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Message from Associate Editor In Chief



Let me first of all take this opportunity to wish all our readers a very happy, peaceful and prosperous year ahead.

This is the Sixth Issue of the Forth Volume of International Journal of Engineering Research and General Science. A total of 38 research articles are published and I sincerely hope that each one of these provides some significant stimulation to a reasonable segment of our community of readers.

In this issue, we have focused mainly on the Innovation. We also welcome more research oriented ideas in our upcoming Issues.

Author's response for this issue was really inspiring for us. We received many papers from many countries in this issue but our technical team and editor members accepted very less number of research papers for the publication. We have provided editors feedback for every rejected as well as accepted paper so that authors can work out in the weakness more and we shall accept the paper in near future. We apologize for the inconvenient caused for rejected Authors but I hope our editor's feedback helps you discover more horizons for your research work.

I would like to take this opportunity to thank each and every writer for their contribution and would like to thank entire International Journal of Engineering Research and General Science (IJERGS) technical team and editor member for their hard work for the development of research in the world through IJERGS.

Last, but not the least my special thanks and gratitude needs to go to all our fellow friends and supporters. Your help is greatly appreciated. I hope our reader will find our papers educational and entertaining as well. Our team have done good job however, this issue may possibly have some drawbacks, and therefore, constructive suggestions for further improvement shall be warmly welcomed.

Er. Pragyan Bhattarai,

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MRI Classification Using fuzzy membership

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ABSTRACT- MRI classification has proven to be useful in many science fields mainly because of its tight association with human healthcare where research has been focused in the past decade. This paper will discuss the classification of brain tumors MRI and classify them using Fuzzy logic into two classes depending on the type of tumor while taking into consideration the two cases of the tumor being malignant or benign. Using these four input membership functions, the system concludes an output, (Area of the segment), (segment color variance) as well as the location of the segment in the MRI by using the two input membership functions (Upper left) and finally (Lower Right). The outputs are used by the system to produce one result and eventually come up with a final decision that the MRI classification is based on.

To measure the system's efficiency, the results were compared to a radiologist diagnosis and were found to be 100% identical in all the experiments in which the cases were diagnosed by both the system and the radiologist.

Keywords: Segmentation, Fuzzy logic, MRI, Feature, FM

INTRODUCTION

Image classification is the second important step after segmentation; any image analysis must go through image segmentation first to extract the useful information from the image. Then these useful information must be classified into decisions the segment is being clarified according to the previously extracted information in this paper the features are the area of the segment which represent the white matter in the MRI that is considers the tumor, other features collected from image is that position of the tumor and color variance. Each study is different from each other when sometimes we need to find the darkest spot, edges, boundaries, lighter spots, lines or curves etc [1].

There are so many studies on cancer MRI in general and on brain cancer in particular the aim of these studies most of the time is to find cure or to know the reason of this fatal disease till these days the progress is very weak therefore this studies should keep going. This paper is to implement a system that helps the doctors and physicians to give a critical diagnose about the type of tumor. Brain tumors is on the top of the worst type of cancer list regarding to the critical location, this type of cancer came as tumor take place in the brain tissue or the surrounding area [2][3].

This paper introduce several memberships to obtain the optimal classification since it is a critical topic involving human health and after the process of segmentation methods and the method that being used. In this paper a classification method will be proposed to classify the tumor wither its benign or malignant to obtain the best result so the patient will have some kind of therapy or surgical interference [2].

IMAGE CLASSIFICATION [1]

Digital images obtained a very high place in all sciences, classifying images regarding to what type of data they carry very important that will make retrieving image a lot easy along with storing and study them. Classifying image is also useful to help the researchers to develop their work and extract useful information from the images, classifying image mostly about study pixels and categorize them in digital images. That means categorize data according to the spectral of the land cover in an image. Most of the time multispectral data are being used to perform the classification then, the spectral pattern is presented in each data pixel that used as a numerical basis for categorizing the advantage of classifying digital images is to identify and describe as a very identical gray level or colored feature in the digital image [13].

The most important thing about digital image analysis is that classification in common perspective people love to store a beautiful image without knowing anything about it but that means nothing without knowing that each image showing a magnitude of many colors that form the image and there useless. If didn't know what do these colors mean, there are two main classification for digital images that are described in the next section [1].

CLASSIFICATION USING FUZZY SYSTEM

Fuzzy logic and fuzzy set of theory give multi solutions to the mathematical morphology algorithm regarding processing the gray scale images. It's the group of all methods that understand process and represent digital images. For their segments and also their features as fuzzy sets that representation depends on the technique of fuzzy logic that been selected and also depend on the problem to be solved, fuzzyfication of an image data (coding) and defuzzification (decoding)

THE PROPOSED FIS FOR DIAGNOSING BRAIN TUMOR

In this the section, the proposed approach for diagnosing brain tumor using FIS technique has been discussed in more details. The general block diagram of the proposed FIS is shown in figure (1). This system includes four input MFs and single output MF.

FUZZY LOGIC IMPLEMENTATION

The proposed classification system for diagnosing the MRI images is fussy system; the input parameter for the algorithm is four parameters area, upper location, lower location and the color variant of the segment, a four membership function used to give the decision

whether the tumor is benign or malignant the input of the member ship function was the results collected from the segment using the five step mentioned previously. The output is the decision either malignant or benign.

Algorithm Diagnosing Brain Tumor based on Fuzzy Inference System
Input : 4 parameter Area , Variance Color, Percentage of Brain Tumor Position in Up , Down, Right , and Left Side
Output: Decision
BEGIN Step1: if (Input1 is not Variance) and (Input2 is not Area) and (Input3 is MinDownLeft) and (Input4 is MaxUpRight) then the MRI segment is Benign Step2: if (Input1 is Variance) and (Input2 is Area) and (Input3 is not MinDownLeft) and (Input4 is not MaxUpRight) then the MRI segment is Malignant END

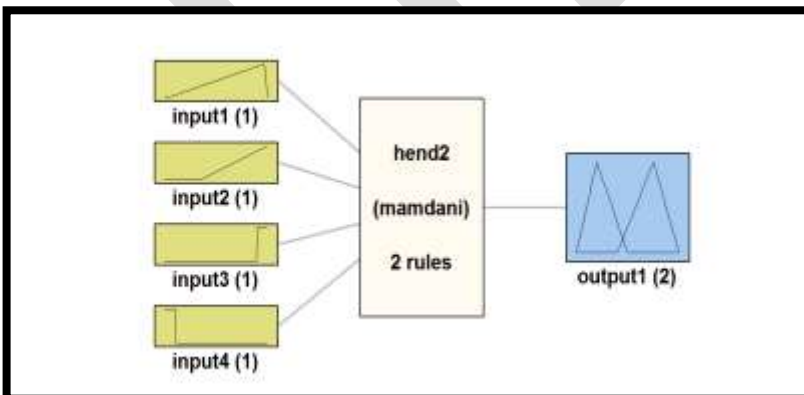


Figure 1: The General Block Diagram of the Proposed FIS for Diagnosing Brain Tumor.

The first input MF (input 1) is of triangular type which represents the variance color in tumor region. The structure of this MF includes three parameters (starting, middle, and end point). The desired values for these parameters in this MF are (500, 29000, and 30000), respectively as shown in Figure (2). The values of middle and end point are selected high because the determined values of variance color in many patients that are annotated by expert radiologists as a Malignant brain tumor are high (exceeds 22000), while the corresponding criterion in Benign brain tumor is low (less than 450), therefore the desired value of starting point in this MF is 500 which is slightly larger than lower limit of Benign patients [5].

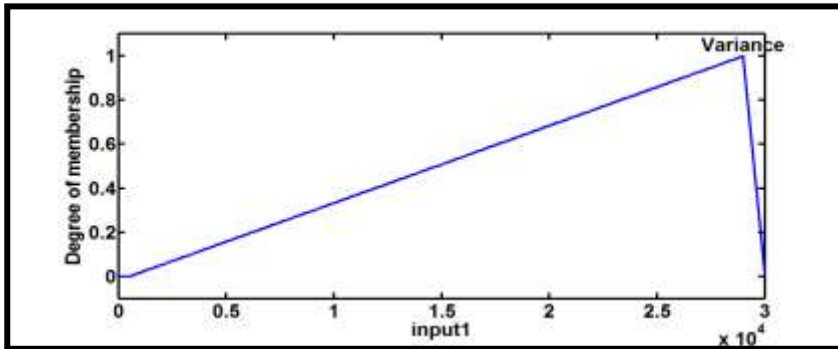


Figure 2: The Graphical Diagram of the first Input MF for the Variance Color in the Extracted Tumor Region.

Similarly, the second input MF take the same type of first input MF, but of course the desired parameters are different. This MF represents the area of the extracted shape that forms the tumor region. The simulation results of area for the tested patients show that the average value of area exceeds (8) for the Malignant cases, while the corresponding average value for Benign cases is about (7). Thus the desired parameters (start, middle, and end) point for this MF are (7, 20, and 20), respectively. The start point is selected to 7 to aggregate all area values above this threshold as a malignant patient while all values less than this threshold as a benign patient. The graphical structure for this MF is shown in Figure (3).

The third and fourth input MFs in the proposed FIS takes trapezoidal types which are different from the triangular type in first and second MF. This MF has four parameters; first and second parameters represent the limits of left side in MF while the third and fourth parameters represent the limits of right side in trapezoidal MF.

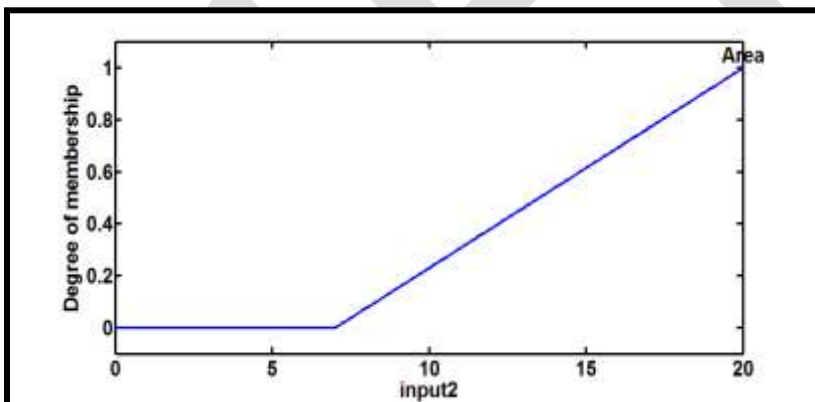


Figure 3: The Graphical Diagram of the second Input MF for the Area in the Extracted Tumor Region.

The third input MF represents a combined value which is determined from the left and down limits of tumor region that is extracted by the proposed diagnosing approach. The minimum value of left and down limits is the conditioning value in the 3rd input MF in the proposed FIS shown in Figure (1). The graphical diagram of this MF is shown in Figure (4). The desired parameters of this MF are (90, 90, 100, and 100). The simulation results of the combined value (minimum of the left and down side in tumor region) not exceed 90 in most Malignant patients, while the same combined value is greater than 90 for Benign patients. Thus the first and second parameters of 3rd MF in the proposed FIS take the same threshold value (90).

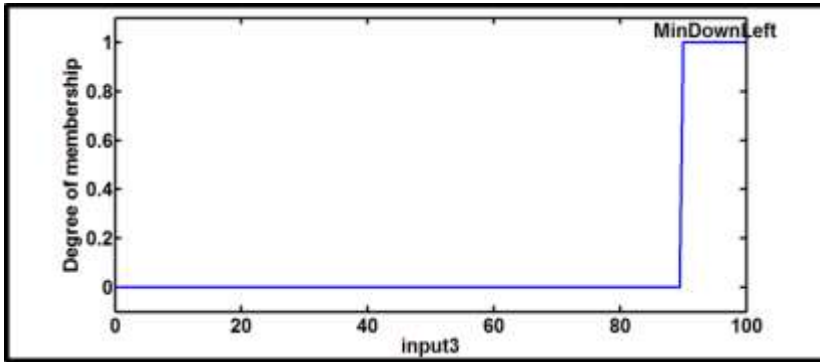


Figure 4: The Graphical Diagram of the third Input MF for the Combined Minimum Value of the Left and Down Side in Tumor Region.

The fourth input MF takes the same type of the third input MF except that the combined value that is determined is the maximum value of Right and Up sides in extracted tumor region. The desired parameters of this MF are (0, 0, 10, and 10). The aggregation value in this MF is the 3rd and fourth parameters (10), because most Malignant patients exceeds this threshold while the same combined value in Benign patients take a value less than this threshold. The graphical diagram of this MF is shown in Figure (5).

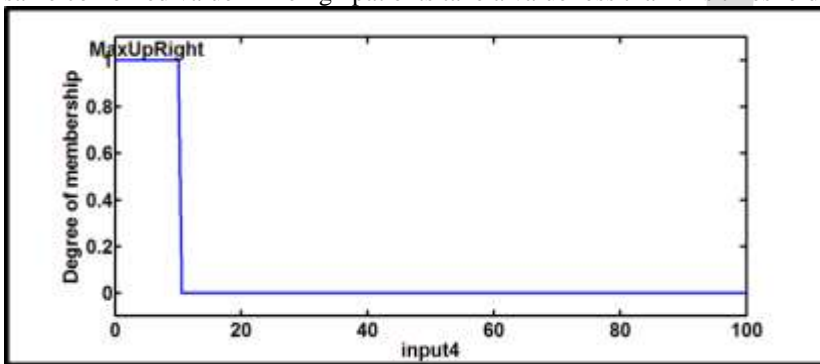


Figure 5: The Graphical Diagram of the fourth Input MF for the Combined Maximum Value of the Right and Up Side in Tumor Region.

The proposed FIS approach includes one output MF. This MF constructs from two sub-MFs, each one takes a trapezoidal type. As mentioned in first and second MFs, this type of MF has three parameters. The desired parameters of the first sub-MF marked with Benign are (-1 -0.6 0) and the parameters of the 2nd sub-MF marked with Malignant are (-0.19 0.5 1). The intersection point between these sub-MFs locates at (-0.5). Thus, the (-0.5) value represents the effective threshold to classify between Benign and Malignant. The graphical diagram of the output MF is shown in Figure (3.6).

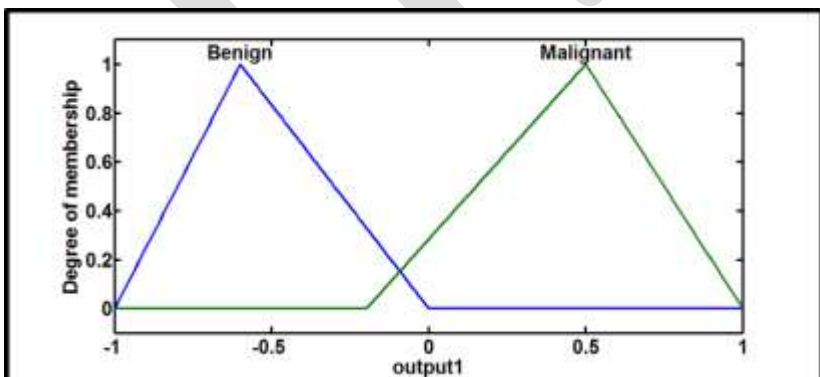


Figure 6: The Graphical Diagram of the Output MF for the Proposed FIS Approach Using Two Sub-MFs.

DIAGNOSIS RESULTS USING PROPOSED FIS MEMBERSHIP FUNCTION

In this section, the results of Brain Tumor diagnosis which are obtained by the proposed (Fuzzy Inertias System) FIS for some patients are presented. The structure design of the proposed FIS illustrated in Chapter three is implemented using fuzzy graphical user interface (GUI) editor by a MATLAB environment. One MRI case for brain tumor patients were selected and tested as the validation data in this implementation. MRI of patient (BRATS_HG0001) were selected and pre diagnosed with Malignant Tumor. Another patient (BRATS_HG0012) was selected and pre-diagnosed with Benign Tumor. The final diagnosis in the proposed FIS takes the form of activating one output MFs based on the conditional results of fuzzy rules that are considered in the proposed FIS. Moreover, the results of these rules are varied according to the desired entry values by input brain tumor patient.

One output MF with two sub- MF s is considered in the proposed FIS, the first is Benign, which denotes the decision of benign diagnostic for the tested brain tumor; the second is Malignant, which denotes of malignant diagnostic for the tested brain tumor.

In the 1st brain tumor patients (BRATS_HG0001), the first input MF Input1 which represents variance of colors in the brain tumor region and the second input MF Input2 which represents the area of the segment activated, while the third input MF Input3 which represent minimum color value in the left and down halves in the brain tumor region are not activated as shown in the rule viewer diagrams in Figure (7). According to these output MFs results, the final diagnosis is malignant brain tumor.

The concept of having the final call which determines case type is to have one input at a time and see the result then comparing with other input result with the pre-diagnose images that collected from the radiologist the final output the same for both system and doctor if we use the same slice number that we fixed before.

In the second image case (BRATS_HG0012), the first input MF Input1 which represents variance of colors in the brain tumor region and the second input MF Input2 which represents the area of brain tumor are not activated, while the third input MF Input3 which represent minimum color value in the left and down halves in the brain tumor region are activated as shown in the rule viewer diagrams in Figure (8). According to these output MFs results, the final diagnosis for the MRI segment is malignant brain.

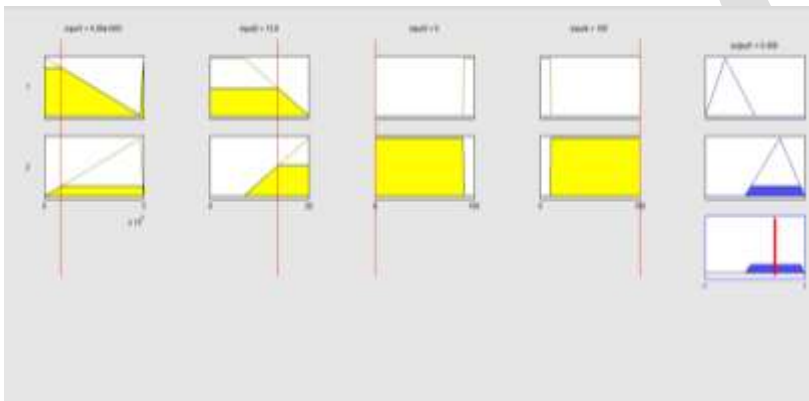


Figure (7) Generated Rule Viewer Diagram by Proposed FIS on BRATS_HG0001

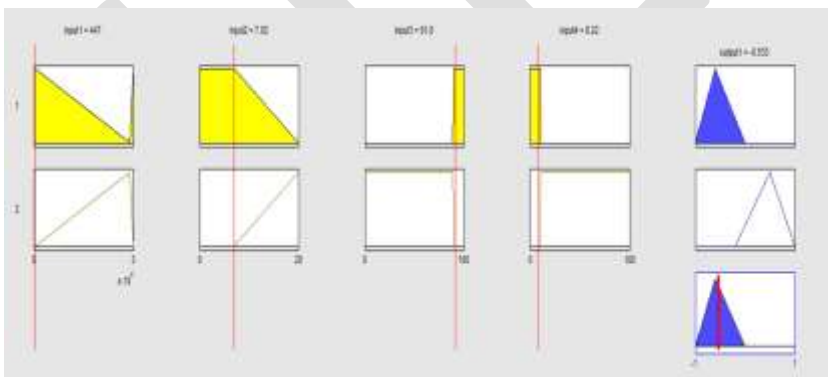


Figure (8) Generated Rule Viewer Diagram by Proposed FIS on BRATS_HG0012

CONCLUSION

This paper describe classification tumors MRI using the fuzzy role result shows the classification depend on the area of the segment and color variation, classification performed using MATLAB software.

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DESIGN OF LOW POWER DIGITALLY OPERATED VOLTAGE REGULATOR BY USING CMOS TECHNOLOGY

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Abstract.- As portable electronic devices become a part of daily life, it creates a huge market for electronic components for those battery driven devices. Low-power digitally operated (LPDO) voltage regulator is an important part that provides steady DC supplies for other components. Low power, low noise and high stability are the desired features of a regulator.

Here, A Low-Power Digitally Operated (LPDO) Voltage Regulator that can operate with a very small Input-output Differential Voltage with 32nm CMOS technology has been proposed. It increases the Packing Density and provides the new approach towards power management.

A voltage regulator is capable of providing 0.8V output under the supply voltage of 1.2V and the output voltage level is controlled externally by means of 2 1-bit control signals.

Keywords: Low Drop-Out, Voltage Regulator, Power management, Reduction in chip Area.

1. INTRODUCTION

A programmable Low power digitally operated voltage regulator has become an essential part of portable electronic devices that provide steady DC supplies for other components. LPDO operates over a very small input output differential voltage. In this, voltage regulator capable of providing 0.8v output has been proposed. where low power dissipation, low noise and high efficiency are the desired characteristics.

Voltage regulators can be divided into two main categories: Linear Voltage Regulators (LVR) and Switching Mode Power Converters (SMPC). SMPC is restricted in the use of portable electronic devices, because of its high cost, high output voltage ripple and noise. whereas, LVR shows the characteristics of very small output voltage ripple, compactness, and low output noise. Low power digitally operated Voltage (LPDO) Regulator presents the lowest dropout voltage and highest power efficiency. However, frequency response of the LPDO system highly depends on load conditions.

Low power digitally operated voltage regulators are the circuit, design to provide a specified stable DC voltage, with low input to output voltage difference. Dropout voltage of regulator is the value of differential voltage at which regulation provided by control loop stops. Minimization of dropout voltages is essential for maximizing dynamic range of PMOS circuit. The low drop out voltage regulator is programmable and offers a range of four different voltages by means of two binary input control signals at its input. The entire circuit has been design by using 32nm CMOS technology by using the Microwind 3.1 tool.

SCOPE OF WORK

The objective of this project is to enhance performance of low power digitally operated voltage regulators for battery powered electronics. a low power digitally operated (LPDO) voltage regulator can operate with a very small input-output differential voltage with 32nm CMOS technology. It provides new approach towards power management.

I. LOW POWER DIGITALLY OPERATED VOLTAGE REGULATOR

The supply voltage of a system-on-chip (SOC) is generally generated from an external supply voltage. In this block diagram, the external supply voltage level is converted to another level with a switching DC-DC converter to obtain a high power efficiency. But at the output of DC-DC convertor we get large ripple. Hence to avoid this ripple noise LDO regulator is inserted in the circuit and output of LDO regulator is given to the load.

