981
- 9. P. Sriyotha, K. Nakamoto, M. Sugai, K. Yamazaki:, A Design Studyon, and the Development of, a 5-Axis Linear Motor Driven Super-Precision Machine, CIRP Annals, 55/1, 2006
- 10. Ohmori, H., Katahira, K., Uehara, Y., Watanabe, Y., Lin, W, Improvement of Mechanical Strength of Micro Tools by Controlling Surface Characteristics, CIRP Annals, 52/1, 2003467-470.
- 11. Tanaka, M.: Development of Desktop Machining Microfactory, Riken Review, 34, 2001, 46-49.
- 12. Pusavac F., Kopac J.: Achiving and Implementation of Sustanability Principles in Machining Proceses, Advances in production Engineering Management, *4*, 2009,3, 151-160
- 13. Yildiz, Y., Nalb, M.: A review of cryogenic cooling in machining processes International Journal of Machine Tools & Manufacture 48 (2008) 947–964
- 14. Courbon C., Kramar, D., Krajnik, P., Pusavec F., Rech, J., Kopac J.: Investigation of machining performance in highpressure jet assisted turning of Inconel 718: An experimental study International Journal of Machine Tools & Manufacture 49 (2009) 1114–1125
- 15. Rahman M., Wang, Z. G., Wong, Y. S.: A Review on High-Speed Machining of Titanium Alloys, JSME I J, Series C, Vol. 49, No.1, 2006
- 16. Fang, F.Z., Wu, H., Liu, X.D., Liu, Y.C., Ng, S.T., 2003, Tool Geometry Study in Micromachining, Journal of Micromechanics and Microengineering, 3/5:726-731.

BIOGRAPHIES



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INC-MPPT based Optimization of Solar Energy Harvesting System for WSN Nodes: A Review

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Abstract—Solar energy is the energy source which is clean and sustainable. The implementation of WSN with Solar energy harvesting technique has been in research in IoT in recent times. The WSN node battery energy is minimal and can last for just a few days depending on the operating duty cycle. In this paper we are proposing a new SEH technique for energy constrained WSN nodes. Solar Energy Harvesting Wireless Sensor Network (SEH-WSN) nodes will usually run for years to come. In the past, the harvesting of solar energy was developed using the technique of P&O Maximum Power Point Tracking (MPPT). This paper review on Solar Energy Harvesting System for WSN Nodes With MPPT.

Index Terms-Solar energy harvesting, INC, MPPT

I. INTRODUCTION

A Wireless sensor network can be defined as a network of devices that can communicate the information gathered from a monitored field through wireless links. The data is forwarded through multiple nodes, and with a gateway, the data is connected to other networks like wireless Ethernet. WSN is a wireless network that consists of base stations and numbers of nodes (wireless sensors). These networks are used to monitor physical or environmental conditions like sound, pressure, temperature and co-operatively pass data through the network to a main location.

Modern innovative enhancements have made the deployment of small, in-expansive and low-power wireless communication devices with computation capability, a reality. Such devices are distributed in a sensor field and are often referred to as sensor nodes [6]. A Wireless Sensor Network (WSN) is an accumulation of sensor nodes, which coordinate to perform a specific task. The sensor nodes are usually randomly deployed in an unattended environment. They perform sensing and work together to monitor the environment and provide high-quality information. Each sensor node takes the decision based on sensed information, its expertise in processing, ability to communicate and energy resources. Sensor nodes sense the environment and then send that information to the sink as shown in Figure 1.





A wireless sensor node is equipped with one or more sensing units, a microcontroller, a radio transceiver for receiving and transmitting information and a source of energy such as battery. The sensing unit or units of a sensor node measures ambient conditions of the surrounding and transform those into an electrical signal. Such ambient conditions may be temperature, humidity, acoustic, seismographic data of the environment or may be motion, direction of living beings. Based on application and capability, those electrical signals are processed to reveal some vicinity properties or compressed to reduce the communication overhead. The communication unit then, wirelessly directs the attained data towards a central control either directly or via other sensors. This central control is often regarded as a sink or a Base station. In this way, these sensor nodes form an ad-hoc network which is referred as Wireless Sensor Network (WSN).

Wireless sensor networks, just like wireless ad-hoc networks are dynamic in nature due to the frequently changing wireless links and thus network connectivity. In addition, the topology of WSNs changes when the nodes die out or join the network. Further, WSNs and wireless ad-hoc networks show similarity in communication as well as WSNs communication conventionally happens in an ad-hoc manner.

Since sensor nodes [6] are remotely deployed and need to communicate through a wireless channel, it is very difficult for sensor nodes to survive on small and finite sources of energy. In WSNs, maximum energy is consumed during communication as compared to processing and sensing of information. In centralized system, some of the sensors nodes need to communicate over long distances that lead to even more energy depletion. As the sensor nodes in a WSN are densely deployed and may suffer from redundant information, therefore, it would be a good idea to process locally as much information as possible in order to minimize the total number of bits transmitted. Hence, distributed processing is another requisite for sensor networks.

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A heterogeneous wireless sensor network consists of different types of sensor nodes, which might measure different data and perform different tasks. To operate such a (sub) network the following devices are required.

Heterogeneous model is shown in figure 2. The nodes always have data to transmit to a base station, which is often far from the sensing area. This kind of sensor network can be used to track the military object or monitor remote environment. Without loss of generality, assume that the base station is located at the center of the square region. The network is organized into a clustering hierarchy, and the cluster-heads execute fusion function to reduce correlated data produced by the sensor nodes within the clusters. The cluster-heads transmit the aggregated data to the base station directly.



Figure 2: Heterogeneous Models for WSN

For many of the WSN applications like deep forest monitoring, disaster management etc. in which the sensor nodes are inaccessible by humans and cannot be intervened, battery replacement is a very difficult task. In such circumstance, the WSN lifetime entirely depends upon the limited battery capacity, making energy a valuable resource. Thus, the energy which is harvested from the environment is currently one of the most promising areas of research and an extensive research work is required to be accomplished from every possible aspect to make the networks energy efficient. Depending upon application, sensor nodes may be mobile through air or underwater after deployment. In such cases, network topology gets affected and so does the network performance and lifetime. Very small and inexpensive nodes are also aimed to be developed for military purposes, which can be heavily stationed in a larger area. Moreover, whether mobile or stationary, WSN communication can be disrupted by other moving objects such as animals, vehicles or by a natural disaster.

The WSN hubs experience the ill effects of a significant plan imperative that their battery energy is restricted and can work just for a couple of days relying on the obligation pattern of activity (Sharma H, Haque A, 2018). The sunlight based energy generally put away in sun powered cells so the energy putting away proficiency must be expanded. Sunlight based energy framework can be changed over quickly into power utilizing PV boards through the photovoltaic impact (Mohamed, S. A., &Abd El Sattar, M., 2019). Be that as it may, the transformation productivity is low and the expense of intensity created is similarly high. PV age has numerous favorable circumstances, for example, it has low fuel costs, doesn't create contamination, requires little upkeep, and PV framework has more different highlights (Ahmad, T., Sobhan, S., &Nayan, M. F., 2016).

Sunlight based photovoltaic (PV) energy collecting alludes to changing over sun based light energy into electrical energy to work an electrical or electronic gadget. As applied to WSNs, sun based light energy is changed over into electrical energy and is used to revive the battery of a WSN hub at the activity site itself (Sharma, H., Haque, A. and Jaffery, Z.A., 2018). In this manner, battery substitution is required over and over once the battery energy has been released. The electrical energy gathered from sun based energy can likewise be utilized legitimately to control a WSN hub. Then again, the gathered energy might be warehoused in a battery-powered battery for future purposes. The SEH-WSNs comprise of little self-sufficient WSN hubs connected to little measure sunlight based boards for their energy collecting needs. It is seen that the greatest conceivable gathered force from sun powered energy at outside is 15 mW/cm2 with a productivity up to 30% (Rasheduzzaman, M., Pillai,2016). Accordingly, we have picked sun based energy gathering for providing substitute capacity to the WSNs as it has the most powerful thickness and great productivity.

Various techniques to follow the most extreme force purpose of a PV module have been proposed (Choudhary, D., &Saxena, A. R., 2014) to beat the restriction of effectiveness. MPPT is utilized for removing the most extreme force from the sun oriented PV module and moving that capacity to the heap. DC-DC converter goes about as an interface between the heap and the PV module as it effectively transfer greatest force from the sun powered PV module to the heap. By changing the obligation cycle the heap impedance is coordinated with the source impedance to accomplish the most extreme force from the PV board (Veerachary, M., &Saxena, A. R., 2011).

II. LITERATURE REVIEW

Power system networks take the PV-created energy by methods for matrix associated inverters. There is some of the time, no coordinating of the working particular highlights of the heap and PV clusters, which is an eminent trouble in PV power frameworks. In particular, with various ecological states, PV Module exhibit shows non-direct style for V-I bend and greatest force point on V-P bend. PV module productivity is in the scope of 10-25%.

This means greatest force point following (MPPT) calculations are gotten together with the whole framework to augment their capacity and lessen modules cost. Different key research findings available in the literature are summarized in Table 1.

fable 1: Summarization	n of different key	approaches pro	posed in literature
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Paper Ref		Objective	Strategy				
	(Baci, A. B.,	Here the creator has depicted the length of	The model of new counterfeit sun based tree is				
	Salmi, M.,2020)	daylight outperforms 2000 hours every year	proposed tentatively by utilizing material				
1	Dage 506		Converight @ 2021 Authors				

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	and can arrive at 3900 hours on the good countries and the Sahara. The significance of this work depends on misusing sun oriented energy to create power	accessible in the nearby market: 25 sun based panels,metal uphold, electrical lines, controller, and battery.
(Sharma, H., Haque, A.,2018)	The WSN hubs experience the ill effects of a significant plan limitation that their battery energy is restricted and can turn out just for a couple of days relying on the obligation pattern of activity.	we propose another answer for this plan issue by utilizing surrounding sun based photovoltaic energy. Here, we propose a profoundly productive and special sunlight based energy reaping framework for battery-powered battery based WSN hubs.
Akinaga, H., KapoorS, 2020)	The principle commitment of thisexploration article is to propose an effective sun based energy gathering answer for the restricted battery energy issue of WSN hubsby using surrounding sun basedphotovoltaic energy. Preferably, theOptimized Solar Energy HarvestingWireless Sensor Network (SEH-WSN) hubs ought to work for an endless organization lifetime.	It propose a novel and effective sun based energy collecting framework with heartbeat width adjustment (PWM) and greatest force point following (MPPT) for WSN hubs. The exploration center is to expand the general collecting framework proficiency, which further relies on sun powered board effectiveness, PWM productivity, and MPPT effectiveness.
(Eseosa, O., & Kingsley, I., 2020).	The paper is on reenactment of MPPT utilizing P&O also, INC techniques. Numerical model of 100KW PV framework was created utilizing Matlab M-document. The two models were planned and reenacted utilizing MATLAB/SIMULINK. t is shown that PV framework yield power increments with ascend in sun powered illumination and in lower cell temperature. Accordingly, sun based cell performs preferred in warm climate over virus climate.	It is suggested that the MPPT The framework should comprise of partial, three-point, temperature-based MPPT for more successful and improved examination. Moresothe annoy and noticed technique ought to be enhanced by fluctuating of the irradiance to keep an increment consistent voltage.
(Kumar, R., Choudhary, A., 2017)	This paper manages reproduction/demonstrating, controlling of greatest force point following (MPPT) utilized in PV frameworks to augment the yield force of photovoltaic framework, light conditions independent of the temperature of VI attributes of burden.	In this exploration a significant greatest force point following method has been created, comprising a lift converter, which is controlling heartbeat given by a microcontroller-based unit.
(Kinjal, P., Shah, K. B.,2015)	Of late, sustainable power innovation has had critical impact in energy application. One commendable sort of sustainable energy will be energy from the sun that creates electrical power straightforwardly by utilizing PV modules helped by MPPT calculations to make as extensive as conceivable the sunlight based yield power.	More or less, by changing the yield force of the inverter, the objective of accomplishing MPPT in PV frameworks is to change the conceivable working voltage of PV boards to the voltage at MPPT.

The table 1 has three columnsfirst one shows reference numbers, second one shows objective of the related work and third column shows strategy of the work that how the perform.

III. NEED OF SOLAR POWER GENERATION

In the field of power sector in these days one of the major concerns is day by day increasing more power demand but the quantity and availability of conventional energy sources are not enough resources to meet up the current day's power demand. While thinking about future availability of conventional sources of power generation, it is become very important that the renewable energy sources must be utilized along with source of conventional energy generation systems to full fill the requirement of the energy demand.

In order to rigging the current day's energy crisis one renewable method is the method in which power extracts from the incoming son radiation calling Solar Energy, which is globally free for everyone. Solar energy is lavishly available on the earth surface as well as on space so that we can harvest its energy and convert that energy into our suitability form of energy and properly utilize it with efficiently. Power generation from solar energy can be grid connected or it can be an isolated or standalone power generating system that depends on the utility, location of load area, availability of power grid nearby it. Thus where the availability of grids connection is very difficult or costly the solar can be used to supply the power to those areas. The most important two advantages of solar power are that its fuel cost is absolutely zero and solar power generations during its

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operation do not emanate any greenhouse gases. Another advantage of using solar power for small power generation is its portability; we can carry that whenever wherever small power generation is required.

In the last few years the power conversion mechanisms for solar energy has been significantly comes in compact size. The advance research in the field of power electronics and material science have greatly helpful for engineers to develop such a system that very small but effective and powerful systems that have capability to withstand for supplying the high electric power demand. For every country day by day power density demand is increasing. Solar power generation have also the capability to handle the voltage fluctuation very effectively by setting the system for the use of multiple input converter units. But in solar power generation system due to its high installation cost and the low efficiency of the solar cells, this power generating systems can hardly participate in the competitive power markets as a main renewable source of power generation. Scientists are constantly trying to improve in the field of development of the solar cells manufacturing technology for increasing efficiency. That will definitely help to make the solar generation as in habit for use in daily life as prime renewable source of electrical power on a wider range basis than present day conditions. In solar power generation system the latest power control mechanisms is using now these days calling the Maximum Power Point Tracking frequently referred as MPPT, it has guide to the increase in the efficiency of operation of power generation from the solar cells. Thus MPPT is most important in the field of consumption of renewable sources of energy.

IV. PV MODEL WITH PARAMETERS

A single PV cell is a thin semiconductor wafer made of two layers generally made of highly purified silicon (PV cells can be made of many different semiconductors but crystalline silicon is the most widely used). The layers have been doped with boron on one side and phosphorous on the other side, producing surplus of electrons on one side and a deficit of electrons on the other side.

When the wafer is bombarded by sunlight, photons in the sunlight knock off some of excess electrons; this makes a voltage difference between the two sides as the excess electrons try to move to the deficit side. In silicon this voltage is 0.5 volt Metallic contacts are made to both sides of the semiconductor. With an external circuit attached to the contacts, the electrons can get back to where they came from and current flows through the circuit. This PV cell has no storage capacity; it simply acts as an electron pump. The amount of current is determined by the number of electrons that the solar photons knock off. Bigger cells, more efficient cells, or cells exposed to more intense sunlight will deliver more electrons.

Transformation of light energy in electrical energy depends on a marvel called photovoltaic impact (Mathew, A., &Selvakumar, A. I., 2006). At the point when semiconductor materials are presented to light, theportion of the photons of light beam is consumed by the semiconductor gem which causes a critical number of free electrons in the gem. This is the essential purpose behind delivering power because of photovoltaic impact. Photovoltaic cell is the fundamental unit of the framework where the photovoltaic impact is used to create power from light energy.

Silicon is the most generally utilized semiconductor material for developing the photovoltaic cell. The silicon molecule has four valence electrons. In a strong precious stone, every silicon iota shares every one of its four valence electrons with another closest silicon particle thus making covalent connections between them. Along these lines, silicon precious stone gets a tetrahedral cross section structure. While light beam strikes on any materials some part of the light is mirrored, some bit is sent through the materials and rest is consumed by the materials. Something very similar happens when light falls on a silicon precious stone. On the off chance that the power of episode light is sufficiently high, adequate quantities of photons are consumed by the gem and these photons, thus, energize a portion of the electrons of covalent bonds. These energized electrons at that point get adequate energy to move from valence band to conduction band. As the energy level of these electron. These are called free electrons move arbitrarily inside the precious stone structure of the silicon. These free electrons and openings have a fundamental part in making power in photovoltaic cell. These electrons and openings are henceforth called light-created electrons and gaps separately. These light created electrons and openings can't deliver power in the silicon gem alone. There ought to be some extra system to do that.



Figure 1: Single diode model of PV cell

Figure 1 is a PV cell in which one current source, one forward bias diode, 2 resistances are connected. The electron-hole pair (EHP) is produced Incident of a photon of light energy (hv>Eg) over a solar cell. The newly created EHP relates to electric current denoted by (IL) termed light induced current. The ideal equation of a solar cell with current-voltage (I – V) is given as

Solar Cell Current (I) =
$$I_{ph} - I_0 \left[\exp\left(\frac{qV}{kT}\right) - i1 \right]$$
 (1)

Where, I = solar cell output current, I_{ph} = light produced by solar cell, Io = Reverse current of saturation because of reconjunction, q = electron charge (1.6 * 10⁻¹⁹ C), V = Open-circuit voltage of solar cell, k= Boltzmann constant (1.38 *10⁻²³J/ K), T = solar cell temperature (300 K).

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The circuit model in figure 1 represents equivalent of solar cell. It comprises light-produced source current (Iph), a Shockley equation-modeled diode (D), and two series and parallel resistances. Figure 3.11 shows the VI and PV characteristic in which on voltage shows and on y axis current lsft side and power right side shows.



