

**ICCS**  
2022

**Abstract Proceedings**

4<sup>th</sup> International Conference  
on  
**INNOVATIONS IN  
COMMUNICATION COMPUTING  
AND SCIENCES**

15<sup>th</sup> – 16<sup>th</sup> September 2022



**CHANDIGARH  
GROUP OF COLLEGES**

Building Careers. **Transforming Lives.**

**EDITED BY:**

Dr. Vinay Bhatia (Conference Chair)  
Dr. Sukhdeep Kaur (Conference Convenor)  
Dr. Mohit Srivastava (Conference Convenor)

**ORGANIZED BY:**

Department of Electronics and Communication Engineering (NBA Accredited)  
Chandigarh Engineering College Landran, Mohali, Punjab, India

# *ICCS 2022*

**Abstract Proceedings of  
International Conference  
on  
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Computing and Sciences**

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NBA Accredited Department  
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# About Chandigarh Group of Colleges

**“Building Careers, Transforming Lives”**

The heritage campus, Chandigarh Group of Colleges Landran, stretching back to a decade and half is superlative in giving professional education to the students from all corners of the country. The group commenced its journey in the year 2001 with strength of only 100 students and with two programmes. Today, the campus has more than 12000 students across 50 programmes. CGC is committed to maintain the numero Uno position in placements in the north Indian region and ensuring that every CGCian gets the best possible placement opportunities and multiple job offers in hand with hefty pay packages.



Chandigarh Engineering College (CEC) offers a wide assortment of degrees pertinent to Engineering technology. It has been running for more than two decades now, and meanwhile, it has expanded its reach. Today, the college offers B.Tech degrees in ECE (NBA Accredited), CSE (NBA Accredited), IT, ME and M.Tech courses. in four different specializations. In addition to that, the college also extends MBA and MCA degrees. The unconventional methods that the college employs have driven practical learning and innovation. Time and again, the college ensures that the students engage in activities that can sharpen their practical skills and make them industry-ready. The college has been ranked 139<sup>th</sup> among top Engineering Institutions by NIRF 2022.

## **ABOUT ICCS**

Just like the various exuberant events organized by Chandigarh group of colleges, International Conference on Communication, Computing and Sciences (ICCS) is also one of the popular conferences organized with its back-to-back successful series ever since 2019. It is a nice opportunity for researchers from all across the world to showcase their works on cutting edge tech. Just like the previous year's sublime central idea, this year ICCS2022's theme is focused on innovations in Communication, Computing and Sciences. Recent advancements in Artificial Intelligence have enabled applications like Computer Vision (CV) and Natural Language Processing (NLP) to assist sectors like financial services, healthcare, and automotive to speed innovation, enhance customer experience, and cut costs. The field of computational science known as machine learning (ML) is concerned with the analysis and interpretation of data patterns and structures to support learning, reasoning, and decision-making without the involvement of humans. ICCS is committed to promote the transformation of fundamental research into institutional and industrialized research and to convert applied exploration into real time application.

## **OBJECTIVES OF ICCS 2022**

The two days conference provides a platform for exchanging and enhancing scientific & technical knowledge from the experts of R&D, academia and industry in the field of communication, computing and sciences. Communication systems are deployed in various applications and span all the aspects of modern life. This conference will encourage us to see the inventions and innovative applications of communication, computing and smart sciences.

The primary goal of the conference is to promote the exchange of innovative scientific information between researchers, developers, engineers, students, and practitioners. Another goal is to promote the transformation of fundamental research into institutional and industrialized research and to convert applied exploration into real time application.

The contributions made by researchers will provide new developments in the field of communication and computing systems with a motive of applying research in development of start-ups and industry-based applications to support the Digital India mission.

## FROM THE CONFERENCE CHIEF PATRON



S. Satnam Singh Sandhu  
Chairman, Chandigarh Group of Colleges  
Landran, Punjab, India

“Technical Education is not only a ladder of opportunity, but it is also an investment in our future.” India has the potential of becoming an economic superpower by focusing on advancements in Computing and Communication Technologies, and Chandigarh Engineering College is committed to being the forerunner in this growth story.

I am delighted to share that Chandigarh Engineering College is organizing the “4<sup>th</sup> International Conference on Innovations in Communication, computing, and sciences (ICCS 2022). Recent years have shown a fast pace in technological development and its application in the social sphere. The path of expeditious development of a country is possible only if the technocrats and researchers explore new areas of research to promote technological innovations.

I am proud that this need was envisioned by our faculty at Chandigarh Engineering College and they opened up a panorama of opportunities for scholars from all over the world to share their ideas in an effort to benefit society at large. I am confident that this conference will bring the convergence of researchers, practitioners, and academicians whose ideas will have a far-reaching impact on the technological world.

I wish you grand success for ICCS 2022 and hope that this conference will stimulate modern innovations among the participants paving way for new inventions.

S. Satnam Singh Sandhu  
Conference Chief Patron  
ICCS 2022

## FROM THE CONFERENCE CHIEF PATRON



S. Rashpal Singh Dhaliwal  
President, Chandigarh Group of Colleges  
Landran, Punjab, India

I am honored and delighted to share that the 4<sup>th</sup> International Conference on "Innovations in Communication, Computing and Sciences" is being hosted by our Department of Electronics and Communication Engineering which aims to provide a platform for exchanging scientific and technical knowledge from the experts of R&D academia and industry in the field of communication and technology.

With a growing number of communication devices, use of networks, IoT, applications, and enormous use of information, it has become the utmost necessity to focus on communication and computing technologies. The evolving techniques and methodologies offer us efficient means of solving problems that help human lives and pace up development. Thus, another dimension we tend to include, in our deliberations during the conference, is intelligent ideas and solutions that are being most talked about and have been successful or promise great potential for the future.

Finally, I would like to express my appreciation to the organizers and the Head of the Department for their initiative and extend my best wishes for a huge success of this conference.

S. Rashpal Singh Dhaliwal  
Conference Chief Patron  
ICCS 2022

## FROM THE CONFERENCE PATRON



Dr. P.N. Hrisheekesha  
Campus Director, Chandigarh Group of Colleges  
Landran, Punjab, India

With immense delectation, I would like to state the that 4<sup>th</sup> International Conference on "Innovations on Communication, Computing and Sciences" (ICCS-2022) organized by our prestigious Department of Electronics & Communication, Chandigarh Engineering College, Punjab is being conducted to facilitate a platform where researchers and academicians acknowledge unexplored ideas in various emerging domains of communication and computing, alongside showcasing their concepts before the participants.

The key fields that play a major role in today's advancement of technology are communication and computing. And thus, maintaining a focus on these areas for learning about intelligent methods, systems, and their usage, is one of the main motives of this conference.

ICCS-22 is one such platform to discuss and collaborate on innovative ideas and find solutions to problem statements for not only betterment of the society but also to accelerate the wheel of development to take our country forward.

My warm greetings to the organizers and participants of ICCS-2022. I wish them a very intriguing and knowledge-sharing sphere.

Dr. P.N. Hrisheekesha  
Conference Patron  
ICCS 2022

## FROM THE CONFERENCE CO-PATRON



Dr. Rajdeep Singh  
Director-Principal, Chandigarh Engineering College  
Landran, Mohali, Punjab, India

I am delighted to share that Chandigarh Engineering College, Landran is organizing a two-day International Conference on “Innovations in Communication, Computing and, Sciences (ICCS-2022). In the present scenario, modern applications like the Internet of things (IoT), Robotics, and Embedded Systems are highly dependent on computing advancements. Innovation in communication computing and sciences is to be credited for providing astounding solutions to meet the needs of the modern world.

This technically oriented program is rich and varied with several keynote speeches, talks, panel discussions, and various technical papers split between parallel oral sessions with a lot more additions on this list. This initiative by the Department of Electronics and Communication Engineering will offer abundant opportunities for a mutually beneficial sharing of knowledge and expertise.

I am thankful to all the participants, sponsors, and, the National and International Advisory Committee of ICCS-2022 and extend my best wishes for the grand success of this conference.

Dr. Rajdeep Singh  
Conference Co-Patron  
ICCS 2022



## FROM THE CONFERENCE CHAIR



Dr. Vinay Bhatia  
Head of the Department  
Electronics and Communication Engineering Department  
(NBA Accredited)  
Chandigarh Engineering College, Landran, Mohali, Punjab

On behalf of Electronics and Communication Engineering Department, it gives me immense pleasure in writing the message for the proceedings of 4<sup>th</sup> International Conference on “Innovations in Communication Computing and Sciences 2022 (ICCS-2022)”, being organized from 15 September to 16 September 2022 by Chandigarh Engineering College, Landran, Mohali.

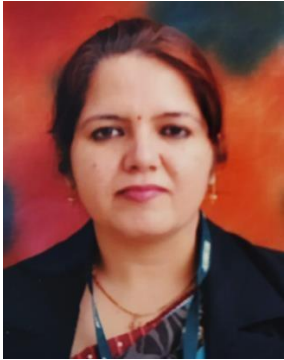
With a large number of participants expected this year, we are delighted to see that these annual conferences are becoming larger and more substantial every year. I am equally excited about the number of sessions, and wide variety of ideas that scholars and practitioners will bring into our fold. The conference provides platform for researchers to get networked and exchange the ideas for further progress in research and development. It covers areas of Computational algorithms for smart systems, robotics and IoT, communication systems, advanced and applied Sciences, but not limited to these areas only.

A high-quality technical program would not be possible without countless hours of hard work from many researchers in the community. I also want to express my sincere appreciation to the members of the Program Committee for their critical review of the submitted papers, as well as the Organizing Committee for the time and energy they have devoted for editing the proceedings and arranging the logistics for holding this conference.

I wish this conference comes up with ample opportunities of applying research in development of start-ups and industry-based applications.

Dr. Vinay Bhatia  
Conference Chair  
ICCS 2022

## FROM THE CONFERENCE CONVENER



Dr. Sukhdeep Kaur  
Electronics and Communication Engineering Department  
Chandigarh Engineering College, Landran, Mohali, Punjab

I'm very pleased to share with you that Electronics and Communication Engineering Department of Chandigarh Engineering College, Landran is organizing two days International Conference at its campus on "Innovations in Communication, Computing and Sciences" (ICCS 2022) from 15<sup>th</sup> to 16<sup>th</sup> September 2022 to a forum is provided for sharing insights and encounter cognizance related to Advanced Computing & Communication Technologies. It will bring in new notions, advocate different approaches, and reckon various tools to enhance intellectual abilities.

The conference aims to bridge the researchers working in academia and other professionals through research presentations and keynote addresses in current technological trends. It reflects the growing importance of Electronics and Computing as a field of research and practice. You will get ample opportunities to widen your knowledge and network. Such a large conference event is the culmination of many individuals.

On the behalf of Chandigarh Engineering College, I hearty welcome the Chief Guest, Guest of Honor, Keynote speakers, eminent academicians, corporate heads/delegates and the paper presenters to ICCS'22.

I wish the conference a great success and extend my good wishes to the organizers and participants.

Dr. Sukhdeep Kaur  
Conference Convener  
ICCS 2022

## FROM THE CONFERENCE CO-CONVENER



Dr. Mohit Srivastava  
Electronics and Communication Engineering Department  
Professor, Chandigarh Engineering College Punjab, India

It is my great honor and pleasure to invite you all to the ICCS 2022, 4<sup>th</sup> International Conference on “Innovation in Communication, Computing and Sciences” being organized by the Electronics and Communication Engineering Department of Chandigarh Engineering College, Landran, Mohali.

Building on the success of previous conferences, the theme for 2022 is based on advanced solutions using Artificial Intelligence and Machine Learning, and I look forward to learning the latest results from researchers, industrial, government, and academic scientists on these topics and everything else that is presented. Large number of submissions of research papers from all over the country for ICCS 2022 shows the popularity of ICCS Series. The researchers not only from India but from different countries shows their interest in ICCS, and submitted their research papers.

The ICCS 2022 will be organized in a hybrid mode. Total 4 technical sessions will be planned for the researchers to present their work. In ICCS 2022, we have invited the great researchers from academia and industry of repute from the globe to share their work as keynote addresses. I believe you all will enjoy great time with good learning.

I am very much thankful to all the committee members involved for the great success of the ICCS 2022. But it is not possible without the participants of the ICCS and the hard work of our reviewers and technical program chair members.

I wish the conference a great success and extend my good wishes to the organizers and participants.

Dr. Mohit Srivastava  
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# Breast cancer diagnosis using SVM classifier with PSO

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## Abstract.

Since the past four decades, India's investment in cancer research has led to a greatly improved understanding of the numerous diseases known as cancer, taking into account some of the biological pathways that contribute to the formation, progression, and spread of cancer. This knowledge has improved the therapy for some tumors and allowed patients suffering from conditions that were typically deadly to live longer. Numerous risk factors are recognized by the National Cancer Act for the classification of cancer based on type. Problems arise when cancer is divided into different types. In our proposed work, we classify dataset1 in 5 type of cancer and dataset2 in 6 type of cancer. The classification is performed when these datasets are compatible with our classification method. So we perform pre-processing step and then Particle Swarm Optimization is used for feature selection of each gene. Now on basis of features, Support Vector Machine performs well to classify data in predicted classes. Accuracy of classification method is compared with proposed method.

**Keywords**—Support Vector Machine, Particle Swarm Optimization

## 1. INTRODUCTION TO BREAST CANCER

The scientific review led to recommendations based on evidence on breast cancer screening for women of average risk, intermediate and high. From the beginning, breast cancer has been fought with the rallying cry of early detection. There is no known exact cause of breast cancer, but evidence suggests that it must be caused by a combination of inherited and environmental factors. Our current scientific knowledge of the disease hampers efforts to prevent breast cancer. Many established breast cancer risk factors, such as being a woman, age, breast density, family background, heredity, or a past breast cancer diagnosis, cannot be changed.

Positively, research shows that maintaining a healthy body weight, engaging in physical activity, eating sensibly, and limiting alcohol intake can all lower the risk of developing breast cancer. However, early detection has been the foundation of hope and action for breast cancer because personal risk reduction is still not a guarantee. Early detection will continue to be our top strategy for lowering breast cancer-related death and sickness until we can successfully prevent the disease.

Breast cancer detection is the process of diagnosing the disease earlier than would otherwise be the case. Breast cancer screening, also known as secondary prevention, is the routine testing of people who do not have any symptoms with the goal of finding breast cancer as early as possible so that appropriate treatment can be provided. Breast cancer mortality in Canada has decreased by an estimated 25–30% since the late 1980s due to the introduction of breast cancer screening.

The recommendations suggest specific technologies for each of the three risk groups. Digital or film mammography is specified for average-risk women, digital supplemented by ultrasound in intermediate-risk women, and digital supplemented by MRI in high-risk women. The differences in technologies are related to differences in breast density and tumor characteristics in higher-risk women. Some imaging systems are better than others for detecting cancer or dismissing it given certain characteristics of an individual woman's breasts.

## 2. RISK FACTORS OF BREAST CANCER CLASSIFICATION

Since the recommendations use three risk groups to sort out differences in screening routines, it may be wondering how to fit the risk profile. Some people would consider just being a woman to be the most common risk factor for breast cancer. While men do get breast cancer, women are about 100 times more likely to get it. Thus the vast majority of women (at least 80%) are

considered “average” risk [1]. The prevalence of breast cancer increases with age, which makes advancing age the most commonly recognized risk factor. The median (middle) age for a breastcancer diagnosis is 61.

After age, the risk of breast cancer increases significantly with family history, certain benign lesions, breast density, a history of previous breast cancer and hormonal factors. According to Dr. Eisen [2], only about 20% of women who have had breast cancer have had a first or second degree relative who also had it. About 5% of women with breast cancer have a very strong family history of the disease, and about a quarter of high-risk cases are due to known genetic mutations such as BRCA1 and BRCA2. That leaves about three quarters of familial risk unexplained, possibly due to environmental factors [3], but more likely genetic factors yet unidentified. An array of other risk factors has been explored. Some lifestyle factors like obesity, particularly in postmenopausal women, can increase risk. A specific diet to reduce breast cancer risk has been hard to pin down [4], but women who exercise regularly and vigorously may decrease their risk. Alcohol is a known risk factor. Low Vitamin D is also a possible risk factor. Reproductive factors also affect breast cancer risk. Both early menarche (the age of first menstruation) and late menopause are associated with increased risk. Breast cancer risk also increases with null parity (having no full-term births) or having a first birth at a later age [5]. According to Dr. Eisen [2], it was common over the past century for women to start families in their twenties and to continue giving birth well into their 30s. Today, women are more likely to have a first birth in their 30s [6]. So it is possible that the social trend of having families later may be increasing breast cancer risk.

Exposure to estrogen is an important risk factor for breast cancer because these hormones stimulate tumor growth. Women who are menopausal and obese have higher circulating estrogen. Excess estrogen can also be ingested with birth control pills or hormonal replacement therapy after menopause [7]. After 2001, breast cancer incidence appeared to decrease with a substantial drop in prescriptions after hormone replacement therapy was recognized as a possible breast cancer risk.

### 3. PROBLEM STATEMENT

New methods have been used in the framework of the human genome model to make it easier to implement experiments in parallel on a large number of genes at once. A notable example are DNA microarrays, also referred to as DNA chips. This method focuses on simultaneously measuring the mRNA levels for numerous genes in specific cells or tissues. A tumour biopsy's array is hybridised after the mRNA has been extracted, tagged, and processed. The intensity value that results from measuring the quantity of label on each spot should be connected to the abundance of the matching RNA transcript in that sample.

Let  $Y = \{y_1, y_2, \dots, y_n\}$  be the random variables for gene  $g_1, g_2, \dots, g_n$  respectively. Let  $C$  be the random variable for the class labels such that  $C = \{1, 2, 3, \dots, k\}$  where  $k$  is the no of classes. Let  $t = \{t_{y_1}, t_{y_2}, \dots, t_{y_n}\}$  be the expression values corresponding to  $n$  genes. We are given  $t$  with the training set of  $m$  tuples

$T = \{(t_1, c_1), (t_2, c_2), (t_3, c_3), \dots, (t_m, c_m)\}$ . where  $c_i$  is the class label of the tuple  $t_i$ . Let  $X = \{t_1, t_2, \dots, t_s\}$  be the test set.

A classifier is the function with two arguments  $T$  and  $X$  where  $T$  is the training set and  $X$  is the test set. We have to identify the class label of all the unknown samples in the test class by using the knowledge or information available from the training sample and then check the accuracy the classifier. Classification accuracy is defined as the number of samples which is predicted accurately by using the classifier trained on the training samples.

### 4. HYBRID METHODS

There are two methods used for implementation. first is support vector machines and second is particle swarm optimization.

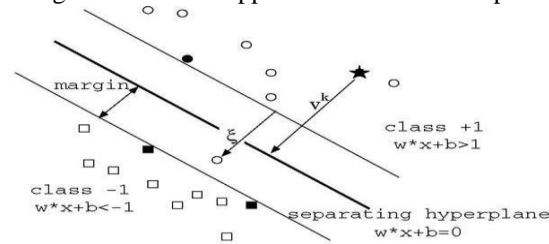
#### 4.4.1 Support vector machines

Support vector machines have the finest theoretical and outstanding empirical level of start-up. They have been used for



projects like database classification, object detection, and handwritten digit detection. Support-vector machines are first presumed for numerical data. The basic idea underlying SVM is to look at separators in the search space that can most effectively separate the various cancer kinds. With SVM, we can anticipate the lowest true error if we are able to identify a pattern for the concept of very low risk. Its likelihood for  $h$  is that randomly chosen test objects will develop a problem. The concept is shown well as shown in fig 1 .

Figure 1: How a Support Vector Machine operates



The main advantage of the SVM technique is that since it tries to discover the optimum distinction in the feature space by defining the appropriate hybrid[8] of features, it is quite robust to high dimensionality.

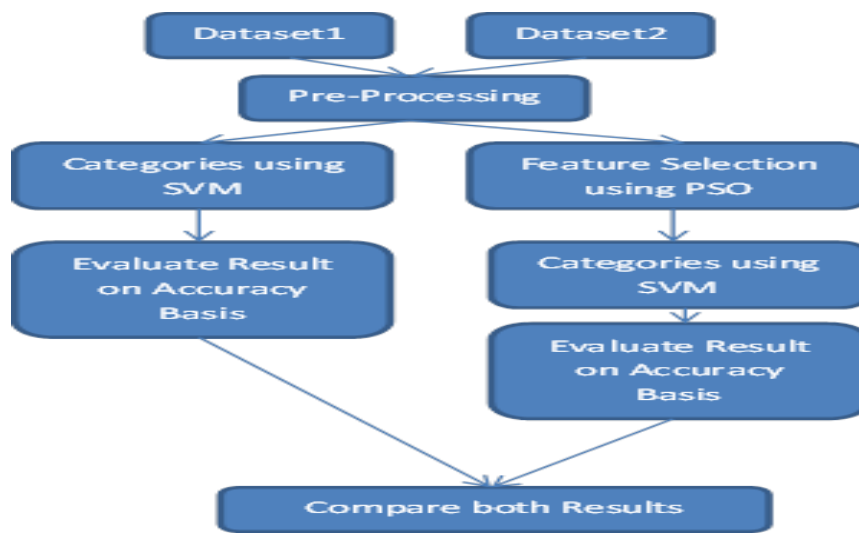
#### 4.4.2 Particle Swarm Optimization

PSO is a technique that uses numbers. Swarm intelligence was the fundamental theory used to develop this method [9]. PSO was created based on the social behaviour of flock-survival birds. There are a lot of responses in the beginning of this procedure, or rather, a counting of replies in which any random pick is termed a particle. This method operates in an iterative manner and approaches the ideal outcome. Every particle makes an effort to move across space at a dynamic velocity  $v_i$  that directs the particle toward the best possible outcome at each iteration. In the search space,  $n$  particles are initially distributed at random [10].

## 5. PROPOSED METHODOLOGY

Flowchart of proposed methodology is shown in figure . Microarray experiments allow us to quantify the expression level of thousands of genes instantly. These either monitor each gene several times under distinct conditions or each gene into a single state, but in the type of different tissues. First type of experiment identify the genes which are related to each other due to common expression while the latter type of experiment identify the genes whose expression are good diagnostic indicator. In order to obtain the significant information from the gene expression profiles various methods have been used. Firstly we need to prepare data which compatible for our proposed work. The step performed before implementation is known as pre-processing. Following certain steps are required to perform:

1. Select the dataset1 and dataset2 from a hugdatabase.
2. Perform pre-processing step to make dataset compatible for our proposed method.
3. Define classes of cancer type and apply SVM algorithm for classification of dataset on basis of classes.
4. Evaluate
5. Define and use



6. Evaluate
7. Compare

the results.  
the classes of cancer type  
a feature selection  
technique PSO. The  
feature categories  
according to classes type  
SVM method.  
the results.  
the results of both  
techniques.

Figure 2: Flowchart of proposed work

## 6. DATABASE

### 1. Dataset 1:GSE22226-GPL1708:

It consists of 129 columns and 44270 rows. Column represents the no of patients or samples while rows represent genes corresponding to each patient. It consist of 5 classes of cancer named as luminal A, luminal B,basal-like,her2 enriched and normal .The no of samples corresponding to each type of cancer is shown in table I.

### 2. Dataset 2: GSE10866-GPL1390:

It consists of 199 columns and 22575 rows. Column represents the no of patients or samples while rows represent genes corresponding to each patient. It consist of 6 classes of cancer named as luminal A, luminal B,basal-like,her2 enriched , normal and claudin. .The no of samples corresponding to each type of cancer is shown in Table II.

**Table I: Patients corresponding to cancer type**

Cancer Type	No of patients
Luminal A	32
Luminal B	25
Basal-like	43
Her 2 enriched	21
Normal	8

**Table II: Patients corresponding to cancer type**

Cancer Type	No of patients
Luminal A	32
Luminal B	25
Basal-like	43
Her 2 enriched	21
Normal	8
Claudin	21

## 7. RESULT ANALYSIS

Many types of database are available on which different type of existing and proposed classification methods implemented. Performance of each method provides us the merits and demerits regarding that method. We assign two different datasets to the proposed method. Each dataset have 129 and 199 samples respectively with multiple classes. These datasets are assigned as input of SVM classifier and evaluate the performance. Some issue generates in front of us one of them is feature selection. This issue resolved using PSO technique with SVM classifier. The same both datasets are assigned to this hybrid approach and evaluate the performance. Now we compare both results and get a conclusion about classification method. Different reading has been taken that based on the different proportion of training and testing set.

### 1. Results Evaluation for Accuracy on Dataset 1:GSE22226-GPL1708

Accuracy of SVM without PSO

Accuracy of SVM with PSO

**Table III: Results of SVM classifier on dataset 1**

**Table IV: Results of PSO with SVM classification on dataset 1**

SVM	Training Ratio	Testing
63.18%	80:20	
61.49%	75:25	
52.79%	70:30	
43.83%	65:35	
59.14%	60:40	

SVM	Training Testing Ratio
65.41%	80:20
61.90%	75:25
53.05%	70:30
56.69%	65:35
58.47%	60:40

Table III represents the results of SVM classification which consist of 129 samples. Each sample consist 44270 genes. There are no genes available which know its parent sample. We can say there is no technique used for feature selection of each gene. There are 5 cancer classes exists in this dataset. The classification performed on these types classes of cancer. Different type of cancer classes are named as luminal A, luminal B, basal-like, her2 enriched and normal cancer. Table IV represents the accuracy result of SVM classification with PSO feature selection technique which has been implemented on dataset 1 in a way to increase the classification accuracy by selecting certain number of genes.

## 2. Results for Dataset 2: GSE10866-GPL1390

Accuracy of SVM without PSO.

**Table V: Results of SVM classification on dataset 2**

SVM	Training Testing Ratio
78.83%	80:20
81.33%	75:25
80.19%	70:30
78.26%	65:35
74.16%	60:40

Accuracy of SVM with PSO

**Table VI: Results of PSO with SVM classification on dataset 2**

SVM	Training Testing Ratio
79.88%	80:20
79.67%	75:25
79.60%	70:30
78.93%	65:35
72.38%	60:40

Table V represents the results of SVM classification which consist of 199 samples. Each sample consist 22575 genes. There are no genes available which know its parent sample. We can say there is no technique used for feature selection of each gene. There are 6 cancer classes exists in this dataset. The classification performed on these types classes of cancer. Different type of cancer classes are named as luminal A, luminal B, basal-like, her2 enriched and normal cancer and claudin. Table VI represents the result of KNN classification with PSO feature selection technique on dataset 2 which consist of 199 samples. Each sample consist 44270 genes. This technique has been implemented in a way to increase the classification technique because large no of features can make the classification process complex.

## 8. CONCLUSION & FUTURE SCOPE

Basic research is always required for further new proposal. It is key of transformative to discoveries about classification of cancer type. A mechanism is used for classification of data. Current research work delivery emphasizes overwhelmingly the classification of acute cancer disease rather than protection and preservation of overall health. The instability performance of SVM classifier helps in categories dataset in different type of cancer. The top level accuracy is 61.49% for dataset 1 and 80.18% for dataset 2 by SVM classifier without using feature selection technique. So it is transparent to us that accuracy of SVM classifier is high when dataset has more samples. Now we deploy a feature selection technique PSO with SVM classifier. This deployment is implemented on both same datasets and evaluates results. The top level of accuracy of SVM with PSO during execution is 65.41% for dataset 1 and 79.88% for dataset 2. This is concluding that SVM with PSO perform very well fewer samples in dataset.

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## Biographies



Currently working as an Assistant professor in Electronics and Communication Department in Chandigarh group of colleges, Landran, (Mohali) Punjab, India. Gold Medalist in B Tech in Electronics from Kurukshetra University, Kurukshetra in 2003. Received M tech degree from Punjab Technical University, Jalandhar in 2008 and pursuing Ph.D in the field of soft Computing. She has teaching experience of 18+ years at Post Graduate and Under Graduate Level. Her research activities include designing model identification using neural networks, fuzzy systems, supervised learning, machine learning. Published more than 40 research papers in reputed journals. Published 4 book chapters in Springer series and 5 text books. Published 6 Indian patents.



Dr. Bhawna Tandon received her B.Tech in Electronics and Instrumentation in 2001, M.E. in Instrumentation and Control in 2009 and Ph.D in Control System from Kurukshetra University, Kurukshetra, Panjab University, Chandigarh and PEC (Deemed to be University) Chandigarh respectively. She is having teaching experience of 20 Years and currently working as an Associate Professor at Chandigarh Engineering College, Landran, Mohali. She is having more than 20 research publications in reputed International journals. Her current research interests include robust control, non-linear control and optimisation techniques.

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# Performance Assessment of Distinct Mobility Models used in Wireless Body Area Network

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## Abstract

In the Internet of Things (IoT) age, Wireless Body Area Networks (WBANs) have developed into a key component with a centre on different applications, as healthcare. These networks offer significant monitoring and diagnostic capabilities. In a typical WBAN setup, there is I a small network close to the body (between 1to2 metres), II a path (sink) connecting to other network groups, which can be one or more nodes with specific routing and records combined features, III a broad-ranging network, which can be an Internet or intranet system, and IV submissions with GUI for medical or different healthcare professionals. Communication between nodes and the sink as a whole becomes rather challenging since the humanoid body's gestures cause the WBAN radio broadcast's features to be robust. Nodes that are close to the static sink appear to be transmitting data constantly. As a result, the node closest to the sink uses up its energy significantly faster than nodes farther away. The solution to the aforementioned problem is sink mobility. Work that is scheduled includes calculating WBAN performance using an entity mobility model. Random waypoint mobility model, Mobility models from the Reference Point Group, and Mobility models from the Reference Velocity Group are examples of random direction mobility models with movable and static sinks. Network Simulator 2.35 is used to simulate. Metrics for evaluation include Average E2E latency, Packet Delivery Ratio, and Average Throughput. Results from simulations indicate that mobile sink improves system performance as a whole.

**Keywords:** Random Waypoint Mobility, Random Direction Mobility, Reference Point Group Mobility, Wireless Body Area Networks, Internet of Things, End-to-End

## 1. Introduction

### 1.1 Wireless Body Area Network (WBAN)

WBAN typically includes mote nodes that can be implanted or worn on or near the body. These sensor nodes will serve as network nodes where two-way communication, from sensor to sensor and from sensor to coordinator, is required. Since a few decades ago, wireless broadcasting has played an extremely important part in our way of life. It contributes in a variety of ways because it's a crucial component of various practical applications including tracking appliances, tracking devices, monitoring, and automation. Because of the world's rapidly expanding population, everyday life has become more expensive, especially in wealthy nations like Japan, Spain, Germany, and Italy, etc. Given the swift increase of population, the average age of those over 60 is rising, which means that they require more care for their health and spend extra on treatments [5]. Tragically, chronic and dangerous illnesses including cancer, asthma, and cardiovascular conditions are frequently detected too late, which raises the average death rate among those who receive a diagnosis. Early detection of these disorders may allow us to lessen their effects and lengthen the life expectancy of patients [7]. Recent research studies show that WBAN is an effective approach to the implementation of an electronic health care system [10].

### 1.2 Entity Mobility Model

#### A. Random Waypoint model

RWP, or the random waypoint mobility model:

A mobile path contains a series of journeys. All mobile nodes are initially given a fixed position in the zone at time 0. The mobile randomly chooses a next waypoint  $M_n$  at the beginning of each journey that is always in the zone and a following quickness  $V_n$  that is always between  $[V_{min}; V_{max}]$ , regardless of the previous and current values. Then, it travels at a constant speed  $V_n$  in the direction of the newly chosen terminus. The mobile pauses for a

predetermined or arbitrary amount of time when it reaches Mn. It restarts the process after this period has passed.

## B. Random direction mobility model

Mobile nodes are initially given a fixed position in the zone at time 0. The mobile randomly chooses a direction theta that is always between [0; 2], a speed Vn that is always between [Vmin; Vmax], and a travel duration t that is exponentially circulated with an assumed mean at the beginning of each tour. Then it moves at speed Vn for a time t in the direction theta. Similar to this, when the mobile reaches Mn, it pauses for a predetermined or random amount of time before randomly choosing a new direction, speed, and travel duration [1][2][3][4]. Several grade of service restrictions, together with PDR, Average Throughput, and Average E2E Delay, are used to assess the effectiveness of WBAN. The direction-finding technique is used to produce two alternative scenarios for testing in the network simulator, each with a different node count (25 - 50) and utilising these two static and mobile sink.

### 1.3 Group Mobility Model

The RPGM model is a group mobility model, where random move of a group and every node private a group is symbolized. Here, each group has a sensible centre or group leader and this group leader chooses the group's motion conduct. In tons of major uses like soldier struggle in battlefield, movement of attendee groups in an presentation etc., there is a sturdy association between the nodes and they are permissible to travel in certain limited areas only. This can be fine denoted by RPGM.

## 2. Related Work

Khan et al. [1] suggested a movement model that is a 3D execution of present Random Direction (RD) mobility model and presented in what way a mobility model influences the whole network. Supriya Agrahari et al. [2] presents the RWM model for relating reconstruction of mobile nodes circulation inside the network. Haque Nawaz et al. [3] explored mobility models which deliver the specific mobility outline to decide the problematic of association, communication. These mobility models deliver the podium to know and implement WBAN. Luis Irio et al. [4] distinguishes the wireless intrusion of a mobile adhoc network, where mobile nodes approves to RMP model. Scattering of the intrusion is examined compelling into clarification of the imaginary nature of path damaged because of movement of nodes. Attard S. and Zammit S. [6] proposed a highly promising technology, i.e. Body Coupled Communications (BCC) technology, has been used to connect BAN devices. Human body is used as a means through which the signals are communicated in this form of wireless communication. For attaching devices to the human body, the capacitive BCC displays very favorable properties. Low signal attenuation is one such property that improves the battery lifespan of BAN devices. The confinement of signal power near to the human body is one more property, making BANs more stable and less vulnerable to interference. Authors have attempted to show that various motions of the body develop in substantially unlike activity of the BCC channel. Channel properties are also affected by the form and speed of human body movement. The proposed work in [9] described a system called Least Distance Movement Recovery (LDMR) which is based on a distributed approach. In this approach, the recovery from network partitioning is accomplished by shifting the roles and responsibilities of failed nodes to its immediate neighbors. The major constrints of LDMR are (i) expenditure of massive proportion of energies by each node to search for the non-vertex node at time of recovery and (ii) the congestion arises in the network due to the flooding of the packets by each node to search the non-vertex node. Protocols in [8] find the updated path each time, when there is a change in topology due to postural mobility. The main drawbacks of these protocols is that a massive amount of energy is absorbed by every node because the huge amount of computation overhead for the path discovery activities during recovery from network dividing. Prabhakar D. Dorge [11] stated that the Reference Point Group

Mobility (RPGM) model is based on correlated node mobility.

## 3. Proposed Work

N numbers of heterogeneous sensor are deployed across geographically area. A static sink node is employed at the Centre of the network (static sink is stationary having a steady point, sit either inside or closer to the sensing zone) and mobile sink node is free to move across the entire wireless sensor network. The same fixed communication radius is used for data transfer between both sinks and all sensor nodes. The Pci (average power consumption) for a BS is designated as: Assuming static power usage and optimum conditions for data traffic,

$$P_{c_i} = N_{sec} N_{ant} \left( A_i P_{tx} + B_j + P_{BHi} \right) \quad (1.1)$$

Nant is intended to reflect the number of antennas per sector for particular base station, whereas Nsec is meant to show the entire number of sectors. Pci is the mean of whole power of all base stations, Ptx is the transmitted power for every base station. Always Ai represents the portion of Pci that is directly proportionate to the power

transferred from a BS, whereas  $B_j$  represents the fraction of power used independently of the typical communicated power from a base station. These are the primary components that make up a base station's energy competency. While  $N_{sec}$  is supposed to display the total number of sectors,  $N_{ant}$  is intended to depict the number of antennas for every sector for a single base station.  $P_{tx}$  is the communicated power for each base station, whereas  $P_{ci}$  is the mean of aggregated power of all BS.  $A_i$  is for the portion of the  $P_{ci}$  that is directly equivalent to the power transferred from base station,  $B_j$  speaks for the component of the  $P_{ci}$  that is spent independently of the typical power broadcast from a base station. These are the essential characteristics that, in actuality, characterize a base station's energy competency.  $P_{bhi}$  is introduced to control the power usage that occurs during communication. The EE model mentioned above provides the idea of a particular heterogeneous system's effectiveness in a region. We want to identify the heterogeneous network region that is fully utilized across various regions. In order to do that, we need to compute the effectiveness over a specific time frame. Assuming that  $T_{het}$  represents the overall data transfer period for a heterogeneous network Calculating time efficiency is as follows:

$$T_e = \frac{EE_{het}}{T_{het}} \quad (1.2)$$

**Table 1: Simulating Parameters**

S. No.	Names	Value
1	Channel type	Wireless channel
2	Propagation model	Propagation / Two Ray Ground
3	Antenna Types	Omni Antenna/ Antenna
4	Total no. of Nodes Entity Mobility Model	25, 50
5	No. of Nodes Group Mobility Model	25-100
6	Protocol	DSDV
7	Simulation Time	1050

## 4. Results and Analysis

### i) Entity mobility model

In this work, the EM s i) RWM ii) Random Direction Mobility Model for Stable and Random Sink Nodes are used to analyze the DSDV routing protocol. In this section, the results of DSDV with a static sink node and DSDV with a random sink node are compared. For 25, 50 nodes, the comparison is conducted.