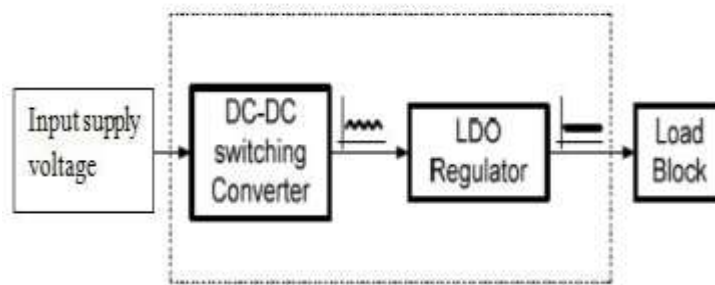


Fig. 1: General block diagram of a LDO with a load

II. SPECIFICATIONS OF LPDO VOLTAGE

1. REGULATION

Low power digitally operated (LPDO) voltage regulators work in the same way as all linear voltage regulators. The main difference between LPDO and non-LPDO regulators is their schematic topology. Instead of an emitter follower topology, a low-dropout regulator uses open collector or open drain topology. This enables transistor into saturation region. If a bipolar transistor is used, additional power may be lost to control it, whereas non-LPDO regulators take that power from voltage drop itself. Power FETs may be preferable to reduce power consumption, but this FET's may give problems when the regulator is used for low input voltage, as FETs generally require 5 to 10V to close completely. And It can also increase the cost of a design.

2. PROPOSED REGULATOR ARCHITECTURE

In this, we are proposing LPDO voltage regulator which will be as compact as possible. The 32nm CMOS technology will provide new approach towards power management. In our architecture, a current-sourcing PMOS in the output stage has been introduced. It is required that the PMOS get pulled to ground so as it get further biased into saturation region. For this reason, the present topology is modified and a common source stage is added. The common-source stage is responsible for enhancing signal swing and boosting. The two gate inputs provided to the proposed LPDO architecture will make the device programmable. Two bit binary values are given to the gate inputs. The variation of the output with respect to these inputs will be as depicted in the following table.

BINARY INPUT	OUTPUT VOLTAGE (V)
00	0.7V to 0.8V
01	0.6V to 0.7V
10	0.6V to 0.7V
11	0.8V

Table 1: Variation in input and output

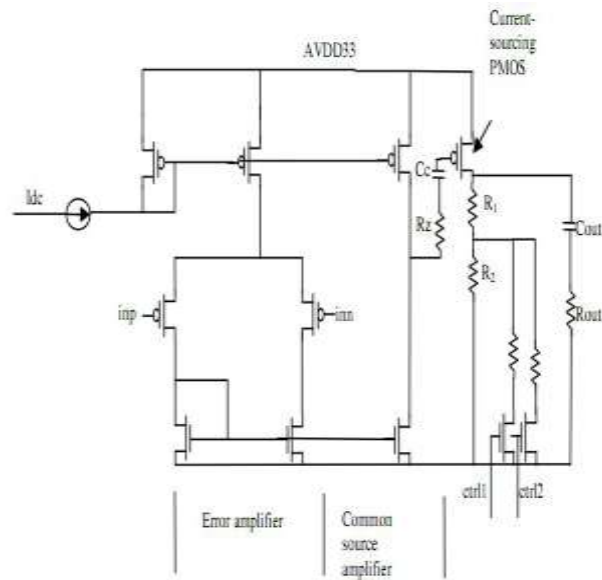


Fig 2: Circuit diagram of proposed regulator

The proposed architecture divided in three different stages:

1. Error Amplifier
2. Common Source Amplifier
3. Current-sourcing PMOS

1. ERROR AMPLIFIER

In this, A high gain operational amplifier is used as the error amplifier, with a stable voltage reference is given as a input to the amplifier. The voltage reference is usually obtained from a band gap reference circuit. It provides load which has the advantage of providing high output impedance and consequently high gain.

2. COMMON-SOURCE AMPLIFIER

In general, a source follower is used as the buffer stage in most LPDO's. The source follower has asymmetric current driving capability, and it provides gain less than one. Hence a common-source amplifier is used, which has a small signal gain equal to

$$A_v = g_m(r_{o1} \parallel r_{o2})$$

where g_m is the transconductance of the amplifying device, r_{o1} and r_{o2} are the output resistances of the load and the amplifying device.

3. CURRENT-SOURCING PMOS

The current-sourcing PMOS is responsible for quick charging and discharging of output node. In this, PMOS with high thresholds voltage is used. Because, low-voltage threshold FET's are known to contribute to leakage currents, and increases the power dissipation in the device.

The schematic view of proposed regulator architecture is given below.

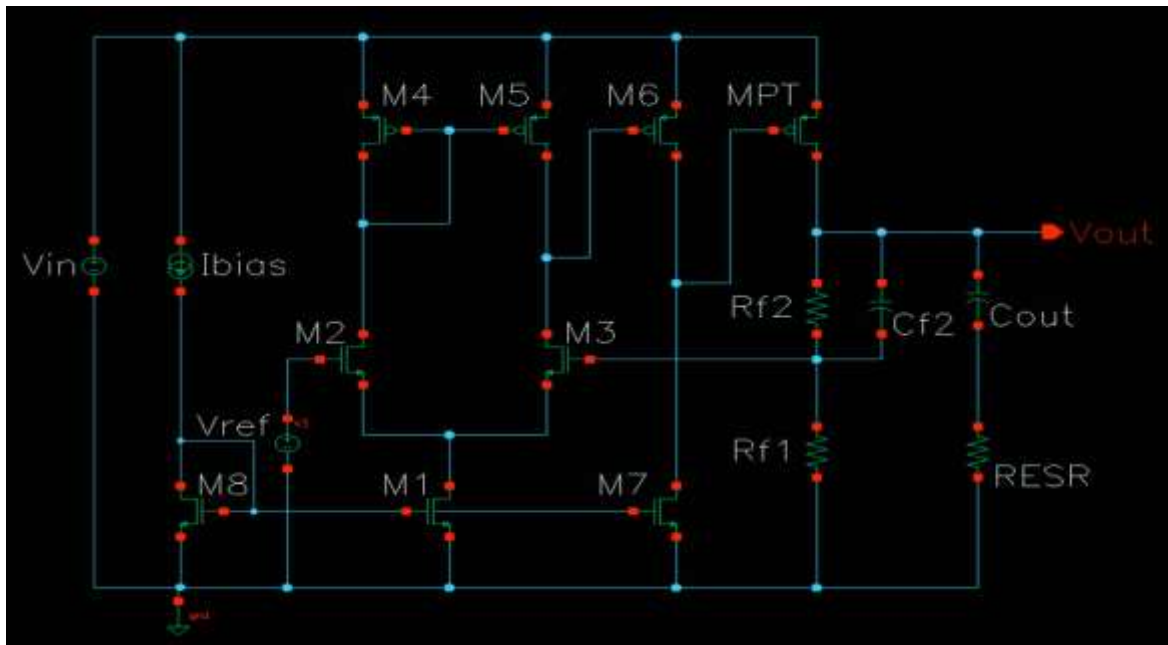


Fig. Schematic views of proposed LPDO regulator

On the basis of this schematic view of LPDO voltage regulator, the proposed regulator is designed by using 32nm technology in vlsi. this design is given as below.

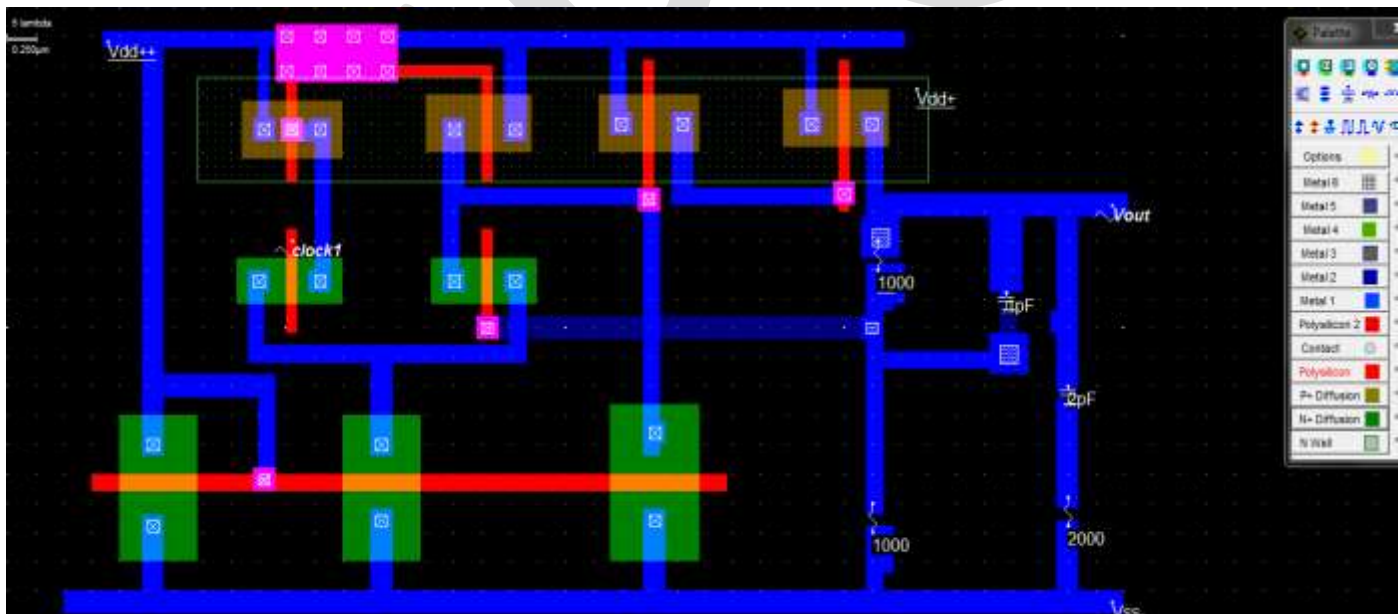


Fig. VLSI design of proposed LPDO regulator.

The design specification of that proposed LPDO is:

CMOS Technology	32nm
Power supply voltage	0.35v,1.20v

Area of complete chip	8.2um ²
Width of complete layout	4.4um
Height of Layout	2.0um
No of PMOS	3
No of NMOS	5

After simulation of that LPDO design, we get the voltage waveform which is as follows.

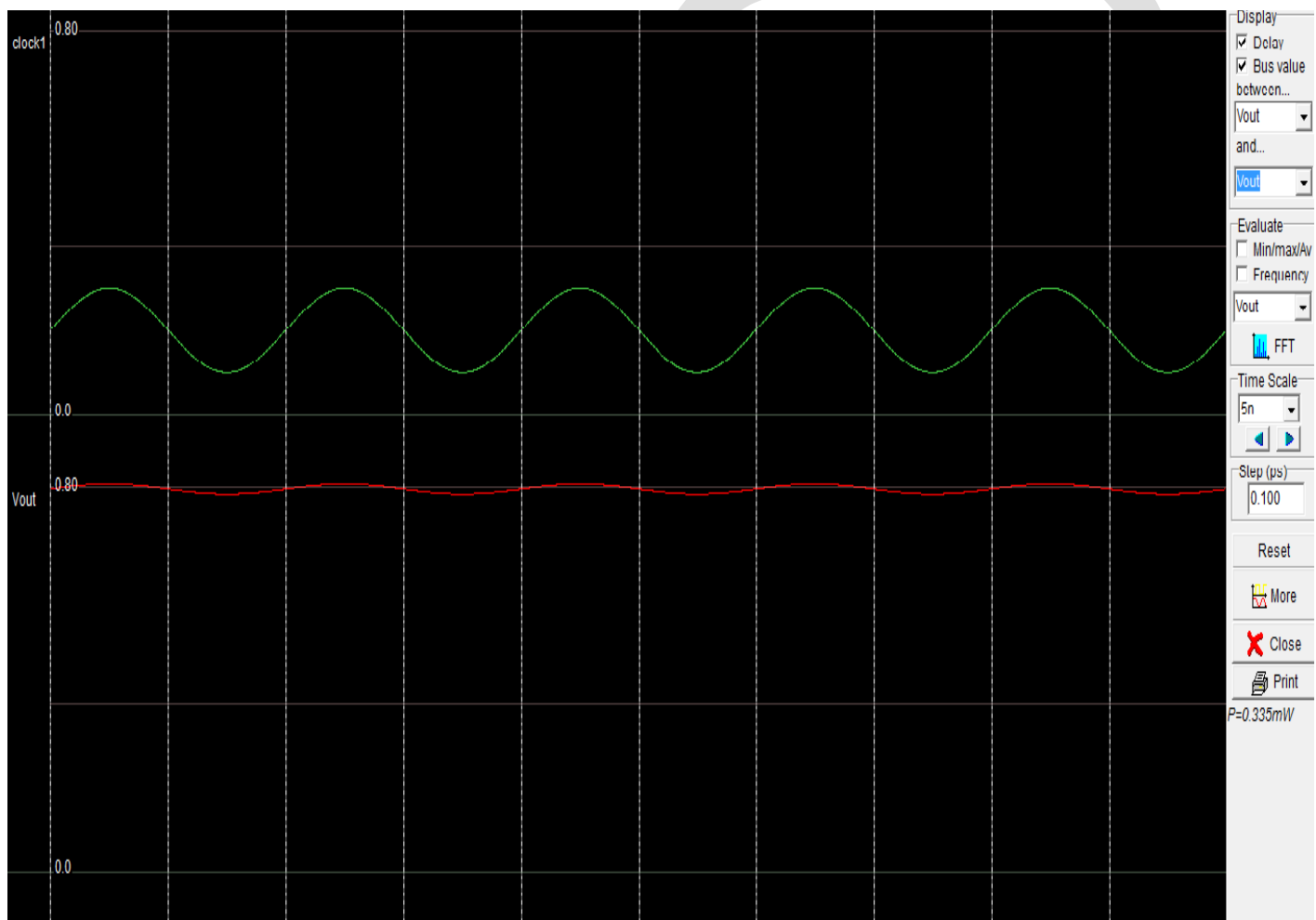


Fig. Output waveform of LPDO regulator

As shown in above waveform, we get the 0.8v voltage at the output end for the given input of 1.2v.

As, different devices required different voltage levels .for that reason, we decide to make our device programmable at the output. In that case, the output voltage level is control externally by using 2 1-bit control signals and we will get 4 different voltage levels.

2. LITERATURE REVIEW

From the rigorous review of related work and published literature, it is observed that many researchers have designed Low Power Digitally Operated Voltage Regulator by applying different techniques.

Gabriel Alfonso Rincon-Mora and Philip E. Allen,[1] was studied and designed a low drop out voltage regulators, and published a paper, which discusses thoroughly the important issues relevant to the design of a LDO circuits. The paper further illustrates the design criteria corresponding analysis relevant to LDOs.

R. Jacob Baker, Stuart K. Tewksbury and Joe E. Brewer,[2] had worked on CMOS Circuit Design, Layout and Simulation.

Vincent Lixiang Bu[3] had worked and studied the CMOS Capacitor less Low Drop-Out Voltage Regulator. In this paper, a 3-5V 50mA CMOS low Drop-out (LDO) linear regulator with a single capacitor of 1pF is presented.

Robert J. Milliken, Jose Silva-Martínez,[4] had studied and presented a paper on Full On-Chip CMOS Low Drop Voltage Regulator. This paper proposes a solution to the bulky external capacitor low-dropout (LDO) voltage regulators with an external capacitor less LDO architecture.

Xinquan Lai And Donglai Xu[5] had studied An Improved CMOS Error Amplifier Design for LDO Regulators in Communication Applications. In this paper, A new CMOS error amplifier, which is primarily used in LDO regulators for communication applications, was presented.

4. PROBLEM DEFINITION

CONVENTIONAL LDO BLOCK DIAGRAM

Low-drop out regulators is one of the most conventional applications of operational amplifiers. Figure3 shows the basic topology. A voltage reference is used with the op-amp to generate a regulated voltage Vreg. and the variation in the gain is desensitized using feedback and makes the regulated voltage stable. The ideal voltage regulator is as shown below.

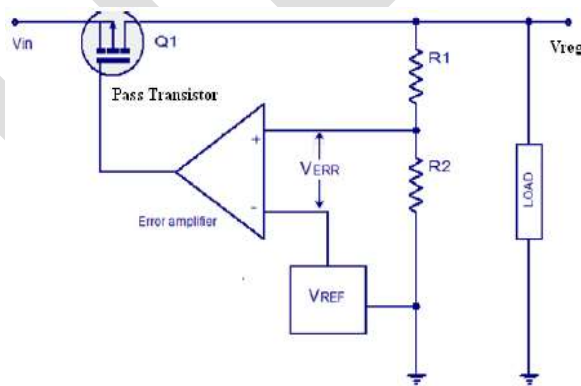


Fig. 3: Conventional LDO

4. RESEARCH METHODOLOGY

To achieve the low drop out regulator, different methodology and techniques can be used for design. The program MICROWIND3.1 allows designing and simulating an integrated circuit at physical description level. It contains a library of analog ICs, metals and different logic to view and simulate the circuit. MICROWIND 3.1 includes all the commands as well as required tools which never present before in a single module. We can simulate the circuit only by pressing single key. The simulation of circuit is automatically performed and it produces voltage and current curves immediately. considering the advancement of future technology and the advantage of 32nm technologies over 90 and 65nm technology, the proposed project has been decided to do with the selection of lower order of nm technology. The proposed LPDO is designed using 32 nm CMOS/VLSI technology in MICROWIND 3.1.

32 nm CMOS technology has advantages as:

- Increase in switching performance
- Reduction in power management
- It gives 2 times higher density
- Reduction in leakage current
- Minimize the area of a chip

5. IMPLICATIONS

We have designed a low power digitally operated voltage regulator that is capable of providing a very small output of 0.8v. this is the 50% of our total work. now, further we will make this voltage regulator programmable..The design provides a 30 dB gain. In this, input is given nearly 1.2v and the output we get 0.8v. total circuit is design by using MICROWIND 3.1 CMOS technology.

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PERFORMANCE OF PARTIAL REPLACEMENT OF FINE AGGREGATE WITH QUARRY DUST AND CEMENT WITH FLYASH ON SELF COMPACTING CONCRETE

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ABSTRACT: Self-compacting concrete (SCC) is a flowing concrete that spreads through congested reinforcement, fills every corner of the formwork, and is compacted under its self weight. SCC requires excellent filling ability, good passing ability, and adequate segregation resistance. The present study focuses on utilization of quarry dust and fly ash in SCC as a partial replacement of fine aggregate and cement respectively. In this project, work done on experimental study on fresh and hardened properties such as flow ability, passing ability, compressive, tensile and flexural strength of M40 grade of SCC. In this investigation SCC was made with partially replacing fine aggregate with quarry dust and cement with fly ash.

INTRODUCTION:

In this investigation SCC was made with partially replacing fine aggregate with quarry dust and cement with fly ash. Six mixes with different percentages of quarry dust (0%, 10%, 20%, 30%, 40% and 50%) as partial replacement for sand 30% of fly ash as partial replacement for cement is considered. For each mix workability and hardened tests are carried out respectively. The test results for hardened properties are carried out at 3, 7, 28 days respectively. The results obtained regarding the possibility for obtaining the SCC using quarry dust and fly ash, and also studied its variation in strength properties for different percentages of quarry dust. Concrete that flows and settles due to its own weight without segregation and bleeding are called SCC. In recent years SCC has gained wider applications as it reduces the time period of construction. In SCC, no vibration is required for the compaction. It flows like "honey" and after placing it has a very smooth surface. SCC and NVC consists of the same constituent elements namely cement, aggregates and water, with the addition of chemical and mineral admixtures in varying proportions. SCC mixes usually contain super plasticizer in form of high range water reducer (HRWR) and viscosity modifying additive (VMA). In the SCC use of super plasticizers (HRWR) maintains the fluidity; VMA provides stability of the mix, resulting in high resistance against bleeding.

Comparison Of NC and SCC:

- Normal concrete cannot reach every hook and corner of the structures while this provision can be satisfied by self compacting concrete. Smooth finish can be obtained without any external equipment. For the purpose of the normal concrete this is not possible.
- In terms of the hardened properties, at similar water/cement ratio, properly proportioned, produced and placed SCC is generally denser and less variable than the equivalent conventional vibrated concrete, thereby resulting in improved strength and durability performance.

METHODOLOGY:

The methodology adopted for experimental work includes

- Mix proportioning for SCC to achieve high flow ability without segregation and bleeding using chemical admixture and fly ash.
- Quarry dust as fine aggregate will be used, in different dosages to study the flow ability and strength of the mix proportions.
- Slump flow test, V-Funnel test and L-Box test will be conducted to find out the ability to pass, ability to fill and resistance to segregation of SCC.
- The test results will be compared with the limits of European standards recommended by EFNARC.
- Hardened concrete tests will be conducted to determine the strength characteristics of SCC.

Testing methods for workability properties Of SCC :

Sl.	Method	Property
1	Slump-Flow	Filling ability
2	T _{50cm} Slump Flow	Filling ability
3	V-Funnel	Filling ability
4	V-Funnel At T _{5minutes}	Segregation resistance
5	L-Box Passing	Passing ability
6	U-Box Passing	Passing ability

Testing methods for hardened properties Of SCC :

Sl.	Method	Property
1	Compressive strength	Compressive strength
2	Split tensile strength	Tensile strength
3	Flexural strength	Flexural strength

ACCEPTANCE CRITERIA FOR SCC:

These typical requirements shown each test method are based on European code SSC specification and practice

Sl.	Method	Unites	Typical Range of values	
			Minimum	Maximum
1	Slump-flow by Abrams cone	mm	650	800
2	T _{50cm} slump flow	sec	2	5
3	V-funnel	sec	6	12
4	V-funnel at T _{5minutes}	sec	0	3
5	L-box Passing	(h ₂ /h ₁)	0.8	1.0
6	U-box Passing	(h ₂ -h ₁)mm	0	30
7	J-ring Passing	mm	0	10

EXPERIMENTAL PROGRAMME:

➤ MATERIAL PROPERTIES

• CEMENT:

The Cement used was Jaypee Ordinary Portland Cement (OPC) of grade 43 conforming to IS: 8112-1989. The various laboratory tests confirming to IS: 4031-1996 (PART 1 to 15) specification was carried out .

• FLY ASH AS CEMENTESIOUS MATERIAL

Fly ash samples taken from NTPC Visakhapatnam are used in this study. Fly ash was not processed and, used as received. The sample satisfied the requirements of IS 3812(Part I).

PHYSICAL PROPERTIES OF CEMENT AND FLY ASH :

Sl no.	Physical Properties	Observed value for cement	Observed values for fly ash
1	Specific Gravity	3.14	2.2
2	Initial Setting (minutes)	38 min	45 min
3	Final Setting (minutes)	600 min	280 min
4	Consistency (%)	30%	35%
6	Fineness	9.25%	31.5%

FINE AGGRIGATES:

Property	value
Specific gravity	2.63
Fineness modulus	2.60
Water absorption	2.56

QUARRY DUST:

Specific gravity	2.75
Water absorption	0.85%

COARSE AGGREGATE:

Test property	Natural coarse aggregate
Specific gravity	2.87
Water absorption	0.25%

CHEMICAL ADMIXTURE:

Poly carboxylic ether based super plasticizer with viscosity modified admixture with a brand name of Master Glenium SKY 8630/8632 was used in the present research work. Master Glenium SKY 8630/8632 is an admixture of a new generation based on modified Poly carboxylic ether which produces Self Compacting Concrete with inbuilt Viscosity Modifying admixture.

