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Accuracy Analysis of Machine Vision for Detection of Malignant Melanoma Using Pixel Intensity Matrix Parameters

Authors

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Punal M. Arabi , Gayatri Joshi, Surekha Nigudgi, N. Vamsha Deepa

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Abstract

Malignant melanoma is a life threatening disease which develops in the skin cells and has the potential to spread the other parts of the body. Early detection and treatment not only increase the survival rate but also reduce the cost of treatment. Sun exposure/ultraviolet exposure, free radicals and history of melanoma in first degree relative are important few factors of the many

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Diagnosis of Ground Glass Opacity in HRCT Lung Images Using High-Intensity Pixels

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Punal M. Arabi , Nanditha Krishna, T. P. Prathibha, N. Vamsha Deepa

Conference paper

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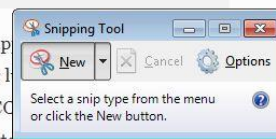
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Abstract

According to the World Health Organization survey done in 2008, approximately 1 billion people were affected by lung diseases worldwide. Some of the major lung diseases are chronic cough, asbestosis, chronic obstructive pulmonary disease (COPD), asthma, cystic fibrosis, influenza, lung cancer, pneumonia, pulmonary hypertension, etc.



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Automatic Screening Method for Bone Health Diagnosis

Authors

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Punal M. Arabi, Gayatri Joshi, Tejaswi Bhat, Varini Chinnabhandar

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Bone is a composite material consisting of both inorganic and organic components. The estimation of bone strength is an important risk factor in the clinical assessment of osteoporosis. There are several bone diseases that cause abnormalities of bone such as osteoporosis, rickets, osteomalacia, osteogenesis imperfecta, osteopenia, fibrous dysplasia etc.

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Abstract

Diabetes is a group of metabolic diseases, characterized by high sugar levels in the blood and caused due to improper production of insulin in the pancreas or cells not responding coherently to insulin production. The earlier leads to Type 1 diabetes whereas the latter leads to Type 2

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Feature Extraction and Classification of X-Ray Lung Images Using Haralick Texture Features

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N. Vamsha Deepa, Nanditha Krishna, G. Hemanth Kumar

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Abstract

According to a survey given by world health organization pneumonia is the leading cause of death. Pneumonia is a disease caused due to bacteria, virus, or fungus infection in one or both the lungs [1]. Before the antibiotics were introduced, one third of all people who suffered from

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Secure online examination by using graphical own image password scheme

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Nowadays exams are conducted through online so to provide more security, this paper proposed self image password scheme for online examination system which replaces the still digital images. These still images are having maior threats and easily hacked by hackers. For that. the online examination svstem requires new

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Nowadays exams are conducted through online so to provide more security, this paper proposed self image password scheme for online examination system which replaces the still digital images. These still images are having major threats and easily hacked by hackers. For that, the online examination system requires new methods to improve the security level and eliminate the threats. This paper implemented new security system by using self image as a password called graphical password with personalized physical tokens in the form of digital pictures which captured from live video. Users selects the positions on the displayed picture, extremely distinguishing optical features are cropped and mined from images. The extracted image is used as a password. New graphical password scheme can be applicable to various real time applications. One such illustration is done in online examination system. This algorithm ensured high-level feasibility studies by examining consistency, integrity, and protection against attackers. The New graphical password scheme is resistance to any kind of attacks. These results indicate that new graphical password scheme demonstrated the results which promise for high level security features while conducting examination.

Published in: 2017 IEEE International Conference on Smart Technologies and Management for Computing, Communication, Controls, Energy and Materials (ICSTM)

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Published in: 2017 Conference on Emerging Devices and Smart Systems (ICEDSS)

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INSPEC Accession Number: 17261299

DOI: 10.1109/ICEDSS.2017.8073664

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Conference Location: Mallasamudram, India

I. Introduction

Estimations are indispensable in software projects to support the decision building in different phases. The very first decision on a project is evaluating, in which it is acknowledged that, whether the project is usually and economically feasible or not. The effort required to make the software is a vital factor in building... its seldom comprise major

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I. Introduction

Grid computing is an internet-based infrastructure which is aggregating, dispersing resources as a group. Hence, it determines major problems [1]. In this grid environment, the resources are grant and supervised by spe... possibility of grid resources is varied by time hence it degrad... time on the grid. Suppose the resource allocator preserve the future allocation of grid resources, this help to the...
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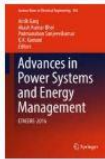
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Smart Controlling of Appliances in Power-Line Communication Using LabVIEW

Authors Authors and affiliations

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Sandwich structures are those gaining the advantage of mechanical damping of foam material and rigidity of the conventional composites to bear additional load than the regular composites. Bio-composites developed with vegetable fibers are emerging in recent years to substitute the synthetic fibrous structures. Present chapter deals with the functional tribological performance of such bio-sandwich materials made with Brazilian curaua fiber/polyester as face materials and polyvinyl chloride (PVC) as core. Structures were made through vacuum infusion technique and curing was done at room temperature. Produced structures were tested to measure the tensile (ASTM C297) and flexural (ASTM C293) strengths in addition to the tribological studies. Wear and friction of the material system was tested in a pin-on-disc experiment as per ASTM G99 under dry condition. Results reveal that structures loaded normal to the sandwich possess less friction and high wear, whereas axial loading developed high friction with less wear. Hence the design of experiment was adopted to attain an optimized run condition to achieve the lowest friction with the bio-sandwich system. Electron microscopy images of the worn structures revealed the wear mechanism of the tested bio-sandwich structures.

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A review on dielectric properties of biofiber-based composites

H. B. Bhuvaneshwari & Narendra Reddy *Advanced Composites and Hybrid Materials* **1**, 635–648 (2018) | [Cite this article](#)**1088** Accesses | **2** Citations | [Metrics](#)

Abstract

The ever increasing consumption and subsequent disposal of electronic goods is a major concern to the environment since most electronic goods contain non-biodegradable components. Regulations on disposal of e-goods and increasing environmental awareness on their use and disposal will necessitate finding alternative materials for electronic goods in the near future. One approach of making electronic goods more environmentally friendly is by developing biodegradable electronic components using natural cellulose and protein fibers. In fact, several studies have been done on using natural fiber-based materials for various

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Author: H. B. Bhuvaneshwari et al

Publication: Advanced Composites and Hybrid Materials

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Abstract:

Life today is getting easier and simpler with advancement of automation technology. Manual systems are getting replaced by automatic systems. With the rapid increase in Internet users it has become part of life. One of its kinds is IoT, latest and emerging technology. Things like consumer goods, industrial goods, etc., can be networked to share information and complete the task remotely. Basic home functions and features can be

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Abstract:

Life today is getting easier and simpler with advancement of automation technology. Manual systems are getting replaced by automatic systems. With the rapid increase in Internet users it has become part of life. One of its kinds is IoT, latest and emerging technology. Things like consumer goods, industrial goods, etc., can be networked to share information and complete the task remotely. Basic home functions and features can be controlled using IoT from anywhere in the world. It is meant to save human and electrical energy. Intel Galileo is used to integrate cloud network and wireless communication to provide users with remote control of various home appliances and storing data in cloud. The system automatically changes according to the sensor's data. The system designed allows addition of variety of devices to be controlled.

Published in: 2017 International Conference on Electrical, Electronics, Communication, Computer, and Optimization Techniques (ICEECOT)

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Smart Device for Ensuring Women Safety Using Android App

Authors

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V. Mareeswari , Sunita S. Patil

Conference paper

First Online: 08 June 2018

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Abstract

Nowadays, physical harassment is the one of the most common and frequently happening offenses against girls and women (all the kind of women) in India. The metro cities have more number of physical harassment cases, and compared to developed countries like Latin America,

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[Innovations in Computer Science and Engineering](#) pp 323-331 | [Cite as](#)

A Novel Approach to Identify Facial Expression Using CNN

Authors

Authors and affiliations

V. Mareeswari, Sunita S. Patil, Lingraj, Prakash Upadhyaya

Chapter

First Online: 04 March 2020

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Abstract

Facial expression recognition (FER) has been one of the actively research topics due to its wide range of application. FER is a very challenging task because of less training datasets. The result of facial expression is the well-classified loss function based on the robust prior knowledge at the end-to-end neural network architecture. The proposed methodology is able to address the

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Categorizing Kidney Stones Using Region Properties and Pixel Intensity Matrix

Authors

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Punal M. Arabi, Gayatri Joshi , Surekha Nigudgi

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Abstract

Kidney stones or renal calculi are crystals which are formed with in the kidney or in the urinary tract. When there is a decrease in urine volume or if there are more crystalline forming substances in urine, kidney stones are formed. The risk of getting more kidney stones is reduced by finding out the type of kidney stones that helps in identifying the cause for the

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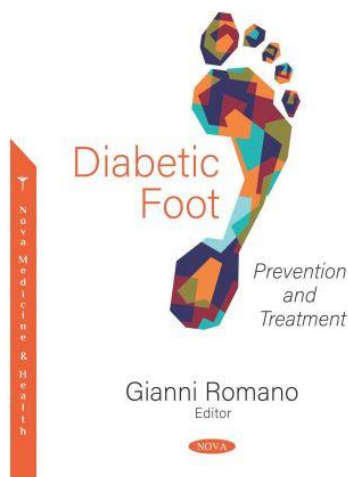
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Diabetic Foot: Prevention and Treatment

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Diabetic Foot: Prevention and Treatment first proposes a noninvasive screening method for diabetes based on the thermoregulation of the peroneal vessel. Since diabetes affects the peroneal vessel of the patients significantly, the thermoregulatory behavior of peroneal vessel is studied for induced hot and cold stress in this work.

Next, the authors highlight recent findings in the area of human mesenchymal stem cells sources, their differentiation ability, immunogenicity, adaptation to the microenvironment, as well as use in human clinical trials.

The authors also propose that, given the increasing prevalence of antibiotic resistant pathogens and the failure of antibiotic-exclusive therapeutics in the treatment of diabetic foot infections, combinations of antimicrobial peptides and antibiotics may be a potential treatment alternative.

Advanced diabetic foot ulcer therapies are explored based on current research. Recent studies show that diabetic patients have a 25% risk of developing diabetic foot ulcers in their lifetime.

Lastly, a study was carried out to investigate the effects of social support on the reduction of wound size after four weeks of treatment with standard care in patients with Grade B, Stage I diabetic foot ulcer. (imprint: Nova)

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(Punal M. Arabi and Gayatri Joshi, Department of Biomedical Engineering, ACS College of Engineering, Bangalore, Karnataka, India, and others)

Chapter 2. Clinical Applications of Mesenchymal Stem Cells in Non-Healing Diabetic Foot Ulcers (DFUs): An Effective Treatment

(Surjya Narayan Dash, Nihar Ranjan Dash and Prakash Chandra Mohapatra, Department of Biochemistry, SCB Medical College Cuttack, Odisha, India)

Chapter 3. Are Antimicrobial Peptides the Answer for Diabetic Foot Infection Management?

(Raquel Santos, Luis Tavares and Manuela Oliveira, Centro de Investigação Interdisciplinar em Sanidade Animal, Faculdade de Medicina Veterinária, Universidade de Lisboa, Lisboa, Portugal, and others)

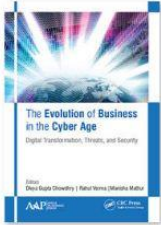
Chapter 4. Prospective on Advanced DFU Therapies: Identifying Alternatives to Conventional Therapy Based on Current Research

(Isa Serrano, Raquel Santos, Rui Soares, Luis Tavares and Manuela Oliveira, Centre for Interdisciplinary Research in Animal Health, Faculty of Veterinary Medicine University of Lisbon, Lisbon, Portugal)

Chapter 5. The Effects of Social Support and Hope in the Healing of Diabetic Foot Ulcers Treated with Standard Care

(Ayfer Peker Karatoprak and Süreyya Karaöz, Health Care Services, Kocaeli University, Kocaeli, Turkey, and others)

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Cyber Threat Detection and Secured Alternative Technology: A Survey

By *S. Anitha, Hemanth G. Kumar*

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ABSTRACT

Cybersecurity plays a vital role in securing the information, data, etc., may be medical of in various other fields. It may act as a guardian during hazards like drive failures or power outages and other attacks. The second one includes everyone from initial threat makers to hackers and groups of criminals who are a threat to the society and also the enterprises. Reviews on various threats in different fields of business and the various existing methods to overcome the said threats have been discussed. Internet of things coupled with integration of internetworks is changing the landscape including utilities. The proposed survey model is based on outcome of the surveys carried on internet banking in other countries. The survey focused on users' practices in internet banking. The proposed model bridges the gap by widening the responsibility of banks to reduce cybersecurity risks for users.

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Innovations in Electronics and Communication Engineering pp 525-533 | [Cite as](#)

Recognition of Handwritten Digits with the Help of Deep Learning

Authors

Authors and affiliations

Sunita S. Patil , V. Mareeswari, V. Chaitra, Puneet Singh

Conference paper

First Online: 23 April 2020

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Abstract

Handwritten numerical recognition is becoming the most interesting topic in research area today due to great growth in artificial intelligence and its different learnings and computer visual perception algorithms. This project shows the comparison of digit recognition among machine learning algorithms like support vector machine (SVM). *K*-nearest neighbor (KNN).

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A Review on the optic disc and optic cup segmentation and classification approaches over retinal fundus images for detection of glaucoma

H N Veena , A Muruganandham & T Senthil Kumaran*SN Applied Sciences* **2**, Article number: 1476 (2020) | [Cite this article](#)**1494** Accesses | **1** Citations | [Metrics](#)

Abstract

Glaucoma is one of the leading severe retinal disease which damages the optic nerve head on the retinal part of the eye irreversibly. Once the person is diagnosed with glaucoma, it cannot be treated entirely, but it can be controlled. If glaucoma is not diagnosed in time, it will lead to vision loss by damaging the Optic Nerve Head. The glaucoma detection is performed based on the optic disc and optic cup parameters on the retinal part of the eye. In the existing system, many image processing and machine learning techniques used for the segmentation and

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An Experimental Study on Utilisation of Red Mud and Iron Ore Tailings in Production of Stabilised Blocks

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M. Beulah , K. Sarath Chandra, Mothi Krishna Mohan, I. Clifford Dean, G. Gayathri

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Abstract

Construction of bricks using waste materials is one among the many ways to address the problems encountered in infrastructure. In the present study, various industrial and mining wastes have been used to manufacture stable bricks. These wastes include red mud (RM) from

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Optimization of Wire Electrical Discharge Machining Parameters of Activated Carbon Reinforced Aluminium Composite

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Abstract:

The quality of machining through process parameters on the responses in wire electrical discharge machining (WEDM) is studied. This paper discusses the optimization of parameters of a process in WEDM machining with the application of the desirability approach on the basis of response surface methodology (RSM). Pulse on time, servo speed rate, discharge current, and pulse off time have been considered as influential factors. The established experimental data of AA7075 aluminium reinforced with 9% of activated carbon composite to analyze the process parameter effects on responses, like material removal rate (MRR) and surface roughness (SR). After machining multiple regression analysis is used to find the interaction among the process parameters is obtained. The optimal parameters were found using the desirability optimization methodologies as 10.43mm³/min and 3.32µm respectively. The performance of the optimization test confirmed that the proposed method in this study effectively improves the performance of the WEDM process.



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Bus Alert System for Blind in Real-Time Environment

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Sunita Patil , V. Mareeswari, G. Amogh, M. S. Giridhar

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Abstract

Talking signs, guide cane, echolocations are all useful in navigating the visually challenged people to reach their destination, but the main objective is not reached. In this paper, we propose a real-time bus alert system which provides information about the bus arrived at the bus station travels to the desired destination of the blind or not. A blind unit is given to the

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An Automated Glaucoma Detection Model to Estimate Glaucoma Abnormalities in Fundus Images Using CNN

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An eye situation glaucoma is analysed effectively with the damages occurred in the optic nerve of the eye and it will become for a long period. This becomes proactive in successive stages mainly pressure built up in the optic nerve inside the eye. The current Scenario state that most predominant glaucoma type is of primary open angle glaucoma (OAG) management Glaucoma

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5 - Computer-aided diagnosis of age-related macular degeneration by OCT, fundus image analysis

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Information and Network Security



Dr.C.S. Pillai
B.S. Shakunthala

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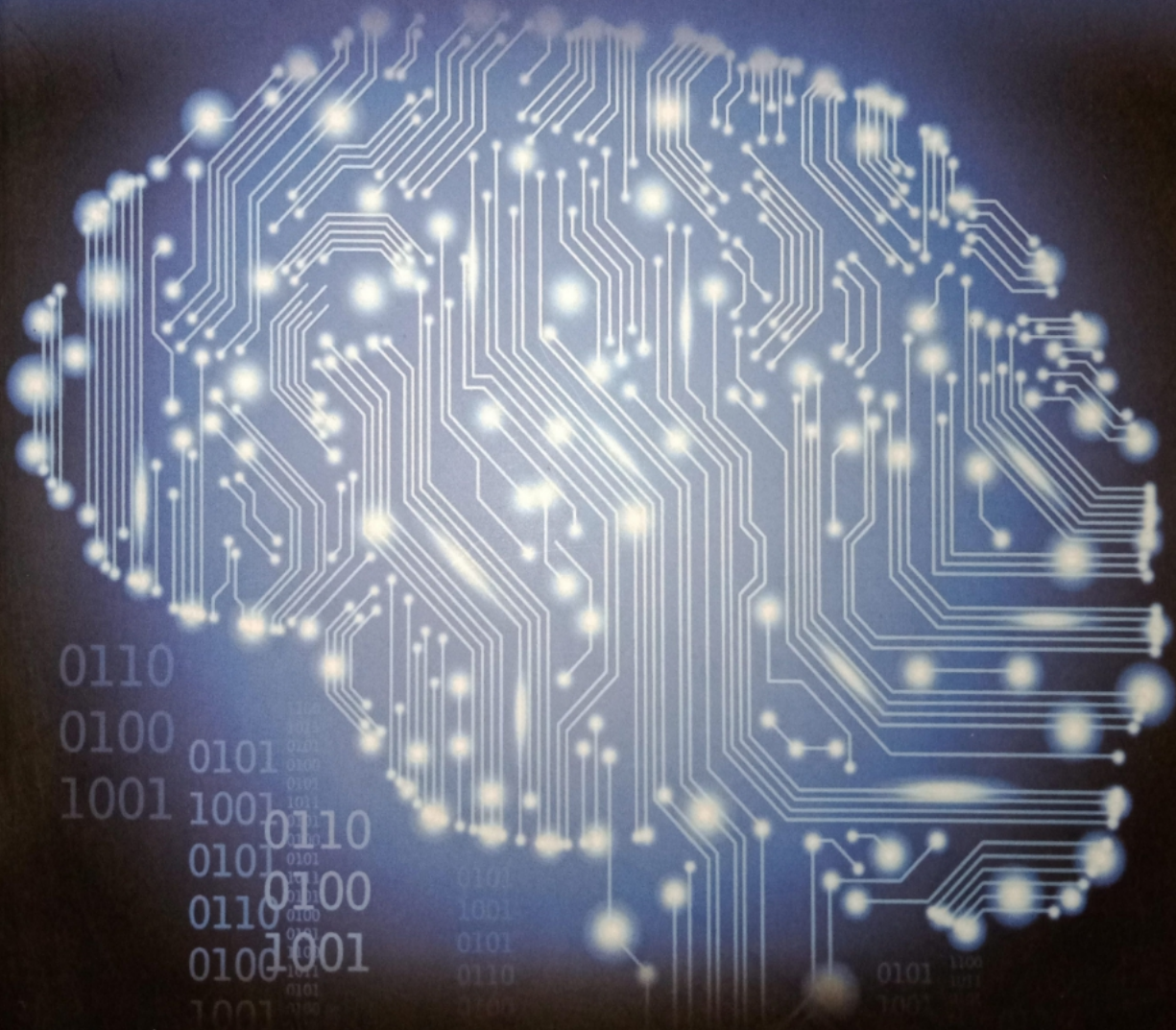
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A novel method to filter and enhance low quality CT images of normal lungs

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A Novel method to filter and enhance low quality CT images of normal lungs

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Abstract: Humans have a pair of lungs which is one of most vital and sensitive organs of the human body. Computed tomography (CT) is a diagnostic medical test that uses x-ray equipment to detect various health conditions. Also, this method is regarded as painless, noninvasive and accurate. Thus, we have obtained CT scanned images of three healthy subjects and in this paper we aim at obtaining signal to noise ratio after image extraction and segmentation. Then, filtering (using five filters) followed by enhancement using Adaptive Histogram Equalization is carried out. After enhancement, we calculate the signal to noise ratio again. Later, we discuss which filter gave the best result among the five filters. Signal to noise ratio is a measure to know the signal power present to the noise power included.

Keywords- Computed Tomography, Signal to noise ratio, Segmentation, Filtering, Adaptive Histogram Equalization.

INTRODUCTION

Lungs are the main pair of organs without which survival is impossible. The right one is bigger and three lobed whereas the left one is slightly smaller and two lobed. Both lungs together weigh about 1.3 kg. Lungs majorly help in breathing (inhaling and exhaling), respiration (oxygen supply), and helps to maintain homeostasis and also help in protection against air-borne infections. Hence, lungs are a vital part of human body.

Computed tomography is a diagnostic test to monitor internal health conditions of human body. Even in case of internal injuries and bleeding, this method helps in quick detection of internal conditions. Cross sectional images of a CT scan can be formatted in multiple planes and three dimensions and also can be viewed on a computer, film or CD. CT scans are ideal for obtaining information regarding conditions of internal organs, bones, soft tissues, and blood vessels. Hence we have used CT images of lungs for analysis.

METHODOLOGY

In this paper we follow these steps for analyzing three CT images of normal lungs:

- (1) Extraction and Segmentation of CT image of normal lungs.
- (2) Measuring the signal to noise ratio for the segmented region.
- (3) Filtering the segmented images using five types of filters.
- (4) Enhancement of the five filtered images using Adaptive Histogram Equalization.
- (5) Calculation of signal to noise ratio of each filtered and enhanced image
- (6) To compare the signal to noise ratio values before and after filtering and analyzing which filter is best suited to enhance normal lung images.

Fig1. shows the series of steps to analyze each image from particular subject.

replaces the original value of the pixel. The process is repeated for every pixel in the image. these filters smoothens the noise in the images.

High-pass filters are used to make an image appear sharper. These filters emphasize fine details in the image – exactly the opposite of the low-pass filter. High-pass filtering works in exactly the same way as low-pass filtering but it uses a different convolution kernel. High-pass filtering *amplifies noise*. You can get away with this if the original image is not too noisy; otherwise the noise will overwhelm the image. High-pass filtering can also cause small, faint details to be greatly exaggerated. So while high-pass filtering can often improve an image by sharpening detail, overdoing it can actually degrade the image quality significantly.

Median filters are used as nonlinear digital filtering devices. They are mainly used to remove noise from an image or signal. It is used because in certain conditions it helps to preserve edges while removing noise. It also has a wide application in signal processing.

Wiener filters are used to produce an estimate of a desired or target random process by linear time-invariant filtering of an observed noisy process, assuming known stationary signal, noise spectra, and additive noise. The Wiener filter minimizes the mean square error between the estimated random process and the desired process.

Gaussian filters are used in electronics and signal processing. The impulse response of a Gaussian filter is a Gaussian function (or its approximation). They have properties of having no overshoot to a step function input while minimizing rise and fall time. Gaussian filters have minimum group delay. Gaussian filter modifies input signal by convolution with Gaussian function.

Adaptive Histogram Equalization (AHE)

AHE is a computerized image processing technique used in order to improve contrast in images. In this method, several histogram computations are made. Each histogram corresponds to a distinct section of image and uses them to redistribute lightness values of image. This method can be used to improve local contrast and enhance definitions edges in each region of an image. This over amplifies noise in relatively homogenous regions of an image.

Signal to noise ratio (SNR)

SNR is used as a physical measure in imaging to gauge sensitivity of an imaging system. It is defined as the ratio of average signal value to standard deviation of the background noise. It is given by:

$$SNR = 20 * \log_{10} ((\text{signal}) / (\text{noise}))$$

RESULTS

For carrying out the proposed method, set of the following CT images of normal lungs were used. They belong to three different subjects.

Fig 2 illustrates a set of three CT images of normal lungs.



FIGURE 2: shows set of three CT images of normal lungs

The signal to noise ratio values of three lung images after segmentation and extraction are as follows in table 1:

Table 1: shows SNR values of normal lung images

LUNG	SNR VALUE(in dB)
Lung 1	3.0348
Lung 2	4.7574
Lung 3	1.7554

Now signal to noise ratio of images after filtering and enhancement are tabulated below. Table 2 shows the SNR values for lung 1 from Low pass filter, High pass filter, Median filter, Weiner filter and Gaussian filter respectively:

Table 2: shows SNR values of lung 1 after filtering and enhancement

SNR	SNR VALUES(in dB)
SNR 1	5.2795
SNR 2	8.7881
SNR 3	4.5657
SNR 4	4.7181
SNR 5	5.8509

Table 3 shows the SNR values for lung 2 from Low pass filter, High pass filter, Median filter, Weiner filter and Gaussian filter respectively:

Table 3: shows SNR values of lung 2 after filtering and enhancement

SNR	SNR VALUES(in dB)
SNR 1	7.4591
SNR 2	8.7864
SNR 3	7.4570
SNR 4	7.4310
SNR 5	7.6423

Table 4 shows the SNR values for lung 3 from Low pass filter, High pass filter, Median filter, Weiner filter and Gaussian filter respectively:

Table 4: shows SNR values of lung 3 after filtering and enhancement.

SNR	SNR VALUES(in dB)
SNR 1	5.7638
SNR 2	6.1727
SNR 3	3.8791
SNR 4	3.7231
SNR 5	5.3342

DISCUSSION

The signal to noise ratio is one of the parameters to find the quality of the image. higher the signal to noise ratio better is image quality as the signal is more in comparison to noise in the image. also lower value of signal to noise ratio indicates that the image quality is low. In this paper, as shown by the results it is evident that this method can be used to enhance the image quality. Before the filtering and enhancement is carried out the signal to noise ratio observed is less. But after the suggested method is applied there is a significant increase in the signal to noise ratio value which indicates that the image quality has enhanced. Irrespective of the filter used there is increase in the value of signal to noise ratio indicating a improved quality of image. but in all three cases it can be clearly noted that the HIGH PASS FILTERS have given the best results.

APPLICATIONS

Even in case of images having high noise this method can be used. This method enables the enhancement of images having high noise also. Further this method can be extended and used for other regulatory organs such as kidney, liver, etc.

CONCLUSION

So far this method has been applied for a set of three images. The result obtained shows that the proposed method works well with clearly distinguished values before and after filtering and enhancement at different ranges. Further to check upon the accuracy of this method it can be applied to more images and tested.

ACKNOWLEDGMENTS

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REFERENCES

- [1] Wikipedia, contents from CC BY-SA3.0, 2017
- [2] diffractionlimited.com/help/maximdl/low-pass_filtering.htm
- [3] diffractionlimited.com/help/maximdl/high-pass_filtering.htm
- [4] diffractionlimited.com/help/maximdl/band-pass_filtering.htm
- [5] <http://in.mathworks.com>

EEG wave based identification of sleep disorders

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EEG wave based identification of sleep disorders

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Abstract: Sleep stage classification is one of the most critical steps in effective diagnosis and the treatment of sleep-related disorders. Sleep stage scoring is the first step to diagnostic of sleep disorders and it is scored by the conventional method known as the visual sleep stage scoring based on human. The first is the new feature of EEG signal using a simple statistical technique and the results prove that the various sleep stages can be discriminated more clearly at significant levels ($p < 0.05$). Second, the dimension reduction is proposed based on the Canonical Correlation Analysis (CCA) technique that explores possible correlated multi-sources to improve the sleep stages classification at 95.42% accuracy by using random forest classification. We also propose a system to classify the wake and sleep stages with high rates of sensitivity and specificity. The Kruskal–Wallis test is used to examine the significance of the features. Non-significant features are discarded. The minimal-redundancy-maximal-relevance feature selection algorithm is then used to eliminate redundant and irrelevant features. A review has been conducted on the EEG based identification of sleep disorders with the above said techniques. The performance of our proposed system is evaluated for different multi-class classification problems. The minimum overall accuracy rates obtained are 95.31% and 86.64% for nested 5-fold and subject cross-validation, respectively.

Keywords—*Sleep Stages Classification; Canonical Correlation Analysis; minimal-redundancy-maximal-relevance (mRMR), random forest (RF), electroencephalogram (EEG)*

INTRODUCTION

Sleep has a significant role in healthiness and well-being throughout our life. Getting adequate sleep at nights can help protect our mental health, physical health, and quality of life. Sleep screening and analysis is a considerable tool in assessment of sleep-related disorders, such as sleep apnea syndrome, schizophrenia, depression, insomnia, narcolepsy, and other neural abnormalities. Sleepers cyclically pass through five different stages of sleep, i.e., stage 1, stage 2, stage 3, stage 4, and stage 5 or rapid eye movement (REM) sleep. The typical length of a complete sleep cycle is about 90 to 110 minutes. Sleep in stage 1 is light. The eyes move slowly and muscle activity is slow. It is in stage 2 that eyes stop moving and the brain waves become slower. Deep sleep occurs in stages 3 and 4 when no eye movement and muscle activity exist. In stage 5 or REM period, the rate of breathing increases and eyes move rapidly. The EEG rhythms or waves, which are delta, theta, alpha, sigma, beta, and gamma waves, demonstrate different characteristics of the sleep stages. Theta wave (4-8 Hz) and alpha wave (8-12 Hz) are present in stage 1 of sleep. During stage 2, the EEG signal amplitude increases and K-complexes appear. Theta waves are also more prominent in this stage. Theta wave and delta wave (0-4 Hz) are more noticeable in stage 3. The frequency of the EEG signal during stage 4 varies between 0.5 and 2 Hz. In REM period, sigma wave (12-15 Hz), beta wave (15-30 Hz), and gamma wave (>30 Hz) are more dominant; hence, the frequency content of the EEG signal is greater than 12 Hz. Beta waves are also more predominant during wakefulness. The sleep stages based on EEG and ECG signals are obtained from many different sources. The feature selection methods and the Principle Component Analysis (PCA) are the most popular methods for sleep stages [3,13-14]. However, they have some limitations that they do not use class information. While, Canonical Correlation Analysis (CCA) is a technique of dimensionality reduction methods that use class information to find the correlation between feature vectors of data sets. An important property of CCA is invariant with respect to affine transformation of the feature vectors that is different from other techniques.

METHODOLOGY

The signals and sleep stage annotation were extracted from PSG recording. These were available on the Physionet database for downloading in EDF format from patients referred to the Sleep Disorders Clinic at St Vincent's University Hospital. Brainwave was recorded with the 10-20 standard electrode placement. The V2 lead was the tracing of ECG signal. Sampling rate of signals was 128 Hz. In this analyze, sleep stages were classified into 5 classes; wake class, REM class, S1, S2, and SWS.

EEG EXTRACTION

We used a temporal and spatial techniques for computation in EEG features extraction. We started with divided EEG signal into segments of 30 second per epoch that equaled the length of a sleep stage annotation provided by the sleep specialists. The annotated sleep stage included wake stages, REM stages, and NREM 1 – 4 stages. But our implement combined NREM3 and NREM4 to be the single stage or SWS according to the recent ASSM standard. EEG features related to sleep stages can be categorized into 2 groups; time and frequency domains. Time domain was computed such as the mean, standard deviation, maximum, minimum value, Hjorth parameters and itakura distance [11]. The new features, of time domain were modified with Maximum–Minimum distance (MMD).

The features were modified based on the ratio of x and y

$$, as m = \sqrt{\frac{|y^2|}{|x^2|}}, \text{ or the slope of the different distance between}$$

maximum and minimum or the extreme values in each sub-windows

Two types of new distances are proposed. One feature is computed by average of the whole sub-windows called avgEVslope and the other is the sum of the whole sub-windows called sumEVslope.

$$\text{Avg EV}_{\text{slope}} = \frac{\sum_{i=0}^w |l_i|}{w}$$

$$\text{sum EV} = \sum_{i=1}^w |l_i|$$

Frequency domain has been the most commonly extracted features which are characterized the spectral structures of the signal. The different frequency bands include low delta (0.5-2Hz.), high delta (2-4Hz.), theta (4-8 Hz.), alpha (8-12Hz.) and beta (13-30Hz.). The PSD features are extract from EEG by using [11]. For the Discrete Wavelet Transform (DWT), this experiment uses Daubechies 8 (db8) with 5 level that are correlated with the required EEG information in range 0-30 Hz. EEG sub-bands are represented by coefficient detail (D3-D5) and the approximation (A5). The extracted data are calculated on mean, standard deviation and the power spectrum density. Totally EEG features are 56.

Dimension reduction

The dimension reduction methods seek a low-dimension common subspace to compactly represent various data. In this work, EEG and ECG are obtained from multi-signal recording of the PSG data. There are related function activity and easy touse, so we select them to study. The various dimension reduction methods are compared including Principle Component Analysis (PCA), Independent Component analysis (ICA), and Canonical Correlation Analysis (CCA).

Canonical Correlation Analysis

The CCA method is introduced to fuse multi feature sets in this work because the aims are to discover the association across two data sources, to reduce the computation complexity and to improve the classification performance. Two types of data are used, one dataset is the EEG and the other is HRV. They are defined as X_1 and X_2 with dimensions $m \times n$ and $m \times p$, respectively. The number of dimensions is equal to the minimum of the columns of them. The new vectors of data projected on direction vectors are defined.

$$\rho = \frac{E[X_1 X_2]}{\sqrt{E[X_1^2] E[X_2^2]}} = \frac{w_{x1}^T C_{x1 x2} w_{x2}}{\sqrt{w_{x1}^T C_{x1 x1} w_{x1} w_{x2}^T C_{x2 x2} w_{x2}}}$$

The model of the dimensionality reduction methods that are used in this study. The model of CCA tries to maximize the inter-subject covariance across two sets of features and generates two linked variables, one from each data set. The ICA model tries to share two or more features that have the same mixing coefficient matrix and maximize the independence among class components. The PCA tries to find the maximum covariance of features without class information. In sleep stage classification, Support Vector Machine (SVM), k-Nearest Neighbor (kNN), Decision Tree (DT), and Random Forest (RF) algorithms are employed. These are useful techniques in the machine learning. We conducted experiment by setting data into separate sets, 80% was used for training and 20% was used as a completely independent test of the recognition method. In the first classifier, the kernel function of multiclass SVM is set by the radial basic function to classify sleep stages. In the second one, the prediction of k-NN algorithm was based on k nearest neighbor so our process set k to 2-4. The third algorithm, the Decision Tree Classifier was conducted by ID3, which used entropy and information gain. The last algorithm, random forest, the number of trees was set to be 10 based on the experiment. We used some libraries of classifier tools for training and testing procedures with MATLAB program.

The first dataset used in this paper is the Sleep-EDF database (SEDFDB) which is available on PhysioNet [28], [29]. In this dataset, EEG signals have been recorded from Caucasian male and female subjects between the ages of 21 and 35. There exist 8 recordings in two subsets (marked as sc* and st*). The first four recordings (i.e., sc4002e0, sc4012e0, sc4102e0, and sc4112e0) are the signals of ambulatory healthy subjects during 24 hours in the normal daily life. These recordings correspond to the wake state (between 15.1 and 17.5 hours) and the sleep state. The remaining four recordings (i.e., st7022j0, st7052j0, st7121j0, and st7132j0) are the signals recorded from the subjects with mild difficulty in falling sleep during a night in the hospital. However, they were healthy otherwise. The dataset contains the EEG and horizontal EOG signals. The EEG signals were recorded from two bipolar channels, Pz-Oz and Fpz-Cz. The sampling rate was 100 Hz.

The EEG signal recorded from the Pz-Oz channel is used, since it has been shown in previous studies [15], [30], [31] that the accuracy rate obtained is higher if the signal of this bipolar channel is used instead of that of the Fpz-Cz channel. Each 30-s epoch of the EEG signal is scored according to the Rechtschaffen and Kales (R&K) guidelines by an expert as stage 1 (S1), stage 2 (S2), stage 3 (S3), stage 4 (S4), REM, wake (W), movement time, or unscored.

The second dataset used in this paper has been provided by St. Vincent's University Hospital and University College Dublin (UCDDB). It is also available on PhysioNet [32]. The polysomnography (PSG) signals of 25 adult individuals with suspected sleep-disordered breathing have been recorded overnight. The participants (i.e., 21 males and 4 females) are between ages of 28 and 68. The dataset contains two EEG signals (i.e., C3-A2 and C4-A1), two EOG signals (i.e., left EOG and right EOG), the submental EMG signal, 3-channel ECG signals, the or nasal airflow, rib cage movements, abdomen movements, the oxygen saturation, snoring and the body position. The sampling rate was 128 Hz and the average recording time was 6.9 hours. The sleep stages have been scored by an experienced sleep technologist according to the standard R&K rules. Each 30-s epoch is scored as wake (W), stage 1 (S1), stage 2 (S2), stage 3 (S3), stage 4 (S4), REM, artifact, or indeterminate. In this paper, the signal of the C3-A2 channel is used.

The third dataset used in this paper is the Expanded Sleep-EDF database (XSEDFDB) which is available on PhysioNet [28], [33]. In this dataset, which is an expanded version of the SEDFDB, PSG signals have been recorded from 10 male and 10 female subjects between the ages of 25 and 34. The subjects are healthy Caucasian, without any sleep-related medication. The dataset contains the PSG signals of about 20 hours recorded during two subsequent day-night periods at the subjects' homes. The dataset is similar to the SEDFDB otherwise. In this paper, the EEG signal recorded from the Pz-Oz channel is used. The six sleep states considered here are W, S1, S2, S3, S4, and REM.

SYSTEM PERFORMANCE EVALUATION

Four criteria (measures) are used to evaluate the performance of the proposed sleep stage classification system. These criteria are the classification accuracy, sensitivity, specificity, and confusion matrix. The classification accuracy, sensitivity, and specificity are defined by:

$$\text{Accuracy (Ac)} = \frac{TP + TN}{TP + FN + TN + FP} \%$$

$$\text{Sensitivity (Sn)} = \frac{TP}{TP + FN} \%$$

$$\text{Specificity (Sp)} = \frac{TN}{TN+FP} \%$$

where TP , TN , FP , and FN denote true positives, true negatives, false positives, and false negatives, respectively.

In order to set the system parameters and to evaluate the system performance, we use a nested k -fold cross-validation process. To do this, the dataset is divided randomly into k equal-size subsets. At each fold, the $(k-1)$ subsets are used as the training and validating data and 1 subset is used for testing. This process is repeated k times (the number of folds), with each subset used exactly once for testing. This makes the outer folds. For each outer fold, k inner folds are made such that the training and validating data is further divided into k equal-size subsets. At each inner fold, the $(k-1)$ subsets are used as the training data and 1 subset is used for validating. This process is repeated k times, with each subset used exactly once for validating. The results of the $k \times k$ inner folds are used for setting the system parameters. The results of the k outer folds are averaged and reported as the system performance. We also use a k -fold subject cross-validation process, where k is the number of subjects in the dataset. At each fold, the data of one subject is used for testing, while the data of other subjects is used as the training and validating data. This process is repeated k times. The results of the k folds are averaged and reported as the system performance.

RESULTS AND DISCUSSION

<i>Classification method</i>	<i>Feature reduction method</i>	<i>Sens. (%)</i>	<i>Spec. (%)</i>	<i>Acc. (%)</i>
SVM	PCA	91.98	91.43	91.87
	ICA	91.37	88.69	90.52
	CCA	94.90	94.35	94.81
k-NN, k=2	PCA	77.98	62.39	69.46
	ICA	77.06	68.08	72.15
	CCA	85.28	77.45	81.71
k-NN, k=3	PCA	74.56	63.26	65.38
	ICA	76.97	67.22	69.13
	CCA	84.45	80.38	81.34
k-NN, k=4	PCA	60.01	62.81	62.24
	ICA	64.08	66.14	65.98
	CCA	82.70	78.07	78.83
Decision Tree	PCA	86.32	87.01	86.89
	ICA	85.24	85.95	85.33
	CCA	90.28	89.91	90.47
Random Forest	PCA	94.25	95.81	93.90
	ICA	94.47	95.85	94.15
	CCA	95.88	97.07	95.42

By comparing the sensitivity, specificity and accuracy of the EEG signals obtained throughout the cycles of sleep (Wake, stage 1, stage 2, stage 3 and REM), the best method is determined. A survey on the two existing techniques is done. After comparing, the best technique is determined as the Methodology 2 which uses the methods of SEDFDB and UCDDDB to identify sleep disorders from EEG waves.

The proposed system has some advantages as follows. First, a single EEG channel is only needed. Second, the high performance of the proposed system implies that, it can be used to assist the experts with the aim of improving the sleep stage classification process. Third, it is not computationally demanding. It can be hence used in portable devices to perform online and real-time classification. Fourth, the system performance does not degrade much using the signals recorded from the subjects with suspected sleep-disordered breathing.

An important limitation of the proposed system is the sensitivity rate obtained in subject cross-validation for REM which is lower than the ones for other states. Improving the sensitivity rate for REM is left for future work. Due to

rapid eye movements during REM, one can investigate the effect of movement-related potential features in this regard.

REFERENCES

- [1]. P. Moeynoi and Y. Kitjaidure, "Dimension reduction based on Canonical Correlation Analysis technique to classify sleep stages of sleep apnea disorder using EEG and ECG signals," *2017 14th International Conference on Electrical Engineering/Electronics, Computer, Telecommunications and Information Technology (ECTI-CON)*, Phuket, 2017, pp. 455-458. doi: 10.1109/ECTICon.2017.8096272
- [2]. P. Memar and F. Faradji, "A Novel Multi-Class EEG-Based Sleep Stage Classification System," in *IEEE Transactions on Neural Systems and Rehabilitation Engineering*, vol. 26, no. 1, pp. 84-95, Jan. 2018. doi: 10.1109/TNSRE.2017.2776149
- [3]. U. R. Acharya et al., "Nonlinear dynamics measures for automated EEG-based sleep stage detection," *Eur. Neurol.*, vol. 74, nos. 5–6, pp. 268–287, 2015.
- [4]. A. L. Goldberger et al., "PhysioBank, PhysioToolkit, and PhysioNet: Components of a new research resource for complex physiologic signals," *Circulation*, vol. 101, no. 23, pp. e215–e220, 2000.
- [5]. V. Steven, "Heart Rate Variability: linear and non linear analysis with applications in humans physiology", Doctoral Thesis of Faculty of Electrical Engineering Kasteelpark Arenberg, Belgium, 2010.
- [6]. S. Baha, P. Musa and et al., "A comparative Study on Classification of Sleep stage Based on EEG signal Using Features and Classification Algorithm", *J. Med Syst*, 2014, 38:18, pp 1-18.

Red laser blood glucose monitoring device

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Red Laser Blood Glucose Monitoring Device

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Abstract: Conventional Invasive technique for blood glucose monitoring requires a finger prick blood sample, a repetitive painful process that creates the peril of infection and costly too. Complications aroused due to the abnormal blood glucose level in diabetic patients have created the necessity of BGM. Laser light based sensors have demonstrated a superior potential for BGM. Near-infrared (NIR) based BGM technique is existing one but it has shortcomings, such as absorption of light in human tissue, higher signal to noise ratio (SNR) and lower accuracy. A simple compact and cost-effective non-invasive device using visible red laser light of 650 nm for Blood Glucose Monitoring (RL-BGM) is implemented in this paper. The RL-BGM device has major technical advantages over NIR such as 30 times better transmittance through human tissue. The refractive index of Red laser light is more sensitive to the variations in glucose level concentration. RL-BGM has faster response time (approx 7-10 s). Linearity and accuracy are higher in case of RL-BGM and both in-vitro and in-vivo cases and several experimental results have been generated to ensure the accuracy and precision of the RL-BGM device.

Index terms- Red laser, Absorbance, blood-glucose monitoring, in-vitro, in-vivo, LCS (Laser Circular Spot)

INTRODUCTION

The Abnormality of blood sugar causes Diabetes or Diabetes Mellitus. They are categorised as Type 1 diabetic patient, diabetes occurs due to the auto-immune destruction of beta cells in the pancreas whereas in type 2 diabetics, the diabetes mellitus occurs from insulin resistance and relative insulin deficiency. Serious secondary health issues have been caused due to diabetes such as blindness, kidney failure, stroke, ulcers, infections, blood vessel damage, obesity and other health complications. Today, India has about 50 million patients with diabetes and this number is projected to increase to 79.4 million by the year 2030. On an individual level Grover S et al. had calculated that the mean annual cost of diabetes care was Rs. 14508 (\$209) to a patient of which 68% was direct cost and 28.8% indirect cost. According to the International Diabetes Federation (IDF) the diabetes patients in 2011 are 366 million worldwide and this number is expected to rise to 552 million by 2030. Blood glucose concentration is currently measured using three broad categories of techniques which are invasive, minimally invasive and non invasive. Invasive techniques require a blood sample which is currently extracted from the fingertip using a device known as lancet. This method of determining blood glucose is currently the most commonly used technique and is a highly accurate method for blood glucose monitoring. Minimally invasive techniques involve attaching electrodes to the skin tissue. This method is not preferred due to its low accuracy and poor signal to noise ratio (SNR) even though this electronic method reduces the chances of infection and minimizes the pain. The latest advances introduced to the field of BGM are non invasive technologies to detect blood sugar concentration using secretions such as sweat, urine, saliva or tears. Besides these secreted fluids glucose concentration is also measured through the skin, earlobe and tongue tissue. These mediums are analyzed to detect glucose concentration non-invasively by employing

optical techniques such as Raman spectroscopy, polarimetry, diffuse reflection spectroscopy, absorption spectroscopy, thermal emission spectroscopy, photo acoustic spectroscopy and fluorescence spectroscopy. Among the available non-invasive techniques absorption spectroscopy is mostly used to observe scattering, absorption, reflection and refraction of light depend on the chemical composition and structure of the sample.

Existing NIR based BGM have prevented medical and commercial applications for this seemingly advantageous and non-invasive technique. Regular blood glucose monitoring plays a significant role in diabetes management and health care, as there is no cure for diabetes [13]. Currently, BGM, which in some cases must be performed several times a day, relies on a crude technique that involves puncturing the skin to draw a drop of blood. Additionally, the technique relies on the use of blood test machines with expensive test strips as consumables raising concerns of running costs thereby decreasing the frequency of testing by patients as well as the issue of the skin puncture in addition to the generated medical waste. The development of a non-invasive and accurate BGM device will be a sign of relief for diabetic patients who are forced to employ this invasive technique.

On the basis of suitable wavelength, a simple, non-invasive, cost effective blood glucose level detection technique and device (RL-BGM) was built based on the variations in the refractive index of red laser light. Intensification of glucose concentration increases the refractive index which is consequently steps up the output voltage at the photo-sensor. Varied output voltages are converted into equivalent glucose concentrations level.

LITERATURE SURVEY

Researchers and scientists for the development of new BGM technologies have more focused on the area of near-infrared spectroscopy (NIRS) rather than on other areas of non-invasive glucose level detection. Yadav, A. Rani, V. Singh, and B. M. Murari, "Prospects and limitations of non-invasive blood glucose monitoring using near-infrared spectroscopy," Biomed. Signal Process introduced a technique to generate an attenuated polarized 785[1] nm wavelength beam from diode laser and directed it towards the glucose sample. When the beam is passed through the sample, the weak coherent laser light is coupled to a fiber and then connected to a photon counting system. This research demonstrated that the photon counts per second and glucose concentration have a linear correlation in samples with glucose concentrations from 10 mg.dL⁻¹ to 260 mg.dL⁻¹. [2015]

M. Tamilselvi and G. Ramkumar, "Non-invasive tracking and monitoring glucose content using near infrared spectroscopy," [2] developed a system by using NIR of wavelengths 940 nm and 950 nm generated from an LED to observe the transmittance of light. The measured output voltage from photo-sensor increased with increasing glucose concentrations. In this experiment, in-vivo results are generated using human finger and observed the output voltage variations before and after a meal for both the aforementioned wavelengths. [2015]

X. Li and C. Li, "Research on non-invasive glucose concentration measurement by NIR transmission," [3] designed a device using NIR transmitter and placed it on the human fingertip to detect the variations in light. The output voltage from photodiode indicated the blood glucose concentration for fasting and non-fasting.[2015]

M. Goodarzi, S. Sharma, H. Ramon, and W. Saeys, "Multivariate calibration of NIR spectroscopic sensors for continuous glucose monitoring," TrAC Trends Anal. [4] proposed a portable device with an accuracy of 84% using near infrared light to display glucose concentration and the required dose of insulin was designed and presented in their paper. [2015]

A. J. Bandodkar and J. Wang, "Non-invasive wearable electrochemical sensors: A review," Trends Biotechnol.[5] Electrochemical sensors offer considerable promise as wearable chemical sensors that are suitable for diverse applications owing to their high performance, inherent miniaturization, and low cost. A wide range of wearable electrochemical sensors and biosensors has been developed for real-time non-invasive monitoring of electrolytes and metabolites in sweat, tears, or saliva as indicators of a wearer's health status[2014]

Similarly, several other researchers have explored the area of NIR for noninvasive BGM using the transmittance characteristics of laser light.