**Table 2: Performance of DSDV (Random Waypoint Mobility Model and Static Sink Node n=25)**

PDR	Throughput (Kbps)	Average E2Edelay (ms)
84.28	0.790500	0.022759

**Table 3: Random Direction Mobility Model with Static Sink Node Performance of DSDV (n = 25)**

PDR	Throughput (Kbps)	Average E2Edelay (ms)
78.74	1.474500	0.193834

**Table 4: Performance of DSDV (Random Waypoint Model and Static Sink Node n = 50)**

PDR	Throughput (Kbps)	Average E2Edelay (ms)
61.42	0.437000	0.011455

**Table 5: Random Direction Mobility Model with Static Sink Node Performance of DSDV (n = 50)**

PDR	Throughput (Kbps)	Average E2Edelay (ms)
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54.59	0.773000	0.010492
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**Table 6: Performance of DSDV (Random Waypoint Mobility Model and Movable Sink Node n = 25)**

PDR	Throughput (Kbps)	Average E2Edelay (ms)
100	0.938000	0.001512

**Table 7: Random Direction Mobility Model with Movable Sink Node Performance of DSDV (n = 25)**

PDR	Throughput (Kbps)	Average E2Edelay (ms)
100	1.872500	0.001174

**Table 8: Performance of DSDV (Random Waypoint Model and Movable Sink Node n = 50)**

PDR	Throughput (Kbps)	Average E2Edelay (ms)
100	0.711500	0.001540

**Table 9: DSDV's (Random Direction Mobility Model with Movable Sink Node n = 50) performance**

PDR	Throughput (Kbps)	Average E2Edelay (ms)
100	1.416000	0.001192

**Table 10: Analysis of Results for 25 Nodes**

Mobility Model	PDR (%)	Throughput Kbps)	Average E2Edelay (ms)
DSDV-RWM Static Sink	84.28	0.790500	0.022759
DSDV-RDM Static Sink	78.74	1.474500	0.193834
DSDV-RWM Movable Sink	100	0.938000	0.001512
DSDV-RDM Movable Sink	100	1.872500	0.001174

**Table 11: Analysis of Results for 50 Nodes**

Mobility Model	PDR (%)	Throughput Kbps)	Average E2Edelay (ms)
DSDV-RWM Static Sink	61.42	0.437000	0.011455
DSDV-RDM Static Sink	54.59	0.773000	0.010492
DSDV-RWM Movable Sink	100	0.711500	0.001540
DSDV-RDM Movable Sink	100	1.416000	0.001192

**ii) Group Mobility Model**

**Table 12: Analysis of PDR for 25 to 100 Nodes**

No. of Mobile Nodes	PDR% (Reference Point Group Mobility Model)	PDR% (Reference Velocity Group Mobility Model)	PDR% Hybrid Mobility Model
25	93.52	99.2	100
50	92.8	99.1	100
75	87.45	99	95.37
100	83.35	98.9	94.03

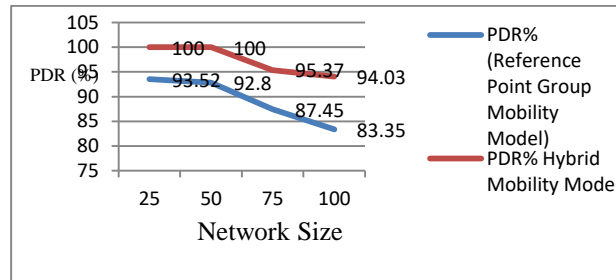


**Table 13: Analysis of Throughput for 25 to 100 Nodes**

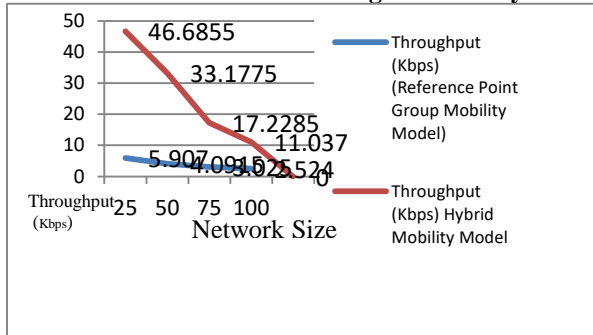
No. of Mobile Nodes	Throughput (Kbps) (Reference Point Group Mobility Model)	Throughput (Kbps) (Reference Velocity Group Mobility Model)	Throughput (Kbps) Hybrid Mobility Model
25	5.907	6.2565	46.6855
50	4.0915	4.4635	33.1775
75	3.025	3.5085	17.2285
100	2.524	3.0725	11.037

**Table 14: Analysis Average of End-to-End delay for 25 - 100 Nodes**

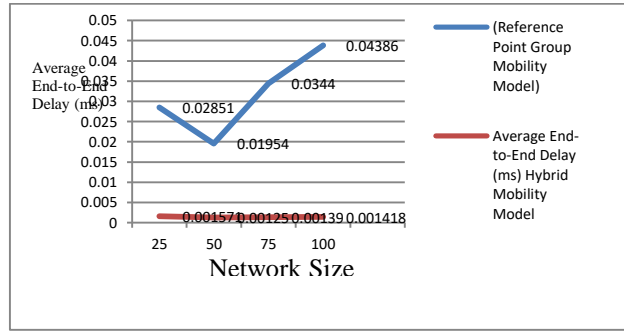
No. of Mobile Nodes	Average End-to-End Delay (ms) (Reference Point Group Mobility Model)	Average End-to-End Delay (ms)			Average End-to-End Delay (ms) Hybrid Mobility Model
		Reference Mobility Model	Velocity Group	Group	
25	0.02851	0.001592			0.001571
50	0.01954	0.001635			0.00125
75	0.0344	0.001492			0.00139
100	0.04386	0.001557			0.001418



**Figure 1: Analysis of PDR for 25 to 100 Nodes**



**Figure 2: Analysis of Throughput for 25 to 100 Nodes**



**Figure 3: Analysis of Average End-to-End delay for 25 to 100 Nodes**

### 5. Conclusion & Future scope

We looked at the most recent mobility models in this paper for a variety of environment scenario trajectories in WBAN. These models have been divided into two categories, with each group being further subdivided. These mobility models offer the framework for comprehending and applying the WBAN. The mobility models were created using the NS 2.35 simulator tool to account for different movement patterns. The results of the simulation demonstrated that a movable sink provides the greatest improvements in throughput, packet delivery ratio, and E2E delay. Future research will focus on creating fault-tolerant algorithms to handle topology changes brought on by postural movement.

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## Biographies:



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Dr. Dinesh Arora- Area of Interest is Optical fiber and Wireless communication. His total experience is 20 years (17 Teaching + 3 Industrial), presently working as Professor (ECE) in Chandigarh Engineering College (Mohali) PUNJAB (INDIA). He has published 64 papers in international journals and has presented many papers in National

/International conferences. He has Guided 19 M.Tech. Students of KUK & PTU and is presently guiding 01 Ph.D. student of PTU.

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## Spreading Code Optimization using Genetic Algorithm

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### Abstract.

In the method of optimization we can determine the best one among all the possible solutions. Optimization in spread spectrum displays a very important role in these days. Hence in wireless communication, optimization of spreading code is very essential because in the modern system of communication utilization of CDMA (code division multiple access) method with one unique code to each user is very essential. Hence researchers should give attention for optimized spreading code generation. This study shows a Genetic Algorithm based spreading code which is generated using logistic map code. Properties of the generated bit is discussed in this paper with the help of mono bit test, run length test, and computational complexity also compared with other existing spreading code (like spreading code generated from logistic map and optimized spreading code using exponential scale factor-based DE). The proposed spreading code shows better results than the existing state-of-the-art spreading code. Therefore, the proposed spreading code can be easily applicable to wireless communication schemes.

**Keywords.** Optimization, Genetic Algorithm, Spreading Code, Logistic map;

### 1. INTRODUCTION

Primary factor of CDMA (code division multiple access) is spread spectrum [1]. Utilization of more bandwidth compared to primary message is the main idea behind spread spectrum [2], [3]. In spread spectrum, same signal power is maintained and is masked by noise, which makes the signal very challenging to separate from noise therefore more difficult to intercept and jam. To spread the spectrum, direct sequence (DS) [4] and frequency hopping (FH) [5] are two very important techniques. To make larger bandwidth rapid phase transition of data is the main idea behind DS method and in FH method, in random narrow bands signal jumps take place within a larger bandwidth. Gold, PN (pseudo noise), Walsh, Kasami are some basic codes which are generally applied in spread spectrum techniques. Not only that spreading code generated from logistic map are also used in today's word [6],[7]. But the result can be improved by applying optimization technique. In the process of Optimization we can determine the best one among all the possible solutions. Optimization in spread spectrum displays a very important role in these days, hence in wireless communication, optimization of spreading code is very essential because in the modern system of communication utilization of CDMA (code division multiple access) method with one unique code to each user is very essential. Hence researchers should give attention for optimized spreading code generation. There are various metaheuristic approaches like ant colony optimization (ACO) algorithm, particle swarm optimization (PSO) algorithm, differential evolution (DE) algorithm etc [8], [9], [10]. Rather than these algorithm, genetic algorithm (GA) displays a very important role in the field of metaheuristic. This study shows a Genetic Algorithm based spreading code which is generated using logistic map. Genetic algorithm is used here because it has several advantages than other optimization techniques, they have superior parallel capabilities, it improves over time, derivative information are not required not only that problems related to continuous functions, multi objective problems, discrete functions can also be optimized using genetic algorithm. Code generated from logistic map is considered here because logistic map based spreading code has several advantages over PN/Gold code [6]. Logistic map is a second order polynomial mapping, it provides a view of how a complex chaotic nature can get from a non-linear dynamic equation. Sensitivity to initial condition is the main property of this logistic map code [7]. Hence, spreading code is

2

generated from logistic map and then genetic algorithm is applied to optimize the spreading code. Properties of the generated bit is discussed in this paper with the help of mono bit test, run length test and computational complexity also compared with other existing spreading code (like spreading code generated from logistic map and optimized spreading code using exponential scale factor-based DE). The proposed spreading code shows better results than the existing spreading code. Therefore, the proposed spreading code can be easily applicable to wireless communication system.

## 2. LITERATURE REVIEW

Some important research papers are discussed in this section. A gist of which are given below. For computer model estimation genetic algorithm is utilized which is taken from the field of genetics in biology. In this review paper, author explained how different problems are solved using Genetic algorithm [10].

Recent advances considering genetic algorithm is carried out in this paper by the authors. In review paper different GA based implementation along with pros and cons are elaborated. Also, operation of genetic algorithm along with their utilization are also displayed in this paper [11]. In this paper, author discussed comparison between wavelet-based DE and exponential scale factor-based DE and also their application in direct sequence spread spectrum techniques. In this paper spreading codes are optimized with the help of wavelet-based DE and then applied to direct sequence spread spectrum scheme [7].

## 3. PROPOSED METHOD

### 3.1 Basic operation of GA

The basic operation of Genetic Algorithm is elaborated with the flow diagram given in Fig. 1.

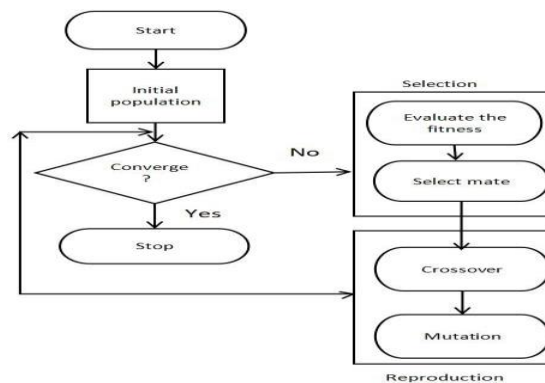


Fig 1: Flow diagram of Genetic algorithm

Steps for genetic algorithm are:

- 1) Binary string encoding
  - 2) Generation of random population
  - 3) Fitness calculation
  - 4) Fitness based pairs of parent string selection
  - 5) Generation of new string with mutation and crossover until a new population has been produced.
- Repeat steps 2 to 5 until the solution is not satisfactory.

### 3.2 Logistic map-based binary spreading code:

Binary spreading code is generated from logistic map using two methods: These are

- **Method 1:** Threshold method

● **Method 2:** Floating point value to bit conversion

Both the methods are elaborated by the flow diagram in Fig. 2 and Fig. 3.

Suppose the floating-point value for the chaotic code is  $x$ . The threshold method to convert  $x$  to binary code is as given in the following equation.

$$\begin{aligned} ( ) &= 1; \geq 0.5 \\ &= 0; < 0.5 \end{aligned} \quad (1)$$

And logistic map equation is given by

$$x_{n+1} = r * x_n * (1 - x_n) \quad (2)$$

Here,  $r$  is the rate at which population is increased or decreased and range is between 0 to 4. And  $x_n$  is the ratio of present population to the possible population (maximum) at year  $n$ . It lies between 0 to 1. And in the second method i.e in integer to bit conversion technique, floating points are converted to integer and then to binary. Frame based sequence is utilized here to convert integer to binary. Properties of both the techniques are elaborated in the following.

**3.3 Properties of proposed spreading code (Method 1 & 2)**

Various tests are executed to set up the properties.

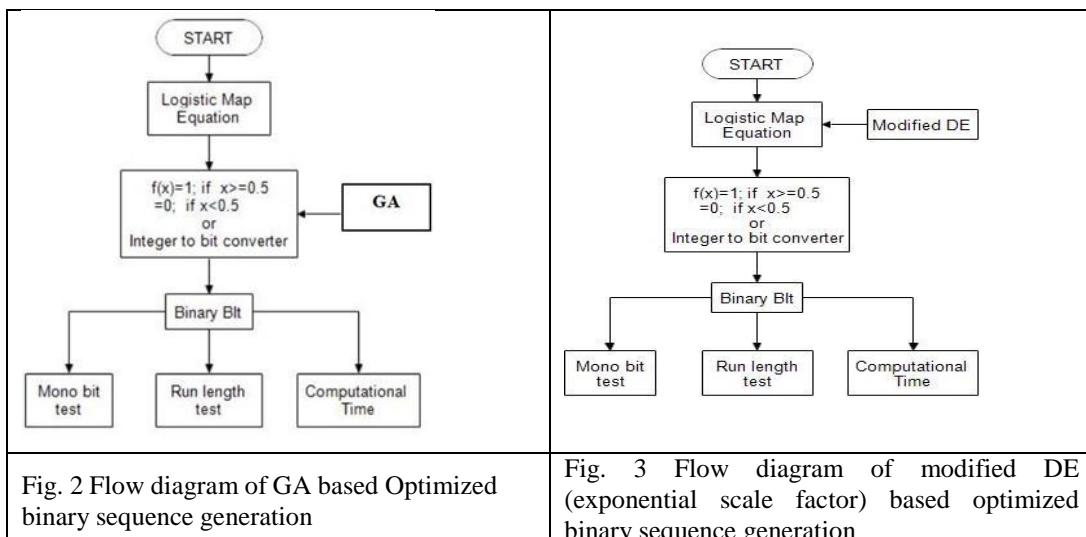
**Mono bit test:** To check the number of ones & zeros for the whole sequence is the main aim of the test. The role of the test is to figure out the number of 0's & 1's in a sequence is almost equivalent or not to check the randomness of the sequence. That means half number 0's and half number 1's should be present in the sequence.

**Run length test:** Number of runs present in the sequence is the main focus of this test. A run is an unbroken sequence of same bits. If  $L$  is the run length, then  $L$  consists of exactly  $L$  same bits and after and before this  $L$  opposite bits are present. This test calculates the oscillation speed, i.e. the oscillation between both the bits (0's & 1's) is too slow or too fast.

**Computational complexity:** Computational complexity of threshold method is less compared to integer to binary method. Computational complexity is calculated by doing auto correlation between then sequences.

**3.4 Spreading code optimization with scale factor-based DE and GA**

The spreading code optimization flow diagram is as given in the Fig. 2 & 3.



The entire simulation is carried out in MATLAB. From logistic map equation binary bits are generated by taking the value of  $r = 3.56$ , and  $x_n$  is between the range 0 to 1. Parameters that are used in this paper are given in Table 1. Properties (run-length test, computational time, mono bit test) of optimized generated bits using GA are compared with the non-optimized one along with the optimized spreading code which are optimized by exponential scale factor based DE as shown in the Table 2.

Table 1: Parameters of proposed method

Parameter name	Value of parameter
r	3.56
$x_n$	0.1
Population size	64/128/256
Crossover rate	1
Mutation rate	1
Maximum number of iterations	32000

Table 2: Comparative study of Properties of the generated bit sequence

Test	Properties of non-optimized generated bit		Properties of optimized generated bit Using exponential scale factor based DE		Properties of optimized generated bit Using GA	
	Method-1	Method-2	Method-1	Method-2	Method-1	Method-2
Mono bit test	No. of Zeros=66 No. of Ones=34 Out of 100 bits	No. of Zeros=41 No. of Ones=59 Out of 100 bits	No. of Zeros=63 No. of Ones=37 Out of 100 bits	No. of Zeros=43 No. of Ones=57 Out of 100 bits	No. of Zeros= 60 No. of Ones= 40 Out of 100 bits	No. of Zeros= 42 No. of Ones= 58 Out of 100 bits
Run length test	Run is 5 out of 20 bits	Run is 5 out of 20 bits	Run is 5 out of 20 bits	Run is 6 out of 20 bits	Run is 7 out of 20 bits	Run is 6 out of 20 bits
Computational complexity	CT is 1.02 seconds	CT is 1.94 seconds	CT is 1.41 seconds	CT is 2.13 seconds	CT is 0.99 seconds	CT is 1.88 seconds

#### 4. CONCLUSION

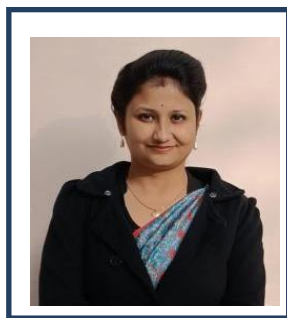
Spreading of the signal spectrum is very essential in wireless communication system. In this modern era, because of the high demand of CDMA communication, optimization of spreading code is necessary. Hence, in this paper spreading code generated from logistic map is optimized using genetic algorithm. Out of all the metaheuristic algorithms, GA is chosen because it has several advantages than other optimization techniques, they are superior parallel capabilities, it improves over time, derivative information are not required not only that problems related to continuous functions, multi objective problems, discrete functions can also be optimized using genetic algorithm. From the properties of the proposed optimized spreading code, it is clear that computation complexity is less in the GA based spreading code, also from mono bit test and run length test it is clear that our proposed method shows better results than other state of art algorithms. Hence, the proposed spreading code can be applicable to wireless communication technology. In future, the GA based spreading code can be utilized in OFDM and massive MIMO system.

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## Biographies



Dr. Katyayani Kashyap has received the bachelor's degree in Electronics & Communication Engineering from Gauhati University (GIMT) in 2012, the master's degree in Electronics & Communication Engineering from Gauhati University in 2014, and the philosophy of doctorate degree in Electronics & Communication Engineering from Amity University in 2021, respectively. She is currently working as an Assistant Professor at the Department of Electronics & Communication Engineering, Chandigarh University. Her research areas include soft computing in wireless communication. She has been serving as a reviewer for many highly-respected journals.



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### **Abstract:**

Over the years, Internet connectivity based on the concept of Wireless Local Area Network (WLAN) has turned out to be one of the most reliable and promising technology. WLANs offer an open link to the customers so as to provide smooth and feasible access to the communication system and associated applications. A wireless system provides flexible installation in comparison with wired networks.

In this paper, a novel WLAN system is analyzed for diverse data rates for FTP protocol in the presence of load balancer and without the use of it. Two scenarios are created with same physical and MAC layer parameters. The WLAN model is evaluated to measure the performance for campus environment. The WLANs parameters such as response time, wireless media access delay and throughput are affected by the number of users per application with and without load balancing.

**Key words:** WLANs, FTP, Load Balancer, QoS, Response Time

## **I. Introduction**

With the technological transformations occurring at a fast pace, the requirement of transmission capacity and communication rate is increasing. This has led to changes in the needs of the end customers and their requirements. The newer application areas have varied needs from the system protocol. Global interconnection of clients through internet having higher bandwidth has become a basic requirement for achieving their goals. Over the years, Internet connectivity based on the concept of Wireless Local Area Network (WLAN) has turned out to be one of the most reliable and promising technology. WLANs offer an open link to the customers so as to provide smooth and feasible access to the communication system and associated applications. A wireless system provides flexible installation in comparison with wired networks. Also, the installation cost of the wireless systems is on a higher side and offers long transmission delays. But with the introduction of the WLANs solutions, the transmission capacity has improved leading to higher transmission rate with lower delays decreasing the cost of the systems.

WLAN interconnects communicating devices like desktop machines, laptops, personal digital assistants (PDAs), smart-phones without a physical connection. The WLAN technology has transformed the way users are accessing internet on their communicable equipments. The elimination of a physical network between users offers a effortless connectivity to the network services. Orthogonal frequency division multiplexing (OFDM) and spread spectrum concepts are utilized in WLANs to communicate through radio waves within a specified region, so as customers can access network while moving within the limited area.

WLANs is required to ensure fulfillment of diverse prerequisites of any connecting system that includes higher bandwidth, lower transmission delays, complete connectivity amongst diverse devices and ability to broadcast signals among others. Furthermore, some specific requirements of wireless networks are increased throughput, connectivity to multiple stations across diverse cells, lower battery usage, interconnection with wired LANs and other networks like wide area networks (WANs), improved data security, dynamic configuration and minimum requirements of license among others.

Wireless systems carry out various tasks so that information signals can be transmitted successfully from source station to destination node. For achieving this, diverse functions are carried out by WLANs that includes offering a transmission channel for transfer of data signals, medium access control (MAC) mechanism so that various devices can effectively utilize the shared channel, routing and error control mechanism are implemented.

There are wide range of products conform to WLANs standards are available in the market. Diverse standards includes IEEE 802.11a, IEEE 802.11b, IEEE 802.11g, or IEEE 802.11n are employed for unique wireless applications. Additionally, Bluetooth also provides wireless access for short range of communication.

The main benefit of employing WLAN in comparison with the wired LAN is ease of installation and providing mobile access to end clients. The basic constituents of WLAN system are customer adaptors, network interface cards known as NIC and access points (APs). Access

point functions similar to a hub and provides connection to backbone network through a Ethernet wire. An antenna is utilized to communicate with various wireless nodes within the defined frequency range. From the interoperability point of view APs adheres to IEEE 802.11 standards. Further, authenticity of the clients and their availability is ensured by the access point. Peer to Peer mode or Infrastructure mode is used to connect client adaptors with the communicating devices through APs. The NIC examines the existing frequency range for connecting an AP in wireless mode. It accompanies a product driver that combines it to the operating system (OS) of the wireless node.

Medium access control (MAC) mechanism is used by the stations to access the shared infrastructure in the wireless networks. The main purpose of the MAC protocol is to characterize various regulations so that all participating nodes in the network have equitable access to transfer data signals. Numerous MAC mechanisms were defined for the WLANs to have a normalized access in the network. MAC ensures different nodes to utilize a common channel through carrier sense multiple access/ collision avoidance (CSMA/CD) mechanism so that cluster of nodes can transfer within the same spectrum. It ensures reliable transportation of information signals over a wireless communication channel.

Wireless LAN employs diverse MAC protocols for its IEEE standards. Distributed coordination function (DCF) is the fundamental mechanism used for IEEE 802.11 b standard that ensure fair access of the shared medium through the CSMA/CD protocol and random back-off time mechanism. Data traffic signals utilizes positive acknowledgement signals for confirmation of the successful receipt of the data, in case acknowledgement frame is not received by the sender within the specified time limit then a retransmission of the data frame is ensure through stop-and-wait automatic repeat request protocol. Both physical and virtual method can be used for sensing the medium. Carrier sense of the channel is accomplished by appropriating reservation data reporting the approaching utilization of the medium; it is cultivated by the use of Request To Send (RTS) and Clear To Send (CTS) packets. Furthermore, the different available spaces in the transmitted packets are utilized to separate between various sorts of transmissions.

Another MAC based mechanism employed by WLANs is Point coordination function (PCF). It is polling based procedure for accessing the channel in which base station works as point coordinator (PC). In PCF available time slots are categorized as super-frames for IEEE 802.11 WLAN standards. Both PCF and DCF mechanism are utilized in the super-frames, for a contention free time DCF is used and for contention based frame PCF can be utilized. The contention free sub period begins through the use a beacon special frame transmitted by the base node. The length of the contention free period might be decreased as the beacon frame is transmitted using a DCF mechanism and the base node has to compete for the availability of the shared channel. The base station maintains a list of mobile nodes that have mentioned to be surveyed to send information. In the contention free sub period, base node transmits the poll packets to the participating nodes when they are obvious to get to the medium. When the poll frame is received by the mobile node, it transmits a information frame that has been lined up for communication. To guarantee that no DCF nodes can during the process, the inter-frame space (IFS) between PCF information packets is more limited than the typical IFS of DCF and is known as PCF Interframe Space (PIFS). To avoid starvation of nodes that are not permitted to transmit during the contention free period, there must consistently be space for no less than one greatest length packet to be sent during the contention time frame.

Enhanced Distributed Coordination Function (EDCF) is another variant of DCF for contention resolution of the shared medium. This mechanism is proposed to give prioritized quality of service (QoS) through an enhanced DCF. The mechanism provides access to the unguided channel through eight diverse user priorities (UPs) for stations. Prior to the frame coming into the MAC layer, a station priority number is allocated to every information frame received from the upper layers. Four diverse first-in first-out (FIFO) methods are outlined by the EDCF to give continuous support for the transfer of data signals with UPs.

Thus efficient MAC mechanism plays a pivotal role in realization of the shared single unguided medium so as stations communicate through a shared radio transmission medium. The MAC protocol is expected to offer a productive utilization of the accessible transmission capacity while fulfilling the Quality of Service (QoS) necessities for both real time services and information carrying applications. Differentiated services (DS) are a bare minimum for improving QoS of communicating applications. DS ensures equitable distribution of resources for diverse categories of data traffic. Diverse implementations are defined to enhance QoS. The main objective of this paper is to provide a comparative examination based on diverse performance measuring metrics in the communication unguided and guided networks. Two application layer protocols Hyper text transfer protocol (HTTP) and File transfer protocol (FTP) and their transactions to achieve a higher throughput in a wireless system is investigated. Also, the effect of access delay and page/object response time is studied.

The rest of the research paper is arranged as follows; the simulation scenarios are presented in next section. The results obtained on various system parameters are explained in section IV of the paper and in the last segment conclusions and future roadmap are provided.

## **II. System Model**

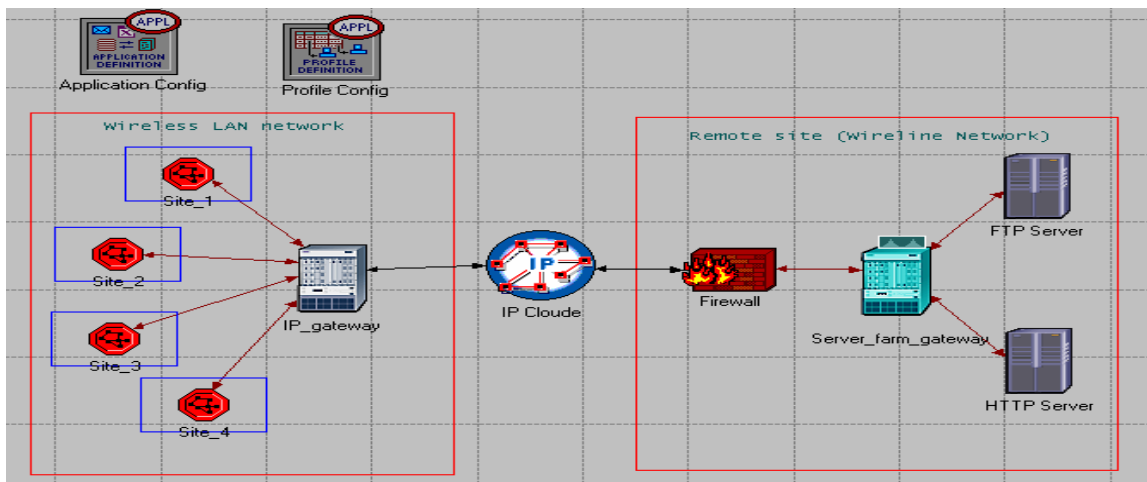


Fig. 1. System Simulation Model

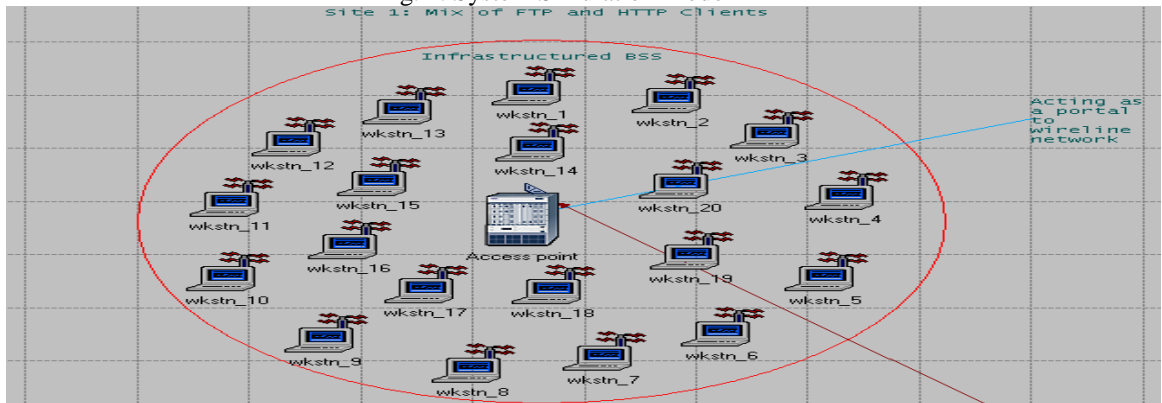
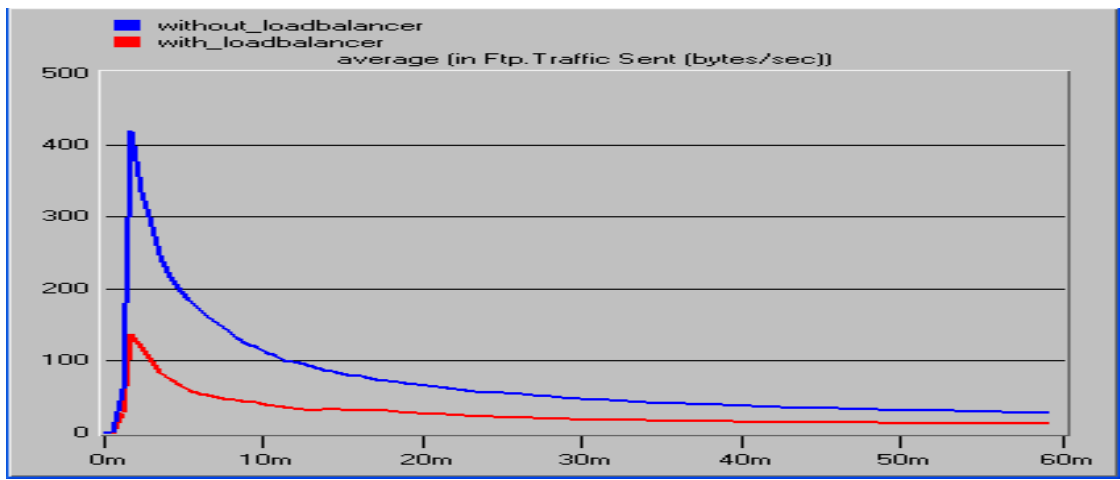


Fig. 2 Site with twenty users

The system model of the wireless network scenario is as shown in figure 1. Four different WLAN sites are selected where each network site connects two users through separate APs. Wireless LAN system is designed with and without load balancer. Load balancing allows APs access of various wireless nodes. For efficient utilization of the system resources every AP gives site management information by employing system functions. To maximize utilization of the available resources, optimizing throughput and reducing response time, the task is redistributed among numerous stations by the load balancer. In the second case, the wireless network is designed without load balancer. Network is configured without a load balancer and it is possible by disabling option of load balancing in the profile off the Wireless system service and can be specified with a Exempt profile. In such scenario, the network does not assign users between APs upon the arrival of new client. Every LAN network contains clients which are communicating using highest layer protocols. For performance evaluation to application layer protocols namely HTTP and FTP are considered. WLAN network is designed with IEEE 802.11b standard using direct spread spectrum technique. The information is transferred with a packet size of 1024 having a slot time of  $20\mu s$  on a unregulated radio spectrum of 2.4 GHz. Adaptive back-off algorithm is utilized in the MAC layer for contention resolution. Furthermore, wireless system containing four diverse sites are connected with wired system through IP cloud. A Mix of FTP and HTTP users are connected with wired network and are accessing information through APs as shown in figure 2. In the wire-line system HTTP server and FTP server are connected through gateway and system is secured through the use of firewall. Firewall secures the system through continuous supervision of the communicated traffic and preventing unauthorized access.

### III. Results and Discussion

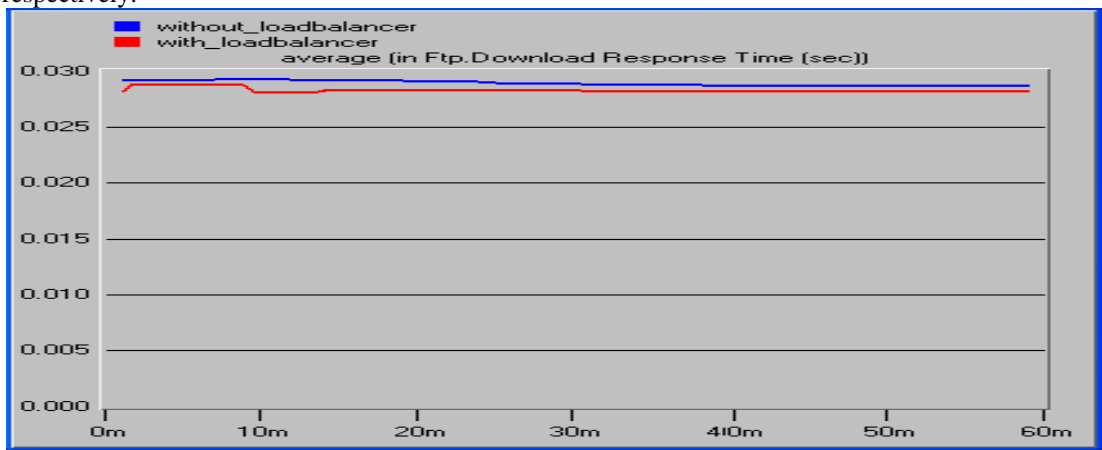
In this section, results of the simulation work are presented and analyzed. All the results of both wireless networks with load balancer and WLAN without the load balancer are depicted in graphical form. The blue line displays the findings of the simulation system without load balancer whereas the red color depicts the results of Wireless system with load balancer.



Time (sec)  
 Fig. 3 FTP Traffic Sent (bytes/sec)

Figure 3 demonstrates the information data traffic transmitted using the FTP protocol. The traffic is measured in bytes per second and the average traffic sent is measured. The peak of the data sent is obtained in between 0ms and 10 ms for both with load balancer and without load balancer simulation environment. The peak FTP traffic sent is 420 and 130 for WLAN without load balancer and with load balancer respectively.

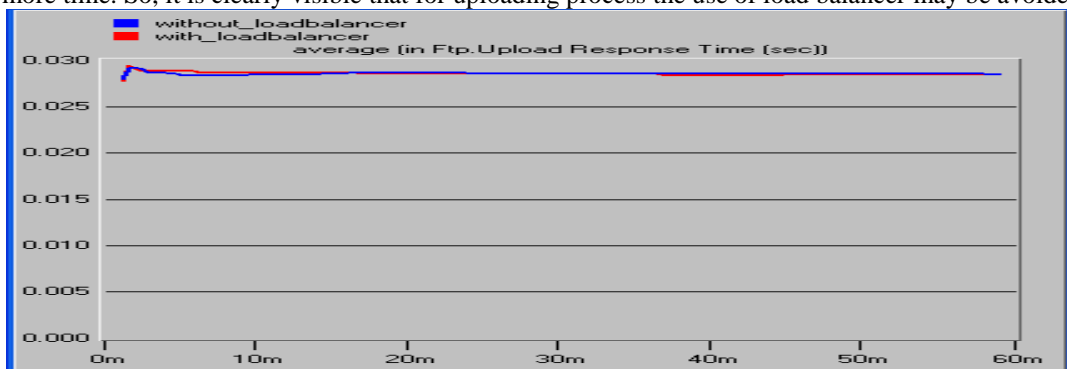
The wireless system is investigated to find the response type for an FTP protocol in both with load balancer and without load balancer as shown in figure 4. It is found that the average download response time with load balancer and without load balancer for FTP protocol is 28.2 ms & 29 ms respectively.