Figure 2: V-I and P-V Characteristic

The maximum power point (MPP) is a point on the Power voltage (P-V) characteristic of the solar cell, where the maximum power can be extracted from the solar cell as shown in Figure 2. Ideally, the solar cell efficiency should be high. But practically, it is limited to 5%–15% only (Green, M. A., Hishikawa, 2018).

In Figure 2, the current law of Kirchhoff (KCL) can provide characteristic equation of current for that corresponding circuit: Equivalent Cell Output Current $(I) = I_{ph} - I_D - I_P$ (2)

Where, I_p = parallel resistance current, I_{ph} = Light produced current, and I_p = diode current.

Diode Current
$$(I_D) = I_o \left[\exp\left(\frac{V + IR_s}{nV_T}\right) - 1 \right]$$
 (3)

Where, $I_o =$ Reverse Saturation current because of reconjunction, V = solar cell open circuit voltage, R_s = series resistance, Ipv = solar cell output current, n = diode norm factor, (1 termed as ideal, 2 termed as practical diode), k = Boltzmann constant (1.38 ×10⁻²³ J/K), V_T = Thermal voltage (kT/q), T = Solar cell Temperature (300 K). Q = electron charge (1.6 ×10⁻¹⁹ C). The parallel-resistance current is determined as:

Current in parallel resistance
$$(I_p) = \frac{V + IpvR_S}{R_n}$$
 (4)

Now, by placing the I_D and Ip value in the equation (4), we obtain complete equivalent circuit fourth equation of solar cell, under that all values are defined as connected with output current and voltage [9]:

Solar Cell Current (I) =
$$I_L - I_0 \left[\exp\left(\frac{q(V+IpvR_s)}{nkT}\right) \right] - \left(\frac{V+IR_s}{R_p}\right)$$
 (5)

Where, Rp = Parallel Resistance and in Equation (5), the other parameters Io, I_L , V, I, q, Rs, n, k, T were already declared. The solar cell efficiency (η) is termed as:

Solar Cell Efficiency
$$(\eta) = \frac{V_{OCI_{SC}}FF}{P_{in}}$$
 (6)

Where Isc is Current Short Circuit, Voc is called Open Circuit Voltage, FF = Fill Factor and Pin = optical incident power. A Solar Cell's Fill Factor (FF) is given as

$$ill Factor (FF) = \frac{P_{max}}{P_{dc}} = \frac{I_m V_m}{I_{SC} V_{OC}}$$
(7)

Where V_m is the solar cell's maximum voltage and I_m is called maximum current. There are practically many kinds of solar cells, like amorphous silicon solar cells (a-Si), mono-crystalline silicon solar cells (C-Si), thin film solar cells (TFSC), polycrystalline solar cells (multi-Si) etc. But the productivity of a-Si solar cells is greater than any other efficiency till 18 per cent.

Solar Radiation Effect (G)

The efficiency of solar cell (η) is proportional to solar radiations variations. The efficiency of solar cell (η) increases, on increasing the solar radiation and vice versa. Figure 3 (a) displays the current-voltage (I–iV) properties of a commercial solar panel of 10 watts with varying values of irradiance.



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(b)

Figure 3: Solar Panel characterization with Irradiance level variations (Watts/m²). (a) Characteristics of (I–V) (b)

Characteristics of (P–V)

The solar panel of 10 watts 10 watts (Dow Chemical DPS 10–1000) is 232 mm * 546 mm in size and has 0.13 m^2 module area. By Figure 3 (a), it is identified that the solar panel current is increasing with increase in degree of irradiance. Here the solar cell current for solar irradiance of 1000 W/m² is optimum (6.2 A). Figure 3 (b) shows the Power-Voltage properties of Solar Panel in various radiation levels. For highest solar irradiance like 1000, the extracted power is the optimum (9.8 W).

Figure 3 (a) shows solar panel irradiance variation IV characteristic in which x axis shows voltage and y axis shows current. In figure 3 (b) x axis is voltage and y axis is power.

> The Temperature Effect (T)

Such as the one in Figure 4 (a), if the temperature of the solar panel increases then the production value decreases and vice versa. And the increase in output is in direct accordance with the fluctuations in temperature. Similarly as the temperature in Figure 4 (b) increases, output capacity decreases, and vice-versa. Hence the output power is inversely proportional to the variations of temperature.



Figure 4:.Characteristics of solar panels with Temperature (°C) variations. (a) Characteristics of (I–V); (b) Characteristics of (P-V)

Figure 4 (a) and (b) shows characteristic of solar panel with temperature variation in figure (a) x axis is voltage and y axis is current, in figure (b) x axis is voltage and y axis is power.

Systems for Harvesting Solar Energy

A simple solar energy harvesting system is a combination of rechargeable battery, solar panel, DC-DC converter, Battery Management System (BMS) safety charging circuit and DC-DC converter control unit. For DC-DC converters, control methods are generally maximal power point tracking control (MPPT). The SEH unit in Figure 3.14 contains rechargeable battery, DC-DC buck converter, maximum power point (MPPT) solar panel and transmitter, and a WSN sensor node attached to the DC.

Solar energy from the natural sun is collected in solar panels and transformed into electricity. The DC-DC Buck converter is shut off and this caused voltage magnitude is controlled and transferred to the same rechargeable unit. An MPPT sensor controls the Solar Panel's current and voltage, changing the duty period as a Buck MOSFET DC-DC converter (Mathews, I., King, 2015).



Figure 5: Solar energy recovery (harvesting) system block diagram, using input from MPPT capacity

Figure 5 shows block diagram of solar energy harvest and it has DC-DC converter, battery, WSN node, solar panel etc.Finally, the wireless sensor node is regulated by the voltage of the batteries. The WSN performs the role of detecting, analyzing and interacting the same characteristics with other nodes. Thus, as with vibration, temperature, acceleration and humidity, the SEH-WSN nodes can be used to track and control any physical phenomenon autonomously. In this scenario, solar harvester circuit's efficiency exhibits a very significant function. If solar power harvester's performance is low, battery will not be recharged sufficiently, thereby reducing the lifespan of the wireless sensor network.

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V. MAXIMUM POWER POINT TRACKING (MPPT) MODELING TECHNIQUE

The efficiency of a solar cell is very low and also when solar cells are connected together to form a panel then its efficiency is still not increased [8]. In order to increase the efficiency (η) of solar cell or solar panel we have to use maximum power transfer theorem.

The maximum power transfer theorem says that the maximum power is transfer when the output resistance of source matches with the load resistance [18] i.e. solar cell or solar panel impedance. So all MPPT technique's principles are based on maximum power transfer theorem that always trying to matching the impedance of load to source.

The effectiveness of MPPT is given by following equation. [15]

$$\eta_{MPPT} = \frac{\int_0^t P_{measured}(t)dt}{\int_0^t P_{actual}(t)dt} (8)$$

The maximum power point tracking (MPPT) is now habitual in grid connected PV power generation system and it is becoming more popular in isolated or stand-alone power generation systems as well because of the V-I characteristics in PV power generation systems is nonlinear, So it is difficult to supply a constant power to a certain load.

There is confusion with MPPT that many people think that it is a mechanical device that tracking the sun, it rotates the solar panel or solar cells as well as tilts it in the direction of sun where the solar irradiance is more. But the MPPT is an electronic device that extracts maximum possible power from solar panel. It varies the electrical operating point of the panel by changing the DC/DC converter duty cycle to matching the load impedance with PV cells impedance. Mechanical tracking system can be used with MPPT, but these two systems are completely different from each other.

To understand how the MPPT works, let's first consider a solar panel. A solar panel generates power by using the photovoltaic effect then obvious a solar panel has a P-V characteristic that means for a different operating point of the solar panel, a different power output can be achieved. Therefore the maximum possible power is obtain from the solar panel when it operates at only for one specific operating point of the P-V characteristic of solar panel. This point in the P-V characteristic is called the Maximum Power Point (MPP). This MPP changes when the solar irradiation changes or temperature changes or when the solar panel is partially shaded [13]. So when these three factor changes, the solar panel operating point is also changes. To track that constantly changing MPP a device is needed called Maximum Power Point Tracker (MPPT).

The efficiency of a solar cell is very low. In order to increase the efficiency, methods are to be undertaken to match the source and load properly. One such method is the Maximum Power Point Tracking (MPPT). This is a technique used to obtain the maximum possible power from a varying source. In photovoltaic systems the I-V curve is non-linear, thereby making it difficult to be used to power a certain load. This is done by utilizing a boost converter whose duty cycle is varied by using an MPPT algorithm. MPPT is algorithm that included in charge controllers used for extracting maximum available power from PV module under certain conditions. The voltage at which PV module can produce maximum power is called 'maximum power point' or peak power voltage. MPPT is most effective under, cold weather, cloudy or hazy days. There are large numbers of algorithms that are able to track MPPs. Some of them are simple, such as those based on voltage and current feedback, like (P&O) method.

The P&O algorithms operate by periodically perturbing (i.e. incrementing or decrementing) the array terminal voltage or current and comparing the PV output power with that of the previous perturbation cycle. If the PV array operating voltage changes and power increases (dP/dV PV>0), the control system moves the PV array operating point in that direction; otherwise the operating point is moved in the opposite direction. In the next perturbation cycle the algorithm continues in the same way. A common problem in P&O algorithms is that the array terminal voltage is perturbed every MPPT cycle; therefore when the MPP is reached, the output power oscillates around the maximum, resulting in power loss in the PV system. This is especially true in constant or slowly-varying atmospheric conditions. Furthermore, P&O methods can fail under rapidly changing atmospheric conditions (Figure 6). Starting from an operating point to B and the perturbation will be reversed due to a decrease in power. However, if the irradiance increases and shifts the power curve from P1 to P2 within one sampling period, the operating point will move from A to C. This represents an increase in power and the perturbation is kept the same. Consequently, the operating point diverges from the MPP and will keep diverging if the irradiance steadily increases.

There are many different P&O methods available in the literature. In this work we consider the classic, the optimized and the three-points weight comparison algorithms. In the classic P&O technique (P&Oa), the perturbations of the PV operating point have a fixed magnitude. In our analysis, the magnitude of perturbation is 0.37% of the PV array VOV (around 2V) In the optimized P&O technique (P&Ob), an average of several samples of the array power is used to dynamically adjust the perturbation magnitude of the PV operating point.



Figure 6: Divergence of P&O from MPPT

In the three-point weight comparison method (P&Oc), the perturbation direction is decided by comparing the PV output power on three points of the P-V curve. These three points are the current operation point (A), a point B perturbed from point A, and a point C doubly perturbed in the opposite direction from point B. All three algorithms require two measurements: a measurement of the voltage VPV and a measurement of the current IPV (Figure 7)



Figure 7: P&O block diagram

VI. INCREMENTAL CONDUCTANCE (INC) ALGORITHM

The process of incremental-conductance (INC) is also used for PV systems. It monitors MPP by comparing PV array's instant and incremental conductance. The INC system problem is close to P&O's. Usually the fixed step size is used which computes MPPT's speed and accuracy of response. Therefore the tradeoff between tracking speed and steady state efficiency has to be made. Such architecture problem can be stable with MPPT strategies of variable step duration.

The Power respect to Voltage derivative (dP/dV) is utilized to change MPPT phase scale. Incremental Conductance (IC) technique surmounts the perturbation disadvantage and observes method in monitoring peak power in rapidly changing atmospheric situation. This method will decide if MPPT has passed the MPP and also stops perturbing point of service. If the condition is not true, it is possible to determine the direction in that MPPT operating point is to be disturbed using relation between dl/dViand -I/V. This relation is found from fact that when MPPT is to right side of MPP, dP/dViis negative and is positive when to left side of MPP. The phase size increases when operating point is far from the MPP, and progressively decreases when the operating point comes close to the MPP.

The quick tracking velocity and steady performance can be achieved simultaneously by changing the phase size. However, the MPPT algorithm convergence involves a scaling factor, and the factor significantly decreases response speed under abruptly change of atmospheric situations. A MPPT algorithm with incremental-resistance (INR) is to be tested with adjusted step variable size (Ibrahim, R., Chung, 2017). For moving between the fixed step and variable step mode, a threshold function is applied, and variable step phase is felt by scaling factor variation.

This method obtains quick response and precisely steady state output but its implementation is limited by the high computing load and best non-linearity of scaling factor. There really are two phase size alteration coefficients in (Li, Y., & Shi, R., 2015) to minimize the perturbation effects (duty ratio) underneath the drastic shift in irradiation with less computing, while the influence of the basic step size upon on method efficiency is not considered.

This algorithm decides when MPPT hits MPP, while P&O toggles around MPP itself. This obviously reflects a benefit over P&O. The Incremental conductance could also monitor rapidly increasing and decreasing conditions of irradiance with greater accuracy than disturbance, and observe method (Praveen, K., Pudipeddi, M., 2016). The downside of the algorithm, compared to P&O, is that it is more complicated.

VII. CONCLUSION

MPPT is algorithm that included in charge controllers used for extracting maximum available power from PV module. The voltage at which PV module can produce maximum power is called 'maximum power point' or peak power voltage. This review paper discussed the INC-MPPT concepts with PV module and Solar Energy Harvesting System for WSN Nodes.

References

- [1] Green, M. A., Hishikawa, Y., Dunlop, E. D., Levi, D. H., Hohl-Ebinger, J., & Ho-Baillie, A. W. (2018). Solar cell efficiency tables (version 51). Progress in photovoltaics: research and applications, 26(1), 3-12.
- [2] Mathews, I., King, P. J., Stafford, F., & Frizzell, R. (2015). Performance of III–V solar cells as indoor light energy harvesters. IEEE Journal of Photovoltaics, 6(1), 230-235.
- [3] Sanchez, A., Blanc, S., Climent, S., Yuste, P., &Ors, R. (2013). SIVEH: Numerical computing simulation of wireless energy-harvesting sensor nodes. Sensors, 13(9), 11750-11771.
- [4] Erickson, R. W., &Maksimovic, D. (2007). Fundamentals of power electronics. Springer Science & Business Media vol. 1,2nd pg. 3-14.
- [5] Pathak, G., Saxena, A. R., &Bansal, P. (2014). Review of dimming techniques for solid-state LED lights. International Journal of Advanced Engineering Research and Technology (IJAERT), 2(4), 108-114.
- [6] H. Al-Bahadili, H. Al-Saadi, R. Al-Sayed, M.A.-S. Hasan, (2013), "Simulation of maximum power point tracking for photovoltaic systems", Applications of Information Technology to Renewable Energy Processes and Systems (IT-DREPS), 1st International Conference & Exhibition, 2013,79-84.
- [7] Hauke, B. (2009). Basic calculation of a boost converter's power stage. Texas Instruments, Application Report November, 1-9.
- [8] Texas Instruments Application Report on "Calculating Efficiency of PMP-DC-DC Controllers". Available online: www.ti.com(accessedion 28June 2018).
- [9] Haque, A. (2014). Maximum power point tracking (MPPT) scheme for solar photovoltaic system. Energy Technology & Policy, 1(1), 115-122.
- [10] Ibrahim, R., Chung, T. D., Hassan, S. M., Bingi, K., &bint Salahuddin, S. K. (2017). Solar energy harvester for industrial wireless sensor nodes. Proced a Computer Science, 105, 111-118.
- [11] Li, Y., & Shi, R. (2015). An intelligent solar energy-harvesting system for wireless sensor networks. EURASIP Journal on Wireless Communications and Networking, 2015(1), 1-12.
- [12] Praveen, K., Pudipeddi, M., & Sivaramakrishna, M. (2016, December). Design, development and analysis of energy harvesting system for wireless pulsating sensors. In 2016 IEEE Annual India Conference (INDICON) (pp. 1-5). IEEE.
- [13] Win, K. K., Wu, X., Dasgupta, S., Wen, W. J., Kumar, R., & Panda, S. K. (2010, November). Efficient solar energy harvester for wireless sensor nodes. In 2010 IEEE International Conference on Communication Systems (pp. 289-294). IEEE.
- [14] LM2575, 1A3.3v-15v (2018)Adjustable OutputVoltage, Step-Down Switching Regulator. ON Semiconductor Company Datasheets. 2009.Available online: <u>http://onsem.com</u> (accessed on 28 June2018).
- [15] Castagnetti, A., Pegatoquet, A., Belleudy, C., & Auguin, M. (2012). A framework for modeling and simulating energy harvesting WSN nodes with efficient power management policies. EURASIP Journal on Embedded Systems, 2012(1), 1-20.
- [16] Weddell, A. S., Merrett, G. V., & Al-Hashim, B. M. (2011, March). Ultra low-power photovoltaic MPPT technique for indoor and outdoor wireless sensor nodes. In 2011 Design, Automation & Test in Europe (pp. 1-4). IEEE..
- [17] Moghadam, H. M., Khalil, A., & Mohammad nodoushan, M. (2015). Comparison Study of Maximum Power Point Tracker Techniques for PV Systems in the Grid Connected Mode. International Journal of Review in Life Sciences, 5(10), 1175-1184
- [18] Pour, N.K., 2016. 'Energy Efficiency in Wireless Sensor Networks', arXiv preprint-Cornell University Library, arXiv: 1605.02393, Research Report, pp. 1-158.
- [19] Enzinger, M., 2012. 'Energy-Efficient Communication in Wireless Sensor Networks', Network Architectures and Services Seminar Proceedings, ISSN: 18627811, pp. 25-31.
- [20] Soua, R. and Minet, P., 2011. 'A Survey on Energy Efficient Techniques in Wireless Sensor Networks', 4th Joint IFIP Wireless and Mobile Networking Conference, IEEE, pp. 1-9.
- [21] Zanjireh, M.M. and Larijani, H., 2015. 'A Survey on Centralized and Distributed Clustering Routing Algorithms for WSNs', 81st Vehicular Technology Conference (VTC Spring)-IEEE, ISSN: 15502252, pp. 1-6.
- [22] Heinzelman, W.R., Chandrakasan, A. and Balakrishnan, H., 2000. 'Energy-Efficient Communication Protocol for Wireless Microsensor Networks', Proceedings of the 33rd annual Hawaii international conference on System sciences, ISBN: 0769504930, pp.1-10.
- [23] Loscri, V., Morabito, G. and Marano, S., 2005. 'A Two-Levels Hierarchy for Low-Energy Adaptive Clustering Hierarchy (TL-LEACH)', In IEEE Vehicular Technology Conference, Vol- 62(3), ISSN: 0780391527, pp. 1809-1813.
- [24] Xiangning, F. and Yulin, S., 2007. 'Improvement on LEACH Protocol of Wireless Sensor Network', International Conference on Sensor Technologies and Applications, SensorComm 2007, ISBN: 0769529887, pp. 260-264.