[7]O. S. Abdalsalam, A.-K. M. Osman, R. M. Abd-Alhadi, and S. D. Alshmaa, “Design of simple noninvasive glucose measuring device,” in Proc. latest advances introduced to the field of BGM are non-invasive technologies to detect blood glucose concentration using secretions such as sweat, urine, saliva or tears. Besides these secreted fluids glucose concentration is also measured through the skin, earlobe and tongue tissue[2013]

S. Vashist, “Continuous glucose monitoring systems: A review,” *Diagnos- tics*, vol. 3, no. 4, pp. 385–412, 2013,[8]’Approximately US \$ 376 billion is spent annually in the US on the treatment and management of diabetes in diabetic patients and this amount is expected to rise to a projected US\$ 490 billion by the end of 2030’[2013]

Wang and C. Li,[9] “Measurement of the light absorption and scattering properties of onion skin and flesh study estimated the optical properties of dry skin, wet skin, and flesh of red, *Vidalia* sweet, white, and yellow onions at the wavelength of 633 nm. The total diffuse reflectance, total transmittance, and collimated transmittance of single-layer onion tissues were measured by spectroscopic systems.[2013]. Vashist, [10] “Non-invasive glucose monitoring technology in diabetes management, study evaluated the performance of GlucoTrack, a non-invasive glucose monitoring device, in all diabetes populations: patients with prediabetes (N=7), newly diagnosed patients with type 2 diabetes (diabetes duration \leq 5 years; N=9) and individuals with a long-duration of type 2 diabetes (diabetes duration $>$ 5 years; N=16[2012]

Leasher et al., “Global estimates on the number of people blind or visually impaired by diabetic retinopathy[11] out of overall 32.4 million blind and 191 million visually impaired people, 0.8 million were blind and 3.7 million were visually impaired because of DR, with an alarming increase of 27% and 64%, respectively, spanning the two decades from 1990 to 2010. DR accounted for 2.6% of all blindness in 2010 and 1.9% of all MSVI worldwide, increasing from 2.1% and 1.3%, respectively, in 1990. These figures were lower in regions with younger populations ($<$ 2% in East and Southeast Asia and Oceania) than in high-income regions (North America, Western Europe, and Australasia) with relatively aging populations ($>$ 4%)[2012]

PROPOSED METHODOLOGY

Two methods are proposed in this paper for RL-BGM that is In-vitro and In-vivo .For in-vitro measurement, we are considering different glucose concentrations mixed in the distilled water, taking constant 100ml of distilled water with varying glucose concentrations (GCs) such as 50mg of glucose in 100ml of water, 100mg of glucose in 100ml of water and 150mg of glucose in 100ml of water.

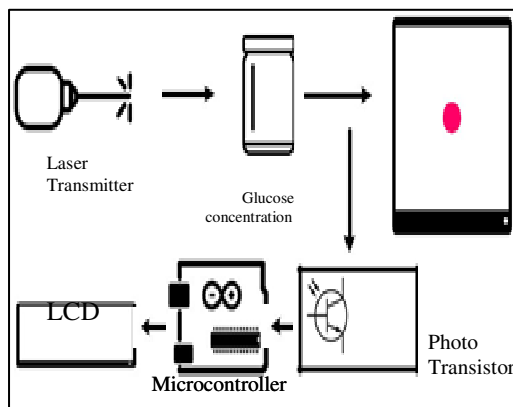


Fig.1: IN-VITRO RL-BGM

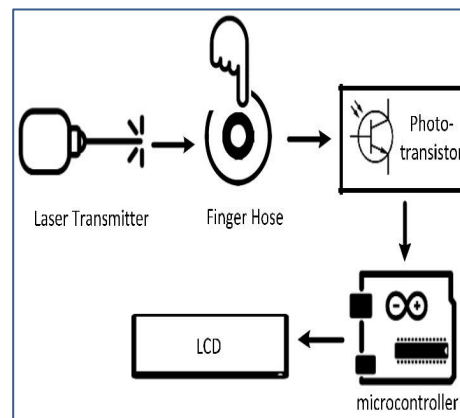


Fig.2: IN-VIVO RL-BGM

Steps involved IN-VITRO RL-BGM:

1. Transmission of visible red laser light on the quartz cuvette, which contains the distilled water, diluted with different concentrations of glucose.
2. The light is passed through the cuvette such that the transmitted light is made fall on paper forming LCS.
3. From the other side of the paper LCS is captured with high-resolution camera.
4. Intensities of LCS were calculated using Image J software.
5. After the calculation of intensities, we can conclude that the concentration of glucose is proportional to refractive index and inversely proportional to the number of pixel in LCS.

Steps involved IN-VIVO RL-BGM:

1. Transmission of visible red laser light on the finger hose
2. The laser light which falls on the finger will transmit the RL light to the receiver on the other side .
3. The received light energy is converted into electrical energy with the help of photo-sensor.
4. The output of the photo-sensor was recorded in voltage and given to microcontroller to display output using 2*16 LCD.
5. The voltage that is displayed on the LCD is calibrated into mg /Dl.

HARDWARE IMPLEMENTATION

Compact designation and fabrication for the proposed technique and testing for both in-vitro and in-vivo cases was performed. The schematics and operations of the hardware are explained below.

A. IN-VITRO HARDWARE IMPLEMENTATION

All the components used here are same as In-vivo setup except finger hose is replaced by a Cuvette containing glucose concentration.

B. IN-VIVO HARDWARE IMPLEMENTATION

In-vivo glucose level detection system is exhibited and labeled in Fig. The hardware consists of 650 nm wavelength transmitter, a photo-sensor to measure light intensity in voltage (mV).

Other components of the RL-BGM are Arduino-UNO microcontroller (8M328), Millimeter, and LM061 LCD (2*16) to display the output voltage.

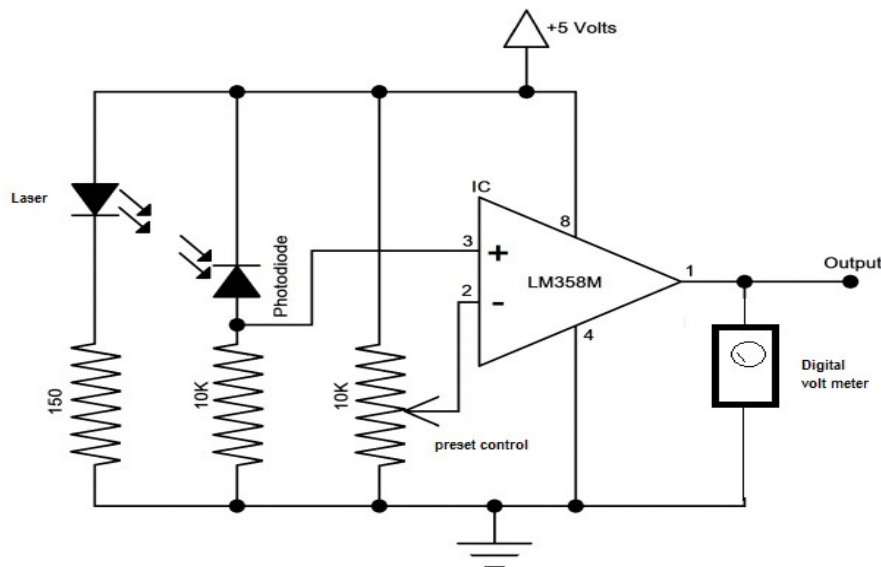


Fig.3:In-Vivo Hardware Implementation

SOFTWARE IMPLEMENTATION

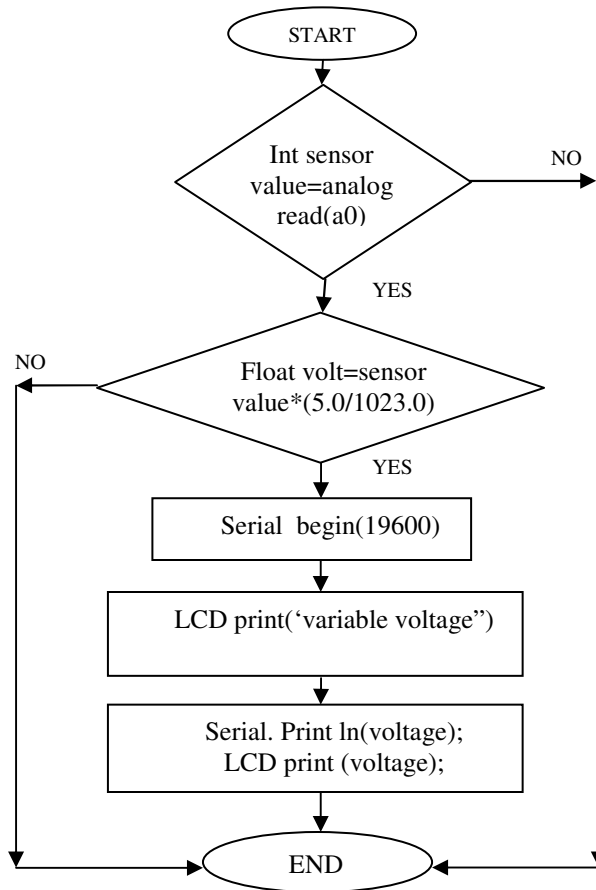


Fig.4:Flow chart of LCD display

ARDUINO software was used to get an display on the LCD with the varying voltage from 0 to 5 volts. The program starts as shown in the figure it will check with the condition whether the sensor value and the analog read output is the same. If the condition is yes then it checks with the second condition whether the float voltage is equal to the sensor values. If the sensor value is not equal to the analog value then the program ends.

The float voltage is checked with the sensor value. If they are equal then it goes for the serial begin or if the condition is not equal then the program ends. From the serial begin it displays on the LCD. Once the voltage is varied using the 10k pot the varied voltage will display on the LCD display.

We have made the setup of IN-VITRO glucose monitoring where the red laser light is focused on the quartz cuvette and the images are captured from the paper which are made to run on the IMAGEJ software from which the intensity and the pixel values are calculated.

CASE STUDIES

Using the different glucose concentrations diluted in the distilled water these are the values tabulated below in fig.



Fig.5:glucose monitoring setup

Using the code as mentioned in the fig these are the LCD display outputs as obtained varying from 0 to 5 volts.

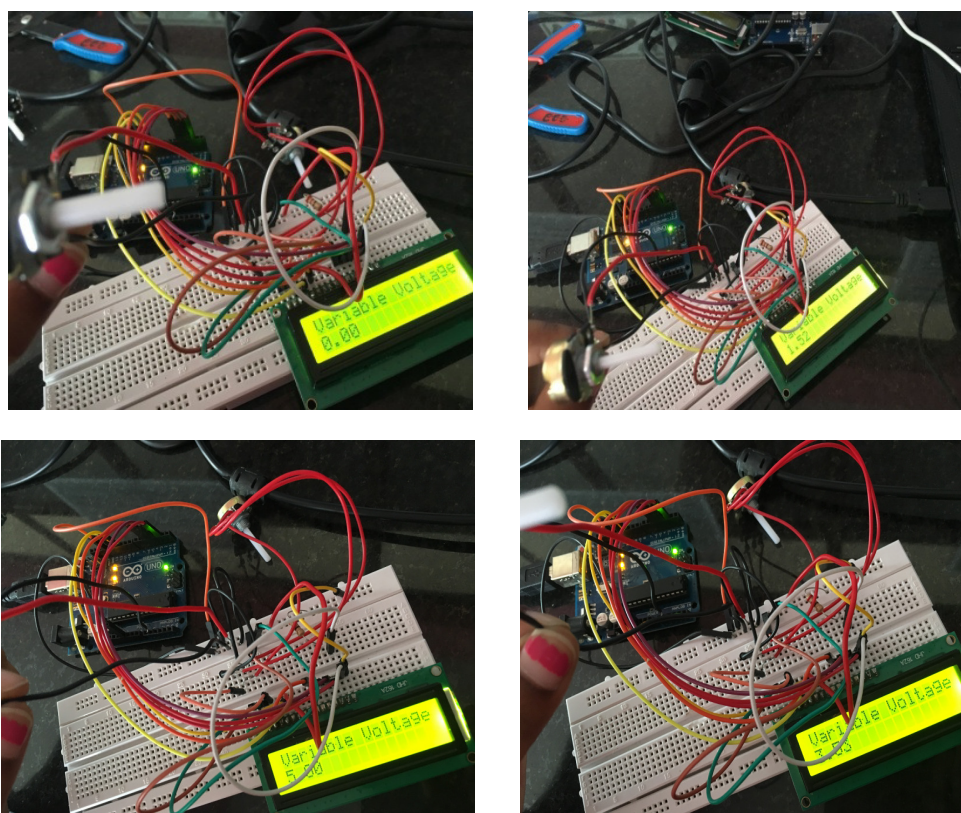


Fig.6:LCD display with varying voltages

RESULTS AND DISCUSSION

We collected the output via invasive and non-invasive method successfully. The non-invasive result was obtained in voltage and non-invasive was obtained in mg/dl. We tried both methods on both category of

normal and diabetic person. The noninvasive output will be calibrated in mg/dl by arduino code. The voltage output of non invasive and mg/dl output from invasive technique has shown the proportional and linear result with the increasing concentration of blood glucose which is shown in below figure.

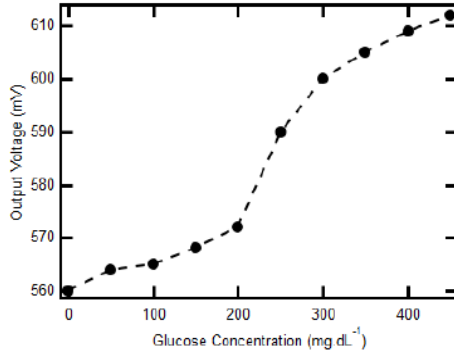


Fig.7: Output voltage increases with the glucose-D concentration in GCSs.

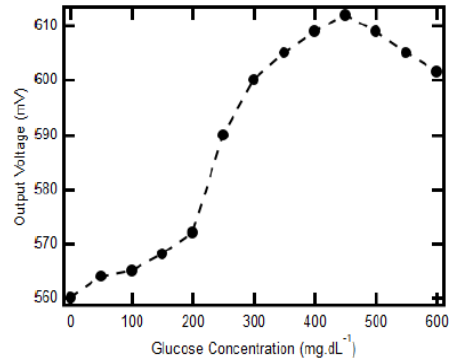


Fig.8: Output voltage at the photo-sensor of RL-BGM device for 0 mg.dL1 to 600 mg.dL1 glucose-D concentrations in GCSs.

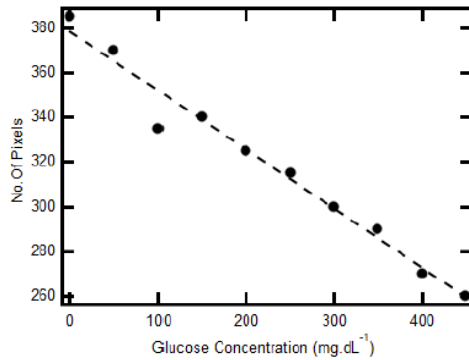


Fig.9: The number of pixels in LCS image reduces with the increase in glucose-D

REFERENCES

- [1]Yadav, A. Rani, V. Singh, and B. M. Murari, "Prospects and limitations of non-invasive blood glucose monitoring using near-infrared spectroscopy," *Biomed. Signal Process. Control*, vol. 18, pp. 214–227, Apr. 2015.
- [2]M. Tamilselvi and G. Ramkumar, "Non-invasive tracking and monitoring glucose content using near infrared spectroscopy," in *Proc. IEEE Int. Conf. Comput. Intell. Comput. Res. (ICCIC)*, Madurai, India, Dec. 2015, pp. 1–3.
- [3]X. Li and C. Li, "Research on non-invasive glucose concentration measurement by NIR transmission," in *Proc. IEEE Int. Conf. Comput. Commun. (ICCC)*, Chengdu, China, Oct. 2015, pp. 223–228.
- [4]M. Goodarzi, S. Sharma, H. Ramon, and W. Saeys, "Multivariate calibration of NIR spectroscopic sensors for continuous glucose monitoring," *TrAC Trends Anal. Chem.*, vol. 67, pp. 147–158, Apr. 2015.
- [5]A. J. Bandodkar and J. Wang, "Non-invasive wearable electrochemical sensors: A review," *Trends Biotechnol.*, vol. 32, no 7, pp. 363–371, Jul. 2014.

- [6]R. A. Buda and M. M. Addi, “A portable non-invasive blood glucose monitoring device,” in Proc. IEEE Conf. Biomed. Eng. Sci. (IECBES), Kuala Lumpur, Malaysia, Dec. 2014, pp. 964–969.
- [7]O. S. Abdalsalam, A.-K. M. Osman, R. M. Abd-Alhadi, and S. D. Alshmaa, “Design of simple noninvasive glucose measuring device,” in Proc. Int. Conf. Comput., Elect. Electron. Eng. (ICCEEE), 2013, pp. 216–219.
- [8]S. Vashist, “Continuous glucose monitoring systems: A review,” *Diagnos- tics*, vol. 3, no. 4, pp. 385–412, 2013.
- [9]W. Wang and C. Li, “Measurement of the light absorption and scattering properties of onion skin and flesh at 633 nm,” *Postharvest Biol. Technol.*, vol. 86, pp. 494–501, Dec. 2013.
- [10]S. K. Vashist, “Non-invasive glucose monitoring technology in diabetes management: A review,” *Anal. Chim. Acta*, vol. 750, pp. 16–27, Oct. 2012.
- [11]J. L. Leasher et al., “Global estimates on the number of people blind or visually impaired by diabetic retinopathy: A meta-analysis from 1990 to 2010,” *Diabetes Care*, vol. 39, no. 9, pp. 1643–1649, 2016.

Error-resilient transmission of image over challenging wireless communication channel

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Error-Resilient Transmission of Image Over Challenging Wireless Communication Channel

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Abstract. Encoding scheme plays a crucial role in image transmission especially over error-prone wireless communication channel. After reviewing existing approaches over similar topic, it was found that existing image transmission scheme doesn't offer any form of assurance or reliability of optimal image quality. Hence, this paper contributes a solution to this research gap by presenting a very simple computational-friendly algorithm of encoding that offers simpler and very much lightweight form of image transmission. The lightweight feature is implemented by constructing pseudonym which makes a good balance between security problems as well as network related problems. The network related problems are solved by presenting a scheme where demanded network resources are allocated to the transmitter in order to ensure highest image quality over a define set of node resources.

Keywords. Image Transmission, Wireless network, lossless image transmission, network coding, pseudonym

INTRODUCTION

With the advancement of the mobile networks and cloud computing, there is an increasing trend of various forms of application that demands image transmission [1][2]. Although, image transmission seems to be easier phenomenon but it is always associated by various challenges that went unobserved. Transmission of image is quite high in banking sector [3], medical sector [4], educational sector [5], industrial sector [6], geological sector [7], aeronautical sector [8], and many more to cite as an example. The area of digital image processing has advanced so much that it offers archival of algorithm to ensure optimal image quality [9]. However, the biggest problem to address here is that there are very less research work where actually image is attempted to be transmitted over a network. It is because when an image is transmitted over a network, there are various forms of routing operation as well as packetization operation that will be leading to transform the image to an unknown extent and thereby causing significant distortion over the image. Irrespective of presence of lossless compression scheme [10], there is no reported algorithm that claims of 100% retention of image data; even a smallest chunk of data degradation may affect the reconstructed image at the other end. Hence, there are already reported studies of image transmission but very few of them actually claims of 100% of quality retention. The problem becomes bigger when the network medium is wireless. There are various application that demands error-free image transmission process irrespective of any faults in the network. However, the existing solution doesn't offer any support to this problem.

Therefore, the prime objective of this manuscript is to introduce a novel idea of image transmission that is proven to offer better signal quality. Section 2 discusses about the existing research work followed by problem identification in Section 3. Section 4 discusses about proposed methodology followed by elaborated discussion of

algorithm implementation in Section 5. Comparative analysis of accomplished result is discussed under Section 6 followed by conclusion in Section 7.

RELATED WORK

Our prior contributed manuscript has offered discussion about scale of effectivity in existing image transmission techniques [11]. This section offer more updates on existing techniques. Existing studies towards image transmission is found to consider the energy-factor associated with it considering different case studies of wireless network. One such research work was reported by Aziz et al. [12] where the study discusses about patterns of energy consumption during image transmission. The significance of energy associated with image transmission was also found advocated in the work of Rehman et al. [13]. Energy as a constraint factor was adopted for accomplishing similar research objective of image transmission was discussed by Wang et al. [14], Wang et al. [15], and Ye et al. [16]. Cho et al. [17] have discussed about dimensionality problems of image during transmission especially in the case of multiple feeds of images connected by network of camera. Similar form of research was also carried out by Liu et al. [18] with difference in considering case study of Internet-of-Things. Dan et al. [19] have presented a study where zig-bee environment was selected to perform image transmission. Kudeshia and Jagannatham [20] have introduced a technique that is capable of performing encoding and decoding operation using Viterbi based approach using JPEG. Salwe and Naik [21] have considered the complexity of heterogeneous network environment in wireless system along with consideration of handover mechanism to investigate its impact on image transmission. A problem associated with secure image transmission was found to be addressed in work of Wang et al. [22]. Apart from the above briefed journals, there are also some unique research ideas presented for addressing similar problems. In this segment, various research-based techniques found as a solution are chaotic-based (Bouridah et al. [23], Cano et al. [24]), performance-based study (Chandra et al. [25]), usage of turbo code (Lahsini et al.[26]), adoption of cross-layer based scheme (Luo et al. [27]), space time transmit diversity (Mithra and Visvaksean [28]), free-space optic (Panic et al. [29]), space time block code (Raj et al. [30]). Hence, above stated literatures are some of the signatory contributions of researchers where there are associated benefits as well as limitations too. The next section discusses about the potential limitation in present literature that are meant to be addressed in this manuscript implementation.

PROBLEM DESCRIPTION

It can be seen from the prior section that majority of the existing implementation has been carried out towards implementing complex form of encoding system towards transmission of an image. However, majority of them are found not to articulate about the problems associated with resource demands especially from the receiver side. It was also seen that existing approaches of image transmission are found to implement highly iterative processes in order to obtain superior version of an image at the cost of computational complexity. Hence, the solution provided by existing system is mainly in the direction of evolving out with highly complex model without even any evidence of faster computational response time. This problem is found to be unsolved till date and hence the propose system chooses to consider this as its code problem i.e. error-free image transmission.

PROPOSED METHODOLOGY

The prime aim of the proposed system is to introduce a novel and very simple technique that can confirm the error-free transmission of any digital image over error-prone wireless networks. The implemented architecture of the proposed system is shown in Fig.1

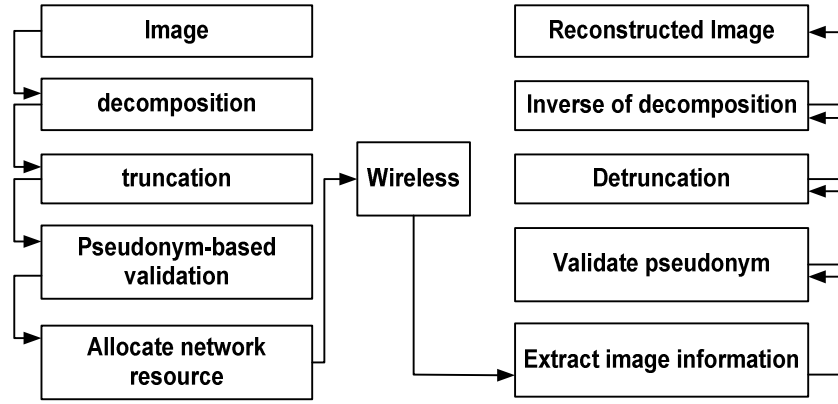


Figure1.Proposed Architecture of Error-Free Image Transmission

Fig.1 highlights an analytical architecture where the input image is subjected to two dimensional decomposition followed by image truncation policy for mapping larger to smaller image size of definite order. The proposed system uses a novel concept of pseudonym which indirectly uses simple cryptographic hash function in order to represent its bits followed by allocation of network resources. The prime idea is to ensure that image transmission should not be affected either due to security problems or due to resource constraint problems. The usage of pseudonym reduces the complexity of image transmission to a higher degree. The next section discusses about the algorithm implementation.

1 Algorithm Implementation

The algorithm is meant for performing encoding of the image in such a manner that it should be capable for retaining maximum signal quality of the reconstructed image on the other end of transmitter. The algorithm takes in the input of l (level), d (data allocated per level), c (compression coefficient) that after processing leads to generation of I_4 (encoded image). The steps involved in the proposed algorithm are as follow:

Algorithm for Robust Image Transmission

Input: Img (Input Image), l (level), d (data allocated per level), c (compression coefficient)

Output: I_4 (encoded image)

Start

1. init Img, l , d , c
2. Apply $f_1(x)^n \rightarrow I_1$
3. Apply $t(I) \rightarrow I_1$
4. Apply $e_c(I_1) \rightarrow I_2$
5. Apply $f_2(I_2) \rightarrow I_3$
6. Apply $f_3(I_3) \rightarrow I_4$

End

The discussions of the steps of the algorithm are as follows: The proposed system considers Img (Image) as an input against which an initialization is made for l (level), d (data allocated per level), c (compression coefficient). The proposed system considers that there are $(n-1)$ levels where each level consists of digital signature, encryption-tag, and image information. For effective security and error resiliency, the study considers that the lower level $(n-1)$ only consists of image information while its upper immediate level $(n-2)$ will concatenate the encryption tag with image information, The formation of the data (i.e. image information and encryption-tag) will be remain until it reaches the last level (i.e. level-0), where the system will concatenate digital signature along with the prior formation of the data i.e. image formation and encryption tag. The proposed system then apply decomposition for two dimensional image in order to extract multiple signal coefficient followed by extraction of approximated coefficient. Hence, $f_1(x)$ represents the decomposition function applied on input image

I in order to obtain the decomposed image i.e. I (Line-2). Finally, the decomposed image I is further subjected to image truncation process by which method the continuous values of the input image is mapped with the smaller version of it. The function $t(I)$ represents truncation function applied over the decomposed image I in order to yield truncated image I_1 (Line-3). This offers better measurable features as well as control complexity of encoding to a very large scale. This operation is followed by applying entropy encoding function e_c (Line-4) that take the input of number of bits, specific size, and scale that after processing yields the outcome of encoded bits i.e. I_2 . The proposed system formulates a different form of function i.e. $f_2(x)$ which is meant for ensuring that underlying communication channel is error resilient (Line-5). For this purpose, the algorithm first computes the number of data packet to be allocated for all the values of defined levels as well as image information. The calculation of the amount of bits in each image is carried out by dividing compressed bits of image packet by the product of number of levels used and data allocated per bits. The next part of the study develops a pseudonym using the dimensions of number of levels used and data allocated per bits and applies a hash-chain on each bit. This leads to the generation of further encoded bits of image i.e. I_3 (Line-6). The next function $f_3(x)$ further performs final level of processing by allocation the exact amount of the network resource required to perform an error free image transmission. The steps of the algorithm are as follow:

Algorithm for Network Resource Allocation for Increasing Network Resiliency

Input: n (number of bits allocated per level), l (level)

Output: I_4 (finally encoded bits of image)

Start

1. **For** $i=1:n$
2. obtain $bs \rightarrow \text{data}(l, n)$
3. $I_4 = [p || bs]$
4. **End**

End

In this algorithm, initially an encoded tag is allocated to all the image data packets. Therefore, for all the number of bits allocated per level (Line-1), the algorithm constructs the encoded bits by developing a cell of row and column dimension equivalent to number of level and number of bits allocated per level respectively. The algorithm, however, doesn't alter the last image packet otherwise it alters all the image packets and record the resultant bits accomplished. The algorithm checks for all the levels from first to last level and then for all the image packets to explore better form of bit streams bs (Line-2). The algorithm then performs concatenation of the generated pseudonym and bitstream in order to generate encoded bits I_4 (Line-3). One of the interesting aspects to observe in this algorithm is that by transforming the complete image in the form of pseudonym, the overall complexity of the processing and then transmitting the image over any form of wireless medium is significantly removed. Along with this, the dimensions of the pseudonym are also lowered in increasing number of level thereby rendering the backward secrecy as well as forward secrecy. Hence, there is no possibility of any form of capturing (or illegal) decoding by any attacker as well as neither there is any possibility of signal quality to be degraded while performing image transmission. The next section discusses about the results obtained from the proposed algorithm implementation.

2 Results Discussion

This section discusses about the outcomes obtained from the proposed study implementation. The algorithm is designed and executed using numerical computation platform. The assessment has been carried out over different numbers of images;; however, this section will only discuss about some standard image usage. highlights the input of original image with a dimension of 512x512 and occupies 233 KB. This image when subjected to decomposition results in decomposed image . The truncated image is further subjected to entropy encoding followed by incorporation of pseudonym in order to ensure better forward and backward secrecy. Finally, the network resource allocation is carried out to ensure that exact allocation of resource to take place in order to transmit the image information without any form of performance degradation. Detruncated image obtained at receiver followed by final reconstructed image.

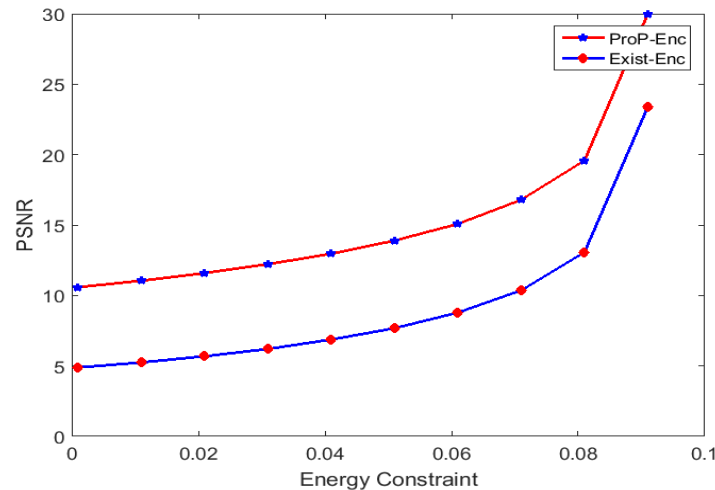


Figure 2 Comparative Analysis

In order to perform the assessment of efficiency, the proposed analysis compared its proposed encoding scheme (ProP-Enc) with the most frequently used existing JPEG encoding scheme (Exist-Enc). The graphical outcome shown in Fig.3 highlights that proposed system offer better PSNR in contrast to existing scheme over increasing value of energy constraint. The parameter energy constraint was essential to consider as the proposed system opted for investigating within wireless communication channel where energy is always a constraint for the communicating devices. Hence, for a given fixed constraint of energy of communicating device, it is anticipated for the receiver node to find the higher possible range of visual quality. Therefore, the proposed system offers error resilient transmission of an image in wireless network. The study also find that cumulative processing time of proposed system is 0.23387 seconds whereas the existing JPEG is found to consume 0.87763 seconds for encoding the same image in one platform and one wireless medium.

CONCLUSION

This paper has presented a simple solution with an aid of pseudonym-based encoding scheme which offers a good security feature as well as it also ensure that information related to pixels are in the form of pseudonym which is not only lightweight but also secured by cryptographic hash function. The proposed system also presented solution for network –based problems by developing a simple scheme where network resources are allocated to the transmitter in order to ensure successful transmission of the image. The study outcome was found to claim that proposed system offer better signal quality in comparison to existing system.

REFERENCES

- [1] Sudip Misra, Barun Kumar Saha, Sujata Pal, [Opportunistic Mobile Networks: Advances and Applications](#), Springer, 2016
- [2] M. Bala Krishna, Jaime Lloret Mauri, *Advances in Mobile Computing and Communications: Perspectives and Emerging Trends in 5G Networks*, CRC Press, 2016
- [3] Kanwar Mehta, *Fence the Fraud: A practical guide To Prevent Bank Frauds (Cheque and Card)*, Notion Press, 2016
- [4] Guorong Wu, Dinggang Shen, Mert Sabuncu, *Machine Learning and Medical Imaging*, Academic Press, 2016
- [5] Magued Iskander, *Innovative Techniques in Instruction Technology, E-learning, E-assessment and Education*, Springer Science & Business Media, 2008
- [6] Brian Goodall, Gregory Ashworth, *Marketing in the Tourism Industry (RLE Tourism): The Promotion of Destination Regions*, Routledge, 2013
- [7] E.A. Hailwood, R. Kidd, *Marine Geological Surveying and Sampling*, Springer Science & Business Media, 2012
- [8] Xuemai Gu, Gongliang Liu, Bo Li, *Machine Learning and Intelligent Communications*, Springer, 2018
- [9] Niceto Salazar, *Advances, Tools and Techniques of Digital Image Processing*, Willford Press, 2016
- [10] J. Shukla, M. Alwani and A. K. Tiwari, "A survey on lossless image compression methods," *2010 2nd International Conference on Computer Engineering and Technology*, Chengdu, 2010, pp. V6-136-V6-141.

- [11] Bharathi Gururaj, G Sadashivappa, "Insights on Error-Resilient Image Transmission Schemes on Wireless Network" *SAI-The Science and Information Organization*, DOI: 10.14569/IJACSA.2017.080106, 2017
- [12] S. M. Aziz and D. M. Pham, "Energy Efficient Image Transmission in Wireless Multimedia Sensor Networks," in *IEEE Communications Letters*, vol. 17, no. 6, pp. 1084-1087, June 2013.
- [13] Y. A. Ur Rehman, M. Tariq and T. Sato, "A Novel Energy Efficient Object Detection and Image Transmission Approach for Wireless Multimedia Sensor Networks," in *IEEE Sensors Journal*, vol. 16, no. 15, pp. 5942-5949, Aug.1, 2016.
- [14] W. Wang, D. Peng, H. Wang, H. Sharif and H. H. Chen, "Energy-Constrained Distortion Reduction Optimization for Wavelet-Based Coded Image Transmission in Wireless Sensor Networks," in *IEEE Transactions on Multimedia*, vol. 10, no. 6, pp. 1169-1180, Oct. 2008.
- [15] Y. Wang, D. Wang, X. Zhang, J. Chen and Y. Li, "Energy-Efficient Image Compressive Transmission for Wireless Camera Networks," in *IEEE Sensors Journal*, vol. 16, no. 10, pp. 3875-3886, May15, 2016.
- [16] S. Ye, Y. Lin and R. Li, "Energy-aware interleaving for robust image transmission over visual sensor networks," in *IET Wireless Sensor Systems*, vol. 1, no. 4, pp. 267-274, December 2011.
- [17] M. Cho, H. Lee, H. H. Choi and B. Javidi, "A Three-Dimensional Image Transmission Using In-Network Computation in Wireless Multi-Camera Networks," in *IEEE Journal of the Electron Devices Society*, vol.5, Iss.6, 2017
- [18] X. Liu, C. Sun, K. Kang and L. Zhang, "Joint 3-D Image Quality Assessment Metric by Using Image View and Depth Information Over the Networking in IoT," in *IEEE Systems Journal*, vol. 10, no. 3, pp. 1203-1213, Sept. 2016.
- [19] D. Tao, G. Yang, H. Chen, H. Wu and P. Liu, "Efficient Image Transmission Schemes over Zigbee-Based Image Sensor Networks," in *Chinese Journal of Electronics*, vol. 25, no. 2, pp. 284-289, 3 2016.
- [20] A. Kudeshia and A. K. Jagannatham, "Optimal Viterbi Based Total Variation Sequence Detection (TVSD) For Robust Image/Video Decoding In Wireless Sensor Networks," in *IEEE Signal Processing Letters*, vol. 21, no. 6, pp. 722-726, June 2014
- [21] S. S. Salwe and K. K. Naik, "Discrete image data transmission in heterogeneous wireless network using vertical handover mechanism," in *IET Image Processing*, vol. 11, no. 7, pp. 550-558, 7 2017.
- [22] H. Wang, D. Peng, W. Wang, H. Sharif and H. H. Chen, "Image transmissions with security enhancement based on region and path diversity in wireless sensor networks," in *IEEE Transactions on Wireless Communications*, vol. 8, no. 2, pp. 757-765, Feb. 2009.
- [23] M. S. Bouridah, T. Bouden and A. Boulkroune, "Image secure transmission using chaotic synchronization," *2017 5th International Conference on Electrical Engineering - Boumerdes (ICEE-B)*, Boumerdes, 2017, pp. 1-6.
- [24] A. Melendez-Cano *et al.*, "Chaotic Synchronization of Sprott Collection and RGB Image Transmission," *2017 International Conference on Mechatronics, Electronics and Automotive Engineering (ICMEAE)*, Cuernavaca, 2017, pp. 49-54.
- [25] M. Chandra, D. Agarwal and A. Bansal, "Performance analysis of image transmission through Rayleigh channel," *2017 8th International Conference on Computing, Communication and Networking Technologies (ICCCNT)*, Delhi, 2017, pp. 1-5.
- [26] C. Lahsini and A. Bouallegue, "Channel decoding of Reed Solomon block turbo codes with a priori information : Application to image transmission," *2017 International Conference on Wireless Networks and Mobile Communications (WINCOM)*, Rabat, 2017, pp. 1-6.
- [27] J. Luo, S. Wu, S. Xu, J. Jiao and Q. Zhang, "A Cross-Layer Image Transmission Scheme for Deep Space Exploration," *2017 IEEE 86th Vehicular Technology Conference (VTC-Fall)*, Toronto, ON, 2017, pp. 1-5.
- [28] K. Mithra and K. S. Vishvakshan, "Security and resolution enhanced transmission of medical image through IDMA aided coded STTD system," *2017 International Conference on Communication and Signal Processing (ICCSP)*, Chennai, 2017, pp. 2061-2065.
- [29] S. Panić, H. Milošević, B. Prlinčević, V. Petrović and O. Taseiko, "FSO transmission of halftoned image over DGG turbulence channel," *2017 First South American Colloquium on Visible Light Communications (SACVLC)*, Santiago, 2017, pp. 1-5.
- [30] P. T. V. Raj, K. S. Vishvakshan, V. Dinesh and M. Elaveni, "System analysis of STBC-CDMA technique for secured image transmission using watermarking algorithm," *2017 International Conference on Communication and Signal Processing (ICCSP)*, Chennai, 2017, pp. 2192-2196.

DEVELOPMENT AND TESTING OF BIO-COMPOSITE STEERING WHEEL FOR AUTOMOTIVE APPLICATION

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ABSTRACT

In the verge of sustainability, an enormous amount of research is carried out in green technologies, to develop eco friendly products. The ultimate intension behind this work is to generate bio-composite material which is bio-degradable. The FRP composites have authoritative function for automobile, structural and various other applications. Natural fibres which can be used as reinforcements are strong, light weight and superior specific properties when compared with synthetic fibres. This investigation intends to replace the existing conventional automobile steering wheel with light weight, cost effective bio-composite steering wheel. The combination of natural fibres like jute, coconut, sisal, banana are reinforced in a shell like structure with epoxy resin as matrix. The natural fibers with relative proportions of 20%,30%,40% and 50% weight fraction, were treated with NAOH. The same were used for experimentation to identify the best results. The test specimens as per ASTM standards were designed, fabricated and tested; fabrication was done using manual hand layup technique. Tests were conducted based on parameters considering flexural strength and impact strength and better results were found. The bio-composite steering wheel exhibited better tensile and flexural strength. bio composite steering wheel exhibited good mechanical properties comparatively supporting our vision to substitute existing various automotive components, thus leading to eco friendliness.

KEYWORDS: Bio composite, steering wheel, Epoxy resin, Hand lay-up method, Automotive, Mechanical properties.

1. INTRODUCTION

The Evolution of most advanced composite material, successfully proven in wide range of engineering applications for products which have markets specifications and its sophistications. The crucial parameters and direction at which composite materials have been headed towards weight reduction and superior mechanical properties, despite maintaining the cost effectiveness for industrial requirements [1-2]. The emergence of the innovative manufacturing techniques has been currently adopted in industries to attain advance manufacturing technology. The essentialities of delivering quality assurance is in been trade off by adopting integrated efforts in process, tooling, materials, design in such a scenario bio composites have created competence podium with MMC[3].

Subbiah Jeeva.Ga, et al., [4] concluded that coir fiber have higher interfacial adhesion when subjected to dry conditions. Ramesha M et al.,[5] Characteristics of natural fibers composites with the combination of polyester matrix with coir fibers subjected to different ageing solutions have shown better interfacial adhesion. Few of the research investigation have also proven the fact that hybrid composites delivered better results when compared to single type of fiber and made these successful attempts of also resulted in better properties when natural fibers are blended with glass fibers. Girisha C et al., the period of composites ageing have great influence on hybrid composites prepared the with glass fiber bamboo fiber and polymer matrix.the ageing phenomenon have crucial effect on tensile characteristics [6] and [7].

Now day's development of automobile technology more lightweight materials like glass material thermoplastic are used to automobile industries [8]. Glass material thermoplastics chemical/corrosion resistance and high strength to weight ratio. Good impact load at low and high temperature [9]. The properties due to visco-elasticity of polypropylene is used in matrix material. Result of the viscoelastic behavior, the strength at practically encountered bend in crash loaded in automobile parts is considerably higher than the "quasi static" strength precise at an elongation rate of 0.001 (1/s) [10]. Now days increasing weight reduction of vehicle: Decrease fuel consumption and bumper is the main parts of vehicle so its weight is significant to the inertia and result as a handling of vehicle [11].

Hybrid composites applications for the aircraft parts very important. Aircraft, other vehicles need high stress on weight and safety. They are using materials with specific properties. Modern technology that has gone past design and application where high. In case Modulus of elasticity is taking away significant role, Hybrid composites are low cost of materials in natural options [12]. Alkali treatment of banana, jute and coconut fiber reinforced with 5% NaOH improved the mechanical properties [13].

2. MATERIALS

2.1 Matrix: Epoxy resin (LY-556) with density (1.1-1.5g/cm³) and a mixing ratio of 10:1.

2.2 Natural Fibers: Natural Fibers like Sisal, banana, Coconut Coir and Jute mat. The properties of the selected natural fibers are as mentioned in Table no. 1.

Table 1: Natural fiber Properties

Plant fibers	Density (Kg/m ³)	Tensile strength (MPa)	Young's modulus (GPa)
Sisal fiber	1300-1500	80-840	9-22
Banana fiber	1300-1350	529-914	27-32
Coconut coir	1150-1250	106-175	6-8
Jute fiber	1300-1500	200-450	20-55

Sisal Fiber: Scientific name of sisal agave sisalana. Completely biodegradable and is extracted by decortications. Sisal fiber strong and is commercially available, Sisal fibers are as shown in Fig. 1.



Figure 1: Sisal fiber

Banana Fiber: Banana fiber which contains cellulose possesses better luster, less weight, small elongation and easy

degrades, commercially available at reasonable prices. Application of manufacturing building board, fire resistance fiber board etc, banana fibers are as shown in Fig. 2.



Figure 2: Banana fiber

Coconut Coir Fiber: Coconut coir is a lingo-cellulosic fiber. Peeled left out coconut coir. The applications are in the roofing sheets, geo- textile, manufacturing building panels etc, coconut coir fibers are as shown Fig. 3.



Figure 3: Coconut coir

Jute Fiber: Jute fiber are strong thread produced from genus *Corehorus* plant by spinning a coarse of plant fiber which is long shiny and soft. Abundant availability of jute stands next to cotton for various uses. Jute contains lignin and cellulose. This is eco friendly recyclable and thus used in various combinations of natural fibers reinforced composites, the jute fiber mat is as shown in Fig. 4.



Figure 4: Jute mat fiber

2.2. Surface treatment of fibers

Fiber Treatment: Selected fibers used for the fabrication of composites were washed with distilled water and dried. The fibers were dipped in 10% of NaOH solution for 10hrs, and washed with water followed by drying. By the fiber surface treatment strong fibers with better mechanical properties are obtained.

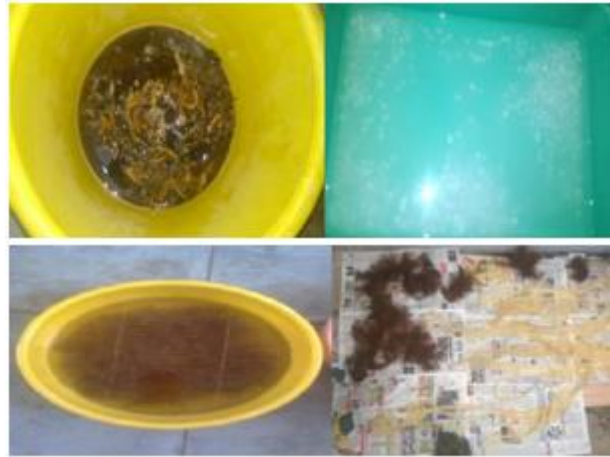


Figure 5: Surface treatment with NaOH solution

2.3. Fabrication of bio-composite with the combinations

The sample specimens for the basic characterization were fabricated by using various fibers; the hybridization pattern is as shown in the table-2

Table 2: Constituents of the sample

Jute fiber
Coconut fiber
Sisal fiber
Banana fiber
Jute fiber

3. TESTING OF COMPOSITE MATERIALS

3.1. Flexural Test

Standard specimen as per the ASTM D256 (180mx50mx15m) were prepared for performing the Flexural test. Sample dimension of the specimen is as shown in Fig. 6. The testing was conducted in UTM. Young's modulus of material, Flexural Strength and ultimate load were measured and tabulated.

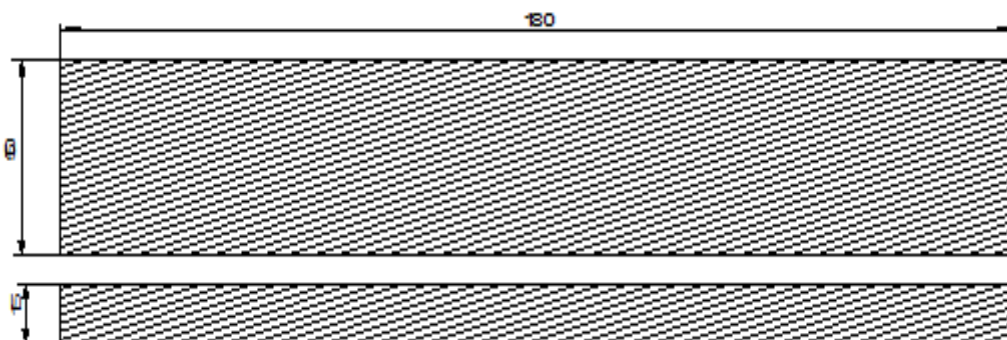
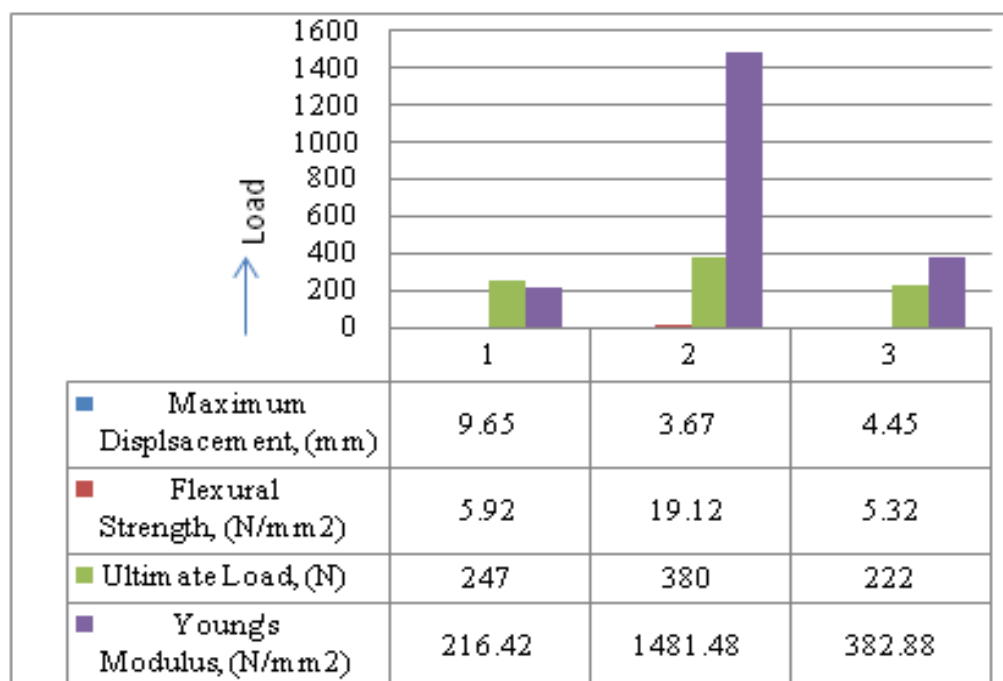


Figure 6: Point bending test specimen



Figure 7: Specimen before test and after test



Average Ultimate Load: 283N

Average Young's Modulus: 693.59N/mm²

3.2. Impact test

Charpy impact strength evaluation was done (according to the ASTM standards) for the fabricated Bio-Composite, Using Impact Testing Machine supplied by MCS MECHATRONICS, Maharashtra, India.