Aspect	Light brown liquid
Relative density	1.08 ± 0.01 at 25°C
pH	≥ 6 at 25°C
Chloride ion content	$< 0.2\%$

Mix-design :

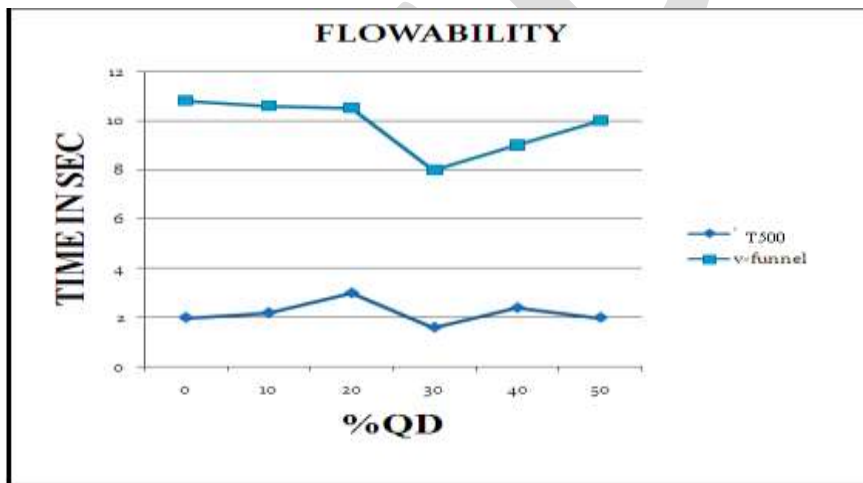
Mix proportion M40

Mix no	Cement(kg)	% fly ash	%QD replaced	QD(kg)	W/B ratio	CA(kg)	FA(kg)	Water(lit)	% admixture
1	270	30	0	0	0.36	1017.2	925.3	168	5.94
2	270	30	10	98.36	0.36	1017.5	832.8	166.3	5.94
3	270	30	20	196.82	0.36	1017.5	740.2	164.7	5.94
4	270	30	30	295.27	0.36	1017.5	605.5	163.12	5.94
5	270	30	40	393.7	0.36	1017.5	555.26	161.5	5.94
6	270	30	50	492.3	0.36	1017.5	461.7	160.4	5.94

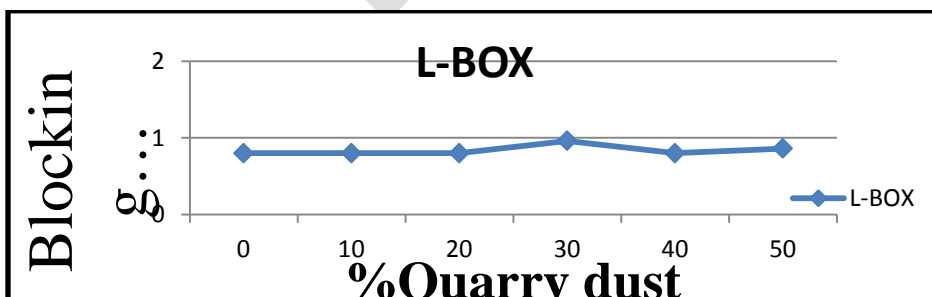
RESULTS AND DISCUSSIONS:

• Workability Test Results

Mix no	% QD	slump flow test (t in sec)		L value(h_2/h_1)	v (t in sec)
		500mm	700 mm		
1	0	2	4	0.8	10.8
2	10	2.2	6	0.8	10.6
3	20	3	8.6	0.8	10.5
4	30	1.6	7.8	0.96	8
5	40	2.4	11.5	0.8	9
6	50	2	9	0.86	10



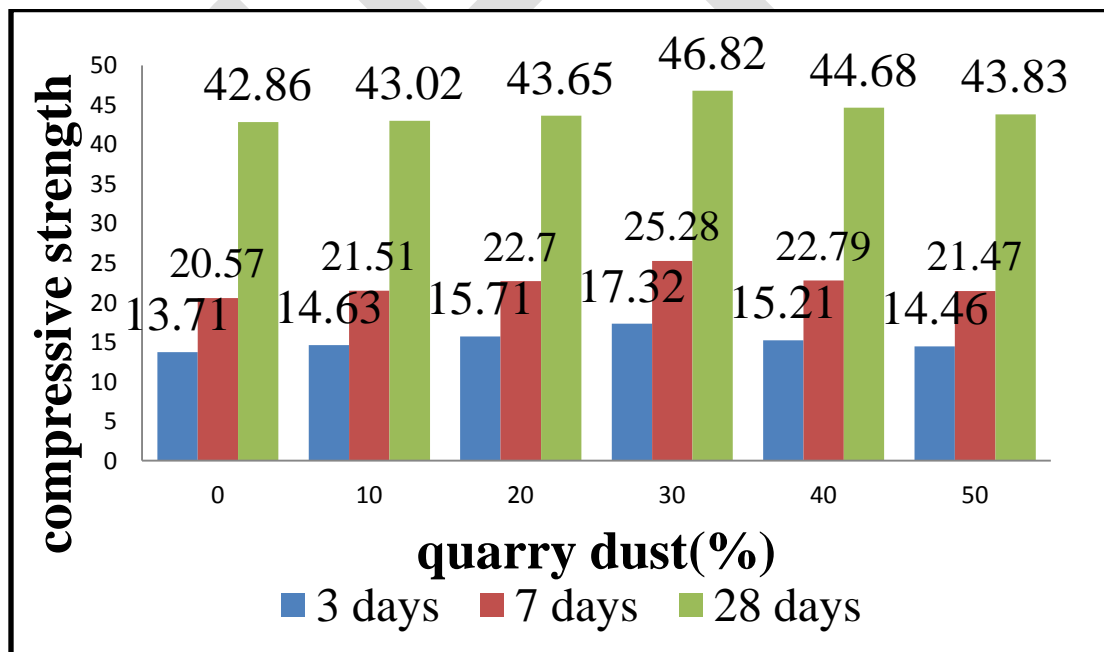
At 30% Partial replacement of fine aggregate by quarry dust the time of flow in slump flow test and in V Funnel test was observed to be minimum.



- The lower results at higher percentage of partial replacement of fine aggregate is attributed to the fact that, there is reduction in the free water content in the SCC mix due to high water absorption of quarry dust. In all the six SCCs mixes, No segregation and bleeding were observed.
- However all the three flow ability tests were within the acceptable limits of EFNARC (2002). Moreover, the fresh concrete properties obtained from slump flow, V-funnel test, L-box provided the same trend for all SCC mixes.

COMPRESSIVE STRENGTH TEST RESULTS:

Mix no	% QD	Compressive strength(Mpa)		
		3days	7days	28days
1	0	13.71	20.57	42.86
2	10	14.63	21.51	43.02
3	20	15.71	22.7	43.65
4	30	17.32	25.28	46.82
5	40	15.20	22.79	44.68
6	50	14.46	21.47	43.83

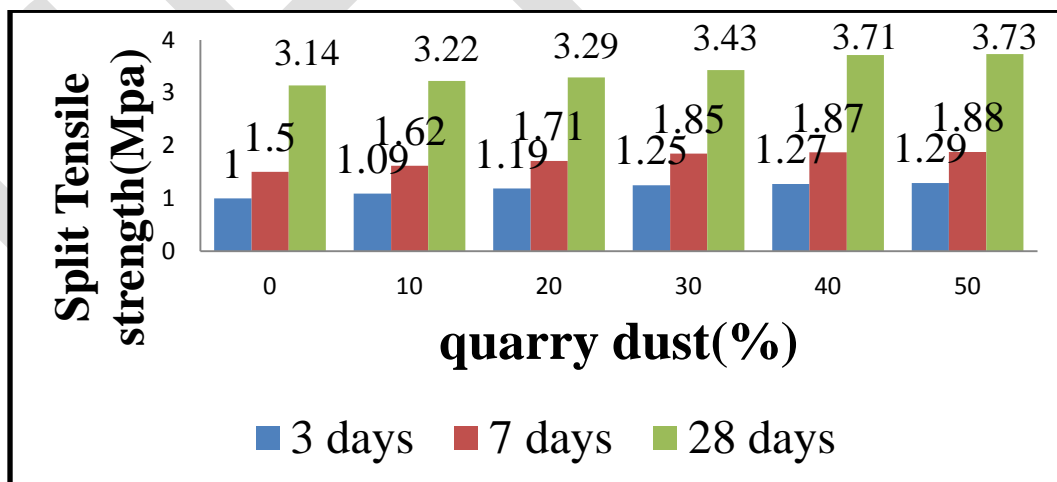


- Examining the strength at 28 days age it can be seen that increasing the quarry dust content from 0% to 20 % has caused increase in compressive strength by 2% as compared to reference mix.

- But when the quarry dust replacement was increased to 30%, the compressive strength increase was almost 8%. An increase in quarry dust content from 30% to 50% reduced the compressive strength by 7% when compared to 30% replacement of quarry dust with river sand.

SPLIT TENSILE STRENGTH TEST RESULTS:

Mix no	% QD	Split Tensile strength		
		3days	7days	28days
1	0	1	1.5	3.14
2	10	1.09	1.62	3.22
3	20	1.19	1.71	3.29
4	30	1.25	1.85	3.43
5	40	1.27	1.87	3.71
6	50	1.29	1.88	3.62

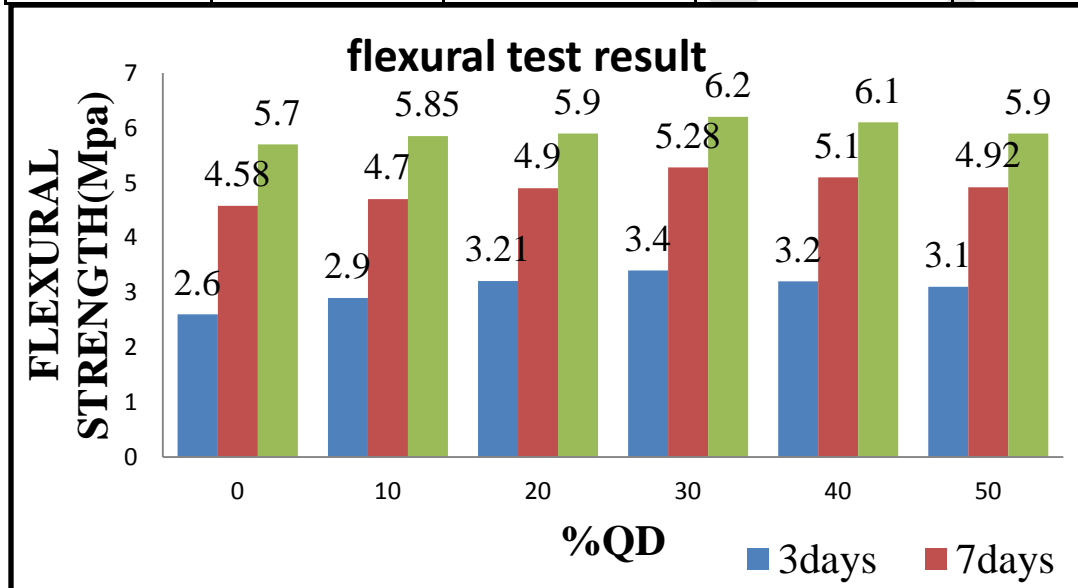


- It is clear that the splitting-tensile strengths of quarry dust SCC mixtures are increasing. The increase was almost 8% at 30% partial replacement while it was almost 15% at about 40% partial replacement.

FLEXURAL STRENGTH TEST RESULTS :

Mix no	% QD	Flexural strength(Mpa)
--------	------	------------------------

		3days	7days	28days
1	0	2.6	4.58	5.7
2	10	2.9	4.7	5.85
3	20	3.21	4.9	5.90
4	30	3.4	5.28	6.20
5	40	3.2	5.10	6.10
6	50	3.1	4.92	5.9



- Examining the strength at 28 days age it can be seen that increasing the quarry dust content from 0% to 20 % has caused increase in flexural strength by 3% as compared to reference mix.
- But when the quarry dust replacement was increased to 30%, the flexural strength increase was almost 8 to 9%. An increase in quarry dust content from 30% to 50% reduced the flexural strength by 5% when compared to 30% replacement of quarry dust with river sand.

CONCLUSIONS:

From the present investigation following are the conclusions derived

- ❖ The slump flow varied between the ranges of 650-725mm. At 30% partial replacement of fine aggregate by quarry dust minimum flow time of 1.6sec and 8 sec was observed in slump flow and v-funnel test respectively.
- ❖ However all the three workability tests were within the acceptable limits of EFNARC.
- ❖ For compressive strength test, with increase in percentage partial replacement of fine aggregate with quarry dust at 10%, 20% and 30%, observed the increase in compressive strength by 1%, 2% and 8% respectively. Further with increase in percentage

partial replacement of fine aggregate with QD at 30 to 40% and 30 to 50% decreased the strength gradually by 5% and 7% respectively.

- ❖ Similarly in case of split tensile test with increase in percentage partial replacement of FA with QD at 10%, 20%, 30%, 40% increased the strength by 2%, 4%, 8%, 15% respectively. Further with increase in partial replacement from 40 to 50% has decreased the strength by 2%.
- ❖ Similarly for flexural strength test increase in strength by 2%, 3% and 8% are observed with increase in partial replacement of FA with QD at 10%, 20% and 30% respectively. Further with increase in partial replacement from 30% to 40% and 30 to 50% has decreased the strength by 2% and 5% respectively.
- ❖ From all the results and points discussed above it can be concluded that the fly ash and quarry dust replacement showed the desirable results that can suggest the usage of the quarry dust as replacement of sand.
- ❖ From overall view it can also be concluded that the partial replacement of quarry dust beyond 30%, there will be decrease in the compressive strength and flexural strength values of cube and prism specimens where as in case of split tensile test decrease in strength is observed with partial replacement of FA by QD beyond 40%.

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STUDY ON SELF CURING CONCRETE USING LIQUID PARAFFIN WAX AS EXTERNAL AGENT

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ABSTRACT: Concrete is most widely used construction material due to its good compressive strength and durability. Curing plays a major role in developing the concrete microstructure and pore structure. Curing is the process of maintaining proper moisture content particularly within 28 days to promote optimum cement hydration immediately after placement. Good curing is not possible in most of the cases such as vertical members, human errors, places where there is scarcity of water, In such conditions self curing concrete is very adaptable. One of the techniques of self curing concrete is by using Hydrophilic materials (water loving, such compounds have an affinity to water and are usually charged or have polar side groups to their structure that will attract water).

INTRODUCTION:

Commonly available Hydrophilic materials are Polyethylene Glycol, Paraffin Wax, Acrylic acid. The use of Hydrophilic materials minimizes the loss of water from the concrete and helps in continuous curing of concrete. In this study, considered grade of concrete is M40. The effect of variation in strength parameters i.e., Compressive Strength, Split Tensile Strength and Flexural Strength were studied with Liquid Paraffin Wax (self curing agent) (0.1% weight of cement) and compared with that of conventional cured concrete. The admixture Conplast SP430 was added (0.3% weight of cement). The design mix proportion was 1:1.45:2.95.

Self Curing Concrete (SCUC):

- Self curing concrete is one of the special concretes in mitigating insufficient curing due to human negligence, scarcity of water in arid areas, inaccessibility of structures in difficult terrains and in areas where the presence of fluorides in water will badly affect the characteristics of concrete.
- The concept of self curing agents is to reduce the water evaporation from concrete and hence increase the water retention capacity of the concrete compared to conventional concrete.
- It was found that Hydrophilic materials (water loving. Such compounds have an affinity to water and are usually charged or have polar side groups to their structure that will attract water) such as Polyethylene Glycol, Paraffin wax, or Acrylic acid can be used as self curing agents in concrete.

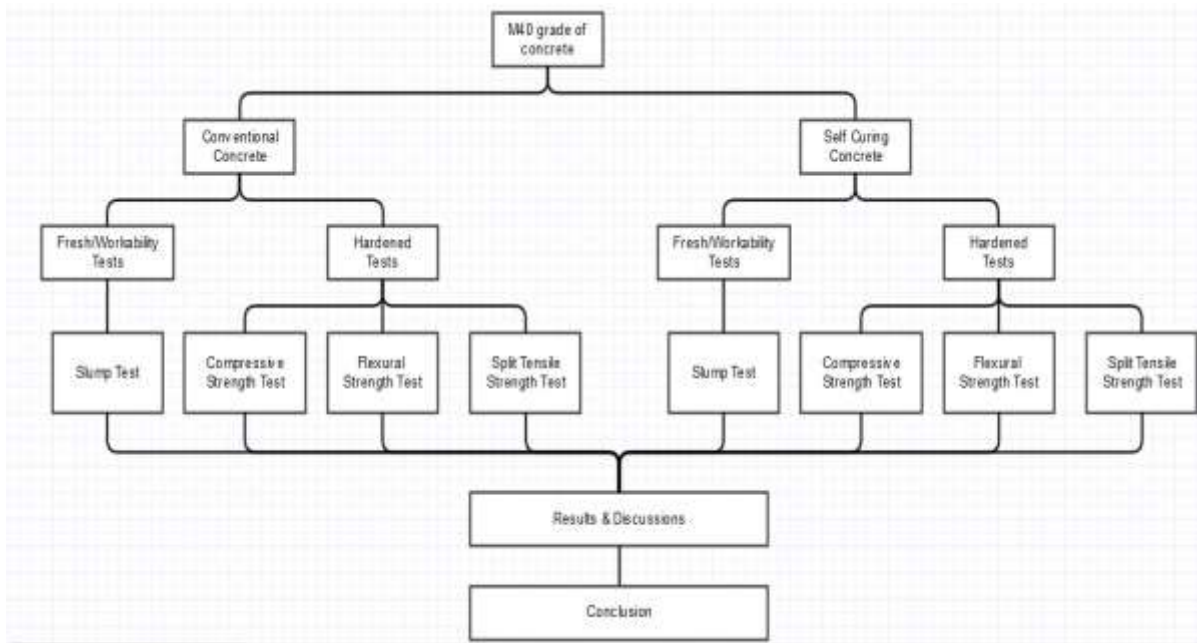
Need of Self Curing:

Conventional curing is not possible in the following cases:-

- For the vertical member
- In the places where there is scarcity of water such as Hill top etc.,
- In the places where manual curing is not possible

In such cases, it may lead to the formation of crack in the member and hence affects strength and durability.

Flow chart of experimental programme:



Experimental Program:

- To study the strength characteristics such as compressive strength, flexural strength, split tensile strength for M40 grade of concrete.
- Total 18 cubes were casted with dosage of 0.1% of self curing agent (liquid paraffin wax) under indoor and water curing conditions. Compressive strength test was conducted after 7, 14 and 28 days of curing.
- Total 18 cylinders were casted with dosage of 0.1% of self curing agent (liquid paraffin wax) under indoor and water curing conditions. Split tensile strength test was conducted after 7, 14 and 28 days of curing.
- Total 18 prisms were casted with dosage of 0.1% of self curing agent (liquid paraffin wax) under indoor and water curing conditions. Flexural strength test was conducted after 7, 14 and 28 days of curing.
- The graphs plotted between strength (compressive strength, flexural strength, split tensile strength) and days of curing.

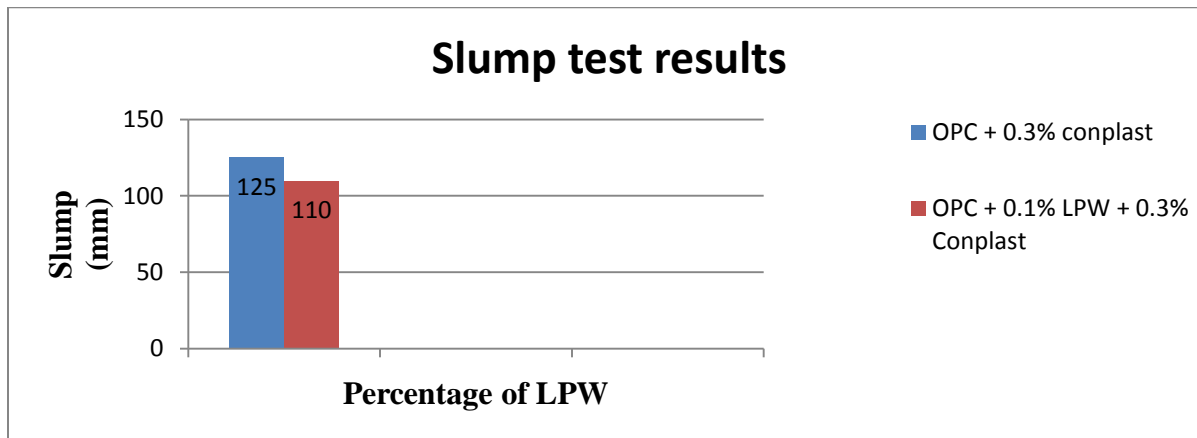
Mix proportion:

Water	Cement	Fine Aggregate	Coarse Aggregate (60% + 40%)
167.4	418.50	607.83	1235.98 (741.59+494.39)
0.40	1.00	1.45	2.95

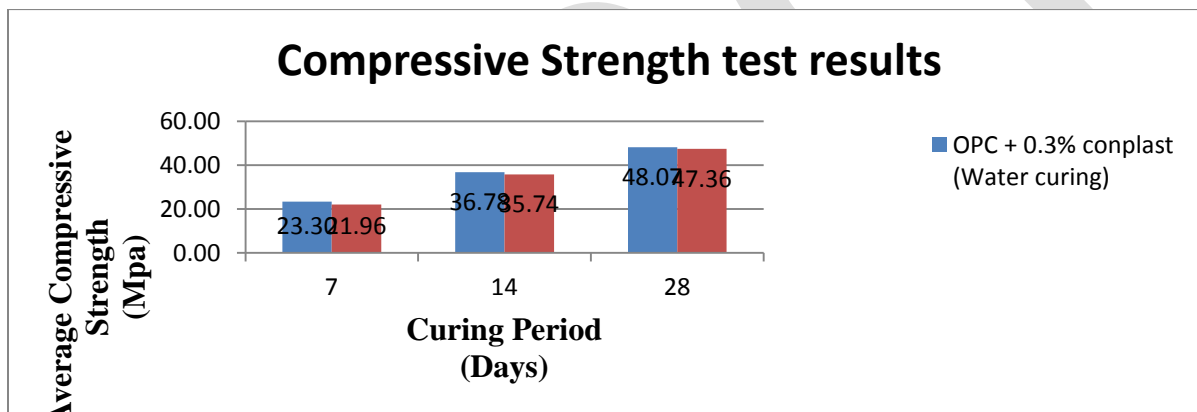
Hence for 1 Cum of Concrete

Cement	418.50 Kg
Water	167.40 Kg
Fine Aggregate	607.83 Kg
Coarse Aggregate	1235.98 Kg
20 mm	741.59 Kg
10mm	494.39 Kg
Paraffin wax (0.1% by weight of cement)	0.42 Kg
Conplast SP430 (0.3% by weight of cement)	1.26 Kg