Double Effect Absorption Optimization of Refrigerator in Finite Time Thermodynamics

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Abstract—Finite-time thermodynamics optimization analysis was conducted based on the efficiency coefficient and the ecological coefficient of success parameters. It was performed analytically and numerically for a parallel flow absorption refrigerator of a double-effect of loss of heat resistance, heat leakage and internal irreversibility. The overall output coefficient and the corresponding optimal conditions were analytically derived. This investigated the optimal performance parameters that optimize the output objective function coefficient. On the basis of COP and ECOP functions, the effects of irreversibility parameters on general and optimal performance were discussed. The results obtained can serve as the basis for the design of real double-effect parallel flow refrigerators.

Index Terms—Double-effect absorption refrigeration system, finite-time thermodynamic, optimization, coefficient of performance, ecological coefficient of performance

I. INTRODUCTION

Absorption refrigeration processes occur in finite-time finite-size devices; thus, reversibility conditions between the absorption refrigeration system and the surrounding environment can not be met. Therefore, the classical thermodynamic efficiency limit does not provide the boundary of the absorption system correctly (Bhardwaj et al., 2003; Kaushik et al . , 2002; NgouateuWouagfack and Tchinda, 2013a). For this reason, the finite-time approach to thermodynamics was introduced to define the absorption system output limit. The thermodynamics of the finite-time appear to model the system in a way closer to truth. Thanks to internal dissipation of the working fluid and thanks to the finite-rate heat transfer between the device, the external heat reservoir and heat-sink, it helps to discern the irreversibilities. This is attempting to close the difference between the heat transfer and thermodynamics. This deals with the optimisation of thermodynamic output in real finite-time and thermodynamic systems in finite-size.

Finite-time thermodynamic applications cover all processes involving thermal phenomena of all devices and systems operating with finite-time and finite-size constraints. The endoreversible loop is the basic physical model followed in thermodynamics of the finite-time.

Finite-time thermodynamics was first suggested by Henri B. Reitlinger in 1929 (Vaudrey et al., 2014), and then independently applied by Chambadal and Novikov in 1957 to nuclear energy. This approach has been popularized in various works including Curzon and Ahlborn (1975), Leff and Teeters (1978), Blanchard (1980), Bejan (1982, 1996, 1997), Andresen (1983), Feidt (1987), Sieniutycz and Salamon (1990), De Vos (1992, 1995), Radcenco (1994), Bejan et al. (1996), Chen et al. (1997), Bejan and Mamut (1999), Berry et al. (2000), Sieniutycz et al. (2002), Stitou et al. (2001, 2002), Zheng and al. (1997), Bejan and Mamut (1999), and Significant findings were collected and literature provides. For absorption refrigerators, the optimal operating area is endoreversible (Yan and Chen, 1989; Chen and Yan, 1993; Chen, 1995; Wijeysundera, 1996; Wu et al., 1997; Ng et al., 1997; Chen et al., 1997 a, b; Chen et al., 2004, 2011, 2013) and irreversible (Chen and Schouten, 1998; Chen, 1999; Chen et al., 2002; Zheng et al., 2003a, b, 2004; Chen et al., 2006; Qin et al., 2010; NgouateuWo, 1998; Chen et al., 2006; Qin et al., 2010;

For double-effect absorption refrigerator systems, the bulk of the theoretical work calls the mass and energy conversion approach for calculating the performance coefficient of the system (Xu and Dait, 1997; Arun et al., 2000, 2001; Ezzine et al., 2004a, b, 2005; Kaushik et al., 2009; Torrella et al., 2009; Arona et al., 2009; Gebreslassie et al., 2010; Huicochea et al., 2011; Vasilescu et al., 20, 2009; Torrella et al., 2009; Gebreslassie et al., 2009; Chua et al. (2000) used the average temperature of the cycle to test the influence of the various dissipative mechanisms on the inverse of the output coefficient (COP-1). But for the work of Göktun and Er (2000), much work still remains to be done on the finite-time thermodynamics method for double-effect absorption refrigerators. We used the finite-time thermodynamics method to compare an irreversible double-effect absorption system with an irreversible cascaded absorption refrigeration system which is influenced by three internal irreversibilities parameters. They didn't set the system's operating area tied.

In this study, the finite-time output is derived from a parallel flow double-effect refrigerator absorption process with loss of heat resistance, heat leakage and internal irreversibility. The irreversibility parameters and the effects of the irreversible process heat leakage on the COP and the ECOP are investigated.

II. LITERATURE REVIEW

The hybrid cooling system was defined as a combination of two or more cooling systems. In general, compression and absorption refrigeration systems are known to be a mix. These combinations have a range of cultural, social, and environmental benefits.

In the form of heat, low-grade energy is supplied to its generator for the operation of a vapor absorption refrigeration device. Low-grade energy sources such as biomass, waste heat recovery from power and process plants, and solar energy are under active study, especially for use in the vapor absorption system. Therefore, the selection of an effective absorbent-refrigerant pair which can be used as the working fluid in the absorption system is subject to exhaustive consideration by the researchers Efforts are under way to find trade-offs between energy sources and the refrigerant absorbent combination.

The driving force for this hybrid investigation (compression-absorption) is the need to use available heat and operate from the same source. Many industrial processes use a large amount of thermal energy by burning fossil fuel for the purpose of producing steam or heat. After the processes are completed, heat is discarded as waste to the surrounding area. In particular in developing countries, the use of waste heat energy from process industries as a source of useful energy is gradually receiving attention (Liao et al., 2004; Alford, 2005; Bombarda et al . , 2009; Chacartegui et al . , 2009; Invernizzi et al., 2007; Kaikko.et.al., 2009; Kosmadakis.et.al., 2009; Lozanova, 2009; Nasir.et.al., 2004; Sami, 2010; Srinivasan.et al., 2010; Vaja and Gambarot.al., 2009; This is due to its intrinsic significance in improving the efficiency of energy utilization, reducing the overall entropy generation and raising the process's carbon footprint. According to the most recent statistics published by the UK Department of Energy and Climate Change (DECC, 2011), waste heat can be transformed to useful cooling by means of a heat-operated cooling system, such as an absorption refrigeration cycle.

There are currently two major commercial approaches through which refrigeration is achieved in an industrial scale. It may be either heat powered $NH_3 + H_2O$ absorption refrigeration (AR) system or mechanically driven NH_3 vapor compression

refrigeration (VCR) system. The use of combined cycle of absorption and compression in industrial refrigeration system, using the thermal waste, has gained more interest.



Figure 1: The Osenbrück cycle

The use of compression-absorption refrigeration cycles allows energy savings of high quality relative to traditional compression cycles. List of research have been performed on the refrigeration periods of the compression absorption. We may trace the first published idea back to a German patent (Osenbrüeck, 1895). Figure.1 displays a diagram of the simplest compression / absorption process, called the Osenbrüeck process in inventor memory. No work on this process was published until early 1950, after 1895.

Such devices use environmentally friendly refrigerant-absorbing mixtures such as ammonia-water and lithium bromide-water, which are ozone-safe and have very low potential for global warming. Therefore, due to the use of mixtures these systems have higher comparative COPs, greater regulation of power and lower pressure levels in the system compared to vapor compression systems.

With Garimella.et. Al . (2011) studied a novel process of cascaded absorption / vapor-compression with a high temperature raise for naval use. A single effect LiBr – H2O absorption cycle and a subcritical CO2 vapor-compression cycle were combined to provide very low temperature refrigerant ($-40 \degree C$) for high heat flux electronic applications, medium temperature refrigerant ($5 \degree C$) for space conditioning and other low heat flux applications, and as an auxiliary gain, a medium temperature heat discharge of about 48 $\degree C$ for water heating applications was given. They developed a thermodynamic model to analyze cascaded system performance, and parametric analysis was performed to estimate system output over a variety of operating conditions. The cascaded system 's output was also contrasted with a two-stage comparable vapor-compression process. This process was found to have very high COPs over a large range of operating conditions and was found to reduce up to 31 per cent energy demand compared to an analogous vapor-compression system.

Tyagi et.al, (2010) studied hybrid vapor compression-absorption process efficiency based on second law, using water-ammonia as a working fluid. Hybrid output was found to be less effective than traditional system in a suitable range. Yet it can be enhanced by optimizing system design and process parameters. A thermodynamic model was developed to evaluate the performance of the cascaded system, and parametric analysis was performed to approximate system output over a variety of operating conditions. The cascaded system 's output was also contrasted with a two-stage comparable vapor-compression process. This process was found to have very high COPs over a large range of operating conditions and was found to reduce up to 31 per cent energy demand compared to an analogous vapor-compression system.

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Yari et al, (2011) compared the GAX and GAX hybrid refrigeration absorption periods from both the first and second thermodynamic rules. Energy analyzes were conducted to measure the overall rate of energy loss within the cycles. They concluded that the generator temperature (Tgen) has more effect on the second law efficiency of both cycles while that temperature influences the coefficient of output (COP) of the cycles comparatively less. An improvement in the GAX cycle efficiency of about 75 per cent was observed when the temperature of the generator was controlled from 400 to 440 ° K. For this generator temperature variance, the resulting COP rise was approximately 5%. In fact, the optimum value of energetic output in the GAX hybrid cycle exists at a marginally higher value of Tgen as opposed to that in the GAX process.

Jelinek.et.al, (2012) analyzed the efficiency of the absorption / compression process by triple pressure point. With mechanical compressor installed in place of a jet ejector, a single stage absorption process was performed at triple pressure level in their analysis. It has resulted in a decrease in the temperature of the generator, a decrease in the diffusion ratio and the heat exchanger region of the solution and COP rise. Such changes may be due to working fluid operating conditions and thermo-physical properties.

Zheng and Meng, (2012) studied hybrid refrigeration cycle thermodynamic mechanism. Two basic principles were introduced, such as ultimate refrigeration temperature (or ultimate temperature lift) and behavioral changing. It studied the impact of compressor pressure, difference in concentration, working fluid circulation ratio, etc. It was found that the output of the refrigeration cycle varies with the change in the compressor outlet pressure and depends on the process of hybrid refrigeration, the absorption sub-system or the compression sub-system. Similarly Jiyoung.et.al, (2013), established the hybrid process of compression / absorption using ammonia water mixture.

Critical study of review literature on hybrid cooling and air-conditioning systems based on a range of input energy sources.

III. SYSTEM DESCRIPTION

Figure 2 provides schematic description of a double-effect system with parallel flow. This figure shows that the weak solution which leaves the absorber is pumped to the low-temperature heat exchanger (LTHE), after which it is divided into two streams.





One stream flows to the HPG through the high-temperature heat exchanger (HTHE) and the other to the low-pressure generator (LPG) via EV_4 . In the LPG, the vapour refrigerant from the high-pressure generator (HPG) is condensed and its latent heat is utilized to generate water vapour from the weak solution in the LPG. A high-temperature heat source is used to provide heat to the HPG for water vapour generation from the weak solution. The strong solution exiting the HPG passes to the mixing point (P1), where it mixes with the other strong solution from the LPG. The combined strong solution is passed to the absorber through LTHE and EV_3 .

IV. PHYSICAL MODEL

A double-effect absorption cooler system with parallel flow has five main components: a high-pressure generator, a low-pressure generator, an absorber, a condenser and an evaporator. The device consists of a 5-temperature (LPG temperature, HPG temperature, evaporator temperature, condenser temperature, and absorber temperature) and a 3-pressure level (low evaporator and absorber pressure, medium condenser pressure and low pressure generator, high pressure in the high pressure generator). Figure 3 displays the diagram of a parallel flow double-effect absorption cooler system adapted by us.

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Figure 3:Schematic diagram of a parallel flow double-effect absorption refrigerator

In this model Q_{HPG} , is the rate of heat absorbed from the heat source at temperature T_{HPG} to high pressure generator Q_{LPG} , is the rate of heat absorbed from the heat source at temperature T_{LPG} to low pressure generator, Q_C is the heat rejection rate from the condenser to the heat-sink at temperature T_c , Q_A is the heat rejection rate from the absorber to the heat-sink at temperature T_A and Q_E is the heat input rate from the cooling space at temperature T_E to the evaporator. The work input required by the solution pump is negligible compared to the energy input to the high and low pressure generator. According to the first law of thermodynamics, we have (Göktun and Er, 2000).

$$\dot{Q}_{LPG} + \dot{Q}_E - \dot{Q}_C - \dot{Q}_A = 0 \qquad (1)$$

The performances of an absorption refrigerator system closely depend on the irreversible factors. We have considered the cycle of the working fluid as a three-irreversible isothermal process and three-irreversible adiabatic process since the double-effect system is a triple thermal system.

The temperatures of the working fluid in the isothermal processes are different from those of the external heat reservoirs such that the heat is transferred under a finite temperature difference. Figure 4 presents a schematic diagram of an irreversible parallel flow double-effect absorption refrigerator.

In this figure, T_1 and T_2 are respectively the temperatures of the working fluid in the HP generator and LP generator. T_3 , T_4 and T_5 are respectively the temperature of the working fluid in the absorber, evaporator and condenser. We also considered the existence of heat leakage from the heat sink to the cooled space denoted Q_L .



Figure 4:Schematic diagram of an irreversible parallel flow double-effect absorption refrigerator The heat exchanged between the working fluid and heat reservoirs obey a linear heat transfer law, such that the equation of heat transfer can be written as:

1

$$\dot{Q}_{HPG} = U_{HPG} A_{HPG} \left(T_{HPG} - T_1 \right)_{(2)}$$
$$\dot{Q}_{LPG} = U_{LPG} A_{LPG} \left(T_2 - T_{LPG} \right)_{(3)}$$

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Q

$$_{E} = U_{E}A_{E}\left(T_{E} - T_{4}\right) \tag{4}$$

$$Q_{A} = U_{A}A_{A}(T_{3} - T_{A})$$
(5)

$$\mathcal{Q}_{c} = U_{c}A_{c}\left(T_{5} - T_{c}\right)_{(6)}$$

Following the idea developed by Chen and Schouten (1998), the heat-leak of a parallel flow double-effect system is given by:

$$Q_{L} = K_{L} \left(T_{A} - T_{E} + T_{C} - T_{E} + T_{LPG} - T_{E} \right)$$
(7)

Where, Equations (1)-(6) are written like Göktun and Er (2000). In equations (2)-(6), A_{HPG} , A_{LPG} , A_E , A_A and A_C are the heat-transfer areas of the HP generator, LP generator, evaporator, absorber and condenser respectively U_{HPG} , U_{LPG} , U_E , U_A and U_C are the overall heat-transfer coefficients of the HP generator, LP generator, evaporator, evaporator, absorber and condenser respectively.