Time (sec)  
 Fig. 4 FTP Download Response Time (sec)

Further, the proposed system is simulated to know the FTP upload response time for both with the load balancer and without the load balancer and is calculated to be 28.6 ms and 28.5 ms respectively as depicted in fig. 5. For measuring FTP download response time and FTP upload response time the setting of various scenarios are kept constant.

From the measured results it can be deduced that the load balancer is helpful in decreasing the FTP download time, while in the process of balancing, in order to avoid the traffic congestion it rather takes more time. So, it is clearly visible that for uploading process the use of load balancer may be avoided.



Time (sec)  
 Fig .5 FTP Upload Response Time (sec)

## IV. Conclusion

Over the years wireless local area networks have grown to be the most critical mechanism in wireless technologies, finding a lot of interest from diverse point of views, including end users, researchers and business communities with a hope that the technology offers opportunity to avail mobile services without the requirement of mobile operators.

This work described a simulation study of an IEEE 802.11b wireless LAN in a campus environment. The simulations are carried out for FTP protocol with and without the use of the load balancer. It is deduced from the analysis that the load balancer is useful in reducing the FTP download time, while in the process of balancing, in order to avoid the traffic congestion it rather takes more time. Thus, it is evident that the use of load balancer is not recommended for up linking processes.

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## Biographies: -



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# Design and Analysis of Circular Slot with Complementary Split Ring Resonator Antenna for 5G Applications

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## Abstract

The proposed study will concentrate on the construction of a Microstrip antenna for 5G Midband operations. Microstrip structures were chosen because they have low mass and structural characteristics, making them easy to insert into the surface of consumer wireless goods such as mobile, Bluetooth devices, aeroplanes, missiles, and so on. The circular-slot antenna using CSRR technology presented reduces the antenna's size without losing performance. The suggested band operation is obtained by adjusting the parameters of a standard complementary ring antenna, building it appropriate for 5G midband applications below 6GHz. This design stimulates the antenna in a sophisticated order kind rather than the typical basic mode. This method reduced the return loss to less than 32dB at precise resonance frequencies of 3.5GHz

**Keywords:** Circular Slot with Complementary Split Ring Resonator, Ultra Wideband, Long Term Evolution, Half Power Beam Width, First Null Beam Width

## 1. INTRODUCTION

Microstrip patch antennas have gotten a lot of attention in recent wireless communications generations, such as Industry 4.0 and Internet of Things devices. Whatever one's personal passions are [1]. A microwave connection is a sort of communication system that uses microwave-frequency radio waves to transport video, audio and statistics amongst two sites that are hundreds of feet or metres apart, or miles or kilometres apart. It was difficult to imagine connections in Gigabits per second before to the arrival of 4G and LTE, let alone wired connectivity, but with the introduction of new technologies into frames, it is currently believable to link devices at Gbps rates [2]. Patch antennas suffer from a significant scheme imperfection in the form of limited bandwidth and moderate gain. Various ways for enhancing the narrow bandwidth of Microstrip patch antennas have been presented to solve the problem. 5G is the next generation of communications technology, with elaborative and creative services that have the ability to change society. It will take considerably more than novel wireless expertise to deliver next-generation 5G; it will necessitate the development of an altogether new technology, which will be a prime and optimal area for researchers [6, 7].

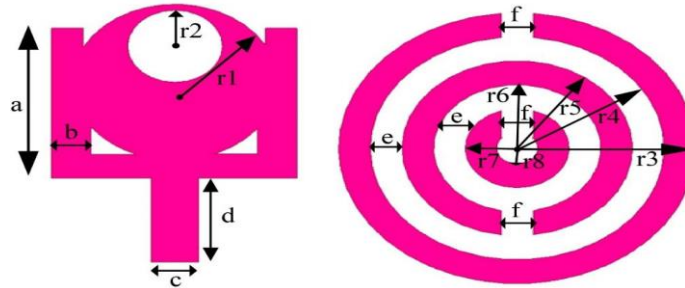
## 2. RELATED WORK

The hexagonal Triangular Fractal Antenna with Tapered Feedline and Reflector for 5G and UWB Submissions was detailed in detail by Pratiknyo Adi Mahatmanto [3] (2019). The suggested antenna has a number of advantages, including a compact design, low-profile material, broad bandwidth, and low-cost material. The antenna is built in a hexagonal three-sided fractal structure among many design architectures to achieve these benefits. The antenna has a hexagonal fractal design for 5G at 28GHz with a broad bandwidth spanning 2.4GHz to 30GHz. The antenna has a maximum gain of 7.65dB and is 35mm x 52mm. The planned antenna takes a broader bandwidth; however it has a significant loss. The hexagonal fractal has a greater capacitive impact, which affects the process of element surface current distribution.

Ashwini K. Arya [4] described the Shark-Fin antenna for railway communications in the LTE-R, LTE, and lower 5G frequency bands (2020). For train communication, the shark fin antenna is 3D printed and developed to work in three bands: LTE-R (700MHz), LTE (2100MHz), and the lower 5G frequency (3500MHz). The constructed antenna is 163mm x 61.9mm x 10mm in size and covers a extensive occurrence variety from 1.4GHz to 4.2GHz, with radiation efficiency of 71.7 percent, 92.6 percent, and 96.4 percent for the railway environment, respectively. The proposed antenna functioned for lower 5G applications, such as sub-6GHz, but it didn't meet the required standard of sub-6GHz bandwidth, and it was also quite massive. Ishteyaq I [5] (2020) demonstrated a sub-6 GHz double-band planar printed slot antenna for 5G wireless applications[6-7]. The constructed antenna includes a rectangular radiation slot on the top edge with an inverted stub to achieve a highest improvement of around 7.17dBi and is suitable for operation at sub 6GHz. It resonates with a bandwidth of 3.26–3.63GHz and 4.3–5.2GHz with a return loss of less than -10dB[8-12]. The antenna is 0.8mm thick and built on a FR4 epoxy substrate with 50 Ohm impedance matching. The surface current is affected by the proposed antenna's usage of an inversion stub in the radiating layer[15-16]. The antenna radiating layer had an unbalanced dispersion process, which resulted in the formation of back lobes.

## 3. PROPOSED WORK AND IMPLEMENTAION

The proposed Slotted Circular Patch with a complement split ring resonator antenna (CS-CSRR) works effectively in the sub-6 GHz frequency region, resonating at 3.5 GHz. In today's communication, being able to operate at frequencies below 6 GHz is essential. The improved CS-CSRR MTM ground works exclusively at sub-6 and 5G mid band frequencies, with a total gain of 4.6 dB. The ground-based utilization of the CSSRR structure improves the gain and effectiveness of essential sub-6 GHz applications.



**Figure 1: Simulated Structure of CS-CSRR**

**Table 3.1: Dimensions of CS-CSRR**

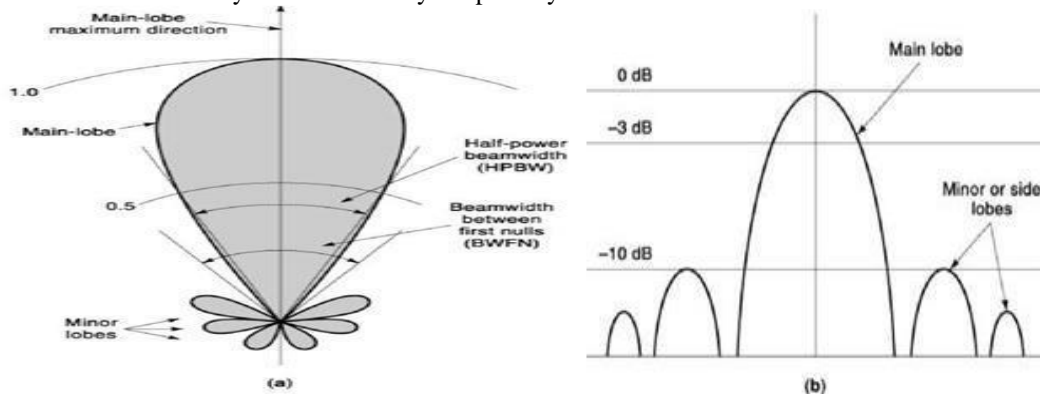
Descriptions	Dimensions (mm)
a * b	1 x 8
c * d	3 x 10
r1	6.5
r2	3
r3	11.3
r4	9.3
r5	7.3
r6	5.3
r7	3.3
r8	1.3
E	2
F	3

### 3.1 Several Performance Parameters

The most important ones are briefly discussed below, including radiation array, return loss, gain, directivity, and radiation efficiency. The standards of these constraints are used to validate an antenna for practical applications.

#### Radiation Pattern

It's a two- or three-dimensional visual representation of the antenna's radiated power in spherical coordinates. Different zones of the radiation outline are denoted to as key lobes, side lobes, and rear lobes, as shown in Figure 2. The useable zone of the antenna is defined by the primary lobe, which contains the common of the radiated energy. The radiated energy is lost and does not contribute to communication in minor lobes and side lobes. As a result, the antenna's directivity is determined by the primary lobe.



**Figure 2: Radiation pattern of antenna in spherical (a) and Cartesian (b) coordinates**

Half Power Beam width (HPBW), which is the angular width between the -3dB point in the main lobe, quantifies the angular region covered by an antenna. The first null beam width is the angular width between two nulls of the



main lobe (FNBW). FNBW is mostly used to define an antenna's resolution. The capacity of an antenna to differentiate among two different targets or sources is described by its resolution[17].

Resolution of antenna=FNBW/2

The radiation pattern is also plotted using Cartesian or rectangular coordinates to provide further insight into the side lobes, as illustrated in figure 2 (b). The azimuth (horizontal) plane and elevation (vertical) plane are two major plane patterns that can be used to describe the radiation characteristics of an antenna without losing information. The yz plane (=90 degrees) is referred to as the elevation plane, whereas the xy plane (=90 degrees) is referred to as the azimuth plane in Figure 3.

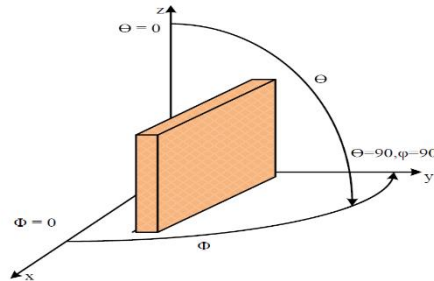


Figure 3: E plane and H plane in polar coordinates

### Return Loss (S11)

It is calculated as the proportion of mirrored power to total input power applied to the antenna and reflects how much power is reflected from the antenna. All power is redirected from the aerial and no power is radiated if S11 is 0dB. A realistic antenna should have S11 less than -10dB in the working bandwidth.

$$S_{11} = P_{reflected(dB)} / P_{input(dB)}$$

### Directivity & Gain

The proportion of the extreme radiation intensity in one direction to the average radiation intensity in all directions is known as directivity. The improvement of an aerial is the proportion of the radiated power in one direction to the total power applied to the antenna.

## 4. RESULTS

With a return loss of -34.16 dB, the suggested antenna performs well at 3.5 GHz. Although the CS-CSRR is a defective ground structure, it has a good return loss performance at sub-6 GHz, making it a viable model for 5G midband applications.

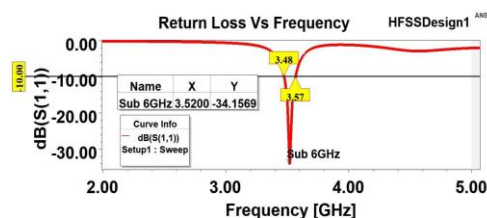


Figure 4: Simulated S parameter of CS-CSRR structure

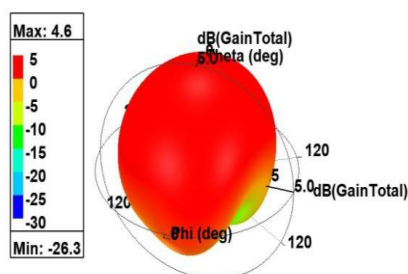


Figure 5: Simulated Gain of CS-CSRR structure

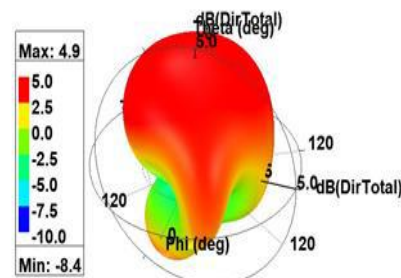


Figure 6: Simulated directivity of CS-CSRR structure

Gain and directivity are the most important factors to consider when calculating an antenna's efficiency. Figures 5 and 6 show the gain and directivity of the CS-CSRR, respectively. The CS-CSRR antenna geometry has the highest overall gain of 4.6 dB and directivity of 4.9 dB, as seen by the linear curve of the 3D gain figure. The effectiveness of the suggested antenna is 94.2 percent.

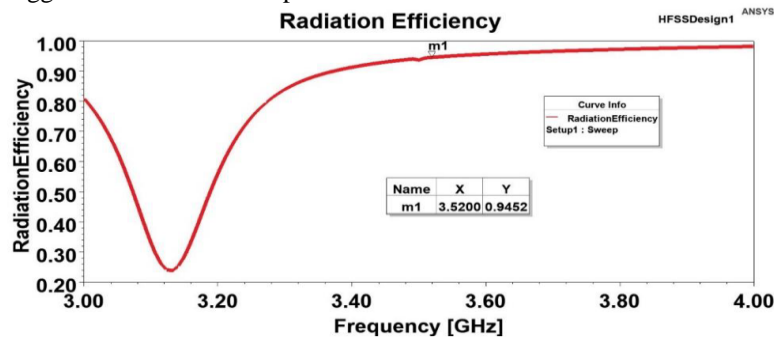


Figure 7: Simulated Radiation Efficiency of CS-CSRR structure

In figure 7, the emission effectiveness of the suggested antenna for Sub-6 GHz applications is investigated and depicted as a 2D plot. The emission efficiency of the suggested CS-CSRR MSPA at resonant frequency is comparable to the estimated value, according to the investigation's findings.

## 5. CONCLUSION AND FUTURE SCOPE

The circular-slot antenna using CSRR technology presented reduces the antenna's size without losing performance. The suggested band operation is obtained by adjusting the parameters of a standard complementary ring antenna, building it appropriate for 5G midband applications below 6GHz. This design stimulates the antenna in a sophisticated order style rather than the typical basic mode. This method reduced the return loss to less than 32dB at precise resonance frequencies of 3.5GHz.

The projected mid-band (Sub-6GHz, Sub-7GHz) would be used in fast-evolving wireless technology products, such as smart computing gadgets.

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## Biographies



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Mohit Srivastava is Faculty in CEC Landran. His current research interests are digital image and speech processing, remote sensing and their applications in Land Cover Mapping, and communication Systems. He has more than 20 years of work experience at various environments includes Industries, educational and research centers. He has successfully completed many DST funded projects, also filled and published various patents.

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# Transconductance Enhanced Cross Coupled Dynamic Comparator using 90nm CMOS Technology

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## Abstract.

Dynamic Comparators are in demand these days due to many advantages they have. A Comparator is a part of an analog circuit. As its name suggests, it compares two values and gives the desired result as required by the user. We use dynamic comparators as they use positive feedback which is not used by others. It improves the timings and also other specifications like speed. It is implemented easily as compared to other designs. It revolves around digital standard cells which operate at low voltages. There are many types of comparators which have their own advantages over the other designs. Kickback noise is the one factor by which a latched comparator suffers also in this type, common-mode kickback noise. We can think of other designs and two stage design is used preferably as it has a low disturbance, lower offset and also this disturbance can be declined by separating the input nodes. The circuit was made in Cadence Virtuoso tool by using GPDK (Generic Process Design Kit) 90nm CMOS technology.

**Keywords.** Dynamic Comparator, Transconductance Comparator, Cadence Virtuoso, latch, transistor, kickback noise.

## 1. INTRODUCTION

Comparators are one of the digital additives which are broadly used within the global. Comparators are a one bit analog to digital converter utilized in ADC converter. In the method of changing an analog signal to digital, the signal is sampled after which is implemented to a series of comparators to decide the digital equal of the analog signal. Comparator reaction time decides the conversion charge. A comparator is likewise utilized in a pass detector, top detector, records transfer, switching energy regulator and others. A comparator is used to evaluate an analog signal in regards to a binary signal. A comparator is primarily based totally on the evaluation. Comparators may be divided into kinds relying on structure. Static comparators are those who carry out threshold detection primarily based totally on an input and reference without a clock. These are easy gadgets with not able as circuit implementations, however do not no longer locate actual use within the global of excessive velocity records converters. So comparators are regularly called Dynamic Comparators. Dynamic comparators, on the alternative hand, use a phase/time primarily based totally clock

mechanism to carry out the switching action. The clock speed commonly defines the rate of the comparator and the every day average speed of the ADC. A CMOS dynamic comparator has different components, a preamplifier and, a dynamic latch. The layout of the preamplifier determines the offset voltage. The latch determines the rate of the comparator, if the offset voltage is decreased it at once facilitates enhance accuracy It calls for big enter transistors of the preamplifier-amplifier which will increase parasitic capacitance and as a result energy in take Voltage in not unusual place mode it's far implemented to the enter to perform the enter transistors in saturation which enables to growth, the rate however the version of enter voltage in not unusual place mode outcomes in large put off variability which makes the circuit now no longer appropriate for excessive speed operation There are numerous strategies that have been proposed to date via way of means of one of a kind through the authors to lessen the energy intake, boom the speed and accuracy of the comparator circuit There are strategies that target on enhancing the preamplifier circuit to lessen the offset whilst preserving the latch. Paintings as it's far, enhancing the dynamic latch to enhance pace, offers 0 static energy intake, however the pace is compromised Comparator isn't best utilized in analog to virtual converter, however has different packages In virtual in formation transfer, switching strength regulators and others, the comparator has its very own meaning.

## 2. CONVENTIONAL DYNAMIC COMPARATOR

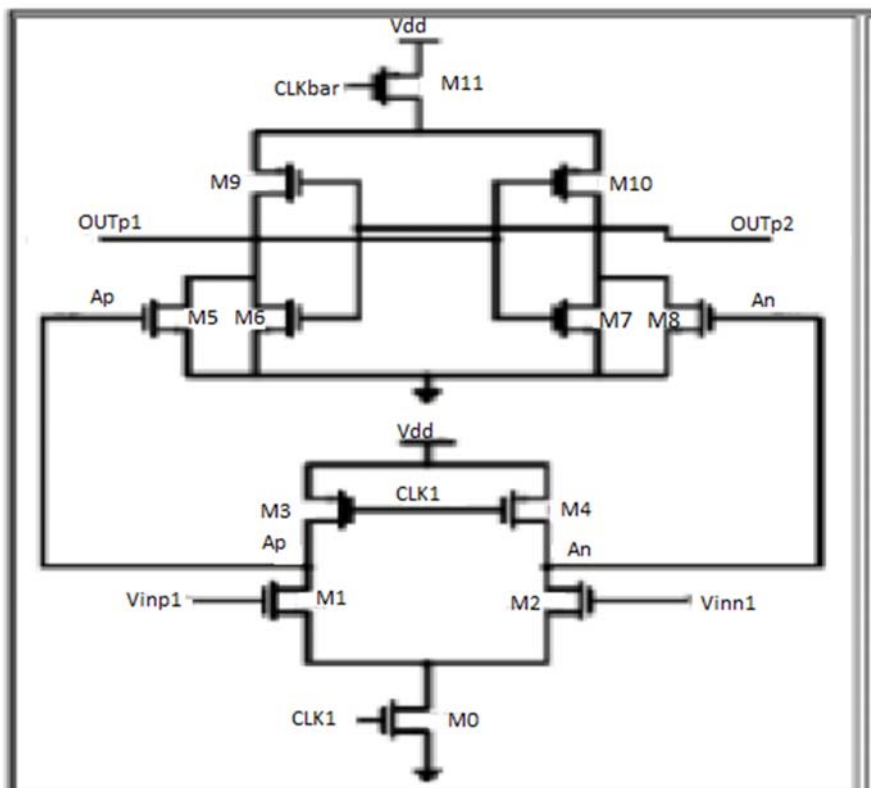


Figure 2.1. Conventional Dynamic Comparator [5]

The standard dynamic comparator is dispensed in given figure. In t represents NMOS type preamplifier and similar diagram can represents PMOS type preamplifier by changing NMOS with PMOS. The operation depends on the clock signal, there are two signals namely CLK and CLKbar to make the circuit operate in two stages, evaluation stage and reset stage. When  $CLK = 0$  i.e.  $CLKbar = 1$ , the transistors M3 and M4 charge  $A_p$  and  $A_n$  node to power supply (VDD) and as M0 is OFF, it in addition to M3 and M4 makes M5 and M6 ON, thus  $OUTp1$  and  $OUTp2$  nodes are released to ground and hence called reset stage. On the other side when  $CLK = 1$  i.e.  $CLKbar = 0$ , the difference in signal is boosted by the pre-amplifier at two transistors M1 and M2 respectively, this signal at  $A_p$  and  $A_n$  wires is created which then gets boosted further by M6 and M5 and hence called the evaluation stage. The difference thus obtained acts as input for the inverters which are cross coupled and are further converted to power supply (VDD) and ground as there is positive feedback. Now the output of the circuit will come according to the difference in inputs which justifies the operation of a comparator. As discussed earlier there are two stages, in the evaluation stage it does not stop working even after latching of correct value and causes dissipation of power. The clock needs a very high accuracy timing as latch measure needs to preserve the difference in input voltages and thus this acts as a disadvantage of this circuit.

### 2.1 Cross Coupled Conventional Dynamic Comparator

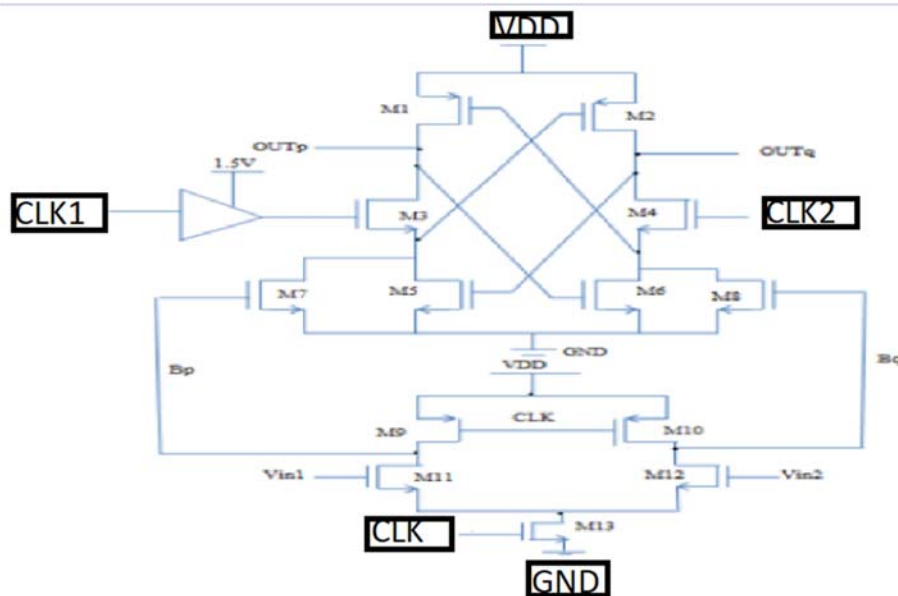


Figure 2.2. Conventional Dynamic Comparator [7]

In this figure, latching level makes use of separately biased gate cross coupled transistors instead of the standard cross-coupled inverter circuit. There are advantages of both as dynamic comparators need positive feedback and low static usage of power and high speed. Standard one stage dynamic comparator have disadvantages as they experience voltage headroom and kickback noise which becomes doubtful as speed and power suffer. Standard two-stage dynamic comparator has advantages like less stacking, appropriate for low-voltage operation and reduced kickback noise which leads to low power usage and hence it is preferred. Improvising the net transconductance is a method to decrease delay and as only PMOS is on it causes low regeneration velocity which leads to increased time in metastable state and inturn leads to higher power consumption .

## **2.2     *Transconductance Enhanced Dynamic Comparator***

A dynamic comparator with a fresh latching stage in addition to transconductance is depicted. This stage consists of transistors which are cross coupled as earlier in place of back to back connection of inverters. The frequency was limited earlier as there was constant re designing of pre amplifier but not the latch. The performance depends on the transconductance in the initial phase and if it is large then there will be low dissipation of power and high speed. Now the transistor sizing is also crucial as the same pre amplifier stage is being used which can also lead to high parasitics and can affect the boosting stage. So, we name it transconductance enhanced as it is totally dependent on this value and by further improvements many constraints can be matched.

## **3.    RESULTS AND SIMULATIONS**

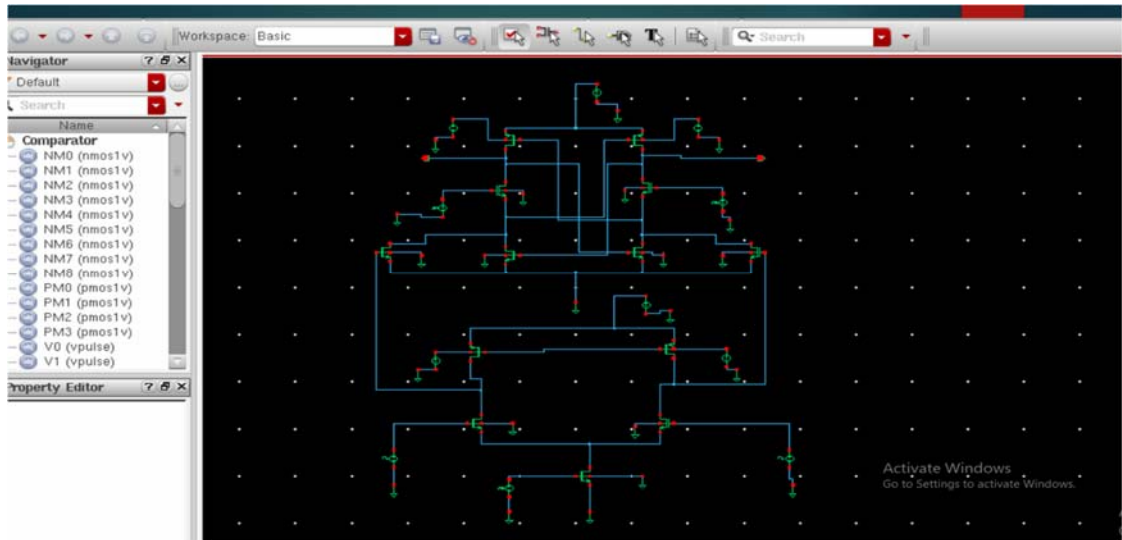


Figure.3.1 Transconductance-Enhanced Dynamic Comparator

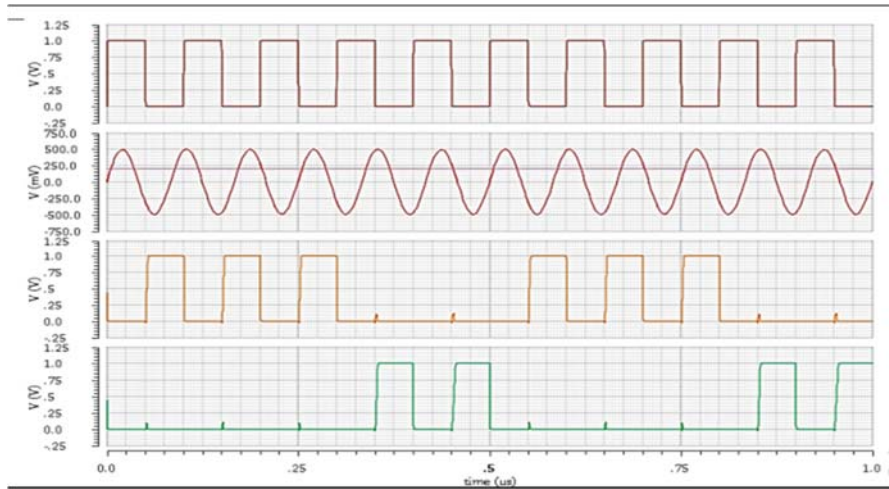


Figure.3.2 Dynamic Comparator Output Waveform

The transient analysis of the transconductance enhanced dynamic comparator circuit is shown above. From this analysis it can be observed that noise affects one of the output nodes in latch as it changes with the transitioning in the clock. For the transient analysis we have taken pulse voltage( vpulse) as input and a dc voltage(vdc) as reference node. Different latching configurations present in the circuit help in increase speed. The delay has been decreased to 228ps when operated at  $f < 2.5\text{GHz}$ . As a modification in latch configuration has



been used it leads to a higher frequency of operation. It also takes up less area than before. If offset voltage is to be reduced to 2mV, the maximum operating frequency drops with a satisfactory delay.

#### 4. CONCLUSION

The tender cross-coupled dynamic comparator has latching level and preamplifier level. In latching level as long as strong positive feedback exists there will be very less power usage. In preamplifier stage there is significant improvement in gain and reduction of unwanted noise. The cross-coupled dynamic comparator has two stages as mentioned earlier, one is reset and other is evaluation or comparison stage. One resets the transistors while the other uses difference in input voltages. In reset phase latching circuit is sway in strong inversion region leading to increase in trans-conductance of the latch. In comparison phase it will tend to decrease delay as well as power usage. The results have been simulated using Cadence Virtuoso in CMOS 90nm technology and it shows improved gain and takes up less area than the standard one.

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## Biographies



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# Brain Tumor Detection and Classification Using CNN

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## Abstract.

Brain Tumor detection is critical for improving patient survival and treatment success. Magnetic resonance imaging (MRI) is difficult to interpret visually. As a result, more precise numerical methods for cancer diagnosis are needed. In contrast, shape, volume, boundary, growth detection, size, segmentation, and classification remain difficult to assess. Using MRI images, we will develop a method for locating and classifying brain tumors during this study. In this study, we use MATLAB code to categorize images as tumors or non-growth. Using this code, we will be able to identify and visualize the precise location and size of the tumors within the brain. We frequently use datasets with a wide variety of growth sizes, types, and locations.

**Keywords.** Magnetic Resonance Imaging, Convolutional Neural Network, Malignant tumors.

## 1. INTRODUCTION

A neoplasm is a brain tumor that is caused by an abnormal collection or mass of cells. The bone that surrounds your brain is extremely rigid. Growth in such a constrained area will cause problems. Brain tumors are frequently either cancerous (malignant) or benign (benign). The pressure within the bone increases as benign or malignant tumors grow. This causes brain damage, which can be severe. Primary tumors are those that develop within the brain, whereas secondary tumors are those that spread to different parts of the body [1-2]. These tumors keep their prime places whereas it will not attack different sections of the human body. They are not spreading to native structures or distant parts of the body. Benign tumors do not appear to be a problem in most cases. A tumor may be less dangerous unless it is located near any vital organs, tissues, nerves, or blood vessels and causes pain. Surgery will be used to remove benign tumors. They'll grow to be quite large, weighing several pounds. They will be dangerous when they occur at regular intervals in the brain and crowd the standard structures at regular intervals in the OS cavity. They'll target vital organs or block channels. Furthermore, some benign tumors, such as organ polyps, are thought to be malignant tumors and are currently being removed to prevent them from becoming malignant. Benign tumors rarely recur after removal; if they do, it's usually at regular intervals in the same location [3]. The tumors have irrepressible physical cell growth that extends internally to detached human parts of the body is referred as malignant tumors. These cancerous tumors enter and attack different parts of the body. They expand to detached sites through the blood or the lymph arrangement and will increase the chances of metastatic growth. This attack can happen any parts in the human body and its mostly found from bone, brain, liver and lungs. It requires to be treated as

early as possible to avoid them expand rapidly. If detected early, treatment will most likely consist of surgery combined with attainable therapy or radiation therapy. If cancer must be treated, the treatment will most likely be general, such as therapy or therapy. Primary brain tumors start in the brain. Tumors can start anywhere in the brain or the wire, medulla spinalis, or neural structure. The neural structure is a part of the brain where the majority of malignant brain tumors in adults begin (forebrain). They will also begin in various components such as the: tissue layers that protect the brain (meninges) pituitary or pineal glands in the spinal cord The majority of benign brain tumors in adults start within the tissue layer. They are referred to as meningiomas [4].

Secondary brain tumors or brain metastases are cancers that have spread to the brain from other parts of the body. Secondary brain cancers are created from the same type of cells as primary cancer. So, if your cancer began in the lungs, carcinoma cells create cancerous areas in the brain. Any type of willer can manifest in the brain. However, the most common types are cancer of the lungs cancer of the breast Cancer of the kidney melanoma carcinoma colon (rectal) cancer This occurs as a result of killer cells escaping from primary cancer and travelling through the bloodstream to the brain. They will develop into new tumors there [5]. Deep learning technique for image classification is Convolutional Neural Network. The reason for adopting convolutional neural network is a system that uses a design of multi-layer viewing platform for minimizing the executable requirements. It will maximize the image processing potential results and remove the unnecessary conditions. It is more effective to train the image processing data and linguistic communication process.

Primary brain neoplasms include any tumour that begins inside the brain. Brain cells, the membranes surrounding the brain (meninges), nerves, or glands can all develop into primary brain tumours [6]. The work on information among medical images was planned to greatly increase machine speed for growth segmentation outcomes [7]. The tumour identification would be possible in such a short period of time. A photograph is segmented into areas or objects. During this time, the item must be phased out of the background to view and classify the image's content correctly [8].

## **2. METHODOLOGY**

Our idea is to identify and visualize the precise location and size of the tumors within the brain. We frequently employ datasets containing a wide range of growth sizes, types, and locations. The proposed system of brain tumor detection and classification flow diagram is illustrated in the below figure.

A dataset is a collection of subsets, and the dataset in this study is MRI scans. This dataset contains 12 malignant images, 11 benign images, and 5 non-tumor images. Figure 2.2. and Figure 2.3. represents the data sets for non-tumor images and tumor images.

### **2.1. Preprocessing**

Our proposed pre-processing component consists primarily of procedures that are typically required prior to the goal analysis and extraction of the given information, as well as geometric corrections of the initial image. Non-brain element photos were removed, then the data was altered the proper mirroring performed on the input. The input magnetic resonance imaging images are converted into suitable type is done from the preprocessing

phase. This work was done frequently. Noise, blur low distinction, bias and partial volume results are the major issues that arisen during the pre-process stage. The pre-process level helps to minimize the noise on images, lightness vital parts with other issues.

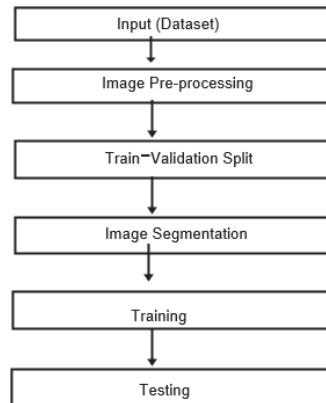


Figure 2.1. Flow of Brain tumor detection and classification diagram

## 2.2. Global Thresholding

This is the most basic type of thresholding. The histogram of the complex image is partitioned by a single threshold in this case. Segmentation is then accomplished by scanning each pixel and labelling it as background or foreground based on its grey level. The tumour area is highlighted more than the rest of the brain in this method. These non-tumours are classified as tumours by setting a threshold, and thus proven to be such has no effect.

## 2.3. OTSU Thresholding

The OTSU technique is a type of world thresholding that relies solely on the image's grey value. It is widely used because it is simple and effective. The brink is chosen by OTSU's thresholding to reduce the intraclass variance of the thresholded's black and white pixels. OTSU's technique is implemented as "grey thresh" in MATLAB. The 2- dimensional bar graph is projected onto the diagonal and then applied to the 2D Otsu theorem bar graph to find the best threshold worth.

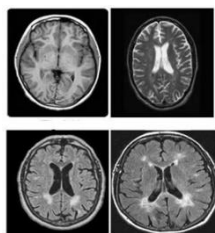


Figure 2.2. Non-Tumor Images from Dataset

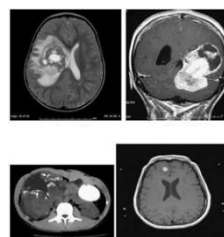


Figure 2.3. Tumor Images from Dataset

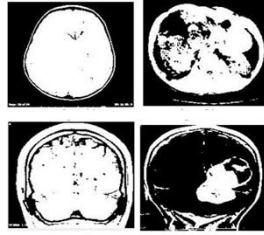


Figure 2.4. Output images of OTSU Thresholding

### 3. OUTPUT AND DISCUSSION

Kernel trick techniques help to measure kernels square, that is the simplest way to solve non-linear problems using linear classifiers. Within the SVM codes, the kernel functions square measure is used as parameters. They aid in determining the shape of the hyperplane and call boundary.