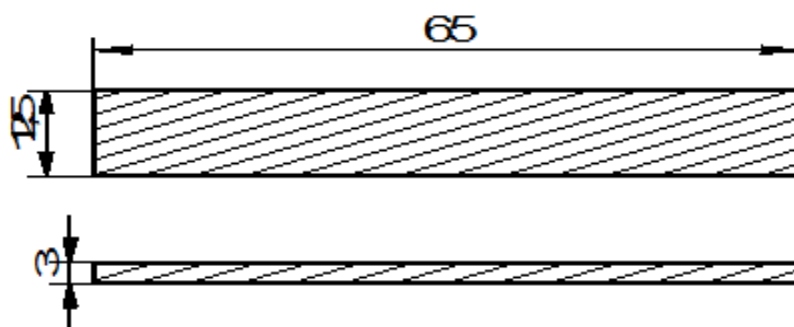


Figure 8: Impact test specimen

Impact test results obtained for various combinations of Natural fibers reinforced hybrid bio-composites are as below.

Table 3: Composition of impact test results

Composition	Impact Energy (J)		
30% Epoxy-70% (Jute+Coconut+ Sisal + Banana)	3.46	3.41	3.26
50% Epoxy-50% (Jute+Coconut+ Sisal + Banana)	4.98	4.67	4.61
70% Epoxy-30% (Jute+Coconut+ Sisal + Banana)	2.78	2.73	2.71

4. DEVELOPMENT OF BIO-COMPOSITES STEERING WHEEL

Natural fiber like sisal, coconut fiber, Banana fiber were initially blended with layer of epoxy and layered inside a cycle tyre, which was taken as a mould, as shown in fig.9. (a) Epoxy acts as a glue for the bottom layer of jute mat, above which natural fiber reinforcements such as sisal fiber, banana fiber, coconut fibers are placed alternatively along with epoxy resin. layer of jute mat is placed on the top layer as shown in fig. 9. (b). These fibers are compressed with help of twinning rope on the sheet metal plate as shown in fig. 9. (c), to ensure the proper bonding between reinforcement and fibers. The hybrid composite prepared is allowed for setting for about 24 hours. After curing, the dried steering wheel is taken out from the cycle tyre, which is used as amould (as shown in fig. 9. (d)), the extra projections are cut and the surface of the steering wheel is smoothened by using a sand paper, as shown in fig. 9. (e).



Figure 9: Fabrication stages of Bio-composite steering wheel

4.1. Fabrication of Hub and Steering Rod

Epoxy resin is coated within the Mould as shown in (fig.10.a, b and c). Jute mat has been used as a base layer, and a mould releasing spray is coated between the mould and the first jute layer. Epoxy was applied over the jute mat followed by the application of the selected natural fibers alternatively. The hybrid composite was allowed to cure for 24 hours.



Figure 10: Fabrication of hub and Steering rod

4.1.1. Design and the Reduction of Weight of Steering Wheel

Conventional material steering wheel weighs 2.5-3 kg, by using the hybrid bio composite steering wheel; we can achieve 50% of weight reduction.

The Figure-11 shows the CAD model and the final actual model of steering wheel, the fabricated Selection wheel was used in a Hyundai Santro car for the testing purpose. Conventional steering wheel which is available in the market ranges from Rs/- 1500-2500. By using the Bio composite steering wheel cost reduction up to 50% can be achieved.



Figure 11: CAD Model and Final model of steering wheel

4.1.2. Force Analysis

Two types of forces are acting on the bio-composite steering wheel namely a) Tangential Force b) Braking Force

Tangential force

The force acting on the outer edge of steering wheel and due to this force the steering process takes place.

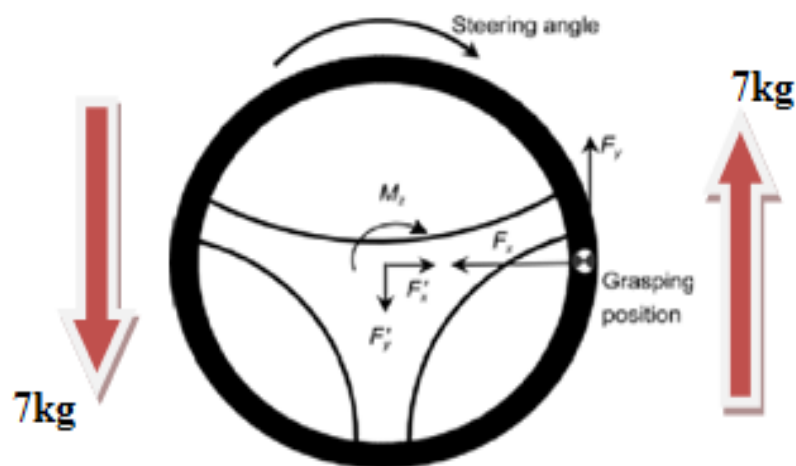


Figure 12: Analysis of Tangential forces

Fig. 12. Shows the force analysis on a steering wheel. One end of the steering wheel is mounted to a spring balance and rotated for a full steer. The reading of the spring balance is obtained on the other end. The obtained reading which was

about 14kg was used for the calculation of the Couple. Average of five readings was taken for the calculation.

Couple $= R \cdot mg = 180 \cdot (7+7) \cdot 9.816 = 24.73 \text{ Nm}$. Where R = Radius of steering wheel = 180mm. Now, this force splits into half on either sides of the steering wheel and the couple is calculated as shown in fig.13.



Figure 13: Testing of Tangential force

Braking Force

The braking force acts on the steering wheel during the time of braking of automobile, which is due to inertia of the driver. Braking force acts perpendicular to the steering wheel. As shown in the fig.14. During the analysis the braking force obtained was 350N (i.e.35kg).



Figure 14: Testing of braking force

5. CONCLUSIONS

Characterization of the natural fiber reinforced bio composites which were prepared by varying the percentage of fibers was done for the impact strength, tensile strength and flexural strength. Using hand layup technique the natural fiber reinforced bio-composite steering wheel was fabricated successfully.

Flexural strength of the hybrid-bio composite was found to be 19.2N/mm² and the load that the hybrid composite could withstand is about 380N. For a tangential force of 14kg acting on the steering wheel of radius 180mm Couple is found to be 24.73Nm and the braking force is found to be 350N. The average impact strength of bio composite fabricated sample

50% Epoxy-50% (Jute+ Coconut+ Sisal + Banana) was found to be 4.75J. Conventional steering wheel weighs around 2.5-3kg while steering wheel manufactured by epoxy and natural fibers (jute, coconut, sisal and banana) weighs up to 1.4kg.i.e more than 50% weight reduction is achieved.

Fabricated steering wheel didn't fail in above testing which implies, our steering wheel is safe and has the potential to replace the conventional steering wheel.

Bio composites steering wheel have been shown good mechanical properties when compared to synthetic fiber reinforced composites, considering the biodegradability, recyclability and reduced cost.

REFERENCES

1. B. Bharath, B.Chandrashekar, C. Girisha "Fabrication and Mechanical Characterization of Bio-Composite Helmet" *Material Today: Proceedings Elsevier*, Vol 5, Issue 1, part 3, PP.2716–2720, 2018.
2. Sanjay M. R, B. Yogesha "Study on Water Absorption Behaviour of Jute and Kenaf Fabric Reinforced Epoxy Composites: Hybridization Effect of E-Glass Fabric" *International Journal of Composite Materials* 2016, 6(2): 55-62.
3. Daniel Antony C, Prince Jerome Christopher J, "Design and Analysis of Two Wheeler Alloy Wheel Rim Using Composite Materials" *IJIRSET*, Vol. 5, Issue 5, May 2016.
4. Subbiah Jeeva.Ga, Subin Kumar.Mb, yabez Raj.D "Fabrication and Testing of Fiber Reinforced Composite Material" *ISSN(Online) : 2319 - 8753 Vol. 4, Special Issue 6, May 2015*.
5. Ramesha M, Palanikumar K, Hemachandra Reddy K. Mechanical property evaluation of sisal–jute–glass fiber reinforced polyester composites. *Compo: Part B* 2013; 48: 1–9.
6. Girisha.C, Sanjeevamurthy, Gunti Ranga Srinivas "Sisal/Coconut Coir Natural Fibers – Epoxy Composites Water Absorption and Mechanical Properties" *IJEIT: 2277-3754 Volume 2, Issue 3, September 2012*.
7. A.Alavudeen,M. Thiruchitrabalam, N.Venkateshwaran and A.Athijayamani "Review of natural fiber reinforced Woven composite" *Advances in Material science*, volume -27: 2011.
8. K. Murali Mohan Rao, K. Mohana Rao 'Extraction and tensile properties of natural fibers: Vakka, date and bamboo'. *Composite Structures* volume 77,(2007), 288–29.
9. Panthapulakkal S, Sain M. "Injection-molded short hemp fiber/glass fiber reinforced polypropylene hybrid composites – mechanical, water absorption and thermal properties". *J Appl Polym Sci* 2007; 103: 2432–41.
10. Arbelaiz et al, "Influence of matrix/fiber modification, fiber content, water uptake and recycling", *Composites Science and Technology*, 2005; 65: 1582–92.
11. Thwe MM, Liao. Durability of bamboo–glass fiber reinforced polymer matrix hybrid composites. *Compos Sci Technol* 2003;63:375–87.
12. Yan Li, Yiu-Wing Mai, Lin Ye, 'Sisal fiber and its composites: a review of recent developments'. *Composites Science and Technology*, volume 60, (2000), 2037-2055.
13. Varghese S, Kuriakose B, Thomas S. "Stress relaxation in short sisal fiber-reinforced natural rubber composites". *J Appl Polym Sci* 1994;53: 1051–60.

Experimental study on multifunctional biomass cooking stove

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Experimental Study on Multifunctional Biomass Cooking Stove

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Abstract: This paper presents the performance enhancement of multifunctional cooking stove with thermal energy storage. The stove consists of cooking pot and thermoelectric generator attached on wall the stove with thermal storage unit on the hot side. An experimental is conducted and found the efficiency of the biomass stove as 20% and combined mode 50%. It is concluded that the proposed system can be used as standalone power generation system to meet power demands at isolated rural house and it will reduce the burden to conventional grid suppliers.

Keywords: Biomass Stove, Thermoelectric Generator, Phase Change Materials.

INTRODUCTION

These traditional stoves are characterized by low energy conversion efficiency which results in inefficient use of scarce biomass fuel supplies, also lead to high emissions of health damaging air pollutants (Champier, et al, 2010). To save biomass fuel and spare rural communities from acute respiratory infection, it is important to replace a traditional open fire stove by an improved one. Improved stoves are produce lesser emission with higher efficiency by incorporating natural draft system and sufficient passages for air circulation in the biomass cook stove design. Improved biomass stove have forced draught system are available in the market is powered by battery. Battery has the problems of short in life and leakage of acid leads to environmental hazards. Repeated charging is inconvenient to users (Lertsatitthanakorn, 2007). The national grid supply system has failed to provide reliable electric supply to rural areas due to its technical and economic factors. The solar photovoltaic system is preferred device to light the rural isolated home. Due to the low power factor value of solar photovoltaic system is not successful. Another option is biomass stove integrated with low cost thermoelectric generator (TEG) to generate heat and electricity.

Thermoelectric Power Generation

Thermoelectric power generation has many features like direct energy conversion, maintenance free, silent in operation and involving no moving or complex parts. The energy conversion efficiency is low as 5–10% and this is not the limiting factor for unused heat in energy conversion system. The recent drop in thermoelectric material prices is an economically feasible proposition. The scope of the paper to study the overall performance of the multifunctional cooking stove integrated by bismuth telluride based TEG with air cooled heat sink. It is expected to generate additional electric power of 10-100W which gives an overall efficiency of 3% higher than biomass stove and about 20% of reduction in emission level. Also, it helps to improve the living standards of the isolated rural people. It is concluded that couple of research work was made on the biomass stove integrated TEG to improve its fuels energy conversion efficiency and economics (Champier et al., 2010; Niu et al., 2009; Lertsatitthanakorn, 2007; Nuwayhid et al, 2003). TEG operated by its cold side based on water cooled or air cooled. But, incorporation of phase change materials on cold side of TEG is not reported in any scientific literature.

In this paper, a study on biomass stove thermoelectric generator with phase change material is carried out from energy balance equations and based on operating and design parameter is carried out.

EXPERIMENTAL SETUP

The photographic view of experimental system is shown in Figure 1. The biolite thermoelectric generator stove 2 module is selected and bamboo waste selected fuel to operate stove system. Boiling water test is selected to study the thermal performance of the system. Mobile battery charging route is used to measure the electrical output of the thermoelectric generator. The flame temperature, water temperature and heat sink temperature are monitored to The combustion of biomass fuel takes inside the stove and combustion flame is transfer the heat from higher temperature to lower temperature. The heat is transferred to TEG through walls of stove.



FIGURE 1 Photographic View of Experimental Setup

PERFORMANCE ANALYSIS

Biomass stove

Thermal efficiency of biomass stove expressed as

$$\eta_{thermal} = \frac{\text{Thermal Energy Output}}{\text{Thermal Energy Input}} \quad (1)$$

The thermal energy output is calculated amount heat gained in water through boiling test and thermal energy supplied terms equal to mass of biofuel consumed and calorific value of fuels. It is expressed as follow:

$$\eta_{thermal} = \frac{m_w C_{p_w} \Delta T}{m_{fuel} CV} \quad (2)$$

Thermoelectric generator

The maximum power output of a realistic thermoelectric module is given (Rowe, 2005)

$$P = \frac{\alpha^2 \sigma}{2} \frac{NA}{(L+n)(1+2rL_c/L)^2} (T_H - T_C)^2 \quad (3)$$

Where α is TE material Seebeck co-efficient (V/K), σ is TE material electric conductivity (1/Ohm.cm) N is the number of elements per modules, L is the height of thermo elements. L_c is the length of contact thickness. Thermal conductivity of the bismuth telluride material will vary with temperature and typical values are presented in Figure 2. (Rowe, 2005). Electrical efficiency of the thermoelectric generator is defined as electrical power generation from thermoelectric generator from Equation 3 and to heat supplied on hot side of thermoelectric generator is expressed as

$$\eta_{teg} = \frac{P}{Q_{in}} \quad (4)$$

The bismuth telluride alloy based thermoelectric module (model: TEP1-12656-0.6) of capacity 14.7W made by M/s Thermonamic Electronic (Xiamen) Co.Ltd, China is used in this study. As per the manufacture specification, it can operate at the maximum hot side temperature of 280°C and at intermittently up to 380°C

while the maximum temperature on the cold side 160°C. The maximum wall temperature of the stove wall is between 200°C-300°C which suitable to operates TEG.

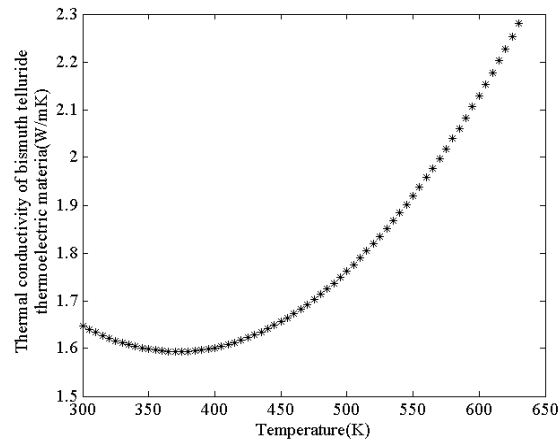


FIGURE 2 Thermal conductivity of bismuth telluride material at different temperature.

The overall efficiency of the multifunctional stove expressed as follow

$$\eta_{overall} = \frac{Q_{o/p} + E_{o/p}}{Q_{in}} \quad (5)$$

It is the ratio of thermal energy output and electrical output to thermal energy input to the stove. Other technical specification of the TEG is mentioned in Table 1.

Table 1 Technical Specification of Thermoelectric Module

Parameters	Value
Make	Thermonamic Ltd China
Module No	TEP1-12656-0.6
No of thermocouples	127
Dimensions	56 x 56 x 5mm
Open circuit voltage	8.6V
Internal resistance	1.2Ω
Match load output voltage	4.2V
Match load output current	3.5 A
Match load output power	14.7W
Heat flow through the module	About 350W
Weight of module	75g

RESULTS AND DISCUSSION

The experiments conducted on 04th April 2018 at central research laboratory to estimate the experimental performance of the stove. The waste bamboo materials of 200 grams used to boil the water and its experimental values are tabulated in Table 2

Table 2 Experimental Results

S.No	Time(min)	Flame Temp(°C)	Water Temp(°C)
1	0	78	28
2	5	300	40
3	10	400	73.5

The time of operation is about 60sec with the consumption of 0.05/60 *kg/sec* fuel. The calorific value of bamboo as 19.36 *MJ/Kg*. From Eq. (1) the heat input estimated as 16.133 *KJ/sec* and heat output as 3.1743*KJ/sec*, Thermal Efficiency estimated as 19.675%. Mobile battery charged about 414mAh of electricity and its thermal equivalent output as 5.666 *KJ*. The overall efficiency of the system estimated from Eq. (5) as 55%



FIGURE 3 Various Stages of Experimental Studies

The various stages of multifunctional cooking stove during experimental studies are shown in Fig 3 (a) to (d). The Figure 3 (a) and (b) shows the mobile charging during flame mode and (c) shows LED lighting from the power generated through thermoelectric generator. Fig 3 (d) shows the mobile charging during non-flame mode. The sensible heat in the metal rod helps to activate the thermoelectric generator to generate power. It is continually monitored the heat sink temperature of thermoelectric generator it varied from 30 to 65°C. The maximum temperature on heat sources can be extended by providing the extended surface and thermal energy storage materials. The minimum of cold side temperature is the chance for higher efficiency by using PCM have low melting point. The multifunctional cooking may be operated using PCM on hot side and cold side to improve performance in the further study. The maximum and minimum efficiency of multifunctional stove found during heat and power generation are concerned is about 54% and stand alone only for heating is 19%.

CONCLUSIONS

An experimental study of multifunctional cooking stove conducted using water boiling test and charging of mobile phone during flame and non-flame period of stove operation. The waste bamboo used as fuel and it is computed that thermal efficiency of stove as 19% and overall efficiency of the system is found as 54%. The experimental result shows that that overall system efficiency of stove is more than the standalone function of stove for the same heat input. It is concluded the system used in this study helps to lighting and heating function is required like high way hotel, remote isolated places where conventional heating and electrical system are not feasible.

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REFERENCES

- [1]. Amen Agbossoua, Qi Zhang, Gael Sebald, Daniel Guyomar (2010) 'Solar micro-energy harvesting based on thermoelectric and latent heat effects Part I: Theoretical analysis' *Sensors and Actuators A* 163 pp. 277–283
- [2]. Champier, D., J. P. Bedecarrats, M. Rivaletto, F. Strub (2010) 'Thermoelectric power generation from biomass cook stoves' *Energy* 35(2), pp.935–942.
- [3]. Ismail, K.A.R., J. R. Henriquez (2002), 'Numerical and experimental study of spherical capsules packed bed latent heat storage system' *Applied Thermal Engineering*, 22 pp.1705–1716.
- [4]. Lertsatitthanakorn C (2007) Electrical performance analysis and economic evaluation of combined biomass cook stove thermoelectric (BITE) generator. *Bioresource Technology* 98:pp.1670–1674.
- [5]. Niu, X., J. Yu, S. Wang (2009) 'Experimental study on low temperature waste heat thermoelectric generator' *Journal of Power Sources* 188 pp.621–626.
- [6]. Nuwayhid, R.Y. , D.M. Rowe, G. Min (2003), 'Low cost stove-top thermoelectric generator for regions with unreliable electricity supply' *Renewable Energy* 28, pp. 205–222.
- [7]. Rowe (2005) *CRC Handbook on Thermoelectrics*
- [8]. Veer Tyagi, V., D. Buddhin (2007), 'PCM thermal storage in buildings: a state of art' *Renewable and Sustainable Energy Reviews* 11 pp. 1146–1166.
- [9]. Zalba, B., J. MaMarin, L. F. Cabeza, H. Mehling, (2003) 'Review on thermal energy storage with phase change: materials, heat transfer analysis and applications' *Applied Thermal Engineering* 23 pp. 251–283.

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Experimental Investigation on Heat Transfer Enhancement and Pressure Drop of Double Pipe Heat Exchanger in Solar Water Heating System

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Abstract. This paper presents the design and performances of double pipe heat exchanger embedded straight rectangular fins in the annulus are presented. Solar water heating systems use heat exchangers to transfer solar energy absorbed in solar collectors to the working fluid used to heat the water or a space. An experimental investigation is conducted for different set values of mass flow rate and varying the number of rectangular fins. The experimental results are validated with plain double pipe heat exchanger. The results of rectangular fins in the annulus side causes increased rate of heat transfer and pressured drop compared to plain double pipe heat exchanger. The experimental study is performed by varying mass flow rate of 0.01 kg/s, 0.02 kg/s and 0.03 kg/s of cold fluid in the annulus side and the mass flow rate of hot fluid in the inner pipe is kept constant. The performance and increased pressure drop is a function of number of fins and mass flow rate.

INTRODUCTION

Heat augmentation technique is the method of improving the performance of a heat transfer system. Many attempts have been made to reduce the size and costs of the heat exchangers. An increase in heat transfer coefficient results in reducing the temperature driving force and it increases the exergy efficiency and decreases entropy generation. In addition, heat augmentation techniques play a vital role for laminar flow, since the heat transfer coefficient is generally low in plain tubes. Swirl flow devices form an important group of passive augmentation methods with twisted tape is one of the most important members of this group. Tubes with twisted tape insert have been used as one of the passive heat transfer enhancement techniques and are most widely used tubes in several heat transfer applications; for example, heat recovery processes, air conditioning and refrigeration systems, and chemical reactors.

Concentric tube heat exchangers place a key role in various heat transfer engineering processes. Heat flows between two fluids, which are flowing in inner and outer pipes respectively. The fluids may flow in parallel or counter flow direction. Concentric tube exchangers are commonly used in applications involving relatively low flow rates and high temperatures for which there are well suited.

Recent literature are concerned; there are many research studies have been conducted done improvements in heat transfer rate by Yang *et al.* [1], Akpınar [2] and Ma *et al.* [3]. Their results in power saving, raising thermal rating and working life of the equipment.

Pourahmad and Pesteei [4] investigated on double pipe heat exchanger by inserting wavy strip turbulators in the inner-pipe, their findings are on considerable improvements in enhancement of heat transfer characteristics. Ibrahim [5] found the increase of laminar flow and heat transfer plane tubes with helical screw tape inserts. Result of porous baffles and flow pulsation on concentric tube heat exchanger efficiency was investigated by Targui and Kahalerras [6], the authors propose that addition of oscillating machinery in the inner pipe increases the heat transfer. An

analysis of using plain and perforated variable spacing with helical tabulators was studied by Sheikholeslami *et al.* [7], heat transfer and fluid flow analysis were carried out for different area ratios and pitch ratios. Results shows that effectiveness is an increasing function of open area ratio and decreasing function of pitch ratio

The fast development of various numerical methods of double heat exchanger is done based on methods [8, 9]. These methods are supplements to experiments and theory. Additionally it offers an economic alternative. Gorman *et al.* [10] presented a numerical investigation of the thermal design in which the wall inner tube is helically grooved. A review was carried out by Ahmed *et al.* [11], on finned tube heat exchangers. The review consist of with and without fins wavy, angular, and longitudinal fins. Further the heat transfer enhancement methods are studied in [12-21].

In the present work numerical and an experimental study of heat transfer for a water to water concentric tube exchanger with rectangular fins at the annulus side is carried out. In the literature baffles are almost used in shell and tube heat exchanger to increase heat transfer rate and to decrease pressure drop, and no publication studying on thermo hydraulic performance for the annulus of the concentric tube heat exchanger could be found. The flow rate in the inner pipe is kept constant as in conventional concentric tube heat exchanger. The experiments were conducted for different cases of number of fins in the annulus side. The experimental results are validated with numerical results.

EXPERIMENTAL STUDY

A schematic diagram of the experimental setup is shown in the Fig. 1. It consists of a specimen section, hot water loop, and cold water loop. The specimen section is the horizontal double pipes with rectangular fins as shown in Fig. 2. The specimen section and the piping system are made such that parts can be changed. The experimental setup after installing the all parts is shown in the Fig. 3. The open loops cold water consist of the 0.5 m³ storage tanks, with a geezer capacity of 10 litres, an electric heater with temperature control. The hot water controlled by temperature controller. The volume flow rate of the hot and cold water are controlled by rotating valve and measured by the rotometer value range of 0.01–0.03 kg/s.

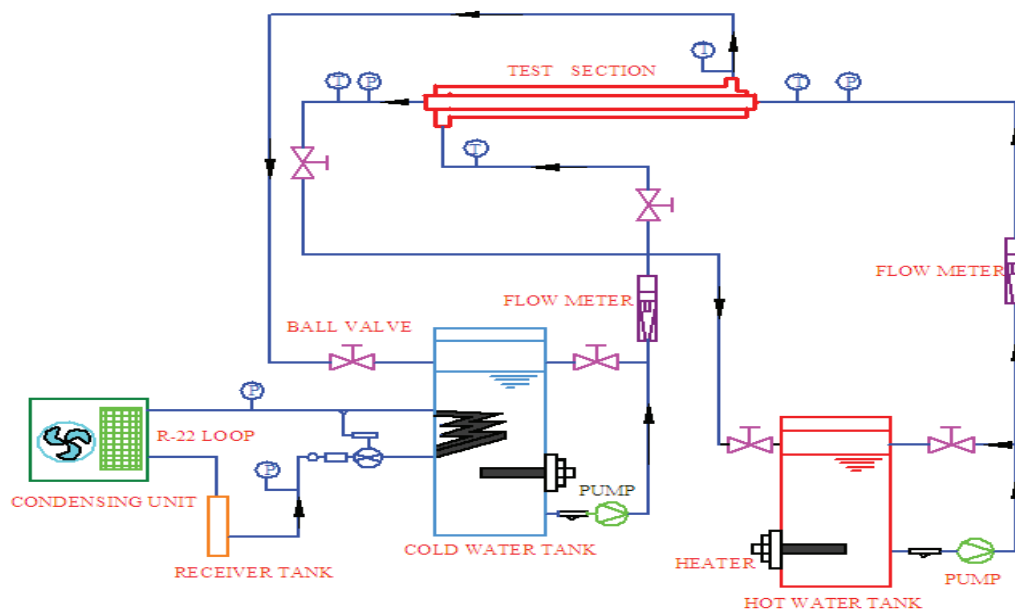


FIGURE 1. A schematic diagram of the experimental setup



FIGURE 2. Photographic view of Specimen of tube with rectangular fins



FIGURE 3. Experimental setup of double pipe heat exchanger

The volume flow rate was checked 4 times for each trail, a 20 litre beaker and stop watch is used to reduce the uncertainty ($\pm 2\%$). A hot water geezer of capacity 10 litre is equipped with adjustable temperature controller, with a temperature control of $\pm 0.5^\circ\text{C}$. The hot temperature was kept at 55°C and 65°C .

The specimen section made from the straight copper tube consists of an outer tube and inner tube and a length of 1100 mm. The inner diameter and outer diameter of the inner pipe are 10 and 12 mm, respectively. The inner diameter of the outer pipe is 37 mm. The rectangular fins are made from the copper strip with the thickness of 1 mm, the length of 1100 mm and a height of 5mm. The thermocouples are mounted to measure the hot water and cold water temperatures at the inlet and outlet sections.

Experiments were conducted at different inlet temperatures of hot water. Flow rate of hot water kept constant and flow rate cold water entering the test section was varied. The inlet hot and cold water temperatures were adjusted with the help of temperature controllers. Before the data were measured, the system was allowed to reach the steady state.

DATA DEDUCTION

For the temperatures deviations, a log mean temperature difference (LMTD)

$$LMTD = \frac{((T_{wh,in} - T_{wc,in}) - (T_{wh,out} - T_{wc,out}))}{\ln\left(\frac{T_{wh,in} - T_{wc,in}}{T_{wh,out} - T_{wc,out}}\right)} \quad (1)$$

for parallel flow and

$$LMTD = \frac{((T_{wh,in} - T_{wc,out}) - (T_{wh,out} - T_{wc,in}))}{\ln\left(\frac{T_{wh,in} - T_{wc,out}}{T_{wh,out} - T_{wc,in}}\right)} \quad (2)$$

for counter flow is used [21–25].

Heat transferred to the cold water in the annulus, $Q_{w,c}$, can be determined from

$$Q_{w,c} = m_{w,c} C_{p,w} (T_{w,c,out} - T_{w,c,in}) = U_o A_o LMTD \quad (3)$$

where $m_{w,c}$ is the mass flow rate of cold water which passing through the annulus, U_o is heat transfer coefficient, A_o is the surface area of the outside diameter of the inner pipe, $C_{p,w}$ is the specific heat of cold and hot water, $T_{w,c,in}$ and $T_{w,c,out}$ are the inlet and outlet temperatures of cold water.

Heat transferred from the hot water in the inner pipe, $Q_{w,h}$, can be determined as

$$Q_{w,h} = m_{w,h} C_{p,w} (T_{w,h,in} - T_{w,h,out}) = U_i A_i LMTD \quad (4)$$

where $m_{w,h}$ is the mass flow rate of hot water which passing through the inner tube of heat exchanger, U_i is heat transfer coefficient, A_i is the surface area of the inside diameter of the inner pipe, $C_{p,w}$ is the specific heat of cold and hot water, $T_{w,h,in}$ and $T_{w,h,out}$ are the inlet and outlet temperatures of hot water.

The average heat transfer rate, Q_{ave} , is determined from the hot water side and cold water side as

$$Q_{ave} = \frac{Q_{w,c} + Q_{w,h}}{2} \quad (5)$$

The overall heat transfer coefficient U_o based on outer surface area of the inner pipe can be determined as per the energy balance equation t, with negligible heat losses to surroundings, from equations (1) and (2):

$$Q_{avg} = U_o A_o LMTD \quad (6)$$

RESULTS AND DISCUSSION

The Fig. 4 and Fig. 5 shows the increase of an average heat transfer rate respect to cold water mass flow rate for plain tube and rectangular fins at a hot water inlet temperature of 55°C and 65°C and it shows that when hot water inlet temperature of 55°C, the heat transfer rate is increases with the mass flow rate of cold water. It is because of heat transfer across the test section is directly depending on heat capacity of the hot water. The presence of fins in the annulus creates the flow surface area is more and it results in the enhancement of heat transfer rate. This is because of outside surface area of the inner tube of heat exchanger is increased. In addition, it shows from the Fig. 4 and Fig. 5 the heat transfer rates for eight fins are higher than of six fins. It can also shown in the Fig 5 that a little

increase in heat transfer rate as compare to the Fig. 4, it is because of change in inlet temperature a hot water. The Fig. 6 and Fig.7 shows the variation of heat transfer coefficient with mass flow rate of cold water for parallel flow, it can be seen that heat transfer coefficients are increased because same explanation described above for the fig. 4 and fig. 5 are given.

The Fig. 8 and Fig. 9 show the validation of experimental results of rate of heat transfer with mass flow rate at inlet temperature of 55°C and 65°C respectively. It is very clear from these graphs that there is an increment in rate of heat transfer with addition of rectangular fins as compared to plain tube at particular mass flow rate of cold water. The agreement between the results of numerical method and experiment are reasonable. The Fig. 10 and Fig. 11 shows the variation of heat transfer coefficient and mass flow rate, at different inlet conditions of temperature for counter flow direction.

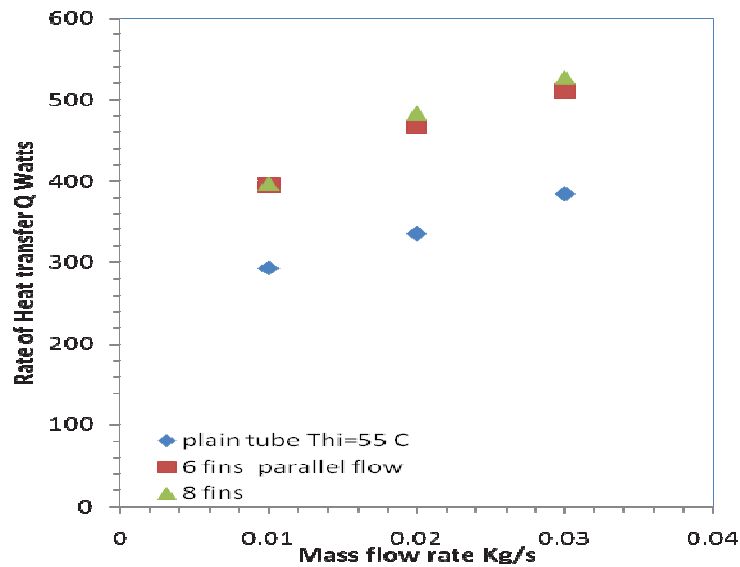


FIGURE 4. The variation of heat transfer rate with mass flow rate at inlet temperature of 55 °C for parallel flow

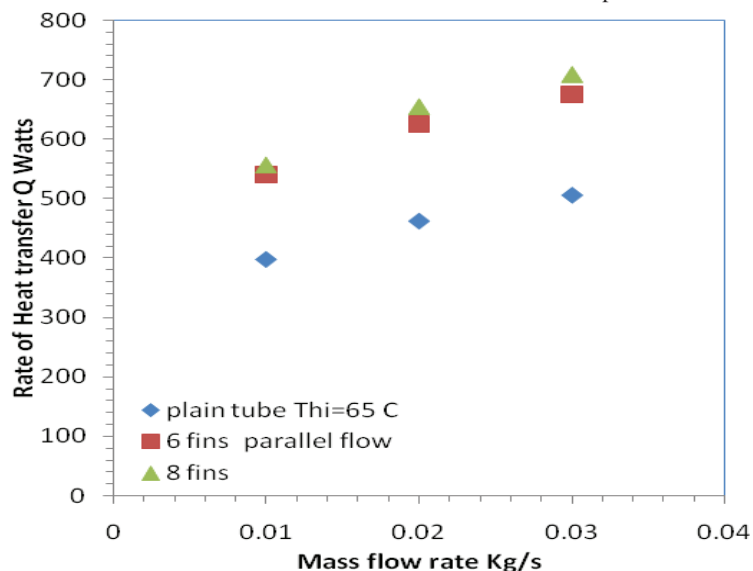


FIGURE 5. The variation of rate of heat transfer with mass flow rate at inlet temperature of 65 °C for parallel flow

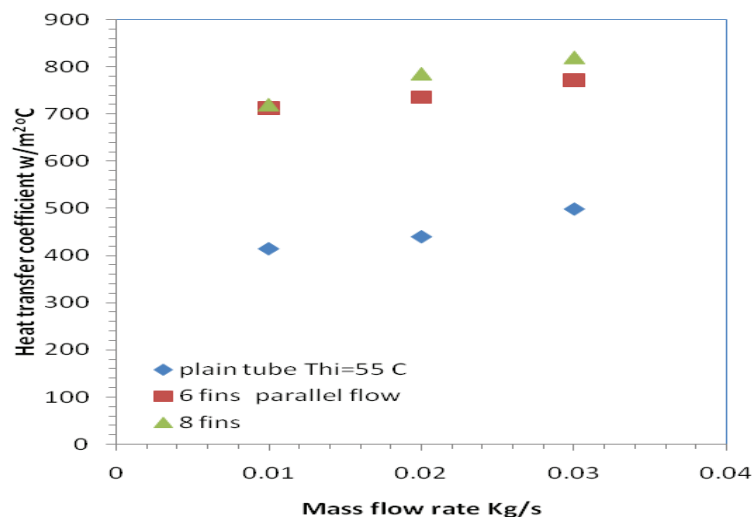


FIGURE 6. The variation of heat transfer coefficient with mass flow rate at inlet temperature of 55 °C for parallel flow

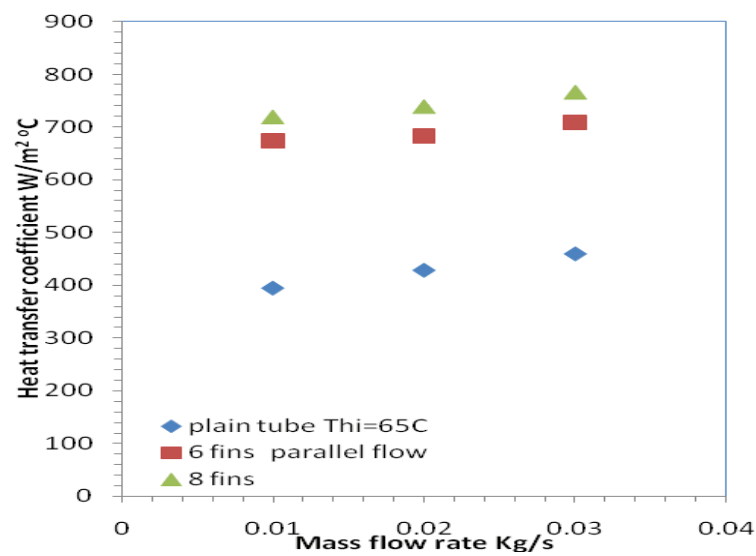


FIGURE 7. The variation of heat transfer coefficient with mass flow rate at inlet temperature of 65 °C for parallel flow

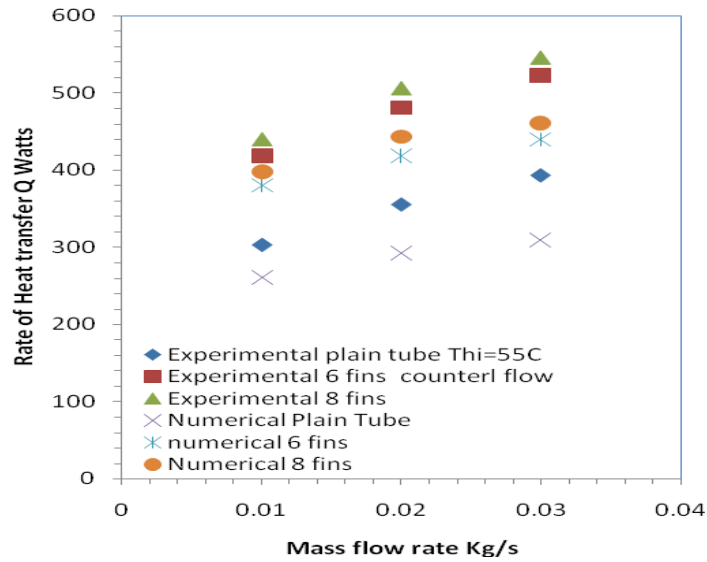


FIGURE 8. Comparison of experimental results with numerical results, Q verses mass flow rate for counter flow

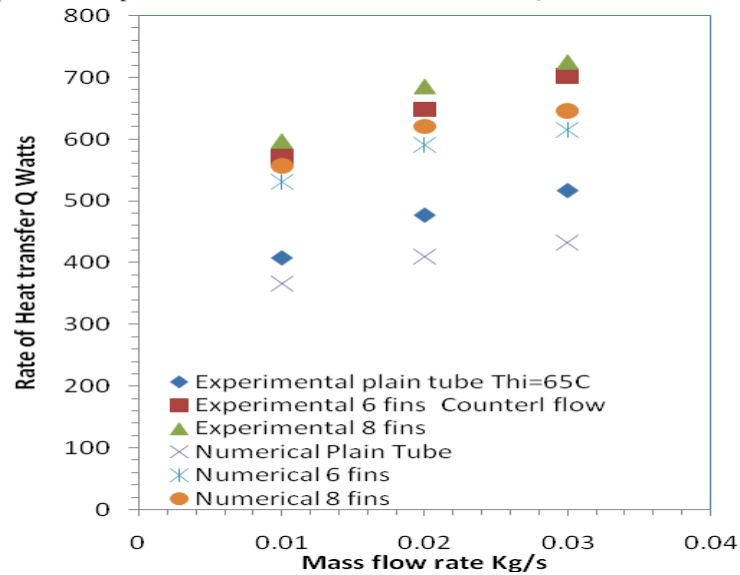


FIGURE 9. Comparison of experimental results with numerical results, Q verses mass flow rate for counter flow

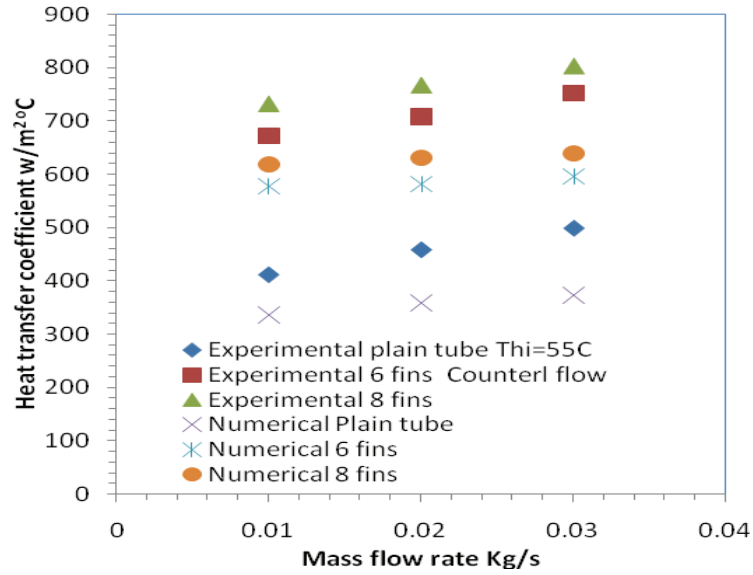


FIGURE 10. Comparison of experimental results with numerical results, overall heat transfer coefficient verses mass flow rate for counter flow

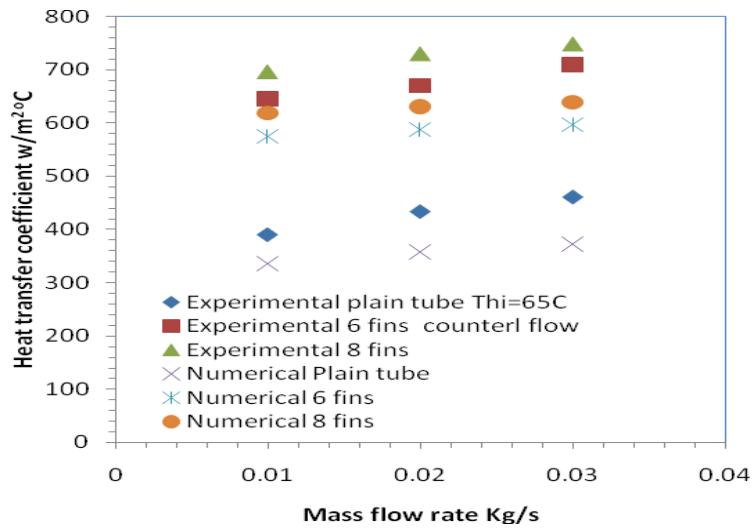


FIGURE 11. .comparison of experimental results with numerical results, overall heat transfer coefficient verses mass flow rate for counter flow

CONCLUSIONS

The experimental study on heat transfer characteristics of the double pipe heat exchanger with straight rectangular insert in annulus was presented. It is found from the study; the heat transfer coefficient has improved by 62% and 54 % for the usage of 8 and 6 rectangular fins respectively as when compared to plain tube. The agreement between the results obtained from the experiments and those obtained from numerical methods were reasonable. It is observed that rate of heat transfer and heat transfer coefficient directly depends on inlet fluid temperature, mass flow rates of the hot and cold fluid.

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REFERENCES

- [1] Yang D, Guo Y, Zhang J, “Evaluation of the thermal performance of an earth to air heat exchanger (EAHE) in a harmonic thermal environment”. [Energy Conversion and Management](#), Vol. 109, pp. 184–94 (2016)
- [2] Akpınar EK, “Evaluation of heat transfer and exergy loss in a concentric double pipe exchanger equipped with helical wires”, [Energy Conversion and Management](#); Volume 47, Issues 18–19, pp. 3473–3486 (2006)
- [3] Ma T, Li L, Xu X-Y, Chen Y-T, Wang Q-W, “Study on local thermal–hydraulic performance and optimization of zigzag-type printed circuit heat exchanger at high temperature”, [Energy Conversion and Management](#), Volume 104, pp. 55–66 (2015).
- [4] Pourahmad S, Pesteei S M, “Effectiveness-NTU analyses in a double tube heat exchanger equipped with wavy strip considering various angles”, [Energy Conversion and Management](#), Volume 123, pp. 462–469 (2016).
- [5] Ibrahim E Z, “Augmentation of laminar flow and heat transfer in flat tubes by means of helical screw-tape inserts”, [Energy Conversion and Management](#), Volume 52, Issue 1, pp. 250–257 (2011).
- [6] Targui N, Kahalerras H, “Analysis of a double pipe heat exchanger performance by use of porous baffles and pulsating flow”, [Energy Conversion and Management](#), Volume 76, pp. 43–54 (2013).
- [7] Sheikholeslami M, Gorji-Bandpy M, Ganji D D, “Effect of discontinuous helical turbulators on heat transfer characteristics of double pipe water to air heat exchanger”, [Energy Conversion and Management](#), Vol.118, pp. 75–87 (2016).
- [8] Du YP, Qu ZG, Zhao CY, Tao WQ, “Numerical study of conjugated heat transfer in metal foam filled double-pipe”, [International Journal Heat and Mass Transfer](#), Volume 53, Issues 21–22, pp. 4899–4907 (2010).
- [9] Rennie T J, Raghavan V G S, “Numerical analysis of the lethality and processing uniformity in a double-pipe helical heat exchanger”. [Chem Eng Process](#), volume 49 Issue7, pp. 672–679 (2010).
- [10] Gorman J M, Krautbauer K R, Sparrow E M, “Thermal and fluid flow first principles numerical design of an enhanced double pipe heat exchanger”, [Applied Thermal Engineering](#), Volume 107, pp. 194–206 (2016).
- [11] Sayed Ahmed E, Mesalhy O M, Abdelatif M A, “Flow and heat transfer enhancement in tube heat exchangers”, [Heat and Mass Transfer](#), Volume 51, Issue 11, pp. 1607–1630 (2015).
- [12] Ibrahim E, Moawed M, “Forced convection and entropy generation from elliptic tubes with longitudinal fins” [Energy Conversion and Management](#), Volume 50, Issue 8, pp. 1946–1954 (2009).
- [13] Sayed Ahmed E, Ahmed Sayed, Mesalhy Osama M, Abdelatif Mohamed A, “Effect of longitudinal-external-fins on fluid flow characteristics for wingshaped tubes bundle in crossflow”, [Journal Thermodynamics](#), 16. (2015)
- [14] Syed KS, Ishaq M, Iqbal Z, Hassan A, “Numerical study of an innovative design of a finned double-pipe heat exchanger with variable fin-tip thickness”, [Energy Conversion and Management](#), Volume 98, pp. 69–80 (2015).
- [15] Zohir A E, Habib M A, Nemitallah M A, “Heat transfer characteristics in a doublepipe heat exchanger equipped with coiled circular wires”, [Exp Heat Transfer](#), Pages 531–545 (2015).
- [16] Eiamsa-ard S, Thianpong C, Promvong P, “Experimental investigation of heat transfer and flow friction in a circular tube fitted with regularly spaced twisted tape elements”. [Int Commun Heat Mass Transfer](#) 2006;
- [17] Sheikholeslami M, Gorji-Bandpy M, Ganji D D, “Experimental study of the influence of perforated circular-ring on pressure loss and heat transfer enhancement using sensitivity analysis”, [Appl Therm Eng](#), pp. 739–748 (2015).
- [18] Agrawal AK, Sengupta S, 1993. “Laminar fluid flow and heat transfer in an annulus with an externally enhanced inner tube”, [Int J Heat Fluid Flow](#), vol. 4, pp. 54–63 (1993)
- [19] Jaisankar S, Radhakrishnan T K, Sheeba K N, “Experimental studies on heat transfer and thermal performance characteristics of thermo siphon solar waterheating system with helical and Left-Right twisted tapes”, [Energy Conversion and Management](#), Volume 52, Issue 5, pp. 2048–2055 (2011).
- [20] Kahalerras H, Targui N, “Numerical analysis of heat transfer enhancement in a double pipe heat exchanger with porous fins”, [International Journal of Numerical Methods for Heat & Fluid Flow](#), Vol. 18 Issue: 5, pp.593–617(2008).