The total area of heat transfer between the cycle system and the external heat reservoirs is given by the relationships:

 $A = A_{HPG} + A_{LPG} + A_E + A_A + A_C (8)$

Defining the parameter *a* as the distribution rate of the total heat reject quantity between the condenser and the absorber given as:

$$a = \frac{Q_A}{Q_C} \tag{9}$$

The parameter b as the ratio of the total heat between the HP generator and the LP generator given as:

$$b = \frac{Q_{HPG}}{Q_{LPG}} \tag{10}$$

Using Equations (4.1)-(4.10), we obtain the coefficient of performance, the specific cooling load and the specific rate of entropy production of a parallel flow double-effect absorption refrigerator given by the following equations:

$$COP = \frac{Q_F - Q_L}{Q_{HPG}} = \frac{Q_F}{Q_{HPG}} \left(1 - \frac{Q_L}{Q_E} \right) = \frac{Q_F}{bQ_{LPG}} \left(1 - \frac{Q_L}{Q_E} \right)$$
(11)

According to the definition of the general thermo-ecological criterion function (Ust and Sahin, 2007; Ust, 2009; NgouateuWouagfack and Tchinda, 2011a,b, 2013a,b; NgouateuWouagfack, 2012 and MedjoNouadje et al., 2013, 2014). The new thermo-ecological objective function called ecological coefficient of performance (ECOP) of a parallel flow double-effect absorption refrigerator system is written as:

$$ECOP = \frac{Q_{E} - Q_{L}}{T_{env}\sigma} = \frac{1}{T_{env}} \left\{ \left| \left(\frac{Q_{E}}{Q_{LPG}} \right)^{-1} \left(\frac{T_{C}^{-1} + aT_{A}^{-1}}{1 + a} - b(T_{HPG})^{-1} \right) + \frac{T_{C}^{-1} + aT_{A}^{-1}}{1 + a} - T_{E}^{-1} \right\} + \left\{ \left| \left(\frac{1}{U_{E}(T_{E} - T_{A})} + \frac{bQ_{LPG}}{Q_{E}U_{HPG}} + \frac{Q_{LPG}}{Q_{E}U_{LPG}} + \frac{Q_{LPG}}{Q_{E}U_{LPG}} + \frac{a\left(1 + \frac{Q_{LPG}}{Q_{E}}\right)}{U_{A}(T_{5} - T_{A})(1 + a)} + \frac{\left(1 + \frac{Q_{LPG}}{Q_{E}}\right)}{U_{C}(T_{5} - T_{C})(1 + a)} \right\} \right\}$$

$$-\xi \big(T_A - T_E + T_C - T_E + T_{LPG} - T_E \big) \Big\}^{-1} \left\{ \xi \big(T_A - T_E \big) \bigg(\frac{T_C^{-1} + aT_A^{-1}}{1 + a} T_A^{-1} \bigg) + \xi \big(T_C - T_E \big) \bigg(\frac{T_C^{-1} + aT_A^{-1}}{1 + a} - T_C^{-1} \bigg) \right\}^{-1} \left\{ \xi \big(T_A - T_E \big) \bigg(\frac{T_C^{-1} + aT_A^{-1}}{1 + a} - T_C^{-1} \bigg) + \xi \big(T_C - T_E \big) \bigg(\frac{T_C^{-1} + aT_A^{-1}}{1 + a} - T_C^{-1} \bigg) \right\}^{-1} \left\{ \xi \big(T_A - T_E \big) \bigg(\frac{T_C^{-1} + aT_A^{-1}}{1 + a} - T_C^{-1} \bigg) + \xi \big(T_C - T_E \big) \bigg(\frac{T_C^{-1} + aT_A^{-1}}{1 + a} - T_C^{-1} \bigg) \right\}^{-1} \left\{ \xi \big(T_A - T_E \big) \bigg(\frac{T_C^{-1} + aT_A^{-1}}{1 + a} - T_C^{-1} \bigg) \right\}^{-1} \left\{ \xi \big(T_A - T_E \big) \bigg(\frac{T_C^{-1} + aT_A^{-1}}{1 + a} - T_C^{-1} \bigg) \right\}^{-1} \left\{ \xi \big(T_A - T_E \big) \bigg(\frac{T_C^{-1} + aT_A^{-1}}{1 + a} - T_C^{-1} \bigg) \right\}^{-1} \left\{ \xi \big(T_A - T_E \big) \bigg(\frac{T_C^{-1} + aT_A^{-1}}{1 + a} - T_C^{-1} \bigg) \right\}^{-1} \left\{ \xi \big(T_A - T_E \big) \bigg(\frac{T_C^{-1} + aT_A^{-1}}{1 + a} - T_C^{-1} \bigg) \right\}^{-1} \left\{ \xi \big(T_A - T_E \big) \bigg(\frac{T_C^{-1} + aT_A^{-1}}{1 + a} - T_C^{-1} \bigg) \right\}^{-1} \left\{ \xi \big(T_A - T_E \big) \bigg(\frac{T_C^{-1} + aT_A^{-1}}{1 + a} - T_C^{-1} \bigg) \right\}^{-1} \left\{ \xi \big(T_A - T_E \big) \bigg(\frac{T_C^{-1} + aT_A^{-1}}{1 + a} - T_C^{-1} \bigg) \right\}^{-1} \left\{ \xi \big(T_A - T_E \big) \bigg(\frac{T_C^{-1} + aT_A^{-1}}{1 + a} - T_C^{-1} \bigg) \right\}^{-1} \left\{ \xi \big(T_A - T_E \big) \bigg(\frac{T_C^{-1} + aT_A^{-1}}{1 + a} - T_C^{-1} \bigg) \right\}^{-1} \left\{ \xi \big(T_A - T_E \big) \bigg(\frac{T_C^{-1} + aT_A^{-1}}{1 + a} - T_C^{-1} \bigg) \right\}^{-1} \left\{ \xi \big(T_A - T_E \big) \bigg(\frac{T_C^{-1} + aT_A^{-1}}{1 + a} - T_C^{-1} \bigg) \right\}^{-1} \left\{ \xi \big(T_A - T_E \big) \bigg(T_A^{-1} + T_A^{-1} - T_C^{-1} \bigg) \right\}^{-1} \left\{ \xi \big(T_A - T_A^{-1} + T_A^{-1} - T_C^{-1} \bigg) \right\}^{-1} \left\{ \xi \big(T_A - T_A^{-1} + T_A^{-1} - T_A^{-1} \right) \right\}^{-1} \left\{ \xi \big(T_A - T_A^{-1} + T_A^{-1} - T_A^{-1} - T_A^{-1} \right\}^{-1} \left\{ \xi \big(T_A - T_A^{-1} + T_A^{-1} - T_A^{-1} - T_A^{-1} - T_A^{-1} + T_A^{-1} - T_A^{-1} \right\}^{-1} \left\{ \xi \big(T_A - T_A^{-1} + T_A^{-1} - T_A^{-1} - T_A^{-1} + T_A^{-1} + T_A^{-1} - T_A^{-1} + T_A^$$

 $+\xi \left[\frac{\dot{Q}_{E}}{\dot{Q}_{LPG}}\right]^{-1} \left(T_{A} - T_{E} + T_{C} - T_{E} + T_{LPG} - T_{E}\right) \left(\frac{T_{C}^{-1} + aT_{A}^{-1}}{1 + a} - b(T_{HPG})^{-1}\right) + \xi \left(T_{LPG} - T_{E}\right) \left(\frac{T_{C}^{-1} + aT_{A}^{-1}}{1 + a} - T_{LPG}^{-1}\right) \right\}^{-1}$

The equation 12 finds the value of ECOP.

V. RESULT AND ANALYSIS

Numerical calculations are carried out by employing the relevant values U_{HPG} =173500 Wm⁻² K⁻¹, U_{LPG} =171900 Wm⁻² K⁻¹, U_{E} =449000 Wm⁻² K⁻¹, U_{A} =379700 Wm⁻² K⁻¹, U_{C} =278200 W m⁻² K⁻¹ taken from refs. (Chua et al., 2000) and T_{HPG} =443 K, T_{LPG} =363 K T_{C} =303 K, T_{A} =305 K, T_{env} =300 K, T_{E} =285 K.

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(12)

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Maple software is used to carry out derivation and to solve polynomial equation. MATLAB software is used for numerical calculations and to plot the curves.

Optimization Based on the Coefficient of Performance

Figure 5presents the effect of the heat leakage coefficient on the maximum coefficient of performance for different values of the internal irreversibility parameter. We can observe that the COP_{max} decreases with an increase in the heat leakage coefficient. It can also be seen that when $\xi = 0$, that is there is no loss due to heat leakage and when I = 1, the system is endoreversible and $\text{COP}_{max} \approx 1.23$.



Figure 5 :Effect of the heat leakage coefficient on COP_{max} for different values of I at a=2.5, b=1.23

Figure 6 presents the effect of the parameter a on the maximum coefficient of performance for different values of the internal irreversibility parameter. We observe that the COP_{max} decreases slightly with an increase in the parameter a, and tends to an asymptotic value when the parameter a is large.

We can conclude that the effect of the parameter a on the maximum coefficient of performance could then be neglected.



Figure 6:Effect of the parameter a on COP_{max} for different values of I at $\xi = 0.7$, b=1.23

Figures 8 and 9 present the effect of the internal irreversibility on the specific entropy generation rate and the specific cooling load at the maximum coefficient of performance respectively. As expected, the specific entropy generation rate increases with the increase in the internal irreversibility while the specific cooling decreases.



Figure 7:Variations of the normalized ECOP and COP with respect to the normalized specific entropy generation rate (I=1.01, $b=1.23, \xi=0.7$)



Figure 8:Variations of S_m with respect to the internal irreversibility I at b=1.23, a=2.5, ξ =0.7



Figure 9:Variations of R_m with respect to the internal irreversibility I at b=1.23, a=2.5, $\xi = 0.7$

Proposed Work

Comparison of COP, ECOP and R as in propose work



Figure 10: Variations of the normalized ECOP and COP with respect to the normalized specific entropy generation rate $(I=1.01, b=1.23, \xi=0.7)$



Figure 11:Effect of the parameter a on COP_{max} for different values of I at $\xi = 0.7$, b=1.23

As the value of a increases Coefficient of performance decreases. Also the value of I affects the system performance. So in order to make the COP high we should lower the value of I and a.

VI. CONCLUSION

In this paper the finite-time performance optimization for a parallel flow dual-effect irreversible absorption refrigerator device with losses of heat resistance, heat leakage and internal irreversibility was investigated by considering the performance coefficient (COP) and the ecological performance coefficient (ECOP) as objective features. This investigates the five optimal working fluid temperatures in the key system components that optimize the COP function and the corresponding ecological efficiency coefficient, specific cooling load, and specific entropy output rate. Then it has been shown that for the same operating conditions the maxima COP and ECOP do not occur. The results of the internal irreversibility, heat leakage and distribution rate of the total heat discharge quantity between the condensers and the absorber and the ratio of the total heat between the HP generator and the LP generator on the general and optimal COP and ECOP were investigated.

References

- [1] Arora A., S.C. Kaushik, 2009. Theoritical analysis of LiBr/H2O absorption refrigeration systems. Int. J. Energy Res.33, 1321-1340.
- [2] Arun, M.B., Maiya, M.P., Murthy, S.S., 2000. Equilibrium low pressure generator temperatures for double effect series flow absorption refrigeration systems. Appl. Therm. Eng. 20, 227-242.
- [3] Chen, L., Li, Y., Sun, F., Wu, C., 2002. Optimal performance of an absorption refrigerator. Exergy Int. J. 2, 167-172.
- [4] Chen, L., Sun, F. (eds.)., 2004. Advances in Finite Time Thermodynamics: Analysis and Optimization. New York: Nova Science Publishers.
- [5] Ezzine N. B., Mejbri K., Bahroumi M., Bellagi A., 2005. Irreversibilities in two configurations of the double generator absorption chiller: Comparison of performance. J. Thermal Analysis and Calorimetry, Vol. 80, 471–475.
- [6] Farshi, L. G., SeyedMahmoudi, S.M., Rosen, M.A., 2011. Analysis of crystallization risk in double effect absorption refrigeration systems. Appl. Thermal Engineering 31, 1712- 1717.
- [7] NgouateuWouagfack, P.A., Tchinda, R., 2011a. Performance optimization of three-heat-source irreversible refrigerators based on a new thermo-ecological criterion. Int. J. Refrig. 34, 1008-1015.

UGC Care Group I Journal Vol-10 Issue-08 No. 15 August 2020

- [8] Qin, X., Chen, L., Ge, Y., Sun, F., 2013. Finite time thermodynamic studies on absorption thermodynamic cycles: A state of the arts review. Arab. J. Sci. and Eng. 38(3), 405-419.
- [9] Sedigh, S., Saffari, H., 2011. Thermodynamic Analysis of Series and Parallel Flow Water/Lithium Bromide Double Effect Absorption System with Two Condensers. J. Materials Sci. Eng. B 1, 206-217.
- [10] Shahata, A.I., Aboelazm, M. M., Elsafty, A. F., 2012. Energy and Exergy Analysis for Single and Parallel Flow Double-Effect Water-Lithium Bromide Vapor Absorption Systems. Int. J. Sci. Tech., Vol. 2 No.2.
- [11] Stitou, D., Feidt, M., 2005. New criteria for the optimization and characterization of thermal energy conversion processes. Int. J. Therm. Sci. 44(12), 1142-1153.
- [12] Torrella, E., Sánchez, D., R. Cabello, Larumbe, J.A., Llopis, R., 2009. On-site real-time evaluation of an air-conditioning direct-fired double-effect absorption chiller. Appl. Energy 86, 968–975.
- [13] Ust, Y., Sahin, B., 2007. Performance optimization of irreversible refrigerators based on a new thermo-ecological criterion. Int. J. Refrig. 30, 527-534.
- [14] Ust, Y., 2009. Performance analysis and optimization of irreversible air refrigeration cycles based on ecological coefficient of performance criterion. Appl. Therm. Eng., 47-55.
- [15] Xu, G. P., Dait, Y. Q., 1997. Theoretical analysis and optimization of a double-effect parallel-flow-type absorption chiller. Appl. Therm. Eng., Vol. 17, No. 2. pp. 157-170.
- [16] Zheng, T., Chen, L., Sun, F., Wu, C., 2003a. Performance optimization of an irreversible four-heat-reservoir absorption refrigerator. Appl. Energy, 391-414.
- [17] Zheng, T., Chen, L., Sun, F., Wu, C., 2003b. Performance of a four-heat-reservoir absorption refrigerator with heat resistance and heat leak. Int. J. Ambient Energy, 24(3), 157-168.

IDENTIFY THE ROLE OF CUSTOMER CARE SERVICE IN TELECOM SECTOR: CASE STUDY OF RELIANCE JIO

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Abstract

Telecom sector in our country is one of the biggest capital intensive sectors in nature. Due to government initiative to encourage telecommunication sector many companies diversified their business. International companies, like Vodaphone, Docomo, has started business in India. Ranking of our country in term of subscribers in second. Private companies like Bharti Enterprises, Reliance Industries, TATA, Aditya Birla are the major investor in telecom sectors. This sector is service based sectors and consumer satisfaction is primary motive. This research paper is based on customer satisfaction level of consumers of Reliance Jio. The data is collected from primary sources by using questionnaire. The method of collection by convinces sampling. Sample size is 50. Analysis of data is through SPSS software.

Keywords : Telecommunication, FDI, Customer Satisfaction

[1]INTRODUCTION

A customer is an important factor and plays a crucial role in any process of marketing. That's why customer are suppose to be a king of the market i.e. the concept of customer preference and their behavior become so important because customer is suppose to makes the market and compels the supplier to retain and redesign the product. They have to think about the market segmentation, market strategies, consumer behavior, consumer's tastes, consumer's lifestyle etc for the satisfaction of needs and wants of the customer. Companies are smart enough to understand the customer's needs and wants according to their belief. It provides them growth, profitability and creativity with lot of innovation.

With increasing number of telecom service providers, the competition is increasing day by day and to attract and retain the customer, customer care services has become very crucial that's why

ISSN NO: 1533-9211

the researcher has thought that the study of customer care services in the Indian telecom sector will be a good subject for research

[2]THE RESEARCH STUDY (OBJECTIVE AND SIGNIFICANCE) OBJECTIVES OF THE STUDY

- > To identify the critical success factors that are vital for success of Telecom Industry
- To identify the reasons for Churn reduction in the telecom industry and measures adopted by Customer Care to address such serious concern.
- To provide awareness of Customer Care role in providing good service to achieve the organization objectives.

[3]SIGNIFICANCE OF THE STUDY

This research helps to understand the importance of customer care in the telecommunication industry. As it is well known that "customer is king", therefore it is necessary to keep him happy. The importance of customer care in the telecommunication industry is Customer care handles the queries of customer about the services of the respective service providers. Customer care is helpful in retaining the customers from switching the operator. It is the effort of customer care that reduces the churn in the industry and makes the customers loyal towards their organization.

[4]RESEARCH METHODOLOGY

Here, researcher's presented the methodology which was adopted for answering the research questions which we have formulated and presented.We'll enlighten the way that how we collected the data concerning our research. We will also describe the frame work which we followed during our research and analysis. For the proper analysis of data simple statistical techniques such as percentage, SPSS analysis of Mean, Median, Standard Deviation and Skewness were used. It helps in making more generalization from the data available. The data which will be collected from a sample of population was assumed to be representing entire population was interest.Classification of data is based on demographic factors like Age, Sex etc.

[5]SAMPLE SUMMARY

Area:	KANPUR
Size:	50 Respondents
Technique:	Purposive Sampling
Selection:	The respondents were selected at purposive and were approached mostly in public
	places, offices, residential in various areas of Kanpur such as Kidwai Nagar, Yashoda
	Nagar.

[6]PROBLEM SELECTION

Telecom sector has changed the ways of communication of people around the world and it has shown vigorous growth in India during past few years. As these services and facilities have penetrated into lives of people, so they are also interfering with the social and cultural setups. For these reasons we thought to choose the topic and our main emphasis was to analyze Customer care services in accordance to marketing and a business strategy as understanding of local consumer is very important for doing a business in a new place.

[7]COLLECTION OF DATA

The data is collected from the people in the form of questionnaire (Google Form) and the sample size is 50 respondents. Because it is a pilot study and due to time constraint the sample size is small.We choose only the prepaid and post-paid customers. For conducting a research, two types of data is used which are Primary and secondary data. We used a combination of primary and secondary data for our research area.

[8]LIMITATION OF THE STUDY

Every study has some limitations; similarly this study has also the following limitation. The limitations for this study are discussed below:

- The study is based only on geographic area of Kanpur, which is very small for this type of study and the sample size for this study is 50, which is too small for the study like this.
- Shortage of important aspect such as time, financial problem, and complete size prevented research from detailed study, while in the main cause of limitation of report.

[9]CONCEPT OF CUSTOMER CARE

Customer care is a crucial element of business success. Every time you have contact with the customers you have an opportunity to improve your reputation with them and increase the likelihood of further sales. There are also specific programmed you can put in place to increase the levels of customer care. Customer care involves putting systems in place to maximize the customers' satisfaction with your business. It should be a prime consideration for every business - your sales and profitability depends on keeping your customers happy.

Customer care is more directly important in some roles than others. For receptionists, sales staff and other employees in customer-facing roles, customer care should be a core element of their job description and training, and a core criterion when you're recruiting.But don't neglect the importance of customer care in other areas of your business.

[10] DATA ANALYSIS AND INTERPRETATION

[10.1]ATTRIBUTES OF SERVICE PROVIDERS FOR ENCOURAGING CUSTOMER PURCHASE

The companies are encouraging the customers by providing various attributes to retain them. There are two aspect of analysis one is based on companies and other one is based on attributes.The researcher will analyze the study by assuming the attribute basis.