#### 3.1. Linear Kernel

When the information is linearly separable, that is, when it can be separated with a single line, a linear kernel is used. It is among the most used kernels. It is mostly used when there are an excessive number of possibilities in a given dataset. The accuracy of linear kernel is illustrated in Figure 3.1.

#### 3.2. Polynomial Kernel

This kernel is known for machine learning kernel. To describe the likeness of vectors is attained by SVM and other kernel models across the polynomial initial variables of highly feature area. It allows the non-linear models learning. The accuracy of this proposed kernel is shown in the below figure.

#### 3.3. Quadratic Kernel

Because the kernel is quadratic, the choice boundary could be a level set of a quadratic mix. It is true for quadratics that a combination of quadratics is itself quadratic, but this is not necessarily true for other types of kernels. The accuracy of quadratic kernel is illustrated in Figure 3.3.

```
ans =
Accuracy of Linear Kernel is: 40%

ans =
Accuracy of Linear Kernel is: 70%

ans =
Accuracy of Linear Kernel is: 60%
```

Figure 3.1. Accuracy of Linear Kernel

```
ans =
Accuracy of Polynomial Kernel is: 30%

ans =
Accuracy of Polynomial Kernel is: 40%

ans =
Accuracy of Polynomial Kernel is: 50%
```

Figure 3.2. Accuracy of Polynomial Kernel

### 3.4. RBF Kernel

The RBF kernel, also known as the radial basis functions kernel, is a common machine learning kernel operation that is used in a variety of kernelized learning techniques. Frequently, it is used in SVM classification.

```
ans =
Accuracy of Quadratic Kernel is: 40%

ans =
Accuracy of Quadratic Kernel is: 60%

ans =
Accuracy of Quadratic Kernel is: 40%
```

Figure 3.3. Accuracy of Quadratic Kernel

```
Accuracy of RBF Kernel is: 60%

ans =
Accuracy of RBF Kernel is: 50%

ans =
Accuracy of RBF Kernel is: 70%
```

Figure 3.4. Accuracy of RBF Kernel

Figure 3.5. (a) and 3.5. (b) represents the output images for the Malignant Tumor. Similarly, Figure 3.6. (a) and 3.6. (b) represents the output images for the Benign Tumor.

Figure 3.5. (a) Malignant tumor output

Figure 3.5. (b) Malignant tumor output



Figure 3.6. (a) Benign tumor detection

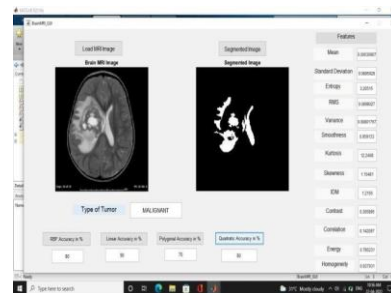


Figure 3.6. (b) Benign tumor detection





#### 4. CONCLUSION

We used the image process to machine-control the identification procedure for tumour detection in this paper. In addition to many existing tumour segmentation and detection methodologies for brain imaging proposed system established. Overall associate degree accuracy is attained up to 97. Sleuthing tumors all steps are mentioned. Two segmentation techniques are used to classify the neoplasm for imaging image acquisition to pre-processing have been completed. Ripple based pre-process operations strategies are stated in the implementation. The image quality and detection procedure are improved by edge sharpening, noise removal, enhancement and unwanted background removal. It is improved the filtering in the imaging process and maximized the quality. Performance of neural network-based segmentation on the noisy field is superior, and no basic information allocation is required, but one of the primary disadvantages is the learning approach. For the production of effective and accurate tumor detection findings, a group of thresholds based and SVM arrangement is added with Self-Organizing Map. These methods can determine whether there is growth and, if so, whether the growth is benign, normal, or malignant.

#### 5. REFERENCES

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# Analysis of a Dumble Shape antenna with reduced ground plane for unlicensed frequency band by the regulatory body FCC

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**Abstract:** In this paper a novel dumble shaped microstrip patch antenna (MSA) with reduced ground plane structures has been proposed for un-licensed frequency bands i.e. ISM (2.41-2.4725GHz), and U-NII (5.16-5.35 and 5.75-5.85GHz) and Space communication (7.2-9.2 GHz). FR4 substrate has been utilized for the design and fabrication of the proposed switch having dimension  $40 \times 50 \times 1.6 \text{ mm}^3$ . For this purpose, the multiband and wideband operations are comprehended in a single antenna design by introducing a dumble shaped patch with reduced ground plane. The proposed antenna geometries are fabricated on the FR4 lossy. All the simulations have been carried out in finite element method (FEM) based HFSS simulator. Considering the bandwidth, gain and radiation properties the proposed MSA is applicable for unlicensed frequency band for the low-range and higher speed communications. The fabricated antenna exhibits the omni directional and figure of eight radiation pattern in H- and E-plane respectively.

**Keywords:** Microstrip antenna, reduced ground plane, HFSS software, ultra-wide band characteristic.

## 1. INTRODUCTION

Now a days the advancement in the region of wireless UWB communication technology is going to be increased gradually, mainly in the data and voice communication [1-17]. The wireless research community has experienced this as an enormous chance to increase the wireless devices to communicate in the unlicensed band i.e. ISM (Industrial Scientific Medical i.e. 2.41-2.42 GHz), and U-NII (5.15-5.35 and 5.75-5.85GHz) and Ultra-wide band (3.1 -10.61 GHz) by the dictatorial body of united state society i.e. Federal communication commission (FCC) [18-22]. The FCC specifies a bandwidth from 3.1-10.6 GHz for UWB wireless communications. But in this spectrum bans several wireless spectrum also exists Wi-MAX (Worldwide Interoperability for Microwave Access) (3.8–4.11 GHz), Wi-BAN (4.81–5.061GHz), WSN (wireless sensor network) (6.11–6.41 GHz), satellite communication band (7.41 – 7.8GHz) [23-24]. In the modern world, the demand of wider bandwidth, high speed data and novel mechanism of feeding encourage the academicians and scientists to research on ultrawide band spectrum band for various wireless applications. Additionally, UWB communication system is a potentially pioneering approach to wireless technology. It sends streams of extremely brief energy pulses that can be dispersed across a wide range of frequencies, typically lasting between 10 and 1,000 picoseconds and receives the narrowband signals that are compressed in time as compared to sinusoidal that are compressed in frequency [25-26]. This is differing to the long-established convention of transmitting the signals over narrow frequency bandwidth such as 802.11a, 802.11b and Bluetooth etc. It allows the transmission over a wide frequencies range along with low power spectral density (PSD). It has been expanded rapidly for commercial as well as for military purposes, due to its cost effective and flexible way of communication [27]. Recently, due to the developments of high-rate data network with low power consumption, ultra wideband (UWB) antennas has become an attractive topic of research. Compared to narrowband, the UWB has large peak gain, multiple sharing with users and low noise PSD [28-29]. Whenever it came to flexibility and battery life, UWB has a significant advantage because the power required levels are so low that they are even lower than that for mobile handset. Furthermore, the wide frequency broadcast sets the UWB extremely interference-resistant. The potential capacity is mentioned in the more than hundreds of megabits per second, coming through much quicker than Bluetooth at 2Mbps and the most recent 54 Mbps Wi-Fi standard technology. It can also transmit a significant quantity of data. [30-31]. It has low cost due to simple hardware and low power consumption also. With UWB, security is a smaller issue because the short pulses are much more challenging to detect, but range is still a problem. Because signals can only travel 10 to 20 meters, because UWB cannot match against 802.11 WLAN technologies [32]. A broad bandwidth is acquired by the majority of the service suppliers. Since small, simple structure antennas with wider bandwidth and high gain are required for the transmission and reception of the large bandwidth. There fore in the present research work, the design and development of a dumble shaped MSA has been introduced that carry all these necessities for high data rate communications [33].

Because MSA has some admirable features like cost effective, light weight, easy to fabrication and amalgamation with complex circuitry [34-35]. On the other hand, the conventional MPA bears with some limitations as narrow

bandwidth along with low gain. In literature, various techniques are offered to enhance the bandwidth of the antenna like as defected ground structure mechanism (DGS) [36-40], antenna stacked with various type of patch shapes [41-43] and by utilizing the different type of feeding mechanism such microstrip feed, coplanar waveguide [44-45], L-strip feed [46], aperture coupled feed [47-50], proximity feed [51-52] and coaxial probe feed [53-54]. Researchers and academician are work together to cover multi-band, full- band and ultrawide band (UWB). To enhance the limited bandwidth and inferior gain, the DGS instigate on the surface of ground that provides the disturbance to the flow of surface current. Additionally, it helps to improve the overall inductance and capacitance of the microstrip transmission line.

The aim of this paper is to present the advantages of Defected Ground Structure to obtain the wider frequency band, impedance matching with high gain. As a result a novel Dumble shape UWB antenna with DGS techniques has been designed and simulated on Ansys HFSS V'13 and fabricated using wet etching photolithography process. The simulated S-parameter, gain and radiation properties results of the proposed antenna are confirmed experimentally by tested it on anechoic chamber and vector network analyzer (VNA).

Table 1 summarizes a comparison between various previously reported and proposed antenna that have been published in terms of resonating band, volume, peak gain, and impedance bandwidth. It has been found that the impedance bandwidth of has less bandwidth than the suggested antenna. In terms of bandwidth, the proposed antenna operates on UWB frequencies, in contrast to the reported antennas' multiband and wide band operations. It was confirmed with certainty that the suggested antenna has a smaller volume. Table 1 show that the suggested antenna is suited for the unlicensed band (2.4–10 GHz) and has a small size, a simple structure, and entire ultra-wideband.

Table1: Comparison between the previously reported and proposed antenna design.

Reference no.	Antenna size	Impedance bandwidth
[11]	$80 \times 80 \times 5.5 \text{ mm}^3$	4.15–6.26 GHz
[9]	$52.3 \times 58.7 \times 1.07 \text{ mm}^3$	176, 4.77 and 335 MHz at resonant frequencies 2.54 GHz, 4.8 and 7.7
[8]	$60 \times 60 \times 3 \text{ mm}^3$	3-20 GHz
[16]	$70 \times 52 \times 1 \text{ mm}^3$	1.1-1.46,2.23-2.9,3.41-3.95 and 5.24-5.96
[17]	$70 \times 52 \times 1.67 \text{ mm}^3$	1.795 to 1.875
[12]	$50 \times 50 \times 1.52 \text{ mm}^3$	NA
Proposed antenna	$40 \times 50 \times 1.6 \text{ mm}^3$	2.4-10 GHz

## 2. CONFIGURATION OF THE DIFFERENT ANTENNA STRUCTURE

The key goal of this proposed is to design a novel dumble shaped ultra-wide band (UWB) used for un-licensed bands i.e. ISM (2.41-2.46 GHz), U-NII (5.15-5.35 and 5.75-5.85GHz) and space communication (7.2-9.2GHz). For this aspect, dumble shaped design with reduced ground plane structure has been designed as shown in figure 1(a). It is able to excite multi-band properties i.e. 3-4.4, 5.1-6.025, 7.2-9.2GHz. In order to achieve the better impedance matching and quite good gain, the dimensions of the conventional antenna configuration is optimized by parametric simulation in ANSYS HFSS software as shown in table 2. The proposed antenna geometries are built and simulated on a mechanically stable FR-4 lossy substrate with overall dimensions of  $40 \times 50 \times 1.6 \text{ mm}^3$ . It contains the three layers like as ground structure i.e. bottom layer followed by a FR4 substrate having high dielectric constant i.e. intermediate layer, microstrip feedline and rhombic patch of copper material i.e. topmost layer. Additionally at the bottom edge of the antenna a  $50 \Omega$  microstrip feed point (width  $W = 3 \text{ mm}$ ) is utilized to for the excitation of the designed antenna. The initial dimensions of the proposed antenna such as i.e. length ( $L$ ) and width ( $W$ ) has been optimized using transmission line model equations given as 1-3 [12].

$$W = \frac{c}{2f_r \sqrt{\left(\epsilon_r + \frac{1}{2}\right)}} \quad (1)$$

$$\epsilon_{eff} = \frac{\epsilon_r + 1}{2} + \frac{\epsilon_r - 1}{2} \left[ 1 + 12 \frac{h}{w} \right]^{-1/2} \dots\dots\dots (2)$$

$$L = \frac{1}{2cf_r \sqrt{\epsilon_{eff}}} - 2\Delta L \dots\dots\dots (3)$$

Where  $c=3 \times 10^8$  m/s,  $\epsilon_r = 4.4$ ,  $h=1.6$ mm,  $\Delta L$  = extended length of proposed antenna design and operating frequency of 2.28 GHz which is nearly equal to simulated value i.e. 3.4GHz. The suggested antenna's dimensions have been tuned to increase its capability in respect of return loss, bandwidth, and impedance matching. The tuned parameters of the designed DRA are shown in figure 1. The proposed antennas are modelled and simulated in an Ansys HFSS software version 13.

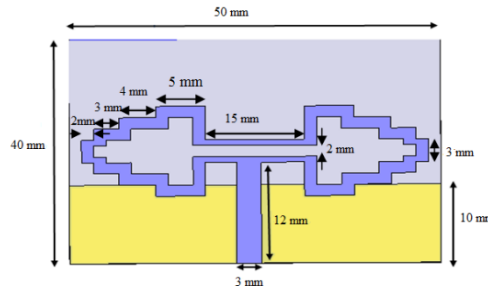


Fig.1 Structure of the designed antenna on FR4 substrate.

## 2.1 Effect of substrate material

In the proposed antenna design, three different materials of substrate are used, i.e. FR4, Duroid and Rogers to analyse the performance of the antenna design. These materials have different effects on proposed antenna's performance i.e. impedance bandwidth, losses. These materials are chosen for this antenna as they enhanced the bandwidth and gives better mechanical results in the presence of air. To check the performance of these different materials a combined S-paramter graph is plotted as shown in the fig. 2 and a table 1 is drawn to show the different frequency bands excited by the antenna with each material. From table 1, it is concluded that the FR4 material provides the better results in terms of impedance bandwidth.i.e. 2.6-11GHz.

**Table 1 Frequency range obtained with different substrate materials**

Substrate Material	Dielectric constant ( $\epsilon_r$ )	Frequency range (GHz)
FR4	4.4	2.6-11
Rogers (3003)	3	4.1-5, 5.5-7.2, 8.5-11
RT-Duroid	2.2	2.8-3.6, 4.6-5.2, 6.4-7.6

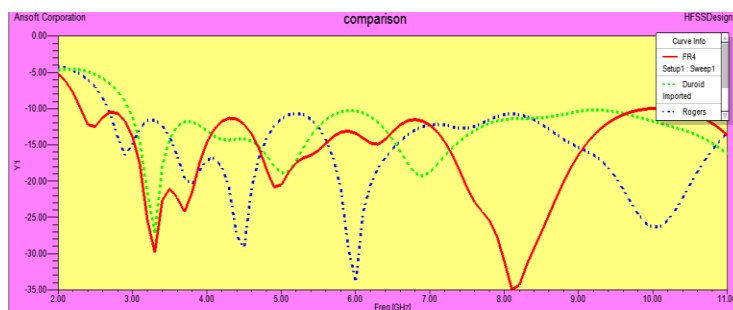


Fig 2. Comparison between the different material used in substrate.

### 3. FABRICATION AND TESTING OF THE PROPOSED ANTENNA DESIGNS.

FR4 substrate has been used as a substrate material for the fabrication of proposed antenna having the dimension  $40 \times 50 \text{ mm}^2$ . To pattern the dumbbell shape structure on substrate wet etching photolithography technique has been utilized. To make the ground plane and dumbbell shape patch on bottom and top of the substrate, respectively a layer of copper material of thickness 0.35 mm has been deposited. On bottom and top of the FR4 substrate material, a thick layer of copper material having the thickness 0.035mm is deposited to be use as a ground plane and dumbbell shaped patch along with microstrip feed-point respectively as depicted in the figure 4 (a-b). The validity of the results obtained from ANSYS HFSS software such as radiation pattern, gain, S-parameter and VSWR is tested on the Agilent's VNA (vector network analyser). The Agilent's VNA (vector network analyser) model no. E-5063A operating from 0.1MHz to 18GHz is connected through a SMA female connector to the  $50 \Omega$  micro strip transmission lines. The comparative graph between the measured (obtained from VNA) and simulated (obtained from HFSS) results in aspects of the S-parameters as demonstrate in figure 4 and polar radiation patters as shown in figure 6 are explained with details in next subsection of this section 3.2. It is observed that designed antenna able to achieve maximum bandwidth i.e. 2.4-10 GHz for simulated case and 3.05-9.67 GHz for measured one along with appropriate impedance matching ( $VSWR < 2$ ).

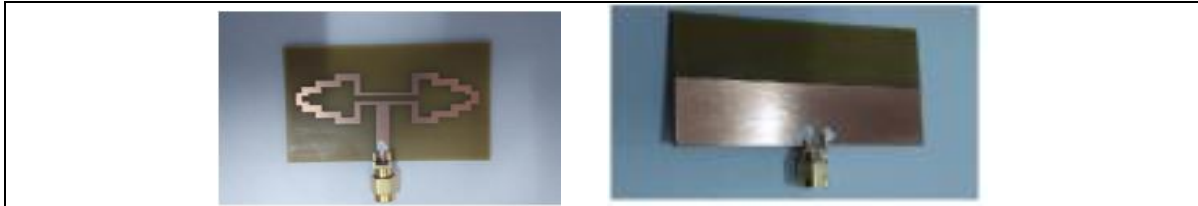


Fig 4: Fabricated dumbbell shape antenna with reduced ground plane (a) Top view (b) Bottom view

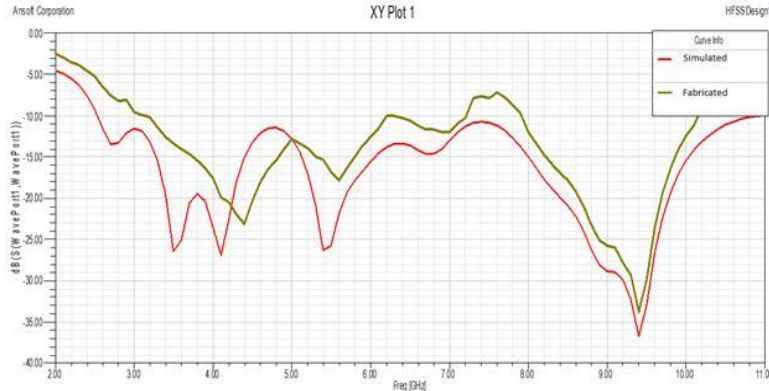


Fig.5 Comparative analysis between measured and simulated results of dumbbell shape antenna.

### 3.2 Radiation pattern

Figure 6 demonstrates the measured and simulated 2D radiation pattern of dumbbell shape antenna with reduced ground plane. In order to measure the radiation pattern practically, a horn antenna that is used as a transmitter is placed 1m away from the proposed antenna that is used as a receiver. The proposed structure exhibits the figure of eight radiation pattern in E plane and like omnidirectional radiation pattern in H -plane.

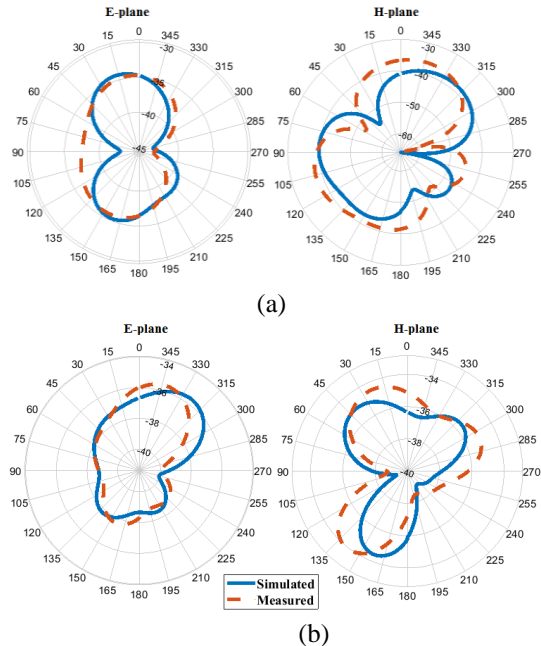


Figure 6 Comparison between simulated and measured radiation pattern plot at (a) 3.4GHz (b) 8.2GHz of resonant frequency for dumbbell shape antenna with reduced ground plane.

#### 4. CONCLUSION

This paper Analysis the effect of Dumbbell Shape microstrip patch antenna with reduced ground plane for unlicensed frequency band i.e. ISM (2.4-2.4835GHz), U-NII (5.15-5.35 and 5.75-5.85GHz) and space communication (7.2-9.2GHz) for impedance bandwidth, gain and radiation properties. The total volumetric parameters of the proposed antenna designs are  $(40 \times 50 \times 1.6) \text{ mm}^3$ . The proposed dumbbell shaped antenna with reduced ground plane is designed and analysed that it operates for multi-band operations i.e. 3-4.4, 5.1-6.025, 7.2-9.2 GHz along with low peak gain. All the simulations have been performed on Ansys HFSS software. The antenna's geometry benefits from a straightforward configuration, making low-cost manufacturing feasible. The suggested antenna is low profile and has the qualities indicated above, making it appropriate for all UWB applications. The designed antenna demonstrates that the simulated and measured data are concisely matched.

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# Power Consumption Monitoring System using IoT

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## Abstract.

In today's scenario, everyone is leading a busy life. We do not have time to monitor the power consumption of each and every electrical appliance used in our home. Power Consumption increases in our home due to unnecessary usage of the appliances like Fan, Tubelight, TV, AC etc.,... We fail to monitor the home appliances in ON State when we leave home. We do not know which appliance consumes more power and which appliance consumes less power. This paper provides you a Power Consumption Monitoring System using IoT to monitor the power consumed by the home appliances through Laptop/Mobile Phone using Wireless Communication Protocols

**Keywords.** Internet of Things, Wi-Fi, Power Consumption, Communication Protocols

## 1. INTRODUCTION

A network of physical and virtual objects interconnected together via the internet is Internet of Things. A greater level of accuracy and service can be obtained by using IoT based Real Time Systems. The data obtained through IoT devices can be used to resolve the real time problems. Traffic Management, Energy Management, Pollution Control, Healthcare, Security are the key sectors where the Internet of Things plays a vital role. Power Consumption Monitoring System using IoT provides the real-time monitoring of power consumed by home appliances and represent the data of power consumed by individual appliance[1]. Once, we start monitoring our own power consumptions, we have an idea about the power consumed by individual appliances. The IoT System includes physical layer, IoT middleware and application layer as shown in Figure 1. To collect the data in real time scenario; IoT devices, sensors, and actuators are used. IoT devices, sensors, and actuators forms the physical layer of the IoT System. IoT middleware layer is used for the exchange of information between the real time sensors and the application layer. The communication protocols transfers the sensed data through Wi-Fi, Ethernet, GSM, The gateway between the physical layer and IoT Middleware establishes the same. The application layer handled by the User is used to send commands to physical objects over the Internet via mobile applications, web applications. The IoT System includes various communication methods like Device to Device, Device to Cloud, Device to Gateway Communication and Back-End Data sharing[2]



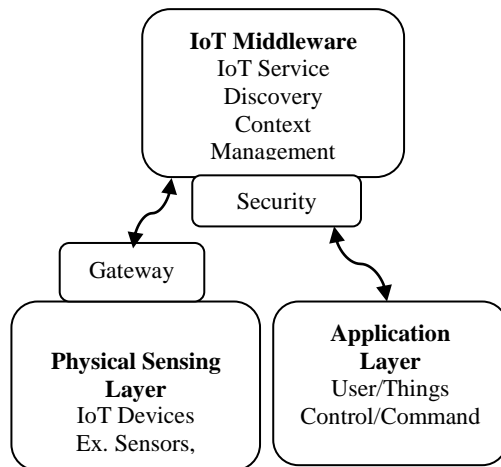


Figure 1. Architecture of an IoT System

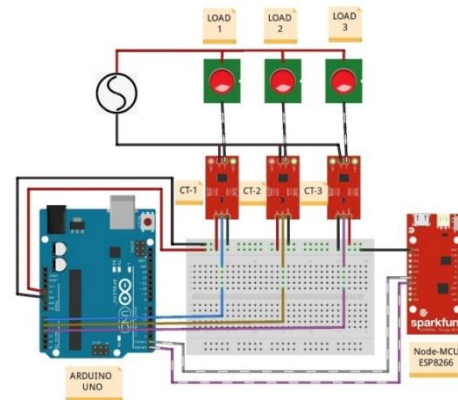


Figure 2. Power Consumption Monitoring System using IoT with three Loads

## 2. POWER CONSUMPTION MONITORING SYSTEM USING IOT

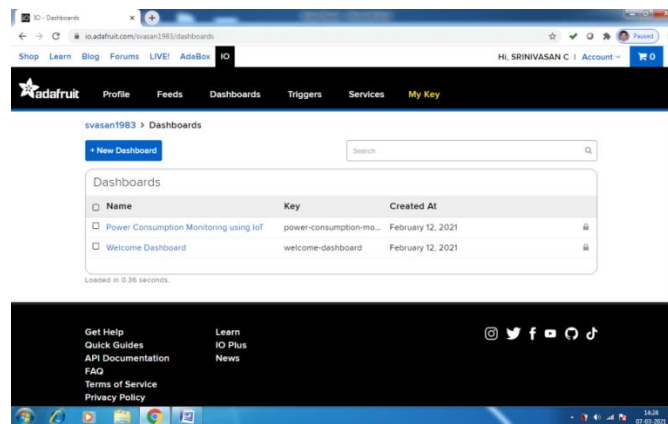
Power Consumption Monitoring System using IoT consists of Arduino Uno, NodeMCU, and Current Sensor (ACS-712). The current sensors(ACS-712) are connected to the analog pins of the Arduino. The  $V_0$  pin of current sensors CT-1, CT-2 and CT-3 are connected to analog pins A6, A5 and A4 in Arduino respectively, which is responsible for the transfer of data from current sensor to Arduino. The current sensors CT-1, CT-2 and CT-3 are connected to their respective loads and these sensors are provided with 5V supply from Arduino. The NodeMCU – ESP8266 and Arduino is connected using TX and RX pins. These pins are responsible for establishing connection between them for transmitting and receiving the data. All the pins should be grounded properly.

## 3. INTERFACING THE IOT SYSTEM WITH CLOUD

In the system, we have to use MQTT broker to monitor our energy uses over the internet[3]. We will use AdaFruit IO platform as MQTT broker and follow the steps to monitor the Power Consumption

1. For storing data on Power Consumption, an AdaFruit account is created
2. Arduino and ESP12 Wi-Fi module is programmed to detect and transfer the data on Power Consumption to cloud

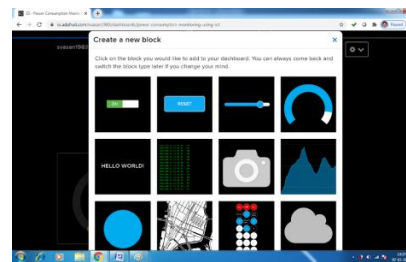
MQTT message headers are simple to enhance network data transmission. MQTT considers informing between gadget to cloud and cloud to gadget. Adafruit IO creates various learning assets, including live and recorded recordings identified with gadgets, innovation, and programming. IFTTT gets its name from the programming contingent proclamation "assuming this, that." What the organization gives is a product stage that associates applications, gadgets and administrations from various designers to trigger any one computerization[4]. The steps involved in creating the Adafruit Account[5] to store the real time data on Power Consumption is as follows



**Figure 3. Create a Dashboard to monitor the Power Consumption**



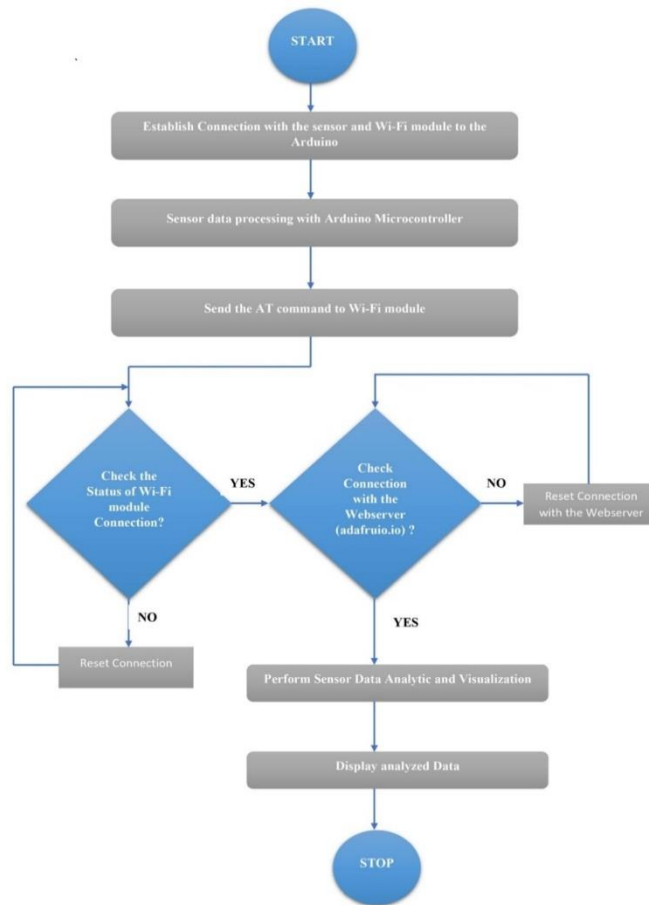
**Figure 4. To setup Adafruit IO Key**



**Figure 5. To create a New Block to monitor the Power Consumption**

The process flow is as illustrated below;

1. When the power is turned on the Arduino establish connection with ESP8266 – NodeMCU and with current sensor ACS-712. The Arduino microcontroller gets input for current sensor and process the data from the sensor. The Arduino transfers the processed data to the NodeMCU Wi-Fi module.
2. NodeMCU Wi-Fi module first check the status of Wi-Fi connection, if there is a problem with the connection NodeMCU will reset the Wi-Fi connection. When the Wi-Fi connection made successfully then NodeMCU will check the connection with webserver (adafruit.io), if there is a problem with the connection webserver (adafruit.io) will reset the webserver connection.
3. When the webserver connection is successfully made, NodeMCU will transfer the processed data received from the Arduino to the cloud platform (adafruit.io)
4. In ADAFRUIT.io platform the received data is visually presented to the viewer. Through the data obtained from the NodeMCU the data is categorized into different forms like pie-chart, graph etc.,
5. ADAFRUIT.io platform may be used to trigger IFTTT platform to send E-mails and SMS to the respective person. This IFTTT platform record the time when the triggered is send. It also records electricity bill amount in it[6].



The flowchart provides the process flow of Power Consumption Monitoring System using IoT.

#### 4. RESULTS AND DISCUSSIONS

The hardware implementation of the Power Consumption Monitoring System using IoT is shown below;



Figure 6. Hardware Implementation of the Power Consumption Monitoring System using IoT

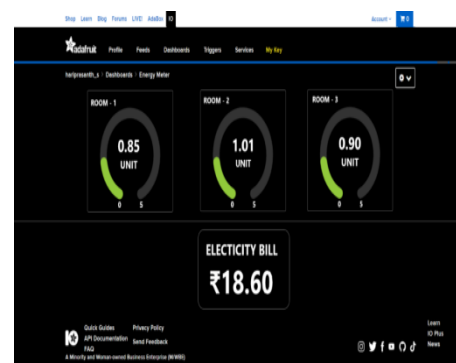
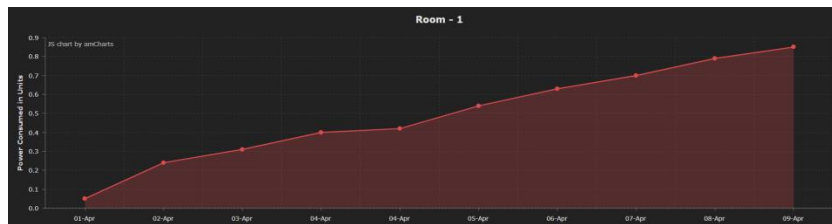


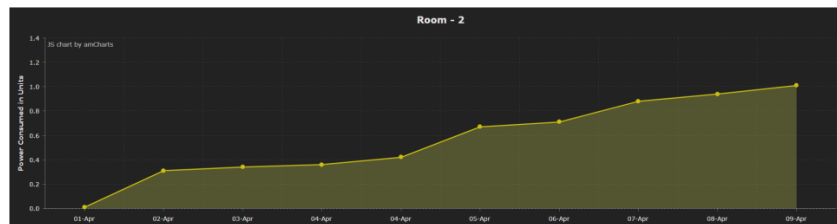
Figure 7. Adafruit Dashboard

The output of power consumption monitoring system is displayed in the adafruit.io platform

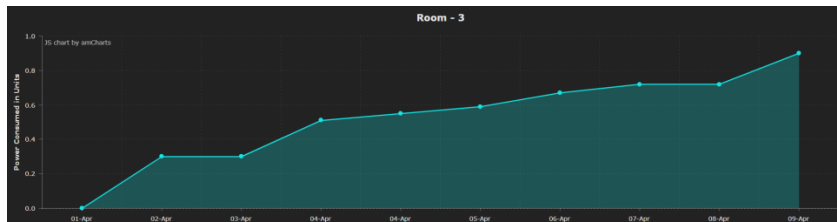
We can clearly see that the units consumed by each bulb vary deepening upon the time. The experiment was conducted periodically for around nine days to monitor the power consumption. Here three bulbs were used to act as three different loads. At the end of ninth day the electricity bill for the power consumed by the bulbs were generated as Rs.18.60. The graphical representation shows us how much power consumed in a room in a day. The adafruit platform creates individual graph for room 1, room 2 and room 3 as shown below.



**Figure 8. Graphical representation of power consumed in Room 1**



**Figure 9. Graphical representation of power consumed in Room 2**



**Figure 10. Graphical representation of power consumed in Room 3**

## 5. CONCLUSION

The system may be deployed in home or industry for monitoring the power consumption and track the usage of power by different appliances. The system may help you in giving out real time data of power consumed in past and present. To end up a perfect smart home a perfect smart meter with enhanced technology is required. The design proposed has an error of around 3% to 4% in three phase power supply. Thus, the accuracy has reached 95% which means most of the time the results obtained is precise. The data collected throughout the month can be accessed from anyplace in the cloud platform and the data is used for bill generation at the end of each month. IFTTT plays its role of triggering the

communication via Email or SMS and it pings the customers. The major issue of stealing power can be eradicated by the system.

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## Biographies



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# A Mechanised Approach to Detect Viral Infections

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## Abstract

Viral infections have been the cause of deaths in many families more recently since the virus can infect a healthy person even if not in direct contact of the infected person. The symptoms of viral infections may vary from high fever, tiredness, dry cough, sore throat, tastelessness, misery, anorexia and diarrhoea in people. Viral infections viz. corona are contagious and communicable so the challenge remains always to diagnose the infections at an early stage with the ultimate aim to save the mankind. In this endeavour, autonomous and miniaturised bot is proposed which can detect the ailing persons remotely by judging the human behaviour, actions and related eventual activities. The same bot can be customised to detect all existing viruses by adopting relevant changes in the procedural algorithms of the whole proposed system or the mechanism embedded into the bot. Due to obvious reasons, it is always desirable that every virus in consideration has to end after being declared pandemic. With the effective use of artificial intelligence and machine learning, the BOT is supposed to detect the symptoms of the affected person and can be prescribed adequate treatment and precautions on the go. The data gathered by bots can further be used by Doctors to diagnose the disease more effectively with a real time approach.