- [21] Yildiz C, Bıçer Y, Pehlivan D, 1996. "Influence of fluid rotation on the heat transfer and pressure drop in double-pipe heat exchangers", Appl Energy, 54:49–56. 5 (1996).
- [22] El Maakoul A, Laknizi A, Saadeddine S, El Metoui M, Zaite A, Meziane M, 2016. "Numerical comparison of shell-side performance for shell and tube heat exchangers with trefoil-hole, helical and segmental baffles", Appl. Thermal Eng. (2016);
- [23] F. Inc., FLUENT User's Guide; 2006.
- [24] Eduardo C, "Heat transfer in process engineering", McGraw-Hill Education, 2010;
- [25] Bergman TL, Incropera FP, DeWitt DP, Lavine AS. Fundamentals of heat and mass transfer. John Wiley & Sons;(2011).

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Experimental Study on Heat Transfer Characteristic of Hexagonal Perforations in Square Fin

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Abstract: This paper presents an experimental analysis on heat transfer characteristic of hexagonal proportion in square fins. The experimental setup consists of eight fins (aluminum 5052) having dimension of 150mm x 150mm x 1mm thickness, arranged at equal intervals along the periphery of an externally slotted hollow cylinder. The fins are heated by using an electrical heater placed inside the hollow cylinder. plane fin, three other fins which are perforated with hexagon shape, having side of 6mm, 9mm and 12mm. Experiments are conducted for three heat inputs viz 35W, 55.5W and 80W and for six different Reynolds number under steady state conditions. It is observed in the steady the convective heat transfer increases with increase in heat supply and Reynolds number. plane fin, fins with hexagonal perforation of 12mm side showed higher convective heat transfer coefficient compared to other types. Hexagonal perforation having side 6mm showed higher heat transfer coefficient compared to 9mm hexagonal perforated fins.

INTRODUCTION

The enhancement of heat transfer has a vital role in thermal engineering. By increasing the heat transfer coefficient of the surface enhances the heat transfer rate to surroundings or by increasing the cross section area of heat transfer, or by both. In many cases, fins are the extended surfaces attached to walls or surfaces to increase the area of heat transfer. The heat transfer between a primary surface and the surrounding fluid in the heat exchangers are mainly done by extended surfaces (fins). There are various shapes of fins, such as rectangular, square, cylindrical, annular, tapered, or pin fins, and combined geometry which was used as the heat exchanging surface. More compact and efficient heat exchangers are the prime goals in the design of modern thermal systems. This duty requires employing heat transfer surfaces with high heat transfer coefficients and high area compactness. Fins must be designed to accomplish maximum heat removal rate with minimum expenditure on material. Mehedi Ehteshum et. Al., [1] conducted experimental investigations into the thermal and hydraulic performance analysis of rectangular fin arrays with perforation size and number. Isam H. E. Qasem and Abdullah [2] conducted experimental and finite element method (FEM) was used in solving one dimensional finite element analysis of heat dissipation from rectangular fin with longitudinal Hexagonal perforations. Heat dissipation by solid and perforated fins was studied. Md Farhad Ismil, M O Reza et, al [3] had carried out numerical investigation of turbulent heat convection from solid and longitudinally perforated rectangular fins. Heat transfer coefficient or surface area must be increased to increase the heat dissipation. O Abdullah H AlEsa and Mohammed Q Al-odat [4] conducted an enhancement of natural convection heat transfer from a fin by triangular perforation of bases parallel and towards its base. In this triangular perforated fins are experimented and heat transfer analysis was done. Saurabh .D. Bahadure and G. D. Gosavi [5] conducted a theoretical and experimental study on enhancement of natural convection heat transfer from perforated fin. Thermal performances of the pin fin heat sink were experimentally done. Explanation of effect on heat transfer coefficient on implementation of effective surface area of pin fin. Narendra R patil and S Y Bhosale [6] conducted an experimental investigation of optimum hole size on perforated fin under natural convection heat transfer. In the

experiment the author explains about the natural convection of the circular fins and perforated fins. The main investigation in experiment was to determine the optimum ratio of fin length to perforation diameter for which the maximum heat transfer takes place by natural convection for different inputs and compared with solid fins. Abhijit G Dhere and Hemant S Farkade[7] reviewed of different triangular perforated fins in staggered arrangement. Adding several fins increases the surface area that they may defend against the air flow and cause boundary layer interference which affects the heat transfer rate negatively. The review reveals that different shapes of fins like triangle, hexagon, drop, lancet etc. most of the research concludes that heat transfer rate is high in staggered arrangement. The orientation of the fins will also affect the heat transfer rate; author suggests two different orientations mainly namely vertex of the triangle facing the flow and lat surface of the triangle facing the flow. Perforation of the fin increases the heat transfer rate. Juan Li, Xiang Ling et,al [8] had carried out field synergy analysis on convective heat transfer and fluid flow of a novel triangular perforated fin. Author describes that based on variable cross section structure a novel triangular perforated fins were proposed. From the literature review it has been observed that perforated fins increases convective heat transfer coefficient. It has also been observed that heat transfer is also affected by different sizes and shapes of the perforations and the number of perforations. The main objective of this project is to conduct experimental investigation into the effect of size of hexagonal perforation for different values of heat input and Reynolds number and for given number of perforations.

PERFORATED FINS

The heat transfer through the perforated fins is to improve the heat transfer characteristics in Forced convection. A plain fins and perforated fins made of Aluminum 5052 are taken for the experiment. It has been found that the heat transfer through the perforated fin is much more efficient than the solid/plain fin. The main objective of the fin is to enhance the heat transfer with different perforations. The use of the perforations is not only to enhance the power, but it also reduces the fin weight which is very important .as the weight reduces the fin efficiency increases and the performance enhances. As the number of perforations of fin increases there will be an enhancement in performance of the fins. The temperature drop along the fins length is consistently higher in perforated fins than, that in the plain/solid fins. The perforation dimension and lateral spacing are main functions which makes gain in heat dissipation rate of the perforated fin. Reduction in the dimension of perforation results in the decline in temperature along the perforated fins. Heat transfer coefficient for perforated fins is higher than that of a plain fins.

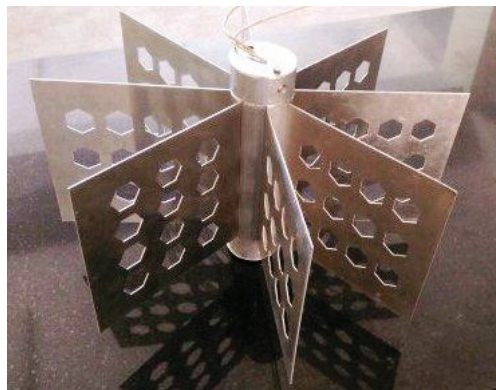


Figure 1. Photographic View

EXPERIMENTAL SET UP

The experimental setup consists of Aluminum 6062 cylinder of inner diameter 25mm and outer diameter 50 mm. eight numbers of grooves having a dimension of 2 mm depth, 1 mm width and 150 mm long were cut at equiangular positions as shown in figure 3.4. Cylindrical heater having 25 mm diameter and 150 mm length is placed inside the cylinder. The top and bottom surfaces of the electrical heater are enclosed by using caps. To reduce heat loss from the caps, in between heater end face and cap, glass wool is used. The complete experimental setup is shown in figure 3.3. Figure 2 shows the sectional view of the experimental set-up. The experimental setup is placed inside the

enclosure. The length of the enclosure is of 1.4 meters and cross section of 0.35m x 0.35m. Top of the enclosure is provided with a fan for inducing air into the duct. The amount of air induced can be varied by varying the speed of the fan using regulator. Heater placed in the cylinder is connected to dimmer stat to regulate the voltage. Dimmer stat is used to regulate the power supply to the heater. It has a range of 0 – 260V. Dimmer stat is used to control the supply voltage and hence heat supply. The velocity of the air at inlet and outlet of the enclosure can be measured by the Digital anemometer. At inlet and exit, velocities were measured at four different points and average velocity was used for calculation purpose. A K-type hand held thermocouple was used to measure the base temperature of the cylinder and surface temperature of the fins. K-type Thermocouples are used to measure temperature of the base of the cylinder at two points and to measure inlet and outlet temperature of air.



Figure 2: Experimental Setup

RESULTS AND DISCUSSION

In the previous chapter experimental setup and procedure has been discussed. In this chapter results of experimental and CFD methods are discussed. Results are explained in terms of variation of heat transfer coefficient, Nusselt number with respect to Reynolds number for various value of heat input. Convective heat transfer coefficient is calculated based on the assumption that the entire heat is convected by the finned surface only. Heatloss from the unfinned area of the cylinder is neglected.

Heat supply of 35.5W

The variation of convective heat transfer coefficient (CHTC) for different types of fins considered, and various values of Reynolds number and heat supply of 35.5W. The Reynolds number varied from 36000 to 68000. For 5% perforated fin the convective heat transfer coefficient varies from minimum of 19.6 W/m²K and maximum of 23.4 W/m²K. For 11.2% perforated fins the convective heat transfer coefficient varies from minimum of 17.5 W/m²K to maximum of 20.3 W/m²K. 20% perforated fins has the minimum value of 20.79 W/m²K to max value of 25.76 W/m²K. The plain fin has the minimum convective heat transfer coefficient of 13.3W/m²K and maximum of 17.4 W/m²K. Figure 4.2 shows the variation of Nusselt Number Nu for different types of fins considered, and various

values of Reynolds number and heat supply of 35.5W. The Reynolds number varied from 36000 to 68000. Figure 4. 2: Nusselt's number for different Reynolds number at 35.5 W heat supplied For each configuration as the Reynolds number increases the Nusselt's number also increases. From the above graph it is observed that the Nusselt's numbers of perforated fins are higher than that of the plain fin. For 5% perforated fins the Nusselt's number varies from minimum of 110.2 and maximum 131.4, 11.2% perforated has the Nusselt's number in the range of 98.4 to 114.1. 20% perforated fins have a Nusselt's number in the range of 110.2 to 144.2, and a plain fin has the range of 74.8 to 99.5.

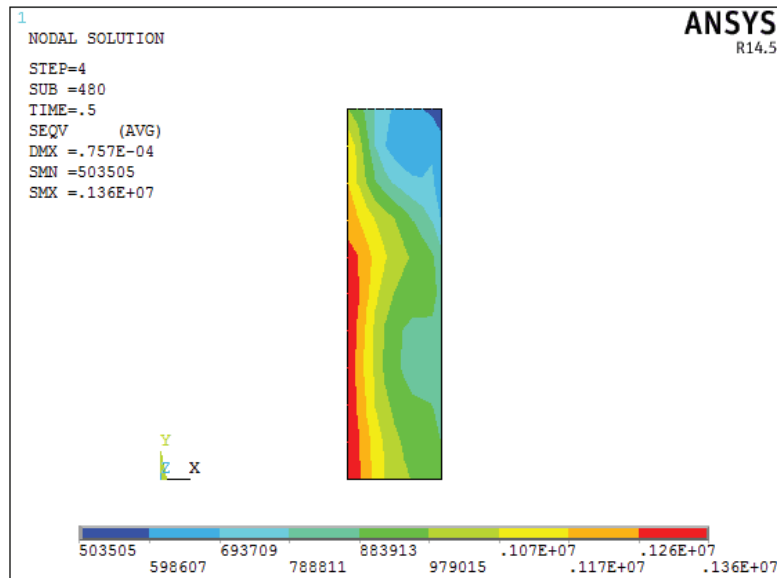


FIGURE 3. Vonmises Stress in the Stainless Steel Material

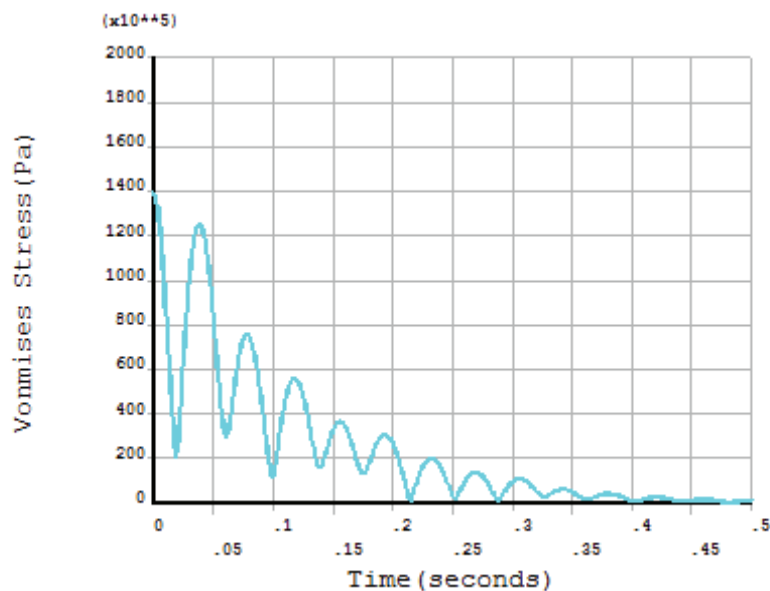


FIGURE 4. Vonmises Stress Plot in the Stainless Steel material (Transient Response)

Analysis is carried out with thermal barrier coatings on the main substrate material stainless steel. Same boundary conditions are applied and problem is analysed for temperature distribution and stress. Maximum stress is observed to be 1.36Mpa as shown in the figure 3.29. This stress is less compared to the stress obtained for pure substrate material. This shows barrier coatings has some effect in reducing the residual stresses in the structure. The figure 3.30 shows Vonmises stress in the expanded plot. Maximum stress is around 1.36Mpa as shown with red colour region. The blue colour region shows minimum stress of 0.5Mpa. Hoop stress generally maximum at the inner surface and minimum at the outer surface for the given boundary conditions. The stress reduction based on time can be observed in the problem. By the end of thermal cycle, the stress value is minimum in the substrate with thermal barrier coatings compared to uncoated structure. Initial stress is observed to be 140Mpa and final stress is 1.36Mpa.

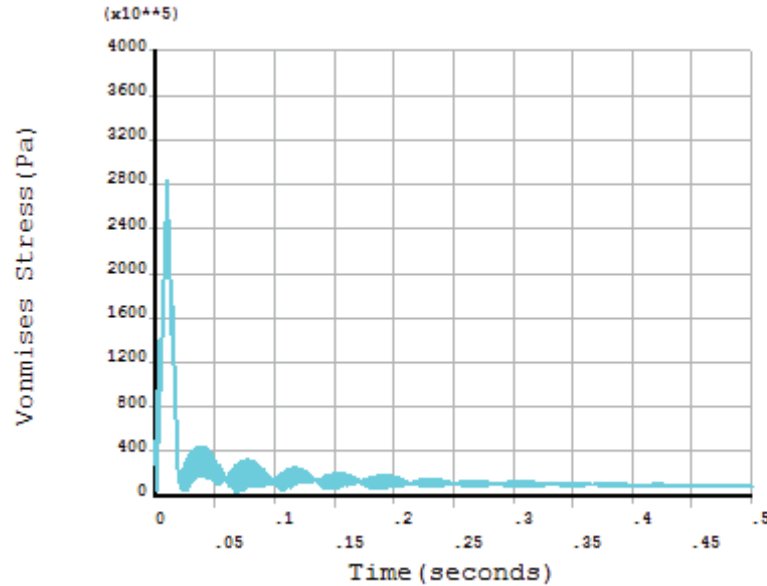


FIGURE 5. .comparison With TBC Layer (Time History plot of stress)

Figure 5 shows sudden drop of stress to the minimum values and later it is again reducing to steady state or residual stress condition. So TBC's has certain effect in reducing the stress gradients during thermal shocks.

CONCLUSIONS

The effect of hexagonal perforation size on convective heat transfer coefficient for different values of heat input and Reynolds number presented in this paper. Number of perforations and pitch are maintained constant and only the size of the hexagonal perforation was varied. Three sizes of the hexagonal perforation were considered, namely 6mm, 9mm and 12mm as its side value. Enhancement of heat transfer coefficient is compared with that of square fin without perforations. Three heat inputs and five speeds of the fan are considered. Experimental study conducted for different heat input and velocity. Results are expressed in terms of variation of convective heat transfer coefficient and Nusselt number for various values of Reynolds number. Reynolds number varied from 36059.2 to 67611.1 and heat input of 35.5W, 55.5W and 80W were considered. On the basis of experimental and numerical analysis results, the following observations are made. Convective heat transfer coefficient (CHTC) of hexagonal perforated fin is more compared to fins without perforations. Convective heat transfer coefficient change with the size of the perforation and velocity of the incoming air.

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REFERENCES

- [1] Mehedi Ehteshum, Mohammad Ali, Md Quamrul Islam, Muhsia Tabassun “Thermal & hydraulic performance analysis of rectangular fins array with perforation sizes and shapes” [Procedia Engineering](#) 105(2015)184-191
- [2] Isam H. E. Qasem, Mechanical Engineering Department, Al-Huson University College, Al-Balqa Applied University Al-Huson- Irbid, JORDAN p-ISSN: 2347-2359
- [3] Md. Farhad Ismail*, M.O. Reza, M.A. Zobaer, Mohammad Ali “Numerical investigation of turbulent heat convection from solid and longitudinally perforated rectangular fins” [Procedia Engineering](#) 56 (2013) 497 – 502
- [4] Abdullah H. M. AlEssa and Nabeel S. Gharaibeh “Effect of triangular perforation orientation on the heat transfer augmentation from a fin subjected to natural convection” *Advances in Applied Science Research*, 2014, 5(3): 179-188
- [5] Mr. Saurabh D. Bahadure, Mr. G. D. Gosavi “Enhancement of Natural Convection Heat Transfer from Perforated Fin” [International Journal of Engineering Research](#) Volume No.3, Issue No.9, pp: 531-535
- [6] Narendra R. Patil, S. Y. Bhosale “Experimental Investigation of Optimum Hole Size on Perforated Fin Under Natural Convection Heat Transfer Process” *International Engineering Research Journal (IERJ)* Volume 1 Issue 5 Page 318-320, 2015
- [7] Abhijit G. Dhere Prof. Hemant S. Farkade “Review on Triangular Perforated Fins in Staggered Arrangement” *IJSRD - International Journal for Scientific Research & Development* Vol. 2, Issue 12, 2015 | ISSN (online): 2321-0613

Finite element analysis on thermal performance of thermal barrier coatings

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Finite Element Analysis on Thermal Performance of Thermal Barrier Coatings

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Abstract: Thermal barrier coatings are improve the thermal performance of the structural members as insulating or minimizing the thermal effects on the structures. Its less thermal conductivity results higher thermal gradient at the barrier coatings and the less heat transfer to the main substrate results low thermal stress in the members. This paper presents analysis of the thermal barrier coatings effect on temperature and stress generation in the structures. The analysis considered based on axisymmetric conditions and the analysis is carried out in both steady state and transient conditions. The shape of Thermally Grown Oxide (TGO) formation on temperature and stress generatiadon on the overall structure is analysed. Along with this the effect of top coat properties on temperature and stress distribution is analyzed using finite element analysis.

INTRODUCTION

Thermal barrier coatings provide protection or thermal insulation to the underlying structural members. Temperatures play very important role in the design of structural members. Also these are the sources of residual stress generation in the structural members. Generally stress is directly proportional to the difference of temperature. Thermal barriers prevent transfer of heat from the surface to the base materials by which temperatures of the base material will reduce. Lesser temperatures results to less stresses. This is very much useful in increasing the safety of aero structural components like turbine blades etc. With this aero structural component operational temperature range also can be changed. Thermal barrier coatings have lesser thermal conductivity by which heat transfer to the base structure is very slow. Lesser the thermal conductivity, the materials has better thermal barrier capacity. yttria stabilized zirconia (YSZ) has better thermal properties in the existing thermal barrier coating materials. Temperature is a critical parameter in structural safety and working. As the industry is heading for high technology production and manufacturing techniques, even the working temperatures are increasing in the industrial sector. The theory says, high temperatures reduce the yield strength of the structure along with other side effects like war page, residual stress formation. The minimization of temperature is utmost important for good working conditions along with life of the components. The temperature flow directly depends on thermal conductivity of materials; the research is towards low thermal conductivity materials. Many researchers are attempted and summarized in this section. Chen [1] has discussed about thermal barrier coating in protecting the high temperature machinery equipment like blades, gas turbine engines, automobile parts etc. Wellman *et al.* [2] discussed the advantage of TBC in the steam turbine in improving the entry gas temperature, discussed about various problems associated with thermal barrier coatings in sustaining high temperature environment. Hassan Mohammad [3] discussed about the use of thermal barrier coatings in reducing the temperature flow to the main metallic materials which helps in higher load capacity in engineering applications. Charles [4] discussed about primary reason of failure of air plasma sprayed thermal barrier coatings. This is a based on life prediction techniques using finite element analysis. Initially the experimental setup is done to model, load and tracing the failure of thermal barrier coatings and later mathematical model development and implementation in finite element analysis is done. Ravi Kumar *et al.* [5] discussed about improving the combustion chamber efficiency by providing thermal barrier coatings. By coating, the transfer of combustion heat to surroundings is less and combustion chamber can be maintained higher temperature. This helps in improving the thermal performance of the assembly as lesser fuel input is required for the same power generation. The present range of 350 to 400°C can be increased to above 800° C for better performance and fuel economy. Sandeep Kumar *et al.*, [6] discussed about the need of thermal barrier coatings in protecting the metallic components from high temperature application. Naveen *et al.* [7] discussed about various techniques to prepare thermal barrier coatings along with discussion on Nano structures. Due to importance in the requirement of insulation materials for thermal

flow, lot of research is towards the development of low thermal conductive materials. Hiren Rana [8] discussed about improving the performance gas turbine system with TBC attachment. The TBC attachment is required to reduce the temperature in the main turbine blade material. But the TBC performance directly depends on the type of top coat material is used along with deposition technique. Also Thermal conductivity is the main parameter in deciding the performance of the TBC system. In his observation, reheat, regeneration, intercooling improve 10 to 15% efficiency by introduction of TBC coatings. He also observed that TGO formation also changes the temperature of main substrate.

The general functioning of thermal barrier coatings on the structural members subjected to higher temperature as shown in Figure 1. Instead of convection process on the metal substrate, thermal barrier coating material is exposed to hot gas. Thermally Grown Oxide (TGO) further prevents flow of temperature to the metal substrate along with further hindrance from Metallic bond coat. Three more layers provide protection to the metal substrate instead of direct exposure.

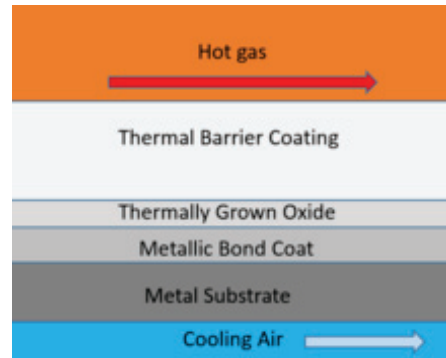


FIGURE 1 Thermal Barrier of Coating

Analyzing the effect of thermal barrier coatings on temperature and stress distribution in the main material is the main definition of the problem. The effect of TGO at the interface of top and coat and bond coat on thermal and stress behavior in the main substrate is another or included definition of the problem. The objective includes finite element modeling of the thermal barrier coatings, the effect of top coat and TGO on thermal and stress behavior. Finding the effect of shape of TGO on thermal and structural behaviour on the main substrate

DEVELOPMENT OF MODEL

Analysing the effect of thermal barrier coatings on temperature and stress distribution in the main material is the main definition of the problem. The effect of TGO at the interface of top coat and bottom coat on thermal and stress behaviour in the main substrate to analysed. Axisymmetric concept is used for demonstrating the effect of thermal barrier coatings on the performance of the structural components.

Two dimensional problems is elimination of angular components. It reduces the size of matrix which helps in faster execution with minimum computer resources. The software has option to represent in three dimensional shapes in virtual simulation environment. The dimensions of the problem are as follows. Inner diameter: 0.1m; Outer Diameter: 0.15m. In an axisymmetric problem, any height can be considered for analysis as it does not have effect on the resulting temperature and stress distributions. The analysis with higher number of cases also helps in finding the effect of design parameters on structural performance under thermal and structural loads.

The figure 2 (a) shows axisymmetric dimensions of the problem. All the dimensions are represented in the meters as this is best unit for dynamic problems. Inner radius is taken as 0.1m and outer diameter is taken as 0.15meter with a height of 0.2m for the main material. The geometry is built using ANSYS top down approach and dimensions are applied using Annotation option in the ANSYS. ANSYS version 14.5 is used for modelling the object as a single entity.

The figure 2(b) shows applied boundary conditions on the problem. Top and bottom surfaces are insulated to prevent any possible heat transfer and the inner surface is subjected to higher temperature with higher convection process. The outer surface is maintained at the atmospheric condition. Even convection film coefficients are different at both inner and outer geometries. The mesh is carried out using Plane55 element, a 4 noded element for thermal problems.

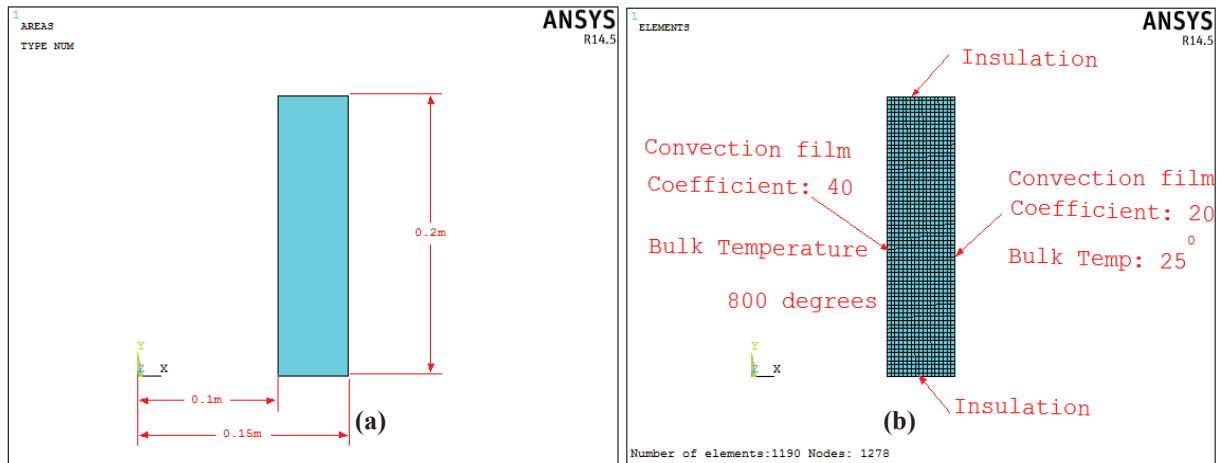


FIGURE 2 (a) Dimension of Problem (b) Boundary condition for the Problem

Later the mesh can be changed for structural elements in case of requirement of structural results. Total number of elements and nodes are represented in the title bar. The table 1 shows material properties considered in the problem. Minimum six properties are required for dynamic analysis and 4 properties for steady state conditions. Material properties are the essential elements of structural behaviour. Low thermal conductivity, low thermal expansion coefficients are the desirable characters of any thermal barrier coatings. Low thermal conductivity prevents transfer of heat to the inner members. Similarly low thermal expansion helps in reducing more strain in the problem which has direct effect on stress generation.

Table 1 Thermal and Structural Properties of Thermal barrier Coating Materials

Material Properties	Top Coat	TGO	Bottom Coat	Stainless Steel
Young's Modulus(GPa)	54	275	280	200
Poisson's ratio	0.25	0.3	0.31	0.3
Thermal Conductivity (W/m°C)	1.5	5	8	42
Specific Heat (J/kg°C)	500	501	496	365
Thermal Expansion Coefficient (/°C)	7.2×10^{-6}	12×10^{-6}	14×10^{-6}	18×10^{-6}

RESULTS AND DISCUSSION

Analysis is carried out with thermal barrier coatings on the main substrate material stainless steel. Same boundary conditions are applied and problem is analyzed for temperature distribution and stress. Maximum stress is observed to be 1.36Mpa as shown in the figure 3.29. This stress is less compared to the stress obtained for pure substrate material. This shows barrier coatings has some effect in reducing the residual stresses in the structure. The figure 3 shows Vonmises stress in the expanded plot. Maximum stress is around 1.36Mpa as shown with red colour region. The blue colour region shows minimum stress of 0.5Mpa. Hoop stress generally maximum at the inner surface and minimum at the outer surface for the given boundary conditions

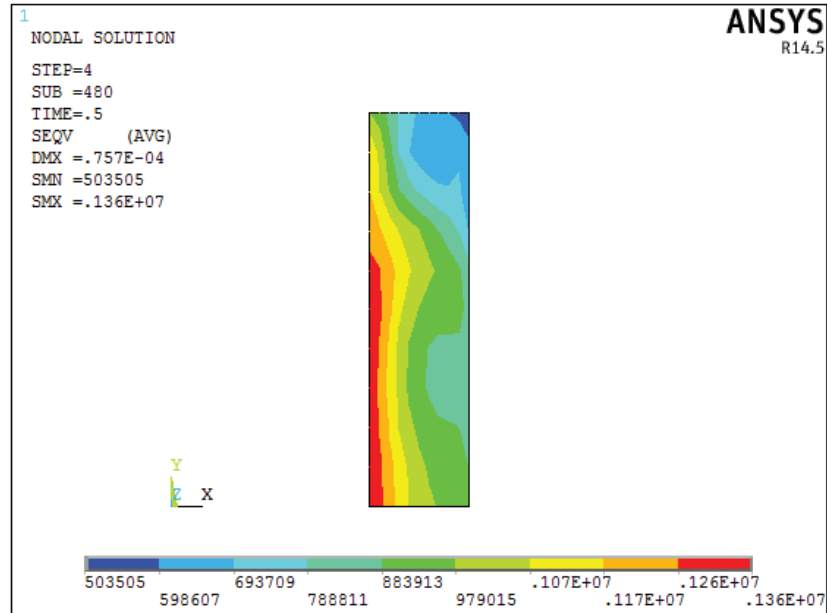


FIGURE 3. Vonmises Stress in the Stainless Steel Material

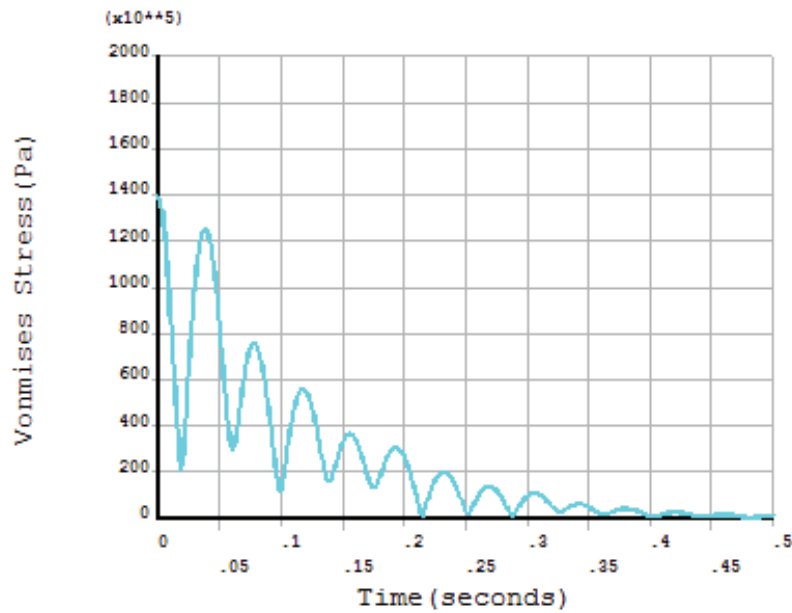


FIGURE 4. Transient Response of Vonmises Stress Plot in the Stainless Steel material

The stress reduction based on time can be observed in the problem. By the end of thermal cycle, the stress value is minimum in the substrate with thermal barrier coatings compared to uncoated structure. Initial stress is observed to be 140Mpa and final stress is 1.36Mpa.

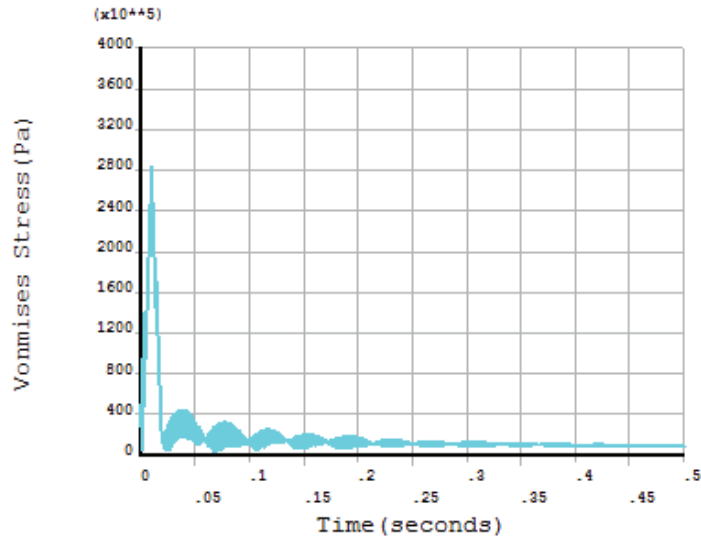


FIGURE 5. Time History plot of stress comparison with TBC Layer

The figure 5 shows sudden drop of stress to the minimum values and later it is again reducing to steady state or residual stress condition. So TBC's has certain effect in reducing the stress gradients during thermal shocks.

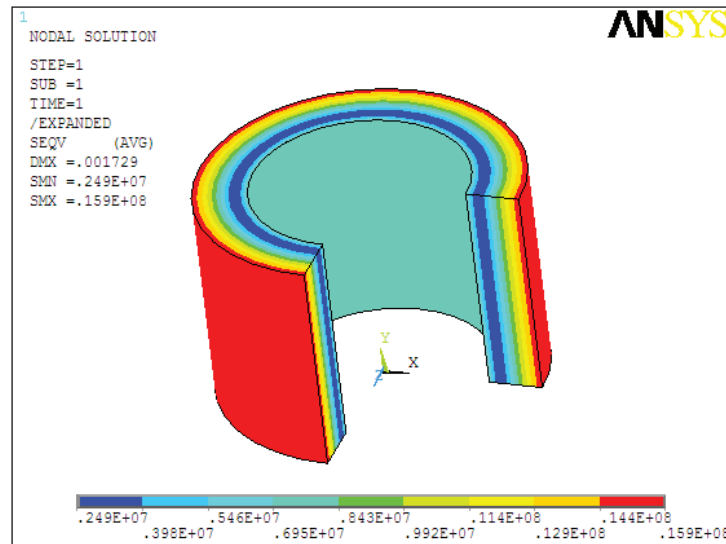


FIGURE 6: With 30 microns of thickness (Vonmises Stress: 15.9Mpa)

The Figure 6 shows smaller effect of thickness of TGO layer on stress generation. Mainly the results are influenced by Top coat thickness. Even the structural analysis with thermal barrier coatings shows stress reduction in the main substrate (16Mpa) compared to the uncoated metallic member (23Mpa). But temperature and stress in thermal barrier coating is more which is an important parameter for finding the structural safety and thermal performance of the thermal barrier coatings. Further thermal shock analysis is carried out based on triangular pulse for smaller duration. The results are obtained for both uncoated and coated structures. Thermal shocks are the main reasons for failure of machine components whose effect can be reduced by these barrier coatings. Further analysis is carried out to find the effect of TGO thickness on stress generation as shown in the figure 7. . The sudden drop of temperature can be attributed to lower thermal conductivity of both top coat and TGO. Reduction of almost 8 degrees in the main substrate observed. Analysis has been carried out to find the temperature and structural stress distribution with and without thermal barrier coatings on the machine members. The effect of Top coat properties and thickness is analysed for structural safety conditions

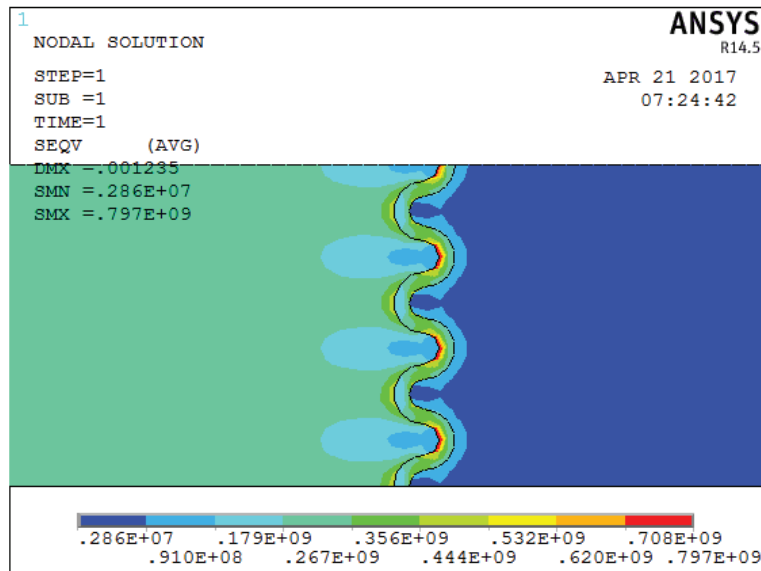


FIGURE 7 Stress Concentrations in the TGO Layer

The results show smaller effect of stress reduction with the increase of TGO thickness. So by increasing the thickness of TGO, stress can be reduced in the main substrate material. Since TGO formation is time based, in prolonged time, the stress in the substrate material will reduce.

CONCLUSIONS

Initially pure metal substrate is considered for analysis. The boundary conditions are applied after modeling using ANSYS top down approach and meshing with thermal element plane55. The element considered is 'h' element which is suitable for faster execution of the problem. The results are obtained for thermal temperature distribution. Temperature variation is plotted across the cross section. By applying sequential coupled field analysis, the stress results are obtained for Vonmises, hoop and radial stresses. With the help of post processing capabilities of ANSYS, three dimensional virtual results are represented for easier understanding of the axisymmetric simplified problem. The results obtained in this work shows sudden drop of temperature in the top coat region and temperature in the substrate is less compared to uncoated substrate.

ACKNOWLEDGMENTS

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REFERENCES

- [1] L.B. Chen,"Ytria-Stabilized Zirconia Thermal barrier coatings – A review", Surface Review and Letters, Volume 13, Issue 5, October 2006
- [2] R.G. Wellman, J. Nicholls, "A review of the Erosion of thermal barrier coatings", Journal of Physics, Vol 40, Number 16, august, 2007,
- [3] Hassan Mohammad" FEA implementation of Thermal barrier Coatings Life time Predictions Methods", B.S. Engineering, Massachusetts Institute of Technology, 2009,
- [4] Charles H. Thistle," Air Plasma Sprayed Thermal Barrier Coatings: Experimental and Finite Element Analysis", University of Connecticut, UCONN library 8-24-2011
- [5] Ravi Kumar T,Kiran K. "Alternative Thermal barrier Coatings for CI Engine – A research Review",IJRAT,Vol no 2, NO. 5, ISSN: 2321-9637, May 2014
- [6] Sandeep Kumar, S. Kant,"Mullete Based Thermal coatings and Coating techniques: A Review", IJAMAE, VOL 1, Issue 3, ISSN 2372-4153, Sep 2014
- [7] Naveen A, Krishana Murthy L." A review on thermal Barrier Coatings and its Depositino Techniques", IJESMR, ISSN: 2349-5193, April 2017
- [8] HirenRana, "A Review paper on thermal barrier coatings to improve efficiency of Gas turbine", IJSRD, Vol.4, Issue 3, 2016, ISSN 2321-0613.

Experimental investigation on heat transfer enhancement and pressure drop of double pipe heat exchanger in solar water heating system

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Experimental Investigation on Heat Transfer Enhancement and Pressure Drop of Double Pipe Heat Exchanger in Solar Water Heating System

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Abstract. This paper presents the design and performances of double pipe heat exchanger embedded straight rectangular fins in the annulus are presented. Solar water heating systems use heat exchangers to transfer solar energy absorbed in solar collectors to the working fluid used to heat the water or a space. An experimental investigation is conducted for different set values of mass flow rate and varying the number of rectangular fins. The experimental results are validated with plain double pipe heat exchanger. The results of rectangular fins in the annulus side causes increased rate of heat transfer and pressured drop compared to plain double pipe heat exchanger. The experimental study is performed by varying mass flow rate of 0.01 kg/s, 0.02 kg/s and 0.03 kg/s of cold fluid in the annulus side and the mass flow rate of hot fluid in the inner pipe is kept constant. The performance and increased pressure drop is a function of number of fins and mass flow rate.

INTRODUCTION

Heat augmentation technique is the method of improving the performance of a heat transfer system. Many attempts have been made to reduce the size and costs of the heat exchangers. An increase in heat transfer coefficient results in reducing the temperature driving force and it increases the exergy efficiency and decreases entropy generation. In addition, heat augmentation techniques play a vital role for laminar flow, since the heat transfer coefficient is generally low in plain tubes. Swirl flow devices form an important group of passive augmentation methods with twisted tape is one of the most important members of this group. Tubes with twisted tape insert have been used as one of the passive heat transfer enhancement techniques and are most widely used tubes in several heat transfer applications; for example, heat recovery processes, air conditioning and refrigeration systems, and chemical reactors.

Concentric tube heat exchangers place a key role in various heat transfer engineering processes. Heat flows between two fluids, which are flowing in inner and outer pipes respectively. The fluids may flow in parallel or counter flow direction. Concentric tube exchangers are commonly used in applications involving relatively low flow rates and high temperatures for which there are well suited.

Recent literature are concerned; there are many research studies have been conducted done improvements in heat transfer rate by Yang *et al.* [1], Akpınar [2] and Ma *et al.* [3]. Their results in power saving, raising thermal rating and working life of the equipment.

Pourahmad and Pesteei [4] investigated on double pipe heat exchanger by inserting wavy strip turbulators in the inner-pipe, their findings are on considerable improvements in enhancement of heat transfer characteristics. Ibrahim [5] found the increase of laminar flow and heat transfer plane tubes with helical screw tape inserts. Result of porous baffles and flow pulsation on concentric tube heat exchanger efficiency was investigated by Targui and Kahalerras [6], the authors propose that addition of oscillating machinery in the inner pipe increases the heat transfer. An

analysis of using plain and perforated variable spacing with helical tabulators was studied by Sheikholeslami *et al.* [7], heat transfer and fluid flow analysis were carried out for different area ratios and pitch ratios. Results show that effectiveness is an increasing function of open area ratio and decreasing function of pitch ratio.

The fast development of various numerical methods of double heat exchanger is done based on methods [8, 9]. These methods are supplements to experiments and theory. Additionally, it offers an economic alternative. Gorman *et al.* [10] presented a numerical investigation of the thermal design in which the wall inner tube is helically grooved. A review was carried out by Ahmed *et al.* [11], on finned tube heat exchangers. The review consists of with and without fins wavy, angular, and longitudinal fins. Further, the heat transfer enhancement methods are studied in [12-21].

In the present work, numerical and an experimental study of heat transfer for a water-to-water concentric tube exchanger with rectangular fins at the annulus side is carried out. In the literature, baffles are almost used in shell and tube heat exchanger to increase heat transfer rate and to decrease pressure drop, and no publication studying on thermo hydraulic performance for the annulus of the concentric tube heat exchanger could be found. The flow rate in the inner pipe is kept constant as in conventional concentric tube heat exchanger. The experiments were conducted for different cases of number of fins in the annulus side. The experimental results are validated with numerical results.

EXPERIMENTAL STUDY

A schematic diagram of the experimental setup is shown in Fig. 1. It consists of a specimen section, hot water loop, and cold water loop. The specimen section is the horizontal double pipes with rectangular fins as shown in Fig. 2. The specimen section and the piping system are made such that parts can be changed. The experimental setup after installing all parts is shown in Fig. 3. The open loop cold water consists of the 0.5 m³ storage tanks, with a gezeer capacity of 10 litres, an electric heater with temperature control. The hot water controlled by temperature controller. The volume flow rate of the hot and cold water are controlled by rotating valve and measured by the rotometer value range of 0.01–0.03 kg/s.

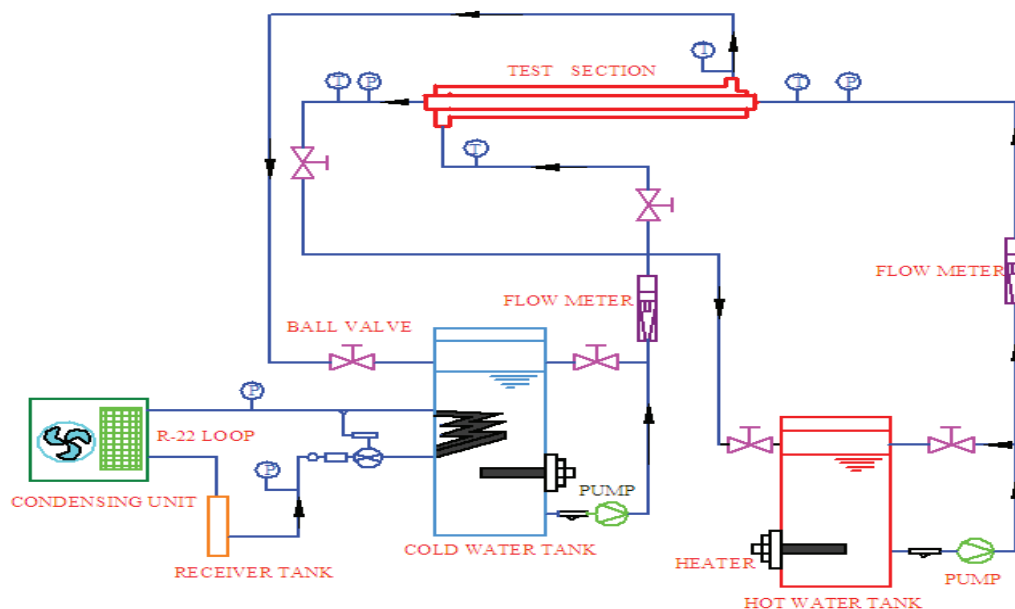


FIGURE 1. A schematic diagram of the experimental setup



FIGURE 2. Photographic view of Specimen of tube with rectangular fins



FIGURE 3. Experimental setup of double pipe heat exchanger

The volume flow rate was checked 4 times for each trail, a 20 litre beaker and stop watch is used to reduce the uncertainty ($\pm 2\%$). A hot water geezer of capacity 10 litre is equipped with adjustable temperature controller, with a temperature control of $\pm 0.5^\circ\text{C}$. The hot temperature was kept at 55°C and 65°C .

The specimen section made from the straight copper tube consists of an outer tube and inner tube and a length of 1100 mm. The inner diameter and outer diameter of the inner pipe are 10 and 12 mm, respectively. The inner diameter of the outer pipe is 37 mm. The rectangular fins are made from the copper strip with the thickness of 1 mm, the length of 1100 mm and a height of 5mm. The thermocouples are mounted to measure the hot water and cold water temperatures at the inlet and outlet sections.

Experiments were conducted at different inlet temperatures of hot water. Flow rate of hot water kept constant and flow rate cold water entering the test section was varied. The inlet hot and cold water temperatures were adjusted with the help of temperature controllers. Before the data were measured, the system was allowed to reach the steady state.