- **A. Talk Time And Validity-:** Considering the attribute the researcher found that Reliance Jio is the leader in providing the best talk time and validity schemes. Schemes such as Recharge with Rs. 299 and get Rs.349, that is more than what is paid to company are been offered to customers in the past.
- **B. Call Charges-:** Considering the call charges, again Reliance Jiocaptured the market. As responded by the respondents, JIO offers best calling tariffsi.e free Call Charge.
- **C. Quality of Services-:** In this attribute the best quality service is been provided by AIRTEL. The quality of service is determined as an important factor while customer churn and retention is concerned.
- **D. Special Offers/ Schemes-:** Considering this attribute again Reliance Jio is found as the attribute leader in this section. As responded by the respondents, it has best in providing special offers and schemes.

- **E. Voice Clarity-:** Voice clarity refers to the clarity of voice while making call, this attribute is very important and if the voice is not clear the message is not clear and it may be called miscommunication. AIRTEL is found as the best in this attribute.
- **F. Network Connectivity-:** This attribute is also known as Network Congestion that is while making call either the call is dropped or it is connected to some other person. It is found in the study that Airtel is the best as far network connectivity is concerned.
- **G. Tariff-:**When talking about tariff, it comes in mind the vouchers such as free call rates, free SMS packs. It is found in data collection that Reliance JIO is the best in providing the tariff.
- **H. Availability of Service-:**Availability of services refers to how easily service is available in the market. It includes availability of recharge coupons, Sim cards etc. In this section it is found that the services of Reliance JIO are easily available in the market.
- I. Value- Added- Service-: Value- added- services as referred by name that additional valued services provided by the service providers to the customers. As per the respondents opinion Reliance JIO was found the best among the service providers under this category.
- **J. Billing System- :** Most of the customers are also partially satisfied with the billing system of Reliance, but they assume that Airtel system is more better.
- **K.** Customer Care Services-:Customer care services are those services that are provided by companies for resolving customer queries. These queries includes- complain resolution, billing disputes, new connection query etc. it is found that best customer care services are provided by Airtel. It is also one of the important factors in calculating the customer satisfaction.

SPSS Analysis of Impact of Customer Care on Customer Satisfaction.

Table 1

Statistics Is customercare significant in determining customer satisfaction?

N	Valid	50
IN	Missing	0
Mean		3.6400
Median		4.0000
Mode		5.00
Std. Deviation		1.17387
Skewness		273
Std. Error of		227
Skewness		.557
Kurtosis		-1.118
Std. Error	of Kurtosis	.662

Is customercare significant in determining customer satisfaction?

		Frequenc y	Percent	Valid Percent	Cumulative Percent
	strongly disagree	1	2.0	2.0	2.0
	disagree	9	18.0	18.0	20.0
Valid	Neutral	13	26.0	26.0	46.0
	Agree	11	22.0	22.0	68.0
	strongly agree	16	32.0	32.0	100.0
	Total	50	100.0	100.0	

Table 2

Analysis:

In the sample size of 50 respondents. The Mean and Median Values are 3.64 and 4.00 respectively which show that considerable number of respondents agree that Customer Care is contributing to Customer Satisfaction. Even the Kurtosis Value of -1.118 suggests that majority of the respondents agree Customer Satisfaction is driven by Customer Care.

Reliability Test through Cronbach Alpha

RELIABILITY /VARIABLES=Talktime ServiceQuality Offers /SCALE('ALL VARIABLES') ALL

/MODEL=ALPHA.

Scale: ALL VARIABLES

Table	3:-	Case	Proces	ssing
-------	-----	------	--------	-------

Summary

		Ν	%
	Valid	49	100.0
Cases	Excluded ^a	0	.0
	Total	49	100.0

a. Listwise deletion based on all variables in the procedure.

Table 4: ReliabilityStatistics

Cronbach's	N of Items
Alpha	
.836	3

Analysis:

Cronbach's alpha is a measure of internal consistency, that is, how closely related a set of items are as a group. It is considered to be a measure of scale reliability. A "high" value for alpha does not imply that the measure is unidimensional. If, in addition to measuring internal consistency, you wish to provide evidence that the scale in question is unidimensional, additional analyses can be performed. Exploratory factor analysis is one method of checking dimensionality. Technically speaking, Cronbach's alpha is not a statistical test – it is a coefficient of reliability (or consistency). The value of Cronbach alpha is 0.836 considering variables as Talktime, Service Quality and Offers which indicates measure of internal consistency.

[11] FACTORS THAT INFLUENCE YOU FOR OPTING SERVICE PROVIDERS:-

Here are few factors that influence the respondents to choose the service provider. The researcher will now analyze that which is the most influencing factor that influences the respondents in selecting the service provider.

As per the data collected, researcher found that 21% of respondents look forward for Quality of Services while making the selection of service provider.20% of respondents prefer Customer Care Services as important factor for making selection of service providers.18% respondents prefer Network Connectivity as selecting factor for service provider.VAS is preferred by 16% of respondents as important factor of selecting service provider.Whereas contribution of other factors in selecting service providers can be Special Offers/ Schemes3%, Brand Image5%, Advertising4%, Tariff3%, Availability3%, Talk time & validity 4%, Billing System3%.

[12] ANALYSIS OF THE SERVICES OF CUSTOMER CARE EXECUTIVE

The customer care executives and their services play an important role in retaining the customer and decrease the customer churn outs. Here the researcher analyzed that how the customer care executives deal up with the customers. The researcher interviewed the respondents about the services provided by customer care executives to the respondents. The researcher analyzed that:





- 46% of respondents told that the customer care executive's services are warm and helpful in solving their queries and providing them the feasible resolution for their queries.
- ➤ 38% of respondents told that customer care services are prompt and they get the resolution promptly.
- 16% of respondents told that the customer care service are lazy and slow, that is they do not take much interest in providing the solution to the customer.





If the services of customer care executives are improved it may help the companies to decrease the customer churn outs.

[13] REASONS FOR CUSTOMER CHURN

The researcher was required to find out the biggest reasons for customer churn. The researcher asked the relevant question from the respondents to find out why they leave their service provider. The researcher found that:

ISSN NO: 1533-9211

- 31% of the respondents preferred leaving the service provider because of the Quality of Services.
- ➤ 45% of the respondents go with the network congestion and call drops for switching to other service provider.
- 17% of the respondents leave the service provider because of delay response from customer care.
- > 7% of the respondents leave the service provider because of Billing System.

H0:-Courteous Language and knowledgeable person are not the most influencing factors for resolving the grievances of the customer

H1:-Courteous Language and knowledgeable person are the most influencing factors for resolving the grievances of the customer

[14] INTERPRETATION

Above data analysis shows that most of the users of all companies found their customer service provider courteous and knowledgeable. But the result of Reliance Jio is not good as the users say that they have not talk to their customer care service provider even for a single time. Some of them have talk but after a lot of waiting time. So they are found not satisfied and rated this question also as dissatisfied. So after studying their views with a personal discussion we can say that the customer care representatives of Reliance Jio are not courteous and knowledgeable.

Out of total 50 respondents more than 60% are concerned with Courteous Language and Knowledgeable person. Because they opted somewhat agree and strongly agree option. Therefore we can say that majority of the respondents are with the Courteous Language and knowledgeable Person are the most influencing factors for resolving the grievances of the customer.

[15] CONCLUSION AND RECOMMENDATIONS

As a result of the liberalization, privatization, and de-monopolization initiatives taken by the government of India, the telecom sector is experiencing a historical growth. The trend is expected to continue in the segment, as prices are falling as a result of competition in the segment. The beneficiaries of the competition are the consumers, who are given a wide variety of services. In the years to come the country is predicted to witness a communication revolution, which would increase the tele-density to match that of the developed world. The need of the time is a new revolution in mobile telephony and it is imperative that service providers work towards the same and make it a reality. The number portability issues will solve many problems and will help the end users, which will change the whole scenario of competition and will make the game tougher for the service providers.

Telecom majors should think to launch the product according to the needs of customers to satisfy them and make them brand loyal .They should also think for searching new space or we can say either creating a new blue space to sustain their growth in long run.There is more room for data analysis but the rest of the part is beyond the scope of this project report. According to the results, the most important determinant for consumers are service quality, Network Coverage, value offered and brand image.

Retaining customers in the service industry has become a major objective of customer care. Customer care tactics are considered to be essential for building long-term relationship with customers in order to achieve mutual benefits of all parties. Although customer care tactics has been widely implemented by service providers, customers still tend to switch to competitor. Therefore, this study was conducted to exam the impact of customer care tactics (service quality, Network Coverage, value offered and brand image) on relationship quality (trust and satisfaction), and in turn effect the customer loyalty within on mobile telecommunication industries.

The final conclusion made out of the research is that, nowadays any firm offering service may lose their customers because of the poor customer service. Studies have shown that firms can boost their profits by almost 100% by retaining 15% more of their customers than their competitors retain. This is because the cost of acquiring new customers is much higher than the

costs associated with retaining customers. Firms with loyal, long time customers can financially outperform competitors with higher customer turnover, even when their costs in limit.

[16] RECOMMENDATIONS ON THE BASIS OF RESEARCH

- All the providers need to gear themselves on their approach. As the market is going to get more competitive, service will be the only key differential factor.
- Immediate improvement plan for all service providers with full action planning is required so as to gap whichever loopholes prevalent in the system. They should have a look at their attributes in totality to give an overall delight feel towards their customers.
- Providers should immediately prepare a action charter as to how they are going to save such a huge base from churning out. Providers like BSNL needs some heavy improvement is terms of process and transactional analysis.
- Providers need to ease out the documentation and address verification system which unnecessarily takes time during initial activation phase.

[17] LIST OF REFERENCES

- Porter, L.W. (1961) "A study of perceived need satisfaction in bottom and middle management jobs", Journal of Applied Psychology, Vol. 45, pp. 1-10.
- Peterson, R.A. and Wilson, W.R. (1992) "Measuring customer satisfaction: fact and artifact", Journal of the Academy of Marketing Science, Vol. 20, pp. 61-71.

[18] **BOOKS**

- Zeithaml, Valarie (2008), Service Marketing, 4th Ed. New Delhi: Tata McGraw Hill Publishing Company Lmt
- AL Golin, "Trust or Consequences Build Trust Today or Lose Your Market Tomorrow", AMACOM, 2004.

[19] REPORTS

Annual report on Telecommunications 2003-04, Department of Telecommunications, Government of India, www.dotindia.com.

[20]WEBSITES

- www.businesslink.com
- ➢ www.trai.gov.in

Double Effect Absorption Optimization of Refrigerator in Finite Time Thermodynamics: A Survey

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Abstract—Refrigeration and air conditioning (RAC) plays a very significant role in our day-to-day operating needs for ventilation and heating. Refrigeration devices are commonly used in working / living environments to regulate temperature and provide human thermal comfort. The use of refrigeration equipment for cooling is not new; but, due to certain environmental requirements, air-conditioning equipment has to change.

Finite-time thermodynamics optimization study was conducted based on the efficiency coefficient and the ecological coefficient of success parameters. This was performed analytically and numerically with a parallel flow absorption refrigerator of a double-effect with lack of heat resistance, heat leakage and internal irreversibility. The overall efficiency coefficient and the corresponding optimum conditions were analytically derived. This paper we study refrigerator and its principles for double impact absorption.

Index Terms—Double-effect absorption refrigeration system, finite-time thermodynamic, optimization, coefficient of performance, ecological coefficient of performance

I. INTRODUCTION

Absorption refrigeration processes exist in finite-time finite-size devices; thus, reversibility constraints between the absorption refrigeration system and the surrounding environment can not be satisfied. Therefore, the classical thermodynamic efficiency limit does not provide the boundary of the absorption mechanism correctly (Bhardwaj et al., 2003; Kaushik et al ., 2002; NgouateuWouagfack and Tchinda, 2013a). Of this reason, the finite-time approach to thermodynamics was adopted to define the absorption system efficiency limit. The thermodynamics of the finite-time appear to model the system in a manner similar to truth. Thanks to internal dissipation of the operating fluid and thanks to the finite-rate heat transfer between the device, the external heat source and heat-sink, it helps to discern the irreversibilities. It is attempting to close the difference between the heat flow and thermodynamics. This deals with the optimisation of thermodynamic output in real finite-time and thermodynamic structures with finite-size.

Finite-time thermodynamic implementations cover all processes including thermal phenomena of all machines and systems working under finite-time and finite-size constraints. The endoreversible loop is the fundamental physical concept followed in thermodynamics of the finite-time.

II. LITERATURE REVIEW

Literature analysis interprets outdated information and provides a mix of new and outdated information. Therefore, there is a short overview of different research papers in this section and the frequency of research papers review and synthesis.

The hybrid cooling system has been described as a combination of two or more cooling systems. This is usually called a variation of the refrigeration method for compression and absorption. These variations have a number of cultural, social, and environmental benefits.

In the form of liquid, low-grade electricity, energy is supplied to your turbine for the operation of a vapor absorption refrigeration device. Low-grade energy sources such as biomass, waste heat recovery from power and process plants, and solar energy are under intensive study, particularly for use in the absorption system for vapour. Furthermore, the choosing of a appropriate absorbent-refrigerant pair that can be used as the working fluid in the absorption device is subject to exhaustive consideration by the researchers Efforts are under way to identify trade-offs between the energy sources and the refrigerant absorbent mix.

The driving force for this combination (compression-absorption) investigation is the need to make use of heat and operate from the same source. Many manufacturing systems consume an immense amount of thermal energy by burning fossil fuel for the purpose of generating steam or gas. Once the processes have been finished heat is discarded as waste to the immediate environment. In developing countries in particular, the usage of waste heat energy from process manufacturing as a source of usable energy is slowly gaining attention (Liao et al., 2004; Alford, 2005; Bombarda et al., 2009; Chacartegui et al., 2009; Invernizzi et al., 2007; Kaikko.et.al., 2009; Kosmadakis.et.al., 2009; Lozanova, 2009; Nasir.et.al., 2004; Sami, 2010; Srinivasan.et al., 2010; Vaja and Gambarot.al., 2009; It is due to its intrinsic significance of increasing energy production use, reducing the total entropy generation as well as raising the process's carbon footprint. According to the most recent figures released by the UK Department of Energy and Climate Change (DECC, 2011), excess heat can be turned into usable cooling by means of a power-operated cooling system, such as an absorption cycle of refrigeration.



Figure 1: The Osenbrück cycle

Today there are two main market methods where refrigeration is done on an global scale. It can either be a heat assisted NH3 + H2O refrigeration absorption (AR) system or a mechanically operated NH3 vapor compression cooling (VCR) system. Using the thermal waste and use the combined process of absorption and compression in the industrial refrigeration device has gained further interest.

The use of compression-absorption refrigeration cycles allows energy efficiency of high quality relative to traditional compression cycles. Amount of experiments have been performed on the refrigeration intervals of the compression absorption. One may trace the first published idea back to a German patent (Osenbrüeck, 1895). Figure 1 displays a diagram of the shortest compression / absorption process, called the Osenbrüeck process in inventor memory. No work on this process was published until early 1950, after 1895.

Such devices use environmentally friendly refrigerant-absorbing mixtures such as ammonia-water and lithium bromide-water, which are ozone-safe and have very little risk for global warming. Furthermore, owing to the use of mixtures these systems have higher comparative COPs, greater regulation of efficiency and lower pressure ratios in the system relative to vapor compression systems.

With Garimella.et. Al . (2011) studied a novel process of cascaded absorption / vapor-compression with a high temperature boost for naval use. A single effect LiBr – H2O absorption cycle and a subcritical CO2 vapor-compression cycle were combined to provide extremely low temperature refrigerant ($-40 \circ C$) for high heat flux electronic applications, medium temperature refrigerant ($5 \circ C$) for space conditioning and other low heat flux applications, and as an auxiliary gain, a medium temperature heat discharge of about 48 ° C for water heating applications was given. They developed a thermodynamic model to analyze cascaded system performance, and parametric analysis was performed to approximate system output over a variety of operating conditions. The cascaded system 's output was also contrasted with a two-stage comparable vapor-compression process. This process was shown to have very high COPs over a large variety of operating conditions and was found to reduce up to 31 per cent power demand relative to an analogous vapor-compression system.

Tyagi et.al, (2010) analyzed hybrid vapor compression-absorption process efficiency based on second law, using water-ammonia as a working fluid. Hybrid output was found to be less effective than traditional system in a reasonable range. But it can be strengthened by improving system configuration and process parameters. A thermodynamic model was developed to evaluate the performance of the cascaded system, and parametric analysis was conducted to approximate device output over a variety of operating conditions. The cascaded system 's output was also contrasted with a two-stage comparable vapor-compression process. This process was shown to have very high COPs over a large variety of operating conditions and was found to reduce up to 31 per cent power demand relative to an analogous vapor-compression system.

Yari et al, (2011) compared the GAX and GAX hybrid refrigeration absorption periods from both the first and second thermodynamic rules. Energy analyzes were conducted to measure the overall amount of energy loss within the periods. They found that the generator temperature (Tgen) has more effect on the second law output of both cycles while the temperature influences the coefficient of operation (COP) of the cycles comparatively less. An improvement in the GAX cycle output of around 75 per cent was observed when the temperature of the generator was controlled from 400 to 440 $^{\circ}$ K. For this generator temperature variance, the resulting COP rise was roughly 5%. In comparison, the optimum value of energetic output in the GAX hybrid cycle exists at a marginally higher value of Tgen as opposed to that of the GAX process.

Jelinek.et.al, (2012) analyzed the efficiency of the absorption / compression process by triple pressure point. With mechanical compressor installed in place of a jet ejector, a single stage absorption process was performed at triple pressure level in their analysis. It has resulted in a decrease in the temperature of the engine, a decrease in the diffusion ratio and the heat exchanger region of the solution and COP rise. Such improvements may be due to working fluid operating conditions and thermo-physical properties.