**Keywords:** Viral Infections, Autonomous BOT, Corona, Symptomatic

## 1.INTRODUCTION

Virus with the passage of time it has a huge impact all over the world and one of them is Coronavirus. Efforts are being made on the medical aspects of this virus by conducting various experiments to preserve populations from this catastrophic virus[1]. Disease infection starts 3-4 days before the symptoms are observed, on the other side the tracing of symptoms take place 2-3 days after the symptoms take place. On the basis of current reports the virus discarding is upto 10 days after the beginning of symptoms take place in people with lenient COVID-19 and the 10 days discarding can reach upto 20 days for the people with extreme level of infection and even for those who have less immune system[2]. (SARS-COV-2) is a new type of corona virus that causes extreme respiratory progression. It was detected for the first time in the city WUHAN, CHINA were the people with infection called pneumonia related to the bunch of acute respiratory illness cases in Wuhan. All systematic functions of the original (SARS-COV-2) virus particle seem related to corona virus in nature. Other remarkable alternatives of (SARS-COV-2) emerged in 2020. As of the end of December 2021, a total of 5 variants of SARS-COV-2 were circulating among the general public Worldwide. Demand, these a real ph a variation, gamma variation, beta variation, delta variation, and micron variation. Confirmation of corona virus disease was given by quantitative analysis by PCR (Polymerase Chain Reaction). Impact of covid-19 on public comprises on different parts/organs One not unusual symptom, lack of odor, outcomes from contamination of the guide cellular of the olfactory epithelium with next harm to the olfactory neurons [3]. In many publications it has been reported the involvement of the central and peripheral nervous system in COVID-19, since the vastness of the ACE2 in the glandular cells is affects in gastrointestinal organs, the duodenal, the rectal epithelium as well as endothelial cells of the small intestine. It can even cause acute heart damage and incurable damage to the cardiovascular system Acute heart injury has been found in 12% of public who are hospitalized in Wuhan, China, and is more common in China severe illness. The prevalence of heart disease symptoms is high, due to structured erythrocytic responses and due to change in immune system during disease progression, but acute heart disease may also be associated with heart ACE2 receptors [4]-[13].

In addition to the coronavirus, there are a number of other viral infections that spread between people through physical contact and lead to widespread spread of the virus. Diseases such as influenza, meningitis, pneumonia and many more diseases are the example of spreadable diseases on the basis of physical contact talking about influenza, viral infection that attacks your respiratory system — your nose, throat and lungs is often known as influenza. It is often called the flu, but not similar to as that of stomach "flu" since this virus causes diarrhoea and vomiting. At first, flu-related symptoms are initial, with a cold-like feeling, rhinitis, sternutation, and tonsillitis. But colds usually develop slowly, while flu tends to come on suddenly. And while a cold can be uncomfortable, you often feel much worse with the flu.[13-16]

Another named viral infection which is mild in terms of infection and usually resolves on its own is known as Meningitis. Group of virus named Enteroviruses caused many cases in the United States, this usually happens in the season of late summer and early fall. Other virus which can cause the infection of meningitis such as HIV, Mumps Virus[17].

Pneumonia is an infection of the lungs. It is characterized by the painfulness and redness of the tiny sac of the lungs. Although pneumonia can be effectively treated with antibiotics, late detection can lead to serious complications and even death. The causes of pneumonia are many and range from mild to severe, but the most common cause is the flu. The disease is spread when germs enter your lungs while breathing. Comprises of symptoms for detection of pneumonia starts with fever, runny nose, headache and it will detect pneumonia if this is true so.[18]

Every viral infection spreads through the physical contact so to overcome this problem and eliminate the chances of physical contact the robot is developed which with the help of sensors can detect the symptoms and identify the problem which the patient has come across. It will reduce the chance of infection spreading since this machine is simply detecting every actions remotely and sending the combined report to the physician who will conclude the result.

## **II. LITERATURE REVIEW**

Several viruses resulted contagious disease embedding symptoms such as high fever, tiredness, dry cough, sore throat, tastelessness, misery, anorexia and diarrhoea has been observed in isolated. Unpredictable cases and flare-ups have been represented with extended for the virus named covid-19 since 2019 from China, the USA and even more starting late from Europe.[19]

The Chinese government alerted the WHO to the infectious covid- 19 virus spreading on the coasts of China, starting with a fish that was the first person confirmed to be infected with this virus. The standard methods to check for the presence of SARS-COV-2 are nucleic acid tests to detect the presence of viral RNA fragments. Because these tests detect RNA but not the infecting virus, its "ability to determine how long the patient has been infectious" is limited. The test is usually performed on respiratory samples obtained with nasopharyngeal swabs ; however, a cotton swab or sputum sample canal so be used. Results are usually a vailable within a few hours. WHO has published several testing protocols for this disease. The virus was later renamed by the corona virus research team to the extremely severe respiratory disorder corona virus 2 (SARS-COV-2) and the disease was named corona virus disease 2019 (COVID-19) by WHO.WHO declared the SARS-COV-2 outbreak a Public Health Emergency of International Concern (PHEIC) at the same time.

With the expansion of spreading the several viruses across the globe death rate due to virus became a point to be noticed, with the starting of the virus the death rate counted to be 2.1% across china and 0.2% across globe excluding china, and soon it arose to 15% across globe and this percent keeps on increasing gradually. Guidelines were taken by WHO to prevent the expansion of the virus amongst the public prevention such as isolation of a person infected by the virus, social distancing among the public so that to stop the spreading of virus amongst the respiratory function, as well as avoid to touching people.[20-21]

Before April 2022, there was proper medication for this infectious disease COVID-19, but now countries have proper medication for this disease only in some of the countries not all countries have. In countries having proper medication there patients with mild/moderate infection is serve by Remdesivir, which prevents the patient from serious illness and reduces the chance of hospitalization of the patient.

Most of the patients were encountered with mild infection of this virus, and this virus generally impacted to the people with age group above 50, since these age groups peoples have less immune and the virus directly attacks on immune system resulting to the mortality of the people. People with mild infection were recommended to isolate themselves in there home and to supply themselves with proper fluids supply in order to let themselves fully hydrated, and this home isolated was only for 2 weeks since it has been observed that within 2-3 weeks people with good immune system recover themselves from this infected virus.

Observing the preventions In mind the BOT will be a great asset in this particular scenario, the main symptom of COVID-19 is fever which is detected by the thermal scanner& infrared scanners, this BOT is embedded with a system which will examine the body temperature of a patient, apart from fever a person with coronavirus infection also come across against tiredness, for this the BOT has a pulse checker which will observe the pulse of the patient as well as the BOT is embedded with a camera which will examine the facial expression of the person through scanning and can identify the expression of the person whether the patient is tired or not this technology is creating results on the basis of different set of instructions which are already feed in the BOT talking in context with the facial expression the different sorts of facial expression are there which on the basis of type tell the level of tiredness and accordingly makes report on it, On the other hand the Sore throat is also a symptom coronavirus which is recognized by the utilization of a camera and a spotlight introduced in the BOT. The camera and electric lamp takes pictures of the throat, the picture captured by the camera is then forwarded to the consultant doctor depending upon which the doctor predicts the throat infection of the infected person, the framework forms the procured pictures utilizing shading change and shading remedy calculations, lastly orders Streptococcal Pharyngitis (or strep) throat from solid throat utilizing AI strategies. The cough is diagnosed by the microphone through which recorded the sound and through artificial intelligence analysis. The sensory nodes in WBAN can be used effective data delivery of various symptoms to the servers for evaluation of patient health.[22-24]

## **III. ARCHITECTURE**

In contrast with the architecture of the BOT, it initialises automatically when a person stands in front of it using the mechanism of artificial intelligence. As soon as the initialization of robot is done it starts with symptoms diagnosing starting with fever diagnosing in terms of body temperature with the help of infrared red sensor, as soon as it is done with fever sensing it senses the cough of the particular patient with the help of microphone which records the audio of that patient taking result from audio technology, thirdly it starts sensing the tiredness of that particular patient in three different levels the first level is pressure sensor strip which detects the pressure of the patient, second level is facial expression detection with the help of sensors and camera to detect the expression of the patient and detect the tiredness level of that patient, lastly it checks the pulse of that patient or heart rate of that patient to give the result on the tiredness level, after this process it analysis the soar throat of the patient with the help of flash light and

camera in the throat to take the photos of that soar throat and depict accordingly , in addition it also performs various other test related to the symptoms of other viral infection and keeps the record of the previous test since it have to accumulate the report, once all the process accomplishes the report which consist the result of all the tested symptoms as well as the final result in terms of whether the person is infected from which virus and which viral infection the patient is infected. The cumulative report processed by the BOT is uploaded on the application as soon as the report is done for and the report is shared to the prescribed doctor to help the patient with the relief action from the infected virus. The application works like the registered patient phone number is there in the report so when that specific patient is nearby (GPS is used by the application to track the patient location) someone has that same application installed in their smartphone. The proposed system can be extended using autonomous ZIGBEE, WIFI, BLUETOOTH and satellite notes for cohesing covid-19 information to all in an Adhoc environment. The architecture is explained and proposed to be implemented through Fig.1. which explains the working of the BOT on the behalf of flow chart.

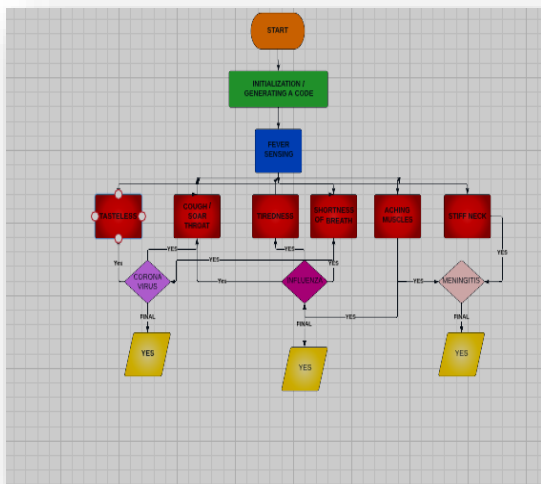


FIGURE-1 FLOW-CHART DIAGRAM

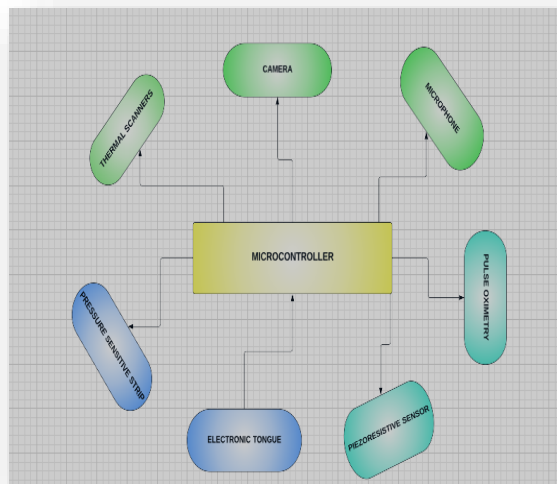


FIGURE 2: COMPONENTS USED IN THE OVERALL CONCEPT

**IV. METHODOLOGY**

The technology used in this particular domain is mainly IOT which is the sub part of artificial intelligence since we are using sensors in this BOT and the sensors technology is particularly based on IOT (internet of things) and all these setups is interconnected with Artificial intelligence technology apart from this we are using camera sensors as well which will be performing on the basis of image scanning technology.

With the presence of BOT the symptoms identification is as follows, fever would be the first step towards the identification of infected virus this process will be completed with the help of infrared sensors, the second step will be the process of identifying the tiredness of a patient with the help of facial recognition which will depict the percentage of the tiredness level in accumulation to it the pulse checker will check the pulse or heart rate of the patient and will depict the rate of the patient on the other hand a pressure sensitive strip will measure the pressure of the patient at that particular situation, In addition to the symptoms of virus Soar throat is also an additional symptom which will be predicted on the basis of camera and microphone which will capture the images and voice record will be processed to the prescribed doctor with the help of specific application and it will be confirmed whether the patient is COIVD-19infected or with the virus leading to Influenza or Meningitis.

This whole process which finalises the report of the particular patient uses the technique of Artificial intelligence and machine learning to predict every symptom and depict whether the patient is virus infected or not, this technology is advanced and will work accordingly to reduce the risk factor for public in order it will avoid contact spreading of the disease accordingly. Figure 2 describes the various components which are being used in the BOT for its functioning.

**V. RESULT**

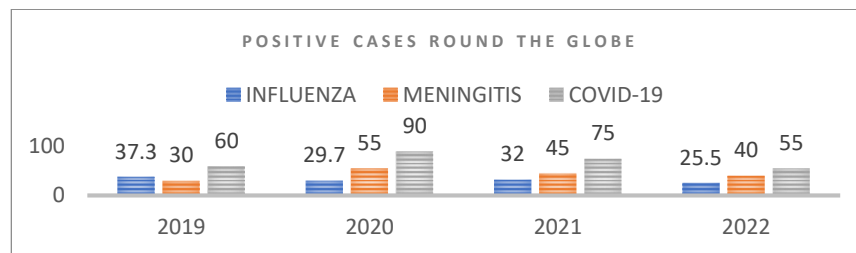
Summary of this project is it is totally based on the machine learning technique in the way that the machine is customized with some worthy teachings related to the symptoms reading of the infection in this way machine will be able to neglect the physical contact between public and will be able to summarise the result on the way it has been setup to.

Initialization will the most basic work which will be done by the machine as soon as the public will walk over to it, after that particular step it will generate a 4-digit code which will individualize the public from the bunch of public based on this 4-digit code the doctor or the nearby physician will depict the patient so that it wouldn't create the mess among the patient and doctor in such a way that particular patient is suffering from COVID-19 or that particular patient is suffering from Influenza.



With the presence of BOT the symptoms identification is as follows, fever would be the first step towards the identification of infected virus this process will be completed with the help of infrared sensors, the second step will be the process of identifying the tiredness of a patient with the help of facial recognition which will depict the percentage of the tiredness level in accumulation to it the pulse checker will check the pulse or heart rate of the patient and will depict the rate of the patient on the other hand a pressure sensitive strip will measure the pressure of the patient at that particular situation, In addition to the symptoms of virus Soar throat is also an additional symptom which will be predicted on the basis of camera and microphone which will capture the images and voice record will be processed to the prescribed doctor with the help of specific application and it will be confirmed whether the patient is virus infected or not, so with the help of technique of artificial intelligence and machine learning the BOT is predicted to depict the correct information by taking the help from various methods such as fever recognition with IR sensors, tiredness prediction with the help of facial expression pulse checker and pressure recognition, soar throat depiction with the help of microphone and camera to capture the throat area image and after all the process the report is forwarded to the prescribed doctor who makes the final report whether the patient is virus infected or not. If YES then which virus the patient is infected from.

Figure 3 shows the chart which describes the positive cases round the globe and it basically aims on three types of viral infections which are Influenza, Meningitis, Corona virus.



**FIGURE 3: STATS RELATED TO THE INCREMENT OF CASES ROUND THE GLOBE IN THESE PARTICULAR DISEASE YEARLY**

## VI. DISCUSSION

The spread of the infectious disease have been the major issue across the countries and to classify them and to have a proper treatment related to the disease this BOT will be a powerful machine in accordance to this particular problem several steps has been considered and attempted in order to overcome these problems for instance Venous Pro BOT which is a clinical categorized BOT having application of biological sample collection such as automatic drawing of blood samples another is Swap OP BOT categorized under clinical condition BOT having application of collecting the swap samples and based on that create a report after particular sets of checking. On the other hand this BOT is different in every aspect to these latest technology as it comprises with set of instructions which are executed to perform a particular task which is investigating the type of viral infections based on the symptoms so the main difference between both the technologies is that they were in physical contact to the infected person which can create or infect the other person but this BOT performs every sort of task without getting in contact with that particular person.

## VII. CONCLUSION

Round the globe according to the stats the problem has disturbed millions of public and keeps on disturbing by the way of spreading amongst them through physical contact and as said the robot is the best way to put a full stop on this way of spreading of all these viral infections through the way of physical contact as this robot will be fully automatic and doesn't require any manual contact as well as it will be assuring the stop on physical contact. In this way it will be contributing in the betterment of the society.

Therefore, BOT performs various operations with the help of different sorts of sensors which are existing in this BOT. Camera is also set-up in order to capture the actions of the public so that it can detect the amount of percentage a person is sick or not, even it has been given the microphone option in order to record the voice and detect the percentage in that matter if a person have soar throat, and to accumulate all these in a specific report. Then the report accumulated will be forwarded to the nearby locality physician so as to treat the affected person at its earliest, even it will warn other public nearby that this particular person nearby is infected by this specific infection and to stay safe from that particular person. By this method it will help in treating the patient at the earliest and by putting a full stop on the spreading of this disease.

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Processing.

# Design and implementation of Real-Time Obstacle detection device

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**Abstract:** - This is an object detection type of device with the help of which we can detect the object. In this firstly, the device detects the obstacles and then the information of the obstacles sends to the visually impaired people by using different modalities such as vibration and beep sound [1].

**KEYWORDS:** - BUZZER, ARDUINO NANO, ULTRASONIC SENSOR...

## 1. INTRODUCTION

We know how difficult is for blind people so this device can make their life easy and they don't need to be dependent on others.

This project makes their life easy. They could use this as a tool or a hand held device that detects the obstruction. This device is very cost effective and economical. And we use Arduino NANO device to execute this functioning [4]. By using this tool or equipment, users can quickly determine whether something is in front of them by hearing the buzzer sound (beep). A Ultrasonic sensor are also attached with that having higher detection range and they can move independently with a greater accuracy [5].

## 2. REAL-TIME OBSTACLE DETECTOR DEVICE

Figure 2.1 gives the overview of the working model. It deals with the accurate and comprehensive coverage of obstacle detection[2,3]. The following devices are used to design this device are as follow: -

1. Arduino NANO
2. Female Header
3. Breadboard
4. Buzzer
5. Male Header
6. LED: Red
7. Ultrasonic sensor
8. Female Header
9. Jumper wires
10. Battery

In the coming section we are going to explain the few components which play an important part to complete the model.

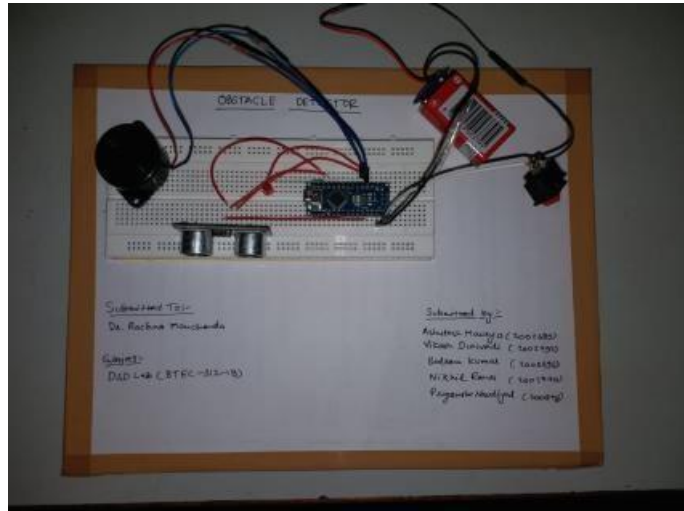


Figure 2.1. Project at final stage

## 1. ARDIUNO NANO



Figure 2.1.1 Arduno Board

Figure 2.1.1 displays an Arduino board which is an open-source hardware and software company. It is based on easy-to-use hardware and software operations on it. It is small and breadboard friendly board that are based on the AT mega 328. These microcontroller devices aid in the sensing and management of things in real-time environments and circumstances. Its weight is 7g and has 22 digital input/ output pins. The codes are written in this are through with C++ addition with function and methods.

## 2. ULTRASONIC SENSOR



Figure 2.1.2 Ultrasonic Sensor

Figure 2.1.2 displays an ultrasonic sensor. It is made up of a transceiver, receiver, and transmitter. In the transmitter, electrical signals are transformed into sound waves. Sound waves are again converted into electrical signals by the receiver. Both sending and receiving tasks are handled by the transceiver. Additionally, it contains crystal oscillators. It will carry out the Stabilizing procedure. By sending out ultrasonic sound waves, an ultrasonic sensor can estimate an object's distance.

### 3. JUMPER CABLES



Figure 2.1.3 Jumper Cables

Figure 2.1.3 displays Jumper wires (du point), which are used to connect devices, are another name for the jump wires. It is an electric wire. We Can make easy connections with the other devices through this. It has the pin on both sides. These are used for the connection between the non-corresponding device and the breadboard.

### 4. PIEZO BUZZER

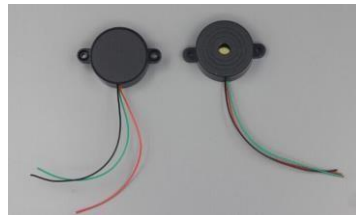


Figure 2.1.4 Piezo Buzzer

Figure 2.1.4 displays a piezo buzzer. A tone, sound, and alarm are produced by the electronic gadget via which they are produced. As an indication, it is utilized. Piezoelectricity serves as its foundation. Jacques and Pierre Curie in 1880 discovered this concept. It works on using a piezo crystal, a type of material changes its shape when we applied voltage on it. When the crystal squeezes against a diaphragm, like a tiny speaker, it gives rise to a pressure wave (sound) which the human ear picks.

#### WORKING PRINCIPLE: -

This System built of the apparatus like bread board, Ultrasonic sensor, buzzers, Arduino NANO, Sensors for detecting the hurdles (obstacles). Using this, the user becomes aware of the impediment. Male and female header pins, Jumper wire, a power bank, some stickers, and elastic are used to assemble the device into a band that users can wear[1].

The Arduino's ground is wired into the buzzer's ground. It makes sense to wire the ultrasonic sensor in this way. Pin for a sonar sensor: The Arduino's PIN 6 is connected to an Echo pin-like ultrasonic sensor. The ultrasonic pin VCC is connected to the ultrasonic pin GND, and the Arduino pin GND is connected to the Arduino pin GND. Pin for a sonar sensor Trig is connected to an Arduino pin, and the switch used in this case is to choose the node. Finally, after all of the connections to the audio board have been made, upload the code to the Arduino board, power the other modules, and utilize a power bank for the power supply. A transmitter is used with the ultrasonic sensor. The transmitter released ultrasonic waves when the thing was discovered. The transmitter and receiver were both sent through the ultrasonic speaker. We determine the time interval and also the distance between the transmitter signal and receiver signal by using this.

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**Author Name:** - All student the members are pursuing bachelor of technology degree Chandigarh Engineering college, Landran, Mohali. Mentors are expertise in their own fields and core interested subjects (topics). All members are played an important role in the building of this project.

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# A Review on Energy Efficient Techniques to Extend the Lifetime of Wireless Sensor Network

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## Abstract.

Wireless sensor networks (WSNs) have gained in popularity over the years and also have a wide range of applications, such as healthcare, the ecosystem, and the army. Despite its impressive capabilities, the creation of WSN remains a difficult process due to its limited lifespan. This paper reviews the current Wireless systems, their applications and the challenges faced by these systems in real world. In addition to this, different phases of wireless communication and its impact on efficiency of various wireless networks is also analyzed. A literature survey is conducted in which various methods that have been proposed by different researchers over the years are discussed. The techniques used by these researchers in order to extend the lifetime of wireless network along with the outcomes achieved by them is also analyzed. In the end, an analytical study is conducted on the basis of routing-based energy efficient protocol and clustering and CH based protocols. After reviewing the different approaches, it is concluded that the selection of appropriate technique can vary from one application to another in order to extend the lifespan of wireless sensor network (WSN).

**Keywords.** Wireless sensor network, clustering protocol, Energy efficient, routing approach, LEACH, etc.

## 1. INTRODUCTION

Wireless sensor networks have been popularizing increasingly in recent years. A WSN is made up of many sensor nodes that can only interact with one another across a limited communication range [1]. The Wireless Sensor (WS) is a tiny sensor that performs critical operations such as transmission, sensing, and data processing. Sink nodes and sensor nodes (SNs) are two types of wireless sensor nodes depending on their operation. SNs sense the surroundings and may also send data to other SNs. The base station (BS) or sink node, gathers information from SNs and aggregates it. Memory, Micro-sensor, transceiver, battery, and microprocessor are the major components of a wireless sensor node [2]. ease of use, ability to survive harsh environmental conditions, scalability to large-scale deployment, heterogeneity of nodes, mobility of nodes, ability to cope with node failure, and energy harvesting are some of the primary properties of wireless sensor networks. The above characteristics ensure that WSN can be used in a variety of applications [3]. A WSN's primary application domains can be categorized as indicated in Fig.1.

Precision farming detects factors such as pressures and temperatures, as well as providing a precise atmosphere for agricultural purposes [4]. Environmental monitoring detects all climatic characteristics to avoid disasters such as forest fires, floods, and gas leaks [5]. Vehicle tracking aids in the prevention of traffic jams and the parking system, as well as the tracking of the vehicle's movement. Medical care monitoring aids in the real-time tracking of physiological signals and helps to avoid life-threatening risks [6]. Smart Buildings use less electricity and provide higher security. Security and Surveillance system assists in early enemy identification and vehicle detecting. Animal tracking system keeps track of the animals by optimizing rearing scenarios and managing the stress level of the animals by movement and vibration monitoring [7,8,9]. It is impossible to replace or even recharge the SN's battery in these systems. As data transmitted from SNs to BS is the main task in sensor networks, therefore clustering is the best option for extending their lifetime[10,11].

Clustering is a form of topology management approach that groups SNs to increase network performance by distributing energy and rotating duties between SNs to ensure equality [12,13]. The clustering implementation

phases in all cluster-based methods: The steady-state phase (data transmission phase), set-up phase (cluster formation), and CH selection phase [14,15].

. Kavitha Kayiram et al. [16], the authors presented a unique data management method in this study that allows for (i) time and energy-efficient data aggregation, (ii) optimal storage space use, and (iii) energy-efficient sensing in a wireless sensor network. Collaborative sensing and Sleep-scheduling strategies were used in suggested data storage and sensing methods. Secondly, the authors used a Lookup approach to take advantage of the collaborative sensing that occurs as a result of the sleep-scheduling of SNs in wireless networks. The accuracy of the suggested approach has been proven by simulation findings. Asad Raza et al. [17], this paper covered all of the risks to encrypted transmission in a wireless network. The purpose of this study was to highlight the safety challenges surrounding broadcast authentication in sensor networks and to evaluate the suggested solutions in terms of several metrics. A. Aliti et al. [18], In this research, authors presented a security architecture for dealing with the most significant security challenges in wireless sensor networks. The concentration of the study was on an optimal CH selection mechanism that rotates the CH location between SNs with greater energy levels than others. According to simulation results, the updated version outperformed the low energy adaptive clustering hierarchy method by increasing performance by 60 percent, lifespan by 66 percent, and remaining energy by 64 percent. R. J. Bhuiyan, et al. [19], The authors presented a simple cluster head selection mechanism in this paper that saves significant energy for SNs while also extending the network's lifetime. The suggested methodology considered the one-hop neighbor data, the distance between Cluster heads and the BS, neighbor data, and the amount of residual energy. They compared the proposed technique to LEACH-C and ECHS in a simulation. They noticed significant improvements in energy usage in each round, Last Node Death (END), First Node Dai (1ND), and total packets sent to Base station as throughput. The fuzzy inference approach was used in this paper to identify the suitable cluster head. The residual energy of the SN, node degree, and distance to the Base station were fuzzy input variables, while 'size' and 'competition radius' are fuzzy output variables. A. Lipare et al. [20], The suggested method surpassed the EAUCF and LEACH algorithms in terms of network stability, active sensor nodes per round, and energy consumption. Routing algorithms are essential in cloud computing for spending power efficiently and maintaining other service quality. Routing algorithms face a variety of architectural difficulties. To address these problems, several researchers have devised a variety of solutions, some of which are listed below:

Hao Li et al. [21], For the loss of LEACH-M packets, this study presented the Leach-MON cluster method focused on mobile sensor networks, that introduced the concept of on-demand routing to the mobile WSNs. The packet loss was relatively lower than LEACH-M when the performance and energy usage of the SNs were fully considered during simulation using the NS3 Network simulator. V. K. Kumar et al. [22], This article proposed a chain-based routing system for the PEGASIS "Power-Efficient Gathering in Sensor Information System". To increase efficiency, a new PEGASIS method was presented, which is more energy-efficient and offers a longer lifespan than the original PEGASIS method. X. Wang et al. [23], the paper considered the energy barriers of clustered sensor networks and suggested an enhanced routing algorithm for these sensor networks to obtain an optimal solution for energy usage in SNs, reducing the impacts of hot spots in some SNs close to the BS and preventing the hot head nodes from becoming overloaded for data communication. A Matlab simulation tool was used to evaluate the new technique. The simulation findings indicated that the revised routing algorithm was highly reliable than the traditional EEUC and LEACH protocols in reducing the overall energy usage of sensor networks with more balanced transmission loads and extending the systems' lifespan. D. Pal et al. [24], In this paper, a clustering strategy based on fuzzy logic was used to improve the network longevity and transmission efficiency of a WSN. The CH was selected using fuzzy logic. In the present architecture, the first node dead (FND) and the longevity of the network employing fuzzy logic were compared to four alternative approaches. In this study, FND and lifespan were determined to be superior, resulting in a more efficient strategy for Sensor networks. C. Xu et al. [25], The authors presented a unique energy-efficient region source routing strategy in this paper to optimize the lifespan of the sensor networks (referred to as ER- SR). V. K. Kumar et al. [26], The authors presented an HDPORP "Heterogeneous DSR PEGASIS Optimization Routing Protocol" in this work, which combines the best characteristics of both PEGASIS and DSR technologies. They utilized Dijkstra's method to discover the lowest route between each SN and the CH in the simulation, and then they utilized an energy list to update the network with high energy SNs and reject SNs with less energy. According to the simulation findings, the HDPORP method increased the lifespan of the Network by 10percent when compared to other methods. After reviewing the techniques proposed by various researchers in order to extend the lifespan of the wireless network, it is observed that most of the researchers worked mostly on two domains;

i.e. either on routing protocols or clustering and CH selection methods. In order to analyze, which technique is providing efficient results, an analytical study is conducted for the traditional models by analyzing their First node death (FND), half node death (HND) and last node death (LND) values. The performance of the traditional model is firstly analyzed for different LEACH variants in terms of their FND, HND and LND and is shown in figure 2. Figure 2 represents the Comparison graph of different traditional models which included LEACH-C, LEACH-MAC,



ECHS, R.j Bhuiyan in [19] and D.pal in [24] in terms of FND, HND and LND. The x-axis represents the variants of LEACH protocols and the y-axis represents the total number of rounds

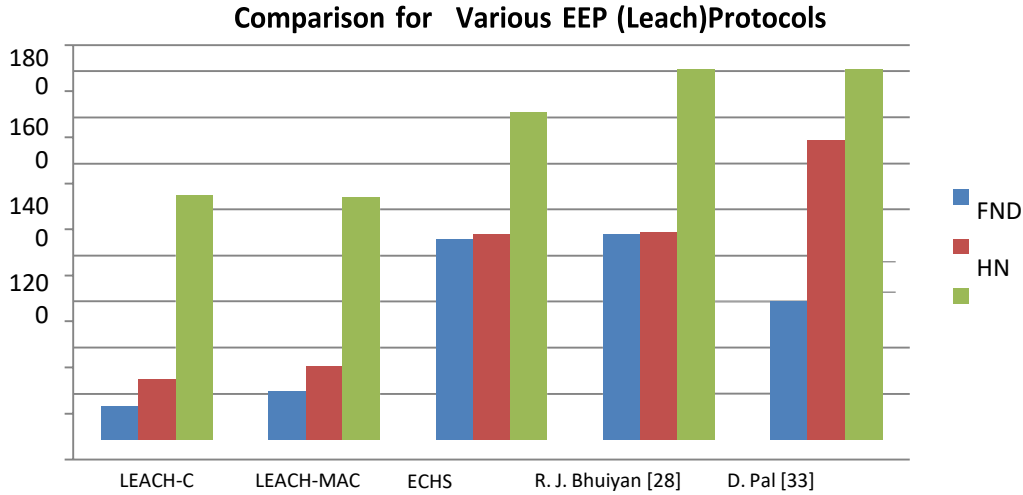


Fig 2. Comparison graph for different LEACH variants

The blue colored bar depicts the FND value whereas the maroon and green colored bars depict the HND and LND values respectively. From the graph, it is analyzed that the value of FND is good in R.J. Bhuiyan in [28] while as the HND and LND value are better in D.pal in [33]. The best results are given by the techniques used by D.pal in [33], followed by R.J. Bhuiyan in [28], then ECHS, LEACH-MAC and lastly LEACH-C. This proves that the technique used by D.pal in [33], are more efficient, long lasting and stable. The specific value of each protocol in terms of FND, HND and LND are given in table 1.

2. **TABLE 1: PERFORMANCE COMPARISON OF ENERGY EFFICIENT PROTOCOLS (LEACH VARIANTS)**

Factors	LEACH-C	LEACH-MAC	ECHS	R. J. Bhuiyan [28]	D. Pal [33]
FND	146	211	870	889	600
HND	261	320	892	900	1300
LND	1060	1054	1422	1607	1610

In addition to this, the efficiency of the routing-based protocols is also analyzed in which PEGASIS protocol is used as chain-based clustering protocol. The PEGASIS routing protocol works on the principle in which the node that is closer to the next neighbor node is selected as the CH node that transfers information from sensor node to the BS node. The performance of the different PEGASIS variants is analyzed in terms of FND, HND and LND and is shown in figure 3. Figure 3 represents the Comparison graph for different PEGASIS variants which include PEGASIS, PDCH, EPEGASIS and EE-PEGASIS in terms of their FND, HND and LND values. The x-axis represents the variants of PEGASIS protocols and the y-axis represents the total number of rounds. The blue colored bar depicts the FND value whereas the maroon and green colored bars depict the HND and LND values respectively. From the graph, it is analyzed that the value of FND, HND and LND are best in EE-PEGASIS. The best results are produced by EE-PEGASIS, followed by EPEGASIS and then PEGASIS and lastly PDCH. After

analyzing the results, it is concluded that EE-PEGASIS is providing more efficient, long lasting and stable results.

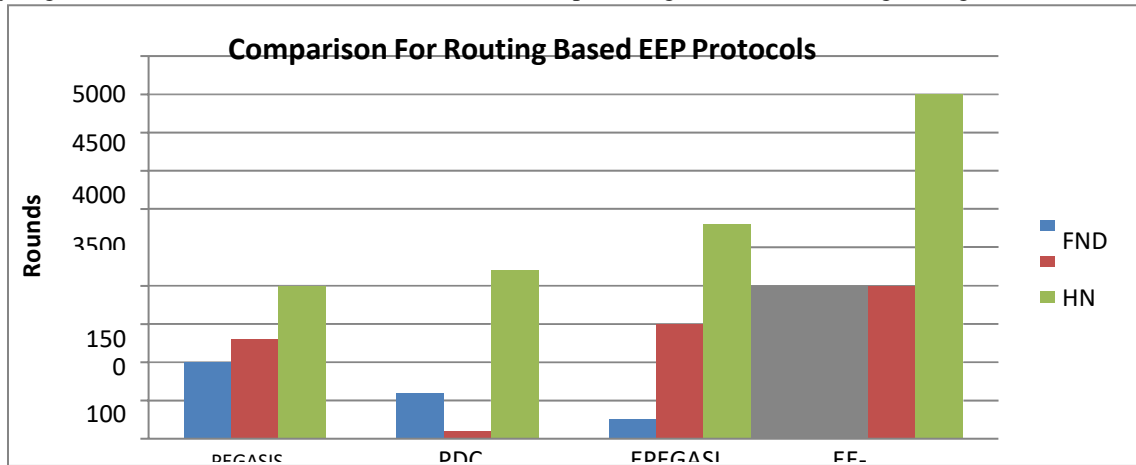


Fig 3. Comparison graph for different PEGASIS variants

### 3. TABLE 2: PERFORMANCE COMPARISON OF ENERGY EFFICIENT PROTOCOLS (PEGASIS VARIANTS) [35]

The specific value of each protocol in terms of FND, HND and LND are given in table 2.

Factors	PEGASIS	PDCH	EPEGASIS	EE-PEGASIS
FND	1000	600	250	1450
HND	1300	100	1500	2000
LND	2000	2200	2800	4500

### 4. CONCLUSION

This paper reviewed various techniques that are used by various researchers in order to enhance the lifespan of wireless networks. From the literature survey, it is conducted that most of the experts focused on two domains; one is called as normal energy efficient protocols which are basically the different variants of LEACH protocol and second is based routing-based protocols which are variants of PEGASIS protocols. After analyzing the results, it is observed that the results produced by different techniques may vary from one application to another. Furthermore, it is also analyzed that, if the model is entirely focused on the routing-based protocols then PEGASIS variants provide a better option as they can extend the lifespan of network efficiently. However, if the model is not based on the routing mechanisms then LEACH variants can also provide good results. The main goal of reviewing different techniques is to look into the viability and use of high-level-based techniques to make WSN design easier and to extend its lifespan.

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# Single Threshold Spectrum Sensing Energy Detector using Whale Optimization

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## Abstract:

Efficiency of spectrum sensing gets affected by less signal to noise ratio. To improve spectrum sensing performance, a single threshold determination approach based on the Whale optimization algorithm is proposed in this study. Spectrum sensing using Energy is being accessed. The simulation results showed that using the best threshold selection raised spectrum sensing performance. The performance has been raised by 30%.

**Keywords:** Spectrum sensing, Energy detection, Threshold, Whale optimization.

## 1. INTRODUCTION:

Current spectrum allocation policy, known as FSA, is a set policy (fixed spectrum allocation). The electromagnetic spectrum is separated into bands that are meant for different types of services under this policy. The authorization to utilize the electromagnetic spectrum has a set duration and is often provided based on the location of the transmitter system. Only the concessionaire or licensee to whom the authorization was issued has access to the electromagnetic spectrum resources within this region and for the period of validity of this authorization, even if the resource is underutilized over time. At first, the strategy was sufficient to avoid interference between the various systems that employed the electromagnetic spectrum, as well as to meet the need for information for wireless communication services.