DATA DEDUCTION

For the temperatures deviations, a log mean temperature difference (LMTD)

$$LMTD = \frac{((T_{wh,in} - T_{wc,in}) - (T_{wh,out} - T_{wc,out}))}{\ln\left(\frac{T_{wh,in} - T_{wc,in}}{T_{wh,out} - T_{wc,out}}\right)} \quad (1)$$

for parallel flow and

$$LMTD = \frac{((T_{wh,in} - T_{wc,out}) - (T_{wh,out} - T_{wc,in}))}{\ln\left(\frac{T_{wh,in} - T_{wc,out}}{T_{wh,out} - T_{wc,in}}\right)} \quad (2)$$

for counter flow is used [21–25].

Heat transferred to the cold water in the annulus, $Q_{w,c}$, can be determined from

$$Q_{w,c} = m_{w,c} C_{p,w} (T_{w,c,out} - T_{w,c,in}) = U_o A_o LMTD \quad (3)$$

where $m_{w,c}$ is the mass flow rate of cold water which passing through the annulus, U_o is heat transfer coefficient, A_o is the surface area of the outside diameter of the inner pipe, $C_{p,w}$ is the specific heat of cold and hot water, $T_{w,c,in}$ and $T_{w,c,out}$ are the inlet and outlet temperatures of cold water.

Heat transferred from the hot water in the inner pipe, $Q_{w,h}$, can be determined as

$$Q_{w,h} = m_{w,h} C_{p,w} (T_{w,h,in} - T_{w,h,out}) = U_i A_i LMTD \quad (4)$$

where $m_{w,h}$ is the mass flow rate of hot water which passing through the inner tube of heat exchanger, U_i is heat transfer coefficient, A_i is the surface area of the inside diameter of the inner pipe, $C_{p,w}$ is the specific heat of cold and hot water, $T_{w,h,in}$ and $T_{w,h,out}$ are the inlet and outlet temperatures of hot water.

The average heat transfer rate, Q_{ave} , is determined from the hot water side and cold water side as

$$Q_{ave} = \frac{Q_{w,c} + Q_{w,h}}{2} \quad (5)$$

The overall heat transfer coefficient U_o based on outer surface area of the inner pipe can be determined as per the energy balance equation t, with negligible heat losses to surroundings, from equations (1) and (2):

$$Q_{avg} = U_o A_o LMTD \quad (6)$$

RESULTS AND DISCUSSION

The Fig. 4 and Fig. 5 shows the increase of an average heat transfer rate respect to cold water mass flow rate for plain tube and rectangular fins at a hot water inlet temperature of 55°C and 65°C and it shows that when hot water inlet temperature of 55°C, the heat transfer rate is increases with the mass flow rate of cold water. It is because of heat transfer across the test section is directly depending on heat capacity of the hot water. The presence of fins in the annulus creates the flow surface area is more and it results in the enhancement of heat transfer rate. This is because of outside surface area of the inner tube of heat exchanger is increased. In addition, it shows from the Fig. 4 and Fig. 5 the heat transfer rates for eight fins are higher than of six fins. It can also shown in the Fig 5 that a little

increase in heat transfer rate as compare to the Fig. 4, it is because of change in inlet temperature a hot water. The Fig. 6 and Fig.7 shows the variation of heat transfer coefficient with mass flow rate of cold water for parallel flow, it can be seen that heat transfer coefficients are increased because same explanation described above for the fig. 4 and fig. 5 are given.

The Fig. 8 and Fig. 9 show the validation of experimental results of rate of heat transfer with mass flow rate at inlet temperature of 55°C and 65°C respectively. It is very clear from these graphs that there is an increment in rate of heat transfer with addition of rectangular fins as compared to plain tube at particular mass flow rate of cold water. The agreement between the results of numerical method and experiment are reasonable. The Fig. 10 and Fig. 11 shows the variation of heat transfer coefficient and mass flow rate, at different inlet conditions of temperature for counter flow direction.

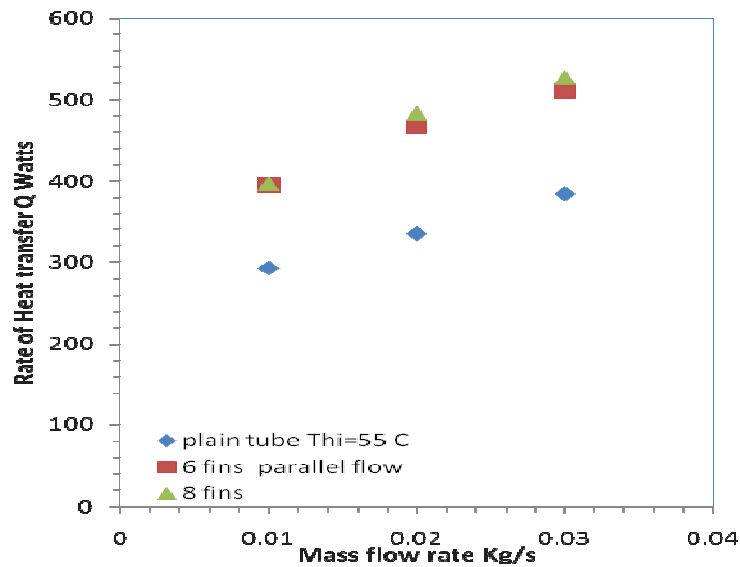


FIGURE 4. The variation of heat transfer rate with mass flow rate at inlet temperature of 55 °C for parallel flow

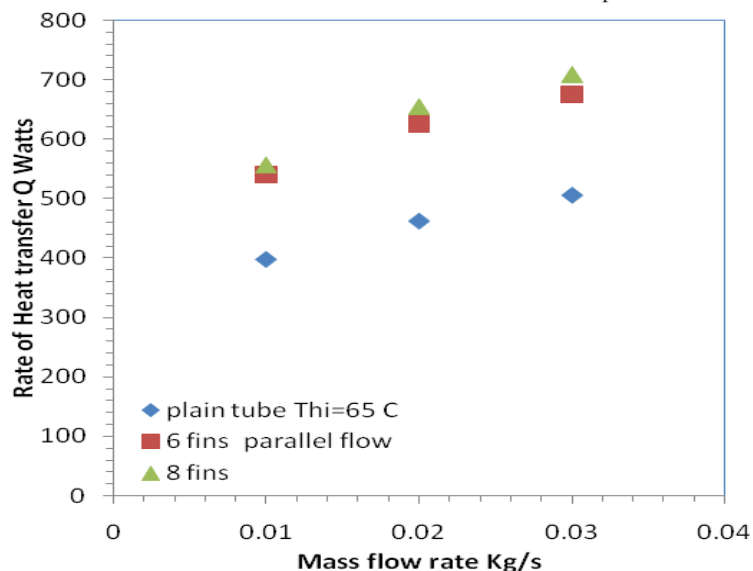


FIGURE 5. The variation of rate of heat transfer with mass flow rate at inlet temperature of 65 °C for parallel flow

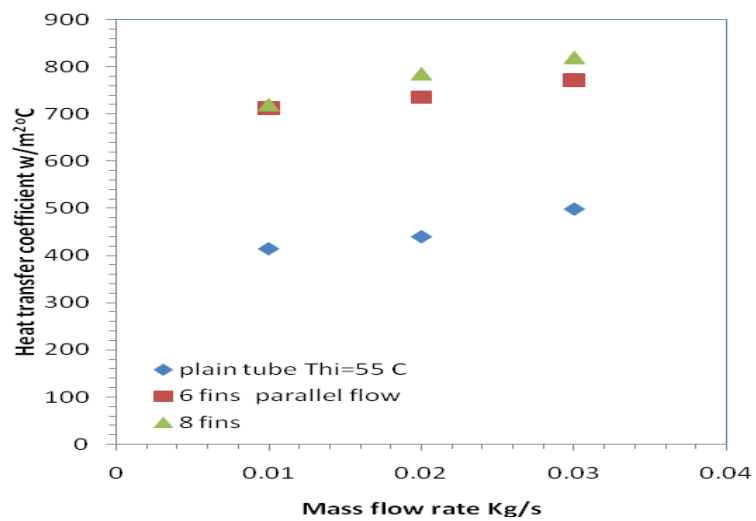


FIGURE 6. The variation of heat transfer coefficient with mass flow rate at inlet temperature of $55\text{ }^\circ\text{C}$ for parallel flow

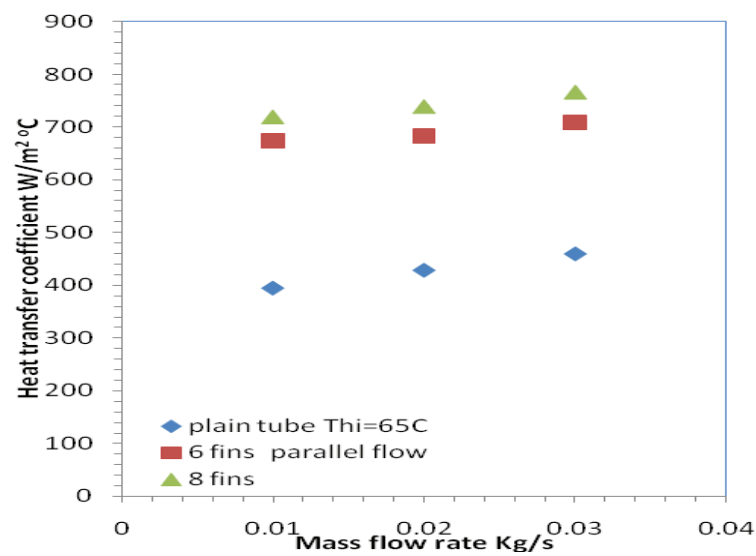


FIGURE 7. The variation of heat transfer coefficient with mass flow rate at inlet temperature of $65\text{ }^\circ\text{C}$ for parallel flow

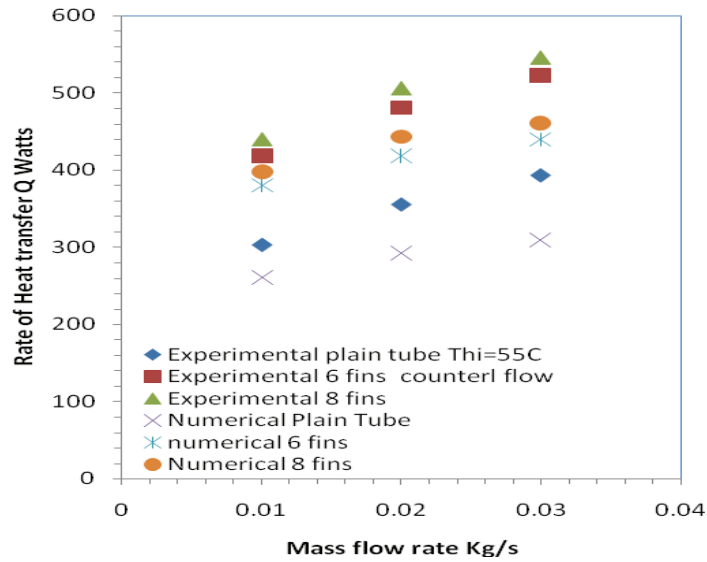


FIGURE 8. Comparison of experimental results with numerical results, Q verses mass flow rate for counter flow

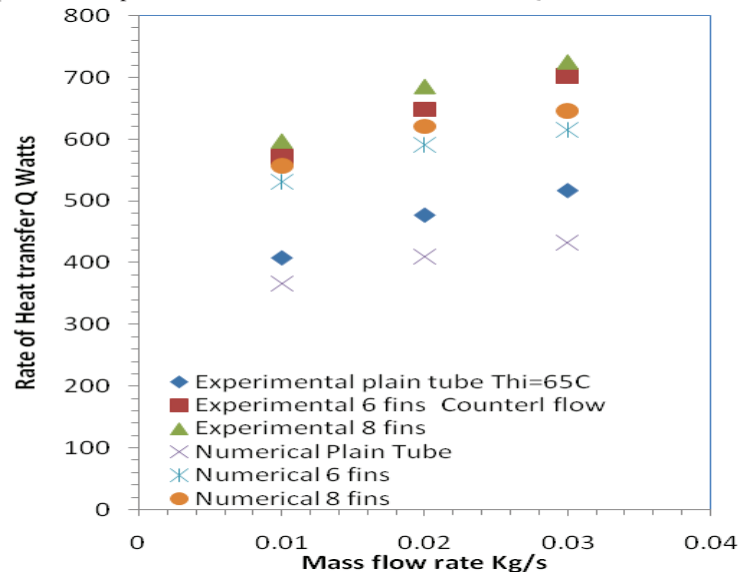


FIGURE 9. Comparison of experimental results with numerical results, Q verses mass flow rate for counter flow

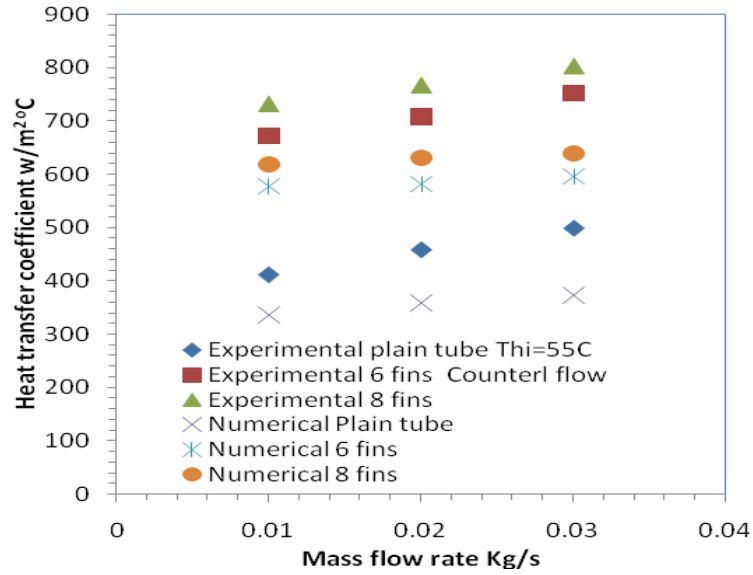


FIGURE 10. Comparison of experimental results with numerical results, overall heat transfer coefficient verses mass flow rate for counter flow

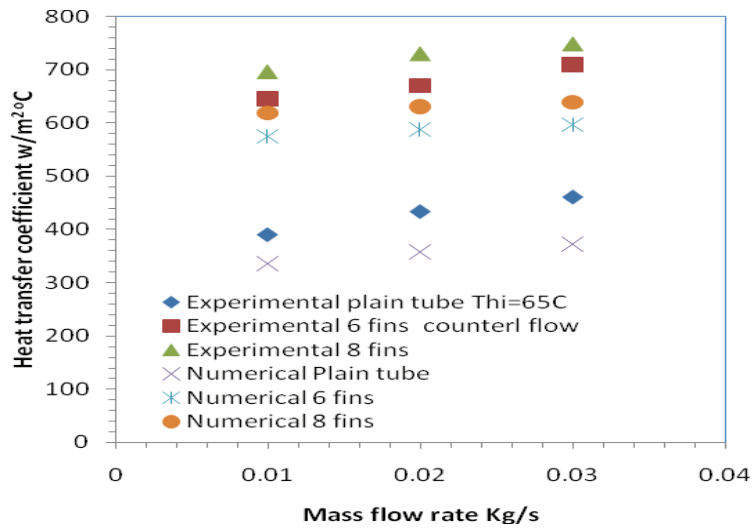


FIGURE 11. .comparison of experimental results with numerical results, overall heat transfer coefficient verses mass flow rate for counter flow

CONCLUSIONS

The experimental study on heat transfer characteristics of the double pipe heat exchanger with straight rectangular insert in annulus was presented. It is found from the study; the heat transfer coefficient has improved by 62% and 54 % for the usage of 8 and 6 rectangular fins respectively as when compared to plain tube. The agreement between the results obtained from the experiments and those obtained from numerical methods were reasonable. It is observed that rate of heat transfer and heat transfer coefficient directly depends on inlet fluid temperature, mass flow rates of the hot and cold fluid.

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REFERENCES

- [1] Yang D, Guo Y, Zhang J, “Evaluation of the thermal performance of an earth to air heat exchanger (EAHE) in a harmonic thermal environment”. [Energy Conversion and Management](#), Vol. 109, pp. 184–94 (2016)
- [2] Akpınar EK, “Evaluation of heat transfer and exergy loss in a concentric double pipe exchanger equipped with helical wires”, [Energy Conversion and Management](#); Volume 47, Issues 18–19, pp. 3473–3486 (2006)
- [3] Ma T, Li L, Xu X-Y, Chen Y-T, Wang Q-W, “Study on local thermal–hydraulic performance and optimization of zigzag-type printed circuit heat exchanger at high temperature”, [Energy Conversion and Management](#), Volume 104, pp. 55–66 (2015) .
- [4] Pourahmad S, Pesteei S M, “Effectiveness-NTU analyses in a double tube heat exchanger equipped with wavy strip considering various angles”, [Energy Conversion and Management](#), Volume 123, pp. 462–469 (2016).
- [5] Ibrahim E Z, “Augmentation of laminar flow and heat transfer in flat tubes by means of helical screw-tape inserts”, [Energy Conversion and Management](#), Volume 52, Issue 1, pp. 250–257 (2011).
- [6] Targui N, Kahalerras H, “Analysis of a double pipe heat exchanger performance by use of porous baffles and pulsating flow”, [Energy Conversion and Management](#), Volume 76, pp. 43–54 (2013).
- [7] Sheikholeslami M, Gorji-Bandpy M, Ganji D D, “Effect of discontinuous helical turbulators on heat transfer characteristics of double pipe water to air heat exchanger”, [Energy Conversion and Management](#), Vol.118, pp. 75–87 (2016).
- [8] Du YP, Qu ZG, Zhao CY, Tao WQ, “Numerical study of conjugated heat transfer in metal foam filled double-pipe”, [International Journal Heat and Mass Transfer](#), Volume 53, Issues 21–22, pp. 4899–4907 (2010).
- [9] Rennie T J, Raghavan V G S, “Numerical analysis of the lethality and processing uniformity in a double-pipe helical heat exchanger”. [Chem Eng Process](#), volume 49 Issue7, pp. 672–679 (2010).
- [10] Gorman J M, Krautbauer K R, Sparrow E M, “Thermal and fluid flow first principles numerical design of an enhanced double pipe heat exchanger”, [Applied Thermal Engineering](#), Volume 107, pp. 194–206 (2016).
- [11] Sayed Ahmed E, Mesalhy O M, Abdelatif M A, “Flow and heat transfer enhancement in tube heat exchangers”, [Heat and Mass Transfer](#), Volume 51, Issue 11, pp. 1607–1630 (2015).
- [12] Ibrahim E, Moawed M, “Forced convection and entropy generation from elliptic tubes with longitudinal fins” [Energy Conversion and Management](#), Volume 50, Issue 8, pp. 1946–1954 (2009).
- [13] Sayed Ahmed E, Ahmed Sayed, Mesalhy Osama M, Abdelatif Mohamed A, “Effect of longitudinal-external-fins on fluid flow characteristics for wingshaped tubes bundle in crossflow”, [Journal Thermodynamics](#), 16. (2015)
- [14] Syed KS, Ishaq M, Iqbal Z, Hassan A, “Numerical study of an innovative design of a finned double-pipe heat exchanger with variable fin-tip thickness”, [Energy Conversion and Management](#), Volume 98, pp. 69–80 (2015).
- [15] Zohir A E, Habib M A, Nemitallah M A, “Heat transfer characteristics in a doublepipe heat exchanger equipped with coiled circular wires”, [Exp Heat Transfer](#), Pages 531–545 (2015).
- [16] Eiamsa-ard S, Thianpong C, Promvong P, “Experimental investigation of heat transfer and flow friction in a circular tube fitted with regularly spaced twisted tape elements”. [Int Commun Heat Mass Transfer](#) 2006;
- [17] Sheikholeslami M, Gorji-Bandpy M, Ganji D D, “Experimental study of the influence of perforated circular-ring on pressure loss and heat transfer enhancement using sensitivity analysis”, [Appl Therm Eng](#), pp. 739–748 (2015).
- [18] Agrawal AK, Sengupta S, 1993. “Laminar fluid flow and heat transfer in an annulus with an externally enhanced inner tube”, [Int J Heat Fluid Flow](#), vol. 4, pp. 54–63 (1993)
- [19] Jaisankar S, Radhakrishnan T K, Sheeba K N, “Experimental studies on heat transfer and thermal performance characteristics of thermo siphon solar waterheating system with helical and Left-Right twisted tapes”, [Energy Conversion and Management](#), Volume 52, Issue 5, pp. 2048–2055 (2011).
- [20] Kahalerras H, Targui N, “Numerical analysis of heat transfer enhancement in a double pipe heat exchanger with porous fins”, [International Journal of Numerical Methods for Heat & Fluid Flow](#), Vol. 18 Issue: 5, pp.593–617(2008).

- [21] Yildiz C, Bıçer Y, Pehlivan D, 1996. "Influence of fluid rotation on the heat transfer and pressure drop in double-pipe heat exchangers", Appl Energy, 54:49–56. 5 (1996).
- [22] El Maakoul A, Laknizi A, Saadeddine S, El Metoui M, Zaite A, Meziane M, 2016. "Numerical comparison of shell-side performance for shell and tube heat exchangers with trefoil-hole, helical and segmental baffles", Appl. Thermal Eng. (2016);
- [23] F. Inc., FLUENT User's Guide; 2006.
- [24] Eduardo C, "Heat transfer in process engineering", McGraw-Hill Education, 2010;
- [25] Bergman TL, Incropera FP, DeWitt DP, Lavine AS. Fundamentals of heat and mass transfer. John Wiley & Sons;(2011).

Data acquisition in car using IoT

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Data Acquisition in Car Using IoT

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Abstract-Data acquisition in car is to record vehicle history which can be used for car forensics in case of car accident or related crimes. Data collection stores engine temperature reading at that instant of time, obstacle detection, seat belt condition, the speed of the vehicle are the clues for investigation vehicle-related accidents or crimes. The images captured can be collected via GSM through android. This is the process of collecting image captured and data's like temperature, obstacle and seat belt worn. This data is then sent through GSM to concerned authorities.

Key words: GSM, Android, temperature sensor, Ultrasonic sensor, alcohol detector.

INTRODUCTION

Earlier method of investigation is where police have to come near accident spot and check for evidence of accident. Later they will check for evidences like wheel skid marks, exact location of incidence, collision part, eye witness etc. Often, there are chances of insufficient evidence or it is also possible that some clues got missed by police and the insurance company. It takes less time and complicated method. From this data acquisition system we can easily take evidence from the police station. This reduces, time and complexity over traditional of the system. The results obtained are been collected. Information related to vehicles crashes can be install in vehicles using event data recorder. In earlier days vehicles do not have evidence collection system. The safety of the vehicles can be improved by evidence collection which is used to collect accident information statistically applicable crash or accident the safety of the vehicles. Car owner collects the information. This objective will collect the car evidence in clear picture Car evidence will reduce the complexity, verification and accidental process. In some cases we can claim the vehicle insurances for the evidence collection system. Hence this system is not on particular objective.

LITERATURE SURVEY

The prototype of Black Box For vehicle diagnosis that can be installed into any vehicle. This prototype can be designed with minimum number of circuits. This can contribute to construct safer vehicles, improving the treatment for crash victims, helping insurance companies with their vehicle crash investigations, and enhancing road status in order to decrease the death rate.

Karthiks et al [6] presents a low price which provides values for the current automotive system. It has two components namely vehicle to obstacle collision and the Black Box which records the relevant details about a vehicle such as seat belt condition, Engine Temperature, Distance from obstacle, Speed of vehicle, Brake status, Alcohol content, Accident Direction, trip Time and Date and the location of the car at that place of incidence.

Ashwini B. Patil et al [7] they use ARM7 to receive and transmit the data using Xbee transmission. This controller it is used for the real time data collection of the vehicle. This controller not only transmit the collect data. Also, saves the data at the end user. Also the application will help to send the data to mail of the user. They use different wireless sensor to know the value of the system and these values can be used as evidence collection of car.

And to claim the vehicle insurance.

Chulhwa hong et al [8] it is to collect the video clips from vehicle black box.and these data are been use as evidence to the police for investigation purpose.

PROPOSED SYSTEM

The heart of the system is at the centre of the black box. The microcontroller is a program that helps the controller to take action's based on the inputs given by the sensors output. An accelerometer is used to know accelerator of a car. An accelerometer generates output voltages against changes in gravitational pull with the axis x & y. These output voltages are analogous in nature. The output of accelerometer is to DC motor which is connected to the microcontroller. The D.C motor speed is varied with respect.

The D.C motor in the project demo represents a vehicle. As acceleration is varied the speed of the D.C motor is varied. To simulate operation of seat belt, slot sensor is utilized in this demo. When anything is placed in slot sensor, it shows a logic 1 signal.

From the figure 1, a temperature sensor is attached to monitor temperature of the vehicle engine. This sensor generates the real time temperature.

Ultrasonic sensor is placed in front of the vehicle. It constantly monitors the distance of the vehicle or the obstacle ahead of it. A toggle switch is used to simulate left and right indication switching of vehicle. LED is used to indicate left and right of the vehicle. So when switch slides to left, LED is ON and when slides to right, LED is ON.\

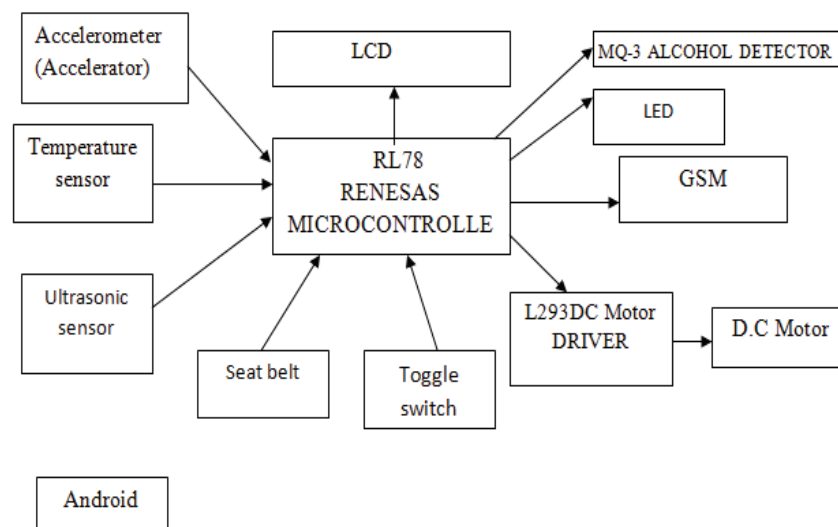


Figure 1: Block diagram of the system

SYSTEM DESIGN

Overall system architecture

Here all the devices will be connected to internet. For the data communication between the microcontroller, GSM and android application. The controller which receives the data from the sensor will collect the readings and send it to the registered mail. To claim the insurance from the company we can have the set of proofs:

- At the time of incident the images of the outer view from the car.
- The location where the incident has taken place.
- The time and speed of the car at the incident.
- The distance between the car and obstacle around it will be know.
- We can find the alcohol content in the car, also the drive has wore the seat belt or not.
- When car is stolen we can easily find its location by means of GPRS.
- All these above data will be mail to the registered mail.

Input design

All the details from these sensors are sent to Android mobile phone. In android mobile phone, an application is created for this specific purpose. When vehicle is met with an accident, the camera in the phone captures image of the accident. GPS directly communicates with satellite thereby giving coordinates of the position of accident. These details are sent to Amazon cloud server via e-mail.

Results & discussion

In figure 2 to 12 ,GSM: This device is used to receive the data from the microcontroller and the data is sent to the android application. The user need to register the mail id in the android application and the data are sent to the email.

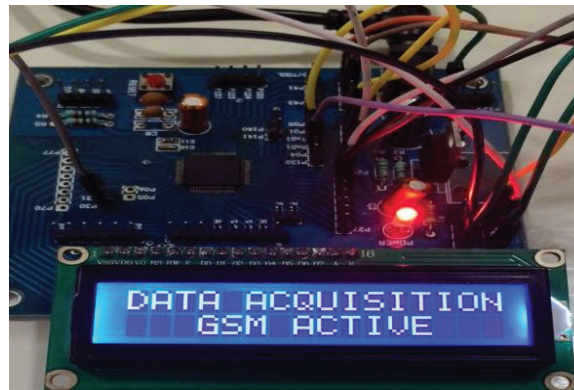


Figure 2: GSM activated

After GSM activates the data from the microcontroller are been sent to registered mobile and the registered email id of the user.



Figure 3: GSM initialized



Figure 4: message sent to registered mobile

The user will receive the message from the GSM.

Temperature sensor: We use LM-35 temp sensor to know the engine temperature at that instant of time. So, that we can identify the reason for the car incident. If it was due to the high temperature of the engine. Here we sent the temperature to 40⁰c as normal temperature.

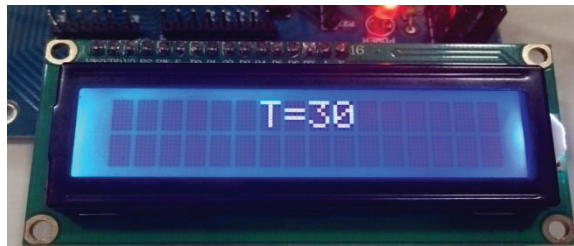


Figure 5: At engine normal temperature

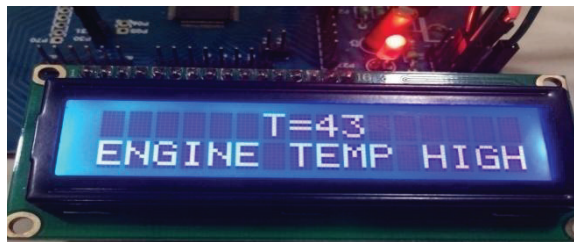


Figure 6: when engine high temperature

The condition is if temperature is more than 40⁰c then it say the car engine was at high temperature. If it was high then it is the condition for the incidence.

Ultrasonic sensor: This identifies the obstacle from 0-meters to 6.45-meters. This is used for the obstacle detection around the car. When an object is identified by the ultrasonic sensor it will identify and read as detected.



Figure 7: when obstacle is detected

The distance from the car to the other obstacle will be noted and the reading will be sent to the microcontroller. Then the text message and the email will be sent to the registered user.

Accelerometer: This is a small device and low power consuming; it has axis with signal and voltage as outputs. This is have the axis x, y & z. They have the values as 145⁰ and 175⁰ in which when the angle of the placed device

goes greater than 175^0 or less than 145^0 then it is said car is vibrated and the reading will be noted. What angle the car was at the instant of time. Also the speed of the car is calculated with respect to the car wheel's.



Figure 8: when the accelerometer sense the variations

The above figure shows when the accelerometer is varied then it reads as vibration sensed. This data are been also sent to the registered mail and phone number.

Alcohol detector: This device is used to find concentration of alcohol based on the driver breathing, just like a common breathalyzer. This is recognizing the percentage of alcohol easily. There can be also perfume content, but the perfume concentration is less then alcohol.

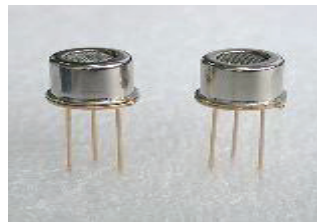


Figure 9: MQ-3 alcohol sensor

MQ-3 alcohol sensor to detect the alcohol content in the car at that time of incidence to know if the driver had drunk or not. LED & LCD : Light emitting diode is used for indication purpose. When the car takes turn's ether left or right we use this led as indicators. At time the incident the indication of the car will be noted for the evidence.

and Liquid crystal display is used to show what are the readings with respect to the sensors connected to it. L293 DC MOTOR : This L293 is an integrated circuit device are two small motors which are very small and these run in opposite direction at same time. The L293 is limited to 600mA, but it can only handle much small currents.

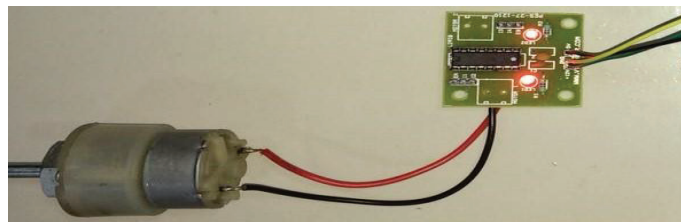


Figure 10: Motor driver

This motor driver is used to run the car at required speed and the Accelerometer is connected to it. When the incident takes place the accelerometer will off the motor and the car stops. Data from these device are been collected.

From all the devices which are connected to the microcontroller. We get the temperature of the engine, the distance of car to the obstacle, the alcohol detection in car if any, seat belt condition, the acceleration of car at that instance of time, the camera images at that instant of time. The gsm will send the message to the registered mobile and from android application we get mail.

OUTPUT

Android application is used and the gsm is initialized and the data are been sent to the registered mobile number and the registered mail id of the user. The below figure shows how to register in android application. Said to be car black box.

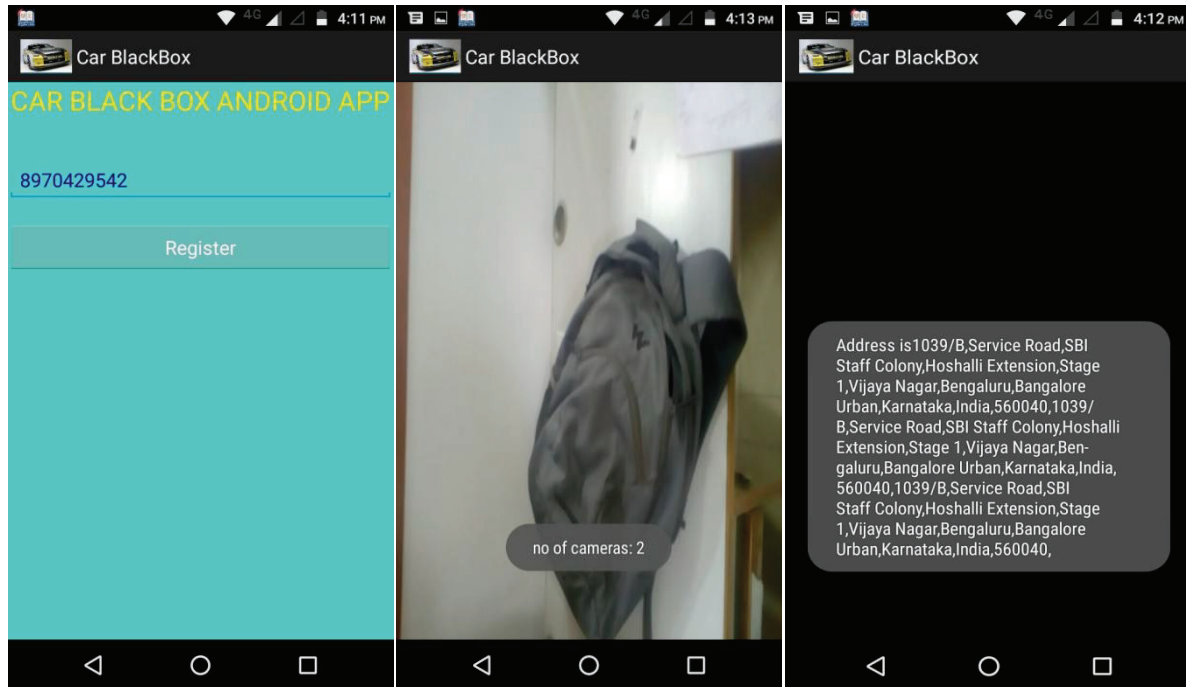
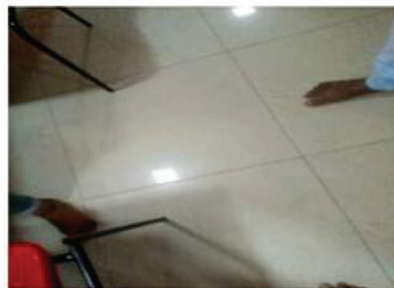


Figure 11: Android app data collection, with images and the location.

To: sagargowda.0095@gmail.com, raieshr2954@gmail.com, umashreenk@gmail.com
Subject: This is an email sent from CAR BLACK BOX ANDROID APP from an Android device



Hi User,
Temperature: 43.
high temperature
Front Obstacle : detected
Seat Belt is NOT LOCKED UP
indicator OFF
null
Location: Address is 1039/B. Service Road, SBI staff Colony, Hoshalli Extension, Stage 1, Vijaya Nagar, Bangalore.

Figure 12: Received mail with data.

Also, the surrounding images are been captured by the cameras and they are stored as the data collection. And used as evidence to claim the insurance of the car.

CONCLUSION

In this system we get collection the data from the devices which are placed inside the car black box. The data like acceleration, temperature, distance, camera image, location, date & time, seat belt condition and the alcohol content present at the time of the incidence. All these are been sent to registered android app and the mail.

FUTURE SCOPE

This model is developed a prototype module. In future, this project model can be implemented to the product level. If we need this project model as user friendly and durable, we need to make it compact, easy to understand and less cost. All the sensor devices are been connected to one single controller and size of the black box is less. The entire evidence collect by the devices in the car will be used as the documents by the insurance company as the proof for the incidence. And also can find the theft car location through the registered android devices.

REFERENCE

1. Shital V.Vaidya, Prof.P.H.Chandankhede, International Conference On Emerging Trends In Science, Engineering, Business And Disaster Management Icbdm 2016, Image Processing And Networking Volume:8 Special Issue Iv, Feb 2016, Issn No:0973-2993.
2. Pravin Kumar, V. Anuragh, Nlp Raju, "Accelerometer Based Vehicle Monitoring And Tracking System Using Gps", International Journal Of Science, Engineering And Advance Technology, Ijseat, Volume 2, Issue 11, Issn 2321-6905 November-2016.
3. Monisha J Prasad, Arundathi S, Nayana Anil, Kariyappa B. S., "Automobile Black Box System For Accident Analysis", International Conference Of Advances In Electronics, Computers And Communications (Icaecc) 2014.
4. Anoop Mathew, Joseph Kuncheria, Yadukrishnan S, Gifty Raju, Haritha Chandrasekhar, "Car Black Box", International Journal Of Innovative Science And Modern Engg. (Ijisme) Issn: 2319-6386, Volume-2 Issue-11, October 2014.
5. Kangsuk Chae, Daihoon Kim, Jaeduck Choi, And Souhwannjung, "Evidence Collecting System From Car Black Boxes", School Of Electronics Engg, Soongshil University, Seoul, Korea 2013.
6. Kaushik " Design And Implementation ' Icetse-2017 Issn: 2278-9359 Volume 6 Issue 5 May.
7. Chulhwa Hong "Evidence Collection From Car Black Box Using Smart Phone" 8th Annual Ieee Consumer Communications And Networking Conference , Korea

An energy efficient broadcasting in mobile WSN

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An Energy Efficient Broadcasting in Mobile WSN

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Abstract. Mobile WSN do not have fixed infrastructure. They are self administrative and support dynamic topology. When a packet is broadcasted through flooding, this leads to problems like redundancy, contention and collision. Counter based broadcast design is supported to overcome above discussed problem. This approach is mainly dividing the network into following regions such as low sparse, average sparse, intermediate dense and high dense region. The packets are then transmitted through the node that has more number of nodes. This way number of rebroadcast, redundancy, chances of contention and collision among the neighboring nodes can be reduced to achieve high packet deliver ratio. Network performance can be enhanced by reducing end to end delay.

Key words — Flooding, Broadcast storm problem, Rebroadcast, End-to-End delay, Latency. Performance

INTRODUCTION

In mobile WSN, Host node broadcasts RREQ to all neighbors in the network using flooding mechanism. Here several applications, broadcasting is very essential[1]. The on demand routing protocols use flooding a simplest broadcasting mechanism for route finding, where an each node rebroadcasts the RREQ until a route is established to a destination. This leads to problems like retransmission of redundant packet, network contention and collision, commonly known as broadcast storm problem. These problems will degrade network performance, packet losses and less packet delivery ratio[2,3,4].

There are two schemes to reduce these problems, deterministic and probabilistic scheme. In deterministic approach, complete information of topology is required, which is unrealistic for Ad hoc Networks for reasonable amount of time. In probabilistic approach there are many schemes. One of them is counter based scheme in which packets are rebroadcasted only received packet is less than the threshold value. This scheme reduces redundant rebroadcasting of message, which is one of the problems in flooding. To improve the efficiency, an efficient three counter based scheme is implemented, which is helped to improve the performance[1,4,5].

AD HOC ON DEMAND DISTANCE VECTOR

AODV is a one the reactive routing protocol which finds route between host and destinations speedily; Link breakages and dynamic topology are responded by mobile hosts in a timely manner by AODV. Due to link breakages, a node initiates RERR message to its neighbors. Route Error messages and HELLO messages are used for route maintenance[1,2,3].

NETWORK CLASSIFICATION BASED COUNTER SCHEME

In mobile WSN, broadcasting is done by flooding mechanism. This results in serious problems in mobile WSN such as packet redundancy, network contention and collisions. This is named as the broadcast storm problem. To overcome these problems, Counter routing protocol is proposed to overcome the issues. The network is divided into five different regions such as low sparse, average sparse, intermediate, middle dense and high dense regions. The five regions are fixed based on the threshold values by applying formula (1.1, 1.2, and 1.3); To identify the five different regions such as high dense, middle dense, intermediate and sparse. To determine average number of neighbors:

$$Cmid = \frac{\sum_{i=1}^n N_i}{N} \quad (0.1)$$

Cmid - Threshold of Average Neighbors
Ni - Number of neighbors of each host.
N - Total number of host.

To determine the minimum number of neighbors:

$$CMin = \frac{\sum_{i=1}^n N_i}{Y} \quad (0.2)$$

Cmin - Threshold of Min Neighbors
Ni - Number of neighbors of each host below average.
Y - Total number of host which are below average

To find the maximum number of neighbors:

$$CMax = \frac{\sum_{i=1}^n N_i}{Z} \quad (0.3)$$

Cmax - Threshold of Max Neighbors
Ni - Number of neighbors of each node above average.
Z - Total number of host which are above average.

After calculating the three threshold values, the network is divided into five regions. When packet is received by the node, it incremented count and decrement time. The message is passed from source node to all other nodes. When the timer expires the transmission is stopped and now the counter threshold values are compared with the threshold values. If the node exists in sparse area it will take the smallest threshold Cmin. If the node exists in the medium area it takes threshold Cmid. If the node exists in dense area it takes threshold Cmax else the rebroadcast is stopped. Then the data packets are transmitted through higher density neighbor nodes. Thus the rebroadcast process is reduced and throughput is increased and the packet delivery ratio is enhanced.

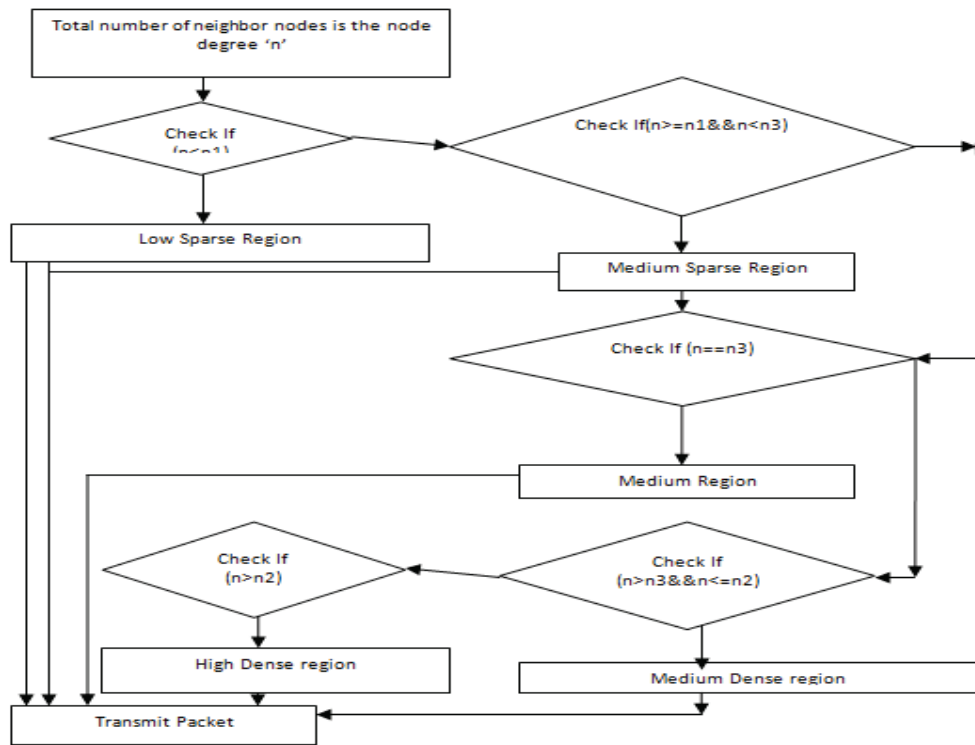


FIGURE 1. Flow Chart of Counter Scheme

From the Figure 1, the total number of neighbors of all the nodes is N . where n_1 is the Minimum number of neighbors, n_3 is an average number of neighbors and n_2 is the maximum number of neighbors. By applying the formula those values and neighbor nodes are counted.

Suppose n is $< C_{mid}$ then the node is belonging to low sparse area, If the $n < C_{mid}$ and $> C_{min}$ then the node is in the medium sparse area. Where $n = C_{mid}$ then node is in average region. The packets are propagated through the dense region. Hence, Rebroadcast has been reduced.

From Figure 2, the counter method is designed, Assume node 'B' wants to send a message to node 'R' through a topology as shown in Figure 3. It chosen dense region either $B \rightarrow A \rightarrow C \rightarrow F \rightarrow G \rightarrow H \rightarrow P \rightarrow Q \rightarrow R$ or $B \rightarrow D \rightarrow E \rightarrow M \rightarrow N \rightarrow Q \rightarrow R$.

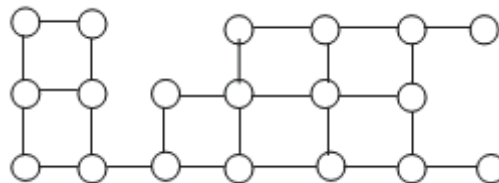


FIGURE 2. Examples of Counter method

IMPLEMENTATION

Testing

This testing is done through NS2 simulation with following results have been analyzed. End to End is delay, lost packets and packet delivery ratio To prove that performance is enhanced, more connections are added and the scenarios are generated. The scenario files are created for the network and the simulation set up is shown in Table 1.

TABLE .1: Simulation Setup

Simulation Parameters	Parameter Values
Packet Size	512 bytes
Maximum Speed	20m/s
Simulation Time	900s
Traffic Type	CBR

The testing is done for different scenarios and the performance will be analyzed after testing by using different performance metrics and those metrics are packet delivery ratio, End to End delay and lost packets ratio. The results vary when the connections are increased. To achieve better results the source and destinations in the network is increased along with its speed and simulation time. After this the network is observed for different packet rates and the simulation is done the trace file is uploaded in the trace graph software to analyze the performance of the network. The reason for adding more source and destination is more the connections increase the better and shorter paths are available. The simulation study is to simulate the AODV route discovery and counter AODV the network with better and shorter paths are available and the simulation of the routing protocol is also done. The network performance will improve with different testing scenario.

RESULTS

Packet Delivery Ratio

When the number of Packets success rate increases with respect to number of connections. The reasons followed: when connections are more, the network are having denser region and paths towards destinations are more. Due to this, success rate of packet delivery is more.

The packet delivery ratio of Normal AODV and Counter AODV is shown in Table.2.

TABLE.2: Packet Delivery Ratio of Counter AODV and Normal AODV

Number of Connections	Counter AODV	Normal AODV
15 nodes	96	90
25 nodes	97	91
30 nodes	95.65	84
35 nodes	95.27	74
40 nodes	92.15	72.41
45 nodes	92.86	71.45
50 nodes	89.83	75.73

Packet delivery ratio for each scenario is calculated in percentage and plotted on x-axis while the number of connections are plotted on y –axis. The analysis of number of nodes with respect to the packet delivery ratio for Counter AODV and Normal AODV is done by increasing the number of connections.

The analysis of the packet delivery ratio in percentage between the Normal AODV and Counter AODV is shown in Figure 3.