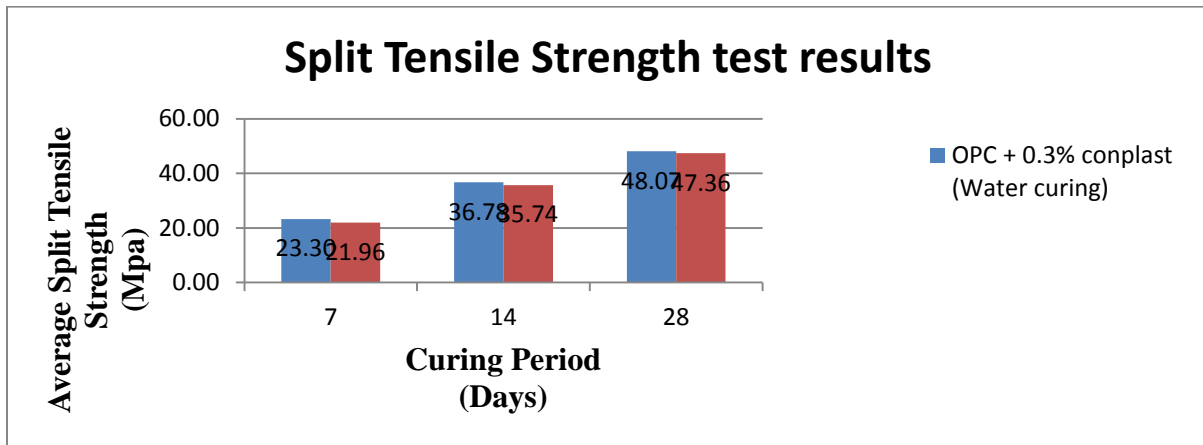
TEST RESULTS:



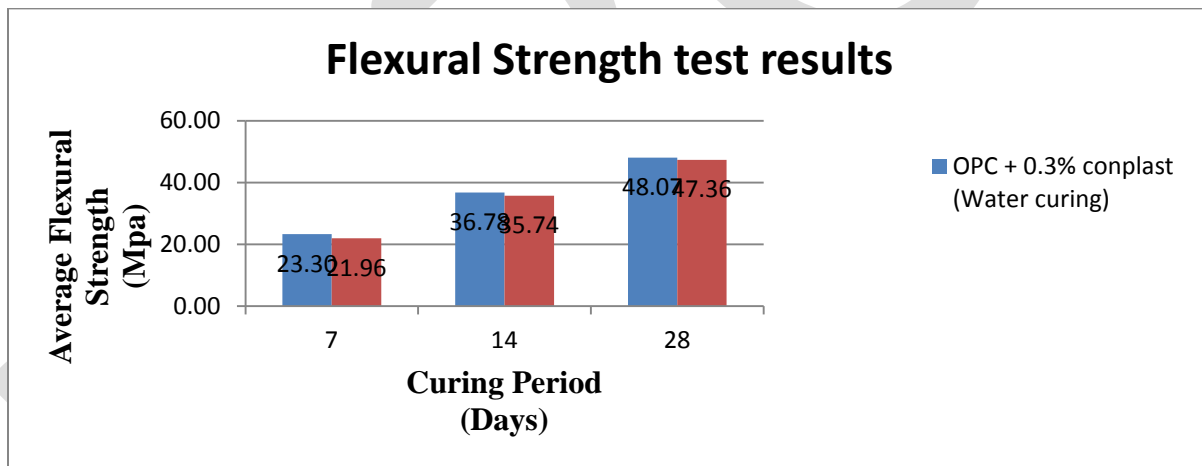
- From the above graph, observed that there was a decrease in the percent of slump of 12 % in self curing concrete when compared to conventional concrete.



- From the above graph, observed that there was reduction in compressive strength of self curing concrete (air curing) of 5.75% when compared to conventional concrete (water curing) at 7 days.
- From the above graph, observed that there was reduction in compressive strength of self curing concrete (air curing) of 2.83% when compared to conventional concrete (water curing) at 14 days.
- From the above graph, observed that there was reduction in compressive strength of self curing concrete (air curing) of 1.48% when compared to conventional concrete (water curing) at 28 days



- From the above graph, observed that there was reduction in split tensile strength of self curing concrete (air curing) of 7.33% when compared to conventional concrete (water curing) at 7 days.
- From the above graph, observed that there was reduction in split tensile strength of self curing concrete (air curing) of 9.49% when compared to conventional concrete (water curing) at 14 days.
- From the above graph, observed that there was reduction in split tensile strength of self curing concrete (air curing) of 6.19% when compared to conventional concrete (water curing) at 28 days.



- From the above graph, observed that there was reduction in Flexural strength of self curing concrete (air curing) of 1.41% when compared to conventional concrete (water curing) at 7 days.
- From the above graph, observed that there was reduction in Flexural strength of self curing concrete (air curing) of 1.03% when compared to conventional concrete (water curing) at 14 days.
- From the above graph, observed that there was reduction in Flexural strength of self curing concrete (air curing) of 2.02% when compared to conventional concrete (water curing) at 28 days.

Conclusions:

- The slump of Self Curing Concrete was decreased by 12% when compared to conventional concrete.
- The compressive strength of Self curing concrete decreased by 1.48% when compared to Conventional concrete.
- The split tensile strength of Self curing concrete decreased by 6.19% when compared to Conventional concrete.
- The flexural strength of Self curing concrete decreased by 2.02% when compared to Conventional concrete.
- Strength of Self curing concrete is on par with conventional concrete.

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Trust Aware Routing Framework

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Abstract- The multi-hop routing in wireless sensor networks (WSNs) offers little protection against identity deception through replaying routing information. An adversary can exploit this defect to launch various harmful or even devastating attacks against the routing protocols, including *sinkhole* attacks, wormhole attacks and *Sybil* attacks. Traditional cryptographic techniques or efforts at developing trust-aware routing protocols do not effectively address this severe problem. To secure the WSNs against adversaries misdirecting the multi-hop routing, we have design and implemented TARS, a robust trust-aware routing framework for dynamic WSNs. TARS provides trustworthy and energy-efficient route. Most importantly, TARS proves effective against those harmful attacks developed out of identity deception; the resilience of TARS is verified through extensive evaluation with both simulation and empirical experiments on large-scale WSNs under various scenarios including mobile and RF-shielding network conditions.

Index Terms- : CTP – Collection Tree Routing Protocol, EWMA-exponentially weighted moving average, RPGM-Reference Point Group Mobility TARS-Trust Aware Routing Framework, WSN – Wireless Sensor Network

I. INTRODUCTION

Wireless sensor networks (WSNs) mainly supports military applications and forest fire monitoring. A WSN comprises battery-powered sensor nodes with extremely limited processing capabilities. With a narrow radio communication range, a sensor node wirelessly sends Wireless sensor networks (WSNs) . With a narrow radio communication range, a sensor node wirelessly sends messages to a base station via a multi-hop path. However, the multi-hop routing of WSNs often becomes the target of malicious attacks. An attacker may tamper nodes physically, create traffic collision with seemingly valid transmission, drop or misdirect messages in routes, or jam the communication channel by creating radio interference. This paper focuses on the kind of attacks in which adversaries misdirect network traffic by identity deception through replaying routing information. Based on identity deception, the adversary is capable of launching harmful and hard-to-detect attacks against routing such as selective forwarding, wormhole attacks, sinkhole attacks and Sybil attacks.

II. DESIGN CONSIDERATIONS

Assumptions : We target secure routing for data collection tasks, which are one of the most fundamental functions of WSNs. In a data collection task, a sensor node sends its sampled data to a remote base station with the aid of other intermediate nodes, as shown in Figure 1. Though there could be more than one base station, our routing approach is not affected by the number of base stations; to simplify our discussion, we assume that there is only one base station.

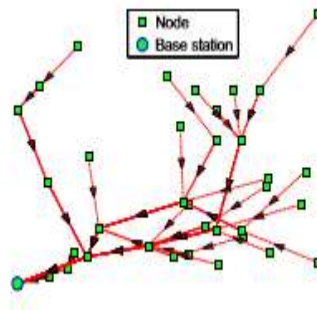


Fig.1. Multi-hop routing for data collection of a WSN

AUTHENTICATION REQUIREMENTS: TARF REQUIRES THAT THE PACKETS ARE PROPERLY AUTHENTICATED, ESPECIALLY THE BROADCAST PACKETS FROM THE BASE STATION. THE BROADCAST FROM THE BASE STATION IS ASYMMETRICALLY AUTHENTICATED SO AS TO GUARANTEE THAT AN ADVERSARY IS NOT ABLE TO MANIPULATE A BROADCAST MESSAGE FROM THE BASE STATION. TARF USES TRUSTMANAGER.

Goals : TARF mainly guards a WSN against the attacks misdirecting the multi-hop routing, especially those based on identity theft through replaying the routing information. TARF aims to achieve the following desirable properties:

High Throughput : *Throughput* is defined as the ratio of the number of all data packets delivered to the base station to the number of all sampled data packets. Here, *throughput* at a moment is computed over the period from the beginning time (0) until that particular moment. Note that single-hop re-transmission may happen, and that duplicate packets are considered as one packet as far as *throughput* is concerned. *Throughput* reflects how efficiently the network is collecting and delivering data. *Throughput should be high.*

Energy Efficiency: We evaluate energy efficiency by the average energy cost to successfully deliver a unit-sized data packet from a source node to the base station. Note that link-level re-transmission should be given enough attention when considering energy cost since each re-transmission causes a noticeable increase in energy consumption. If every node in a WSN consumes approximately the same energy to transmit a unit-sized data packet, we can use another metric *hop-per-delivery* to evaluate energy efficiency. Here, the energy consumption depends on the number of hops, i.e. the number of one-hop transmissions occurring. It is abbreviated as *hop-per-delivery*.

Scalability & Adaptability : It should support large magnitude and high dynamic data. We will evaluate the scalability and adaptability of TARF through experiments with large-scale WSNs and under mobile and hash network conditions.

III. DESIGN OF TARF

Before introducing the detailed design, we first introduce several necessary notion here.

Neighbor : For a node N , a neighbor (neighboring node) of N is a node that is reachable from N with one-hop wireless transmission.

Trust level : For a node N , the trust level of a neighbor is a decimal number in $[0, 1]$, representing N 's opinion of that neighbor's level of trustworthiness. Specifically, the trust level of the neighbor is N 's estimation of the probability that this neighbor correctly delivers data received to the base station. That trust level is denoted as T in this paper.

Energy cost : For a node N , the energy cost of a neighbor is the average energy cost to successfully deliver a unit-sized data packet with this neighbor as its next-hop node, from N to the base station. That energy cost is denoted as E in this paper.

OVERVIEW : FOR A TARF-ENABLED NODE N TO ROUTE A DATA PACKET TO THE BASE STATION, N ONLY NEEDS TO DECIDE TO WHICH NEIGHBORING NODE IT SHOULD FORWARD THE DATA PACKET CONSIDERING BOTH THE TRUSTWORTHINESS AND THE ENERGY EFFICIENCY. ONCE THE DATA PACKET IS FORWARDED TO THAT NEXT-HOP NODE, THE REMAINING TASK TO DELIVER THE DATA TO THE BASE STATION IS FULLY DELEGATED TO IT, AND N IS TOTALLY UNAWARE OF WHAT ROUTING DECISION ITS NEXT-HOP NODE MAKES. N MAINTAINS A NEIGHBORHOOD TABLE WITH TRUST LEVEL VALUES AND ENERGY COST VALUES FOR CERTAIN KNOWN NEIGHBORS. IT IS SOMETIMES NECESSARY TO DELETE SOME NEIGHBORS' ENTRIES TO KEEP THE TABLE SIZE ACCEPTABLE. THE TECHNIQUE OF MAINTAINING A NEIGHBORHOOD TABLE OF A MODERATE SIZE IS EMPLOYED BY TARF. A BROADCAST MESSAGE FROM THE BASE STATION IS FLOODED TO THE WHOLE NETWORK.

In TARF, in addition to data packet transmission, there are two types of routing information that need to be exchanged: broadcast messages from the base station about data delivery and energy cost report messages from each node. Neither message needs acknowledgement. A broadcast message from the base station is flooded. The freshness of a broadcast message is checked through

its field of source sequence number. The other type of exchanged routing information is the energy cost report message from each node.

For each node N in a WSN, to maintain such a neighborhood table with trust level values and energy cost values for certain known neighbors, two components, *EnergyWatcher* and *TrustManager*, run on the node (Figure 2). *EnergyWatcher* is responsible for recording the energy cost for each known neighbor, based on N 's observation of one-hop transmission to reach its neighbors and the energy cost report from those neighbors. *TrustManager* is responsible for tracking trust level values of neighbors based on network loop discovery and broadcast messages from the base station about data delivery. Once N is able to decide its next-hop neighbor according to its neighborhood table, it sends out its energy report message: it broadcasts to all its neighbors its energy cost to deliver a packet from the node to the base station. The energy cost is computed as in Section 3.3 by *EnergyWatcher*.

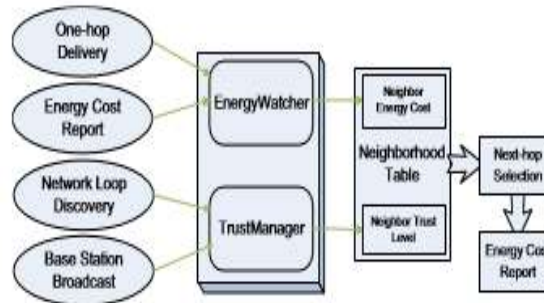


Fig. 2 : Design of TARF

Routing Procedure : TARF, as with many other routing protocols, runs as a periodic service. The length of that period determines how frequently routing information is exchanged and updated. At the beginning of each period, the base station broadcasts a message about data delivery during last period to the whole network consisting of a few contiguous packets (one packet may not hold all the information). Each such packet has a field to indicate how many packets are remaining to complete the broadcast of the current message. The completion of the base station broadcast triggers the exchange of energy report in this new period. Whenever a node receives such a broadcast message from the base station, it knows that the most recent period has ended and a new period has just started. During each period, the *EnergyWatcher* on a node monitors energy consumption of one-hop transmission to its neighbors and processes energy cost reports from those neighbors to maintain energy cost entries in its neighborhood table; its *TrustManager* also keeps track of network loops and processes broadcast messages from the base station about data delivery to maintain trust level entries in its neighborhood table.

Structure and Exchange of Routing Information : A broadcast message from the base station fits into at most a fixed small number of packets. Such a message consists of some pairs of <node id of a source node, an undelivered sequence interval [a, b] with a significant length>, <node id of a source node, minimal sequence number received in last period, maximum sequence number received in last period>, as well as several node id intervals of those without any delivery record in last period. To reduce overhead to an acceptable amount, our implementation selects only a limited number of such pairs to broadcast (Section 5.1) and proved effective (Section 5.3, 5.4). Roughly, the effectiveness can be explained as follows: the fact that an attacker attracts a great deal of traffic from many nodes often gets revealed by at least several of those nodes being deceived with a high likelihood. The undelivered sequence interval [a, b] is explained as follows: the base station searches the source sequence numbers received in last period, identifies which source sequence numbers for the source node with this id are missing, and chooses certain significant interval [a, b] of missing source sequence numbers as an undelivered sequence interval. For example, the base station may have all the source sequence numbers for the source node 2 as {109, 110, 111, 150, 151} in last period. Then [112, 149] is an undelivered sequence interval; [109, 151] is also recorded as the sequence boundary of delivered packets. Since the base station is usually connected to a powerful platform such as a desktop, a program can be developed on that powerful platform to assist in recording all the source sequence numbers and finding undelivered sequence intervals.

Accordingly, each node in the network stores a table of <node id of a source node, a forwarded sequence interval [a, b] with a significant length> about last period. The data packets with the source node and the sequence numbers falling in this forwarded sequence interval [a, b] have already been forwarded by this node. When the node receives a broadcast message about data delivery, its *TrustManager* will be able to identify which data packets forwarded by this node are not delivered to the base station. Considering the overhead to store such a table, old entries will be deleted once the table is full. Once a fresh broadcast message from the base station is received, a node immediately invalidates all the existing energy cost entries: it is ready to receive a new

energy report from its neighbors and choose its new next-hop node afterwards. Also, it is going to select a node either after a timeout is reached or after it has received an energy cost report from some highly trusted candidates with acceptable energy cost. A node immediately broadcasts its energy cost to its neighbors only after it has selected a new next-hop node. That energy cost is computed by its *EnergyWatcher* (see Section 3.3). A natural question is which node starts reporting its energy cost first. For that, note that when the base station is sending a broadcast message, a side effect is that its neighbors receiving that message will also regard this as an energy report: the base station needs 0 amount of energy to reach itself. As long as the original base station is faithful, it will be viewed as a trustworthy candidate by *TrustManager* on the neighbors of the base station. Therefore, those neighbors will be the first nodes to decide their next-hop node, which is the base station; they will start reporting their energy cost once that decision is made.

Route Selection : Now, we introduce how TARF decides routes in a WSN. Each node N relies on its neighborhood table to select an optimal route, considering both energy consumption and reliability. For a node N to select a route for delivering data to the base station, N will select an optimal next-hop node from its neighbors based on trust level and energy cost and forward the data to the chosen next-hop node immediately. The neighbors with trust levels below a certain threshold will be excluded from being considered as candidates. Among the remaining known neighbors, N will select its next-hop node through evaluating each neighbor b based on a trade-off between TNb and E_{Nb} , with E_{Nb} and TNb being b 's energy cost and trust level value in the neighborhood table respectively. Basically, E_{Nb} reflects the energy cost of delivering a packet to the base station from N assuming that all the nodes in the route are honest; $1/TNb$ approximately reflects the number of the needed attempts to send a packet from N to the base station via multiple hops before such an attempt succeeds, considering the trust level of b .

Thus, E_{Nb}/TNb combines the trustworthiness and energy cost. However, the metric E_{Nb}/TNb suffers from the fact that an adversary may falsely reports extremely low energy cost to attract traffic and thus resulting in a low value of E_{Nb}/TNb even with a low TNb . Therefore, TARF prefers nodes with significantly higher trust values. For deciding the next-hop node, a specific trade-off between TNb and E_{Nb} is demonstrated in Figure 5 (see Section 5.2).

EnergyWatcher : Here we describe how a node N 's *EnergyWatcher* computes the energy cost E_{Nb} for its neighbor b in N 's neighborhood table and how N decides its own energy cost E_N . Before going further, we will clarify some notations. E_{Nb} mentioned is the average energy cost of successfully delivering a unit-sized data packet from N to the base station, with b as N 's next-hop node being responsible for the remaining route. Here, one-hop re-transmission may occur until the acknowledgement is received or the number of re-transmissions reaches a certain threshold. The cost caused by one-hop retransmissions should be included when computing E_{Nb} . Suppose N decides that A should be its next-hop node after comparing energy cost and trust level.

Then N 's energy cost is $E_N = E_{NA}$. Denote $E_{N \rightarrow b}$ as the average energy cost of successfully delivering a data packet from N to its neighbor b with one hop. Note that the re-transmission cost needs to be considered. With the above notations, it is straightforward to establish the following relation: $E_{Nb} = E_{N \rightarrow b} + E_b$

Since each known neighbor b of N is supposed to broadcast its own energy cost E_b to N , to compute E_{Nb} , N still needs to know the value $E_{N \rightarrow b}$, i.e., the average energy cost of successfully delivering a data packet from N to its neighbor b with one hop. For that, assuming that the endings (being acknowledged or not) of one-hop transmissions from N to b are independent with the same probability P_{succ} of being acknowledged, we first compute the average number of one-hop sendings needed before the acknowledgement is received as follows:

$$\sum_{i=1}^{\infty} i = 1/P_{succ} \cdot (1 - P_{succ})^{i-1} = 1/P_{succ}$$

Denote E_{unit} as the energy cost for node N to send a unit-sized data packet once regardless of whether it is received or not. Then we have $E_{Nb} = E_{unit}/P_{succ} + E_b$

The remaining job for computing E_{Nb} is to get the probability P_{succ} that a one-hop transmission is acknowledged. Considering the variable wireless connection among wireless sensor nodes, we do not use the simplistic averaging method to compute P_{succ} . Instead, after each transmission from N to b , N 's *EnergyWatcher* will update P_{succ} based on whether that transmission is acknowledged or not with a weighted averaging technique. We use a binary variable Ack to record the result of current transmission: 1 if an acknowledgement is received; otherwise, 0. Given Ack and the last probability value of an acknowledged transmission $P_{old succ}$, an intuitive way is to use a simply weighted average of Ack and $P_{old succ}$ as the value of $P_{new succ}$. That is what is essentially adopted in the aging mechanism. However, that method used against sleeper attacks still suffers periodic attacks. To solve this problem, we update the P_{succ} value using two different weights as in our previous work, a relatively big $W_{degrade} \in (0,1)$ and a relatively small $W_{upgrade} \in (0,1)$ as follows:

$$pnew\ succ = (1 - W_{degrade}) \times Pold\ succ + W_{degrade} \times Ack, \text{ if } Ack = 0.$$

$$(1 - W_{upgrade}) \times Pold\ succ + W_{upgrade} \times Ack, \text{ if } Ack = 1.$$

The two parameters $W_{degrade}$ and $W_{upgrade}$ allow flexible application requirements. $W_{degrade}$ and $W_{upgrade}$ represent the extent to which upgraded and degraded performance are rewarded and penalized, respectively. If any fault and compromise is very likely to be associated with a high risk, $W_{degrade}$ should be assigned a relatively high value to penalize fault and compromise relatively heavily; if a few positive transactions can't constitute evidence of good connectivity which requires many more positive transactions, then $W_{upgrade}$ should be assigned a relatively low value.

TrustManager : A node N's TrustManager decides the trust level of each neighbor based on the following events: discovery of network loops, and broadcast from the base station about data delivery. For each neighbor b of N, T_{Nb} denotes the trust level of b in N's neighborhood table. At the beginning, each neighbor is given a neutral trust level 0.5. After any of those events occurs, the relevant neighbors' trust levels are updated. Note that many existing routing protocols have their own mechanisms to detect routing loops and to react accordingly. In that case, when integrating TARF into those protocols with anti-loop mechanisms, TrustManager may solely depend on the broadcast from the base station to decide the trust level; we adopted such a policy when implementing TARF later (see Section 5). If anti-loop mechanisms are both enforced in the TARF component and the routing protocol that integrates TARF, then the resulting hybrid protocol may overly react towards the discovery of loops. Though sophisticated loop-discovery methods exist in the currently developed protocols, they often rely on the comparison of specific routing cost to reject routes likely leading to loops [32]. To minimize the effort to integrate TARF and the existing protocol and to reduce the overhead, when an existing routing protocol does not provide any anti-loop mechanism, we adopt the following mechanism to detect routing loops. To detect loops, the TrustManager on N reuses the table of <node id of a source node, a forwarded sequence interval [a, b] with a significant length> (see Section 3.2) in last period. If N finds that a received data packet is already in that record table, not only will the packet be discarded, but the TrustManager on N also degrades its next-hop node's trust level. If that next-hop node is b, then $T_{old\ Nb}$ is the latest trust level value of b. We use a binary variable Loop to record the result of loop discovery: 0 if a loop is received; 1 otherwise. As in the update of energy cost, the new trust level of b is

$$T_{new\ Nb} = (1 - W_{degrade}) \times T_{old\ Nb} + W_{degrade} \times Loop, \text{ if } Loop = 0.$$

$$= (1 - W_{upgrade}) \times T_{old\ Nb} + W_{upgrade} \times Loop, \text{ if } Loop = 1.$$

Once a loop has been detected by N for a few times so that the trust level of the next-hop node is too low, N will change its next-hop selection; thus, that loop is broken. Though N can not tell which node should be held responsible for the occurrence of a loop, degrading its next-hop node's trust level gradually leads to the breaking of the loop.