The scenario of electromagnetic spectrum use has changed dramatically as a result of today's continual expansion of wireless communication technology. Despite attempts by business and research to improve the spectral efficiency of new communication systems, an increase in transmission rate requires an increase in the bandwidth required for transmission. The phenomenon known as spectral scarcity is caused by the increased demand for transmission frequencies combined with the fixed offer [1].

In addition to limiting the electromagnetic spectrum's availability, the policy that was formerly appropriate for the resource utilization profile is now ineffective. The spectrum cannot be reused by other systems because it is reserved and not used at particular periods of the day.

In this scenario, a new proposal for spectrum allocation, known as DSA (dynamic spectrum allocation), develops (dynamic spectrum access). This new strategy advises that the resource be used opportunistically, i.e., spectrum access would be depending on demand, and spectrum bands would no longer be completely protected for certain types of services.

Currently, the 2.4GHz band, an unlicensed usage band shared by wireless telephone, 802.11 WLAN, and Bluetooth devices [2], is an example of this form of allocation. The new policy recommends a significant shift in the architecture of receiving and transmitting devices, in addition to significantly modifying the way spectrum use is governed. The assurance that there will be no interference between the different systems is one of the primary barriers to the adoption of a dynamic spectrum access strategy. There will be no interest in changing the current strategy if it is not possible to ensure that the DSA network does not interfere with legacy FSA systems, as networks with both spectrum allocation policies must coexist.

Spectrum sensing appears as one of the key properties of DSA networks in this setting. Transmission possibilities, also known as spectrum holes, or sections of the electromagnetic spectrum that are not in use at any particular time, are found in this step. If spectrum sensing is ineffective, radios will be unable to recognize transmission opportunities, or, even worse, they will be unable to distinguish when spectrum is in use, leading to the misleading impression that spectrum is available when it is not.

For cognitive radio networks, the development of efficient approaches that can be applied in real time and can detect signals with a high probability is critical.

## 2. LITERATURE SURVEY:

A cognitive radio user is a system that monitors and determines whether or not the main user is present. The second user must use the free spectrum if the primary user (PU) is not accessible [3]. Due to key user recognition, this is not as dependable as many dimming and dimming alternatives for the average user [4]. The problem is caused by secondary user access to the primary user licensing range as a result of this issue. This topic was posed in order to increase detection accuracy and address issues with shared spectrum perception. The fundamental idea behind collaborative spectrum sensor performance is to empower secondary users to improve their own performance [5] [6].

Outside of the voting rule N, the cognitive recognition spectrum is specified. Secondary users point out primary users N with an external SU at the merging center [7]. Users increase their power usage within seconds to proclaim the Fusion Center's spectral sensitivity and sensitivity (FC). To raised efficiency of energy , storage solutions have been suggested [8] [9]. Spectrum allocation can minimize time and power usage if the SNR is too high or the primary user (PU) is too high. If this is not the case, the spectrum detection sensitivity will be employed again to increase performance. [10] [11] A strategy for reducing power consumption is provided, which includes time recording and transmission time. As a result, by eliminating interference, PU improves energy efficiency. In order to enhance energy efficiency, several well-known channels have been proposed for efficient input recognition [12].

Each secondary user knows the channel in some modes, yet the same second user FC and other secondary users can transmit the same message in others [13]. To increase spectral energy detection performance, [14] presents a dependable high energy threshold circuit. Based on the influence of the SU transmit power, the authors proposed the limitation as adaptive in [15]. The detection threshold is solely determined by the incoming signal's statistical features, as outlined by the authors in [16]. The authors get the appropriate threshold value in [17] by using the Lagrange multiplier approach. In [15], a two-threshold method is proposed, which differs from the traditional one-threshold design and enhances detection performance substantially. In [18], it takes longer to detect the spectrum before getting results, whereas in [19], the authors present a method for generating threshold value. The author specifies the maximum number of entries in [20]. The SU will switch to detecting a different spectrum if the quantity of spectrum detection time surpasses the upper limit.

Furthermore, all of the techniques have difficulty obtaining spectrum on the cognitive radio network. As a result, to avoid all shortcomings, this research presents a single threshold energy measurement technique.

## 3. PROPOSED METHODOLOGY:

### 3.1 Introduction:

Cooperative gain refers to the improvement in performance that occurs as a result of spatial variety. From the standpoint of sensor hardware, the cooperative gain can also be considered .Having low signal-to-noise ratio of the received primary signal as a result of multipath fading and shadowing, making detection challenging. Because receiver sensitivity refers to the receiver's capacity to detect weak signals, a strict sensitivity requirement will be imposed on the receiver, More crucially, when the signal-to-noise ratio of PU signals is below a particular level called as an SNR wall, the detection performance cannot be increased by raising the sensitivity. Fortunately, cooperative sensing can alleviate the sensitivity need as well as the technology limitations.

Cooperative sensing consists of Local sensing, reporting, and data fusion Other key components of cooperative sensing, in addition to these phases, are essential. The elements of cooperative sensing are what we term these basic but necessary components.:

### 3.2 Energy Detection Technique:

Energy detector method is the most widespread form of spectrum sensing, It can also be considered a coarse detection technique, as it does not provide detailed information about the signals occupying the spectrum. Detection is based on the test of two hypotheses:

$$\begin{aligned} H_0 : y(p) &= z(p) \\ H_1 : y(p) &= x(p) + z(p) \end{aligned} \quad (1)$$

In hypothesis  $H_0$ , the signal is not present and the received signal  $y(p)$  is formed only by  $z(p)$  noise samples. In hypothesis  $H_1$ , the signal of interest  $x(p)$  is present together with the noise.

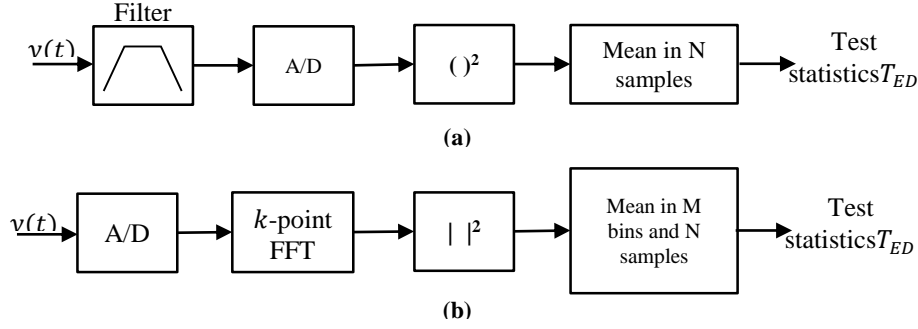


Figure 1: Energy detector implementation diagrams (a) in time and (b) in frequency

The energy detector can be implemented in two main ways, exemplified in Figure 1. In the first form, Figure 1(a), a filter is used to select the band of interest. The filter must be centered on the frequency of interest,  $f_c$ , and preferably, have a bandwidth equal to the channel of interest. In the case of spectrum sensing in a wide range of frequencies, for a better estimate of the occupation of the selected band, it is interesting that the sweep filter has a narrow band. Another possible hypothesis is the existence of a narrowband filter bank. After the input filter, the signal passes through an analog-digital converter and a quadratic elevation device and only then the  $T_{ED}$  test statistic is calculated.

$$T_{ED} = \frac{1}{L} \sum_{n=1}^L |y(p)|^2 \quad (2)$$

The second proposed architecture, shown in Figure 1 (b), proposes the processing of samples at frequency. In this architecture, there is the flexibility to process larger bands and multiple signals simultaneously, as the selection filter is replaced by the processing of the corresponding frequency ranges of the FFT, Fast Fourier Transform. Choose a fixed FFT size and the number of samples,  $N$ , becomes a parameter for improving the detection.

In both forms of implementation, the  $T_{ED}$  test statistic is compared with a threshold  $\lambda_{ED}$  to choose between the two hypotheses. As the detection threshold depends on the signal to noise ratio of the received signal, the technique's detection capability is impaired in scenarios where the noise is not stationary and varies rapidly.

In equation (2),  $T_{ED}$  is the summation of energy of  $y(p)$  over  $L$  samples via energy detection statistics. Probability of detection  $P_d$  is used is defined as follows:

$$P_d = P_r\{T_{ED} > \gamma | H_1\} \quad (3)$$

Probability of false alarm  $P_{fa}$  is used is defined as follows:

$$P_{fa} = P_r\{T_{ED} > \gamma | H_0\} \quad (4)$$

The chi-square distribution is the output of the integrator in MAP detection.

$$T \sim \begin{cases} N(n \sigma_n^2, 2 n \sigma_n^4) \\ N(L (\sigma_n^2 + \sigma_s^2), 2 n (\sigma_n^2 + \sigma_s^2)^2) \end{cases} \quad (5)$$

Where  $L$  is the number of samples, variance of noise is  $\sigma_n^2$ , the is the variance of received signal is  $\sigma_s^2$ , As from the equation (18),  $(\sigma_n^2 + \sigma_s^2)$ , is the total variance of signal plus noise as  $\sigma_t^2$  therefore,

$$\sigma_t^2 = \sigma_n^2 + \sigma_s^2 = \sigma_n^2 (1 + SNR) \quad (6)$$

The Nyquist sampling theorem states that the minimum sample rate should be  $2W$ , therefore  $L$  can be written as  $2 TsW$ , where  $Ts$  is the observation time and  $W$  is the bandwidth. The likelihood of false alarm can be stated using the  $Q$  function as follows:

$$P_{fa}(W, Ts) = Q\left(\frac{\gamma - 2 Ts W \sigma_n^2}{\sqrt{4 Ts W \sigma_n^4}}\right) \quad (7)$$

The threshold value  $\gamma$  is controlled based on the noise variance (noise power). We can first set the false alarm probability  $P_{fa}$  be a specific constant and  $P_f$  should be kept small to avoid underutilization of transmission opportunities, from equation (20), threshold value  $\gamma$  can be obtained.

$$\gamma = \sqrt{4 Ts W \sigma_n^4} Q^{-1}(P_f) + 2 Ts W \sigma_n^2 \quad (8)$$

$$Q(x) = \frac{1}{\sqrt{2\pi}} \int_x^\infty e^{-\frac{t^2}{2}} dt \quad (9)$$

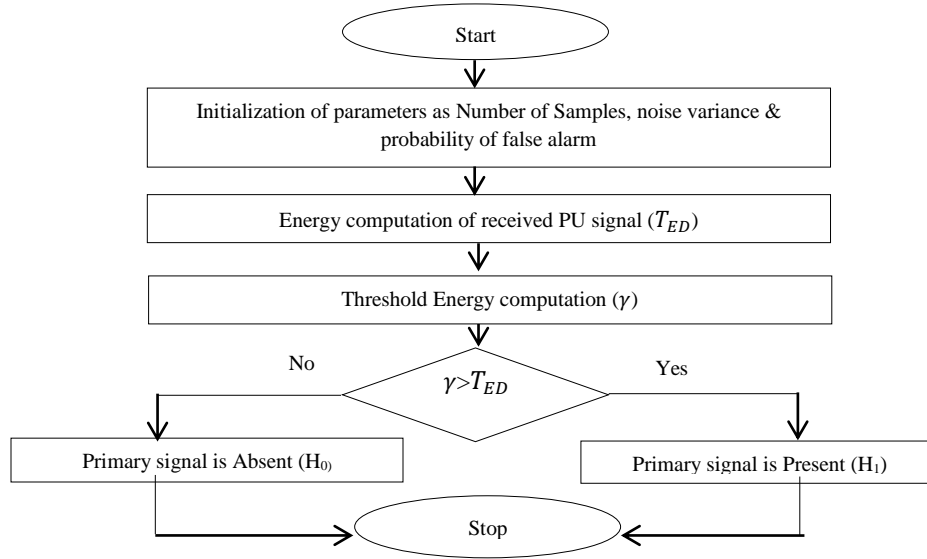


Figure 2: Flow chart of Energy Detector

### 3.3 Whale Optimization Algorithm (WOA):

WOA is a population-based algorithm. Exploitation and exploration stages are balanced, it is considered a global optimizer. Furthermore, "B" associated with the search vector, exploration and exploitation: as the operator ( $|B| \geq 1$ ) or phase ( $|B| < 1$ ). [21] [22].

#### 3.3.1 Surround or Trap Prey:

The behavior represented mathematically as below:

$$\vec{E} = |\vec{D} \cdot \vec{X}_p(x) - \vec{X}_w(x)| \quad (10)$$

$$\vec{X}_w(x+1) = |\vec{X}_p - \vec{B} \cdot \vec{D}| \quad (11)$$

Where  $X$  indicates the current iteration,  $D \rightarrow$  and  $B \rightarrow$  which are the coefficient vectors,  $X \rightarrow_{prey}$  is the prey location vector and  $X \rightarrow_{whales}$  denotes the location vector of a humpback whale. The vectors  $D \rightarrow$  and  $B \rightarrow$  are calculated as follows:

$$\begin{cases} \vec{B} = 2b \cdot \vec{t} - \vec{b} \\ \vec{D} = 2 \cdot \vec{t} \end{cases} \quad (12)$$

Where  $b$  varies between 0 and 2 and  $\vec{t}$  varies between 0 and 1.

#### 3.3.2 Bubble Net Attack Strategy:

This behavior's mathematical model of Humpback whales swim is given below,

$$\vec{X}(x+1) = \begin{cases} \vec{X}^*(x) - \vec{B} \cdot \vec{E} & \text{if } s < 0.5 \\ \vec{E}' \cdot e^{bl} \cdot \cos(2\pi l) + \vec{X}^*(x) & \text{if } s \geq 0.5 \end{cases} \quad (13)$$

Where  $s$  is a randomly generated value in a range of [0,1].

#### 3.3.3 Search for Prey (Exploration Phase):

The technique depend on the variation of the value  $A$  is employed in this stage. The whales, of course, wander about the search space at random, dependent on the positions of the other whales in the group.

Furthermore, the vector  $A$  is linked to the search vector's random value, which moves between [-1, 1] to drive the candidate agent to move away from a reference whale. As a result, the placements of search agents are updated depending on a previously established agent at random. Mathematically it is as given below:

$$\vec{E}' = |\vec{D} - \vec{X}_{rA} - \vec{X}| \quad (14)$$

$$\vec{X}_w(x+1) = |\vec{X}_p - \vec{A} \cdot \vec{E}'| \quad (15)$$

Where  $\vec{X}_{rA}$  is a position vector



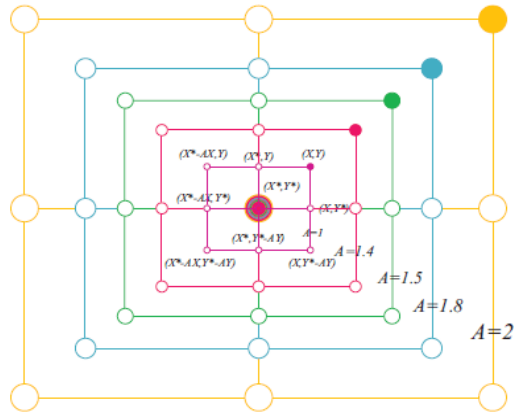


Figure 3:WOA Exploration [22]

#### 4. SIMULATION RESULTS:

Figure 4 shows SNR (dB) vs.  $P_d$  graph for single threshold based energy detection and comparative graph of SNR (dB) vs.  $P_d$  shows in figure 5

#### 5. DISCUSSION ABOUT RESULTS:

Figure 4 shows SNR (dB) vs.  $P_d$  graph for single threshold based energy detection. It can be observed that probability of detection increases as the SNR value increases.

Figure 5 shows comparative graph of SNR (dB) vs.  $P_d$  it seems that probability of detection raise as the SNR value raise. It is clear from Figure 5 that the value of  $P_d$  in optimized threshold simulation is higher at -10dB SNR level when compared with theoretical and single threshold simulation which proves the good performance of proposed method at higher SNR.

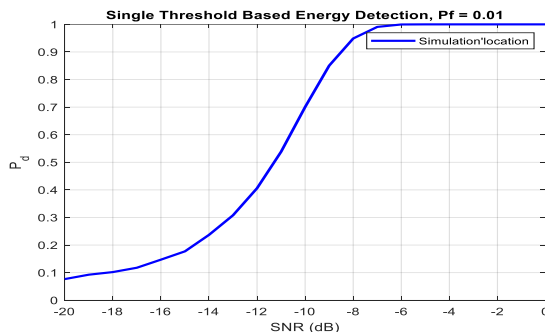


Figure 4: Graph of single threshold energy detection at  $P_f=0.01$

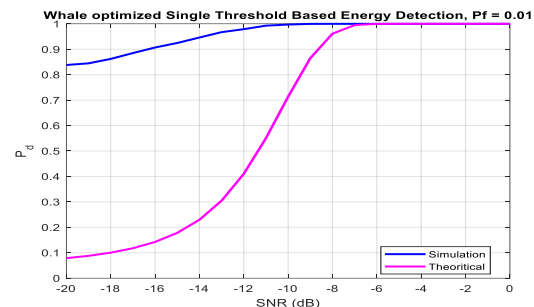


Figure 5: Graph of single threshold based energy detection using whale optimization at  $P_f=0.01$

#### 6. CONCLUSION:

A single threshold detection model based on Energy detection is implemented. It raises the detection probability over the signal-to-noise ratio. Simulation result shows that proposed system can increase the probability of detecting and investigating spectral gaps in areas with a low signal-to-noise ratio.

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# Cost Effective Approach to implement all Optical Logic Gates using Semiconductor Optical Amplifier

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**Abstract.** Optical computing is the future of high speed computational and networking devices, having a prodigious importance in enlarging extremely high speed optical networks. This paper focuses on investigation of various design schemes of SOA (Semiconductor Optical Amplifiers) based MZI AND, OR, XOR, NOT gates exploit the component performance on even very low powers and average high bit rate of 20Gbps, making a comparison of obtained results with latest reports. Conclusions are drawn on the basis of design that substituting couplers instead of modulators provide better results in terms of Q-factor, logical outputs, computational speed at the minor power levels.

**Keywords:** Optical networks, SOA, modulation, Cross gain, phase modulation, Wave mixing, Gates

## 1 Introduction

In order to achieve the edge of speed of electronic devices, high bandwidth is desired. Opto-electronic conversion is one of the complex processes in the digital gates [1]. For jam-full benefit of impending of optical fiber in the development of contemporary networks, all-optical gates are obligatory modules without any disadvantage of conversions full of losses which occur in electric domain. SOA used for the designing of gates related to optics. This is due to because SOA provides very high change in the refractive index which is required for the desired logic outputs along with high gain. With the usage of SOA, all-optical gates can be operated at wider bandwidth and undemanding photonic amalgamation is possible [2].

For designing of optical gates, a non-linear medium is required as it enables the modulation of the signal to get the desired output. The nonlinear loop mirror and fibers, acoustic wave filters, waveguide, thyristors, or semiconductor optical fiber generates the nonlinearity. The gain recovery time of SOA induces limitations to this approach having prodigious speed but it can be improved by using band pass filters after SOAs. Detuning of these filters reduces the distortions occurring due to pattern effects. [3]. In literature, number of methods have been used to realize different logic and mathematical operations using nonlinear processes such as cross gain and phase modulation and four wave mixing in SOA using Mach-Zehnder interferometer configuration [4].

The SOAs have various applications apart from generating logic operations like amplification using stimulated emission and wavelength conversions. Using SOA in Interferometry configuration has shown better results till now but sometimes the delay produced in one of the arms is of longer duration that the correct logic is not received at the instance of time. Reportedly configuration used modulators but here i.e. in the current setup couplers are used instead of them.

## 2 System Setup

Non linearity effect with or without SOA is used in every optical door. Various methods without SOA uses parameters like length, waveguide with attenuator and circulators structures, channels with acoustic optic waves, and changes in refractive index etc.

The information streams A with 1550nm frequency and B with frequencies of 1550.5nm separately are applied through consistent wave (CW) laser sources having 0.8 mW of intensity. The test signal at a 1540 nm frequency is created from another CW laser source. Non straight activities happen in voyaging wave SOA which is one-sided at 600 mA with a line width improvement factor of 5.

The consolidated information stream alongside test signal makes the non-direct medium in SOA. Depending upon the structure of framework arrangement non straight procedure happen inside SOA, which is additionally, trailed by an optical channel whose data transmission and frequency is balanced by the necessary door activity. Various SOA boundaries that are balanced for impeccable SOA execution are appeared in Table-1:

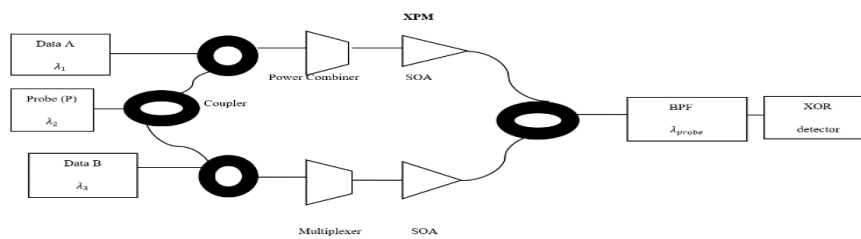
The various ways of generating logic outputs have been reported out of which recently reported is realization of logic gates using components like modulators, SOA etc. The configurations of these gates were simpler than earlier reported gates and quality factor outputs at different parameters have been given.

Parameter	Value
Bias Current	0.6 amp
Length	0.0005m
Width	3x10-06 m
Height	8x10-08 m
Optical Confinement value	0.35
Line width factor	5
Transparency Carrier Density	1.4x10 <sup>24</sup> m <sup>-3</sup>
Initial Carrier Density	3x10 <sup>24</sup> m <sup>-3</sup>
Gain	2.75x10 <sup>-20</sup> m <sup>2</sup>

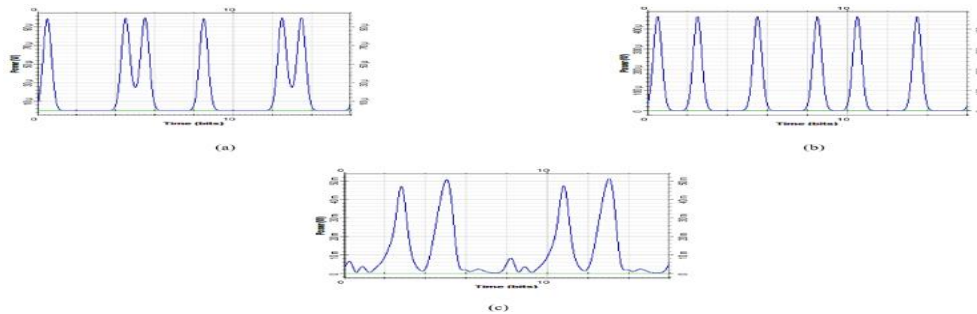
**Table 1.** SOA Parameters

### 2.1 XOR Gate

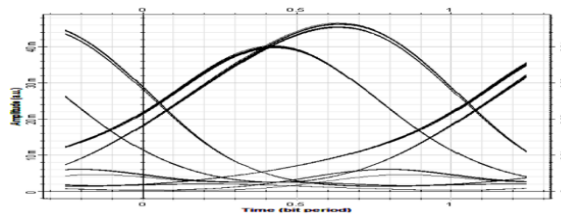
Data signals having comparative or various frequencies are sent through the port 1 and 2 of independent MZI. A ceaseless wave for example the test signal is coupled to port number 3 as the control signal which further parts into halves, one arriving at the upper part and other at the lower branch of interferometer [5]. The presentation of the information signal prompts the regulation of increase and refractive list, causing the stage move over the control signals spreading through the SOAs. These stage shifts happens regarding the force variety of the information signals A and B. The square graph, waveforms and particular eye outline are appeared in Figure. 1, 2 and 3.



**Fig.1.** SOA-MZI coupler based XOR logic detection.



**Fig.2.** Input signals (a) data A (b) data B and (c) XOR output

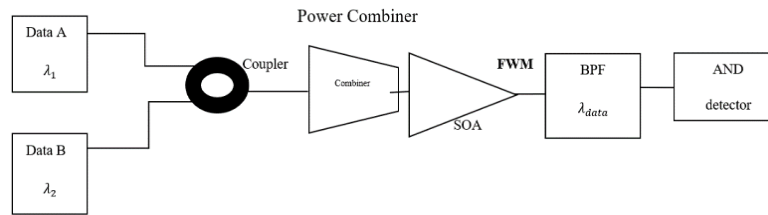


**Fig.3.** Eye diagram (Q-factor of 36.3) of XOR output

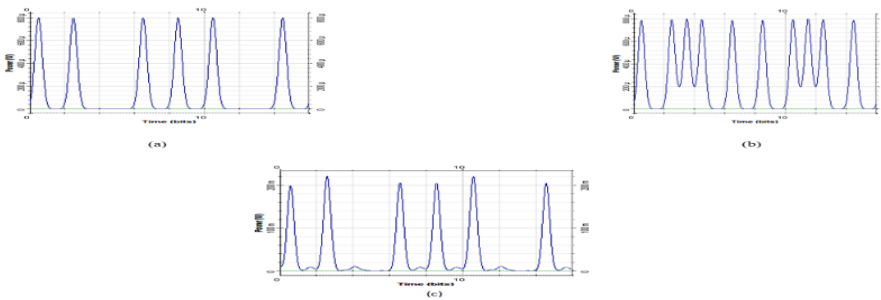
### 2.2 AND Gate

For the AND entryway, the information signal, data B enters the gadget at port 1 and 3 with port 2 having test signal is grounded. No extra control signal required as for this situation both signals go about as test signal for one another. With the nearness of both the information streams, the FWM happens inside the SOA and novel frequencies are delivered [6]. It must be noticed that FWM relies upon different boundaries, for example, frequency detachment between input signals, input power levels and SOAs boundaries. Utilizing the band pass

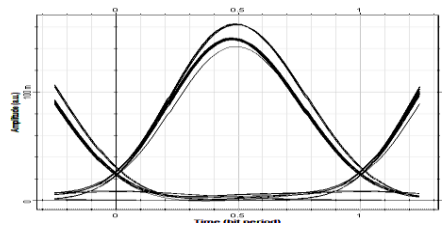
channel after SOA at suitable frequency and data transfer capacity, the AND activity is accomplished. The square graph, waveforms and separate eye chart are appeared in Figure. 4, 5 and 6.



**Fig.4.** SOA-FWM coupler based AND logic detection



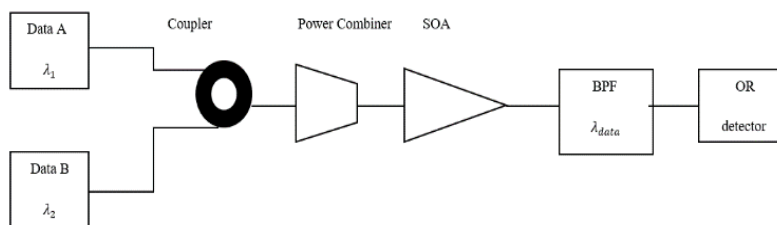
**Fig.5.** Optical waveform of input waveforms (a) data A (b) data B (c) XOR output



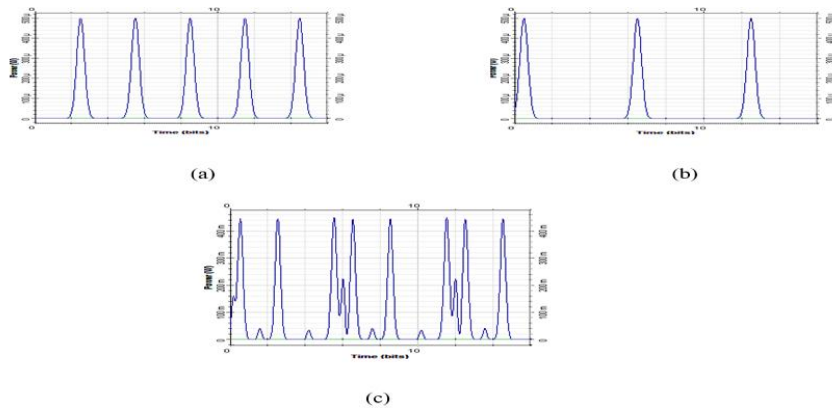
**Fig.6.** Eye diagram of AND output with Q-factor of 105.12

### 2.3 OR Gate

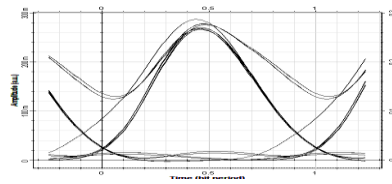
For OR gate, no MZI design is required, both the information signals are joined at a similar port [7]. As a result of the XGM and XPM nonlinear procedures, the falling edge of the sign is additionally moved towards a more drawn out frequency and the rising edge is moved towards a shorter frequency, therefore range is enlarged. With this, we accomplish the OR door activity. The square graph, waveforms and particular eye chart are appeared in Figure 7, 8 and 9.



**Fig.7.** SOA-MZI coupler based OR logic detection



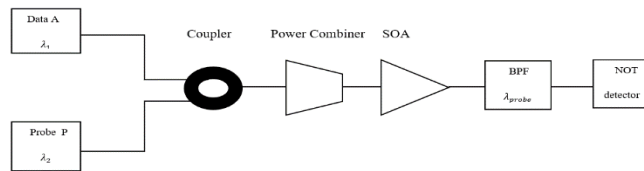
**Fig.8.** Optical waveform of input signals (a) data A (b) data B (c) OR output



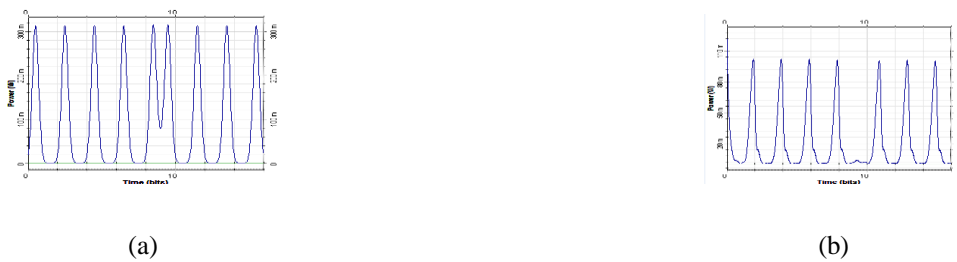
**Fig.9.** Eye diagram (Q-factor of 30.56) of OR output

## 2.4 NOT Gate

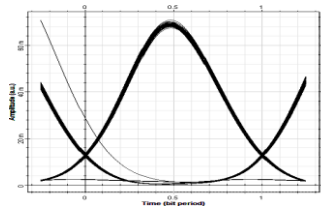
For the NOT Gate, one of the two (A or B) is shot with test signal to SOA [8,9]. The adjusting boundary when consolidates with the test signal, brings about the altered extremity of test and NOT rationale is accomplished. 10GHz transfer speed is adequate for the NOT activity. The square graph, waveforms and separate eye chart are appeared in Figure 10, 11 and 12.



**Fig.10.** SOA-MZI coupler based NOT logic detection



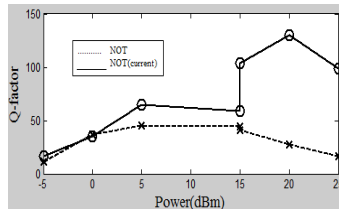
**Fig.11.** Optical waveform of input signals: (a) data A (b) NOT output



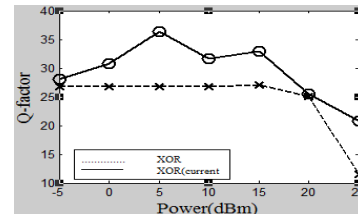
**Fig.12.** Eye diagram with Q-factor of 56.80 of NOT gate output

### 3 Results with Discussions

SOA shows highly nonlinear qualities for various logic input. Utilizing XGM in SOA Optical OR and NOT gates are acknowledged while the XOR doors are executed utilizing FWM and SOA-MZI nonlinear procedures. The plot of intensity versus nature of NOT gate shows the impromptu creation in Q-factor as appeared in Figure 13.



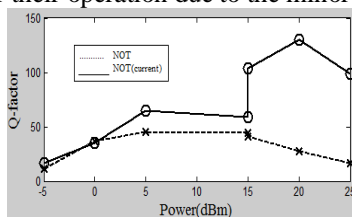
**Fig.13.** Power Vs Q-factor for NOT gate



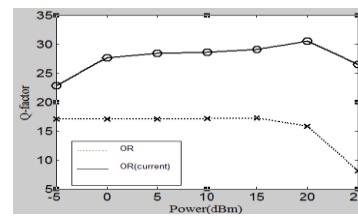
**Fig.14.** Plot for improved quality factor for XOR gate

The new pulse generated is phase conjugate imitation of the probe pulses, and can be extracted using an optical filter of 20GHz bandwidth.

FWM nonlinear procedure empowers the system to acknowledge AND logic. An ideal AND gate required speed of 60GHz for their operation due to the minor competence of FWM.

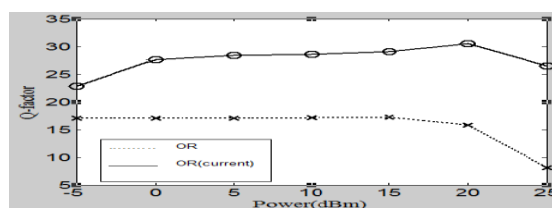


**Fig.15.** Plot of improved quality factor of AND gate for different values of power



**Fig.16.** Plot of improved quality factor of OR gate for different values of power

The combination of data stream when introduced in the SOA modulates the carrier, further leading to the modification in gain and phase of the probe signal causing XGM and XPM. The plotting clearly indicates the marginal difference of Q-factors by using couplers instead of modulators as shown in Figure 16.



**Fig.16.** Plot of improved quality factor of OR gate for different values of power

**Table 2.** Quality factor for different input power

Input power (dBm)	Quality factor			
	OR	AND	NOT	XOR
-5	22.83	8.89	16.23	28.02
0	27.69	18.94	35.17	30.80
5	28.39	18.84	65.08	36.35
10	28.57	105.12	59.26	31.67
15	29.12	20.53	103.52	32.92
20	30.56	28.72	130.04	25.43
25	26.53	28.17	98.61	20.77

From the table shown above it is evident that high quality factors are achievable with low power consumption using couplers instead of modulators. Making use of coupler which is less expensive comparative to modulator decreases the manufacturing cost of the setup, thus, making it a less expensive, power efficient and good quality setup.

#### 4 Conclusion

In this work optical gates have been designed using SOA. Performance is evaluated on the basis of quality factors and observed that using couplers in the same configuration instead of modulators can give higher operational speeds along with the high quality factor and received power. System has become more power efficient and inexpensive as use of expensive and bulkier components like HNLF and modulators have been eliminated. In future, this system can be used to high quality and power efficient sequential circuits like comparators, encoders etc.

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#### Biography



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# Low-Profile MIMO Antenna For 5G Midbands

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## Abstract.

The multiple input and multiple output approach are the most common and vital technique used in current wireless communication, and it is the only technique that can match the demands of modern fifth generation wireless communication. By using the MIMO approach, the throughput of the microstrip patch antenna may be increased, resulting in higher data rates in transmission. It contains numerous inputs and outputs, as the name implies, and its most important job is to create extremely high throughput even in high signal traffic zones. To achieve the high throughput, the signal traffic patch is ignored and the data is transmitted in a bypassed way. The most essential technology used in the proposed UWB-DGS-MSPA is slotted ground, which is also known as "Defected Ground Structure" in technical terms (DGS). Slotted ground is used to increase antenna performance by intentionally inserting slots in the ground plane to improve return loss, bandwidth, and radiation properties of the microstrip antenna.

**Keywords— Multi Input Multi Output, Random Capacitive Ground Slots, Ultra Wide Band, Radio Frequency**

## 1. INTRODUCTION

Traditionally, wireless setups have been designed for a specific purpose. Antennas in these configurations take into account static restrictions such as gain, frequency of repetition mob, radiation configuration, divergence, and so on. Reconfigurable antennas have recently attracted a lot of interest for a variety of applications, including cellular wireless communication, finding systems, digital television message, hovering machines, and robots in flying automobile locater and well-designed projectile protection [1].

### 1.1 Reconfigurable Antenna

If the radio antenna change produces the best results, the receiving antenna should be changed or rebuilt to observe the new results. Using precisely portable parts diodes, tunable constituents, or vibrant resources, reconfigurable wireless antenna vary their presenting features by modifying the current stream on a receiving antenna. A solitary receiving antenna or a cluster of reconfigurable radio antennas can be used [2]. Reconfigurable reception antennas are useful in a variety of applications (e.g., 3G, Bluetooth, WLAN, WiMAX) to enable a variety of principles (e.g., 3G, Bluetooth, WLAN, WiMAX) overcome solid impedance signals and adapt to changing environmental conditions. However, in radar applications, multifunctional activity frequently necessitates reconfigurability at the receiving antenna level.