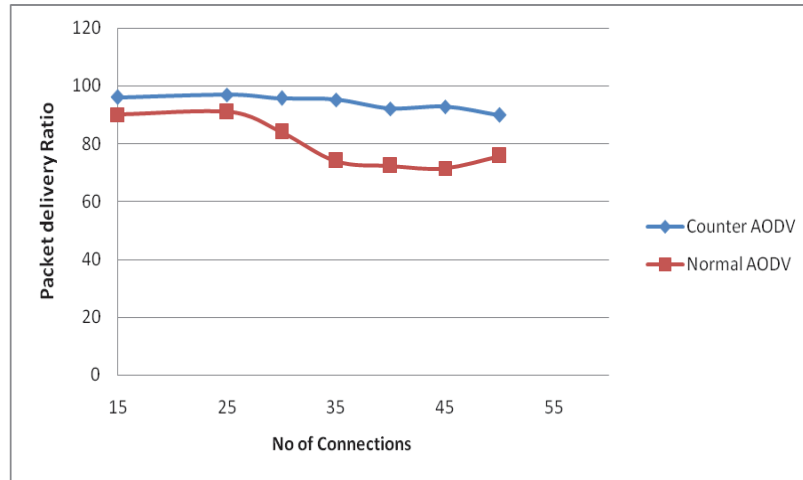


FIGURE 3 Packet Delivery Ratio vs No of Connections

End – to – End Delay

The End-to-end delay of Normal AODV and Counter AODV is shown in Table 3..

End to End Delay for each scenario are plotted on x-axis while the number of connections are plotted on y –axis. Due to the increase of number of collisions, contentions and redundant rebroadcast packets, the End to End delay increased in AODV where as it is reduced in Counter AODV. The analysis of End to End delay between the Normal AODV and Counter AODV is shown in Figure 4.

TABLE 3: End to End Delay of Counter AODV and Normal AODV

Number of Connections	Counter AODV	Normal AODV
15 nodes	0.1116	0.4884
25 nodes	0.1484	0.5654
30 nodes	0.1474	1.9637
35 nodes	0.2745	1.5871
40 nodes	0.2073	1.7918
45 nodes	0.2073	2.2019
50 nodes	0.2705	1.8911

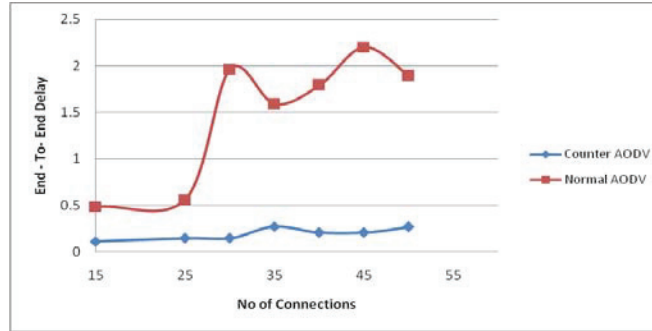


FIGURE 4. End to End delay vs No of Connections

Lost Packets Rate

Lost Packets is rate of packets dropped or lost due to collision or the expiry of time to live of the source node. The Lost Packets rate of Normal AODV and Counter AODV as shown in Table.4.

TABLE 4: Lost Packets of Counter AODV and Normal AODV

Number of Connections	Counter AODV	Normal AODV
15 nodes	806	3276
25 nodes	851	4733
30 nodes	1055	4823
35 nodes	1464	12377
40 nodes	1913	12371
45 nodes	1844	11045
50 nodes	1891	5379

Lost packets rate results are obtained for each scenario and the values are plotted at x-axis while the number of connections are plotted at y –axis. Due to collisions and retransmission the packets are dropped and lost simultaneously and the rate of packets lost is increased. When the number of connections increased and the data packets are transmitted from source to destination through dense region, the collision and rebroadcast is reduced so the rate of packets lost is reduced. The analysis of lost packets between the Normal AODV and Counter AODV is shown in Figure 5.

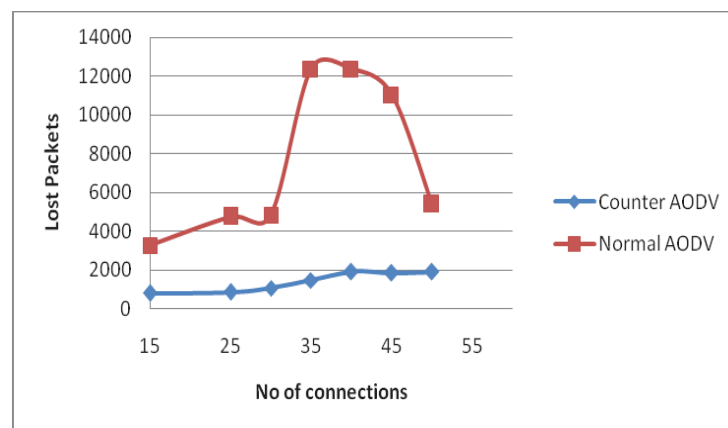


FIGURE 5. Lost Packets vs No of Connections

CONCLUSION AND SCOPE FOR FURTHER WORK

Thus the network is divided into regions and the transmission of packets through the dense region is implemented using counter based scheme in network simulation. The packets are transmitted through the dense region so that the packet delivery ratio is increased. The network overhead and delay are reduced by transmitting the packets through higher neighbour nodes. The simulation results between the Normal AODV and Counter AODV are used to compare the performance of the network by measuring the metrics packet delivery ratio and average delay. The flooding of packets is reduced by the counter scheme and the throughput is enhanced.

In current technique counter based broadcasting method is proposed to reduce the flooding. This can be improved by implementing rebroadcast probability technique where the rebroadcast probability values are calculated. The rebroadcast probability function will take the key parameters such as number of nodes, transmission range and network topology to assign rebroadcast probability for a mobile node and then the packets are transmitted between the nodes. The performance of the network must be evaluated by comparing the network overhead, delay and packet delivery ratio with the counter scheme.

REFERENCES

1. Perkins, C.E., Belding-Royer, E.M., Chakeres, I., 2003. Ad hoc on demand distance vector (AODV) routing. IETF Internet Draft.
2. Ramanathan, R., Redi, J., 2002. A brief overview of ad hoc networks: challenges and directions. [IEEE Communications Magazine](#) 40 (5), 20–22.
3. Senthilkumaran T, Sankaranarayanan V. Dynamic congestion detection and control routing in ad hoc networks. *J King Saud Univ – Comput Inform Sci* 2013;25(1):65–175. Senthilkumaran T, Sankaranarayanan V. Early congestion detection and adaptive routing in MANET. [Egypt Inform J](#) 2011;12(3):165–75
4. Syed SA, Kumaran TS, Ahmed AS. Energy efficiency distributed routing algorithm based on HAC clustering method for WSN. *Indian Journal of Science and Technology*. 2014; 7(S7):66–75.
5. Siva Ram Murthy, C., Manoj, B.S., 2007. Ad hoc Wireless Networks Architectures and Protocols, second ed. Pearson Education, Delhi, India.
6. Zhuangbin Chen,1 Anfeng Liu,1 Zhetao Li,2 Young-June Choi,3 Hiroo Sekiya,4 and Jie Li5, 2017, [Energy-Efficient Broadcasting Scheme for Smart Industrial Wireless Sensor Networks](#), Article ID 7538190, 17 pages, doi.org/10.1155/2017/7538190
7. Ji-Young Jung, Dong-Yoon Seo and Jung-Ryun Lee, 2018. Counter-Based Broadcast Scheme Considering Reachability, Network Density, and [Energy Efficiency for Wireless Sensor Networks](#). 2018, 18, 120; doi:10.3390/s18010120
8. Nikolaos Papanikos, March 2017, Energy-efficient Networking in Wireless Ad Hoc Networks

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Review on Remote Sensing and GIS for Lake Management

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Abstract: The lake management widely depends on control of drainage sources and lake management. Remote sensing and Geographical Information Systems can offer quick understanding of lake changes and in building lake management plan. The assimilation of remote sensing and GIS as an investigative tool allows the planners to capture and bring up to date all the appropriate information, plan, compare, visualise and assess from simulate various lake management scenarios.

Keywords: Remote sensing, Geographical Information Systems, Lake management,

INTRODUCTION

The essentials of lake management are well identified and extensively realized that both manage of watershed sources as well as in lake management are necessary. Remote sensing and GIS can be used to offer a fast or a large scale understanding of Lake Transform and in developing lake rejuvenations scenarios (Baban et al. 1999).

The assimilation of remote sensing data and GIS as n tool to allow planners to analyze and bring them up to date of all appropriate information like quality parameters, plan, compare, visualize and assess from simulated various lake management scenarios.

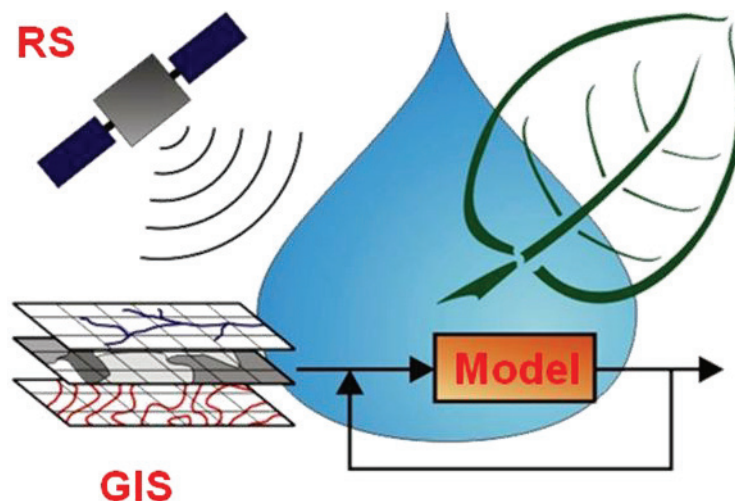


Figure 1 Use of RS and GIS in Lake Management

REMOTE SENSING AND LAKE MANAGEMENT

Remote sensing has been used progressively more in lake management over the past decades, but is still far behind land ocean remote sensing in implementation and in general community understanding. The specific information that looks like reality as narrowly as possible obtained from satellite images (Wulder et al. 2008). The satellite images skill to deliver synoptic measurement of same area, which put together numerous appropriate environmental uniqueness of area (Ballatore et al., 2014). The satellite images are ability to give the information concerning land use and land cover. The soft copy of remotely sensing information and analyze large quantity of data at very low-priced cost in a short time (Bradt et al. 2013). Recent advances in remote sensing and improvement in automated methods for satellite imagery data ranging from large to small sized lake have been possible and are economical.

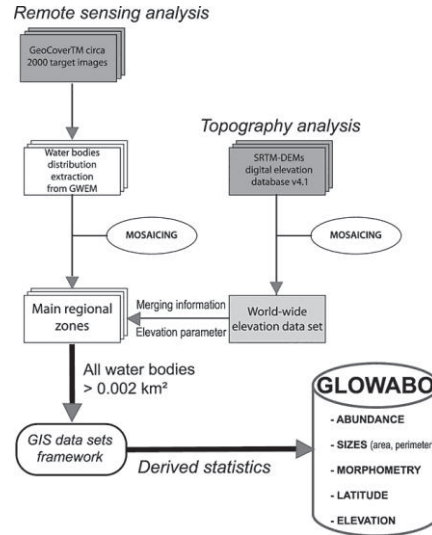


Figure 2 Methodology for Remote Sensing data analysis (Verpoorter et al. 2014)

DATA ACQUISITION

Land surface temperature and surface reflectance were two essential variables to estimating the evapotranspiration. In this paper data from MODIS sensor mounted on terra platform its having a frequent global coverage (every day) and High-precision temperature measurement and vegetation indices, Albedo and emissivity are also available. Aster 30 m resolution DEM data were used to estimate the relative parameters. The satellite images and hydrologic field measurements like water quality parameters and land cover changes were used. The OCEANSAT, Enhanced Thematic Mapper (ETM) images were used mainly to analyze in sort to pull out assured features like the area of lake and quality parameters of the lakes. GIS Map for lake restoration & management are based on digitized inventories, registers, archives, and remote sensing data from various platforms, e.g. Global Lake and Wetland Database (GLWD) have been compiled by (Lehner and Döll, 2004)

MODIS DATA

Land surface temperature and surface reflectance were two essential variables to estimating the evapotranspiration. In this paper data from MODIS sensor mounted on terra platform its having a frequent global coverage (every day) and High-precision temperature measurement and vegetation indices, Albedo and emissivity are also available. The data were downloaded from the LPDAAC website (<https://wist.echo.nasa.gov/api/>) and listed in the table 1. Aster 30 m resolution DEM data were used to estimate the relative parameters.

Table 1 The MODIS standard products and land surface parameters.

MODIS codes	MODIS products	Spatial resolution	Temporal resolution
MOD11A1	Land Surface Temperature	1000m	1 day
MOD09A1	Land Surface Reflectance	500m	1 day
MOD12Q1	Land Cover Type	1000m	yearly
Aster DEM	Digital Elevation Model	30m	

MAPPING OF DRAINAGE LINES AND LAKES

Repeatedly small drainage lines require be upgrading and stabilising when a basin is developed to provide for better and more normal flows. Lacking these improvements, enlarged flows can erode drainage lines and can lead to too much sediment incoming the major streams of the receiving drainage lines.



Figure 3 Urban poor ecological and no water quality treatment

VEGETATED WATERWAYS

Vegetated drainage streams are also called grassed waterways. Such type of streams are either constructed or naturally formed with plant and grass. These streams are used for avoiding erosion during excess runoff from crop land. Generally, it is recommended that there should be a gap of one year between construction of vegetated waterways and traces. Figure 4 shows vegetated waterways.

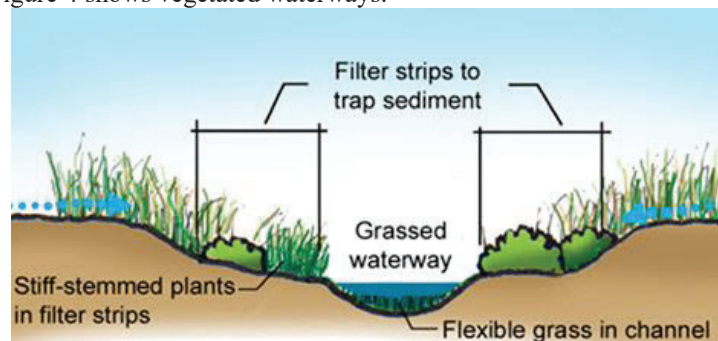


Figure 4 Vegetated waterways (sectional view). (Source: <https://www.nac.unl.edu>)

MAPPING OF WATER QUALITY PARAMETERS

The water quality parameters such as turbidity, chlorophyll-a, secchi disk depth, and total phosphorous are main factors effecting the water. The turbidity is linked with suspended particles in water like soil, sediments, sewage.

Chlorophyll-a is a photosynthetic pigment in submerged plants and algae. Secchi disk depth is used to measure the transparency or clarity of water in lake. Total phosphorus is a measure of dissolved form of phosphorus. Satellite images with OCM sensor and use of green, blue and red showed significant relationship between water quality parameters.

CONCLUSION

With remote sensing and GIS get together provide in order on the comparative difference of water quantity and water quality parameters. Different satellite data sources from IRS series and Landsat series proved to be effective in extracting useful information regarding land use and land cover changes and water quality parameters of a water bodies. Integrating with in-situ observed data lake management studies provides the water quality of lakes with respect depth and time. Land cover changes in the lake and its surroundings ecological can be consistently evaluated from the remote sensing data. Remote sensing data are efficient way in generating GIS catalog information necessary for hydrological models. Models can reduce sedimentation due to construction of silt traps and plantation and no significant deterioration of the water quality. Remotely sensed images provide to assessing water quality in lake management project and through its capability to illustrate spatial patterns of different ecological scenarios.

REFERENCES

1. Baban, S. M. "Use of remote sensing and geographical information systems in developing lake management strategies". In *The Ecological Bases for Lake and Reservoir Management*, (1999). pp. 211-226.
2. Wulder, Michael A., Joanne C. White, Samuel N. Goward, Jeffrey G. Masek, James R. Irons, Martin Herold, Warren B. Cohen, Thomas R. Loveland, and Curtis E. Woodcock. "Landsat continuity: Issues and opportunities for land cover monitoring." *Remote Sensing of Environment* 112(3), (2008):pp. 955-969.
3. Bradt, Shane. "Applications of remote sensing for lake basin management." International Lake Environment Committee Foundation 2013.
4. J. Ballatore, Thomas & Bradt, Shane and Olaka, Lydia & Cózar, Andrés & Loiselle, Steven.. Remote Sensing of African Lakes: A Review. (2014) pp. 403-422.
5. Ghanshyam Das "Hydrology and soil conservation engineering", Prentice Hall of India 2000
6. J.V.S Murthy "Watershed Management", New Age international Publications,1991
7. Lehner, Bernhard, and Petra Döll. "Development and validation of a global database of lakes, reservoirs and wetlands." *Journal of Hydrology* 296, no. 1-4 (2004): 1-22.
8. Verpoorter, Charles, Tiit Kutser, David A. Seekell, and Lars J. Tranvik. "A global inventory of lakes based on high-resolution satellite imagery." *Geophysical Research Letters* 41, no. 18 (2014): 6396-6402.

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Application of Hybrid AI Techniques for Wind Speed Modeling in the Arabian Sea

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Abstract: Winds are considered to be the one of driving forces that alters the climatic parameters resulting in different weather patterns. The circulation of winds as a result of temperature, atmospheric pressure changes are interdependent in nature and are important studying monsoon occurrence. To study the circulation patterns over oceans at a small scale, generally statistical models are employed. In this study, one such attempt has been made to apply hybrid Artificial Intelligence (AI) model- Artificial Neuro-Fuzzy Information System (ANFIS) to capture the non-stationary characteristics of winds that are measured by the buoys in the Arabian Sea. The AI models have been tested for their performance using RMSE and MAPE indices, at different locations to address the limitation of site specific models. Wavelet transform was introduced to control the volatility associated with the wind speeds inputs to the ANFIS models. However, it was found that the ANFIS model outperformed Wavelet+ANFIS model and it was concluded that ANFIS can be a complementary tool for modeling and in future forecasting exercises.

Keywords: ANFIS, Buoy observations, hybrid AI, Wavelet transform, Wind speed

INTRODUCTION

Winds as we know are generated mainly due to changes in pressure, temperature, rotation of earth and difference in global environment. There exists a complex phenomenon in the development of winds. The interactions of these atmospheric variables responsible for winds make it highly unpredictable, intermittent and stochastic in nature. The word monsoon comes from Arabic - meaning season. Monsoon winds are result of seasonal changes in circulation over sea and land. An interesting question with regard to climate changes is whether global warming will have positive influence on zonal circulation (i.e. Trades and Westerlies) or the monsoon circulation. In the day, land heats up much faster than the sea. The air above the land gets heated from below and expands. Expanded air becomes lighter and it rises to upper heights. Colder air moves in and replaces the hot air; in the coastal regions source for this incoming air would be the sea. Overall, global warming will change conditions in the sea more slowly than conditions on land, because of the difference in the rate of response to heating, a concept familiar from the sea breeze. Thus, we would expect the summer monsoons to be amplified by stronger warming in summer. In addition, with more moisture in the air, extracted from a warming ocean, rainfall (and flooding) might be expected to increase. Conversely, in winter, we should expect less of a difference, as the land refuses to get quite as cold as previously. Hence, the winter monsoons should weaken, as should any of the nutrient-supplying coastal upwelling associated with winter monsoons (calospace.ucsd.edu).

The study of winds in the seas/oceans is of great importance and addresses a wide horizon of research from climate studies to renewable source for power generation. Recently, winds as energy source have gained significant importance and they are seen as alternative to generate electricity with reduction in emission of carbon gases. The

reduction is aimed at lowering the CO₂ concentrations globally. This can lead to reduction in greenhouse effect and consequently reducing temperature globally. This article is aimed at highlighting the importance of wind speeds and its characteristics. For the wind power industry, it is vital to have prior knowledge of wind speeds at particular interval of time and the time of the day. Therefore, accurate forecasting of wind speed and power is associated with the safety of renewable energy utilization. On comparison with the onshore wind power generation, the offshore wind energy resources can be more efficient (3 to 4 times) due to the smaller ocean surface roughness. India, with its longest coastline of 7600 km is beginning to explore offshore wind energy as a 'strategic energy source' to enable long-term energy security. It is having the fifth largest installed wind power capacity in the world, mainly from onshore wind farms. The power generation capacity has increased from 1.4 GW to 201.6 GW in 2010. With the utilization of onshore and the proposed offshore wind farms, it is expected to reach 60,000 MW generation capacities by 2022 [1]. India is yet to venture into offshore wind power production and advancements required to make it a primary source of energy are still in development stage.

Circulations of winds are monitored at different scales – global to regional and its importance can be observed on the spatial distribution of rains. The measurements of met-ocean parameters are carried out on different platforms based on the inputs required by the circulation models. Wind speeds prior to 1990 were seldom measured for wind energy, few measurements that were carried out were either ship based or oil & gas platform based. Such in-situ measurements can be insufficient for predictions of wind energy from a specific site and majorly these measurements undertaken were below 80 m height [2]. Tapping of offshore wind energy is being amplified in recent years globally at various heights above sea level and huge capacity offshore wind farms are being installed [3]. Wind resource study is needed to quantify this potential. Resource assessment plays a pioneering role in quantifying wind farm projects as it allows determining the technical and economical feasibility of power generation farms [4]. In recent times, offshore wind resources prediction can be performed based on minimum of one year of wind observations [5].

In this context, to provide information regarding the availability of wind speed and power in next few minutes, hours or days for operational scheduling of offshore wind farms, forecast time intervals have been classified as

- i) Very short (few seconds to 30 min),
- ii) Short-term (30 min- 6h),
- iii) Medium-term (6-24h) and
- iv) Long-term (1-7days) [6].

Wind speed forecasting can be complex, due to high degree of volatility and deviation associated with it. Generally, the forecast models have been classified into- Numerical Weather Prediction, Statistical and ANN methods [7]. NWP models are highly complex structured models and take several hours to obtain a solution, but are the most accurate models. Governing factor that influences the accuracy of NWP models is the spatial resolution of the grid. Two resolutions have been identified as appropriate for wind speed predictions at wind farm site – syn optic gradient (20-400 km) and meso-scale modeling (1-20km) [8].

ANN is one of the most widely used models in wind speed forecasting for very short term to short term time periods. The ability to learn from historical data and to look for patterns between the input and output data makes it an efficient tool. However, limitations of ANN models can be - accuracy tends to degrade with increase in lead-time and its inability to deal with non-stationary data [9].

Wavelet transforms are extensively used in time series modeling. The pros of using wavelets are its capability to handle jumping data, highly irregular and non-stationary data. The accuracy of wavelet-combined models has proven to be higher than other methods [10].

Hybrid methods like ANFIS, Wavelet combined with neural networks has demonstrated higher performance for short and very short-term forecasts [11]. These models used meteorological and buoy recorded data for European continent, limited studies can be found in Indian subcontinent. In the present work a series of analysis were carried out using ANFIS, Wavelet transformation combined with ANFIS for moored buoy observations deployed in the Arabian Sea. The buoy data was provided by INCOIS Hyderabad. The objective here is to assess the performance of hybrid techniques and its suitability for offshore wind speed forecasting.

STUDY AREA

Systematic real-time meteorological and oceanographic observations are required to improve forecasting capacity of short and long-term climatic changes [12]. Time series observations are vital to improve the understanding of ocean dynamics and its variability. Moored buoys can be one of the sources for these time series data. Considering the importance of ocean observations to a country like India, which has a long coastline (7600km), Government of India has established the National Buoy Programme in 1997 at National Institute of Ocean Technology (NIOT). INCOIS plays a key role in acquiring the moored buoy data from NIOT, assessing the quality of data and dissemination of data. Figure 1 represents the buoy network deployed in Arabian Sea and Table 1 describes briefly about moored buoys. In the present study data from buoy id **CB02** has been considered.

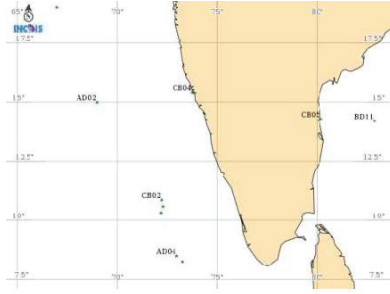


FIGURE 1. Study Area- INCOIS Moored Buoy [13]

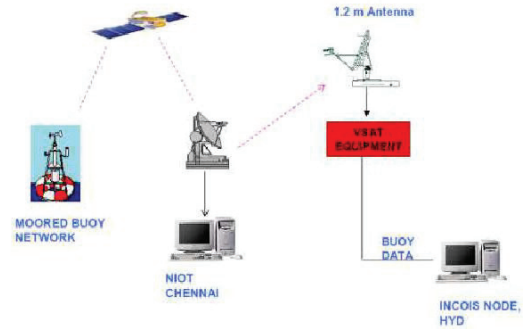


FIGURE 2. Schematic representation of collection, processing and transmission of data.

TABLE 1. Details of moored buoys

Buoy Profile		Characteristics
Diameter	2.2 m	Can carry a suit of meteorological and oceanographic sensors up to 16 numbers.
Overall Height	6.5m	Operable from 20m water depth to full ocean depth.
Weight	700 kg	20 W, 4 numbers solar panels ensure constant recharging of batteries
Reserve Buoyancy	2000 kg	[14]

METHODOLOGY

In the present work a buoy with id- CB02, with co-ordinates $10^{\circ} 52' 12''$ latitude and longitude of $72^{\circ} 12' 36''$ was selected, which is located in medium water depth and approximately 350 km from shoreline. The data is recorded hourly and the real time in-situ data is transmitted via INSAT satellite to NIOT, Chennai. By antenna link, the INCOIS receives the data in real time. Figure 2 shows a schematic representation of collection, processing and transmission of data (Moored Buoy Data path from NIOT Chennai).

During the southwest monsoon, wind speeds are correspondingly higher and fluctuations in wind speeds are generally high. With this as the primary reason, the month of July was selected for analysis. ANFIS is required to be trained for such volatility, spike and random fluctuations associated with offshore wind speeds. Hence, the dataset of 744 observations was divided into training and testing dataset as 520 and 224 (70:30 %).

The dataset prepared are clustered such that model M1 includes all the input parameters that influence wind speeds. M2 and M3 models were selected out of other various models on the basis of combinations of input parameters

influencing wind speeds. Table 2 presents the details of model combination. RMSE [Root Mean Square Error] and MAPE [Mean Absolute Percentage Error] were the indices used to evaluate the performance of models.

RMSE is given by:

$$RMSE = \sqrt{\frac{1}{N} \sum_{i=1}^N (F - O)^2}$$

where,

N = no. of observations

F = Predicted/Forecasted value

O = Observed value

MAPE is given by:

$$MAPE = \frac{1}{N} \sum \frac{|Observed - Forecast|}{|Observed|} \times 100$$

Figure 3 shows the flowchart of methodology adopted in the present study. The models are trained using training dataset and then the performance of the trained models is tested using the testing dataset. The inferences are drawn based on inter-comparison of performance indices for the developed models.

TABLE 2: Parameter designation & model combination

Parameter designation	Model combination
Atmospheric Pressure (AP) – 1	
Atmospheric Temperature (AT) – 2	M1 – 1,2,3,4
Humidity (HUM) - 3	M2 – 1,2,3
Sea Surface Temperature (SST) – 4	M3 – 1,2,4

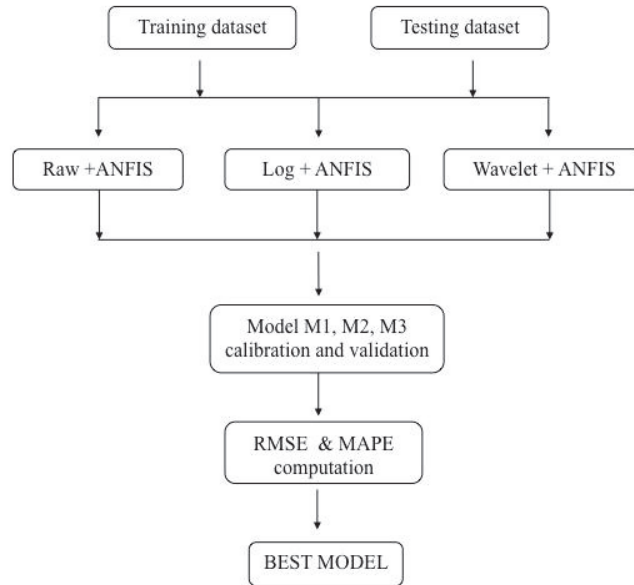


FIGURE 3. Flowchart of methodology

RESULTS & DISCUSSIONS

ADAPTIVE NEURO FUZZY INFORMATION SYSTEM [ANFIS]

Analysis using three membership functions was carried out for all models and results have shown in Table 3. M1 model is a preliminary step in ANFIS analysis, as this model includes all the four parameters that influence wind speeds and provides preliminary understanding about estimated wind speeds.

Both models M2 and M3 are having 3 input parameters and 1 output parameter. The input parameters for M2 model are AP, AT and HUM. The parameters vary and are inter-related in a highly complex phenomenon of atmospheric circulation. It is noticed from the datasets that there occurs frequent fluctuations in parameters with time.

TABLE 3. RMSE (m s⁻¹) and MAPE values for M1, M2 and M3 models

Models	RMSE Training			RMSE Testing		
	Bell	Gaussian	Triangle	Bell	Gaussian	Triangle
M1	0.71	0.71	0.82	2.41	2.26	2.02
M2	1.12	0.29	0.55	2.18	2.03	2.03
M3	1.09	1.08	0.57	1.89	1.96	1.91

Models	MAPE Training			MAPE Testing		
	Bell	Gaussian	Triangle	Bell	Gaussian	Triangle
M1	9.12	9.18	10.96	25.04	20.26	24.68
M2	14.83	15.52	14.99	27.31	21.72	22.79
M3	14.72	16.00	16.83	29.12	24.00	22.22

Model M3 has input parameters AP, AT and SST. From in-situ observations it was found that, in the dataset variations in AP values were small compared to AT values. AT & SST were found to be rigorously varying. However, it is to be noted that AT and SST can be interdependent and may vary with respect to each other. Furthermore, the exercise was also aimed at studying the *influence of relative humidity* on wind speeds and it's variation on ANFIS technique. Multiple membership functions (Bell, Gaussian and Triangle) have been applied to estimate wind speeds. The RMSE of testing dataset for model M2 can be approximated to 2 m s⁻¹ for all three membership functions and that of model M3 may be approximated 1.9 m s⁻¹, thus a clear conclusion of the performance comparison between models cannot be based on RMSE alone. Further MAPE for testing dataset points that M2 model error can be summed as 34% and model M3 error as 33% not much of statistically significant difference. However, the total number of predicted values with error tolerance limit < 10% can be helpful in understanding the performance and accuracy of estimated (model) wind speeds to observed wind speeds (Table 4).

TABLE 4. Number of forecasts, error tolerance < 10%

Models	Bell	Gaussian	Triangle
M2 Training	383	381	396
M3 Training	400	389	377
M2 Testing	41	36	33
M3 Testing	31	25	28

The model M2 has larger number of estimated wind speeds than model M3, within the error tolerance limit of 10%. Therefore, it can be inferred that model M2 outperformed M3 model, which also indicates that relative humidity has significant influence on wind speeds and affects the prediction process.

TABLE 5. Coefficient of correlation (R) for M2 and M3 models.

R		Raw	Training Dataset		
			Bell	Gaussian	Triangle
M2	AP	0.52	0.65	0.65	0.65
	AT	0.31	0.21	0.27	0.17
	HUM	0.28	0.35	0.35	0.35
	SST	0.23	0.20	0.24	0.22
R		Raw	Testing Dataset		
			Bell	Gaussian	Triangle
M2	AP	0.30	0.20	0.41	0.35
	AT	0.15	0.21	0.12	0.12
	HUM	0.13	0.12	0.14	0.18
	SST	0.12	0.12	0.15	0.18

From Table 5, it can be observed that in case of Gaussian MF $R=0.41$ and Triangular MF $R=0.35$ for testing dataset were the maximum for models M2 & M3 respectively. The R value indicates higher dependency of wind speeds on the atmospheric pressure, which has been substantiated in theory (Bernoulli's equation for gas/air flow between two points: $P \propto V^2$). With increase in number of inputs model performance can be improved.

WAVELET TRANSFORM

Daubechies wavelet transformation was applied to raw wind speeds to obtain synthesised time series data; with different wavelets at decomposition level 5. The synthesised wind speeds were then inputted to ANFIS and corresponding estimation of wind speeds for models M2 and M3 were obtained. Initial examination of the various decomposition levels was carried out and at level 5 models were found to be performing better, after level 5 RMSE was found to increase. From Table 6, RMSE of testing dataset values for both the models M2 and M3 it can be observed that wavelet db4 produces lower RMSE values. Db1 (a.k.a Haar) wavelet results are not considered since db1 is the simplest wavelet, where noise reduction achieved is small when compared to higher order wavelets. With the increase in order of wavelets, higher noise reductions are possible and thus sub classes of uniform wind speeds are derived which is then provided as input to ANFIS and correspondingly wind speeds are estimated.

TABLE 6. RMSE values for Raw and Wavelet transformed M2 and M3 models

Model	RMSE Training	RMSE Testing	MAPE Training	MAPE Testing
M2	RAW	1.345	2.187	21.73
	db1	1.534	1.947	26.13
	db2	1.528	1.995	26.04
	db3	1.533	2.038	26.99
	db4	1.554	1.980	23.95
	db5	1.532	2.101	28.67
M3	RAW	1.284	2.118	36.93
	db1	1.466	3.354	36.67
	db2	1.470	3.155	36.63
	db3	1.458	2.726	36.27
	db4	1.469	2.581	36.32
	db5	1.470	2.930	36.27

After fourth order wavelet there is an increase in RMSE value observed, which indicated that models performance is decreased on further increase in decomposition levels and correspondingly noise reductions is low.

CONCLUSION

The study carried out for a particular buoy located approximately 350 km off Kerala coast and hence the inference drawn is limited to the site. The study leads to comparison between ANFIS and hybrid structures (Wavelet + ANFIS) and provides insight of the performance and suitability of models for wind speeds prediction process.

1. Wind speed predictions using ANFIS for raw dataset was carried out with three different model combinations and for three membership functions. Difference in RMSE & MAPE values for the models is numerically less, hence by the number of predictions that fall in category of error < 10% indicates M2 performs better than M3.
2. Comparison of model performance between ANFIS with *raw data* and *wavelet transformed data*, it can be inferred that ANFIS with raw wind speeds outperforms the other models and hence pre-processing of data using wavelet transformation can be avoided for the current site.

REFERENCES:

1. Arun Kumar, Jagadish and Raj Kumar, "Evaluation of offshore wind energy resources for power generation based on scatterometer and SAR data along the Indian coast." Proceedings of SPIE, Remote Sensing of the Oceans and Inland Waters: Techniques, Applications, and Challenges, (2016) page: 9878-98780.
2. M T Pontes, A M Sempreviva, R Barthelmie, G Giebel, P Costa and A Sood Integrating Offshore Wind and Wave Resource Assessment, (2007)
3. S Shruti, N Patel, R Kharul G M Pillai and S Steve, India Wind Energy Outlook (IWEO), Global Wind Energy Council Tech Report. (2012)
4. J F Manwell, A L Rogers, J G McGowan and B H Bailey "An offshore wind resource assessment study for New England", [Renewable Energy](#), 27(2), (2002) pp. 175-187.

5. J Jung and R P Broadwater “Current status and future advances for wind speed and power forecasting”, [Journal of Renewable and Sustainable Energy Reviews](#), 31, (2014) pp. 762-777.
6. S SSoman, H Zareipour, O Malik and P Mandal “A review of wind power and wind speed forecasting methods with different time horizons”, in Proc. North American Power Symposium (NAPS), (2010) pp. 1-8. IEEE
7. F Castellanos and N James, “Average hourly wind speed forecasting with ANFIS”, 11th American Conference on Wind Engineering, San Juan, Puerto Rico, June 2009.
8. C Potter, M Ringrose and M Negnevitsky, “Short-term wind forecasting techniques for power generation”, Proc. Australasian Universities Power Engineering Conference (AUPEC 2004), (2004) pp. 26-29.
9. H Liu, HQ Tian, C Chen and Y F Li “A hybrid statistical method to predict wind speed and wind power”, [Renewable energy](#), 35(8), (2010) pp. 1857-1861.
10. K Hunt and G P Nason, “Wind speed modelling and short-term prediction using wavelets”, [Wind Engineering Journal](#), 25(1), (2001) pp. 55-61, 2001.
11. C Yao, X Gao and Y Yu, “Wind speed forecasting by wavelet neural networks – A comparative study”, *Journal of Mathematical Problems in Engineering*, (2013).
12. A M Sempreviva , R J Barthelmie, G Giebel, B Lange and A Sood, "Offshore wind resource assessment in European seas, state-of-the-art. A survey within the FP6 "POW'WOW" coordination action project", in Proc. of European Wind Energy Conference and Exhibition, (2007).
13. SrideviTiwari, VenkatShesu R, Pattabi Rama Rao E, UdhayBhaskar TVS and Kiran Kumar N, “Automated Real Time Control System for Moored Buoy Data”, Data Management group, INCOIS India. (2009)
14. S Tiwari, V Shesu, P R Rao, UdhayBhaskar TVS and Kiran Kumar N, “Automated Real Time Control System for Moored Buoy Data”, Data Management group, INCOIS India, Tech Report.(2009)

Implementation of repair tree algorithm for fast repair in distributed storage system

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Implementation of Repair Tree Algorithm for Fast Repair in Distributed Storage System

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Abstract. Data is an important asset that needs to be safeguarded. Loss of data leads to direct financial losses. Storing data has evolved to meet the increasing needs of companies and individuals. The traditional storage approach, a specialized storage box no longer works for technical and economical reasons. Need is not for faster drives or networks but need is for a new approach for satisfying current demands for storing data. “Storing data on many standard servers but behave as one storage system although data is distributed between these servers.” This Distributed Storage System (DSS) is an advanced form of the “Storage” concept. Data security is a major issue for businesses and organizations today. Ensuring that your data is secure is becoming more important every day and vital to business operations. Protection of sensitive data is end goal of many IT security measures. The agenda is to ensure the avoidance of theft and protect privacy. Hence it comes to everyone’s advantage to ensure sensitive data protection. Measures are taken to keep data secure. Measures are like having regular backups of documents, protecting against attacks, using authentications for accessing data and so on. This paper speaks about data storage over distributed system ensuring data security with Erasure codes, a new technology ensuring data security. Here Erasure codes are a part of Repair tree algorithm. Repair tree algorithm helps to get the data of interest over distributed storage system.

Keyword- Erasure code, Repair Tree, DSS, CSP,

INTRODUCTION

Over last few decades data security has drawn significant attention. Failure of safe network causes loss of data. This requires data recovery process. Data recovery adopts redundancy policies. Erasure approach is one useful method to recover the lost data. Although the current approach is largely used, this method primarily addresses single point failure. The present paper discusses a more robust approach to address for more than single point failures. This methodology fuses Erasure method into Repair tree algorithm to attain enhanced performance. State-of-art repair tree algorithm collects the data across the distributed network. Current approach of Erasure code handles the repair process. Existing data security mechanisms have a concern due to increasing usage of data. Further, recovery using techniques similar to mirroring shall cause increased data space and shall degrade the performance. In particular big data applications, like banking systems, have serious impacts. Increased features of online banking and virtual transactions have attracted large number of customers. This has further caused big data storage issues and problems during constant updation of the core banking systems. The data being sensitive and non-revocable, protecting the data is the prime necessity of the banking process. The motivation of the present approach is to facilitate updation over the distributed system, while maintaining data security. The approach is designed to resist failure occurring at any particular node without affecting the overall system performance. This further allows easy implementation of storage optimization methods using new technologies.

The rest of the paper is organized as follows: Section 2 discusses the state-of art methods employed for performing data security and retrieval. The problem formulation presents the proposed model. Case studies on real data sets are conducted. The last section gives the conclusion of our work.

LITERATURE SURVEY

N.Fotious et al. conveyed that INC-Information-Centric Networking is an emerging pattern as predicted by researchers. These structures have better assistance for multicast, mobility and security [1]. In this architecture information is distribution is expected efficiently without any loss over n-number of network locations. This system is observed with high security performance. But it is found that designing this kind of system is very hard. **Wang et al.** has said that Attribute Based Group Signature (ABGS) is other new pattern of cryptography and a new generation group of signatures [2]. The idea is authenticating person with his credentials. This system is observed with more scalability and efficiency. But complete security is not been able to achieve. **D. Huang et al** said that huge amount of users and their data id been managed by information systems and application managers [3]. Users share data such as photos or documents etc, with these applications. The control over this content is the consequence. This kind of system is expected with high performance access control mechanism since users specify multiple access rights. But older access control mechanisms do not fit the need for flexibility. High efficiency is observed but even this system suffers from improper security.

PROPOSED SYSTEM

The proposed system here has reduced the repair traffic. Researchers have found the substitutions between storage and repair traffic and presented codes by combining network coding. This combined structure proposes a Repair tree model based on general Erasure code procedures, which simplifies the repair procedure. As computations is decomposed and distributed over the tree nodes the proposed model can reduce the computation tension. Performance of Repair tree model is analyzed and evaluated at elementary emulations. Results are expected with faster computations when compared to conventional measure. The proper topology would significantly reduce the repair traffic. Fig. 1 illustrates the overall architecture of Global Shard Map. The architecture includes **CSP Registration and Login, Host and VM Creation, Data Allocation, Data Duplication (Erasure Code), Malware Attacks**.

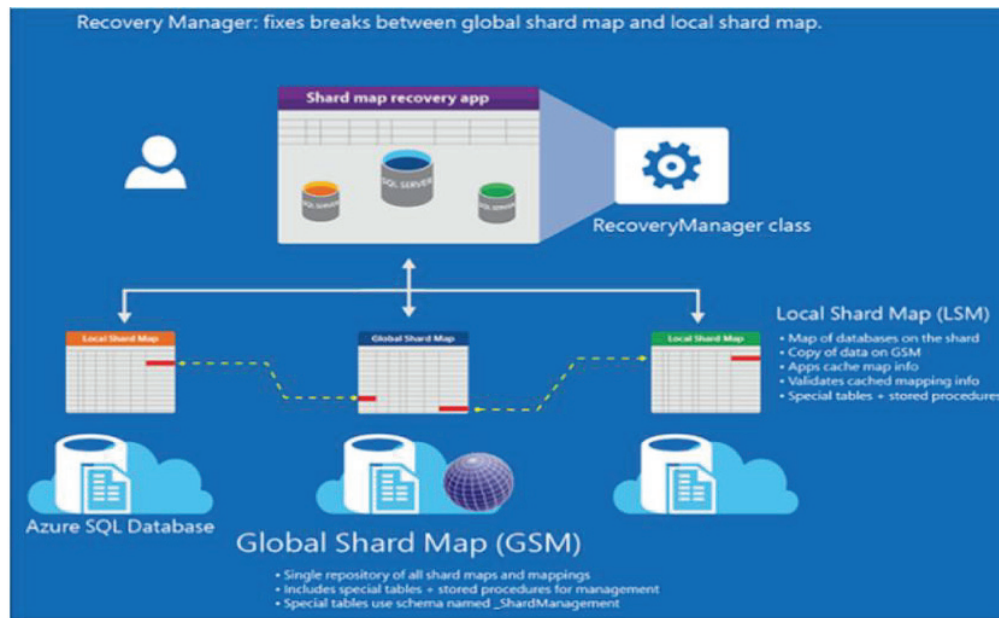


Fig. 1. Architecture of Global Shard Map (MAP)

CSP Registration and Login

The CSP registration process is security process. This process would classify the registration process to existing and new registrations. The new CSP user enters the cloud process, where the user information is gathered and stored. This would avoid unauthenticated logins. Whereas, the existing user would enter the different process and can view or load or transfer data of interest from their data which is stored. Fig. 2 and Fig. 3 shows the existing user's data loading process. Further Fig. 4 shows the structured form of data of interest.

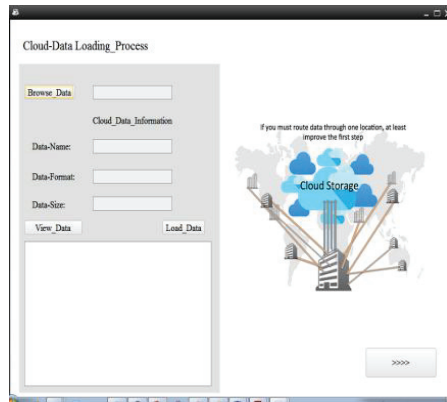


Fig. 2. Cloud data loading process.

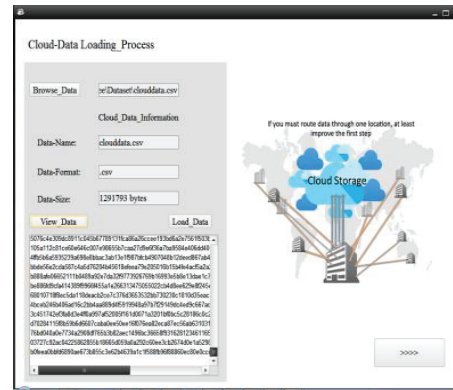


Fig. 3. Viewing the loaded data from cloud.

Server and VM Creation

This module concentrates on well-known scheduling taxonomy in distributed computing systems. Any scheduling algorithm can be classified into optimal or sub-optimal. The former characterizes scheduling algorithms when the complete information regarding the state of the distributed environment (e.g., hardware capabilities and load) as well as resource needs (e.g., time required by each job on each computing resource) are present. When this information is not available, or the time to compute a solution is unfeasible, sub-optimal algorithms are used. Fig. 6 and Fig. 7 shows the VM creation process.

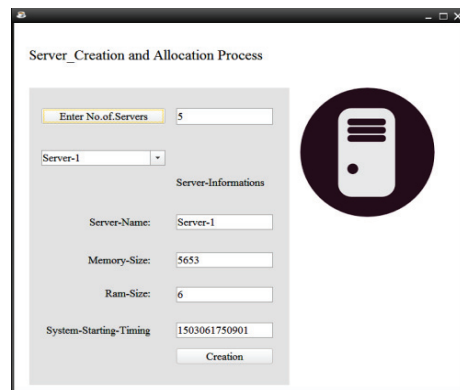


Fig. 4. Server creation and Allocation process.

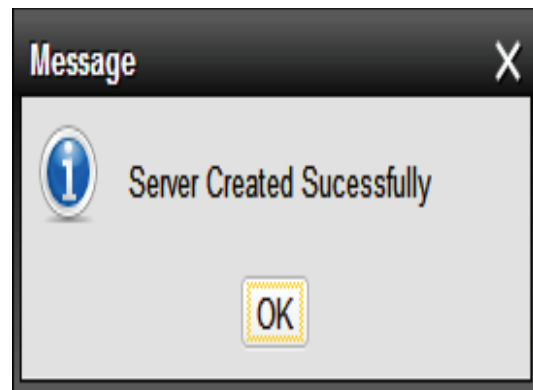


Fig. 5. Msg box confirming successful creation.

Data Allocation

In modern computer systems, each thread has a reserved region of memory referred as stack. When a function executes, it may adds its state data to the top of the stack; when the function exits it is responsible for removing that data from the stack. At a minimum, a thread's stack is used to store the location of function calls in order to allow return statements to return to the correct location, but programmers may further choose to explicitly use the stack.

Data Duplication (Erasure Code)

In information theory, for binary erasure channel an erasure code is a forward error correction (FEC) code, which transforms a message of k symbols into a longer message (code word) with n symbols such that the original message can be recovered from a subset of the n symbols. The fraction $r = k/n$ is called the code rate. The fraction k'/k , where k' denotes the number of symbols required for recovery, is called reception efficiency.

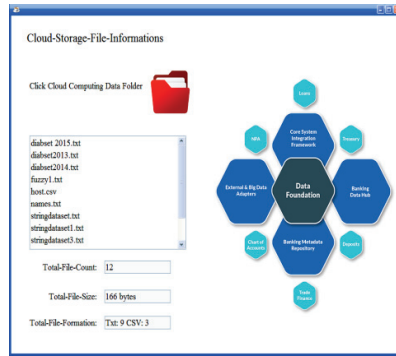


Fig. 6. File information in cloud storage.

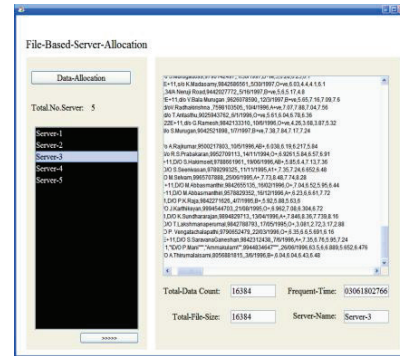


Fig. 7. File based server allocation.