On the other hand, to detect the traffic misdirection by nodes exploiting the replay of routing information, TrustManager on N compares N's stored table of <node id of a source node, forwarded sequence interval [a, b] with a significant length> recorded in last period with the broadcast messages from the base station about data delivery. It computes the ratio of the number of successfully delivered packets which are forwarded by this node to the number of those forwarded data packets, denoted as DeliveryRatio. Then N's TrustManager updates its next-hop node b's trust level as follows:

$$T_{new\ Nb} =$$

$$(1 - W_{degrade}) \times T_{old\ Nb} + W_{degrade} \times DeliveryRatio, \text{ if } DeliveryRatio < T_{old\ Nb}.$$

$$(1 - W_{upgrade}) \times T_{old\ Nb} + W_{upgrade} \times DeliveryRatio, \text{ if } DeliveryRatio \geq T_{old\ Nb}.$$

Analysis on EnergyWatcher and TrustManager : Now that a node N relies on its EnergyWatcher and TrustManager to select an optimal neighbor as its next-hop node, we would like to clarify a few important points on the design of EnergyWatcher and TrustManager. First, as described in Section 3.1, the energy cost report is the only information that a node is to passively receive and take as "fact". It appears that such acceptance of energy cost report could be a pitfall when an attacker or a compromised node forges

false report of its energy cost. Note that the main interest of an attacker is to prevent data delivery rather than to trick a data packet into a less efficient route, considering the effort it takes to launch an attack. As far as an attack aiming at preventing data delivery is concerned, TARF well mitigates the effect of this pitfall through the operation of TrustManager. Note that the TrustManager on one node does not take any recommendation from the TrustManager on another node. If an attacker forges false energy report to form a false route, such intention will be defeated by TrustManager: when the TrustManager on one node finds out the many delivery failures from the broadcast messages of the base station, it degrades the trust level of its current next-hop node; when that trust level goes below certain threshold, it causes the node to switch to a more promising next- hop node.. First of all, it is often difficult to identify an attacker who participates in the network using an id “stolen” from another legal node. For example, it is extremely difficult to detect a few attackers colluding to launch a combined wormhole and sinkhole attack . Additionally, despite the certain inevitable unfairness involved, TrustManager encourages a node to choose another route when its current route frequently fails to deliver data to the base station. Though only those legal neighboring nodes of an attacker might have correctly identified the adversary, our evaluation results indicate that the strategy of switching to a new route without identifying the attacker actually significantly improves the network performance, even with the existence of wormhole and sinkhole attacks. Fig 3 gives an example to illustrate this point. In this example, node A, B, C and D are all honest nodes and not compromised. Node A has node B as its current next-hop node while node B has an attacker node as its next-hop node. The attacker drops every packet received and thus any data packet passing node A will not arrive at the base station. After a while, node A discovers that the data packets it forwarded did not get delivered. The TrustManager on node A starts to degrade the trust level of its current next-hop node B although node B is absolutely honest. Once that trust level becomes too low, node A decides to select node C as its new next-hop node. In this way node A identifies a better and successful route (A - C - D - base). In spite of the sacrifice of node B’s trust level, the network performs better.

0

Fig.3. An example to illustrate how TrustManager works.

Finally, we would like to stress that TARF is designed to guard a WSN against the attacks misdirecting the multi-hop routing, especially those based on identity theft through replaying the routing information.

IV. Simulation

In our experiments, initially, 35 nodes are randomly distributed within a 300*300 rectangular area, with unreliable wireless transmission. All the nodes have the same power level and the same maximal transmission range of 100m. Each node samples 6 times in every period; the timing gap between every two consecutive samplings of the same node is equivalent. We simulate the sensor network in 1440 consecutive periods. Regarding the network topology, we set up three types of network topologies. The first type is the static-location case under which all nodes stand still. The second type is a customized group-motion-with-noise case based on Reference Point Group Mobility (RPGM) model that mimics the behavior of a set of nodes moving in one or more groups . The last type of dynamic network incorporated in the experiments is the addition of scattered RF-shielded areas to the afore mentioned group-motion-with-noise case.

The performance of TARF is compared to that of a link connectivity-based routing protocol. With the Link-connectivity protocol, each node selects its next-hop node among its neighborhood table according to an link estimator based on exponentially weighted moving average (EWMA). The simulation results show, in the presence of misbehaviors, the throughput in TARF is often much higher than that in Link-connectivity; the hop-per- delivery in the Link-connectivity protocol is generally at least comparable to that in TARF. Both protocols are evaluated under three common types of attacks: (1) a certain node forges the identity of the based station by replaying broadcast messages, also known as the sinkhole attack; (2) a set of nodes colludes to form a forwarding loop; and (3) a set of nodes drops received data packets. Generally, under these common attacks, TARF produces a substantial improvement over Link-connectivity in terms of data collection and energy efficiency. Further, we have evaluated TARF under more severe attacks: multiple moving fake bases and multiple Sybil attackers. TARF succeeds in achieving a steady improvement over the Link-connectivity protocol.

Incorporation of TARF into Existing Protocols : To demonstrate how this TARF implementation can be integrated into the existing protocols with the least effort, we incorporated TARF into a collection tree routing protocol (CTP). The CTP protocol is efficient,

robust, and reliable in a network with highly dynamic link topology. It quantifies link quality estimation in order to choose a next-hop node. The software platform is TinyOS 2.x.

To perform the integration, after proper interface wiring, invoke the `TrustControl.start` command to enable the trust evaluation; call the `Record.addForwarded` command for a non-root node to add forwarded record once a data packet has been forwarded; call the `Record.addDelivered` command for a root to add delivered record once a data packet has been received by the root. Finally, inside the CTP's task to update the routing path, call the `Record.getTrust` command to retrieve the trust level of each next-hop candidate; an algorithm taking trust into routing consideration is executed to decide the new next-hop neighbor. (See Figure 5).

Similar to the original CTP's implementation, the implementation of this new protocol decides the next-hop neighbor for a node with two steps (see Figure 5): Step 1 traverses the neighborhood table for an optimal candidate for the next hop; Step 2 decides whether to switch from the current next-hop node to the optimal candidate found. For Step 1, as in the CTP implementation, a node would not consider those links congested, likely to cause a loop, or having a poor quality lower than a certain threshold. This new implementation prefers those candidates with higher trust levels; in certain circumstances, regardless of the link quality, the rules deem a neighbor with a much higher trust level to be a better candidate (see Figure 5). The preference of highly trustable candidates is based on the following consideration: on the one hand, it creates the least chance for an adversary to misguide other nodes into a wrong routing path by forging the identity of an attractive node such as a root; on the other hand, forwarding data packets to a candidate with a low trust level would result in many unsuccessful link-level transmission attempts, thus leading to much re-transmission and a potential waste of energy. When the network throughput becomes low and a node has a list of low-trust neighbors, the node will exclusively use the trust as the criterion to evaluate those neighbors for routing decisions. As shown in Figure 5, it uses trust/cost as a criteria only when the candidate has a trust level above certain threshold. The reason is, the sole trust/cost criteria could be exploited by an adversary replaying the routing information from a base station and thus pretending to be an extremely attractive node. As for Step 2, compared to the CTP implementation, we add two more circumstances when a node decides to switch to the optimal candidate found at Step 1: that candidate has a higher trust level, or the current next-hop neighbor has a too low trust level.

V. Empirical Evaluation on Motelab

We evaluated the performance of TARF against a combined sinkhole and wormhole attack on Motelab at Harvard University. 184 TMote Sky sensor motes were deployed across many rooms at three floors in the department building (see Figure 6), with two to four motes in most rooms. Around 97 nodes functioned properly while the rest were either removed or disabled. Each mote has a 2.4GHz Chipcon CC2420 radio with an indoor range of approximately 100 meters. In Figure 6, the thin green lines indicate the direct (one-hop) wireless connection between motes. Certain wireless connection also exists between nodes from different floors. We developed a simple data collection application in TinyOS 2.x that sends a data packet every five seconds to a base station node (root) via multi-hop. This application was executed on 91 functioning non-root nodes on Mote-lab. For comparison, we used CTP and the TARF-enabled CTP implementation as the routing protocols for the data collection program separately. The TARF-enabled CTP has a TARF period of 30 seconds. We conducted an attack with five fake base stations that formed a wormhole. As in Figure 6, whenever the base station sent out any packet, three fake base stations which overheard that packet replayed the complete packet without changing any content including the node id. Other fake base stations overhearing that replayed packet would also replay the same packet. Each fake base station essentially launched a sinkhole attack. Note that there is a distinction between such malicious replay and the forwarding when a well-behaved node receives a broadcast from the base station. When a well-behaved node forwards a broadcast packet from the base station, it will include its own id in the packet so that its receivers will not recognize the forwarder as a base station. We conducted the first experiment by uploading the program with the CTP protocol onto 91 motes (not including those 5 selected motes as fake bases in later experiments), and no attack was involved here.

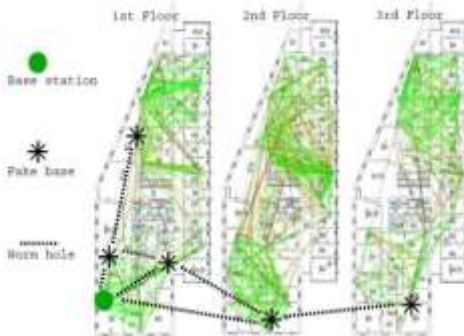


Fig. 6. Connectivity map of Motelab

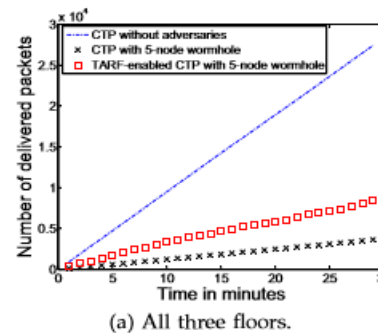


Fig.7 . Empirical comparison of CTP and TARF- enabled CTP on Motelab

Then, in another experiment, in addition to programming those 91 motes with CTP, we also programmed the five fake base stations so that they stole the id the base station through replaying. In the last experiment, we programmed those 91 motes with the TARF-enabled CTP, and programmed the five fake base stations as in the second experiment.

Each of our programs run for 30 minutes. As illustrated in Figure 7(a), the existence of the five wormhole attackers greatly degraded the performance of CTP: the number of the delivered data packets in the case of CTP with the five-node wormhole is no more than 14% that in the case of CTP without adversaries. The TARF-enabled CTP succeeded in bringing an immense improvement over CTP in the presence of the five-node wormhole, almost doubling the throughput. That improvement did not show any sign of slowing down as time elapsed. The number of nodes from each floor that delivered at least one data packet in each six-minute sub-period is plotted in Figure 7. On each floor, without any adversary, at least 24 CTP nodes were able to find a successful route in each six minute. However, with the five fake base stations in the wormhole, the number of CTP nodes that could find a successful route goes down to 9 for the first floor; it decreases to no more than 4 for the second floor; as the worst impact, none of the nodes on the third floor ever found a successful route. A further look at the data showed that all the nine nodes from the first floor with successful delivery record were all close to the real base station. The CTP nodes relatively far away from the base station, such as those on the second and the third floor, had little luck in making good routing decisions. When TARF was enabled on each node, most nodes made correct routing decisions circumventing the attackers. That improvement can be verified by the fact that the number of the TARF-enabled nodes with successful delivery record under the threat of the wormhole is close to that of CTP nodes with no attackers, as shown in Figure 7.

VI. CONCLUSIONS

We have designed and implemented TARF, a robust trust-aware routing framework for WSNs, to secure multi-hop routing in dynamic WSNs against harmful attackers exploiting the replay of routing information. TARF focuses on trustworthiness and energy efficiency, which are vital to the survival of a WSN in a hostile environment. With the idea of trust management, TARF enables a node to keep track of the trustworthiness of its neighbors and thus to select a reliable route. Our main contributions are listed as follows. (1) Unlike previous efforts at secure routing for WSNs, TARF effectively protects WSNs from severe attacks through replaying routing information; it requires neither tight time synchronization nor known geographic information. (2) The resilience and scalability of TARF is proved through both extensive simulation and empirical evaluation with large-scale WSNs; the evaluation involves both static and mobile settings, hostile network conditions, as well as strong attacks such as *wormhole* attacks and *Sybil* attacks.

(3) We have implemented a ready-to-use TinyOS module of TARF with low overhead; as demonstrated in the paper, this TARF module can be integrated into existing routing protocols with the least effort, thus producing secure and efficient fully-functional protocols.

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Proximate Nutritional Analysis of Dried Watermelon seed

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Abstract— To carry out proximate of dried watermelon seed in order to ascertain their nutritional content values. Dried seeds of moringa oleifera lam were plucked from watermelon fruits growing at Tamil nadu, Egbooda, Oshiri in Onicha area of Ebonyi State, Nigeria. The period of sampling was for 2 weeks in the month of March. The seeds were dried at room temperature and their proximate contents determined using standard analytical techniques. Ash and moisture contents were determined using the Association of Official Analytical Chemists (AOAC) method. Fat, crude fibre and protein content were determined using soxhlet fat extraction method and kjeldahl method respectively. In addition, carbohydrate content was determined using arithmetic difference method. Results show that the mean nutritional content of the samples were: 68.4% protein, 6.4% moisture, 1.2% crude fibre, 47.1% Fat, Ash 2.6% Ash and 25.8% carbohydrate.

Keywords— Watermelon seed; nutritional value; ash, carbohydrate, fat, moisture, fibre, protein.

INTRODUCTION

Watermelon (*Citrullus lanatus*) is of the cucurbitaceae family. As a member of the cucurbitaceae, watermelon is related to the cantaloupe, squash and pumpkin and other plants that grows on vines on the ground. Watermelon is a good source of carotenoid and lycopene. Lycopene has been found to be protective against a growing list of cancer [1].

Watermelon is also expectedly high in citrulline; an amino acid the body make use of to make another amino acid, arginine (used in the urea cycle to remove ammoniacal from the body) [2]. Watermelon is delectable, thirst-quencher which helps quench the inflammable that contributes to conditions like asthma, atherosclerosis, diabetes, colon cancer and arthritis [3]. Cucurbit seeds are source of food particularly protein and oil [4]. Dehulled cucurbit seeds were reported to contain about 50% fat and 35% protein [5].

Watermelon fruit contained many smooth compressed seeds that thickened at the margin and of black or yellow-white colour [6]. Achu, et al., [7] reported high lipid level in five cucurbitaceae oil- seeds from different regions in Cameroon. Oil provides concentrated energy in diet and enhanced palatability. It worthy to note that major edible oils are from palm oil and peanut which are capital and labour intensive [8] and therefore there is need to source for good, cheap and novel source of oils that would be useful domestically and perhaps industrially.

The aim of this research work is to determine some functional properties of the seed and physicochemical properties of the oil extract with a view of harnessing it for consumption and possible industrial usage.

2. Experimental Section

2.1 Sampling

Matured watermelon fruits (fresh condition) were purchased from market, Ikirun, Osun State, Nigeria. The fruits were sliced open using a clean stainless steel laboratory knife. The seeds were washed severally with distilled water, sun-dried for a week, sorted to remove bad ones, shelled, grinded with a laboratory blender, packed in an air tight container and stored in desiccators (containing silica gel) ready for further analysis.

2.2 Proximate analysis

The proximate compositions of the dried Watermelon seed were determined using standard analytical methods. All measurements were done in duplicates and values presented in percentage.

2.2.1 Ash content determination

2g of the sample was weighed into a crucible in a muffle furnace and heated at 130⁰C for three hours until it became gray ash. The dish was removed from the muffle furnace using crucible tong and placed in desiccators to cool. The weight of ash was obtained by the difference.

2.2.2 Moisture content determination

5g of the sample was then placed in a preweighed Petri dish, and then placed in an oven to dry at 130⁰C for three hours. The dish and dry sample were transferred to desiccators to cool at room temperature before being weighed again. The experiments were repeated until constant weight was obtained.

2.2.3 Fat content determination

Fat was determined using soxhlet fat extraction method [10]. 250ml oil flask was washed thoroughly and dried in oven at 130°C for 30 minutes and then placed in desiccators to cool. 2g of the dried sample was then weighed accurately into labeled thimbles. Cooled oil flask was filled with 200ml hexane and boiled at 180°C. The extraction thimble was plugged lightly with a cotton wool and the oil flask containing hexane was placed in the extraction thimble to boil and the soxhlet apparatus was allowed to reflux for three hours. The thimble was removed carefully and the hexane on top of the container was collected and drained into another container for reuse. When the flask was free of hexane, it was removed and boiled for an hour at 130°C. It was finally transferred from the oven into desiccators to cool before weighing.

2.2.4 Fibre content determination

Crude Fibre content was determined by Weende's method [11]. 2g of the defatted sample was weighed into a 500ml beaker and 200ml of 1.25% H₂SO₄ was added and the mixture was boiled under reflux for 45 minutes. The solution was filtered with whatman filter paper; the residue was rinsed thoroughly with distilled water until it was no more acid. The residue was transferred into a 250ml beaker and 200ml of 1.25% NaOH was added and boiled for 45 minutes in a digestion apparatus after which it was filtered and rinsed with distilled water until the filtrate was neutral. The residue was transferred into a crucible and placed in electric oven at 130°C for three hours to dry. It was then removed and placed in desiccators to cool before weighing. After weighing, the sample was incinerated, cooled in desiccators and reweighed.

2.2.5 Protein determination

Protein content of the sample was determined using the Kjeldahl method [12]. The total nitrogen was determined and multiplied by a conversion factor of 6.25 to obtain the protein content. 0.2g of powdered sample was weighed into a Kjeldahl digestion flask. 1g of CuSO₄ was added to the flask and 10ml conc. H₂SO₄ digested by heating under a fume hood chamber till the solution digested completely and changed to blue color. The solution was carefully removed and allowed to solidify for 1hr until a white colour was obtained. The mixture was distilled until a total of 10ml distillate was collected into 250ml conical flask was titrated with 0.1N HCl. Add 2 drops of mixed indicator (promosal green and methyl red) when the color of the distillate is light blue color change into light pink.

2.2.6 Carbohydrate determination

The carbohydrate content of the test sample was determined by estimation using the arithmetic difference method [12]. %CHO = 100 – (% fat. + % ash + % fiber + % protein)

3. Results and Discussion

Table 1 shows the results of proximate analysis of dried Watermelon seed. The results indicated that dried watermelon seeds contained appreciable amount of crude protein content (30.9 ± 0.9%) making it to be a good source of supplementary protein for man and livestock, The results also showed that Moringa seed contain nutritious compounds

Table 1: Proximate contents of the analyzed sample

S.NO	Parameters%	values
1	Moisture	6.4 %
2	Fat	47.1 %
3	Protein	68.4 %
4	Fiber	1.2 %
5	Ash	2.6 %
6	Carbohydrates	25.1 %

ACKNOWLEDGMENT

The authors acknowledge Mr. S. Kumaravel for providing laboratory facilities for this study. Thanks to Mr. S. Kumaravel from Extension Department of the Indian Institute of Crop Processing Technology for his technical support.

CONCLUSION

Conclusion must be short and precise and should reflect the work or research work you have gone through. It must have same as above in introduction paper adjustment.

Proximate analysis results show that dried watermelon seed is a good source of nutrients and thus, the plant might be explored as a viable supplement in both animal and human food. Other nutritional contents in watermelon seed not covered in this study and the possible roles on the nutritional makeup of watermelon plants are areas for further investigation in future research. Furthermore, the phytochemical constituents of watermelon seed can be further explored in the search for further uses of moringa plants as herbal remedies

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High Speed Area Efficient Modulo $2^n + 1$ Adder

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Abstract—Modular adder is one of the key components for the application of residue number system (RNS). Moduli set with the form of $2^n + 1$ can offer excellent balance among the RNS channels for multi-channels RNS processing. As one of the processor's ALU performance issues, the carry propagation during the addition operation limits the speed of arithmetic operation. In this paper review on $2^n + 1$ addition in the residue number system. The architecture design of CCS modular adder is simple and regular for various bit-width inputs. The review modulo adder in the aforementioned paper consists of a dual-sum carry look-ahead (DS-CLA) adder, a circular carry generator, and a multiplexer, which can reduce both number of slice and maximum combination path delay (MCPD).

Keywords:- Modulo Adder, Prefix Carry Computation Residue Number System (RNS), Moduli Set, Diminished-1 Number representation, VLSI design, Xilinx Software

Introduction

A Residue number system is a non-weight numeric system [1] which has gained importance during the last decade, because some of the mathematical operations can be divided into categories of sub-operations based on RNS [2]. Addition, subtraction and multiplication are performed in parallel on the residues in distinct design units (often called channels), avoiding carry propagation among residues [3]. Therefore, arithmetic operations such as, addition, subtraction and multiplication can be carried out more efficiently in RNS than in conventional two's complement systems. That makes RNS a good candidate for implementing variety of applications [4] such as: digital Signal Processing (DSP) for filtering, convolutions, FFT computation, fault-tolerant computer systems, communication and cryptography.

Choosing a proper moduli set greatly affects the performance of the whole system. The prevalent issue is that as the number of moduli increases the speed of the residue arithmetic units increases, whereas the residue-to-binary converters become slower and more complex. Thus, I carried out a detailed study on different moduli sets with different moduli numbers and different dynamic ranges and compared timing performance of systems based on them in order to determine the moduli number effect on the overall RNS timing performance and find out the most efficient set for each dynamic range. The study has been published in an international conference in Dubai, UAE [13] and an extended version of it has been published in the international journal of Emerging Trends in Computing and Information Sciences [14]. Based on the analysis and outcomes of this research, the unexpected issue I have ascertained is that, the number of moduli does not affect that much the overall delay of the system considering all its components. Five-moduli sets do not show any superiority over other sets taking into account the three components of RNS (modular adders, modular multipliers and residue to binary converters). Moreover the three-moduli set $\{2n+1 - 1, 2n, 2n - 1\}$ [4] showed the best timing performance concerning all the three components. Hence, there is no point for choosing a five-moduli set if the overall timing performance will be worse than that based on three or four-modulus sets.