### 1.2 Design Ideas for Reconfigurable Antennas

The following are the three basic design techniques for achieving antenna frequency suppleness:

- (1) Microelectronic controls, automatic actuators, and tunable tools for reconfigurability in footings of circuit features, emission stuffs are added into antennas.
- (2) Tunable filters and ultra wide band (UWB) or multiband antennas
- (3) Multiband/reconfigurable systems in which the same aperture is employed for several operative modes [1].

RF engineers must consider three perplexing requirements while designing reconfigurable antennas.

- 1) Which reconfigurable properties (such as occurrence, emission configuration, or polarity) must be altered?
- 2) In what way the antenna's many searing essentials rearranged to attain the compulsory stuff?
- 3) What type of design decreases the antenna radiation/impedance individualities' unwanted properties?

MIMO is essentially a radio antenna technique since it employs multiple antennas at the transmitter and receiver to provide a number of signal routes to transfer data, selecting different paths for each antenna to allow for numerous signal paths to be used. These additional routes can be leveraged to their advantage by employing MIMO.

## 2. RELATED WORK

Since the recommendations use three risk groups to sort out differences in screening routines, it may be wondering how to fit **Christos G. Christodoulou, et al. [1]** in today's telecom frameworks, reconfigurable reception antennas with the ability to send several examples at varied frequencies and polarizations are critical. Within a bound volume, the requirements for increased utility (e.g., bearing discovering, pillar controlling, radar, control, and order) impose a greater emphasis on current communication and receiving frameworks. This problem can be solved by using reconfigurable receiving antennas. The various reconfigurable pieces that can be used in a radio antenna to modify its design and capacity are discussed in this study. These methods of reconfiguration are based on a combination of radio-frequency miniature electromechanical frameworks (RF-MEMS), PIN diodes, varactors, and photoconductive components, or on a physical change of the receiving antenna radiating structure, or on the use of sharp materials such as ferrites and fluid gems. Different actuation instruments are offered and analyzed that can be used in each unusual reconfigurable execution to get optimum execution. There are a few examples of reconfigurable reception antennas for both terrestrial and space applications, such as cognitive radio, multiple information various yield (MIMO) frameworks, and satellite correspondence. **N. Ramli et al. [2]** the recurrent reconfigurable receiving antenna can be used in both LTE (2.6 GHz) and WiMAX (3.5 GHz) applications. This radio antenna is known as a Frequency Reconfigurable Stacked Patch Micro-strip Antenna because it is designed with a combination of an opening coupled as the handling method and stacked fix innovation (FRSPMA). It consists of three substrate layers, each of which is planned using RT-Rogers 5880 with a thickness of 0.787 mm. To improve the addition exhibitions and reduce the deceptive impacts from the taking care of line, a 3 mm thick air hole is placed between the ground and the base fix substrate. **A. Anusuya et al. [3]** Due to rapid advancements in remote correspondence technology, the use of small receiving antennas has exploded. The size of the receiving wire, as well as its cost, execution, and ease of installation, has all been taken into account when planning the radio wire. A small strip receiving antenna is presented to suit all of the requirements. Miniature strip radio wires are now used in a variety of applications, including aero planes, spacecraft, satellites, and rockets. In this work, we discuss miniature strip reception wire, different types of miniature strip radio wire, different substrates used in radio antenna planning, and our writing assessment. **Muhammad Abid, et al. [4]** the radio recurrence range has gotten scarce due to rapid development and the detonating prevalence of distant innovations. Another innovation that uses dynamic range access tactics to improve range usage and proficiency is intellectual radio. Another reception antenna plan for psychological radio remote correspondence frameworks is presented in this research. The radio antenna is etched on FR4 substrate and can operate in the 3.0GHz to 14GHz spectrum with a standard of S11-10dB, allowing for a 129 percent useable division data transmission range. A half circular radiator with two rectangular apertures and a ground plane on the opposite side of the substrate make up the receiving wire. The suggested receiving wire includes psychological radio detecting capabilities, which identifies the underutilized range in its operating band of 3.0GHz to 14GHz. The Omni directional radiation design of Plan radio wire is suitable for channel detection. **Asmita M. Sonwalkar et al. [5]** Multi-band Antenna with Reconfigurable Antenna is an option. To achieve multi-band and wideband radio antenna activity, many approaches are applied. Reconfigure Antenna allows you to quickly switch between multiple receiving antenna boundaries. In areas such as letters, it has attracted a lot of attention. The working frequency, polarizations, and radiation design of a radio antenna can all be adjusted using reconfigurable technologies. Reconfigurable radio antennas could make versatile correspondence more useful. The ability to reconfigure radio antennas allows us to redistribute range in multi-band communication frameworks, reducing the quantity and size of receiving antennas. The purpose of reconfigure radio antennas is to assist multiband and wideband distant applications in a variety of recurrence groups. This paper discusses different types of reconfigurable radio antennas and how they work, such as Frequency Reconfigurable Antennas, Radiation Pattern Reconfigurable Antennas, Polarization Reconfigurable Antennas, and Radiation and Frequency Reconfigurable Antennas. **Harender Pal Singh et al. [6]** the exhibition of Microstrip fix radio antenna with and without the Meta material design was discussed and examined. The return loss of a standard fix radio antenna designed for complete recurrence at 2.4 GHz was compared to the return loss of a similar fix receiving antenna with a further layered Meta material design. **Veerendra Singh Jadaun et al. [7]** the receiving antenna's Microstrip line has been exhibited, planned, and replicated. Also, the planning was done in IE3D programming, which is an EM solver that deviates from the Method of Moments guideline. **Ranjan Mishra et al. [8]** the plan of a rectangular and square-shaped Microstrip radio antenna is examined. The suggested Microstrip radio antenna has a wide transfer frequency of 500 MHz and a low

yield loss of - 24 db. **Sathishkumar N et al. [9]** Plan a Microstrip radio antenna with a good radiation design that reduces main complexity and, as a result, the receiving antenna size. The presentation boundaries of the radio antennas, such as S-boundary, Gain, VSWR, and directivity, are obtained and broken down using ANSYS HFSS programming. **Mandar P. Joshi et al. [10]** For the Indian Regional Navigation Satellite System, a circularly polarized Microstrip antenna is proposed. To recognize circular polarisation, an oval cross designed turn traitor ground structure is mounted on the ground plane. **W. Hunag et al. [11]** a polarizations that is circular In the frequency range of 4.35 GHz to 4.84 GHz, a Microstrip antenna with a condensed square patch is in use.

### 3. PROPOSED WORK AND IMPEMENTATION

In this two-port network, the two feeding lines are perpendicular to each other with single radiating resonance and also the introduction of slot on the ground is used to achieve better isolation and mutual element coupling between two-ports. Hence, the proposed antenna acts like a MIMO antenna. It's also utilized to attenuate higher mode harmonics and for element mutual coupling. Moreover, the integration of slots on ground will optimized the performance to 27% more than the reported antenna.

The DGS influences the surface current density, which might result in better or worse results. The antenna's design introduces resistance into the circuit, restricting its size but enhancing its bandwidth. This study discusses 5G mid-band applications by resonating the suggested structure at Sub-6 GHz, Sub-7 GHz/Vo5G, Wifi6, and 5GV2x-c. It is quite difficult to cover as many bands in a single miniaturised patch antenna without optimization. This intended result is obtained by the use of a combination of two optimization strategies (i.e., slotting techniques techniques)

In the early phases of fifth generation wireless communications, mmwaves over 24 GHz are the most dominant frequency band. The frequency range between 1 GHz and 7 GHz is now the most significant frequency band for 5G wireless communications, and this frequency band is termed the 5G mid-band applications. Because of their wide penetration range and long distance coverage, 5G midband frequencies may easily reach high data rates and throughput values in wireless data transmission. So, the suggested antenna's miniaturization is done by dividing the wavelength ( $\lambda$ ) by four, which achieves miniaturization in the communication process alone. That is why we picked a small miniaturized method in this case. Change the half wavelength to a quarter wavelengths and proceed as before, according to the transmission line formula. A circular slot is proposed in the radius of the directed wavelength quarter value. The circular slots that have been introduced are arranged in a sequence. The identical two port feeds are each angled at 90 degrees to process equivalent distribution process principles. The calculated values tabulated as below table 3.1.

**Table 3.1: Dimensions of RCGS-MIMO**

Description	Dimensions (mm)
a * b	10 * 10
c * d & e * f	0.7 * 4.8
g * h	16.62 * 16.62
i,j & p	1.41
K	1.5
l, m, n & q	1
O	2.23

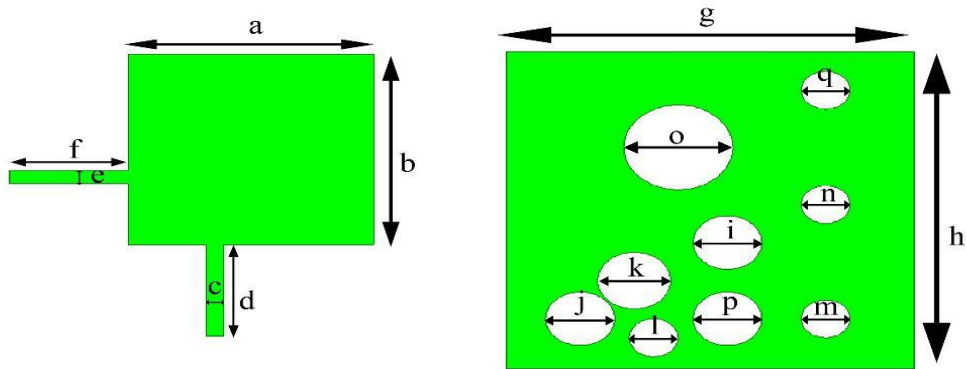


Figure 3.1: Structure of Simulated Two-Port RCGS-MIMO Antenna

Figure 3.1 shows the structure of Simulated Two-Port RCGS-MIMO Antenna

#### 4. RESULTS

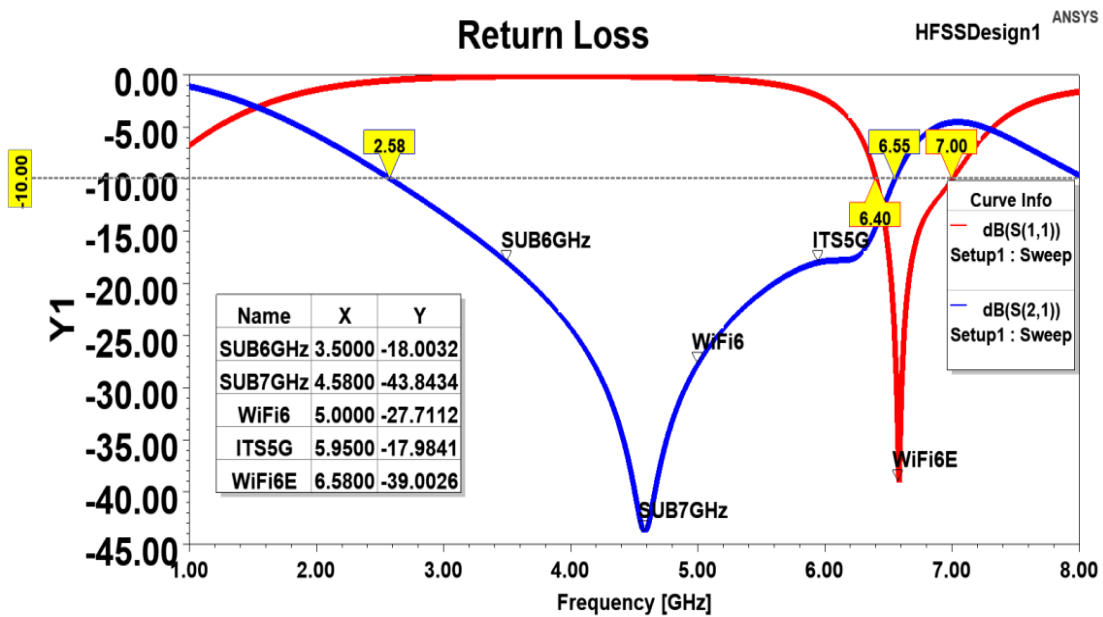


Figure 4.1: Return Loss of Two-Port RCGS-MIMO Antenna

Figure 4.1 depicts the predicted return loss vs. frequency plot of the 5G midband antenna. Because the proposed antenna has two identical ports, we must validate the matrix results analysis. S11, S12, S22, and S21 are four sets of findings for the proposed antenna.

The most important parameters to consider when calculating an antenna's efficiency are gain and directivity. Figures 4.2 and 4.3 depict the proposed antenna gain and directivity.

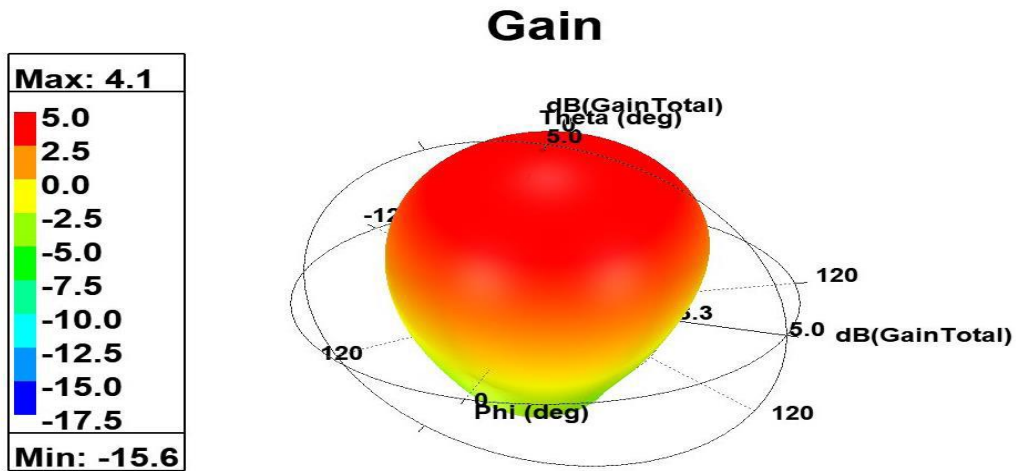


Figure 4.2: Gain of Two-Port RCGS-MIMO Antenna

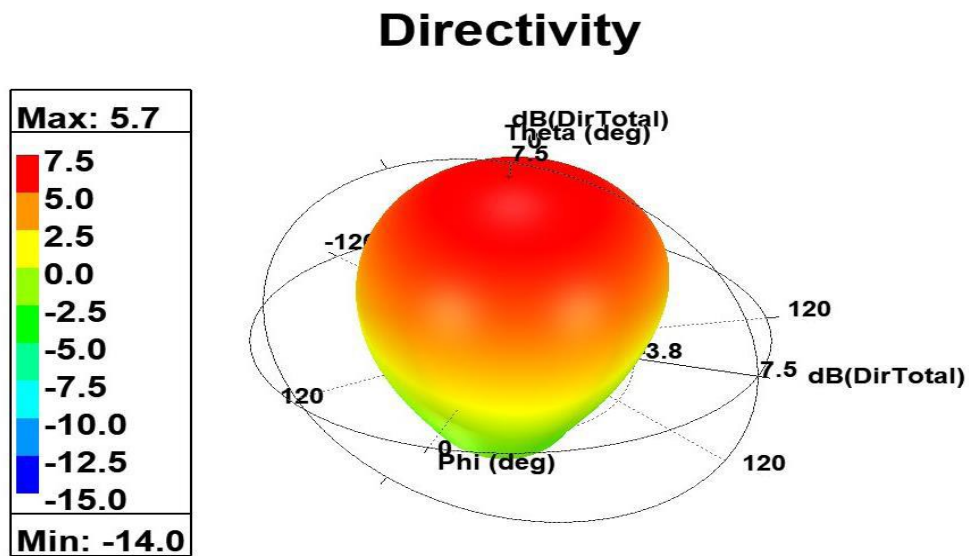


Figure 4.3: Directivity of Two-Port RCGS-MIMO Antenna

The red region of the 3D gain figure 4.2 shows that the maximum overall gain of the RCGS-MIMO antenna geometry measured is 4.1 dB with whole 4G and 5G midband applications and directivity is 5.7 dB.

The suggested RCGS-MIMO's efficiency may be calculated using equation 4.1

$$\text{Efficiency} = \text{Gain}/\text{Directivity} \tag{4.1}$$

Hence the radiation efficiency is 72 percent based on the simulated gain and directivity.

## 5. CONCLUSION AND FUTURE SCOPE

Design of compact size 2 port RCGS-MIMO antenna has a high gain profile at below 7GHz with a pinnacle gain of 4.1dB. For two-port implementations, the execution of the suggested antenna is further studied by finding the Return Loss, Gain and Directivity. The simulated results indicate that the suggested two-port antenna is a promising candidate for the entire 5G Mid-band applications. The quality of service of communications can be increased by increasing the number of elements for the proposed two-port antenna system; it is the easily extendable system.

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## Biographies



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Dr. Bhawna Tandon received her BTech in Electronics and Instrumentation in 2001, ME in Instrumentation and Control in 2009 and PhD in Control System from Kurukshetra University, Kurukshetra, Panjab University, Chandigarh and PEC (Deemed to be University) Chandigarh respectively. She is having teaching experience of 21 Years and currently working as a Professor at Chandigarh Engineering College, Landran, Mohali. She is having more than 30 research publications in reputed International journals. Her current research interests include robust control, non-linear control and optimisation techniques.

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# Smart Baby Monitoring Cradle Using IOT

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## Abstract.

In a current digital age, the majority of women are in charge of newborn care, which is difficult and causes concern about the baby's safety, health, comfort, and other factors. Smart devices are capable of sensing their surroundings and transmitting that data to a higher level. Because of the current era of digitalization, data and computer skills are now widely available and those technologies connects the working mother and child. This study suggested super-smart cradle gadget would send a message to the parent. While the parents are not present, the cradle is live streamed through a webcam using Alfred camera software. If there's too much movement detected, the PIR motion sensor alerts the parents. The humidity sensor determines whether or not the baby has urinated. It will notify the parents if it detects any type of dampness. The sound sensor detects whether the infant is crying or making other noises, while the temperature sensor measures the child's body temperature. If any of the sensors mentioned above detects an abnormality, an alarm is sent to the parents or other people caring for the baby. Twilio will keep the user informed of all actions. The information presented is saved on the ThingSpeak server webpage and application. This strategy employs a cloud service for remote child monitoring. Our Smart Cradle System has been professionally demonstrated to be the least harmful to newborns. As a result, the IoT-based Super Smart Cradle system real-time monitoring is used to monitor the child using the cradle.

**Keywords.** *Internet of Things, Alfred Camera Software, Twilio, ThingSpeak Server & Application, Cloud.*

## 1. INTRODUCTION

Industrialization has resulted number of women increases now a days. As a result, many female professionals are often required to work away from home. As a result, these mothers are now unable to care for a newborn. Mother is constantly concerned about the infant's well-being. India and other industrialising countries, parents must work while also providing for their children, putting an additional burden on both parents. These families will benefit greatly from the development of a system that allows parents to keep track of

their children when they are ill or simply going about their everyday lives, as they will be able to focus more on their work difficulties and less on the baby. All the unusual activity tracked instantly, an alert about the situation will also be sent out, and it to be addressed quickly. A baby frequently cries when they are thirsty, ill, awakened from nap, or want their diaper changed.

In our proposed prototype, we provide a cradle with intelligence to monitor the aforementioned acts, identify the cause, and alert the parents. The Internet of Things (IoT) is a network of interconnected things that can collect and communicate data over a wireless network without human interference. Because of this technology, devices can now communicate sensor data over the Internet without requiring human intervention. Using this proposed technology, parents would be informed of the infant's condition within the cradle, allowing them to relax and worry less about the child's welfare while they are away. Another advantage is the ability of sensors to detect suspicious behavior and send alert signals in such cases.

A smart cradle based on Arduino UNO and GSM was developed for baby monitoring [1]. An Internet of Things (IoT)-based smart programmed monitoring of infants based on parameters such as temperature, pulse rate, and gas molecules, as well as recording the baby's movement and position [2]. A video output-based baby intensive care system based on a Raspberry Pi B+ module and a pi camera has been proposed [3]. Using an Arduino UNO, a microcontroller, and a GSM module, an automated cradle system will send an alarm message to the parent's mobile phone [4]. A smart infant cradle that allows working mothers to keep an eye on their children was proposed [5]. A Smart Baby Cradle prototype, an IoT-based Cradle Management System, was created in 2018. The cradle will be able to communicate with a smartphone using this system [6]. An IoT-based Smart Cradle System Baby Monitoring Android App with video monitoring includes an automated rotating toy for the infant's entertainment, which minimizes the possibility of a baby crying [7].

The majority of existing baby monitoring systems use a swinging cradle with a sound sensor to detect crying. To help with ventilation, a small fan is attached to the cradle. The fan turn on automatically when the temperature reached 28 °C or higher. To provide real-time video monitoring, an Wi-Fi camera used on the cradle. The primary goal of the system is to drown out distracting noises for the baby by playing soothing music. The architecture of the existing methods is illustrated in Fig.1. The existing monitoring system does not utilize any optimization algorithms. Secondly the data storage is not utilizes the cloud platform.

## **2. METHODOLOGY**

Our idea is to create a super-intelligent cradle system that sends an alarm message to the parent. When the parents are not present, the cradle is monitored live via webcam using Alfred Camera software, and the PIR sensor detects motion and sends an alarm to the parents



if there is too much motion. The Humidity Sensor detects whether the newborn has peed and alerts the parents.

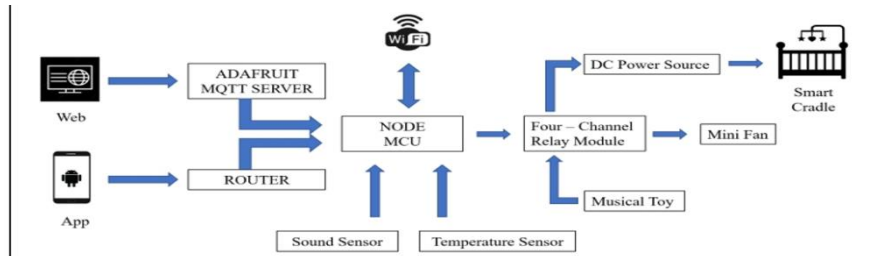


Fig. 1. Architecture of Node MCE based baby monitoring system

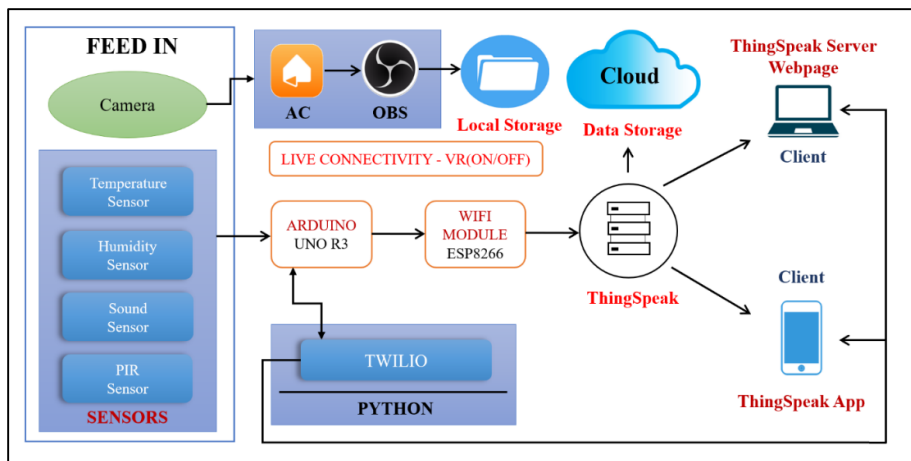


Fig.2 Architecture of the proposed system

To enable faster operation, we use the Arduino UNO R3. Twilio will keep the user informed about all operations. Twilio is a platform that is used thousands of businesses and million developers all over the world to create unique, personalized experiences for their customers. Everything displayed is saved in the ThingSpeak server's webpage and application, which functions as a cloud service. ThingSpeak is open-source software that helps users to connect with internet-enabled devices. ThingSpeak was originally launched in 2010 by ioBridge as a service to support IoT applications. The architecture of the proposed system is illustrated in Fig. 2. The major advantage of the projected system is that the Twilio is notified of any activity that occurs in the cradle. secondly it requires no additional hardware or software knowledge, nor does it require any human input to rock the cradle. Operation is made possible by RIS because it minimizes the antenna's contact with its substrate [6].

### 3. OUTPUT AND DISCUSSION

In our proposed system, the PIR motion sensor alerts the parents if there is too much movement detected. The humidity sensor determines whether the baby has urinated or not. If it detects any type of dampness, it will notify the parents. The sound sensor detects whether the infant is crying or making other noises, and the temperature sensor determines the child's body temperature. If any of the above-mentioned sensors detects an abnormality, an alarm is sent to the parents or other people responsible for the baby. Twilio will keep the user up to date on all actions. Fig. 3 depicts a sample notification message on a mobile screen. Fig. 4 depicts the live monitoring of a baby via mobile using an Alfred camera.



Fig.3. Sample message received on mobile through Twilio sandbox

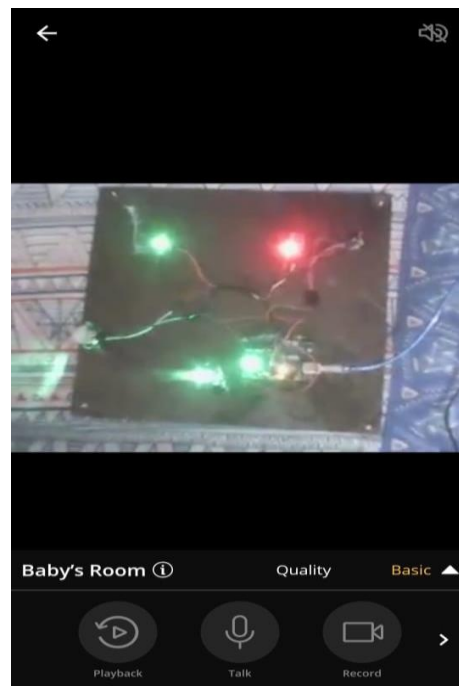


Fig. 4. live monitoring of a baby via mobile

#### Performance metric analysis

ThingSpeak is used to observe the temperature and humidity when the system is turned on, and the results are depicted below. When the system is turned on, the graph displays the temperature and humidity fluctuations over time. The results are precise because the values

are kept consistent with the date and time. The performance metrics of ThingSpeak is illustrated in Fig.5.

**a) Metrics of twilio**

Key performance metrics must be analyzed in order to understand the performance characteristics of your hardware devices and how they relate to the performance of your applications. The Twilio performance statistics are shown below. The total number of messages is displayed, and as of July 6th, there were approximately 105 messages, with 99 percent of them having the status "ok." The 1 percent unsuccessful status is caused by a network problem while Twilio is delivering the modified messages. Fig.6 represents the performance metrics of humidity and temperature using Twilio.

**b) Metrics of ThingSpeak**

The overall assembly of the proposed smart baby curdle system which included the sensors, camera and board is illustrated in the Fig.7.

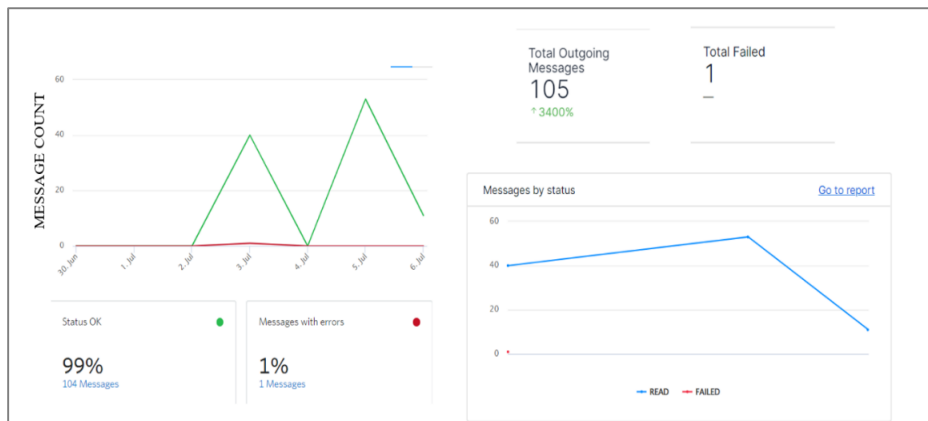


Fig. 5 Performance metrics of Twilio.

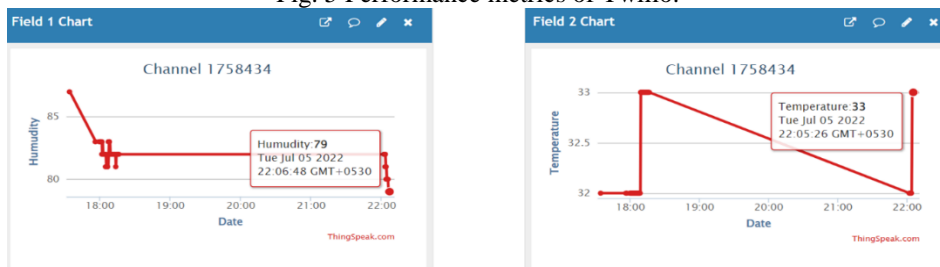


Fig. 6 performance metrics of ThingSpeak a) Humidity b) Temperature

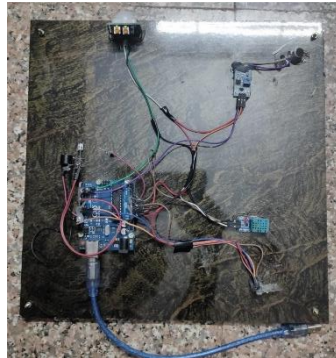


Fig. 7 overall assembly of the proposed smart baby cradle system

#### 4. SUMMARY

IoT applications are expected to bring about significant changes in the near future. We mitigated the risks of the Smart Baby Monitoring Cradle by connecting it to IoT devices. IoT and ThingSpeak can be used together until scalability issues are resolved. Data from multiple devices in an IoT network is stored in a centralized database, making it vulnerable to security breaches. The proposed architecture creates a Wi-Fi network to allow ThingSpeak to spread to all end users while also ensuring communication security. We present an architecture that uses the Arduino UNO Board to securely interact with ThingSpeak and Twilio. Clinical studies have shown that this Smart Cradle System is the least harmful to newborns.

Deep Learning technology can be used to detect pests in real-time while monitoring the child's cradle. In the future, machine learning and deep learning algorithms may be used to assess the baby's comfort based on facial expressions and crying patterns.

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### Biographies

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# Homotopy analysis method (HAM) for solving 3D Heat equations

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## ABSTRACT

In this research paper, we present a classical analytical method known as homotopy analysis method for solving three- dimensional heat equations arising in several applications of sciences and engineering. Some numerical experiments have been presented to illustrate the simplicity and accuracy of the presented technique.

**KEYWORDS:** Homotopy analysis method, Three- dimensional heat equations, Numerical examples.

## INTRODUCTION

Three- dimensional partial differential equation has several applications in different branches of sciences and engineering. Numerous numerical techniques have been developed for solving such equations like wavelets method, Adomian decomposition method, Homotopy perturbation method, Finite difference method and many more. In this research, a classical technique has been presented for solving three- dimensional heat equation. In literature, such technique has proven to be an efficient technique for solving various mathematical models. In [1], basic concept of homotopy analysis method has been discussed. To find the solutions of nonlinear problems, homotopy analysis method has been presented in [2]. A comparison study of homotopy analysis method and homotopy perturbation method has been explained in [3]. For the solutions of generalized second grade fluid, homotopy based technique has been discussed in [4]. Homotopy analysis method has been presented in [5] for the solutions of boundary layer flow towards stretching sheet. In [6], quadratic Riccati differential equation has been solved with the aid of homotopy analysis method. For the solutions of nonlinear equations produced during heat transfer, homotopy analysis method has been discussed in [7]. In [8], homotopy analysis method has been presented to find the solutions of generalized Hirota- Satsuma coupled with KdV equation. Analytical solutions of Laplace equation with two types of boundary conditions such as Dirichlet and Neumann boundary conditions have been presented in [9]. Analytical solutions of BBMB equations have been discussed with the aid of homotopy analysis method in [10]. Exact solutions of Emden-Fowler type equations have been discussed in [11] by using homotopy analysis method. In [12], homotopy analysis method has been presented to find the solutions of Cauchy reaction-diffusion problems arising in various applications of sciences and engineering.

In this study, we have discussed the classical technique, known as Homotopy analysis method (HAM), which has numerous applications in both science and engineering, for the analytical solutions of three-dimensional heat equations.

The most general form of three-dimensional heat equation is:

$$\eta_t = c^2(\eta_{xx} + \eta_{yy} + \eta_{zz}) - \rho\eta, \quad a < \{x, y, z\} < b, \quad t > 0 \quad (1)$$

with initial conditions

$$\eta(x, y, z, 0) = \alpha(x, y, z), \quad \eta_t(x, y, z, 0) = \beta(x, y, z)$$

where  $\alpha$  and  $\beta$  are functions of  $x, y$  and  $z$ .

## BASIC CONCEPTS OF HOMOTOPY ANALYSIS METHOD

Consider the differential equation

$$S\{\eta(\xi)\} = 0, \quad (2)$$

where  $S$  represents a nonlinear operator,  $\xi$  is an unknown variable and  $\eta(\xi)$  is the unknown function. For ease of understanding, disregard all initial and boundary conditions. The zero-order deformation equation as discussed in Liao (2003) is given by:

$$(1 - p)L[\eta(\xi; p) - \eta_0(\xi)] = p\hbar H(\xi)S[\eta(\xi; p)], \quad (3)$$

where the symbol  $p \in [0, 1]$  indicates the embedding parameter and  $\hbar \neq 0$  represents a supplementary parameter. The function  $H(\xi) \neq 0$  denotes a non-zero auxiliary function and  $L$  denotes an auxiliary linear operator. The initial guess is taken as  $\eta_0(\xi)$  and  $\eta(\xi; p)$  represents an unidentified function.

when  $p = 0$  and  $p = 1$ , then the values of  $\varphi$  are considered as:  $\eta(\xi; 0) = \eta_0(\xi)$  and  $\eta(\xi; 1) = \eta(\xi)$ . The solution  $\eta(\xi; p)$  may vary from initial guess  $\eta_0(\xi)$  to the unknown function  $\eta(\xi)$ , when the value of  $p$  increases from 0 to 1.

Using Taylor's series to expand the function  $\varphi(\xi; p)$  as:

$$\eta(\xi; p) = \eta_0(\xi) + \sum_{m=1}^{\infty} \eta_m(\xi)p^m, \quad (4)$$

where

$$\eta_m(\xi) = \frac{1}{m!} \left. \frac{\partial^m \eta(\xi; p)}{\partial p^m} \right|_{p=0}$$

The series (4) converges when  $p = 1$ , then we have

$$\eta(x, t) = \eta_0(x, t) + \sum_{m=1}^{\infty} \eta_m(x, t) \quad (5)$$

When  $\hbar = 1$  and  $H(\tau') = 1$ , the equation (3) becomes

$$(1 - p)L[\eta(\xi; p) - \eta_0(\xi)] = pS[\eta(\xi; p)] \quad (6)$$

This relation is mostly used in Homotopy analysis method. Establish the vector

$$\vec{\eta}_n = \{\eta_0(\xi), \eta_1(\xi), \eta_2(\xi), \dots, \eta_n(\xi)\}$$

The  $m^{\text{th}}$  order deformation equation is obtained by differentiating (6),  $m$  times with respect to the parameter  $p$ , setting  $p = 0$ , and at the last dividing the result by  $m!$

$$L[\eta_m(\xi) - \chi_m \eta_{m-1}(\xi)] = \hbar H(\xi) R_m(\vec{\eta}_{m-1})$$

where

$$R_m(\vec{\eta}_{m-1}) = \frac{1}{(m-1)!} \frac{\partial^{m-1} \eta(\xi; p)}{\partial p^{m-1}}$$

and

$$\chi_m = \begin{cases} 0 & m \leq 1 \\ 1 & m > 1 \end{cases}$$

### Test Examples:

Examples have been provided in this section to show how straightforward and precise the suggested method is.