Malware Attacks

Malware, short for malicious software, is an umbrella term used to refer to a variety of forms of hostile or intrusive software, including computer viruses, worms, Trojan horses, ransom ware, spyware, adware, shareware, and other malicious programs. It can take the form of executable code, scripts, active content, and other software. Malware is defined by its malicious intent, acting against the requirements of the computer user - and so does not include software that causes unintentional harm due to some deficiency. Programs supplied officially by companies can be considered malware if they secretly act against the interests of the computer user. Fig. 10 shows the attack monitoring process.



Fig. 8. Malware attack monitoring process.



Fig. 9. Viewing attacked data.

Advantages observed are: Repair Tree algorithm that minimizes the monetary cost of deployment of a workflow application across federated clouds. The algorithm takes into account security and reliability requirements as well as the monetary cost incurred from three main sources in the cloud: computation, data transfer and data storage. The allocation speed may high and job group's may easily created the host and VM creation may high secured the CSP (cloud service provider) authentication may high. The security process may be high when compared to existing system.

METHODOLOGY

Erasure Coding: Erasure coding (EC) is a method of data protection in which data is broken into fragments, expanded and encoded with redundant data pieces and stored across a set of different locations or storage media.

The goal of erasure coding is to enable data that becomes corrupted at some point in the disk storage process to be reconstructed by using information about the data that's stored elsewhere in the array. Erasure codes are often used instead of traditional RAID because of their ability to reduce the time and overhead required to reconstruct data. The drawback of erasure coding is that it can be more CPU-intensive, and that can translate into increased latency.

Erasure coding can be useful with large quantities of data and any applications or systems that need to tolerate failures, such as disk array systems, data grids, distributed storage applications, object stores and archival storage. One common current use case for erasure coding is object-based cloud storage.

Erasure coding creates a mathematical function to describe a set of numbers so they can be checked for accuracy and recovered if one is lost. Referred to as polynomial interpolation or oversampling, this is the key concept behind erasure codes. In mathematical terms, the protection offered by erasure coding can be represented in simple form by the following equation: $n = k + m$. The variable “k” is the original amount of data or symbols. The variable “m” stands for the extra or redundant symbols that are added to provide protection from failures. The variable “n” is the total number of symbols created after the erasure coding process. For instance, in a 10 of 16 configurations, or EC 10/16, six extra symbols (m) would be added to the 10 base symbols (k). The 16 data fragments (n) would be spread across 16 drives, nodes or geographic locations. The original file could be reconstructed from 10 verified fragments.

RESULTS AND DISCUSSIONS

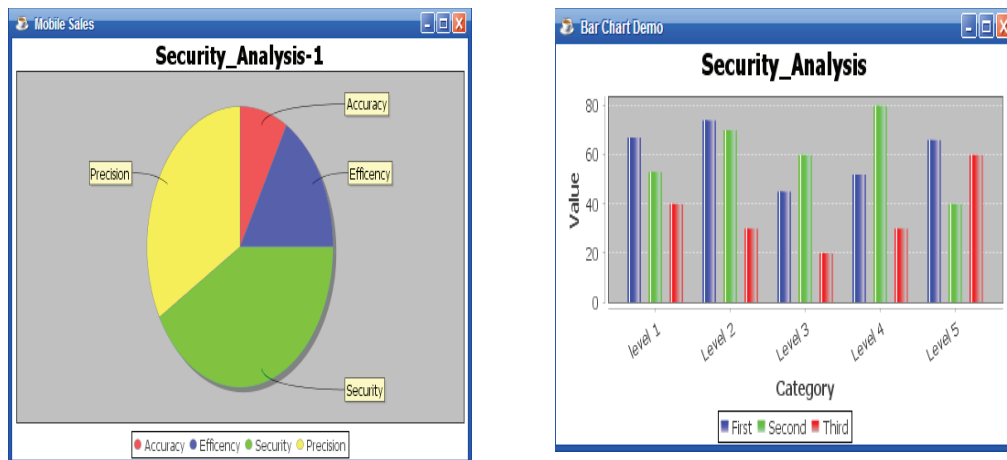


FIG. 10 Graph showing Security Analysis.

This paper we present a new way of repairing failure in erasure coding-based distributed storage system. Firstly, we decompose complex repair computing at replacement nodes and distribute it to all the helpers, leaving simple XOR operations for remaining network nodes. Secondly, we combine the network topology to optimize repair traffic by embedding these simple XOR operations in intermediate nodes. We propose the repair tree model and prove repair tree Gauss-property. Graphs above shows the security analysis performed and proved that is more efficient than the former

CONCLUSION

This Distributed Storage System (DSS) is an advanced form of the “Storage” concept. Data security is a major issue for businesses and organizations today. Ensuring that your data is secure is becoming more important every day and vital to business operations. Protection of sensitive data is end goal of many IT security measures. The agenda is to ensure the avoidance of theft and protect privacy. Hence it comes to everyone’s advantage to ensure sensitive data protection. Measures are taken to keep data secure. Measures are like having regular backups of documents, protecting against attacks, using authentications for accessing data and so on. This paper proposed the data storage over distributed system ensuring data security with Erasure codes, a new technology ensuring data security. Here Erasure codes are a part of Repair tree algorithm. Repair tree algorithm helps to get the data of interest over distributed storage system. This paper concentrated more on

security and precision and less on accuracy and efficiency. The future scope of the paper is to improve the accuracy as well as efficiency.

REFERENCES

1. N.Fotious ,G.F Marias and Polyzos “Access control enforcement delegation for information-centric networking architectures”, 2012.
2. B. Li, Z. Wang, and D. Huang “An efficient and anonymous attribute-based group setup scheme”, 2013.
3. Z. Wang, D. Huang, Y. Zhu, B. Li, and C.-J. Chung “Efficient attribute-based comparable data access control”, 2015.
4. H. Zhang, H. Li, B. Zhu, and J. Chen, “Fast repair for single failure in erasure coding-based distributed storage systems,” in *Reliable Distributed Systems (SRDS)*, 2014 IEEE 33rd International Symposium on, Oct 2014, pp. 146–151.
5. S. Ghemawat, H. Gobi off, and S.-T. Leung, “The Google file system,” *iMac SIGOPS Operating Systems Review*, vol. 37, no. 5. ACM, 2003, pp. 29–43.
6. K. Shvachko, H. Kiang, S. Radia, and R. Chansler, “The hadoop distributed file system,” in *Mass Storage Systems and Technologies (MSST)*, 2010 IEEE 26th Symposium on. IEEE, 2010, pp. 1–10.
7. S. C. Rhea, P. R. Eaton, D. Gaels, H. Weather-spoon, B. Y. Zhao, and J. Kubiatawicz, “Pond: The ocean store prototype.” in *FAST*, vol. 3, 2003, pp. 1–14.
8. A Clever safe, “Paradigm shift in digital assets storage” Clever safe Whitepaper, 2008.
9. D. Borthakur, “Hdfs and erasure codes, aug.2009,” URL <http://hadoopblog.BlogSpot.Com/2009/08/hdfs-and-erasure-codes-hdfs-raid.Html>.
10. H. Weather spoon and J. D. Kubiatawicz, “Era-sure coding vs. replication: A quantitative com-parison,” in *Peer-to-Peer Systems*. Springer, 2002, pp. 328–337.
11. R. Rodriguez and B. Liskov, “High availability in dhfs: Erasure coding vs. replication,” in *Peer-to-Peer Systems IV*. Springer, 2005, pp. 226–239.
12. A. G. Demakis, P. B. Godfrey, Y. Wu, M. J. Wain-wright, and K. Ramchandran, “Network coding for distributed storage systems,” *Information Theory, IEEE Transactions on*, vol. 56, no. 9, pp. 4539– 4551, 2010.
13. Y. Hu, C.-M. Yu, Y. K. Li, P. P. Lee, and J. C. Lui, “Ncfs: On the practicality and extensibility of a network-coding-based distributed file system,” in *Network Coding (NetCod)*, 2011 International Symposium on. IEEE, 2011, pp. 1–6.

IoT based continuous monitoring of cardiac patients using Raspberry Pi

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IoT Based Continuous Monitoring of Cardiac Patients using Raspberry Pi

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Abstract: In the recent development the Internet of Things (IoT) brings all electronics objects in to a single domain and it is easy to access everything through internet. The applications of IoT are Smart agriculture, Smart Home, Smart City, Smart health monitoring system etc. The automation of health care is one of the application which monitors the patient health status using IoT to make medical equipments more efficient by monitoring the patient's health, in which identifies the body conditions and reduces the human error. A health care monitoring system is used to monitor patient's body parameters for the particular disease and obtain the various values about it. The heart rate monitor is one of the in system using IoT to recognize the cardiac patients condition and monitor the status in emergency situations. It monitors the heart rate of the patient with long term cardiovascular disease. Here the Arduino based microcontroller is used to communicate to the sensors such as pulse sensor and ECG Sensor. The system can analyze the signal, extract features from it, detect the normal or abnormal conditions with the help of Raspberry Pi and the results of the ECG signals is sent to the web server. It ensures the signal transmission of heart rate signal to the database through IoT. This also suggests doctors to care the patient follow-up their patient using the patient's data stored in the database. Thus IoT brings one of the solution for cardiac patient monitoring and also reduces the complexity between patient outcome and technology.

Keywords : ECG, Heartbeat, Internet of Things(IoT), Heart attack.

INTRODUCTION

In the advancement of Internet technologies all machineries are inter-related. Using the technology improvement, we can make many things high effective and simple for human life. The latest technique in the field of medical electronics and communication can help to decrease the cost of healthcare. There is also a demand of quality healthcare[1] from remote locations. Today increasingly people are growing with chronic diseases such as food habits, obesity, and alcohol consumption etc. Based on the survey in the next 10 years, deaths from chronic diseases will be increased by 17%, about 64 million people, chronic diseases are highly variable in their symptoms as well as their curing methods. If it is not monitored properly and treated with in the time, then they will end their life. Among the most of the diseases like diabetes, blood pressure, heart diseases it can be monitored by some monitoring systems. Patients with these diseases besides having limitations in their physical conditions. Amongst these, the heart diseases cause millions of death worldwide because of high blood pressure, lack of physical exercise and sleep, anxiety, stress, illness, ingestion of drugs, increase in the aging population, and consumption of alcohol, high cholesterol levels and the rising of healthcare costs. In this paper a automatic cardiac monitoring system is introduced. Nowadays, the patient monitoring systems is one of the major method in healthcare because of it has technology improvement. Health monitoring of patients is a way to check if the health of the patients[9]s is being harmed or it aims to detect early signs of ill health or disease. Recording of biomedical signals of the patient by continuous or occasional is particularly critical for the

diagnosis and giving treatment. In this project, using modernize approach the cardiac disease patients are monitored to improve their health status.

LITERATURE SURVEY

Liang-Hung Wang, et, al, [2] have proposed an outdoor monitoring system for aged persons, which sent the information of biomedical signals and falling events to a healthcare monitoring system at any time and from any place. A healthcare box is used to determine the relative position of the patient through a global positioning system (GPS) for fall detection, moreover, an ECG signal acquisition thread is adopted to increase the precision of the fall detection system. The fall is determined by the altitudinal change of the antenna position on the GPS module. Movement, location variation and environmental interference present challenges to the successful probability and accuracy of detection. The healthcare center would be notified of the need for rescue when the fall was continuously detected based on the GPS and ECG interaction monitoring information. Advantage of this method is that the patient can be located using a GPS module, even if the person is not in a position to contact someone in emergency cases. Prosanta Gope et al, [3] have proposed the tele-monitoring system, based on SMS, which is used to develop by remotely monitor the mobility levels of aged people in the natural environment through GSM. If a patient's mobility levels are found to be below the certain thresholds, the server software will alert the appropriate caregiver by querying the database for that subject's name and address, formatting a string containing this information and forwarding it, over the GSM network, to the caregiver as an SMS message. The caretaker will receive an alert, by reviewing the patient's medical data and to inform the condition of the patient decline before making a medical decision. The disadvantage is that the caretaker might not know about the database of the patient. Instead of that the database should be along with the doctor to monitor the patients status and diagnose them. Cristian F. Pasluosta, et, al, [6] have proposed about the existing wearable technologies and the IoT concept is applied to the Parkinson's Disease, with an emphasis on how this technological platform may lead to success. It supports maximum efficiency and resources improved the patients experience. The patient's data fed into intelligent algorithms to discriminate some conditions, adjust the based on online obtained physical deficits and facilitate strategies to modify disease progression. The limitation is that the combinational use of IoT and wearable sensor technology has made a alternative way for Heart disease patients. The patients can be monitored in emergency conditions.

METHODOLOGY

To model knowledge based on paradigms proposed by in the Internet of Things[7], there are different alternatives such as ontologism that enable sharing knowledge because they provide a formal specification of the semantics of context data, allowing different heterogeneous entities and distributed and ubiquitous mobile environments, to exchange context information of users.

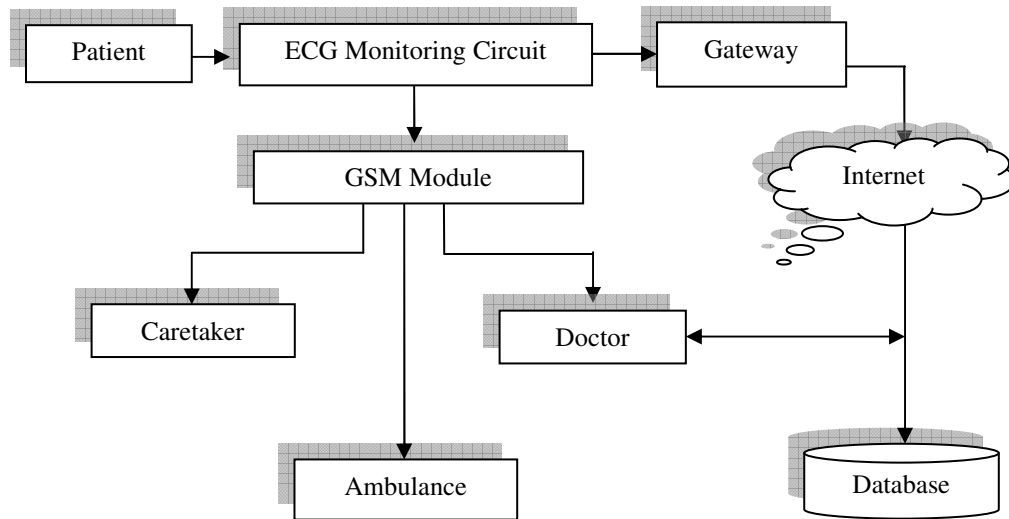


FIGURE 1: General block diagram of proposed Patient Monitoring System.

Usually heart rate is the speed of the heart beat measured by the number of contractions per minute. The heart rate can vary according to the body's physical needs, including the need to absorb oxygen and excrete carbon

dioxide. It is usually equal or close to the pulse measured at any peripheral point[8]. Activities that can provoke change include physical exercise, sleep, anxiety, stress, illness, and ingestion of drugs.

IMPLEMENTATION

The system described here consists of a portable unit, worn by each monitored subject, and a server and a client. The portable unit measures, analyzes, and transmits the mobility data of each monitored subject to the server at hourly intervals. The mobility data are received, analyzed, and stored on the client's database. This database is automatically queried every day, and the appropriate medical personnel are informed if an alarming trend is observed in a patient's mobility status. The patient's heartbeat rate and the ECG is monitored continuously using pulse and ECG sensor[4]. If the signals are found normal, it stored in the database. If there is any abnormality in the heartbeat rate then ECG is checked. If the abnormality condition persists, then immediate message is sent to the doctor through GSM and also through internet also for caretaker and ambulance.

These normal and abnormal conditions are stored in the database. The data stored in a database can be displayed in a website that can be accessed only by authorized personel. If the doctor is in a situation where he cannot respond to the patient within the given time limit, the software is programmed in such a way that the information is passed on to the nearby doctor where he can provide the medical assistance. Also these information's are stored in the database.

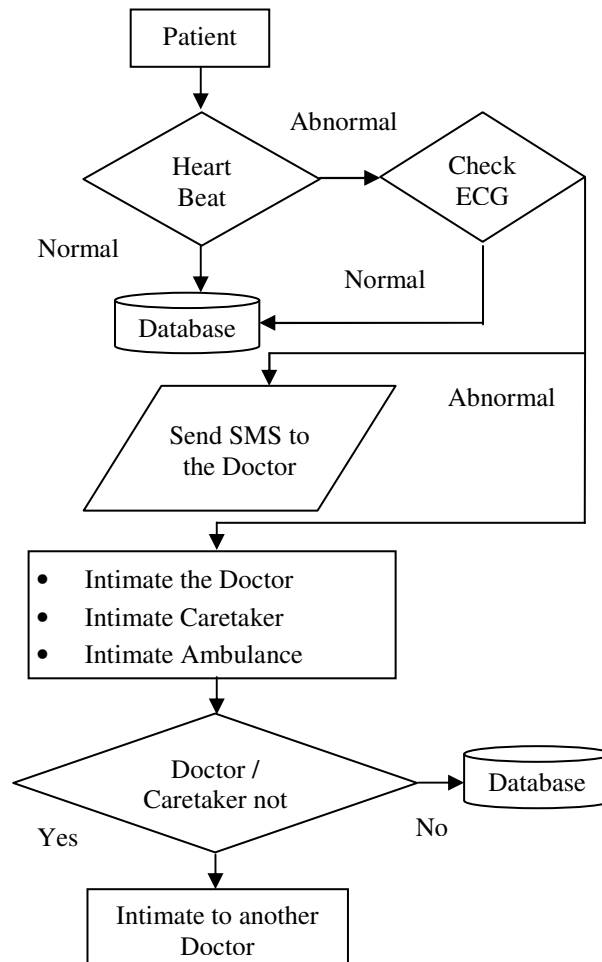


Figure 2: Flow diagram of Patient Monitoring System.

Algorithm

Step 1: The patient's heart beat is monitored and checked for normality and abnormality conditions.

Step 2: If normal, the values are stored in the database.

Step 3: If abnormal, ECG is checked for normal and abnormal conditions.

Step 4: The normal values of the detected ECG signals are again stored in the database.

Step 5: If abnormality is detected in the ECG signals an immediate message is sent to the doctor through GSM.

Step 6: The detected abnormal ECG signals are also sent to the doctor (also to the caretaker and ambulance) through Wi-Fi (Internet) and is also stored in the database for future medical assistance.

Step 7: If in case the doctor fails to respond the patient with in the given time limit, an immediate next doctor is informed about this case.

RESULTS & DISCUSSIONS

Pulse Sensor Output

Live heartbeats and BPM can be monitored using this sensor. It works with Arduino, Raspberry pi, and many others. Here this sensor is used along with the Arduino mega board. This pulse sensor plugs get into the Arduino board and easily clips onto sensors. It's very small, and the button-sized with holes, so it can be attached into a garment. These are the optical heart-rate monitors which are common to use by the patients.

In the pulse sensor, light is shot into a finger tip. The light may bounces return to a light sensor, or gets absorbed by cells. As the light continues to shine (into say a fingertip) and take light sensor readings, a heart-beat pulse reading is obtained. This way the sensor senses the signals and sends it to the Arduino mega board and the waveforms are displayed as shown below.

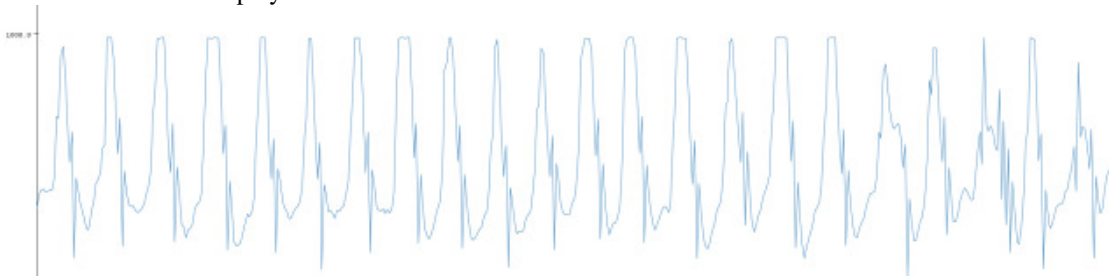


FIGURE 3: Output of the sensed signals observed through the Serial Plotter

Basic OP-AMP circuit for measuring ECG

Here operational amplifier is used because it is a DC coupled Op-Amp with high gain, with a differential input and output. An Op-Amp produces an output that is typically larger than the potential difference between its inputs.

Op-Amps are used to perform mathematical operations in many linear, non-linear and circuits. The popularity of the op-amp is due to building block in analog circuits. The characteristics of an op-amp circuit are the gain, input and output impedance, bandwidth etc., are determined by external components and due to negative feedback which have temperature coefficients. The ECG circuit using basic differential op-amp outputs to the CRO performs low-pass filtering and the real time ECG signals are obtained.

Steps to Execute Op-Amp Based ECG Monitoring

- The output goes to the CRO.
- Resistor values were chosen accordingly just to make sure both resistors are matched, and Resistor 3 should be large.
- “BAT+” and “BAT-” are the connected with a single 9V battery.
- Note that the leg electrode is grounded.

- Resistor 5 and Resistor 4 form a voltage divider circuit like for an Op-Amp with a gain which is more than 50.
- Resistor 4 can be connected to ground, but since the body is grounded, chest 2 is essentially the same.
- Resistor 3 must be high, but it reduces the body potential near the input voltage level.
- Resistor 1 and Resistor 2 split the 9V battery's voltage in to 4.5 and middle is at ground, creating -4.5Volts and +4.5Volts equally.
- Altogether, the body stays grounded, and the op-amp becomes powered by -4.5V and +4.5V, and the body is near the middle level and to have a small signal from source1 amplified. Amplification is with respect to source2, rather than actual ground, so that a lot of noise is neglected.

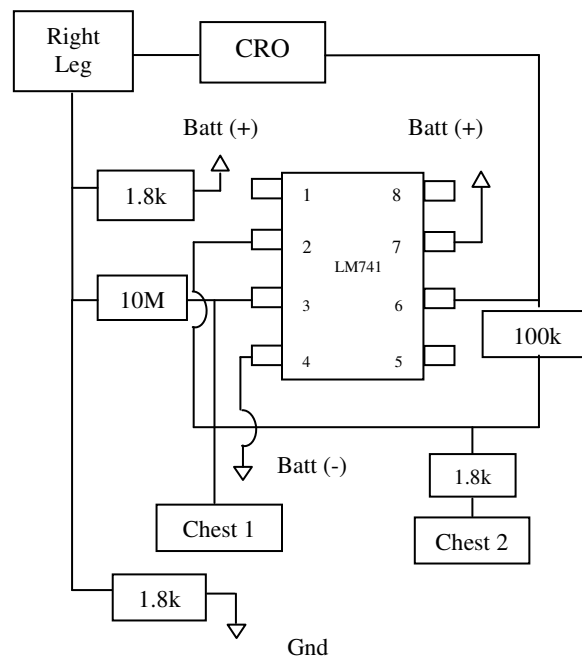


FIGURE 4: ECG Monitoring using LM 741 OP-AMP circuit

The outputs of the OP-AMP based ECG monitoring circuit is shown in the Fig.5. The P,Q,R and S positions are identified from the CRO to obtain the similarity from the patient's body.



FIGURE 5: The output observed in CRO when all three electrodes are placed in the appropriate positions along with ground.

Heart Beat Sensor Output

Doctors measure the patient's heart rate while checking manually. By holding the hands, doctors find the pulse in the nerve and look at the pulse to count the heart beats per minute. Even the patient also can feel the pulse on the finger when it pumps blood into the blood vessels. It happens due to the expansion and contraction of blood vessel when blood enters and leaves it. The heart does this around 72 to 84 times a minute for a healthy person. While doing the measure of heart rate, first pulse rate is counted for one minute to get the beats per minute. So to detect the pulse rate, the light is passed from one side of the finger and intensity is measured at the place of light received on the other side.

Whenever the heart pumps the blood in and out, the light is absorbed with the increasing of blood cells and the intensity of light received on the LDR. So the resistance value of the LDR increases. This converts the resistance into voltage variation using Op-Amp circuit. The signal is amplified by the microcontroller inputs. The signal given to the microcontroller input will be like shown in the image above in CRO. The microcontroller can be programmed to measure the pulses by the interrupts or pulses in a minute. The count value of pulses is the Heart rate in BPM (Beats Per Minute). To save the time, the number of pulses are counted and then multiplied by 6 to get pulse count for 1 minute.

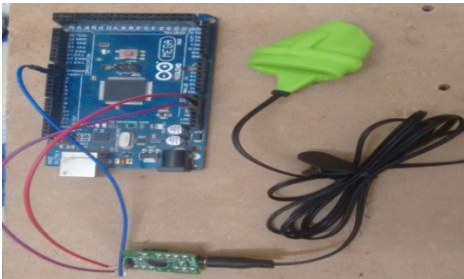


FIGURE 6: Heart Beat Sensor to the Finger

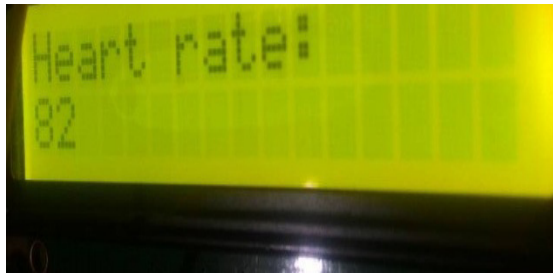


FIGURE 7: Digital value of the Human Heart Beat

ECG Sensor Output

The AD8232 is an IC block for ECG and other biopotential measurement applications. It is designed to extract, amplify, and filter small biopotential signals, such as those created by motion or remote electrode placement. This design allows an analog-to-digital converter (ADC) or a microcontroller to acquire the output signal easily. It can be implemented with a high-pass filter for eliminating motion artifacts and the electrode half-cell potential. This filter is connected with an instrumentation amplifier to send large gain and high-pass filtering, thereby reducing the space and price of the circuit.

The IC includes a restoring function that produces better performance in the HPF. After the signal change the amplifier, the IC adjusts to a higher filter cutoff frequency. This feature allows the IC to recover, and therefore to get a valid result, the electrodes are connected to the circuit. This sensor is designed to measure the electrical activity of the heart. This electrical activity can be listed in ECG. ECGs are low amplitude with more noise, and the IC Single Lead Heart Rate Monitor will act as an Op-Amp to help to get a clear signal from the PR and QT intervals.

The IC module breaks out 9 leads from the circuit that can connect each connector to, SDN, LO+, LO-, OUTPUT, 3.3V, GND provide essential pins for operating this monitor with a microcontroller and other development board. It also performs for RA (Right Arm), LA (Left Arm), and RL (Right Leg) pins to attach with sensors. Here an Arduino mega board is used to obtain the signals sensed from the sensor through the electrodes which are in contact to the body, and the sensed signals are programmed and displayed in the processing software associated to the Arduino platform.

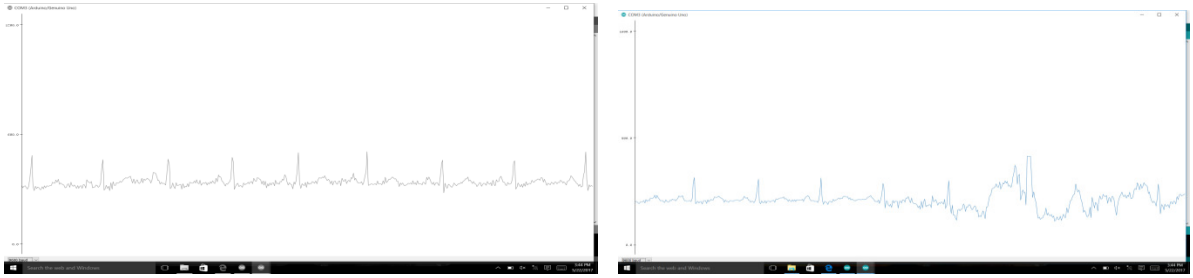


FIGURE 8: Normal ECG signals observed in the Proposed System

THINGSPEAK OUTPUT

These obtained ECG signals are sent to the Raspberry pi board through wi-fi from Arduino mega board. The signals that are sent from the Arduino mega board are in the form of digital and these digital values are sent to the Raspberry pi board[5], where this Raspberry pi board here acts as the client and the signals sensed through the Arduino mega board also acts as the client. These clients are connected to a server where in which a mobile hotspot is used as the server here which gives the IP address to the raspberry pi board and the digital data's sensed are simultaneously uploaded in the database (Thingspeak). Here the doctor is given the user id and the password so that he can monitor the patient whenever there is an abnormality.

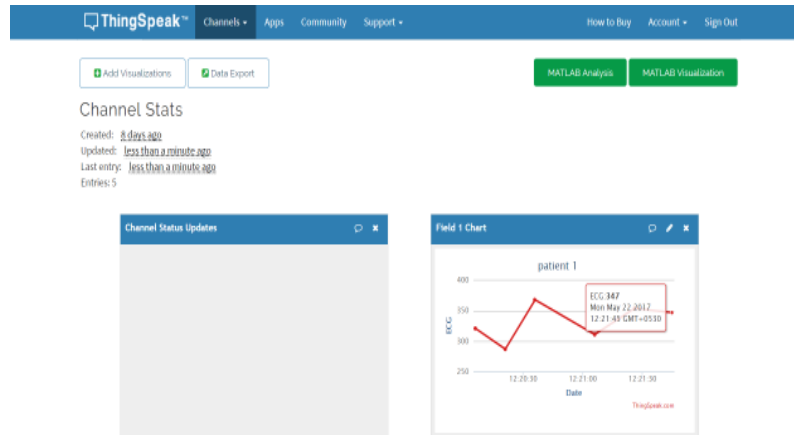


FIGURE 9: Screenshot of the waveform obtained in Thingspeak Website

CONCLUSION

Generally in this approach we can detect or track the heart attack before it occurs or heart diseases and save the lives of many people using IOT. This proposed system helps the people who are frequently affected by heart attacks or heart diseases by tracking their heart anomalies by notifying with an alert message to the Doctors, Caretakers and Ambulance. The data set collected from the pulse rate is analyzed by using data analytics which creates user friendly and transparent environment by using different tools and platforms. By using data analytics it provides potential and transforms the way to healthcare provides sophisticated technologies. In the future we'll see the rapid, widespread implementation and use of these analytics across the healthcare organization and the healthcare industry. The proposed system provides great flexibility and server as doctor's caution for the patient.

REFERENCES

1. Sanjeev Kumar Jain and Basabi Bhaumik, "An Energy Efficient ECG Signal Processor Detecting Cardiovascular Diseases on Smartphone", *IEEE Transactions on Biomedical Circuits and Systems*, vol. 11, no. 2, April 2017.
2. Liang-Hung Wang et. Al., "An Outdoor Intelligent Healthcare Monitoring Device for the Elderly", *IEEE Transactions on Consumer Electronics*, vol. 62, no. 2, May 2016.

3. Prosanta Gope and Tzonelih Hwang, "BSN-Care: A Secure IoT-Based Modern Healthcare System Using Body Sensor Network", [IEEE sensors journal](#), vol. 16, no. 5, March 2016.
4. Bandana Mallick and Ajit Kumar Patro, "Heart rate monitoring system using fingertip through arduino and processing software", *International Journal of Science, Engineering and Technology Research*, vol. 5, no. 1, Jan 2016.
5. Abdurrachman Mappuji et. al., "Study of Raspberry Pi 2 Quad-core Cortex-A7 CPU Cluster as a Mini Supercomputer", 8th International Conference on Information Technology and Electrical Engineering (ICITEE), Yogyakarta, Indonesia, 2016.
6. Cristian F. Pasluosta, et. al., "An Emerging Era in the Management of Parkinson's Disease: Wearable Technologies and the Internet of Things," [IEEE Journal of Biomedical and Health Informatics](#), vol. 19, no. 6, November 2015.
7. Geng Yang et. al., "A Health-IoT Platform Based on the Integration of Intelligent Packaging, Unobtrusive Bio-Sensor, and Intelligent Medicine Box," [IEEE transactions on Industrial Informatics](#), vol. 10, no. 4, November 2014.
8. Xiaochuan He et. al., "Secondary Peak Detection of PPG Signal for Continuous Cuffless Arterial Blood Pressure Measurement", [IEEE Transactions on Instrumentation and Measurement](#), vol. 63, no. 6, June 2014.
9. Shivam Patel and Yogesh Chauhan, "Heart attack detection and Medical attention using Motion Sensing Device-Kinect", *International Journal of Scientific and Research Publications*, vol. 4, no.1, ISSN 2250-3153, Jan 2014.

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Performance Evaluation of White Noise for Different Noisy Speech Signals in Mobile Applications

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Abstract: Speech is the main mode of communication between human beings and man-machine environment. Due to large use of mobile communication to long distance the speech in mobile communication plays a vital role. The mobile speech suffers from more number of noises due to surrounding environment and makes the person in conversation complex to hear. Hence there is a need for enhancing mobile speech for better understanding. In this paper various stationary noises like car noise, airport noise, exhibition noise, restaurant noise etc are analyzed with spectral subtraction and additive White Gaussian noise for the clean speech and noisy speech. The energy of the various samples are compared by calculating the energy of the speech content and compared. The noisy speech is filtered and analyzed for improving the quality, with speech data alone without the silent area.

Keywords : Stationary Noise, White Noise, Spectral Subtraction.

INTRODUCTION

Speech is a form of communication used by humans and living beings while Enhancement is defined as an increase or improvement in quality or value of something beyond the original parameters. Noise can be termed as unwanted sound which is judged to be unpleasant or loud for hearing. White noise is present in our daily life where we can term it as practically impossible to avoid white noise. Some research are going on how to remove white noise where the white noise is considered as a unwanted sound or parameter but actually speaking White Noise does not really mean as unwanted sounds, but it is useful in our daily life as well as science. White noise is excellent for sound masking. Masking can be defined as protecting something from unintended change from original. Therefore we can consider random signals to be white noise.

The human brain is such that it recognizes only one speech at a time; this is where white noise comes into play. Suppose u hear two people speaking and your brain is confined to recognize only one speech at a time and so is the case with three people where the speech of the other two people are suppressed and you concentrate on only one speaker. This concept can be related to white noise, i.e. *for e.g.* you hear a sound of two people speaking from the next room, and you turn on the fan so that the sound of the conversation of the people from the adjacent room is suppressed by the fan noise. White Noise is a type of noise that is produced by combining sounds of all different frequencies together, i.e. if you took all of the imaginable noises that a human can hear and combined together you get white noise. The term "WHITE" is used to describe this type of noise is because of the concept of how light white works where different colors of light are combined together.

Noise Reduction

In environment, there is presence of noise in speech signal. The source of the speech is the main component of noise. The effects of the noise addition make listening difficult for direct listeners. Similarly there are other negative effects when the degraded speech is processed for other applications. One of the problems is processing the

degraded speech in preparation for coding by bandwidth compression system. Therefore, speech enhancement not only involves processing speech signal but also for further processing prior to listening. Main objective is to improve the perceptual aspects of speech such as overall quality, intelligibility or degree of listener. Various Types of Speech Degradations are occurred at the source of speech and the background noise is added to speech signal when the source is in the noisy environment. The background noise maybe noise such as –Aircraft cockpit, other moving vehicles or environmental sounds or it may be speech comprised of competing speakers. Noise effect can also arise due to room reverberation where the source speech is present. During the transmission of speech signal like telephone lines to reach the listener at a distance, speech also requires transmission channels. During transmission, due to the non-idealities of channel behavior, addition noise is added to the speech signal. Noise can also be added either during the data conversion or during the speech reproduction at the listeners end. Even though speech source is in the quite environment, at the listener end it may have highly noisy environment. Speech enhancement is needed at this case because here listening fatigue arises as the quality of speech is lowered. It is generally operated in the spectral domain by removing the noise from each spectral band which corresponds to the noise contribution. Some of the researchers have done their research by using spectral subtracting method and is proved to be effective in estimating the spectral magnitude of the speech signal.

LITERATURE SURVEY

Urmila Shrawankar and Vilas Thakare published the research in Noise Estimation and Noise Removal Techniques for Speech Recognition. In this paper the author mainly concentrated on the noise estimation and the noise reduction, where a signal is taken into consideration and the level of the noise present is identified and then noise reduction is done through various noise reduction techniques. In this paper the author uses the Voice Activated Detection(VAD) technique for noise removal. At the end the author also sums up that there is no versatile algorithm that works in diverse environmental conditions.

Fatemeh Saki and Nasser Kehtarnavaz, 2017 performed the research with Real-Time Unsupervised Classification of Environmental Noise Signals. In this paper the author took the unsupervised signal at different environmental conditions and parameters and then studies the characteristics of the signal and concentrates on the removal of the noise present in the signal. The author used techniques such as Noise-fading, which helps in the generation of clean signal.

Shambhu Shankar Bharti, Manish Gupta and Suneeta Agarwal, 2016 performed the analysis in the spectral subtraction method for speech enhancement using adaptive noise estimation. In this paper the author discusses about the need of Spectral Subtraction and Speech Enhancement. The main objective that the author concentrates in this paper is to reduce the background noises that are present in the noises transmitted and the need of Speech Enhancement which increases the intelligibility and quality of the speech.

METHODOLOGY

The input signal is first being preprocessed where the signal is being passed through the Band Pass Filters (BPF) where only set of frequency of signals are allowed. Here both the signals i.e. both the clean signal and the noisy signal are passed through and then the White Noise is added to both the signals and the energy level of both the signals after adding white noise is noted down.

The energy is calculated by the interpreting the formula,

$$\sum_0^m (x(n))^2 \quad (1)$$

where the amplitude of the signal is squared and then the mean of the values is taken and the energy is calculated. Now Spectral Subtraction is performed for both White Noise added signals and then comparison is made for both

the values.

The equation describing spectral subtraction may be expressed as

$$|x^{\wedge}(f)|^b = |y(f)|^b - a|N(f)|^b \quad (2)$$

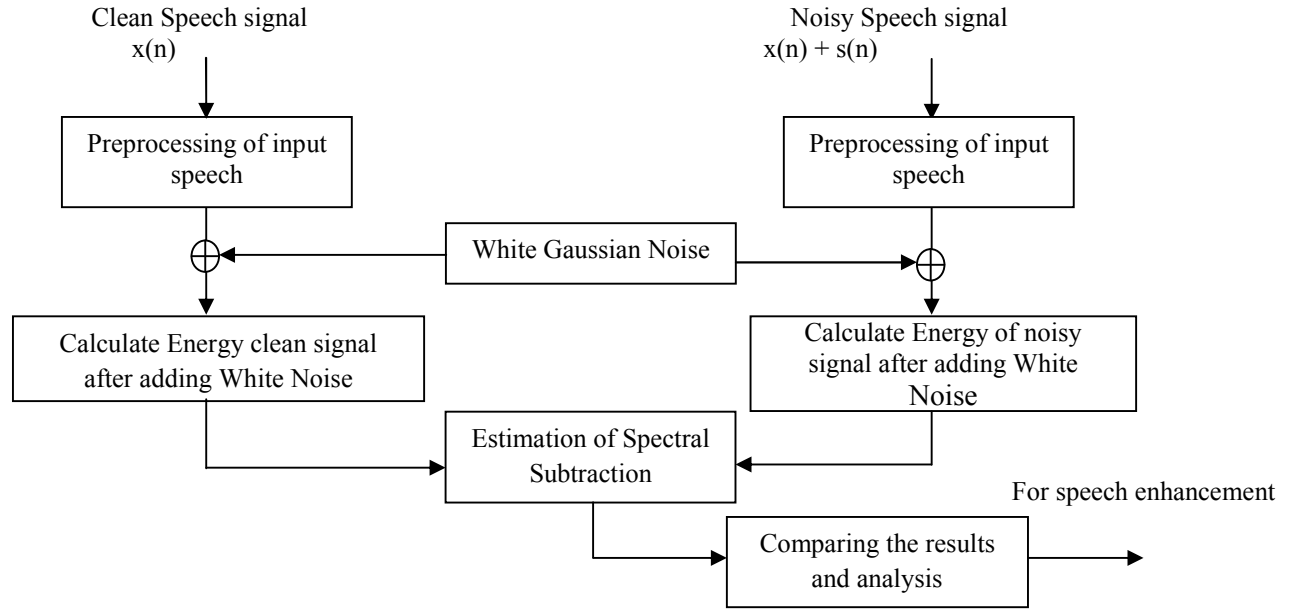


Figure 1: Proposed diagram of Noise reduction technique

Where $|x^{\wedge}(f)|^b$ is an estimate of the original signal spectrum $|x(f)|^b$ and $|N(f)|^b$, b is the time-averaged noise spectra. Compare to the other noise reduction algorithms like LMS algorithm, Wiener filter and adaptive noise cancellation methods, the initial noise analysis is done in this paper to understand the nature of speech and noise by looking the energy for various time samples. The equation (1) gives the energy calculation which shows the clean, noisy and noise reduced samples. The Equation (2) gives the spectral subtraction of original and noise signal. It is assumed that the noise is a wide-sense stationary random process.

RESULTS AND DISCUSSION

After processing with various speech signal samples the following observations are taken with tables and wave forms obtained from the MATLAB Software. The figure below gives a pictorial representation of the two different signals of a clean speech and a noisy speech before performing any experiments on the signal. Later white noise is added to both the signals and performed the spectral subtraction and compared the results.

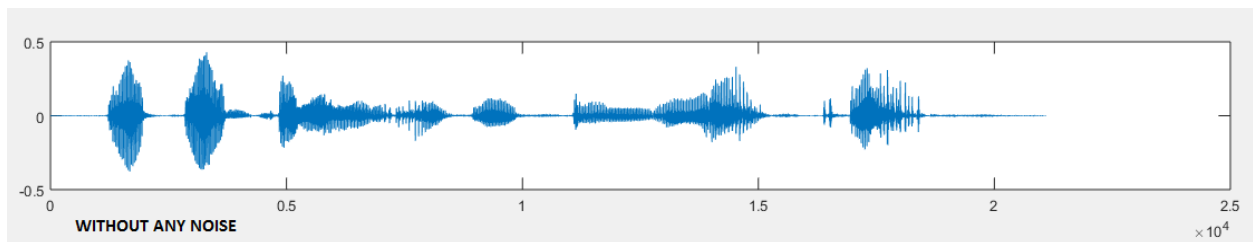


Figure 2. Clean signal before adding noise.

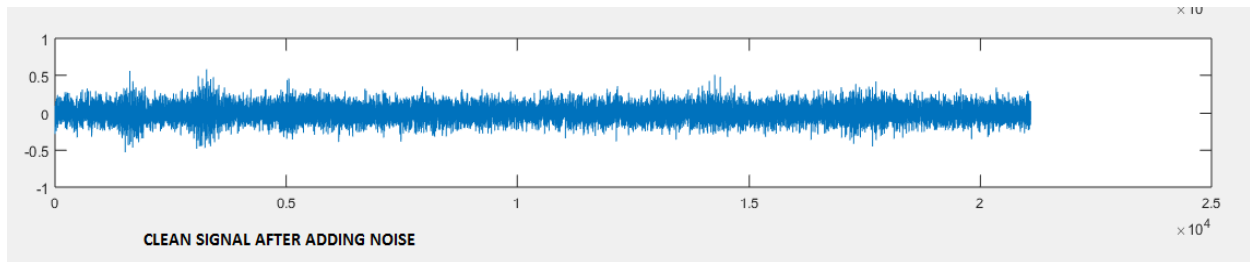


Figure 3. Clean signal after adding noise.

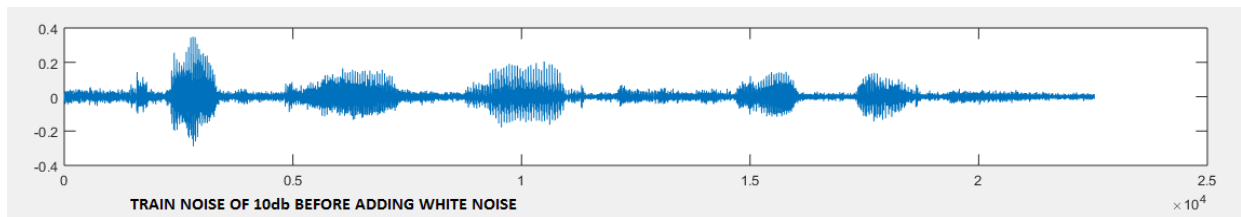


Figure 4. Noisy signal before adding White noise

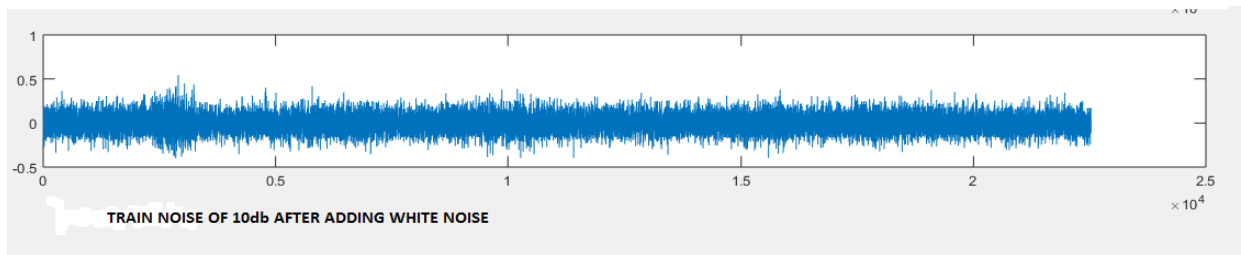


Figure 5. Noisy signal after adding White noise

From the above speech waveforms it is identified that the speech content and noise are well shown for the various samples. The energy calculated for all time samples are displayed in the MATLAB software and analyzed.

Table - 1

Sl.no	Type of noise	Energy before adding white noise	Energy after adding white noise
1	Car Noise(5db)	0.00098	0.0198
2	Car Noise(10db)	0.00001	0.0278
3	Station Noise(10db)	0.00011	0.0034
4	Station Noise(15db)	0.00023	0.0053

Table-1 shows us the mathematical permutations of two different noises with respect to the energy levels of the signal before and after adding the White Noise. The figure below shows the two energy levels of the signals where the upper part of the image gives you the plot of the signal before adding White Noise while the lower part of the image gives you the plot of the signal after adding the White Noise. Here we have taken two different signals such

as Car Noise (5db-10db) and Station Noise (10db-15db) and the plots and energy levels are taken. Similarly different signals of different Decibels such as are taken into consideration and then the energy and signal plots are noted and consideration.

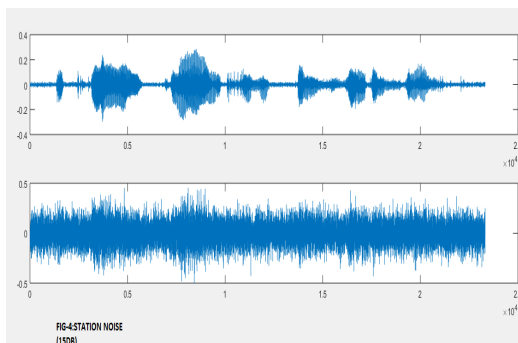
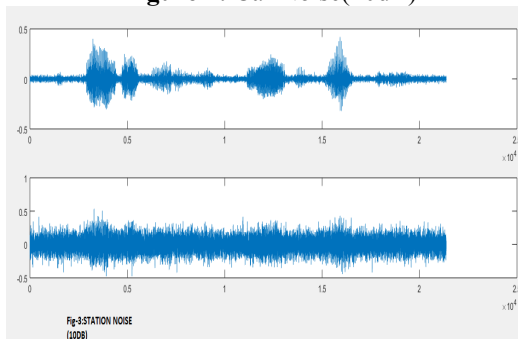
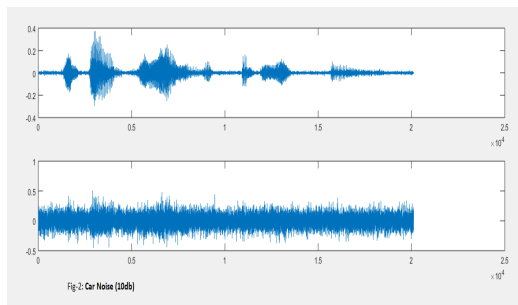
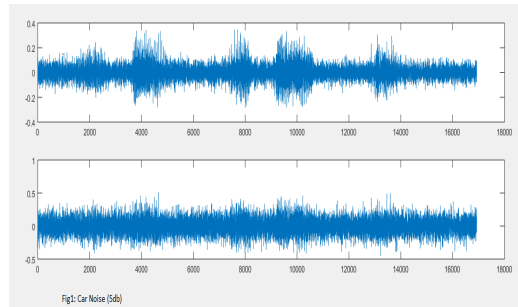


Table - 2

Sl.no	Type of noise	Energy before adding white noise	Energy after adding white noise
1	Train Noise	0.00018	0.0205
2	Street Noise	0.00002	0.0601
3	Exhibition Noise-1	0.00010	0.00071
4	Exhibition Noise-2	0.00002	0.0036

Table-2: shows us the mathematical permutations of two different noises at different environmental parameters with respect to the energy levels of the signal before and after adding the White Noise.