DIMINISHED -1 NUMBER REPRESENTATION

The modulo $2^n + 1$ arithmetic operations require $(n+1)$ bit operands. To avoid $(n+1)$ -bit circuits, the diminished-1 number system [15] has been adopted. Let $d[A]$ be the diminished-1 representation of the normal binary number $A \in [0, 2^n]$, namely

$$d[A] = |A - 1|_{2^n+1} \quad (i)$$

In (i), when, $A \neq 0$, $d[A] \in [0, 2^n - 1]$ is an n -bit number, therefore $(n+1)$ -bit circuits can be avoided in this case. However,

$$A = 0, d[A] = d[0] = |-1|_{2^{n+1}} = 2^n \quad (\text{ii})$$

is an $(n+1)$ -bit number. This leads to special treatment for $d[0]$. The diminished-1 arithmetic operations [15] are defined as

$$d[-A] = \overline{d[A]}, \text{ if } d[A] \in [0, 2^n - 1] \quad (\text{iii})$$

$$d[A + B] = |d[A] + d[B] + 1|_{2^{n+1}} \quad (\text{iv})$$

$$d[A - B] = |d[A] + \overline{d[B]} + 1|_{2^{n+1}} \quad (\text{v})$$

$$\begin{aligned} d[AB] &= |d[A] \times d[B] + d[A] + d[B]|_{2^{n+1}} \\ &= |d[A] \times B + B - 1|_{2^{n+1}} \quad (\text{vi}) \end{aligned}$$

$$d[2^k, A] = iCLS(d[A], k) \quad (\text{vii})$$

$$d[-2^k, A] = iCLS(\overline{d[A]}, k) \quad (\text{viii})$$

Where $\overline{d[A]}$ represents the one's complement of $d[A]$. In (vii) and (viii) $iCLS(d[a], k)$ is the k -bit left-circular shift of in which the bits circulated into the LSB are complemented.

MODULO ADDER

Due to the fact that binary to residue converters are rather simple, little work has been dedicated to enhance their performance. Since my research dealt with special moduli sets rather than general moduli sets, the utilized components to obtain residues with respect to the moduli set $\{2n - 1, 2n, 2n + 1\}$ are presented in this section. Since the majority of moduli sets have moduli of the following forms $(2k - 1)$, $(2k)$ or $(2k + 1)$, thus, the illustrated forward converters can be used to obtain the RNS representation with respect to any of those sets. The most straightforward residue to obtain is the one with respect to modulo $2n$. This residue represents the least n bits of the binary number. Thus, no adders or any logical components are needed. However, computing a residue with respect to modulo $(2n - 1)$, demands two consecutive modulo $(2n - 1)$ adders. Instead of using this structure, a carry save adder with end around carry (CSA-EAC) followed by carry ripple adder with end around carry (CRA-EAC) can perfectly fulfill the task. This structure is shown in Figure 1.

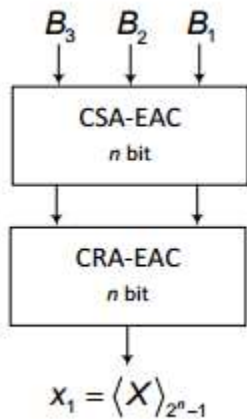
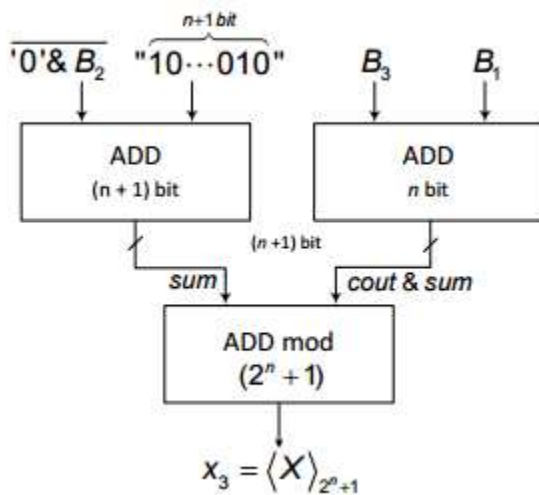


Figure 1: Proposed binary to residue converter – (a) modulo $(2n - 1)$ channel



(b) Modulo $(2n + 1)$ channel

The most difficult residue to obtain is the one with respect to $(2n + 1)$ modulo. Typically, this one requires modulo $(2n + 1)$ subtractor followed by modulo $(2n + 1)$ adder. This structure is rather complicated, since both components are complex and time consuming. However, by a proper extraction of the equations needed for the forward conversion process, the proposed structure of the component that computes the residue with respect to modulo $(2n + 1)$ is considerably simplified. It is realized using two parallel binary adders followed by modulo $(2n + 1)$ adder as illustrated in Figure 1 (b). Since one of the inputs of the first binary adder is constant, its structure can be simplified, the $(n + 1)$ full adders can be replaced by $(n - 2)$ half adders. However, this simplification does not reduce the delay (due to the second adder that adds $B1 + B3$), but the overall hardware complexity decreases.

Majority of the published structures of modulo $(2n - 1)$ adder perform addition first, and then apply the necessary correction, in order to get the correct result that corresponds to this modulo. The standard structure of this adder depends on two binary adders and a multiplexer. However, the proposed modular adder employs the prefix adders' concept in order to pre calculate the carry-out needed for the correction process. This design has been published in an international conference in Brno [1] and an extended version has been published in Electro Scope journal.

MODULO $(2N + 1)$ ADDER – BASED ON PREFIX CARRY COMPUTATION

Contrary to the previously proposed modulo $(2n + 1)$ adder, this one consists of $(n + 1)$ -bit circuits. However, it utilizes the concept of prefix carry computation used in parallel prefix adders in order to speed-up the computation process. This modular adder has been published in an international conference in Brno [2] and an extended version has been published in Electro Scope journal.

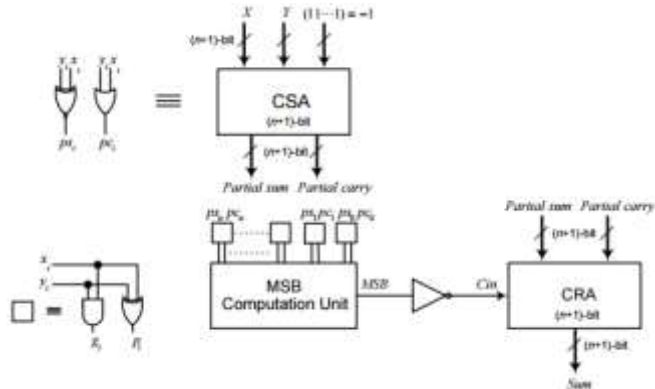


Figure 2: Proposed modulo $(2n + 1)$ adder - based on the prefix computation

The structure of the proposed adder is illustrated in Figure 2. The main concept of this adder is based on the prefix computation of the MSB of $(X + Y - 1)$, and then applying the necessary correction. This correction is represented in applying the correct carry-in into the CRA. To prove the efficiency of this adder, it was compared with another already published one, which was published in [9] and denoted as (k). This Modular adder (k) was chosen due to its superiority over other modular adders stated in [9]. Both adders were implemented on Spartan-3 xc3s200 FPGA.

RESULT AND SIMULATION

All the designing and experiment regarding algorithm that we have mentioned in this paper is being developed on Xilinx 14.1i updated version. Xilinx 9.2i has couple of the striking features such as low memory requirement, fast debugging, and low cost. The latest release of ISETM (Integrated Software Environment) design tool provides the low memory requirement approximate 27 percentage low. ISE 14.1i that provides advanced tools like smart compile technology with better usage of their computing hardware provides faster timing closure and higher quality of results for a better time to designing solution. ISE 14.1i Xilinx tools permits greater flexibility for designs which leverage embedded processors. The ISE 14.1i Design suite is accompanied by the release of chip scope ProTM 14.1i debug and verification software. By the aid of that software we debug the program easily. Also included is the newest release of the chip scope Pro Serial IO Tool kit, providing simplified debugging of high-speed serial IO designs for Virtex-4 FX and Virtex-5 LXT and SXT FPGAs. With the help of this tool we can develop in the area of communication as well as in the area of signal processing and VLSI low power designing. To simplify multi rate DSP and DHT designs with a large number of clocks typically found in wireless and video applications, ISE 14.1i software features breakthrough advancements in place and route and clock algorithm offering up to a 15 percent performance advantage. Xilinx 14.1i Provides the low memory requirement while providing expanded support for Microsoft windows Vista, Microsoft Windows XP x64, and Red Hat Enterprise WS 5.0 32-bit operating systems.

Device utilization summary:

Selected Device : v50ecs144-6

Number of Slices:	18	out of	768	2%
Number of 4 input LUTs:	32	out of	1536	2%
Number of bonded IOBs:	24	out of	98	24%

Figure 3: Device summary of 8-bit residue number

Device utilization summary:

Selected Device : v50ecs144-6

Figure 4: Device summary of 12-bit residue number

Number of 4 input LUTs:	50	out of	1536	3%
Number of bonded IOBs:	48	out of	98	48%

Figure 5: Device summary of 16-bit residue number

VI. CONCLUSION

The main aim of this paper was designing RNS based building blocks for applications in the field of DSP applications (binary-to-residue converter, residue-to-binary converter and residue adder).

The main RNS components have been introduced including a binary to residue converter, modular adders, modular subtractors, modular multipliers, a residue comparator, components for overflow and sign detection and correction and a residue to binary converter. The antithesis to the prevalent issue regarding the number of moduli within a set has been also presented. The three-moduli set $\{2n+1-1, 2n, 2n-1\}$ have shown the best timing performances among all other sets.

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Vibrational Analysis on Sandwich Composites in Aerospace Applications

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Abstract— This paper deals with the static and dynamic analysis of a sandwich beam, comprising of a honeycomb core layer and face layers, each with varying Fibre Reinforced Polymer (FRP) and metallic layers subjected to a) Simply supported and b) Clamped-clamped boundary conditions. It is observed that the thickness of the core layer influences both static and dynamic response. This type of analysis is useful in selecting the materials and their arrangement for the safe design of sandwich structures in view of strength and stiffness. The problem is modelled using in HyperMesh 14.0 and is analysed using MSc NASTRAN

Keywords—Sandwich composites; Mode shapes; Construction; Beam; Plate; Carbon fibres; HyperMesh; MSc NASTRAN.

INTRODUCTION

Sandwich structures are composite constructions of alloys, plastics, wood or other materials consisting of a core laminated and glued between two hard outer sheets (skins). The core is in general light weight foam or solid core, honeycomb, web core, tubular or corrugated/truss core. The facing skins of a sandwich panel can be compared to the flanges of an I-beam, as they carry the bending stresses to which the beam is subjected. With one facing skin in compression, the other is in tension. Similarly, the honeycomb core corresponds to the web of the I-beam. The core resists the shear loads, increases the stiffness of the structure by holding the facing skins apart, and improving on the I-beam, it gives continuous support to the flanges or facing skins to produce a uniformly stiffened panel. The core-to-skin adhesive rigidly joins the sandwich components and allows them to act as one unit with a high torsional and bending rigidity.

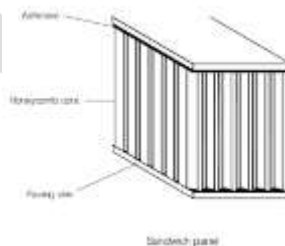


Figure-1. Construction of a sandwich panel.

Unlike structural components which exhibit fairly straight-forward dynamic response, honeycomb materials are somewhat more difficult to model mathematically. Because most high load bearing structures tend to implement high strength metal alloys, which usually have fairly straight-forward stress-strain and strain-displacement relationships, the dynamics of such structures are simple to formulate and visualize.

METHODOLOGY

Two different geometries are considered: A beam and a plate. Both beam and plate is modelled with fixed core thickness and varying face sheet thickness, and then with fixed face sheet thickness and varying core thickness. In the second step the face sheet is changes from metallic to composite and the results are compared for static deflection with different total thickness to core layer thicknesses. the plate is considered under simply supported as well as clamped conditions. the plate is analysed only using simply-supported condition.

Parameter	Value
E	7e4 MPa
ν	0.3
ρ	1e-6 Kg/mm ³

Table - 1. Material properties of metallic face sheet

Parameter	Value for face sheet	Value for honeycomb
E1	1.3e5 MPa	400 MPa
E2	1e4 MPa	1 MPa
ν_{12}	0.35	0.05
G12	5e3 MPa	150 MPa
ρ	1.6e-6 Kg/mm ³	3.7e-8 Kg/mm ³

Table - 2. Material properties of composite face sheet and honeycomb

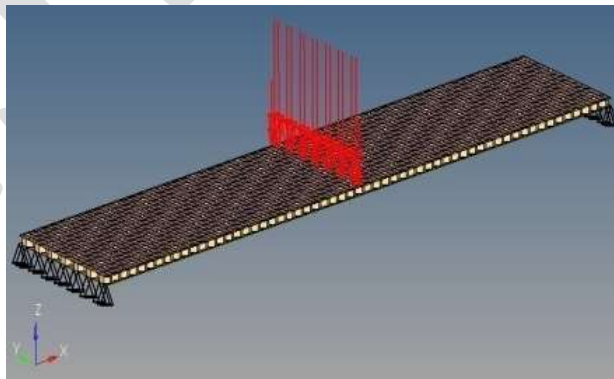
FINITE ELEMENT MODELLING AND ANALYSIS

A. Modelling:

A Three layered sandwich beam and plate of 0.5 m length, 0.1m wide and 0.004 m height is modelled in HyperMesh 14.0 Software using CQuad4 elements. The thickness of the face sheets is varied as per t_2/h ratio (0.6, 0.7, and 0.8). Where t_2 is core layer thickness and h is the total height of the beam. The core layer is located at the centre of the beam.

B. Analysis:

A line load of 1000N is applied at the top centre nodes of the beam shown in Figure6 after meshing. A pressure load of 1.5 KN/m² is applied on the top face sheet of the plate for both the TYPE-A and TYPE-B plates (Figure2). For the analysis of sandwich plates, simply supported boundary condition is used i.e., this simply supported boundary condition is applied to both the cases of plates. once the static analysis is done modal analysis is done to get the natural frequency.



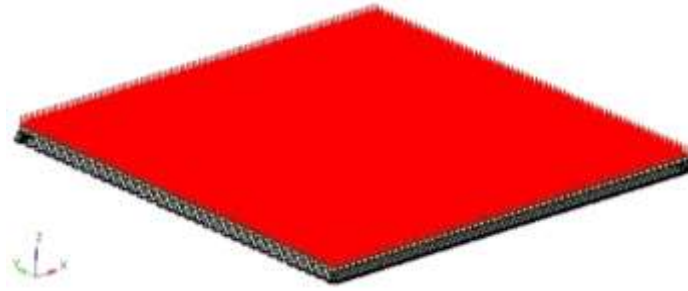


Figure - 2. Beam and plate with applied loads and BC's

RESULTS AND DISCUSSIONS

The static deflection versus the t_2/h ratios are plotted and are observed as follows:

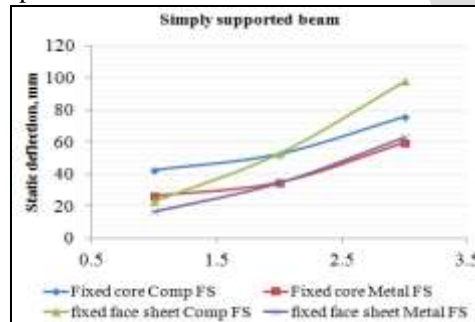


Figure - 3. Comparison of static deflection in simply supported beam

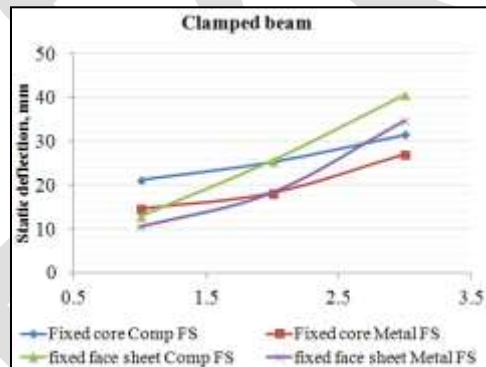


Figure - 4. Comparison of static deflection in clamped beam

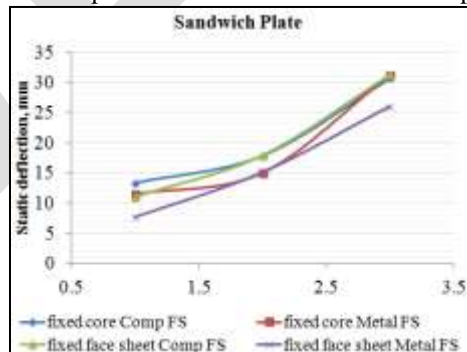


Figure - 5. Comparison of static deflection in simply supported plate

It is observed that the static deflection is increasing with the increase in t_2/h value because beam stiffness is decreasing. Fig.4 shows the variation of static deflection with respect to t_2/h for all the cases of beam conditions considered. Figure - 5 shows the variation of static deflection in simply supported plate. The dynamic analysis (modal analysis) is performed on the beam under simply supported loading conditions and clamped boundary conditions subjected to line load at the top centre nodes of the beam. The First four mode shapes of the beam for $t_2/h = 0.7$.

Model	Mode 1	Mode 2	Mode 3
Fixed core with composite face sheet(clamped)	2.65	7.59	9.21
Fixed core with composite face sheet(Simply supported)	4.20	9.34	10.91
Fixed core with metallic face sheet(clamped)	6.20	13.36	14.16
Fixed core with metallic face sheet(simply supported)	4.13	11.45	11.93

Table - 3. Mode frequencies of the beam

Model	Mode 1	Mode 2	Mode 3
Composite face sheets	4.73	9.78	9.81
Metallic face sheets	6.49	13.17	13.31

Table - 4. Mode frequencies of the plate

MODE SHAPES

The first four mode shapes of the beam are captured for all the cases and Figure 11 (a-d) represent the contour plots of first four mode shapes for simply-supported beam with composite face layers. Here we can observe that the 0.7 thickness ratio of fixed core and fixed face sheet (Type - A & B models) are the same.

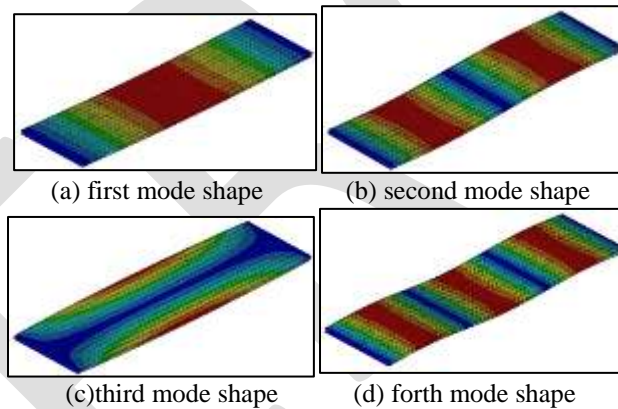


Figure - 6. Mode shapes of the beam

The mode shapes of the second type of the beam also looks similar.

There is an increase in frequency with mode number and decreasing trend with respect to t_2 is observed. Increase in t_2 causes for the reduction in stiffness of the structure resulting in decreasing the natural frequencies.

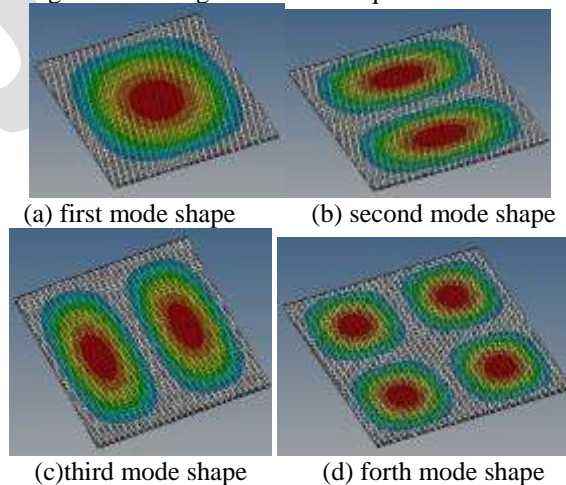


Figure - 6. Mode shapes of the plate.

CONCLUSIONS

The following conclusions can be drawn from the analysis:

- The static deflection (δ) is increasing with t_2/h value for beam subjected to clamped- clamped and simply supported boundary conditions for same loading.
- The model frequency values of the beam increased with t_2/h value.
- The static deflection (δ) is decreasing with t_2/h value for beam subjected to clamped- clamped and simply supported boundary conditions for same loading. The model frequency values of the beam decreased with t_2/h value.

The present analysis can be extended in following ways:

- Composite layers can be considered for the manufacturing of honeycomb core.
- Contact bonding between the honeycomb core and the face sheets can be analysed.
- Further analysis can be done on the lap joint of the honeycomb sandwich plates.
- The honeycomb materials can be analysed further in the component point of view as well.

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Additive Manufactured Aircraft Brake Housing Design Assessment Using Finite Element Analysis

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Abstract- The braking action generates a torque which transmits a braking force into the wheel and brake assembly which brings an aircraft to a stop. The aircraft brake housing experiences a large number of fluctuating or cyclic loads during its service life. Therefore, design assessment, optimization and fatigue analysis has been considered in the design process. The present research focuses on three major sections: static structural analysis, high cycle fatigue analysis and tie bolt strength analysis for severe brake operating pressure conditions. Results are correlated using empirical results. Proposed aircraft brake housing design meets the minimum performance standards as specified in the TSO - C135.

Keywords- Aircraft Brake Housing, Additive Manufacturing, Direct Metal Laser Sintering, Brake Operating, Pressure, Fatigue, S-N Method, Goodman Diagram, Tie Bolt.

1. INTRODUCTION

Aircraft Braking System is one of the critical subsystems of an aircraft and is often configured along with the aircraft structure because of its substantial influence on the aircraft structural configuration itself. Braking System and Landing gear detail design is taken up early in the aircraft design cycle due to its long product development cycle time. The need to design these with minimum weight, minimum volume, reduced life cycle cost and development cycle time, poses many challenges to designers and practitioners. These challenges have to be met by employing advanced technologies, materials, analysis methods, processes and product methods. Various design and analysis tools have been developed over the years and new ones are still being developed.

An aircraft braking system is given in Figure 1. As shown, the brake is composed of a stack of rotating brake discs (rotors) which engage the wheel, and stationary brake discs (stators), which engage the torque tube. The torque tube is attached to the brake housing that links to the landing gear through a torque take-out rod. During operation, the brake is activated by the fluid pressure, which compresses the heat stack: the rotors and the stators are squeezed together by fluidic pistons and the brake produces torque by virtue of which aircraft stops.

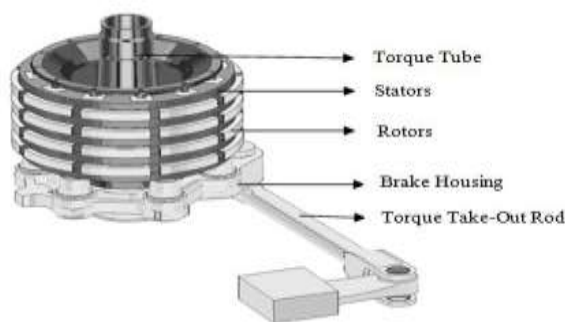


Figure 1: Aircraft Brake System.