Zheng and Meng, (2012) studied hybrid refrigeration process thermodynamic mechanism. Two fundamental principles were introduced, such as ultimate refrigeration temperature (or ultimate temperature lift) and behavioral changing. This studied the effect of compressor pressure, difference in concentration, operating fluid diffusion ratio, etc. It was found that the output of the refrigeration process varies with the difference in the compressor outlet pressure and depends on the period of hybrid refrigeration, the absorption sub-system or the compression sub-system. Likewise Jiyoung.et.al, (2013), established the hybrid process of compression / absorption using ammonia water mixture.

Important study of research literature on hybrid cooling and air-conditioning applications based on a combination of variable energy sources.

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III. TWO-STAGE DUAL-FLUID ABSORPTION CYCLE (DUAL)

Figure 2 shows a two-step dual-fluid vapor absorption system with a first step LiBr-H2O cycle and a second stage ammonia cycle. The two-stage operation of the systems is identical to those running independently as a single step clear absorption process (SSAC). However, at second stage the cooling effect created by the E1 evaporator is used to cool the A2 absorber. In the ammonia process, H2O-NH3, LiNO3-NH and NaSCN-NH3 mixtures are chosen at the second level of the working fluids. In the case of the H2O-NH3 process, the generator consists of a mixture of rectifier and analyzer in the rectification column to isolate the concentrations of escaping water vapor and ammonia vapor. And almost pure ammonia vapor is required to leak into the C2 condenser after rectification. The cooling effect created by the ammonia liquid coming from the condenser in the evaporator E2 and then through the precooler and the throttle valve TV1, is intended to cool spaces. The heat required for the G1 and G2 generators will be obtained from the energy sources under analysis. The rectifier and the analyser are not needed in the LiNO3-NH3 and NaSCN-NH3 cycles.



Figure 2: Two Stage Dual Fluid Vapour Absorption Cycle

IV. PHYSICAL MODEL

A double-effect refrigerator absorption system with parallel flow has five primary components: a high-pressure generator, a low-pressure generator, an absorber, a condenser and an evaporator. The machine consists of five temperatures (LPG temperature, evaporator temperature, condenser temperature, and absorber temperature) and three pressures (low evaporator and absorber pressure, medium condenser pressure and low pressure generator, high pressure in the high pressure generator). Figure 3 displays the diagram of a parallel flow double-effect refrigerator absorption system adapted by us.



Figure 3: Schematic diagram of a parallel flow double-effect absorption refrigerator

In this model QHPG, is the heat rate absorbed from the heat source at temperature THPG to the high pressure generator QLPG, is the heat rate absorbed from the heat source at temperature TLPG to the low pressure generator, QC is the heat-release rate

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from the condenser to the heat-release at temperature Tc, QA is the heat-release rate from the absorber to the heat-release at temperature TA and QE is th Compared to the high and low pressure generator the work input provided by the solution pump is negligible. We have (Göktun and Er, 2000) according to first law of thermodynamics.

$$\dot{\mathcal{Q}}_{LPG} + \dot{\mathcal{Q}}_E - \dot{\mathcal{Q}}_C - \dot{\mathcal{Q}}_A = 0$$
(1)

The efficiency of a refrigerator absorption device depends strongly on the irreversible factors. We found the working fluid cycle to be a three-irreversible isothermal process and a three-irreversible adiabatic process, as the dual-effect system is a triple thermal system.

In the isothermal systems, the temperatures of the working fluid vary from those of the external heat reservoirs, such that the heat is transferred under a fixed temperature difference. Figure 4 shows a schematic diagram of a double-effect absorption refrigerator with an irreversible parallel flow.

For this example, the temperatures of the working fluid in the HP generator and LP generator are T1 and T2, respectively. T3, T4, and T5 are the temperature of the absorber, evaporator, and condenser working fluid, respectively. We also took into account the presence of heat leakage from the sink to the cooled space denoted Q_{L} .



Figure 4:Schematic diagram of an irreversible parallel flow double-effect absorption refrigerator

The heat exchanged between the working fluid and heat reservoirs obey a linear heat transfer law, such that the equation of heat transfer can be written as:

$$\begin{aligned}
\dot{Q}_{HPG} &= U_{HPG} A_{HPG} \left(T_{HPG} - T_{1} \right)_{(2)} \\
\dot{Q}_{LPG} &= U_{LPG} A_{LPG} \left(T_{2} - T_{LPG} \right)_{(3)} \\
\dot{Q}_{E} &= U_{E} A_{E} \left(T_{E} - T_{4} \right)_{(4)} \\
\dot{Q}_{A} &= U_{A} A_{A} \left(T_{3} - T_{A} \right)_{(5)} \\
\dot{Q}_{C} &= U_{C} A_{C} \left(T_{5} - T_{C} \right)_{(6)}
\end{aligned}$$

Following the idea developed by Chen and Schouten (1998), the heat-leak of a parallel flow double-effect system is given by:

$$Q_{L} = K_{L} \left(T_{A} - T_{E} + T_{C} - T_{E} + T_{LPG} - T_{E} \right)$$
(7)

Where, Equations (1)-(6) are written like Göktun and Er (2000). In equations (2)-(6), A_{HPG} , A_{LPG} , A_E , A_A and A_C are the heat-transfer areas of the HP generator, LP generator, evaporator, absorber and condenser respectively U_{HPG} , U_{LPG} , U_E , U_A and U_C are the overall heat-transfer coefficients of the HP generator, LP generator, LP generator, evaporator, absorber and condenser respectively.

The total area of heat transfer between the cycle system and the external heat reservoirs is given by the relationships: $A = A_{HPG} + A_{LPG} + A_E + A_A + A_C (8)$

Defining the parameter *a* as the distribution rate of the total heat reject quantity between the condenser and the absorber given as:

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$$a = \frac{Q_A}{Q_C}$$

(9)

(10)

The parameter *b* as the ratio of the total heat between the HP generator and the LP generator given as:

$$b = \frac{Q_{HPG}}{Q_{LPG}}$$

Using Equations (4.1)-(4.10), we obtain the coefficient of performance, the specific cooling load and the specific rate of entropy production of a parallel flow double-effect absorption refrigerator given by the following equations:

$$COP = \frac{Q_{E} - Q_{L}}{Q_{HPG}} = \frac{Q_{E}}{Q_{HPG}} \left(1 - \frac{Q_{L}}{Q_{E}} \right) = \frac{Q_{E}}{bQ_{LPG}} \left(1 - \frac{Q_{L}}{Q_{E}} \right)$$
(11)

Within the general thermo-ecological criterion feature concept (Ust and Sahin, 2007; Ust, 2009; NgouateuWouagfack and Tchinda, 2011a, b, 2013a, b; NgouateuWouagfack, 2012 and MedjoNouadje et al., 2013, 2014). The new thermo-ecological objective function called the ecological output coefficient (ECOP) of a double-effect parallel flow

absorption cooler system is written as:

$$ECOP = \frac{Q_{E} - Q_{L}}{T_{eev} \sigma} = \frac{1}{T_{eev}} \left\{ \left\{ \left(\frac{Q_{E}}{Q_{LPG}} \right)^{-1} \left(\frac{T_{C}^{-1} + aT_{A}^{-1}}{1 + a} b(T_{HPG})^{-1} \right) + \frac{T_{C}^{-1} + aT_{A}^{-1}}{1 + a} - T_{E}^{-1} \right\} + \left\{ \left\{ \frac{1}{U_{E}(T_{E} - T_{A})} + \frac{bQ_{LPG}}{Q_{E} U_{HPG}(T_{HPG} - T_{1})} + \frac{Q_{LPG}}{Q_{E} U_{LPG}(T_{2} - T_{LPG})} + \frac{a\left(1 + \frac{Q_{LPG}}{Q_{E}}\right)}{U_{A}(T_{3} - T_{A})(1 + a)} + \frac{\left(1 + \frac{Q_{LPG}}{Q_{E}}\right)}{U_{C}(T_{5} - T_{C})(1 + a)} \right\}$$

$$\xi \big(T_A - T_E + T_C - T_E + T_{LPG} - T_E \big) \Big)^{-1} \Bigg\{ \xi \big(T_A - T_E \big) \bigg(\frac{T_C^{-1} + aT_A^{-1}}{1 + a} T_A^{-1} \bigg) + \xi \big(T_C - T_E \big) \bigg(\frac{T_C^{-1} + aT_A^{-1}}{1 + a} T_C^{-1} \bigg) + \xi \big(T_C - T_E \big) \bigg(\frac{T_C^{-1} + aT_A^{-1}}{1 + a} T_C^{-1} \bigg) + \xi \big(T_C - T_E \big) \bigg(\frac{T_C^{-1} + aT_A^{-1}}{1 + a} T_C^{-1} \bigg) + \xi \big(T_C - T_E \big) \bigg(\frac{T_C^{-1} + aT_A^{-1}}{1 + a} T_C^{-1} \bigg) + \xi \big(T_C - T_E \big) \bigg(\frac{T_C^{-1} + aT_A^{-1}}{1 + a} T_C^{-1} \bigg) \bigg) \bigg) \bigg\} = 0$$

$$+\xi \left(\frac{\dot{\varrho}_{E}}{\dot{\varrho}_{LPG}}\right)^{-1} \left(T_{A} - T_{E} + T_{C} - T_{E} + T_{LPG} - T_{E}\right) \left(\frac{T_{C}^{-1} + aT_{A}^{-1}}{1 + a} - b\left(T_{HPG}\right)^{-1}\right) + \xi \left(T_{LPG} - T_{E}\right) \left(\frac{T_{C}^{-1} + aT_{A}^{-1}}{1 + a} - T_{LPG}^{-1}\right) \right) \right\}^{-1}$$
(12)

The equation 12 finds the value of ECOP.

V. CONCLUSION

In this paper we analyze the finite-time performance optimization for a double-effect parallel flow irreversible absorption refrigerator system with losses of heat resistance, heat leakage and internal irreversibility by considering the performance coefficient (COP) and the ecological performance coefficient (ECOP).

References

- [1] Chen, L., Li, Y., Sun, F., Wu, C., 2002. Optimal performance of an absorption refrigerator. Exergy Int. J. 2, 167-172.
- [2] Chen, L., Sun, F. (eds.)., 2004. Advances in Finite Time Thermodynamics: Analysis and Optimization. New York: Nova Science Publishers.
- [3] Ezzine N. B., Mejbri K., Bahroumi M., Bellagi A., 2005. Irreversibilities in two configurations of the double generator absorption chiller: Comparison of performance. J. Thermal Analysis and Calorimetry, Vol. 80, 471–475.
- [4] Farshi, L. G., SeyedMahmoudi, S.M., Rosen, M.A., 2011. Analysis of crystallization risk in double effect absorption refrigeration systems. Appl. Thermal Engineering 31, 1712- 1717.
- [5] NgouateuWouagfack, P.A., Tchinda, R., 2011a. Performance optimization of three-heat-source irreversible refrigerators based on a new thermo-ecological criterion. Int. J. Refrig. 34, 1008-1015.
- [6] Qin, X., Chen, L., Ge, Y., Sun, F., 2013. Finite time thermodynamic studies on absorption thermodynamic cycles: A state of the arts review. Arab. J. Sci. and Eng. 38(3), 405-419.
- [7] Sedigh, S., Saffari, H., 2011. Thermodynamic Analysis of Series and Parallel Flow Water/Lithium Bromide Double Effect Absorption System with Two Condensers. J. Materials Sci. Eng. B 1, 206-217.
- [8] Stitou, D., Feidt, M., 2005. New criteria for the optimization and characterization of thermal energy conversion processes. Int. J. Therm. Sci. 44(12), 1142-1153.
- [9] Torrella, E., Sánchez, D., R. Cabello, Larumbe, J.A., Llopis, R., 2009. On-site real-time evaluation of an air-conditioning direct-fired double-effect absorption chiller. Appl. Energy 86, 968–975.

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- [10] Ust, Y., Sahin, B., 2007. Performance optimization of irreversible refrigerators based on a new thermo-ecological criterion. Int. J. Refrig. 30, 527-534.
- [11] Ust, Y., 2009. Performance analysis and optimization of irreversible air refrigeration cycles based on ecological coefficient of performance criterion. Appl. Therm. Eng., 47-55.
- [12] Xu, G. P., Dait, Y. Q., 1997. Theoretical analysis and optimization of a double-effect parallel-flow-type absorption chiller. Appl. Therm. Eng., Vol. 17, No. 2. pp. 157-170.
- [13] Zheng, T., Chen, L., Sun, F., Wu, C., 2003a. Performance optimization of an irreversible four-heat-reservoir absorption refrigerator. Appl. Energy, 391-414.
- [14] Zheng, T., Chen, L., Sun, F., Wu, C., 2003b. Performance of a four-heat-reservoir absorption refrigerator with heat resistance and heat leak. Int. J. Ambient Energy, 24(3), 157-168.

ORIGINAL PAPER



Impact of Temperature on Analog/RF Performance of Dielectric Pocket Gate-all-around (DPGAA) MOSFETs

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Received: 29 March 2020 / Accepted: 14 July 2020 $\hfill \mathbb{C}$ Springer Nature B.V. 2020

Abstract

In the present paper, the dielectric pocket (DP) technology has been employed in the Gate-All-Around (GAA) MOSFETs to improve the scalability and performance of the device. The upgraded immunity towards short-channel effects (SCEs) and elevation in the device analog/RF performance is demonstrated through comparison between Gate-All-Around (GAA) and dielectric pocket Gate-All-Around (DPGAA) at the 20 nm channel length with temperature variation from 200 K to 400 K by using the Sentaurus three-dimensional (3D) simulator.

Keywords Dielectric pocket \cdot Gate-all-around \cdot I_{ON}/I_{OFF} ratio \cdot Analog/RF performance \cdot Temperature-dependent characteristics \cdot OFF current (I_{OFF}) \cdot And SCEs

1 Introduction

The boosted performance of field-effect transistors (FETs) with miniaturization into sub-20 nm regime incessantly stimulate the scientists and designers to look for novel FET structures so that the shrinking may be continued below 7 nm. According to ITRS (2017), the size of devices will reach a few nanometers (3 nm) by 2020–2025 [1, 2]. In such deep nanometer regimes, MOS devices suffer from some fundamental physical hurdles for further scaling, frequently known as short-channel effects (SCEs) and are often judged by the degree of control of gate, source and drain over the MOSFET channel region [3]. At present, multi-gate transistors [4, 5] such as FinFETs [6, 7] and Gate-All-Around (GAA) FETs [8, 9] are spearheading the challenges posed by SCEs owing to their better controllability on channel charge by the gate. In

this continuation, the GAA structure has been reported to provide excellent performance and scalability, which reduces SCEs [10]. In contrast to FinFETs, GAA FETs have emerged as potential candidates for 3 nm MOSFET technology nodes with superb electrical characteristics [11]. Under high operating temperature conditions, the practical and theoretical limitations of silicon lead to unpredictable variations in device parameters such as change in threshold voltage with temperature. Consequently, structural modifications in the MOSFET device structure to enhance the reliability of the device becomes mandatory [12, 13].

A dielectric pocket (DP) MOSFET also known as insulated shallow extension (ISE) MOSFET is being seen as potential technology to curb the SCEs and lower the Off-current while rendering extremely low variation against temperature of MOS devices [14–17]. However, DP MOSFETs suffer from low drive current and transconductance (g_m) compared to bulk MOSFET because of larger effective channel length [14]. Kok et al. [15] had termed the DP as a diffusion stopper, infused at the interface of source-channel and drain-channel. It greatly lowers the Off current (I_{OFF}) as it impedes the path of punch-through.

Keeping in view the future perspective of the GAA MOSFET below 7 nm technology node, the implementation of dielectric pocket at the source/drain and channel interface becomes obligatory to alleviate the analog performance. In the present manuscript, the advantages of utilizing dielectric pockets in the GAA MOSFET is demonstrated relative to the GAA MOSFET in the

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Fig. 1 The 3D schematic of the DPGAA MOSFET

20 nm regime against the temperature variation by using the Sentaurus three-dimensional (3D) simulator [18]. The performance evaluation of DPGAA and GAA devices have been done in terms of variation in Off current (I_{OFF}), ON-OFF current ratio (I_{ON}/I_{OFF}), subthreshold swing (SS), electron mobility, electron concentration, drain current, transconductance and transconductance generation factor (TGF) against temperature.

2 Device Structure and Simulation Details

The 3D schematic of the DPGAA MOSFET for simulation is demonstrated in Fig. 1. The two dimensional (2D) crosssectional view of DPGAA MOSFET is shown in Fig. 2; where $DP_{\rm L}$, $DP_{\rm D}$, L, t_{ox} , and t_{si} represent DP length, DP thickness, channel length, oxide thickness, and channel thickness, respectively. The source and drain regions are heavily doped with an *n*-type concentration 10^{20} cm⁻³, and the channel region is lightly doped with *p*-type concentration 10^{15} cm⁻³. The silicon-tubular channel region is wrapped by thin oxide layers of SiO₂. For the dielectric pocket, SiO₂ has been used with the length $DP_{\rm L}$ =6 nm and thickness $DP_{\rm D}$ =6 nm near the source-channel and drain-channel interface. The numerical values of the dimensional and physical parameters considered for the simulation of DPGAA structure have been given in Table 1. The Sentaurus 3D TCAD device simulator [18] has been used to simulate the proposed FET structure. In order to



Fig. 2 The 2D schematic cross-sectional view of DPGAA MOSFET

Table 1Device parameters used for the simulation of GAA andDPGAA MOSFETs.