**Example 1:** Take a look at the following 3D heat equation

$$\eta_t = \frac{1}{3\pi^2} \{\eta_{\lambda\lambda} + \eta_{\mu\mu} + \eta_{\nu\nu}\},$$

with initial conditions

$$\eta(\lambda, \mu, \nu, 0) = \sin \pi\lambda \cdot \sin \pi\mu \cdot \sin \pi\nu,$$

$$\eta_t(\lambda, \mu, \nu, 0) = -\sin \pi\lambda \cdot \sin \pi\mu \cdot \sin \pi\nu$$

The exact solution is

$$\eta(\lambda, \mu, \nu, t) = e^{-t} \cdot \sin \pi\lambda \cdot \sin \pi\mu \cdot \sin \pi\nu$$

Choose the linear operator using the Homotopy analysis technique as follow:

$$J[\eta(\lambda, \mu, \nu, t; p)] = \frac{\partial \eta}{\partial t}(\lambda, \mu, \nu, t; p)$$



The linear operator  $J^{-1}$  is.

$$J^{-1}(\cdot) = \int_0^t (\cdot) dt$$

Define the term "nonlinear operator" as follow:

$$S[\eta(\lambda, \mu, \nu, t; p)] = \frac{\partial \eta}{\partial t} - \frac{1}{3\pi^2} \left( \frac{\partial^2 \eta}{\partial \lambda^2} + \frac{\partial^2 \eta}{\partial \mu^2} + \frac{\partial^2 \eta}{\partial \nu^2} \right)$$

Create the equation for zeroth-order deformation as

$$(1 - p)J[\eta(\lambda, \mu, \nu, t; p) - \eta_0(\lambda, \mu, \nu, t)] = p\hbar H(\lambda, \mu, \nu, t)S[\eta(\lambda, \mu, \nu, t; p)]$$

For  $p = 0$  and  $p = 1$

$$\eta(\lambda, \mu, \nu, t; 0) = \eta_0(\lambda, \mu, \nu, t) \text{ and } \eta(\lambda, \mu, \nu, t; 1) = \eta(\lambda, \mu, \nu, t)$$

As a result, we arrive at the  $m^{\text{th}}$  order deformation equations.

$$L[\eta_m(\lambda, \mu, \nu, t) - \chi_m \eta_{m-1}(\lambda, \mu, \nu, t)] = \hbar H(\lambda, \mu, \nu, t)R_m(\vec{\eta}_{m-1}), \quad m \geq 1$$

$$\eta_m(\lambda, \mu, \nu, 0) = 0, \quad (\eta_m)_t(\lambda, \mu, \nu, 0) = 0$$

where

$$R_m(\vec{\eta}_{m-1}) = \frac{\partial \eta_{m-1}}{\partial t} - \frac{1}{3\pi^2} \left( \frac{\partial^2 \eta_{m-1}}{\partial \lambda^2} + \frac{\partial^2 \eta_{m-1}}{\partial \mu^2} + \frac{\partial^2 \eta_{m-1}}{\partial \nu^2} \right)$$

The  $m^{\text{th}}$  order deformation equation has now found its solution, which is

$$\eta_m(\lambda, \mu, \nu, t) = \chi_m \eta_{m-1}(\lambda, \mu, \nu, t) + \hbar H(\lambda, \mu, \nu, t)L^{-1}[R_m(\vec{\eta}_{m-1})], \quad m \geq 1 \quad (7)$$

We begin by estimating something roughly.  $\eta'_0(\lambda, \mu, \nu, t) = \sin \pi x' \cdot \sin \pi y' \cdot \sin \pi z'$ , by using the iterative formula (7). Letting  $\hbar = -1$ ,  $H(\lambda, \mu, \nu, t) = 1$ , Direct access to the other component is possible.

$$\eta_1(\lambda, \mu, \nu, t) = -t \cdot \sin \pi \lambda \cdot \sin \pi \mu \cdot \sin \pi \nu$$

$$\eta_2(\lambda, \mu, \nu, t) = \frac{t^2}{2!} \cdot \sin \pi \lambda \cdot \sin \pi \mu \cdot \sin \pi \nu$$

$$\eta_3(\lambda, \mu, \nu, t) = -\frac{t^3}{3!} \cdot \sin \pi \lambda \cdot \sin \pi \mu \cdot \sin \pi \nu$$

As a result, the parts of  $\eta(\lambda, \mu, \nu, t)$  are written as follows:

$$\eta(\lambda, \mu, \nu, t) = \eta_0(\lambda, \mu, \nu, t) + \sum_{m=1}^{\infty} \eta_m(\lambda, \mu, \nu, t)$$

$$\eta(\lambda, \mu, \nu, t) = \sin \pi\lambda . \sin \pi\mu . \sin \pi\nu . \left( 1 - t + \frac{t^2}{2!} - \frac{t^3}{3!} + \dots \right)$$

$$= e^{-t} . \sin \pi\lambda . \sin \pi\mu . \sin \pi\nu$$

which is exact solution.

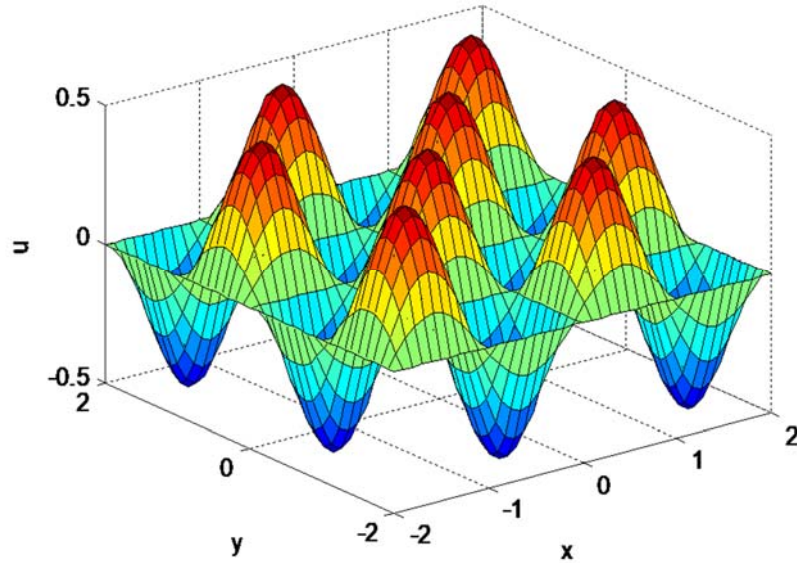


Figure 1

Figure 1 shows the physical behavior of solutions of Example 1 for  $t = 0.001$  and  $\nu = 1/6$  and  $2 \leq (\lambda, \mu) \leq 2$ .

**Example 2:** Consider the following 3D heat equation.

$$\frac{\partial \eta}{\partial t} = \frac{\partial^2 \eta}{\partial \lambda^2} + \frac{\partial^2 \eta}{\partial \mu^2} + \frac{\partial^2 \eta}{\partial \nu^2} - \eta$$

with initial conditions

$$\eta(\lambda, \mu, \nu, 0) = \sin 2\pi\lambda . \sin 2\pi\mu . \sin 2\pi\nu$$

and

$$\eta_t(\lambda, \mu, \nu, 0) = -13\pi^2 . \sin 2\pi\lambda . \sin 2\pi\mu . \sin 2\pi\nu$$

The exact solution is

$$\eta(\lambda, \mu, \nu, t) = e^{-13\pi^2 t} \cdot \sin 2\pi\lambda \cdot \sin 2\pi\mu \cdot \sin 2\pi\nu$$

The linear operator should be chosen using the Homotopy analysis technique.

$$J[\eta(\lambda, \mu, \nu, t; p)] = \frac{\partial \eta}{\partial t}(\lambda, \mu, \nu, t; p)$$

The equation for the linear operator  $J^{-1}$  is.

$$J^{-1}(\cdot) = \int_0^t (\cdot) dt$$

Explain a nonlinear operator.

$$S[\eta(\lambda, \mu, \nu, t; p)] = \frac{\partial \eta}{\partial t} - \frac{\partial^2 \eta}{\partial \lambda^2} - \frac{\partial^2 \eta}{\partial \mu^2} - \frac{\partial^2 \eta}{\partial \nu^2} + \eta$$

The zeroth-order deformation equation should be built as.

$$(1 - p)J[\eta(\lambda, \mu, \nu, t; p) - \eta_0(\lambda, \mu, \nu, t; p)] = p\hbar H(\lambda, \mu, \nu, t)S[\eta(\lambda, \mu, \nu, t; p)]$$

For  $p = 0$  and  $p = 1$

$$\eta(\lambda, \mu, \nu, t; 0) = \eta_0(\lambda, \mu, \nu, t) \text{ and } \eta(\lambda, \mu, \nu, t; 1) = \eta(\lambda, \mu, \nu, t)$$

As a result, we have the  $m^{\text{th}}$  order deformation equations.

$$J[\eta_m(\lambda, \mu, \nu, t) - \chi_m \eta_{m-1}(\lambda, \mu, \nu, t)] = \hbar H(\lambda, \mu, \nu, t)R_m(\vec{\eta}_{m-1}), \quad m \geq 1$$

$$\eta(\lambda, \mu, \nu, 0) = 0,$$

and

$$(\eta_m)_t(\lambda, \mu, \nu, 0) = 0$$

where

$$R_m(\vec{\eta}_{m-1}) = \frac{\partial \eta_{m-1}}{\partial t} - \frac{\partial^2 \eta_{m-1}}{\partial \lambda^2} - \frac{\partial^2 \eta_{m-1}}{\partial \mu^2} - \frac{\partial^2 \eta_{m-1}}{\partial \nu^2} + \eta_{m-1}$$

The  $m^{\text{th}}$  order deformation equation has now found its solution.

$$\eta(\lambda, \mu, \nu, t) = \chi_m \eta_{m-1}(\lambda, \mu, \nu, t) + \hbar H(\lambda, \mu, \nu, t) L^{-1}[R_m(\vec{\eta}_{m-1})], \quad m \geq 1 \quad (8)$$

We start with an underlying guess  $\eta_0(\lambda, \mu, \nu, t) = \sin 2\pi\lambda \cdot \sin 2\pi\mu \cdot \sin 2\pi\nu$ , by using the iterative formula (8). Letting  $\hbar = -1$ ,  $H(\lambda, \mu, \nu, t) = 1$ , we can acquire the other part straightforwardly.

$$\eta_1(\lambda, \mu, \nu, t) = -13\pi^2 t \cdot \sin 2\pi\lambda \cdot \sin 2\pi\mu \cdot \sin 2\pi\nu$$

$$\eta_2(\lambda, \mu, \nu, t) = \frac{(13\pi^2 t)^2}{2!} \cdot \sin 2\pi\lambda \cdot \sin 2\pi\mu \cdot \sin 2\pi\nu$$

$$\eta_3(\lambda, \mu, \nu, t) = -\frac{(13\pi^2 t)^3}{3!} \cdot \sin 2\pi\lambda \cdot \sin 2\pi\mu \cdot \sin 2\pi\nu$$

:

:

In this manner, the parts which comprise  $\eta(\lambda, \mu, \nu, t)$  are composed as:

$$\eta(\lambda, \mu, \nu, t) = \eta_0(\lambda, \mu, \nu, t) + \sum_{m=1}^{\infty} \eta_m(\lambda, \mu, \nu, t)$$

$$\eta(\lambda, \mu, \nu, t) = \sin 2\pi\lambda \cdot \sin 2\pi\mu \cdot \sin 2\pi\nu \cdot \left( 1 - 13\pi^2 t + \frac{(13\pi^2 t)^2}{2!} - \frac{(13\pi^2 t)^3}{3!} + \dots \right)$$

$$= e^{-13\pi^2 t} \cdot \sin 2\pi\lambda \cdot \sin 2\pi\mu \cdot \sin 2\pi\nu$$

which is exact solution.

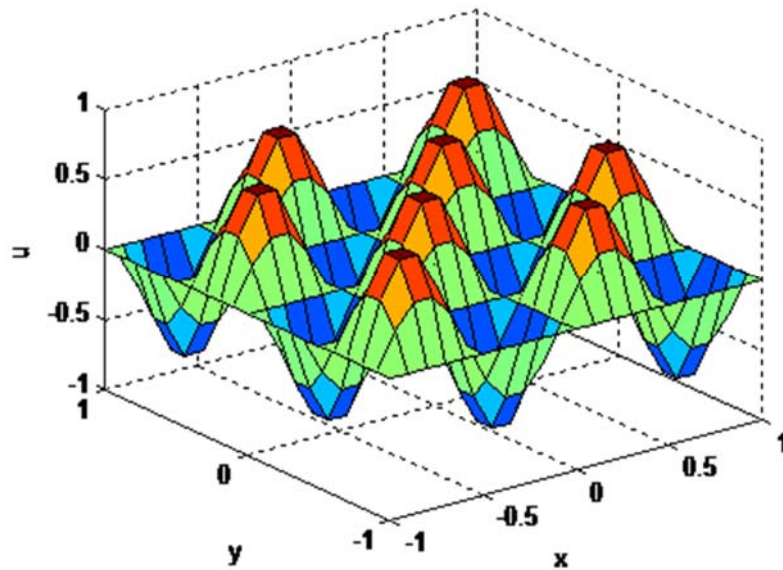


Figure 2

Figure 2 shows the physical behavior of solutions of Example 2 for  $t = 0.001$  and  $\nu = 1/6$  and  $-1 \leq (\lambda, \mu) \leq 1$ .

## CONCLUSION

In the perspective on the above delineated models, it is presumed that Homotopy examination strategy (HAM) is extremely strong procedure for tackling three layered heat conditions, which are emerging in numerous utilizations of sciences and designing. For future extension, this strategy will be relevant for various straight and nonlinear incomplete differential conditions as well as three layered fragmentary fractional differential conditions.

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# Enhancement of Energy Efficiency in WSN Protocols for Precision in Agriculture

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## Abstract:

Wireless sensor networks (WSN) advance technology and improve people's quality of life. Today, it is quite difficult to consider technology without a sensor network. Everywhere uses sensor networks to gather data for monitoring. We will focus on improving the energy efficiency in WSNs using various strategies in this study, and the effectiveness of the ELEACH protocol will be demonstrated by comparison with LEACH. The procedures' energy efficiency has been investigated and compared. The MATLAB Programme has been used to view the results. ELEACH could be improved in the future to use less energy.

**Index Terms**—Wireless Sensor Network (WSN); Cluster Head (CH); Low Energy Adaptive Clustering Hierarchy (LEACH)

## I. INTRODUCTION

In a wireless sensor network, each node is put in a distinct location. Some nodes are far from human access, making it difficult to change the node's battery on a regular basis. This issue is fixed by energy-efficient routing techniques, which also lengthen network lifetime. The emphasis on algorithms, protocols, and physical circuitry of sensor nodes can increase the lifetime of the sensor nodes. The three types of most popular routing algorithms include cluster-based algorithms, hop-to-hop transmission techniques, and direct transmission algorithms. Each time a network's sensor nodes access and process information, battery power is used.

Ad-hoc networks are highly developed networks that allow for the installation of nodes as needed. More advancements were made with the multi-hop network's introduction. The development age was the era of machine-to-machine communication. The three primary functions of all networks are sensing, computation, and data transcription. These activities drain the nodes' batteries. WSN needs an energy source to carry out all of these tasks. All sensor node modules come with their batteries already fitted.

Each sensor node in these wireless sensors' ad-hoc networks takes part in routing by sending data to other sensor nodes via the closest neighboring communication. Until the gateway is reached, without using a pre-defined infrastructure These gateways may be connected to other gateways through a bridge, either to expand data transmission to a region where sensor nodes cannot easily reach it or to integrate networks like the Internet.

## II. RELATED-WORK

Assembling of remote sensor hubs having adequate calculation and communicating/getting abilities are accessible at this point. Subsequently many hubs can be sent in an organization for any expected application. These sensor hubs have a restricted power which should be used in extremely exact way to expand hub's life. Presumably effective circuit is important for productive utilization of energy, nonetheless, directing convention running on the organization assumes an imperative part in transmission capacity utilization, security and energy protections too (taking into account WSN's). To check with these requirements, at first direct transmission approach [1] was talked about . In direct transmission, a hub sense information from its current circumstance and sends it directly to base station. Purpose for early expiry of closer hubs is directing of all information traffic to base station. Also, sending majority of detected information from every hub utilize a lot of energy. To conquer this issue, idea of Coordinated Dispersion was presented that examine information handling and spread [2]. Estrin et. al [3] worked on a hierarchical clustering mechanism dealing with asymmetric communication for power saving in sensor nodes. M. Tahiret.al [21] [7, 8] introduces connect quality measurement to isolate an organization into three coherent bits bringing about lower directing above. Creators of [9, 10] states that hubs having high starting energy will be chosen as bunch heads (if there should be an occurrence of heterogeneous sensor organizations). While concurring [11, 12, 13] any hub that exist in organization can be chosen as a group head. PEGASIS [15] are noticeable directing procedures for remote sensor organizations. Principal method of choosing a group head was given by Filter and that is additionally improved by SEP and DEEC. Q-LEACH [16] streamline network life season of homogenous remote sensor organization. [18] gives a de-followed examination on various variations of Filter as A-LEACH, S-LEACH and M-Filter regarding energy effectiveness and applications. Creators of [17] upgrades SEP with regards to heterogeneity. They proposed model that gives three level heterogeneity. Though [19] gives another convention that works better compared to SEP as far as organization security and life time having two level heterogeneity. T.N. Qureshiet. Al [20] changed DEEC convention as far as organization soundness, throughput as well as organization life time.

## III. PROPOSED WORK

Wireless sensor network has gained popularity among the research community due to its various features. It is

deployed in a wide range of applications such as industry, medical domain, agriculture, etc. In [1], the author had deployed a wireless sensor network to enhance the fertility of the soil i.e. a WSN based irrigation system was developed. The author performs the irrigation related decision by deploying various sensors in the field. Along with this, the cluster head selection scheme that was utilized evaluates the decision on the basis of the energy of the nodes. It means that the energy was the only factor that was considered for measuring the eligibility of a node for becoming a CH. Thus, on the basis of these observations, it is concluded that the traditional work lacks at various points as follows:

- The cluster head selection criteria were not as efficient as only the energy of the nodes is considered for measuring the eligibility of the nodes.
- The sensed data was stored on the sink node thus to operate the system by sitting far away was not possible enough.

In the current framework, a novel methodology is developed, with WSN serving as the main innovation (Remote Sensor Organization). The CH (Cluster Head) determination scheme is additionally updated in the proposed work by increasing the number of boundaries. The factors taken into account include the hubs' energies, their separation from one another, and their distances from sink hubs. The energy of the hubs is given a lot of weight, and this is done to increase the organization's precision and longevity.

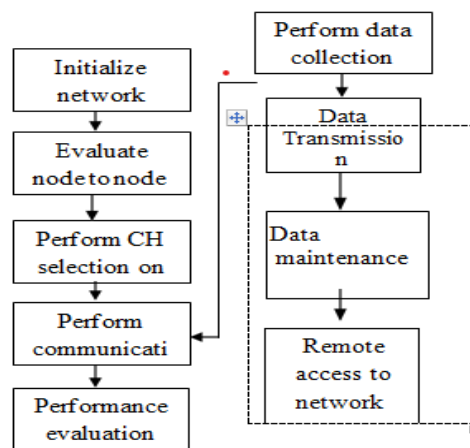


Figure 1: Proposed Frameworks

- Step 1. The First step is to initialize the network by defining the various parameters such as the area of the network, initial energy of the nodes deployed in the network. on the basis of the defined parameters, the network is deployed.
- Step 2. In this step, the distance from the candidate node to its adjacent nodes and from the candidate node to the sink node is evaluated.
- Step 3. On the basis of the evaluated weight values, select the cluster head.
- Step 4. While initialization of the network, simultaneously perform data collection from the sensors.
- Step 5. After collecting the data, the collected data is transmitted to the server from sensors for further processing. On the server side, the received data is stored and maintained properly for future use. Here, the remote access to the data is provided to the user in order to take the decisions regarding the irrigation of the crops in the field.
- Step 6. On the basis of the collected data from the sensors, the communication takes place among deployed sensors and base station.
- Step 7. The Last step in this process is to perform the evaluation of the proposed work and network in terms of the lifetime of the network.

## IV. RESULTS AND EXPERIMENTS

MATLAB is a modelling environment with an undisputedly clear, powerfully written language that supports practical, object-centered, and event-coordinated models. It is crucial for computations involving several numbers, explicit calculations involving network applications, and simple polynomial math. Information perception has benefited greatly from MATLAB's short and expressive punctuation, as well as the many predefined tools that create a special environment ideal for rapid prototyping with little overhead. Be that as it may, MATLAB isn't simply a prearranging language for fast and messy calculations. Most recent renditions have inspected a power increment for the help of huge scope, profoundly organized code to match the dialects like C++, Java and numerous others.

## V. EXPERIMENTAL ANALYSIS

The comparison investigation of LEACH and Extended LEACH is displayed in diagram. The examination is finished for network lifetime. The graph makes sense of that the organization with high energy have more lifetime in contrast with the network with lower energy. As seen from the graph, when the underlying energy is set to 0.2 joule

then the organization lifetime of LEACH is close to by 200 rounds though for proposed work it ranges to the 1100 adjusts around. At the point when the energy level is set to the most noteworthy for example 0.9 then the network lifetime of the proposed component is higher for example it works till 4500 rounds though the LEACH exhaust after 1500 rounds. The noticed raw numbers are adjusted in table 1.1

Table 1.1 Proposed network lifetime concerning first node dead

Energy	LEACH	ExtendedLEACH
0.1	117	506
0.2	301	1016
0.3	470	1501
0.4	618	2062
0.5	788	2492
0.6	955	2989
0.7	1115	3499
0.8	1283	3962
0.9	1433	4438

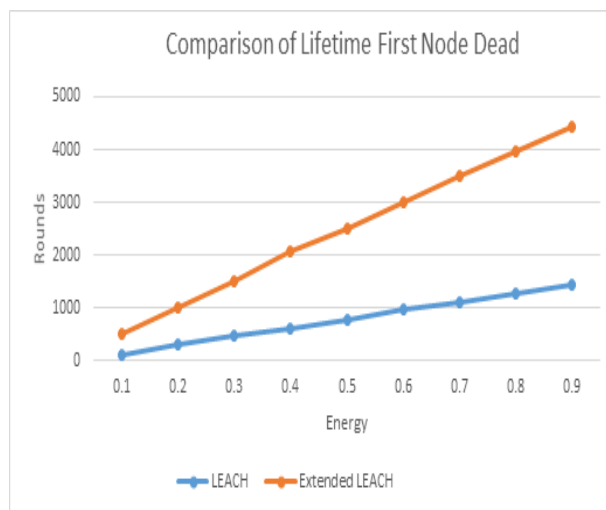


Figure 2. Comparison analysis of network lifetime in terms of first node dead

Additionally, the diagram in figure 2 makes the analysis of network lifetime with relation to the network's final dead nodes clear. The diagram makes it clear that the last node dead in the Extended LEACH approach is located at 2000 rounds with a slower energy flow at the hubs, for instance 0.2. The last hub to die is around 8200 adjustments away at the moment where energy levels increase to 0.5. The final dead hub is located near the end of 15000 rotations and is quite low energy at 0.9 joules. For conventional schemes, the longest network lifetime has been documented up to 2,000–3,000 rotations. Table 1.2 shows the perceptions of the diagram.

Table 1.2 proposed network lifespan as measured by the last dead node

Energy	LEACH	Extended LEACH
0.1	399	1750
0.2	635	3461
0.3	1154	5496
0.4	1344	7169
0.5	1736	9031
0.6	1983	10778
0.7	2458	12032
0.8	2516	13635
0.9	2966	15286



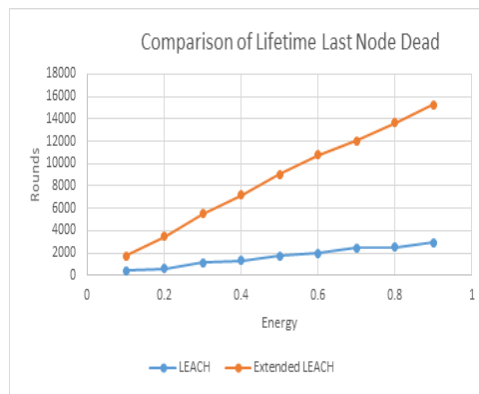


Figure 3: Comparison analysis of network lifetime in terms of last node dead

## VI. CONCLUSION

As we probably are aware WSN (wireless sensor network) plays a basic part in different spaces where the getting of information from general conditions is the significant errand. The simulation of the proposed work is finished based on the different measure of beginning energy of the sensors concerning the primary hub dead and last hub dead. The results imply that the suggested framework is very easy to access because there is no need for a specific range, it generates extraordinarily helpful yields, and it causes a reduction in water consumption. The suggested work has been thoroughly examined using the conventional LEACH protocol, and it has been determined that it is more effective than conventional protocols in terms of network lifetime.

### Future Scope

While the performance of the proposed work is very subjective yet at the same time changes are conceivable in not so distant future. These strategies can characterize the constant worth in the climate. The more examination should be possible to diminish the information blockage and energy utilization in the network. Alongside this improving the framework's reliability is likewise system reliability.

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#### Biography:-



<sup>1</sup>**Dr. Pooja Sahni** is working as Professor in ECE Department at Chandigarh Engineering College, CGC, Landran. She has more than 30 publications to her credit in referred international journals and has presented more than 15 papers in international and national conferences. She has also filed more than 10 Patents and also completed 3 Sponsored Projects. Her main research interest includes wireless communication.



<sup>2</sup>**Dr. Rachna Manchanda** is an assistant professor working in Chandigarh Engineering College in ECE department and having an experience 15 years. He has published many research papers in various international journals. His areas of interest are wireless communication, VLSI and soft computing.



<sup>3</sup>**Dr. Sukhdeep Kaur** is having 21 Years of experience and presently working as Professor in ECE Dept. at CGC, Landran. She has more than 40 publications to her credit in referred international journals and has presented more than 15 papers in international and national conferences. Her main research interest includes Antennas Design and Wireless communication.



<sup>4</sup>**Nidhi Chahal** is currently working as an Assistant Professor at the Department of Electronics and Communication Engineering. She has more than 15 research papers in reputed National and International Conferences and Journals. She has 11 years of academic experience. Ms. Nidhi Chahal interest areas include VLSI Design, Embedded System Design and Digital System Design



<sup>5</sup>**Dr. Rinkesh Mittal** is a professor working in Chandigarh Engineering College in ECE department and having an experience 18+ years. He has published more than 50 research papers in various international journals. His areas of interest are wireless communication, Antenna & networking.

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## Use of Piezoelectricity for Renewable Source of Electricity

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### Abstract.

Heavy noises around us are way too common and disturbing, what if that disturbance could be used in a manner that generates resources for us and our future needs, the time is fast and in near future, there would be a need for various renewable energy resources as the current ones are being used too much.

The data shows that currently, we use 90% of electricity in our daily lives, the usage is mainly in our appliances and our types of equipment for recharging their batteries, theoretically there can be a method using that disturbance of noise or technically the sound waves into electromagnetic waves. The process of modulation and collecting it in a channel to demodulate those input signals the process can be done. The statistics show that India is a hub of mechanical factories with the types of machinery producing a lot of sound in the environment, even vehicles produce a lot of sound for better functioning of those things' silencers are being used.

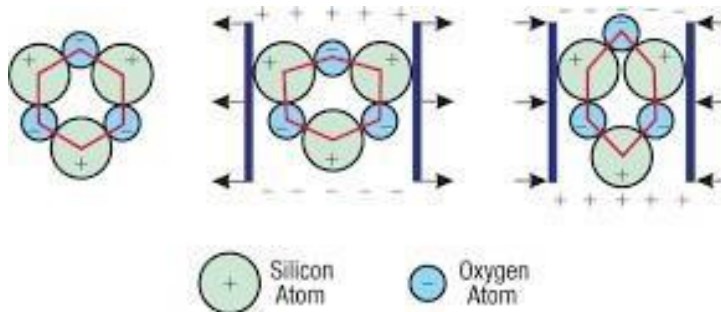
Piezoelectricity is a technique using which we can store the sound waves or the sound signals and further convert them into electrical signals, the idea is to create a storage unit using piezoelectric principles and store the electric current, the current produced would be direct current and can directly be used to charge the devices like mobile phones, laptops; piezoelectricity can be stored in super capacitors for various purposes and used in different aspects in means of consumption, to have a secure

and safe future there must be some unconventional ways generate renewable resources.

## 1. INTRODUCTION

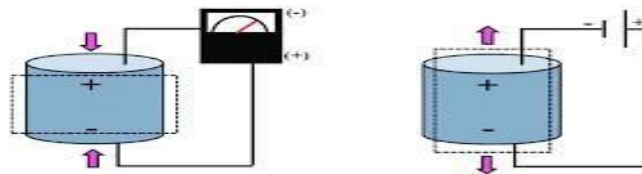
Piezoelectricity is the type of electric charge that is generated in some very specific solids like crystals, certain ceramics, and biological matter. The word piezoelectric means the production of electricity due to external factors like pressure and latent heat.

The piezoelectric effect shows relativity to the electric dipole in solids. The induced ions on crystal lattice show asymmetrical charge dipole or can be held by molecular groups. Piezoelectric materials tend to produce the inverse effect, commonly known as the converse piezoelectric effect.



**Figure 1.1 : Working of Piezoelectricity**

Piezoelectric devices are consuming the industrial, manufacturing, and automotive industries. Demand for medical instruments and telecommunications devices in the field is increasing a lot. The piezoelectric crystals are used in various ways;



**Figure 1.2: Direct & Converse Piezoelectric Effect**

High Voltage and power sources - The piezoelectric devices produce a sufficient

high-voltage electric current. A piezoelectric transformer is an AC voltage multiplier, instead of the regular coupling between the input source and output source the piezoelectric transformer uses acoustic coupling (acoustic coupling is an interface device for electric signals by acoustical means, in general, mobile phone signals)

Actuators - An actuator is a component in any mechanism that could be made responsible for the movement of the particular mechanism, in simple terms, it moves the system and can be generalized as a mover. There are piezo actuators and enhanced piezoelectric actuators, which could be helpful in the conversion of sound wave to electrical signals. ex- speakers; voltage is converted to mechanical movement, piezoelectric motors, etc.

Whereas piezo elements present in the atmosphere are responsible for the reduction of sound waves and vibrations in the surrounding by the process of absorption and can later be used for the conversion of one form of energy to the other. Piezoelectric devices can be used for infertility treatment, surgeries (piezo-surgery), photovoltaic cells, etc.

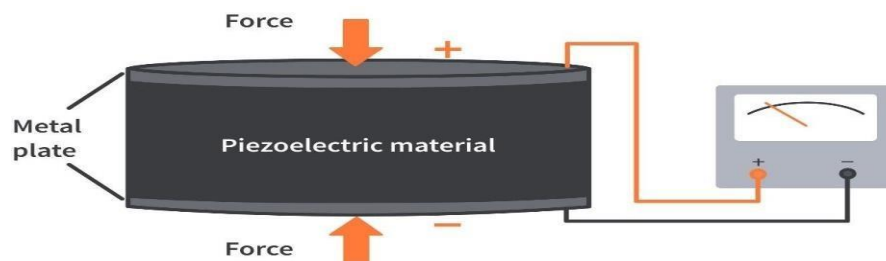


Figure 1.3 : Piezoelectric effect

## 2. WORKING:

In fig. iv(a) & fig. iv (b) it is visible about the working of piezoelectric devices. Fig-iv(a) shows that the input is receiving the electric signals on its one end and in return, it is providing the sound signals those sound signals are produced via the moving coil of the microphone. Whereas in fig-iv(b) we can see that from the given flow diagram the input source requires a source of sound that further is processed in the magnetic diaphragm or the coil and the produced energy through the coil must be stored in a supercapacitor then according to the requirement of the user one may or may not use the amplifier or the multiplier and finally have the output in the form of battery.

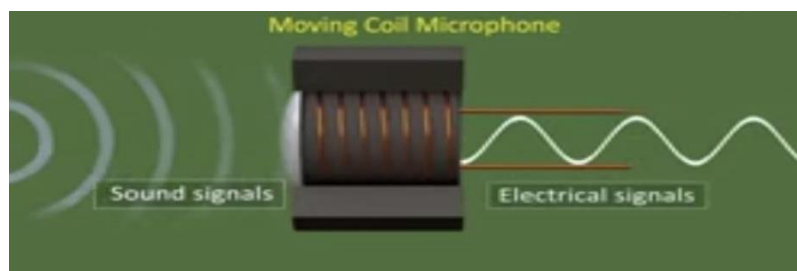
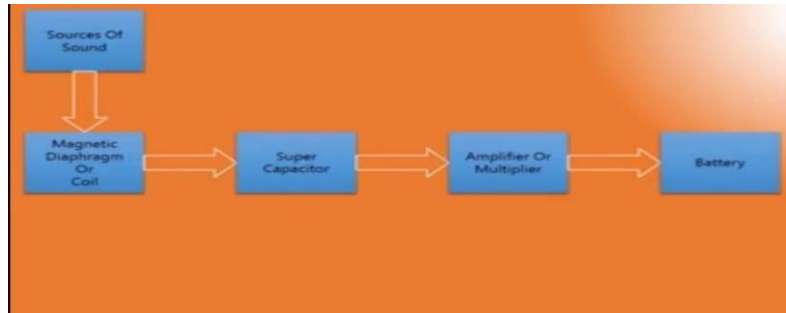


Fig- 2.1(a): Piezoelectric effect working



**Fig- 2.1(b): Piezoelectric effect working**

### 3. LITERATURE SURVEY:

The piezoelectric devices require the transducer which is of two types the input transducer is a type of sensor which sense the input sound wave and receive it for processing in the magnetic coil and the output transducer is finally an actuator. The actuator is used as the amplifier of the frequency signal used generally in the speakers. The input transducer, or in simple terms the sensor responds to every small change in the surroundings and converts it into a readable electrical signal.

The piezoelectric material's output is combined, rectified, and step up using an accurate circuit, so the energy can be utilized properly. The utilization of energy is done via storing them or harvesting them into batteries. The fullest utilization is done while using them for LEDs, recharging the batteries, fans, etc., the sources of input are majorly the engines producing heavy sounds such as airplanes or horns in trains or some other loud sound. To store a conventional amount of sound and reproduce a convincing number of electric signals. The utmost motive behind is to produce and supply free electricity around the globe or at the cheapest possible price.

The piezoelectric effect is useful and has options in applications that involve the detection of high-frequency sound waves and the production of an ample amount of electric signal and vice-versa as well. The non-acoustic piezoelectric devices include motors and actuators. Sensors, high voltage generators, etc., it is the basis of lots of scientific instruments and instrumental techniques with atomic resolution, such as scanning microscopes.

The level of noise pollution is increasing drastically day by day which is harmful to our nature, it can be converted using piezoelectricity and its concepts. A sound wave is a mechanical wave that is not capable of transmitting its energy through a vacuum, according to this concept we can convert the sound energy into electrical we have to convert our sound energy to one piezoelectric plate as shown in the above fig. iv(b) to compensate the losses we'll have a magnetic diaphragm and further stored in a supercapacitor and used as the input for the amplifier circuit and used as the output in the battery.

A piezoelectric generation device, includes some rectifying means which would rectify the signals to AC voltage and the voltage generated by the vibration is of at least one piezoelectric plate

The energy wave can be one of the biggest possible sources of potential energy, which could easily be used by piezoelectric devices. The coastal areas have high tension of the cruises and the high-frequency water waves and also somewhere the industry of crude oil and salt production that can be used for harnessing the natural resources of the sea through the water-breaking through piezoelectric means for the help in generation of power.

The piezoelectric sensors use the piezoelectric effects are measures to pressure, acceleration, and force by changing them to an electrical signal. Whenever pressure is applied to piezoelectric crystals electricity can be developed over the crystal lattice. The piezo-sensor converts mechanical energy to electrical energy and sends to AC ripple neutralizer to a unidirectional diode that would only allow to flow it in one direction and then stores into the battery which is sent to the inverter that converts direct current to alternating current and switch the circuit on the electrical energy will flow through the circuit.

Piezoelectric materials are simple, light in weight, cost-efficient, and easy to control as well. The adaptability in a vast range of applications in different structures; piezoelectric materials which are most commonly used in automotive and aerospace engineering, some elements like; Lead Zirconate Titanate (PZT), Lead Titanate (LT), Sodium Potassium Niobate (SBN), etc.

Power consumption is now dominant in the present scenario when it comes to comparison with the past data, it is hard to fulfill needs in terms of electricity of everyone. The conversion of mechanical vibrations into electrical energy can be done by piezoelectric elements and principles. The converted electrical energy is accumulated so that it could attain the required threshold value. The energy used provides feedback for avoiding the external charging in the circuit.

#### 4. CONCLUSION:

The idea states the conversion of mechanical vibrations or mechanical energy into electrical energy, using piezoelectric means. The piezoelectric designs are capable of self-charging using the superconductor, they are much more effective when it comes to supplying the power for the charging of electronic devices such as mobile phones, laptops, etc., without any external charging equipment.

The piezoelectric energy device performance depends on numerous factors such as type of configuration, the material selected, the design of the circuit, etc.

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## Biographies

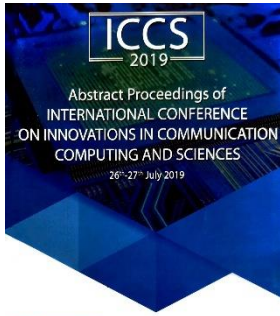


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