Additive manufacturing (AM) is a process of making a three-dimensional solid object of virtually any shape from a digital model. The aerospace industry expects to derive value from additive manufacturing in the aerospace field at the strategic level. The four supposedly critical aspects of AM in the aerospace industry are (1) reduction of lead times, (2) reduction of component weight, (3) reduction of both production and operational costs, and (4) reduction of the negative environmental impacts of production. Numerous additive manufacturing technologies have been developed since the mid-eighties, including stereo lithography (STL) as oldest technology as well as laminated object manufacturing (LOM). In addition, technologies such as direct and indirect laser sintering (LS) have become established. Out of the various processes we have preferred Direct Metal Laser-Sintering process because of its higher accuracy, surface quality and freedom to design.

Direct metal laser-sintering (DMLS) is a production method for creating metal parts. It works by taking 3D geometry data such as a CAD file or scan data, which are sliced into layers by software. From this layer data, laser exposure vectors are calculated for each layer of the build process. In the production machine, very thin (typically between 20 and 60 μm) layers of metal powder are applied onto a powder bed, the surface of which is selectively exposed using a scanned, focused laser beam. The energy of the laser beam melts the powder in the exposed areas, creating a metallic bond to the surrounding exposed material including the previous layer. The process of applying and exposing layers is repeated, thereby creating solid metal parts additively, layer by layer, from the powder material.

2. METHODOLOGY

- Design and numerical modeling of the required Aircraft Braking System parts are modeled in Part Design and then assembled in Assembly workbench of CATIA. This model is now imported to ANSYS, where meshing and Finite Element Analysis is carried out.
- The assembly is subjected to various load conditions such as Maximum brake operated pressure, Proof and burst pressure conditions.
- Static linear finite element analysis is performed to determine the strength margins for design substations.
- Optimization of the design values for Additive Manufacturing.
- High cycle Fatigue analysis is performed to determine the Cumulative Fatigue Damage for Brake housing.
- Tie-Bolts strength assessment is performed.

3. GEOMETRICAL CONFIGURATION OF AIRCRAFT BRAKE HOUSING

3.1 Modeling

The 3D CAD model of Aircraft Brake Housing and Tie-Bolts are developed using CATIA V5 software separately, later assembled for tie bolt strength analysis. The modeled Brake housing and assembly of Brake housing with Tie-Bolts are imported to ANSYS Workbench, where analysis is carried out for various loads and various conditions.

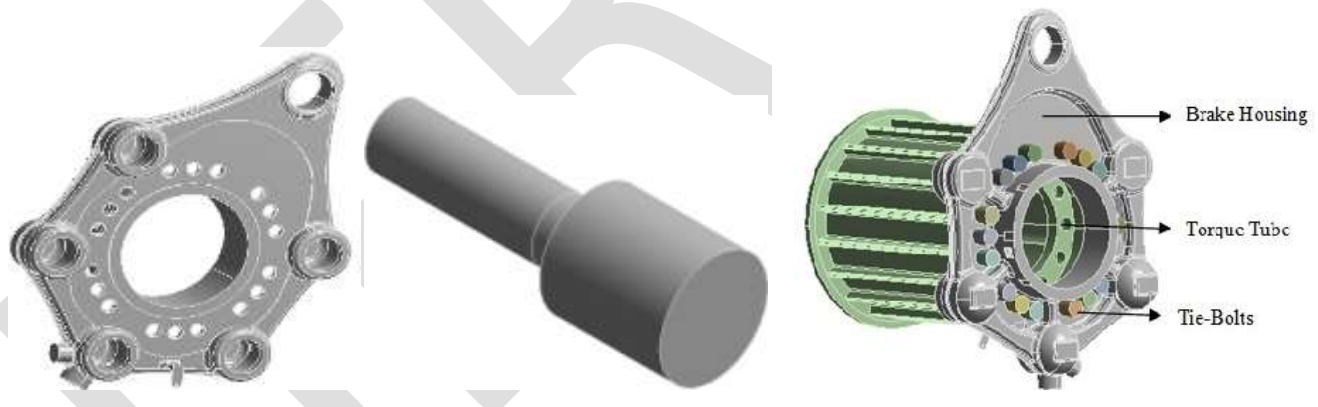


Figure 3.1: CAD models of Brake housing, Tie-Bolt & Assembly.

3.2 Material Properties

Aluminium 2014 T6 is the second most popular of the 2000 series aluminium alloys, after 2024 aluminium alloys. It is commonly extruded and casted. It is easily machined in certain tempers; having high hardness, difficult to weld and mainly this alloy are used for cycling frames and components. Inconel-718 is a high strength, corrosion resistance nickel chromium material, ease and economy. Inconel-718 can be fabricated, combined with good tensile, fatigue, creep and ruptured strength.

Al 2014-T6 material is used in aircraft brake housing component design and Inconel-718 material is used in tie-bolt design. The material properties of Aluminium and Inconel-718 are listed in Table 3.1 and Table 3.2 respectively as per the tie bolt design consideration.

Table 3.1: Material Properties of Al2014-T6 (Brake Housing)

DESCRIPTION	VALUE
Young's Modulus (E)	72700 MPa
Poisson's ratio (ν)	0.33
Density (ρ)	2.8×10^{-6} kg/mm ³
Yield Strength (σ_y)	380 MPa
Ultimate Strength (σ_u)	435 MPa
Mass of Aircraft Brake Housing Component	6.7 kg
Volume of Aircraft Brake Housing Component	2.4×10^6 mm ³

Table 3.2: Material Properties of Inconel-718 (Tie- Bolts).

DESCRIPTION	VALUE
Young's Modulus (E)	190×10^3 MPa
Poisson's ratio (ν)	0.29
Density (ρ)	8280 kg/m ³
Yield Strength (σ_y)	552 MPa
Ultimate Strength (σ_u)	1411 MPa
Mass of Tie-Bolt	0.12 kg
Volume of Tie-Bolt	15738 mm ³
Shear Strength	353.3 MPa

3.3 Meshing

The CAD models are imported to ANSYS 16.0 Work bench where the meshing and analysis is carried out. Here carefully, the critical regions are selected for fine mesh such as Passage Hole, Lug Region, Critical fillet Region, Piston Area and Rib region. Brake Housing is meshed with tetra and Tie Bolts with Hex dominant mesh.



Figure 3.2: Meshed CAD models of Brake housing, Tie-Bolt & Assembly.

4. STRUCTURAL ANALYSIS OF BRAKE HOUSING

As per the TSO - C135 standards, Aircraft brake housing is evaluated for various static loading conditions. The stress observed in the aircraft brake housing must be within the material yield or ultimate strength limit. Static requirements for aircraft brake housing are listed in Table 4.1.

- As per FAR 25.1435: Proof Pressure = $1.5 \times \text{Maximum Operating Pressure}$
□□ As per FAR 25.1435: Burst Pressure = $2 \times \text{Maximum Operating Pressure}$

Table 4.1: Static Load Requirements

Static Load conditions	Pressure (MPa)
Maximum Operating Pressure	21.37
Proof pressure	32.06
Burst pressure	42.74

4.1 Boundary Conditions

The fastener bolts tied between brake housing and torque plate transfers the high torque load from the torque pin and supports the aircraft brake housing. In static structural and fatigue analysis the brake housing part is only considered and bolts analysis is discussed separately. Therefore, tie bolt holes are constrained in all DOF's (Degrees of Freedom) = 0.

4.2 Maximum Operating Pressure

The piston-cylinder, piston area and lug regions are considered for loading conditions. The piston end load on piston area in cylinder top, brake pressure in cylinder and maximum structural torque at lug region are considered and applied as per the requirement.

Calculation of Piston End Load and Structural Torque

Maximum Operating Pressure = 21.37 MPa.

Piston Area = 1275.29 mm^2 .

Maximum Piston End Load = Operating Pressure x Piston Area
= $21.37 \times 1275.29 = 27.27 \text{ kN}$.

Maximum Structural Torque = $1.44 \times \text{Load} \times \text{Loaded Radius}$
= $1.44 \times 26310 \times 170$
= $64407 \times 10^6 \text{ N-mm}$.

(As per ARP5381 for gear with main wheels and brakes)

Piston end load of 27.27 kN is applied on the end face with respect to local coordinate system in negative X-direction and Brake pressure of 21.37 MPa is applied and Torque as shown in Figure 4.1.



Figure 4.1: Application of load and torque.

4.3 Proof Pressure

Same model and boundary condition has been used in Proof pressure analysis as maximum operating pressure analysis. However, there is no torque load applied in this condition. The piston end load of 40.8 kN and brake pressure of 32.06 MPa is applied.

4.4 Burst Pressure

Same model and boundary condition has been used in Burst pressure analysis as maximum operating pressure analysis. However, there is no torque load applied in this condition. The piston end load of 54.5 kN and brake pressure of 42.74 MPa is applied.

4.5 Results

Total deformation plot and Equivalent Von-Mises Stress Plot is taken at all the critical parts in all the pressure requirement cases and values are tabulated as shown in below table.

Table 4.2 (i) (ii) Results of Maximum operating and Proof Pressure condition

Load Case	Description	Maximum Stress (MPa)				Material Yield Strength (MPa)
		Lug Region	Passage Hole	Inside Cylinder	Critical fillets	
1	Maximum operating Pressure	291.95	126.88	112.12	144.78	380
2	Proof Pressure	43.16	176.18	143.41	119.10	380

(i)

Load Case	Description	Margin of Safety (FOS-1)			
		Lug Region	Passage Hole	Inside Cylinder	Critical Fillets
1	Maximum operating Pressure	0.3	2.0	2.4	1.6
2	Proof Pressure	7.8	1.2	1.6	2.2

Table 4.3 (i) (ii) Results of Burst Pressure condition.

Load Case	Description	Maximum Stress (MPa)				Material Ultimate Strength (MPa)
		Lug Region	Passage Hole	Inside Cylinder	Critical fillets	
1	Burst Pressure	57.55	234.91	191.22	158.80	435

(i)

Load Case	Description	Margin of Safety (FOS-1)			
		Lug Region	Passage Hole	Inside Cylinder	Critical fillets
1	Burst Pressure	6.6	0.9	1.3	1.7

From the above table it is clear that, the maximum stresses observed in all critical regions of the aircraft brake housing component are less than the material allowable yield and ultimate strength and thereby having a positive design margin. Hence Design is Safe.

4.6 Optimizing Design values for Additive Manufacturing.

According to the Engineering Laboratory, Material standard for Additive Manufacturing, National Institute for standards and Technology, when properly processed, the static mechanical properties of Additive Manufactured metallic materials are comparable to conventionally fabricated metallic components. The relatively high cooling rates achieved reduce partitioning and favour reduced grain sizes. The yield strength of the components decrease by 9% and upon controlled cooling it will further decrease by 26%. Hence there will be a total decrease of 35% in yield strength. According to this, Yield strength of Al2014-T6 will be 247 MPa (35% of 380 MPa).

Design values from result summary:

Table 4.4 (i) (ii) Results of Maximum operating and Proof Pressure condition.

Load Case	Description	Maximum Stress (MPa)				Material Yield Strength (MPa)
		Lug Region	Passage Hole	Inside Cylinder	Critical fillets	
1	Maximum operating Pressure	291.95	126.88	112.12	144.78	247
2	Proof Pressure	43.16	176.18	143.41	119.10	247

(i)

Load Case	Description	Margin of Safety (FOS-1)			
		Lug Region	Passage Hole	Inside Cylinder	Critical fillets
1	Maximum operating Pressure	-0.15	0.95	1.20	0.70
2	Proof Pressure	4.70	0.40	0.72	1.07

From the above Table, For Maximum operating Pressure condition at Lug region Margin of safety is negative, which is not acceptable. Hence it is to be redesigned by adding material locally at the lug region.

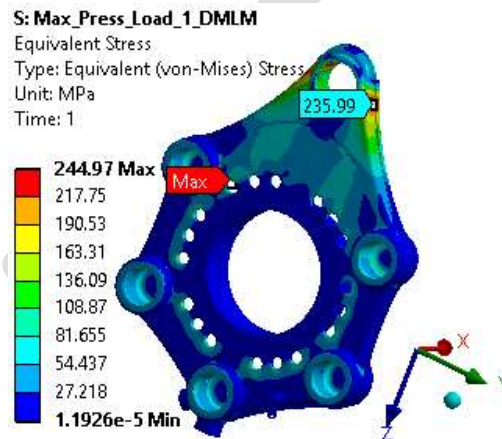


Figure 4.2 Equivalent Von-Mises stress.

After adding material at Lug region, the maximum Von-Mises stress at Lug region is found to be 235.99 MPa. Since the maximum Von-Mises stress at Lug region is less than the yield strength of 247 MPa. Hence design is safe.

$$\text{Margin of Safety (MOS)} = 247/235.99 - 1 = 0.04$$

Takeaway: The maximum stresses observed in all critical regions of the aircraft brake housing component are less than the material allowable yield limit of 247 MPa and thereby having a positive design margin.

5. FATIGUE ANALYSIS

As per the TSO - C135, fatigue requirements for aircraft brake housing are listed in Table 5.1. Ref. ARP 5381. The BRPDL “brake rated pressure for the design landing” is determined from the normal of the peak brake pressures from the 100 normal stop tests. The BRPDL pressure used is 12.41 MPa, from brake performance data.

Table 5.1 Fatigue Life Requirements.

Load Case	Brake Pressure Cycle	Required Number of cycles
Design Landing Pressure	12.41 MPa	100000
Maximum Operating Pressure	21.37 MPa	5000

5.1 Design Landing Pressure

Piston end load of 15.83 kN is applied on the end face with respect to local coordinate system in positive X – direction and brake pressure of 12.41 MPa is applied in the pressure cavity include passage hole region.

5.2 Maximum Operating Pressure

Same model and boundary condition has been used in maximum pressure fatigue analysis as design landing pressure condition. However, brake pressure of 21.37 MPa and piston end load of 27.27 kN is applied.

5.3 Results

5.3.1 Design Landing Pressure

The maximum displacement of 0.12 mm is observed at fluid inlet region. It is more than the displacement value of design landing pressure condition and it is less than the displacement observed in static structural analysis. The maximum von-Mises stress of 68.2 MPa is observed in passage hole fillet region and it is less than the material allowable yield limit of 380 MPa.

Fatigue Estimation Based on SN Method

S-N diagram plots nominal amplitude stress versus cycles to failure. S-N method does not function admirably in low cycle applications.

Goodman diagram can be used to estimate a failure condition. It plots stress amplitude against mean stress with the fatigue limit and the ultimate strength of the material as two extremes.

S-N Curve and Goodman Diagram for the maximum stress are shown in Figure 5.1(i) (ii). Maximum stress is observed in passage hole fillet region and empirical results are shown for corresponding maximum value.

- i. $\sigma_{\max} = 68.2 \text{ MPa}$.
- ii. $\sigma_{\min} = 0 \text{ MPa}$. (Because of Repetitive loading)
- iii. $\sigma_a = \frac{\Delta\sigma}{2} = \frac{\sigma_{\max} - \sigma_{\min}}{2} = 34.1 \text{ MPa}$.
- iv. $\sigma_m = \frac{\sigma_{\max} + \sigma_{\min}}{2} = 34.1 \text{ MPa}$.
- v. Corrected Alternating Stress (σ_{ac}) to make $\sigma_m = 0$.
 $\sigma_{ac} = \sigma_a / (1 - \sigma_m / \sigma_u) = 34.1 / (1 - 34.1 / 435) = 37 \text{ MPa}$.
- vi. Fatigue Strength Margin = Endurance Factor of Safety-1
$$= \frac{\text{Endurance Strength}}{\text{FE stress}} - 1$$
$$= \frac{193}{37} - 1$$
$$= 4$$

Since Fatigue Strength Margin > 1, Hence Design is safe.

- vii. Fatigue Damage at Passage Hole = Required Cycles / Actual Cycles
$$= (1e5) / (1.4e13)$$
$$= 0$$

Since Fatigue Damage < 1, Hence Design is safe.

- viii. The Fatigue Damage effect is extremely weak and negligible on aircraft brake system for 1e5 cycles.

Aircraft brake housing passage hole fillet region is having a corrected alternating stress of 37 MPa and it is less than the material endurance strength of 193 MPa and there by having an infinite design life of more than 1e6 cycles.

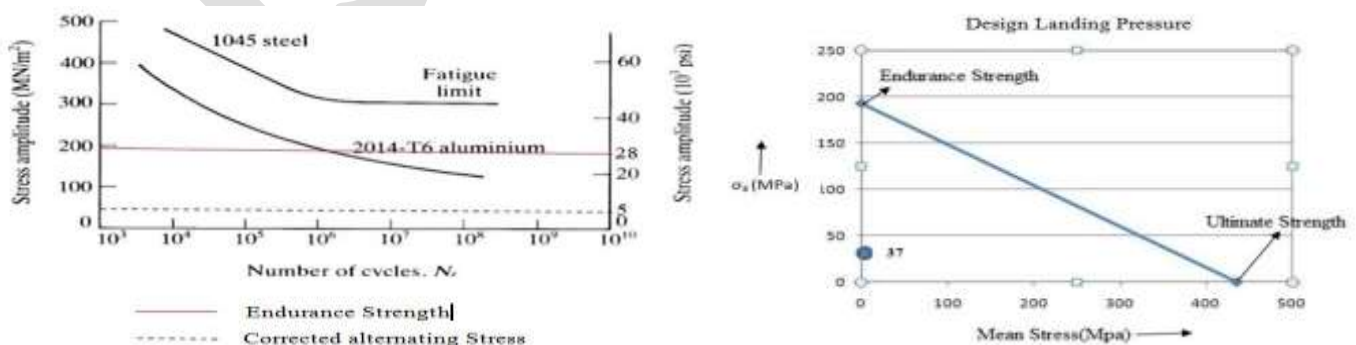


Figure 5.1(i) (ii) Graphs Showing SN curve and Infinite Design Life Curve.

From the above graph it's clear that, the corrected stress value lies below the Infinite life curve hence the design is safe.

5.3.2 Maximum Operating Pressure

The maximum displacement of 0.2 mm is observed at fluid inlet region. It is more than the displacement value of design landing pressure condition and it is less than the displacement observed in static structural analysis. The maximum von-Mises stress of 117.45 MPa is observed in passage hole fillet region and it is less than the material allowable yield limit of 380 MPa.

Fatigue Estimation Based on SN Method

S-N Curve and Goodman Diagram for the maximum stress are shown in Figure 5.2(i) (ii). Maximum stress is observed in passage hole fillet region and empirical results are shown for corresponding maximum value.

- i. $\sigma_{\max} = 117.45 \text{ MPa}$.
- ii. $\sigma_{\min} = 0 \text{ MPa}$. (Because of Repetitive loading)
- iii. $\sigma_a = \frac{\Delta\sigma}{2} = \frac{\sigma_{\max} - \sigma_{\min}}{2} = 58.73 \text{ MPa}$.
- iv. $\sigma_m = \frac{\sigma_{\max} + \sigma_{\min}}{2} = 58.73 \text{ MPa}$.
- v. Corrected Alternating Stress (σ_{ac}) to make $\sigma_m = 0$.
 $\sigma_{ac} = \sigma_a / (1 - \sigma_m / \sigma_u) = 58.73 / (1 - 58.73 / 435) = 67.9 \text{ MPa}$.
- vi. Fatigue Strength Margin = Endurance Factor of Safety-1
$$= \frac{\text{Endurance Strength}}{\text{FE stress}} - 1$$
$$= \frac{193}{67.9} - 1$$
$$= 1.8$$

Since Fatigue Strength Margin > 1, Hence Design is safe.

- vii. Actual number of cycles at 67.9 MPa for Maximum Stress Location: >1e6 Cycles
- viii. Fatigue Damage at Passage Hole = Required Cycles / Actual Cycles
$$= (5000) / (3e10)$$
$$\approx 0$$

Since Fatigue Damage < 1, Hence Design is safe.

- ix. The Fatigue Damage effect is extremely weak and negligible on aircraft brake system for 1e5 cycles.

Aircraft brake housing passage hole fillet region is having a corrected alternating stress of 67.9 MPa and it is less than the material endurance strength of 193 MPa and there by having an infinite design life of more than 1e6 cycles.

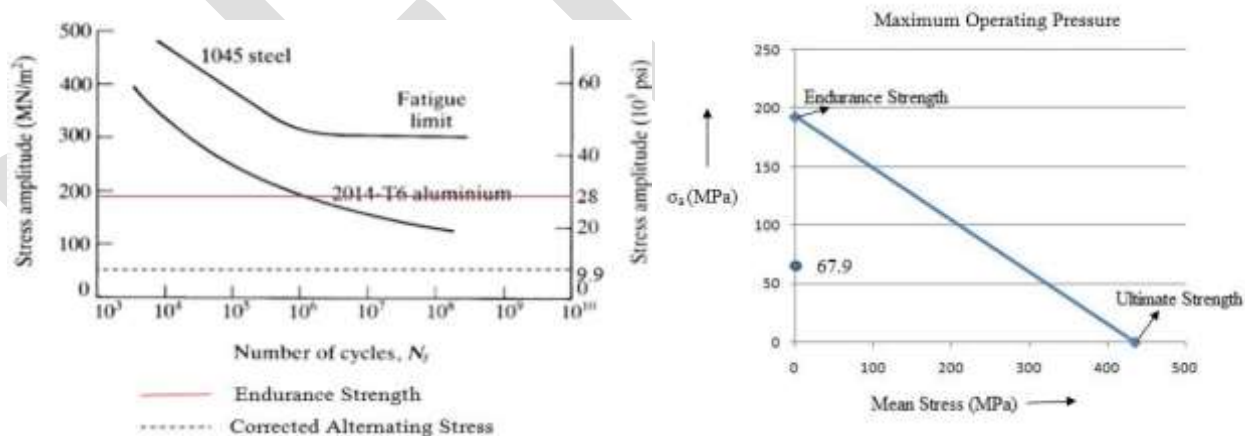


Figure 5.2(i) (ii) Graphs Showing SN curve and Infinite Design Life Curve.

From the above graph it's clear that, the corrected stress value lies below the Infinite life curve hence the design is safe.

6. TIE BOLT STRENGTH ANALYSIS.

6.1 Boundary Conditions

Aircraft Torque Tube is constrained in all degrees of freedom as shown in Figure 6.1.

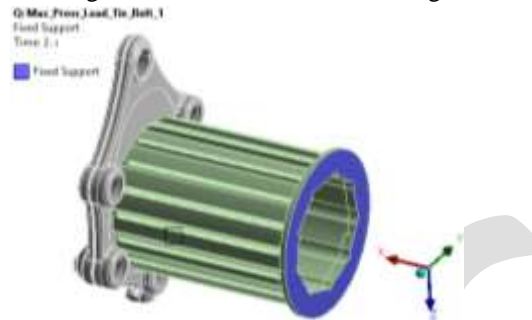


Figure 6.1: Boundary condition applied to Torque Tube.