SI. No.	Device simulation parameters		
	Parameters	GAA MOSFE	

	Parameters	GAA MOSFET	DPGAA MOSFET
1	Channel Length (L)	20 nm	20 nm
2	Source/Drain Doping (N _D)	$10^{20} {\rm ~cm^{-3}}$	10^{20} cm^{-3}
3	Channel doping (N_A)	$10^{15} {\rm ~cm}^{-3}$	10^{15} cm^{-3}
4	Oxide thickness (t_{ox})	2 nm	2 nm
5	Channel thickness (t_{si})	10 nm	10 nm
6	Metal Work-function (ϕ_M)	4.81 eV	4.8 eV
7	Dielectric pocket length (DP_L)	-	6 nm
8	Dielectric pocket thickness (DP_D)	-	6 nm

support the better performance of the DPGAA structure, the TCAD results of GAA structure [8] have been compared with the simulation results of DPGAA structure. The recombination model such as Lombardi (CVT) and Shockley-Real-Hall (SRH), and drift-diffusion charge transport have been used for proposed DPGAA as well as GAA Devices simulation [18]. The considered temperature range is 200 K to 400 K with proper concentration and temperature-dependent models. The carrier mobility models used for the simulations are Caughey-Thomas mobility model, Lombardi model, and high field saturation model.

3 Results and Discussion

In Fig. 3, the plot of electron concentration for DPGAA and GAA MOSFET against the gate-to-source voltage (V_{GS}) is shown at the interface of SiO₂/silicon and the center of silicon



Fig. 3 The variation of electron concentration against gate-to-source voltages (V_{GS}) at half-length (L/2) in the z-direction beneath the surface and center of the channel for DPGAA and GAA MOSFETs



Fig. 4 Plots of electron mobility against gate-to-source voltages ($V_{\rm GS}$) of DPGAA and GAA MOSFETs at half-length of the channel (L/2) in z-direction underneath the surface and center of the channel



Fig. 5 Variation of drain current (I_D) of DPGAA and GAA MOSFETs with V_{GS} for different temperatures in logarithmic and linear scale at V_{DS} = 1 V



Fig. 6 Plot of drain current (I_D) of DPGAA and GAA MOSFETs against $V_{\rm DS}$ for different temperatures at $V_{\rm GS}$ = 1.0 V



Fig. 7 The drain current (I_D) variation with temperature for V_{GS} = 0.6 V, 0.8 V and 1.0 V of DPGAA and GAA MOSFETs

nanowire. The existence of volume inversion throughout the channel region can be observed at low V_{GS}. However, when V_{GS} goes beyond the threshold voltage ($V_{TH} \approx 0.665$ V), the electron concentration becomes higher than the doping concentration at the SiO₂/silicon interface as well as at the center of the channel region. It can be observed that the DPGAA MOSFET holds low electron concentration at $V_{GS} < V_{TH}$ compared to GAA MOSFET; whereas, for $V_{GS} > V_{TH}$, both of the devices enjoy identical concentration. From this result, it is obvious that the presence of dielectric pockets in DPGAA helps to lessen the I_{OFF} which is, in fact, desirable for enhanced I_{ON}/I_{OFF} current ratio. Fig. 4 deals with the variation of electron mobility against gate-to-source voltage (V_{GS}) at $V_{DS} = 1$ V and T = 300 K. Obviously, the DPGAA MOSFET renders higher electron mobility in contrast to the GAA MOSFET at the interface of SiO₂/ silicon as well as at the center of silicon film. Further, it can be easily observed in both of the devices that electron mobility at the surface is higher compared to mobility at the center. However, the decrease in mobility at the surface with increasing V_{GS} (above 0.75 V), may be attributed to scattering from higher electric fields at the surface. Figure 5 demonstrates the comparison of transfer characteristics of DPGAA and GAA MOSFET for different temperatures at $V_{DS} = 1.0$ V on linear as well as



Fig. 8 Transconductance (g_m) versus gate-to-source voltage (V_{GS}) for different temperatures of DPGAA and GAA MOSFETs at V_{DS} = 1.0 V

Table 2Analog performancecomparison of DPGAA and GAAMOSFETs in the linear andsaturation region for $V_{DS} = 0.1$ Vand 1.0 V at temperature 300 K

V _{DS}	Linear region = 0.1 V		Saturation region = 1.0 V	
Devices	GAA MOSFET	DPGAA MOSFET	GAA MOSFET	DPGAA MOSFET
SS (mV/decade) I _{OFF} I _{ON} /I _{OFF}	71.24 2.51 \times 10 ⁻¹³ 5.99 \times 10 ⁺⁰⁷	$\begin{array}{c} 69.10 \\ 1.15 \times 10^{-13} \\ 1.27 \times 10^{+08} \end{array}$	$72.07 3.40 \times 10^{-13} 6.41 \times 10^{+07}$	$69.96 \\ 5.34 \times 10^{-13} \\ 2.14 \times 10^{+08}$

logarithmic scale. According to the logarithmic scale, in the subthreshold region, the I_D current of DPGAA MOSFET is lower than GAA MOSFET. In fact, the presence of dielectric pocket mitigates the charge sharing between the source-channel and drain-channel interfaces, and hence the I_{OFF} current gets reduced, which subsequently renders improved I_{ON}/I_{OFF} current ratio in the DPGAA MOSFET [16, 17]. The deterioration in I_{OFF} current with increasing temperature may be due to emergence of additional components of current such as thermal generation and thermal ionization. The reduction in drain current with high operating temperature may be attributed to increased scattering events in DPGAA and GAA MOSFETs. In Fig. 6, the plot of drain current (I_D) variation with V_{DS} at different temperatures for DPGAA and GAA MOSFET is shown. From the output characteristics of DPGAA and GAA MOSFETs, it is observed that there is a very nominal difference between the drain current values of the two devices for lower drain voltages. However, above $V_{DS} = 0.8$ V, both of the devices have alike drain current values. Further, decrease in drain current (I_D) with increasing temperature is due to the degradation in mobility as already discussed in Fig. 4. The variation in drain current (I_D) with temperature for three different values of V_{GS} at $V_{DS} = 1.0$ V for DPGAA and GAA MOSFETs is displayed in Fig. 7. When $V_{GS} = 0.8$ V, the I_D current does not change with temperatures. On the other hand, for $V_{GS} > 0.8$ V, the I_D current can be found decreased with increasing temperature; whereas for $V_{GS} < 0.8$ V, the I_D current increases with an increase in temperature. The slight decrease in drain current at $V_{GS} = 1V$ may be due to a significant deterioration in mobility at the interface of SiO₂/silicon, as already described in Fig. 4. It can be pointed out that, in the subthreshold regime of device operation, DPGAA MOSFET is found to give much improved results. Figure 8 shows the graph of transconductance (gm) versus VGS at different temperatures for DPGAA and GAA MOSFETs at $V_{DS} = 1.0$ V. The transconductance (g_m) mainly depends on the drain current of the device. It is an essential parameter for analog applications, and the maximum value of g_m gives the high amplification to the device. It can be seen that in the subthreshold region the transconductance (g_m) increases with increase in temperature; whereas, above threshold (> 0.6 V), the trends get inverted; which, as discussed in Fig. 5, may be attributed to the increased rate of scattering events with increasing temperature. Further, for a given temperature, in the subthreshold region, the DPGAA device shows lower transconductance; while, in above threshold region, g_m of DPGAA MOSFET is found higher compared to GAA device. In short, DPGAA MOSFET performs better against temperature variations. The next figure (Fig. 9) deals with variation in transconductance generation factor (TGF) (gm/ I_D) of DPGAA and GAA MOSFETs against V_{GS} for temperatures 200 K, 300 K and 400 K at V_{DS} = 1.0 V. The outstanding TGF value of nearby 50 V^{-1} in the weak inversion region can be related to near ideal values of subthreshold swing 60 mV/decade. For TGF between 10 V^{-1} and 5 V^{-1} variations with V_{GS} from 0.6 V to 0.8 V typically used for analog performance [19]. It can be observed from the figure that as the temperature decreases from 300 K to 200 K, the TGF increases from 50 V^{-1} to 130 V^{-1} . Therefore, the subthreshold swing deepens below 60 mV/decade. It is also clear from Fig. 9 the TGF is higher in the case of DPGAA MOSFET compared to the GAA device. In Table 2, the assessment of the impact of inserting dielectric pockets in the GAA MOSFET in the linear and saturation region of the device is given. From the table, it is obvious that the DPGAA device suppresses the SCEs and I_{OFF} current and as a result enhances the I_{ON}/I_{OFF} ratio more efficiently compared to GAA MOSFET. Further, Table 3 shows the effect of temperature on the analog performance of DPGAA and GAA at V_{DS} = 1.0 V. The TGF (g_m/I_D) is higher in the case of the DPGAA MOSFET and decreases with the increase in temperature.

Table 3 Effect of temperature on the analog performance of DPGAA and GAA MOSFETs at V_{DS} = 1.0 V

Temperature	T=200 K	T = 200 K		T = 300 K		T = 400 K	
Devices	GAA	DPGAA	GAA	DPGAA	GAA	DPGAA	
I _{OFF} I _{ON} /I _{OFF} TGF (V ⁻¹)	2.10×10^{-17} $1.12 \times 10^{+12}$ 106.61	3.43×10^{-18} $6.88 \times 10^{+12}$ 129.84	3.40×10^{-13} $6.41 \times 10^{+07}$ 47.09	1.02×10^{-13} $2.14 \times 10^{+08}$ 49.92	5.00×10^{-11} $4.12 \times 10^{+05}$ 29.96	$2.04 \times 10^{-11} \\ 1.01 \times 10^{+06} \\ 31.47$	



Fig. 9 TGF (g_m/I_D) variation with gate-to-source voltage (V_{GS}) at different temperatures for DPGAA and GAA MOSFETs at V_{DS} = 1.0 V

However, TGF is higher for DPGAA MOSFET compared to GAA MOSFET for a given temperature. Moreover, the increase in I_{OFF} current of DPGAA MOSFET with the rise in temperature is much better in contrast to GAA MOSFET.

4 Conclusion

The impact of introducing dielectric pockets in GAA MOSFETs on analog/RF performance against temperature variation from 200 K to 400 K is assessed in this paper in terms of comparative analysis for the GAA and DPGAA. Higher value of TGF of DPGAA MOSFET is observed which in turn renders higher amplification at low temperatures. The proposed DPGAA device has better immunity towards SCEs owing to insertion of dielectric pocket compared to GAA MOSFET. In the DPGAA MOSFET, the leakage current (I_{OFF}) is seen to be effectively suppressed which results in much improved I_{ON}/I_{OFF} current ratio in contrast to GAA MOSFET with temperature variation. The presence of dielectric pocket as a diffusion stopper at sourcechannel and drain-channel interfaces is found to improve the analog/RF performance of the proposed DPGAA MOSFET much efficiently. It can be inferred that the DPGAA device is more competent compared to GAA MOS structure for high speed analog and as well as digital applications.

Acknowledgements One of the authors, Mr. Vaibhav Purwar acknowledges the Sentaurus device simulation facility received from Department of Electrical Engineering, IIT Patna, Bihar, India.

References

- International technology roadmap for semiconductors (ITRS). 2017 [Online] Available: http://www.itrs.net/itrs-reports.html. Accessed 28 March 2020
- Kim Y-B (2010) Challenges for Nanoscale MOSFETs and emerging Nanoelectronics. Trans On Electronics and Electronic materials 11:93–105

- Kumar M, Mishra V, Misra R, Dubey S (2019) Investigating the Possibility to Extend Planar Technology to 10 nm Scale with UTBB DMG SSOI MOSFETs. International Conference on Cutting-edge Technologies in Engineering (ICon-CuTE), Uttar Pradesh, India:63–68
- Ferain I, Colinge CA, Colinge JP (2011) Multigate transistors as the future of classical metal–oxide–semiconductor field-effect transistors. Nature 479:310–316
- Colinge J-P (2007) Multi-gate SOI MOSFETs. Microelectron Eng 84:2071–2076
- Zhang X, Hu J, Luo X (2016) Optimization of double-threshold independent-gate FinFET for compact low power logic circuits. IEEE 16th International Conference on Nanotechnology (IEEE-NANO), https://doi.org/10.1109/NANO.2016.7751552
- Colinge J-P (2008) FinFET and other multi-gate transistors. In New York: Springer-Verlag, ISBN 978-0-387-71751-7
- Song J-Y, Choi WY, Park JH, Lee JD, Park BG (2006) Design optimization of gate-all-around (GAA) MOSFETs. IEEE Trans Nanotechnol 5:186–191
- Zhang Y, Li Z, Wang C, Liang F (2016) Compact analytical threshold voltage model of strained gate-all-around MOSFET fabricated on Si₁₋ _xGe_x virtual substrate. IEICE Trans on Electron E99-C:302–307
- Yang-kyu Choi, Still room at the bottom, nanoparticle news, 1 April 2006
- Cheng H, Uno S, Nakazato K (2014) Analytical compact model of ballistic and quasi-ballistic transport for cylindrical gate-all-around MOSFET including drain-induced barrier lowering effect. J. Comput Electron 14:321–328
- Kumari V, Gupta M, Saxena M, Gupta RS (2012) Temperature dependent model for dielectric pocket double gate (DPDG) MOSFET: A Novel device architecture. IEEE International Conference on Emerging Electronics. https://doi.org/10.1109/ ICEmElec.2012.6636264
- Hasanuzzaman MD, Islam SK, Tolbert LM (2004) Effect of temperature variation in MOSFET modeling in 6-H silicon carbide. Solid-State Electronics, 48:125–132
- Jurczak M, Skotnicki M, Gwoziecki R, Paoli M, Tormen B, Ribot P, Dutartre D, Monfiray S, Galvier J (2001) Dielectric pocket- a new concept of the junctions for deca-nanometric CMOS devices. IEEE trans. Electron Devices 48:1770–1774
- Kok O-P, Ibrahim K (2009) Simulation of two-dimensional 50nm vertical metal oxide semiconductor field effect transistor incorporating a dielectric pocket. Jpn J Appl Phys 48:111201–111205
- Gupta A, Maurya N, Rai S (2017) Impact of dielectric pocket on analog/RF performance of short channel double gate MOSFET.4th IEEE International Conference on Power, Control & Embedded Systems (ICPCES). https://doi.org/10.1109/ICPCES.2017. 8117649
- Trivedi N, Kumar M, Halder S, Deswal SS, Gupta M, Gupta RS (2017) Assessment of analog RF performance for insulated shallow extension (ISE) cylindrical surrounding gate (CSG) MOSFET incorporating gate stack. Microcyst Technology. https://doi.org/10. 1007/s005423456z
- Synopsys (2016) Sentaurus Device User Guide, Version N-2017.09, Mountain View, CA, USA
- Raskin J-P, Chung TM, Kilchytska V, Lederer D, Flandre D (2006) Analog/RF performance of multiple gate SOI devices: wideband simulations and characterization. IEEE trans. Electron Devices 53: 1088–1095

Publisher's Note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Double Effect Absorption Optimization of Refrigerator in Finite Time Thermodynamics: A Survey

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Abstract—Refrigeration and air conditioning (RAC) plays a very significant role in our day-to-day operating needs for ventilation and heating. Refrigeration devices are commonly used in working / living environments to regulate temperature and provide human thermal comfort. The use of refrigeration equipment for cooling is not new; but, due to certain environmental requirements, air-conditioning equipment has to change.

Finite-time thermodynamics optimization study was conducted based on the efficiency coefficient and the ecological coefficient of success parameters. This was performed analytically and numerically with a parallel flow absorption refrigerator of a double-effect with lack of heat resistance, heat leakage and internal irreversibility. The overall efficiency coefficient and the corresponding optimum conditions were analytically derived. This paper we study refrigerator and its principles for double impact absorption.

Index Terms—Double-effect absorption refrigeration system, finite-time thermodynamic, optimization, coefficient of performance, ecological coefficient of performance

I. INTRODUCTION

Absorption refrigeration processes exist in finite-time finite-size devices; thus, reversibility constraints between the absorption refrigeration system and the surrounding environment can not be satisfied. Therefore, the classical thermodynamic efficiency limit does not provide the boundary of the absorption mechanism correctly (Bhardwaj et al., 2003; Kaushik et al ., 2002; NgouateuWouagfack and Tchinda, 2013a). Of this reason, the finite-time approach to thermodynamics was adopted to define the absorption system efficiency limit. The thermodynamics of the finite-time appear to model the system in a manner similar to truth. Thanks to internal dissipation of the operating fluid and thanks to the finite-rate heat transfer between the device, the external heat source and heat-sink, it helps to discern the irreversibilities. It is attempting to close the difference between the heat flow and thermodynamics. This deals with the optimisation of thermodynamic output in real finite-time and thermodynamic structures with finite-size.

Finite-time thermodynamic implementations cover all processes including thermal phenomena of all machines and systems working under finite-time and finite-size constraints. The endoreversible loop is the fundamental physical concept followed in thermodynamics of the finite-time.

II. LITERATURE REVIEW

Literature analysis interprets outdated information and provides a mix of new and outdated information. Therefore, there is a short overview of different research papers in this section and the frequency of research papers review and synthesis.

The hybrid cooling system has been described as a combination of two or more cooling systems. This is usually called a variation of the refrigeration method for compression and absorption. These variations have a number of cultural, social, and environmental benefits.

In the form of liquid, low-grade electricity, energy is supplied to your turbine for the operation of a vapor absorption refrigeration device. Low-grade energy sources such as biomass, waste heat recovery from power and process plants, and solar energy are under intensive study, particularly for use in the absorption system for vapour. Furthermore, the choosing of a appropriate absorbent-refrigerant pair that can be used as the working fluid in the absorption device is subject to exhaustive consideration by the researchers Efforts are under way to identify trade-offs between the energy sources and the refrigerant absorbent mix.