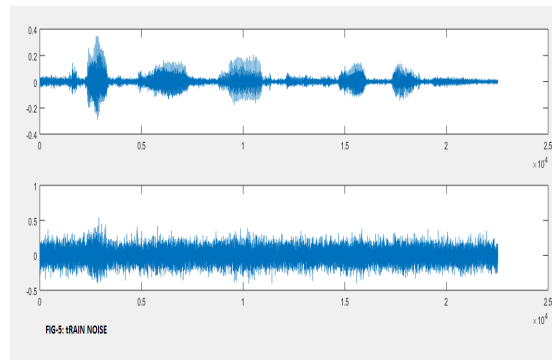


Figure 10: Train Noise(10dB)

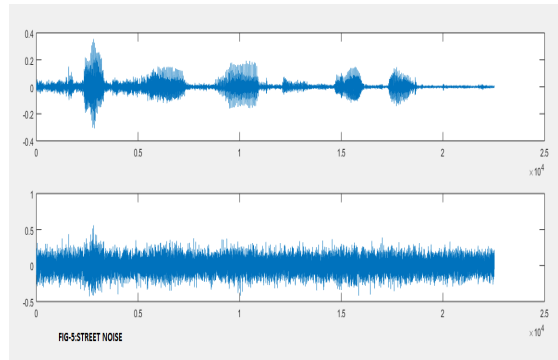


Figure 11: Street Noise(15dB)

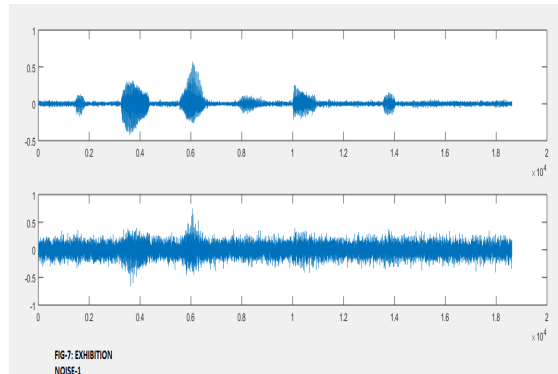


Figure 12: Exhibition Noise-1

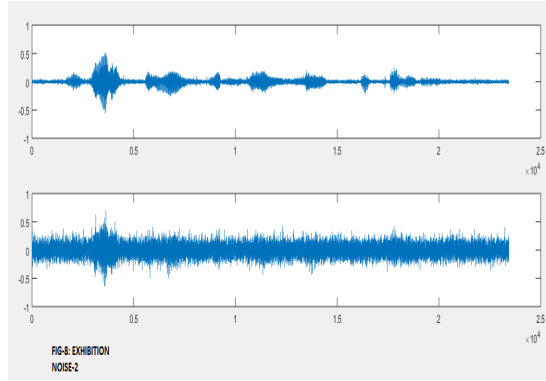


Figure 13:Exhibition Noise-2

Table -3

Sl.no	Type of noise	Energy before adding white noise	Energy after adding white noise
1	Airport-1	0.00031	0.0038
2	Airport-2	0.00002	0.00046
3	Airport-3	0.000096	0.0109
4	Composite Noise	0.000028	0.00153

Table-3 shows us the mathematical permutations of two different noises at different environmental parameters with respect to the energy levels of the signal before and after adding the White Noise.

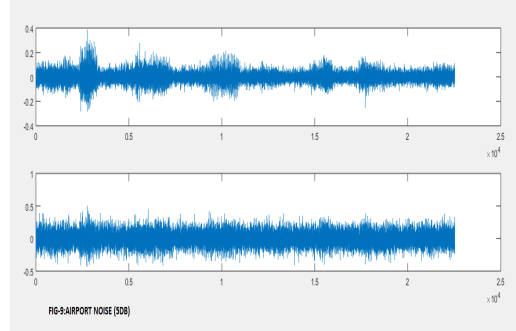


Figure 14:Airport Noise(5dB)

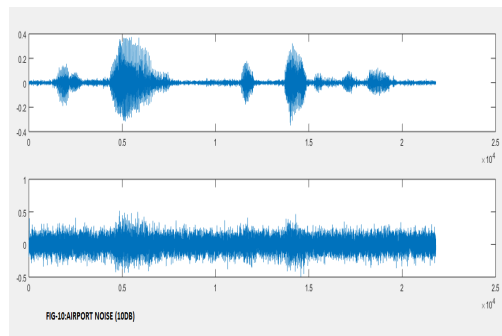


Figure 15:Airport Noise(10dB)

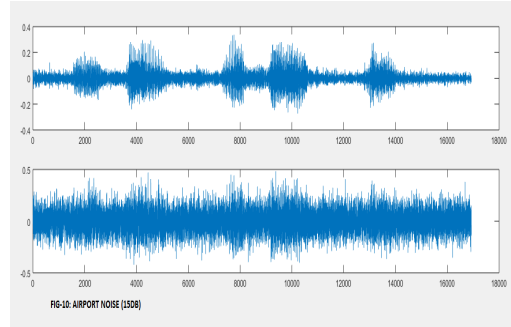


Figure 16:Airport Noise(15dB)

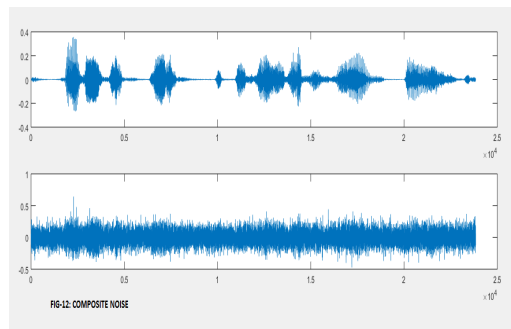


Figure 17:Composite Noise

This below table gives us comparison between the two signals where the signals are Clean signal and a Noisy signal. The Clean signal is first taken into consideration where the Spectral subtraction is performed for both White noise added signals and a clean signal. Then the Noisy signal is taken into consideration and then the Spectral subtraction is performed and the values are evaluated. Now both the values are compared where we can see that the values of the energy levels of signals before performing Spectral subtraction of the clean signal and the values of the energy levels of the Noisy signal after performing Spectral Subtraction is almost same.

Table -4

Sl.no	Speech Samples	Energy before adding white noise to clean signal	Energy after adding white noise to clean signal	Spectral subtraction for white noise added clean signal
1	Speech-08	2.3842×10^{-7}	0.1061	1.7282×10^{-7}
2	Speech-09	1.5739×10^{-7}	0.2188	4.1158×10^{-7}
3	Speech-10	8.3819×10^{-9}	0.0011	7.7302×10^{-9}
4	Speech-12	1.5739×10^{-7}	0.0348	1.0443×10^{-7}
5	Speech-22	3.7253×10^{-7}	0.1459	2.4735×10^{-7}
6	Speech-25	1.5739×10^{-7}	0.0015	3.0068×10^{-7}
7	Speech-28	1.8254×10^{-7}	0.1467	1.4314×10^{-7}

Table 4 shows the comparison of the energy calculated for the clean speech signal and noise added signal initially. Then the energy is calculated after the spectral subtraction and both cases compared in the table. From these it is clearly understood that the energy before adding the white noise and after doing spectral subtraction are close together and the proposed algorithms is suitable for removing the noise for the different types of noise added with the speech signals.

Table -5

Sl.no	Speech Samples	Energy before adding white noise	Energy after adding white noise	Spectral subtraction for white noise added clean signal	Noisy signal after spectral subtraction
1	Speech-04	5.9605×10^{-8}	0.0365	2.2984×10^{-6}	1.2054×10^{-8}
2	Speech-11	303528×10^{-6}	0.0678	2.5501×10^{-7}	4.0881×10^{-6}
3	Speech-15	8.3819×10^{-9}	0.0675	1.2865×10^{-6}	2.4225×10^{-9}
4	Speech-24	5.9605×10^{-8}	0.0431	4.3936×10^{-7}	2.8058×10^{-8}
5	Speech-26	1.4901×10^{-8}	0.1003	2.0006×10^{-7}	1.9345×10^{-8}
6	Speech-29	8.9500×10^{-7}	0.0202	8.9985×10^{-8}	2.0091×10^{-7}
7	Speech-30	2.5183×10^{-6}	0.0307	3.8913×10^{-7}	3.8855×10^{-6}

Similarly the Table -5 shows the various comparison of the speech signals along with clean, noise added and noise removed speech signal samples. It is understood that the energy calculated before adding white noise and after had much different but the energy of the samples for white noise which is added with noisy signals got the similar amount of energy using the proposed algorithms.

CONCLUSION

By the end of this paper the process of mobile communication finds better methods for noise reduction and in future the speech enhancement is planned for improving the noise reduced speech signals. The energy of the speech is calculated with and without noise using the algorithms and the original signal is compared with the white noise added signal and noisy signals. In future the noise reduced signal is planned to enhance for getting better quality for various types of speech processing applications. One more factor that the communication finds its application is that the bandwidth is getting reduced for a speech transmitted through a channel.

REFERENCES

1. Urmila Shrawankar and Vilas Thakare, "Noise Estimation and Noise Removal Techniques for Speech Recognition in Adverse Environment", IFIP International Federation for Information Processing, 2010.
2. Jui-Chuan Cheng Te-Jen Su Tsung-Ying Li Chia-Hua Wu, "The Noise Reduction of Speech Signals Based on RBFN", [IEEE sponsored International Conference on Intelligent Information Hiding and Multimedia Signal Processing](#), 2015. DOI 10.1109/IIH-MSP.2015.111.
3. Chang Huai You, Susanto Rahardja, and Soo NgeeKoh, "Audible Noise Reduction in Eigen domain for Speech Enhancement", [IEEE Transactions on Audio, Speech, and Language Processing](#), vol. 15, no. 6, 2007.
4. Sara Shahi, Daniela Tuninetti, and Natasha Devroye, "On the capacity of the AWGN channel with additive radar interference", [IEEE Transactions on Communications](#), vol. 66, no. 2, 2018.
5. M Mathivanan and S. Chenthur Pandian, "Analysis of Noise Characteristics in VMR-WB Speech Using Sub Band Filters", Australian Journal of Basic and Applied Sciences, vol. 7, issue 2, pp: 79-88, 2013

Comparison of total electron content of IRNSS with IRI and GPS-TEC at equatorial latitude station

R. Mukesh, P. Soma, P. Sindhu, and R. R. Elangovan

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Comparison of Total Electron Content of IRNSS with IRI and GPS-TEC at Equatorial Latitude Station

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Abstract: Total Electron Content (TEC) is the key element for observing the variation of the ionospheric signals. TEC is integrated electron density over the signal path from transmitter to receiver and measured in TEC units. The IRNSS SPS RX is used to track and provide accurate location information with 7satellite constellation system. The receiver consists of three individual channels which operate at frequencies of 1575.42MHz – L1, 1176.45MHz – L5 and 2492.028MHz – S band. We have used two methods to calculate TEC by using IRNSS data collected from IRNSS SPS receiver at ACSE. In first method, we have calculated TEC from ionospheric group delay (in meters) and in the second method, we have calculated TEC from pseudo range (in meters) of L5 and S band. The TEC measured from dual-frequency IRNSS SPS receivers (IRNSS TEC) at the ACSCE station was analyzed, during the period 2017–2018. The Calculated IRNSS TEC is compared with the TEC acquired from International Reference Ionosphere model as well as the TEC taken from the Ionolab. The ACSCE station (12.89°N, 77.46°E) is positioned at equatorial latitude. Our measured IRNSS TEC is closely matched with IRI-TEC than GPS TEC from Ionolab.

Keywords: IRNSS-TEC, GPS & IRI TEC, Equatorial latitude, Pseudo range, Ionospheric group delay.

INTRODUCTION

NavIC/IRNSS Constellation

The Navigation with Indian Constellation (NavIC) or Indian Regional Navigation Satellite System (IRNSS) is an Indian regional navigation system which delivers accurate real time position and time services. The IRNSS constellation consists of a 7 satellites. The IRNSS is owned by the Indian government and it was developed by Indian Space Research Organization. The IRNSS will broadcast the signals in L5 and S band frequency. The IRNSS has been established for regional navigation services over India using a combination of GEO and GSO spacecrafts. The NavIC (IRNSS) constellation comprises of 7 satellites — 3 Satellites are in Geo Stationary Orbit and 4 Satellites are in Geo Synchronous Orbit inclined at 29 degrees to the equatorial plane. All the satellites are visible over the Indian region for 24 hours to provide accurate position information. IRNSS have 3 segments, namely ground segment, space segment and user segment. An IRNSS user receiver comes under ground user segment of IRNSS system. Space Applications Center (SAC-ISRO) is engaged in the development of IRNSS SPS User Receivers. The ground user segment of IRNSS system consists of navigation receivers having IDU and ODU (Antenna with LNA) which will be installed all over Indian region. The Indoor Unit (IDU) is being developed by Data Patterns (India) Pvt. Ltd. for IRNSS SPS User Receivers.

Total Electron Content (TEC)

TEC is a measure of the total amount of electrons available along a path from transmitter to receiver and its unit is 10^{16} electrons/m². The IRNSS dual frequency signals transmitted from an altitude of 36,000 km is used to measure the total amount of free electrons, along ray path from IRNSS satellite to IRNSS Receiver.

This paper describes the calculation of total electron content of dual-frequency IRNSS observations collected by IRNSS SPS receiver at ACSE, Bangalore, using MATLAB software and comparison of IRNSS TEC with International Reference Ionosphere Total Electron Content and GPS Total Electron Content.

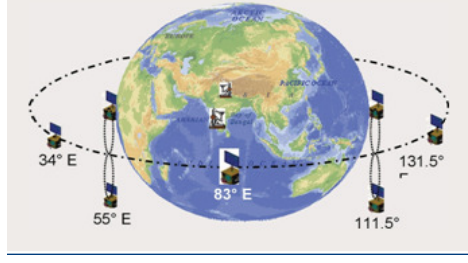


Figure 1: IRNSS constellation

DATA USED

IRNSS TEC Information

The IRNSS TEC information used here for writing this paper were received by the IRNSS SPS receiver (12.89°N, 77.46°E) during the period 2017 to 2018. In the IRNSS system, all the seven satellites transmit the signals on f_1 and f_2 frequencies ($f_1 = 1176.45$ MHz and $f_2 = 2492.028$ MHz). TEC measurement is done by dual-frequency IRNSS receiver. The IRNSS receiver starts functioning when it continuously receives IRNSS signals from six satellites. From the data received from IRNSS satellites is used to compute Slant TEC values. Pseudorange from navigation satellite to the receiver is used to compute STEC. STEC can be obtained from a difference between pseudo range (P_1 is pseudo range for L5 band and P_2 is pseudo range for S band frequency) [1, 2, 3] i.e.

$$TEC = \frac{1}{40.3} \left[\frac{f_1^2 f_2^2}{f_1^2 - f_2^2} \right] (P_2 - P_1) \quad (1)$$

Where,

$\alpha_1 = (40.3/f_1^2)$ and $\alpha_2 = (40.3/f_2^2)$ are constant (m^3 per electron),
 f_1 is the frequency of L5 band and f_2 is the frequency of S band.

P_1 and P_2 are the pseudorange belongs to the f_1 & f_2 frequencies respectively.

The vertical TEC (VTEC) can be calculated by using the Eq. (2) [4, 5].

$$VTEC = \frac{STEC}{MF} \quad (2)$$

$$MF = \frac{1}{\cos^2(Z^\circ)} \quad (3)$$

$$\sin(Z^\circ) = \frac{R_E}{R_E + H_{max}} \sin(Z) \quad (4)$$

$$Z = (90^\circ - E) \quad (5)$$

Where,

STEC = Slant TEC in TECU,

MF = mapping function,

Z = zenith angle

E = elevation angle,

R_E = Earth radius = 6378 KM

H_{max} = Height of ionospheric layer ($H_{max} = 350$ km).

IRI TEC data

IRI is an International Reference Ionospheric model and it was developed based on data available from ground stations and satellite observations. IRI model is used to predict the TEC globally in order to understand

the uncertainty in ionosphere. The IRI -2007 model is used to predict TEC by giving input as the dates, location, and time. The IRI-2007 is a standard model of the ionosphere. To overcome the limitations of IRI-2001 model, IRI-2007 model is developed. IRI-2007 is improved version of IRI-2001[6].

GPS TEC data from Ionolab

IONOLAB introduces an automatic, robust online computation method for real time TEC. The users have option to choose one or multiple stations and date for TEC computation. GPS TEC from Ionolab can be related with IGS TEC data. The TEC obtained from Ionolab is available either in graphical manner or in an excel file. Ionolab estimates TEC values from preprocessed RINEX files receiver and satellite locations. TEC from Ionolab can be obtained for one day or continuously 3 days for one or more IGS/EUREF stations.

The GPS TEC data used for comparison was taken from the IISC GPS station receiver (13.0219° N, 77.5671° E) during the period 2017 to 2018. GPS satellite transmits the signals in L1 and L2 frequencies.

TEC data plotting procedure

In order to know variation of TEC at ACSCE-Rx-1 station, daily TEC plots obtained using the database that contains TEC data computed using pseudorange at an interval of 10 minutes. To improve the accuracy of the TEC map at ACSCE Rx-1 station TEC is smoothed.

Results & analysis

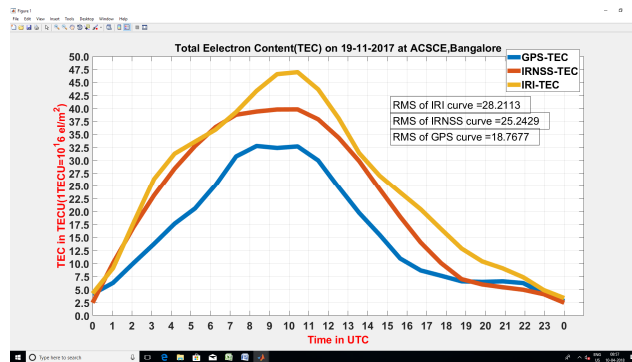


Figure 2: Comparison of TEC from IRI, IRNSS & GPS on 20/11/2017

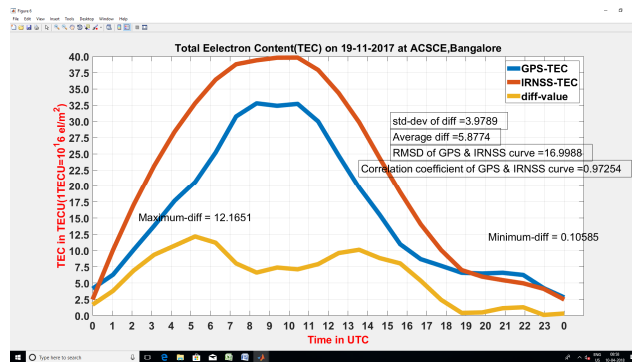


Figure 3: Comparison of TEC from IRNSS & GPS on 20/11/2017

The TEC data which is obtained from IRI model is derived from ionogram. The TEC data which is obtained from Ionolab is derived from GPS data and IRNSS TEC is derived from IRNSS data. In order to know TEC variation, we need to compare our IRNSS TEC data with GPS TEC from Ionolab and IRI TEC data. So, we used the IRI & GPS TEC (Ionolab-TEC) data at 12.02°N, 77.57°E, (IISC, Bangalore). The IISC station is near to the ACSCE station. The Figure2 shows the comparison of GPS TEC, IRI TEC, and IRNSS TEC on 20-11-2017[7].

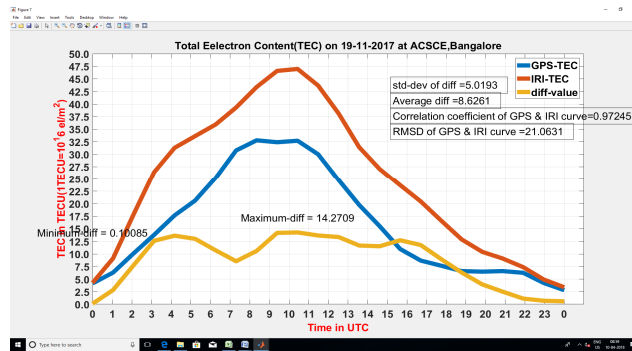


Figure 4: Comparison of TEC from IRI & GPS on 20/11/2017

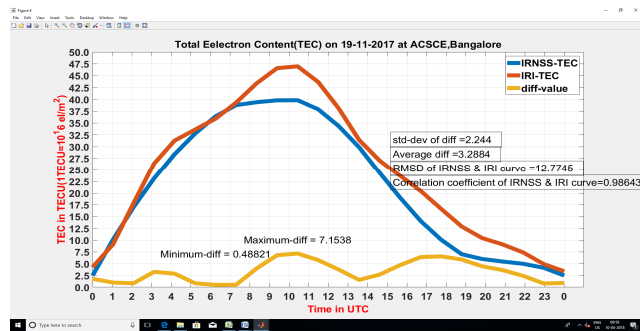


Figure 5: Comparison of TEC from IRNSS & IRI on 20/11/2017

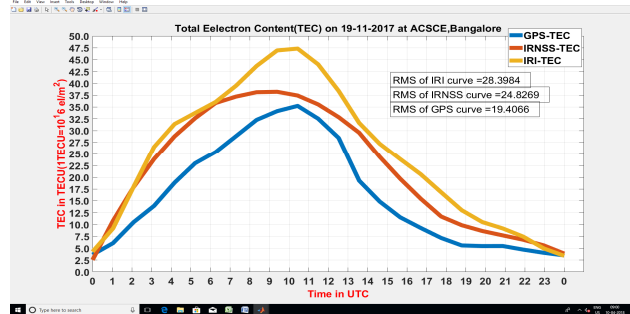


Figure 6: Comparison of TEC from IRI, IRNSS & GPS on 19/11/2017

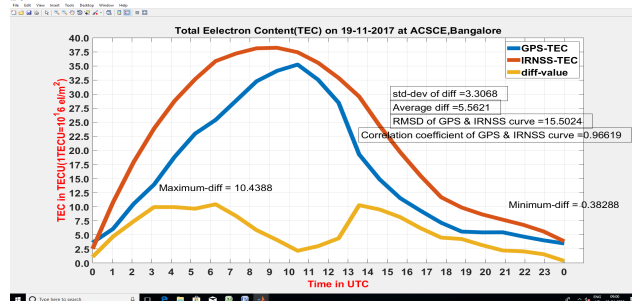


Figure 7: Comparison of TEC from IRNSS & GPS on 19/11/2017

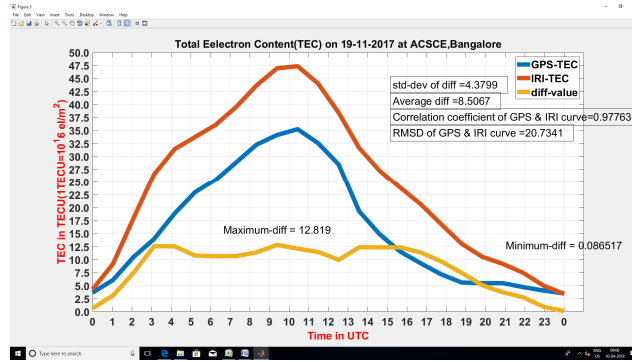


Figure 8: Comparison of TEC from IRI& GPS on 19/11/2017

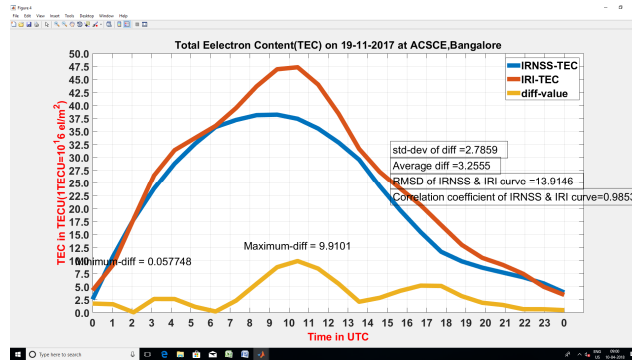


Figure9: Comparison of TEC from IRNSS & IRI on 19/11/2017

Comparison of IRI, IRNSS & GPS curve is done from figure 2 to figure 5 for 20/1/2017. Result from these comparisons is explained in the following statements.

From Figure 2 it can be noticed that, the IRI model over estimates than the IRNSS & GPS TEC. TEC are very similar during the night time. The note worthy difference witnessed is that IRNSS TEC is greater than GPS TEC & lower than IRI TEC. In addition, the maximum TEC values happened at during the noontime, between 09:00 UTC and 15:00 UTC. The IRI TEC is usually greater than the IRNSS & GPS TEC at about 15 TEC Units during daytime.

Figure 3 shows, comparison between IRNSS & GPS TEC. Here, IRNSS TEC over estimates the GPS TEC from Ionolab.

TEC are similar during night time. The important difference observed is that IRNSS TEC is superior to GPS TEC. In addition, the maximum TEC values happened at around the noontime, between 09:00 UTC and 15:00 UTC. The IRNSS TEC is greater than GPS TEC at about 15 TEC Units in the daytime.

Figure 4 shows, comparison between IRI & GPS TEC. Here, IRI TEC over estimates the GPS TEC from Ionolab. TEC is similar during night time. We have observed that IRI TEC is larger than GPS TEC. In addition, the TEC values reaches maximum at about the noontime, between 09:00 UTC and 15:00 UTC. The IRI TEC is usually greater than GPS TEC at nearly 15 TEC Units in daytime.

The Figure 5 shows that, the IRI model overestimates the IRNSS TEC. TEC are very similar during the night time. The important point observed is that IRNSS TEC is lower than IRI TEC. In addition, the maximum TEC values happened around the noontime, between 09:00 UTC and 15:00 UTC. The IRI TEC is greater than IRNSS TEC around 15 TEC Units in the daytime. The figure 6, 7, 8 and 9 also shows that IRNSS TEC is greater than GPS TEC and lesser than IRI TEC. Similar comparison is done for 19/1/2017 as shown in figures 6, 7, 8 & 9.

CONCLUSION

TEC is one of the most significant factors of ionosphere. Analysis of TEC helps to study the space weather conditions also it is used to understand the complex phenomena happening in near earth environment. The result of our analysis shows that the IRNSS TEC agrees with IRI-2007 model. It normally underestimates than the IRI TEC & over estimates than compare to GPS TEC. The maximum differences are about 15 TEC Units in the daytime and 5 TEC Units in the night time.

REFERENCES

- [1] Arikan F., Arikan O., Erol C.B., "Regularized estimation of TEC from GPS data for certain midlatitude stations and comparison with the IRI model," [Advances in Space Research](#), 39(5):867-74, 2007.
- [2] Erol C.B., Arikan F., Arikan O., "A new technique for TEC estimation," in Geoscience and Remote Sensing Symposium, 2002. IGARSS'02 2002 IEEE International (Vol. 2, pp. 1284-1286), Toronto, Canada, Jun 2002.
- [3] Nayir H., Arikan F., Arikan O., Erol C.B., "Total electron content estimation with Reg-Est," [Journal of Geophysical Research: Space Physics](#), 112(A11), 2007.
- [4] Arikan F., Erol C.B., Arikan O., "Regularized estimation of vertical total electron content from Global Positioning System data," [Journal of Geophysical Research: Space Physics](#), 108(A12), 2003.
- [5] Arikan F., Erol C.B., Arikan O., "Regularized estimation of vertical total electron content from GPS data for a desired time period," [Radio Science](#), 39(6), 2004.
- [6] Bilitza, D. and B. W. Reinisch, International Reference Ionosphere 2007: Improvements and new parameters, [Adv. Space Res.](#), **42**, 599–609, 2008. 10.1016/j.asr.2007.07.048
- [7] P. Kenpankho, K. Watthanasangmechai, P. Supnithi, T. Tsugawa and T. Maruyama "Comparison of GPS TEC measurements with IRI TEC prediction at the equatorial latitude station, Chumphon, Thailand", April 2011, Volume 63, Issue 4, pp 365–370

Novel approach for mitigation of collision in mobile ad-hoc networks

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Novel Approach for Mitigation of Collision in Mobile Ad-hoc Networks

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Abstract— In MANETS, conventional back-off models do not precisely forecast the performance, hence, it suffer with high packet smash. The main objective of this work is to decrease collision using the Adaptive Contention Window Size Back-off (ACWSB) scheme for increasing window size and reduce collision by disseminating the traffic into a bigger time space. The ACWSB algorithm manages the contention window of the nodes suffering collisions. During packet transmission, the back-off counter is evenly selected from the given range of $[0, \text{CntWdw}-1]$. The value of CntWdw value is determined by the number of unsuccessful transfers for any packet. On first transmission effort, CntWdw is set to minimum value (Cmin). The value of CntWdw is doubled if the transmission attempt fails. The value of Cmin is, once again, set to minimum value on successful transmission. ACWSB is simulated in NS2 and it is compared with Binary Exponential Back-off Algorithm. The results illustrate improvement of ACWSB compared to that of the conventional back-off algorithm.

Keywords: MANETs; collision mitigation; contention window; ACWSB;

INTRODUCTION

MANETs is an infrastructure-less dynamic network without fixed routers. MANETs are containing a routable networking environment on top of a link layer of ad hoc network. The Figure1 illustrates the scenario of MANETs where a set of mobile nodes are connected in a wireless network environment. In MANETs, energy conservation is of primary focus for transmission power control and collision control [3][4][5].

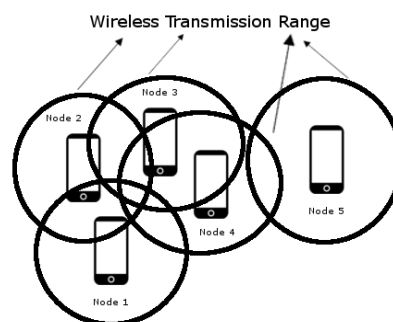


Figure 1 MANETs Scenario

PROBLEM IN EXISTING SYSTEM

The major problem in MANET is degradation in throughput because of node mobility, unreliable medium, interference and route failure. The degradation in throughput is because MANET is unable to distinguish packet loss. The packet loss occurs due to hidden node and congestion. This problem can be solved by using certain back-off scheme [3][5]. Media Access Control (MAC)[1] protocol is used to avoid collision by allowing nodes in the network to try access the channel, if one of these nodes gains access the channel while the other nodes still compete for a time period. Collision occurs in MANETs when the node chooses same value for data transmission. In Figure 2, A and B are two nodes. During the transmission of data between these two nodes, collision occurs. After receiving the collision signal, transmission is stopped from A and B. They will try to retransmit, since there is no restriction [2][6][7].

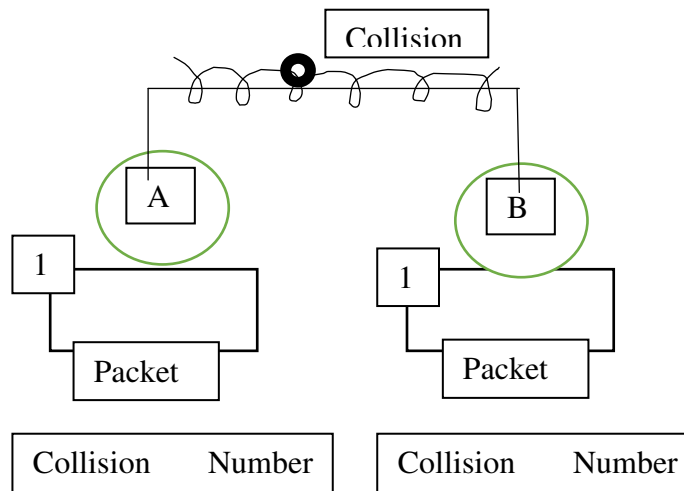


Figure 2 Collision Problem

To overcome from the problem of collision, a new Adaptive Contention Window Size Back-off scheme is proposed. ACWSB provides minimum transmission delay and maximum throughput by improving collision. This collision can be improved by certain mechanism. In the existing Binary Exponential Back-off algorithm, for every packet transmission, the back-off time value will be uniformly opted in the range between 0 and 1, whereas W is the initial contention window size. When the packet transmission is a failure or unsuccessful, the node increases the contention window size and thereby the node will be made to sense the channel for prolonged length of time. As a result of this, throughput gets decreased automatically that results in the increased average delay required for the packet delivery.

SYSTEM DESIGN

The different phases of Adaptive Contention Window Size Back-off algorithm are described in the Figure 3. Consider a node as source and another as destination node. The data is transmitted from source to destination. During the transmission it will check if channel is idle or not. If channel is idle it will transfer the packet. If channel is not idle it will wait for random back-off time. The new ACWSB algorithm is used to increase and decrease the contention window size whenever required. If acknowledgement is not received it automatically increases the size of the contention window size to the maximum allowed value. During successful transmission of packets their contention window size decreases to minimum.

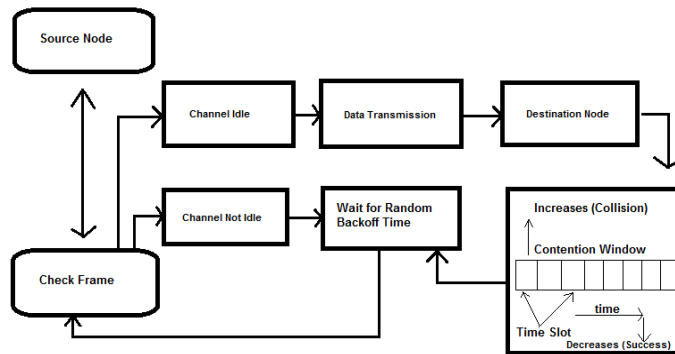


Figure 3 Overall Architecture Diagram

ADAPTIVE CONTENTION WINDOW SIZE BACK-OFF ALGORITHM (ACWSB)

Each transmitter must attempt to transmit only after confirming the channel to be idle for a time period equal to Distributed Inter-Frame Spacing (DIFS) seconds. Subsequently, after the DIFS period, the stations select a back off value for an extra adjournment time is selected based on ACWSB that is equal to an integer number of time slots of the protocol. When a transmission is detected in the channel the back off procedure stops and the transmission is resumed only after the transmission medium is idle for one DIFS period. The stations that were involved in transmission have to restart the access procedure after a collision with a DIFS period and new back off value. As a first response to collision or failure, ACWSB exponentially increases the CntWdw size. The formula for the new Contention Window (CntWdw) is in 1.1:

$$CntWdw_{new} = CntWdw_{old} * K \quad (1.1)$$

Where K is an exponential increase factor.

The steps for ACWSB is implemented as follows,

Step 1: Initially source node sends data when channel is in idle state until the destination is reached. The data transmission process consists of two states namely idle and non-idle state.

Step 2: In Figure 4 S,A,B,D are nodes where S is source node and D is destination node, This node check for idleness, if channel is in idle state, then it transfers the data to destination. If channel is not idle then it waits for random back-off time.

Step 3: When random back-off time value reaches zero it will transmit packet again to the destination.

Step 4: When the frame is correctly received, an acknowledgement (ACK) frame is sent from the receiving node to sender. If ACK is not received, the size of the contention window increased and retransmit packet again to the destination.

Step 5: During successful transmission, the contention window size is decreased to minimum.

Step 6: The size of contention window is increased exponentially by $CntWdw = CntWdw \times 4$.

Step 7: The size of the contention window is decreased by $CntWdw = \text{current value of } CntWdw / 2$ during the third attempt.

Step 8: When an acknowledgement is received, go to step1.

Step 9: Stop

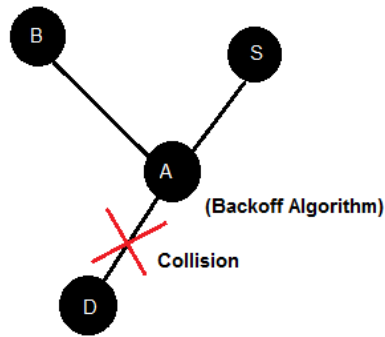


Figure 4 A Scenario of Collision Detection

The pseudo code describes the overall process of ACWSB algorithm. The node transmits only if the medium is idle for DIFS time period. The receiving node sends an acknowledgment (ACK) frame if the frame is exactly received after another fixed amount of time, which is the Short Inter-Frame Space (SIFS) period. In the scenario of busy medium for DIFS time period, to avoid the collisions with the packets transmitted by neighboring nodes, the node generates random back-off interval. In channel idleness phase every node must sense the medium, in order to check the state of the channel (idle or busy). If a node has data to send, but it finds that the channel is busy, then it waits for the end of transmission. At the end of transmission, it must wait for a DIFS. The various back off time counter status is given below,

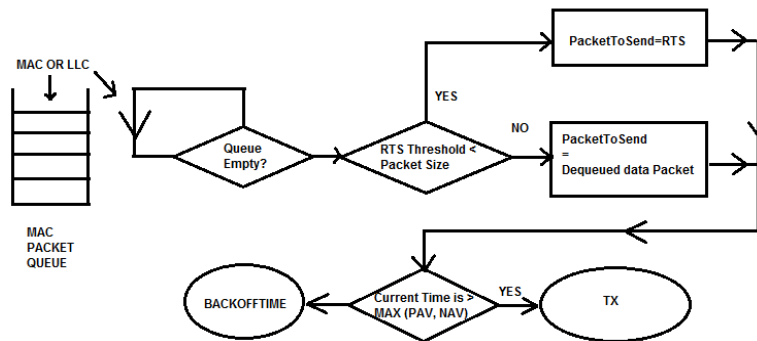


Figure 5 IDLE Procedure Finite State Representation

In Figure 5, the contention period can be determined by the ACWSB algorithm. It increments the appropriate retry counter associated with the frame. The ACWSB Mechanism is responsible for selecting a random number within a specific range (contention window) that needs to be elapsed during the idle phase of the medium. A station starts retransmission once the back-off time equals zero. In such a case, every node is made to increase the contention window by the multiplicative factor m .

In Figure 6, the contention period can be determined by the ACWSB algorithm. It increments the appropriate retry counter associated with the frame. The ACWSB Mechanism is responsible for selecting a random number within a specific range (contention window) that needs to be elapsed during the idle phase of the medium. This range is reduced to its permissible minimum value when there is a successful transmission. The random number gets incremented to its maximum allowed value whenever an attempt to transmit is postponed.

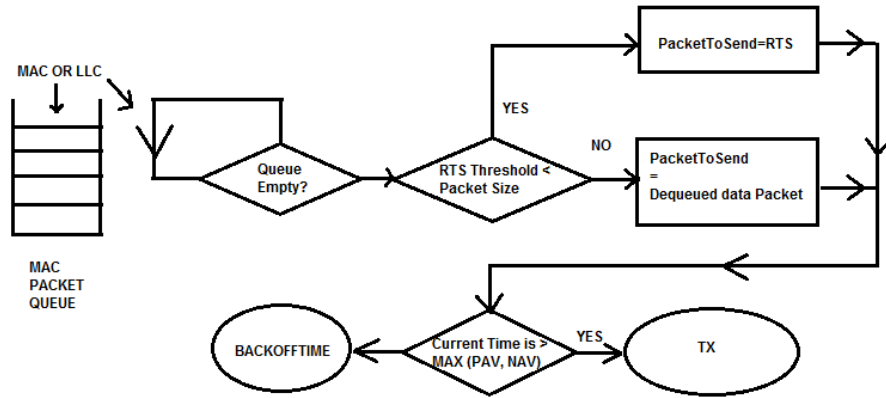


Figure 6 BACK-OFF Procedure Finite State Representations

The Figure 7 depicts the back-off procedure for finite state representation. To prevent all nodes sensing the channel from beginning of the transmission at the same time, each node chooses a random waiting time called Back-off before starting transmission. The selected Back-off value range is called the Contention Window (CntWdw). If the channel becomes busy during Back-off, Back-off counter decrementing is stopped until the channel becomes idle again. Let us consider, 'i – present back-off stage' with contention window $CntWdw(i) = 4i * CntWdwmin$.

Every successful delivered, the forthcoming back-off assign to 0 with contention window $CntWdw(0) = 31$. Collision is expected to occur at back-off stage 0 when the total number of competing nodes is large enough ($>>31$). There is good amount of chance of recent collision at the preceding stage as the main argument of 'i – present back-off stage'. In a scenario where the back-off stage is set to 0 and the number of present rival nodes are higher than or close to $CntWdw(i)$, the probability of new collision is relatively high.

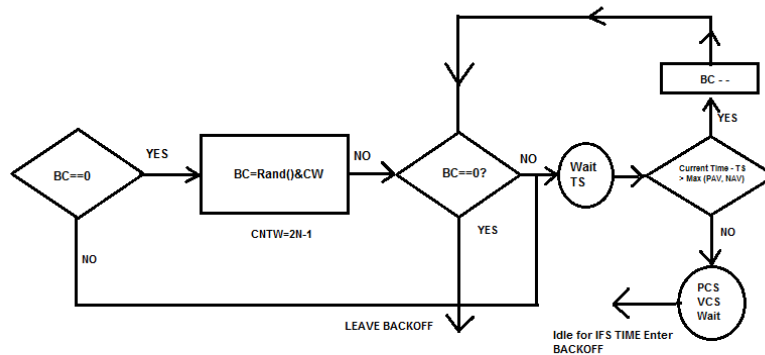


Figure 7 BACK-OFF Procedure Finite State Representations

RESULT AND ANALYSIS

Here in this work, performance comparison is done with ACWSB and Binary Exponential Back-off (BEB). This performance comparison is made by taking into the consideration the performance metrics like packet delivery ratio (PDR), Energy, Throughput. While making comparison ACWSB is proven to be highly energy conservation and efficient one than other. The characteristics of NS2 parameter like throughput, packet information, etc can be plotted using trace graph.

The packet delivery ratio (PDR) of ACWSB is gradually increased from 10.28 percent to 91.92 percent. The PDR ratio is high because ACWSB send the packets by manipulating the size of the. Finally, the end-to-end delay of ACWSB also initially increases and then it decreases. This is because of finding new routes for transmission. But once the route is idle the packets are immediately and rapidly transferred from source to destination. Thus with PDR, indicates the efficiency of ACWSB algorithm. The simulation analysis of ACWSB algorithm is achieved by considering the following performance metrics like,

- Packet delivery ratio
- Throughput
- Packet Delivery Ratio (PDR)

Packet delivery ratio

PDR can be termed as the total amount of packets received by the receiver and total amount of data packet sent by source. Then by taking into the account number of sending packets, receiving packets and routing packets the graph is plotted. Here, the packet delivery ratio gradually increases with time in ACWSB. Here, the PDR of ACWSB is 97.94%.The Figure 8 shows the packet delivery ratio between ACWSB and BEB.

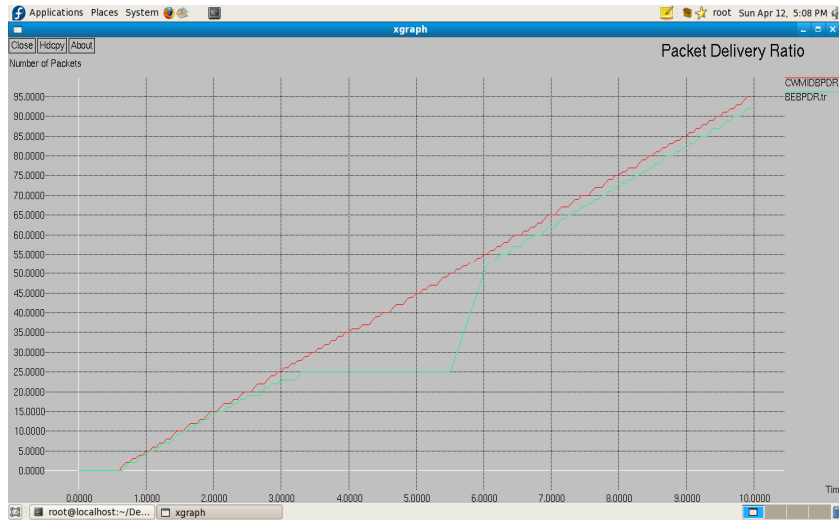


Figure 8 Packet Delivery Ratios between ACWSB AND BEB

Throughput analysis

On comparing the routing throughput by each node, it has been found that AODV has the higher throughput which corresponds to the effectiveness of a routing protocol. On comparing the ACWSB algorithm's throughput with the BEB, the former has a higher throughput. Here, the throughput ratio increases with increase in number of packets received. The Figure 9 shows the throughput comparison between ACWSB and BEB. It shows that ACWSB has high throughput than BEB. The throughput percentage of ACWSB is 97.14%

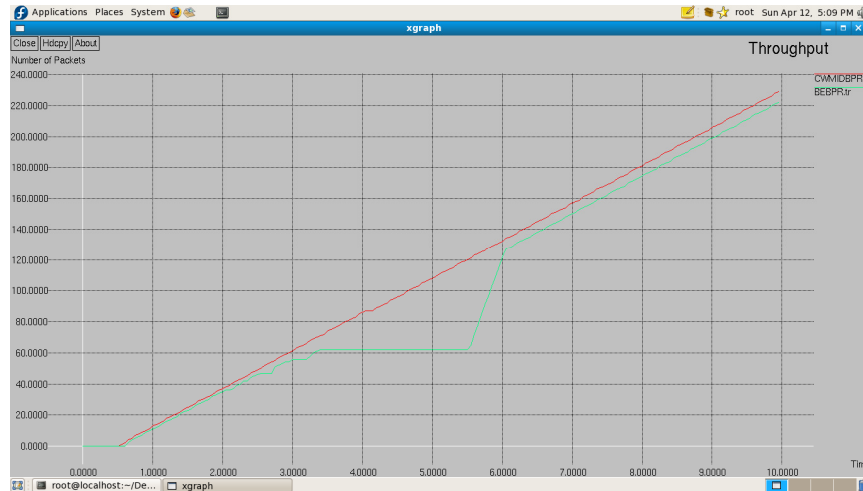


Figure 9 Throughput comparisons between ACWSB and BEB

CONCLUSION AND FUTURE WORK

In this paper, the proposed algorithm avoids channel capture and it brings down the number of collisions. After a collision, using this algorithm, the contention size will not be increased exponentially. But, it increases by four times for first collision and decreases by half for second collision and so on. The performance of the ACWSB is significantly efficient particularly when basic access mechanism is employed under high jam-packed environments as well as in Ad hoc networks. The simulation result and analysis shows that the proposed algorithm has higher efficiency with high packet delivery ratio and throughput than the Binary Exponential Back-off algorithm. ACWSB can be extended further by taking into account the data transmission among number of nodes. If number of node increases there is a slight deflection in the performance. The future work concentrates on the reduction of collision by increasing the number of nodes. Integration of modified BEB and ACWSB may produce high throughput which may help in increasing the efficiency of ACWSB.

REFERENCES

1. Aghigh Rahdar a , Mohammad Khalily-Dermanyb, "A schedule based MAC in wireless Ad-hoc Network by utilizing Fuzzy TOPSIS", *Procedia Computer Science* 116 (2017) 301–308
2. Felipe Jovel Joshua McCartney Patricia J.Teller Esau Ruiz Michael P.McGarry , "Neighbor discovery message hold times for MANETs". *Computer Communications*, 112(1), 38-46,2017
3. Tatineni Madhavi, GottapuSasi BhushanaRao., "Development of Collision Alleviating DCF Protocol with Efficient Back-off Algorithm for Wireless Ad hoc Networks". *Wireless PersCommun* (2015) 80:1791–1814.1 November 2014.
4. SasiBhushanaRao, G., Madhavi, T., "Performance analysis of collision alleviating distributed coordination function protocol in congested wireless networks - a Markov chain analysis", *IET Networks*, 2(4), 204–213. 2013.
5. Ibrahim SayedAhmad., "Modified Binary Exponential Back-off Algorithm to Minimize Mobiles Communication Time", *I.J. Information Technology and Computer Science*, 20-29, 2014.
6. Seo, S-H., Won, J., Sultana, S., Bertino, E Effective Key Management in Dynamic Wireless Sensor Networks. *Information Forensics and Security, IEEE Transactions*, Vol.10, No.2, pp.371-383,2015
7. M. Gholipour, A. T. Haghighat, and M. R. Meybodi, "Opportunistic Routing Algorithm for Relay Node Selection in Wireless Sensor Networks," *IEEE Transactions on Industrial Informatics*, Vol. 11, No. 1, Pages 112 – 121, February 2015