The driving force for this combination (compression-absorption) investigation is the need to make use of heat and operate from the same source. Many manufacturing systems consume an immense amount of thermal energy by burning fossil fuel for the purpose of generating steam or gas. Once the processes have been finished heat is discarded as waste to the immediate environment. In developing countries in particular, the usage of waste heat energy from process manufacturing as a source of usable energy is slowly gaining attention (Liao et al., 2004; Alford, 2005; Bombarda et al., 2009; Chacartegui et al., 2009; Invernizzi et al., 2007; Kaikko.et.al., 2009; Kosmadakis.et.al., 2009; Lozanova, 2009; Nasir.et.al., 2004; Sami, 2010; Srinivasan.et al., 2010; Vaja and Gambarot.al., 2009; It is due to its intrinsic significance of increasing energy production use, reducing the total entropy generation as well as raising the process's carbon footprint. According to the most recent figures released by the UK Department of Energy and Climate Change (DECC, 2011), excess heat can be turned into usable cooling by means of a power-operated cooling system, such as an absorption cycle of refrigeration.



Figure 1: The Osenbrück cycle

Today there are two main market methods where refrigeration is done on an global scale. It can either be a heat assisted NH3 + H2O refrigeration absorption (AR) system or a mechanically operated NH3 vapor compression cooling (VCR) system. Using the thermal waste and use the combined process of absorption and compression in the industrial refrigeration device has gained further interest.

The use of compression-absorption refrigeration cycles allows energy efficiency of high quality relative to traditional compression cycles. Amount of experiments have been performed on the refrigeration intervals of the compression absorption. One may trace the first published idea back to a German patent (Osenbrüeck, 1895). Figure 1 displays a diagram of the shortest compression / absorption process, called the Osenbrüeck process in inventor memory. No work on this process was published until early 1950, after 1895.

Such devices use environmentally friendly refrigerant-absorbing mixtures such as ammonia-water and lithium bromide-water, which are ozone-safe and have very little risk for global warming. Furthermore, owing to the use of mixtures these systems have higher comparative COPs, greater regulation of efficiency and lower pressure ratios in the system relative to vapor compression systems.

With Garimella.et. Al . (2011) studied a novel process of cascaded absorption / vapor-compression with a high temperature boost for naval use. A single effect LiBr – H2O absorption cycle and a subcritical CO2 vapor-compression cycle were combined to provide extremely low temperature refrigerant ($-40 \circ C$) for high heat flux electronic applications, medium temperature refrigerant ($5 \circ C$) for space conditioning and other low heat flux applications, and as an auxiliary gain, a medium temperature heat discharge of about 48 ° C for water heating applications was given. They developed a thermodynamic model to analyze cascaded system performance, and parametric analysis was performed to approximate system output over a variety of operating conditions. The cascaded system 's output was also contrasted with a two-stage comparable vapor-compression process. This process was shown to have very high COPs over a large variety of operating conditions and was found to reduce up to 31 per cent power demand relative to an analogous vapor-compression system.

Tyagi et.al, (2010) analyzed hybrid vapor compression-absorption process efficiency based on second law, using water-ammonia as a working fluid. Hybrid output was found to be less effective than traditional system in a reasonable range. But it can be strengthened by improving system configuration and process parameters. A thermodynamic model was developed to evaluate the performance of the cascaded system, and parametric analysis was conducted to approximate device output over a variety of operating conditions. The cascaded system 's output was also contrasted with a two-stage comparable vapor-compression process. This process was shown to have very high COPs over a large variety of operating conditions and was found to reduce up to 31 per cent power demand relative to an analogous vapor-compression system.

Yari et al, (2011) compared the GAX and GAX hybrid refrigeration absorption periods from both the first and second thermodynamic rules. Energy analyzes were conducted to measure the overall amount of energy loss within the periods. They found that the generator temperature (Tgen) has more effect on the second law output of both cycles while the temperature influences the coefficient of operation (COP) of the cycles comparatively less. An improvement in the GAX cycle output of around 75 per cent was observed when the temperature of the generator was controlled from 400 to 440 $^{\circ}$ K. For this generator temperature variance, the resulting COP rise was roughly 5%. In comparison, the optimum value of energetic output in the GAX hybrid cycle exists at a marginally higher value of Tgen as opposed to that of the GAX process.

Jelinek.et.al, (2012) analyzed the efficiency of the absorption / compression process by triple pressure point. With mechanical compressor installed in place of a jet ejector, a single stage absorption process was performed at triple pressure level in their analysis. It has resulted in a decrease in the temperature of the engine, a decrease in the diffusion ratio and the heat exchanger region of the solution and COP rise. Such improvements may be due to working fluid operating conditions and thermo-physical properties.

Zheng and Meng, (2012) studied hybrid refrigeration process thermodynamic mechanism. Two fundamental principles were introduced, such as ultimate refrigeration temperature (or ultimate temperature lift) and behavioral changing. This studied the effect of compressor pressure, difference in concentration, operating fluid diffusion ratio, etc. It was found that the output of the refrigeration process varies with the difference in the compressor outlet pressure and depends on the period of hybrid refrigeration, the absorption sub-system or the compression sub-system. Likewise Jiyoung.et.al, (2013), established the hybrid process of compression / absorption using ammonia water mixture.

Important study of research literature on hybrid cooling and air-conditioning applications based on a combination of variable energy sources.

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III. TWO-STAGE DUAL-FLUID ABSORPTION CYCLE (DUAL)

Figure 2 shows a two-step dual-fluid vapor absorption system with a first step LiBr-H2O cycle and a second stage ammonia cycle. The two-stage operation of the systems is identical to those running independently as a single step clear absorption process (SSAC). However, at second stage the cooling effect created by the E1 evaporator is used to cool the A2 absorber. In the ammonia process, H2O-NH3, LiNO3-NH and NaSCN-NH3 mixtures are chosen at the second level of the working fluids. In the case of the H2O-NH3 process, the generator consists of a mixture of rectifier and analyzer in the rectification column to isolate the concentrations of escaping water vapor and ammonia vapor. And almost pure ammonia vapor is required to leak into the C2 condenser after rectification. The cooling effect created by the ammonia liquid coming from the condenser in the evaporator E2 and then through the precooler and the throttle valve TV1, is intended to cool spaces. The heat required for the G1 and G2 generators will be obtained from the energy sources under analysis. The rectifier and the analyser are not needed in the LiNO3-NH3 and NaSCN-NH3 cycles.



Figure 2: Two Stage Dual Fluid Vapour Absorption Cycle

IV. PHYSICAL MODEL

A double-effect refrigerator absorption system with parallel flow has five primary components: a high-pressure generator, a low-pressure generator, an absorber, a condenser and an evaporator. The machine consists of five temperatures (LPG temperature, evaporator temperature, condenser temperature, and absorber temperature) and three pressures (low evaporator and absorber pressure, medium condenser pressure and low pressure generator, high pressure in the high pressure generator). Figure 3 displays the diagram of a parallel flow double-effect refrigerator absorption system adapted by us.



Figure 3: Schematic diagram of a parallel flow double-effect absorption refrigerator

In this model QHPG, is the heat rate absorbed from the heat source at temperature THPG to the high pressure generator QLPG, is the heat rate absorbed from the heat source at temperature TLPG to the low pressure generator, QC is the heat-release rate

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from the condenser to the heat-release at temperature Tc, QA is the heat-release rate from the absorber to the heat-release at temperature TA and QE is th Compared to the high and low pressure generator the work input provided by the solution pump is negligible. We have (Göktun and Er, 2000) according to first law of thermodynamics.

$$\dot{\mathcal{Q}}_{LPG} + \dot{\mathcal{Q}}_E - \dot{\mathcal{Q}}_C - \dot{\mathcal{Q}}_A = 0$$
(1)

The efficiency of a refrigerator absorption device depends strongly on the irreversible factors. We found the working fluid cycle to be a three-irreversible isothermal process and a three-irreversible adiabatic process, as the dual-effect system is a triple thermal system.

In the isothermal systems, the temperatures of the working fluid vary from those of the external heat reservoirs, such that the heat is transferred under a fixed temperature difference. Figure 4 shows a schematic diagram of a double-effect absorption refrigerator with an irreversible parallel flow.

For this example, the temperatures of the working fluid in the HP generator and LP generator are T1 and T2, respectively. T3, T4, and T5 are the temperature of the absorber, evaporator, and condenser working fluid, respectively. We also took into account the presence of heat leakage from the sink to the cooled space denoted Q_{L} .



Figure 4:Schematic diagram of an irreversible parallel flow double-effect absorption refrigerator

The heat exchanged between the working fluid and heat reservoirs obey a linear heat transfer law, such that the equation of heat transfer can be written as:

$$\begin{aligned}
\dot{Q}_{HPG} &= U_{HPG} A_{HPG} \left(T_{HPG} - T_{1} \right)_{(2)} \\
\dot{Q}_{LPG} &= U_{LPG} A_{LPG} \left(T_{2} - T_{LPG} \right)_{(3)} \\
\dot{Q}_{E} &= U_{E} A_{E} \left(T_{E} - T_{4} \right)_{(4)} \\
\dot{Q}_{A} &= U_{A} A_{A} \left(T_{3} - T_{A} \right)_{(5)} \\
\dot{Q}_{C} &= U_{C} A_{C} \left(T_{5} - T_{C} \right)_{(6)}
\end{aligned}$$

Following the idea developed by Chen and Schouten (1998), the heat-leak of a parallel flow double-effect system is given by:

$$Q_{L} = K_{L} \left(T_{A} - T_{E} + T_{C} - T_{E} + T_{LPG} - T_{E} \right)$$
(7)

Where, Equations (1)-(6) are written like Göktun and Er (2000). In equations (2)-(6), A_{HPG} , A_{LPG} , A_E , A_A and A_C are the heat-transfer areas of the HP generator, LP generator, evaporator, absorber and condenser respectively U_{HPG} , U_{LPG} , U_E , U_A and U_C are the overall heat-transfer coefficients of the HP generator, LP generator, LP generator, evaporator, absorber and condenser respectively.

The total area of heat transfer between the cycle system and the external heat reservoirs is given by the relationships: $A = A_{HPG} + A_{LPG} + A_E + A_A + A_C (8)$

Defining the parameter *a* as the distribution rate of the total heat reject quantity between the condenser and the absorber given as:

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$$a = \frac{Q_A}{Q_C}$$

(9)

(10)

The parameter b as the ratio of the total heat between the HP generator and the LP generator given as:

$$b = \frac{Q_{HPG}}{Q_{LPG}}$$

Using Equations (4.1)-(4.10), we obtain the coefficient of performance, the specific cooling load and the specific rate of entropy production of a parallel flow double-effect absorption refrigerator given by the following equations:

$$COP = \frac{\dot{Q}_{F} - \dot{Q}_{L}}{\dot{Q}_{HPG}} = \frac{\dot{Q}_{F}}{\dot{Q}_{HPG}} \left(1 - \frac{\dot{Q}_{L}}{\dot{Q}_{E}}\right) = \frac{\dot{Q}_{F}}{\dot{b}\dot{Q}_{LPG}} \left(1 - \frac{\dot{Q}_{L}}{\dot{Q}_{E}}\right)$$
(11)

Within the general thermo-ecological criterion feature concept (Ust and Sahin, 2007; Ust, 2009; NgouateuWouagfack and Tchinda, 2011a, b, 2013a, b; NgouateuWouagfack, 2012 and MedjoNouadje et al., 2013, 2014). The new thermo-ecological objective function called the ecological output coefficient (ECOP) of a double-effect parallel flow

absorption cooler system is written as:

$$ECOP = \frac{Q_{E} - Q_{L}}{T_{eev} \sigma} = \frac{1}{T_{eev}} \left\{ \left\{ \left(\frac{Q_{E}}{Q_{LPG}} \right)^{-1} \left(\frac{T_{C}^{-1} + aT_{A}^{-1}}{1 + a} b(T_{HPG})^{-1} \right) + \frac{T_{C}^{-1} + aT_{A}^{-1}}{1 + a} - T_{E}^{-1} \right\} + \left\{ \left\{ \frac{1}{U_{E}(T_{E} - T_{A})} + \frac{bQ_{LPG}}{Q_{E} U_{HPG}(T_{HPG} - T_{1})} + \frac{Q_{LPG}}{Q_{E} U_{LPG}(T_{2} - T_{LPG})} + \frac{a\left(1 + \frac{Q_{LPG}}{Q_{E}}\right)}{U_{A}(T_{3} - T_{A})(1 + a)} + \frac{\left(1 + \frac{Q_{LPG}}{Q_{E}}\right)}{U_{C}(T_{5} - T_{C})(1 + a)} \right\}$$

$$\xi \big(T_A - T_E + T_C - T_E + T_{LPG} - T_E \big) \Big)^{-1} \Bigg\{ \xi \big(T_A - T_E \big) \bigg(\frac{T_C^{-1} + aT_A^{-1}}{1 + a} T_A^{-1} \bigg) + \xi \big(T_C - T_E \big) \bigg(\frac{T_C^{-1} + aT_A^{-1}}{1 + a} T_C^{-1} \bigg) + \xi \big(T_C - T_E \big) \bigg(\frac{T_C^{-1} + aT_A^{-1}}{1 + a} T_C^{-1} \bigg) + \xi \big(T_C - T_E \big) \bigg(\frac{T_C^{-1} + aT_A^{-1}}{1 + a} T_C^{-1} \bigg) + \xi \big(T_C - T_E \big) \bigg(\frac{T_C^{-1} + aT_A^{-1}}{1 + a} T_C^{-1} \bigg) + \xi \big(T_C - T_E \big) \bigg(\frac{T_C^{-1} + aT_A^{-1}}{1 + a} T_C^{-1} \bigg) \bigg) \bigg) \bigg\} = 0$$

$$+\xi \left(\frac{\dot{\varrho}_{E}}{\dot{\varrho}_{LPG}}\right)^{-1} \left(T_{A} - T_{E} + T_{C} - T_{E} + T_{LPG} - T_{E}\right) \left(\frac{T_{C}^{-1} + aT_{A}^{-1}}{1 + a} - b\left(T_{HPG}\right)^{-1}\right) + \xi \left(T_{LPG} - T_{E}\right) \left(\frac{T_{C}^{-1} + aT_{A}^{-1}}{1 + a} - T_{LPG}^{-1}\right) \right) \right\}^{-1}$$
(12)

The equation 12 finds the value of ECOP.

V. CONCLUSION

In this paper we analyze the finite-time performance optimization for a double-effect parallel flow irreversible absorption refrigerator system with losses of heat resistance, heat leakage and internal irreversibility by considering the performance coefficient (COP) and the ecological performance coefficient (ECOP).

References

- [1] Chen, L., Li, Y., Sun, F., Wu, C., 2002. Optimal performance of an absorption refrigerator. Exergy Int. J. 2, 167-172.
- [2] Chen, L., Sun, F. (eds.)., 2004. Advances in Finite Time Thermodynamics: Analysis and Optimization. New York: Nova Science Publishers.
- [3] Ezzine N. B., Mejbri K., Bahroumi M., Bellagi A., 2005. Irreversibilities in two configurations of the double generator absorption chiller: Comparison of performance. J. Thermal Analysis and Calorimetry, Vol. 80, 471–475.
- [4] Farshi, L. G., SeyedMahmoudi, S.M., Rosen, M.A., 2011. Analysis of crystallization risk in double effect absorption refrigeration systems. Appl. Thermal Engineering 31, 1712- 1717.
- [5] NgouateuWouagfack, P.A., Tchinda, R., 2011a. Performance optimization of three-heat-source irreversible refrigerators based on a new thermo-ecological criterion. Int. J. Refrig. 34, 1008-1015.
- [6] Qin, X., Chen, L., Ge, Y., Sun, F., 2013. Finite time thermodynamic studies on absorption thermodynamic cycles: A state of the arts review. Arab. J. Sci. and Eng. 38(3), 405-419.
- [7] Sedigh, S., Saffari, H., 2011. Thermodynamic Analysis of Series and Parallel Flow Water/Lithium Bromide Double Effect Absorption System with Two Condensers. J. Materials Sci. Eng. B 1, 206-217.
- [8] Stitou, D., Feidt, M., 2005. New criteria for the optimization and characterization of thermal energy conversion processes. Int. J. Therm. Sci. 44(12), 1142-1153.
- [9] Torrella, E., Sánchez, D., R. Cabello, Larumbe, J.A., Llopis, R., 2009. On-site real-time evaluation of an air-conditioning direct-fired double-effect absorption chiller. Appl. Energy 86, 968–975.

Dogo Rangsang Research Journal ISSN : 2347-7180

UGC Care Group I Journal Vol-10 Issue-08 No. 15 August 2020

- [10] Ust, Y., Sahin, B., 2007. Performance optimization of irreversible refrigerators based on a new thermo-ecological criterion. Int. J. Refrig. 30, 527-534.
- [11] Ust, Y., 2009. Performance analysis and optimization of irreversible air refrigeration cycles based on ecological coefficient of performance criterion. Appl. Therm. Eng., 47-55.
- [12] Xu, G. P., Dait, Y. Q., 1997. Theoretical analysis and optimization of a double-effect parallel-flow-type absorption chiller. Appl. Therm. Eng., Vol. 17, No. 2. pp. 157-170.
- [13] Zheng, T., Chen, L., Sun, F., Wu, C., 2003a. Performance optimization of an irreversible four-heat-reservoir absorption refrigerator. Appl. Energy, 391-414.
- [14] Zheng, T., Chen, L., Sun, F., Wu, C., 2003b. Performance of a four-heat-reservoir absorption refrigerator with heat resistance and heat leak. Int. J. Ambient Energy, 24(3), 157-168.