6.2 Tie Bolt Preload (Load Step-1)

Tie bolt assessment is analyzed in two load steps. Bolt preload is defined in load step-1 and its deformation is retained for load step-2 where other mechanical loads (proof and burst loads) are defined. To be on the conservative side, applied preload is 30% less as compared against the yield load limit. Based on torque tension relationship, bolt preload at yield is 91505 N. Bolt preload of 64054 N is applied in load step-1 with respect to local ordinate system in axial direction as shown in Figure 6.2.

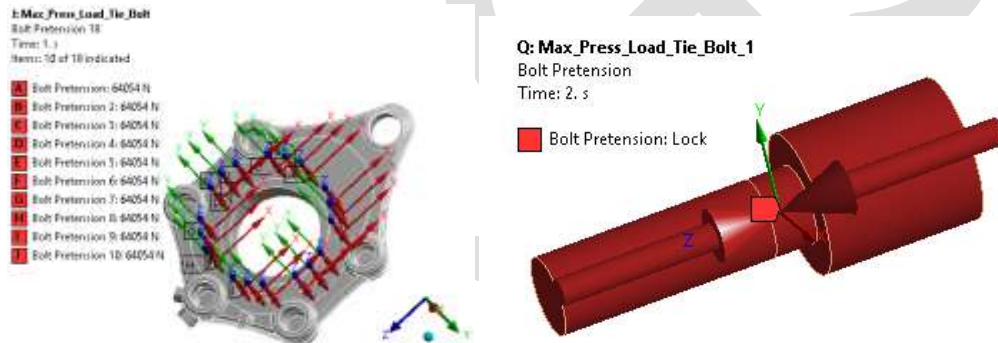


Figure 6.2 Bolt Pretensions.

6.3 Maximum Operating Pressure

In Load Step 2, Piston end load of 27.27 kN is applied on the end face with respect to local coordinate system in negative X-direction and Brake pressure of 21.37 MPa is applied in Cylinder.

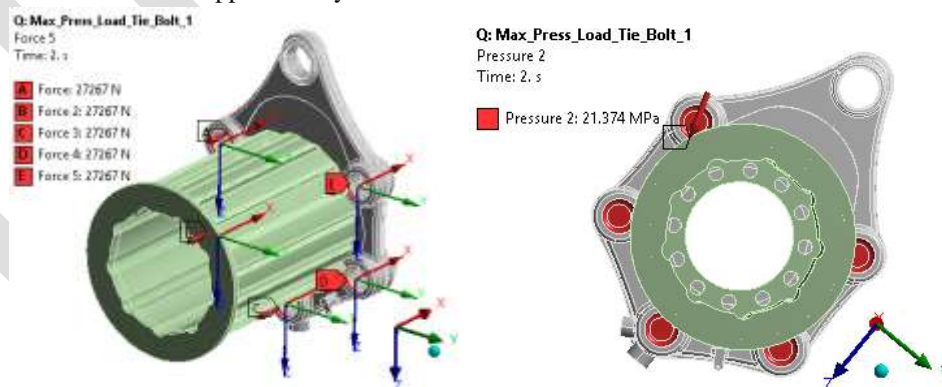


Figure 6.3 Load conditions.

6.4 Results

a) Tie Bolt Axial Displacement (Z-Direction)

Total deformation from Ansys is 0.09 mm.

From Empirical relations we have

- Deflection equation for Tensile Load $= \frac{PL}{AE}$
- Where, Bolt Pre Load (P) = 64054 N.
- Length of the shank (L) = 41.91 mm.

- iv. Diameter of the shank (D) = 12.7 mm.
- v. Area = 126.68 mm².
- vi. Young's Modulus (E) = 2x10⁵ N/mm².

Therefore,

$$\text{Deflection} = \frac{64054 \times 41.91}{126.68 \times 2 \times 10^5} = 0.1 \text{ mm.}$$

Estimated tie bolt displacement of 0.09 mm closely matches with the empirical result of 0.1 mm.

b) Normal Stress Plot

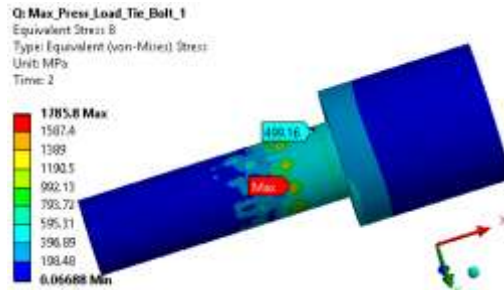


Figure 6.4: Normal Stress Plot

Maximum normal stress of 499.16 MPa observed at the shank is considered as shown in Figure 6.4 and validated to normal stress using empirical results.

$$\text{Normal Stress} = \frac{\text{Load}}{\text{Area}} = \frac{64054}{126.68} = 505.64 \text{ N/mm}^2.$$

Estimated normal stress of 499.16 MPa is less than material allowable yield limit of 552 MPa and thereby having a positive design margin of 0.1. The estimated normal stress of 499.16 MPa closely matches with empirical result of 505.64 MPa.

c) Shear Stress Plot

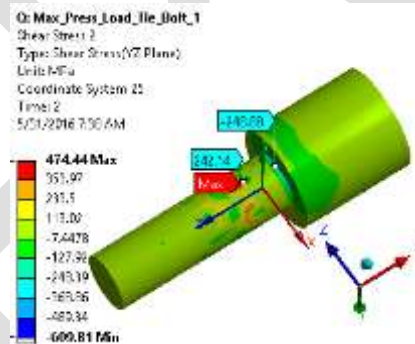


Figure 6.5 Shear stress plot.

Maximum Shear stress of 248.88 MPa observed on the shank is considered as shown in Figure 6.5 and validated to Shear stress using empirical results.

- i. Tie Bolt Allowable Shear Strength = 353.3 MPa
- ii. Diameter of shank (D) = 12.7 mm.
- iii. Length of shear (L) = 20.95 mm.
- iv. Shear Area = D x L = 12.7 x 20.95 = 266.12 mm.
- v. Shear load = 63.89 kN
- vi. Shear Stress = $\frac{\text{shear Load}}{\text{shear Area}} = \frac{63890}{266.12} = 240 \text{ N/mm}^2$.
- vii. Shear Margin of Safety = $\frac{353.3}{240} - 1 = 0.5$

Maximum shear stress of 248.88 MPa is less than allowable shear strength of 353.3 MPa and thereby having a positive design margin of 0.5. The estimated shear stress is closely matches with empirical result of 240 MPa.

Similarly the analysis can be done for Proof and Burst Pressure requirements.

7. CONCLUSION

It is concluded that Additive Manufactured aircraft brake housing design provides the best solution with regards to acceptable maximum operating, proof and burst pressure design margins as per the TSO-C135 minimum performance standards. The following analysis for the aircraft brake housing proves the design substantiation as per the TSO-C135 guidelines. Results shows that aircraft brake housing and tie bolt are safe under all brake operating pressure conditions.

- 1) Structural analysis of the aircraft brake housing shows the maximum displacement is observed at lug top edge region and the maximum von-Mises stress is observed in passage hole region. All observed stress values are within the safe limits for the aluminum 2014 - T6 material.
- 2) Aircraft brake housing is having infinite fatigue life of more than $1e6$ cycles. It satisfies the design requirements of $1e5$ cycles for design landing pressure and 5000 cycles for maximum operating pressure conditions.
- 3) Aircraft brake housing tie bolt meets tensile and shear strength requirements. Estimated results are within the safe limits for the Inconel-718 material and closely match with empirical results.

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ASSESSMENT OF ENERGY DEMAND AND SUPPLY FRAMEWORK IN BOTSWANA

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Abstract— This paper gives a complete examination of the prospect of further development of energy sector in Botswana. As per word bank sources, it has been found that, only 53.2% of family units have access to electrical power in country territories of Botswana. Circulation of power is troublesome in light of the fact that little towns are spread out over an expansive desert. The expense of amassing electrical cables to remote towns is high, and the low energy utilization by the little and poor townships won't pay off the hypothesis. According to a study done the patterns in Botswana demonstrates that renewable energy sources e.g., solar based, biofuel, or wind power can give energy to provincial towns more economically than by association with a national electrical grid. The paper depends on different government and other related documentations investigations, site visits in the Botswana's vitality area and present status of awareness and supply. In this study, a PPP model is suggested which aims to increase the employment as well as to fulfill the demand for power and energy in the country. It is contemplated that, there is a need of appropriate policies, observing and arrangement making for the development, usage and establishment of integrated and hybrid renewable power based plants.

Keywords— PV, GDP, Biofuel, electricity, NDP, energy supply.

INTRODUCTION-

Botswana is one of the fastest growing economies in Africa, because of its being the world's biggest maker of precious stones. Botswana is a sheltered nation, with a stable just government and a low wrongdoing rate, a significant part of the nation is secured by sandy soils. The eastern regions have slopes and seepage sorrows which encourage the Limpopo River. These soils are basically sandy top soils to sandy mud soils, with shallow skeletal soils where overwhelming, sporadic precipitation washes recently framed soil materials into low lying zones and down seepage lines. The soils are accordingly primarily alluvia. Water is gotten by penetrating boreholes to a profundity of around 200 m, where it is found in fossil, underground tanks. In a few regions in the amazing west boreholes dive as deep as 500 m. On the off chance that discussing the wellspring of energy and power, it has been commanded by an overdependence on coal as an essential source of energy, to a great extent in view of its plenitude and claimed cost-viability. Botswana has an expected 212.8 Billion metric huge amounts of coal stores found in different areas, albeit just the stores at Morupule are being mined for power era [12]. Morupule Power Station, close Palapye, represents 80% of Neighborhood generation. Botswana, similar to a few different nations in the Southern Africa sub district. Depends on modest, plenteous, and electric power from South Africa [11]. The greater part of Botswana's refined oil needs are supplied by South Africa, aside from a little supply toward the western part of the nation by Namibia country. Botswana is geographically level, with up to 70 percent of its domain being the Kalahari Desert. It covers an area range of 581730 km² between roughly 20° and 29° E and 18° and 27° S. The chief area spread is characteristic field, Shrubland and forest, a quarter of which is moderated in parks or holds. A significant part of the nation comprises of the Kalahari, an immeasurable, dry sandy range of inadequate populace however bottomless natural life. The wetlands of the Okavango Delta and Chobe River in the north are of global significance for the protection of biodiversity, as perceived under the RAMSAR Convention. The present populace of Botswana is 1.5 million, of which half live in provincial territories. The per capita GDP in 1994 was US\$ 2 800. Botswana is a creating nation, with a glad record of enduring change in the personal satisfaction of its kin, and a stable majority rule political framework. The economy depends on mining, (especially precious stones, additionally copper-nickel, coal and pop cinder), light assembling, tourism and domesticated animals. Commitments of the different segments to the GDP are: mining 35.7%, general government 15.6%, banks, protection and business 10.1%, exchange, lodgings and eateries 8.3%, development 6.5%, producing 4.6%, agribusiness 4.4%, transport and correspondence 3.7%, water and power 2.2%, and social and individual administrations 4.3%. Botswana just contributes around seven percent of Africa's aggregate nursery gas emanations while Africa itself contributes just around five percent of the worldwide aggregate. The nation is, in this way, a minor supporter to the issue of an unnatural weather change and environmental change. In any case, Botswana, in the same way as other of the creating nations, will be essentially affected by climatic change. The nation is not plentifully supplied with rich surface water assets so water lack is a

key concern. The accessibility and nature of water, which might turn out to be all the more genuinely influenced under the anticipated environmental change situations, are along these lines formative difficulties. Botswana's energy demand was about 3660 GWh in 2008 (peak load of 500MW), which is projected to grow at about 6% per annum reaching 5300 GWh by 2017 (peak load of 850MW) and 6890 GWh by 2026 (peak load of 1130MW). Botswana, like many African countries, has a consistent electricity deficit, which peaked in 2008 at 1174.83 Kilo-watts (KWh) per capita [2]. This is because of declining power era and a diligent increment in power utilization. Botswana has chiefly depended on imports to take care of its developing demand for power. In 2008 its top interest achieved 500MW and is anticipated to be around 600MW in 2012. However, the deepening energy crisis across the Southern Africa sub-region is a major impediment to Botswana's economic growth plans, posing a threat to stability and requiring a major concerted effort at the national and regional levels to address the energy challenge [7]. Figure 1 shows the Botswana-

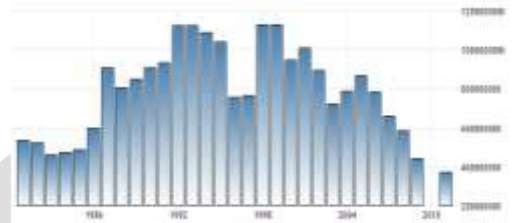


Fig.1- Botswana-electricity-production-kwh [6].

electricity-production-kwh during the period of 1986 to 2010.

2. Main sources of Energy:

Aside from alternate sources of energy in Botswana, the renewable power sources with the best potential are wood, biomass, wind and sun based energy. Wind and sun based energy (solar power) have been to a great extent undiscovered sources of energy in Botswana. Nearby energy assets thought to be in wealth in Botswana incorporate coal (200 billion tons), daylight (3,200 hrs. at 21MJ/m²), biogas (2.2 million cows, 3 kg compost/LSU/day) and fuel wood (200 tons/annum). Complete introduced power limit (2011) was 132 MW warm (for the most part coal). Botswana's energy sources comprise basically of power, fuel wood, and Liquefied petroleum gas (LPG), petrol, and diesel and aeronautics gas. Solar, biogas and biodiesel constitute a little extent, around 1%. Fuel wood utilization has been declining throughout the years while LPG and power utilization has been on the ascent [14]. This is mostly credited to the rising level of abundance and additionally the expanded access to power. Fuel wood keeps on assuming a critical part as an energy hotspot for some family units, particularly in provincial regions. It is the vital energy source utilized for cooking as a part of 46% of the family units broadly; and in 77% of families situated in provincial ranges. This speaks to a decrease from around 90% in 1981 yet at the same time sufficiently noteworthy to pull in arrangement consideration. Peak power demand is set to increase from 578 MW in 2012 to 902 MW by 2020, a 56% increase. Peak demand stands at 598 MW with current supply of 392 MW (excluding 200 MW emergency supply from Eskom), resulting in a shortfall of 206 MW [7].

Table-1 Latest BPC Electricity Tariffs showing the increment in rates from 1 April, 2015 [23].

Type OF Consumption	Fixed Charge		Energy Charge				Demand Charge	
	Old Tariff	New Tariff	Old Tariff		New Tariff		Old Tariff	New Tariff
Domestic Customers (TOU 4)			Up to 200 kWh	More than 200 kWh	Up to 200 kWh	More than 200 kWh		
	21.98	21.98	0.6051	0.8025	0.6505	0.8828	Nil	Nil
			Up to 500 kWh	More than 500 kWh	Up to 500 kWh	More than 500 kWh		
Small Business (TOU 6)	66.53	66.53	0.6993	0.9534	0.7693	1.1202	Nil	Nil
Medium Businesses (TOU 7)	66.53	66.53	0.4814		0.5656		135.0389	158.6707
Large Businesses (TOU 8)	66.53	66.53	0.4340		0.5099		127.111	149.3554
Government water pumping (TOU 2)	66.53	66.53	1.3481		1.5840		Nil	Nil

Table 1 shows the latest BPC Electricity Tariffs the increment in rates from 1 April, 2015. As per the Annual report of BPC 2014, Total operating expenditure for the year amounted to P3.642 billion compared to P3.660 billion in the prior year, reflecting 0.5% reduction (P17 million). The total loss for the year amounted to P1.373 billion compared to P2.125 billion loss reported in 2013 [28].

Africa will thus have to increase its energy consumption if the continent is to emerge from its current state of underdevelopment, to address the need for improving living standards for its people [24].

3. Present Scenario in Botswana-

At present Ghanzi is supplied through a 132 kV line from Namibia. Shakawe by a 33 kV line also from Namibia. Pandamatenga by a 33 kV line from Zimbabwe and Kasane by a 66 kV line from Zambia. [31]. BPC Annual Report, 2013 [16] says that Utilization of petroleum items had, in 2007, surpassed 1,500 million m³ however began to diminish amid the fuel value treks of 2008 to 800 million m³ and settled at just around 900 million m³. As per the World Bank, Electricity creation (kWh) in Botswana was last measured at 372000000 in 2011. At present sources of energy and electrical power are Fuel wood, Coal Fired Thermal Power Plants, Diesel Generators, Solar, Biogas, Natural gas (in the form of coal bed methane), while ESKOM, Zimbabwe Electricity Supply Authority, Namibia, Zambia electricity authority are other providers. Botswana's energy sources comprise fundamentally of power, fuel wood, Liquefied Petroleum Gas (LPG), petrol, diesel and aeronautics gas. Sun based, biogas and biodiesel constitute a little extent, around 1 %. LPG and all the petroleum based powers are foreign made. Fuel wood utilization has been declining throughout the years while LPG and power. Utilization has been on the ascent. Botswana has huge stores of coal evaluated at more than 200 billion tons. There is broad woody biomass from 3 to 10t/hectare. Most electric force is produced thermally in establishments keep running by the Botswana Power Corporation, an open endeavor set up in 1970. Electric creating limit comprises of the 132 MW Morupule coal-terminated plant. The 60 MW coal-let go plant at Selebi-Phikwe has been shut. Absolute limit in 2002 remained at 132 MW. Creation of power in that same year totaled 930 GWh. Fossil fills were utilized only. Utilization of power totaled 1.989 TWh. Coal creation in 2002 comprised altogether of the bituminous sort and totaled 992,000 tons. Coal is mined exclusively at Morupule Colliery by Debswana, for the most part for the era of power. The legislature is considering developing a coal-let go power plant at the same coal field, which would be intended to fare energy to South Africa. Further coal-to power stations are under thought. A few organizations are prospecting for oil, yet none had been found starting 2002. Be that as it may, Amoco (now BP) has examined the likelihood of coal bed methane extraction. The Botswana Energy Master Plan (BEMP, 2004) highlights the linkages in the middle of energy and the accomplishment of the financial and natural objectives set out in Vision 2016 and NDP 9. BEMP recognizes issues for incorporated energy arranging, the interest segments, supply areas (power, oil and gas, biomass, coal and new and renewable wellsprings of energy), energy proficiency, cross-cutting issues, administration and regulation in the energy division. Execution of improvement projects is embraced in accordance with the NDP. The arrangement is likewise adjusted to the long haul destinations set out in the national vision arranging report and might likewise incorporate improvement benchmarks taking into account globally concurred targets, for example, the Millennium Development Goals.

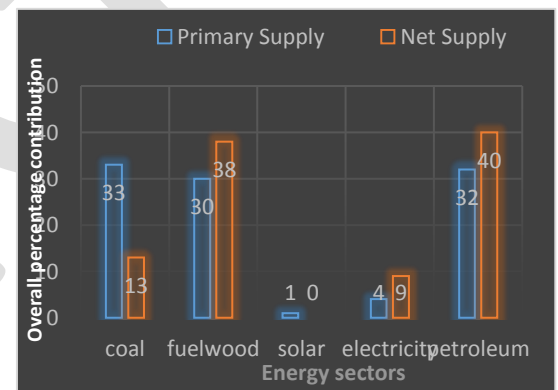


Fig. 2 - Energy Supply statistics [15].

4. Coal and Wood fuel -

In Botswana, Wood is as of now a broadly utilized as the renewable energy source. Country has shown stores of somewhere in the range of 212 billion tons of coal. As of now, Morupule mine is the main store mined, supplying Morupule Power Station, BCL Smelter and Botswana Ash. Most by far of Botswana's coal assets stay undeveloped.. Botswana has noteworthy coal assets assessed at 212 billion tons. The greater part of this coal is relied upon to be mined, with some of it utilized as a part of coal plants in Morupule and Mmamabula coal plant refineries to create the nation's required energy. The nation's economy will be helped by the coal fares to these Nations sought after. More cash will be gotten in the national banks, all the sufficiently more to fabricate bases and put resources into small undertakings in around the nation. The nation will likewise profit by Power and energy delivered from the force plants with all accessible organizations up and running subsequently adding to the country's economy. Concerning the abundance coal mined, the vast majority of it is required to be traded to China and India through the Trans-Kalahari Railway and Wavis sound, Namibia.

Table 2- Coalfields of Botswana [12]

Coalfields in Botswana				
Coalfield	Tones	Published resources		Location
	(Mt) (1998)#	Resources M/Ind/Inf	Figures (Mt)	
Dukwe	1,604	1,969		Sowa/Dukwe
		-1,500 Exploration target		
Foley	6,860	3,377+860		Sese/Mabesekwa
		3-6,000 Exploration target		
Serule	9,685	915		Lechana/Tshimoyapula
		-3,900 Exploration target		
Bobonong	179	None declared		Poorly Explored
Morupule	18,072	190		MCL
		7,234		Kgaswe
		2,400		Morupule South
Moijabana	3,539	1,460		Mijabana
		+5,000 Exploration target		Kweneng
Mmamabula	23,213	2,925+442+2,512+3,144+2,493		MME/MMNC/MMS/MMW
Mmamantswe	2,898	1,300		MmaMantswe
Letlhakeng	70,353	4,230+2,654		Takatokwane remainder poorly explored
Dutlwe	71,740	None declared		Poorly explored
Ncojane	4,725	None declared		Poorly explored
Total	212,868	60,021(28%)		

5.

Potential and utilization of Solar Photovoltaic-

Botswana has one of the most elevated sun based insolation on the planet. Botswana was one of the principal nations to advance the utilization of solar powered in Southern African region using solar water heaters in government lodging improvements. Botswana is near the sub-tropical high weight belt of the southern half of the globe. The atmosphere is driven by two unmistakable atmosphere zones with the dominant part falling under the Zaire Air Boundary atmosphere zone toward the north. There are without further ado 3 vast lattice associated frameworks in Botswana. One single substantial scale 1300 kW sun powered homestead in Phakalane toward the north of Gaborone; an as of late developed, yet not yet operational, 20 kW EU-supported UB research framework introduced in Mokolodi town, only south of Gaborone; and a 34 kW framework, claimed by Scales Associates and situated in the Broadhurst area of Gaborone close to the Western Bypass. There are various other little scale establishments with comparative setups, i.e. matrix associated yet simply utilizing the network as reinforcement, that have been introduced on homes in Gaborone and environment. Solar energy in Botswana adds up to more than 3,200 hours/annum with a quality of 22Mega Joules for every hour (MJ/hr) speaking to one of the most noteworthy sunlight based qualities on the planet. Normal sun based radiation is phenomenal at 6.1 KWh/m² every day. Various photovoltaic pilot ventures have been begun in Botswana since 1990. The first was the Manyana PV project which began in 1992. The JICA PV sun powered pilot venture in Botswana, propelling in 2003 at Kudumatse, Motlhabaneng, and Lorolwana towns. The essential goal of every one of these ventures was to get to the feasibility and supportability of solar based innovation as an option energy source, particularly for country based groups. Contingent upon the discoveries, such ventures were likewise planned to be imitated in different parts of the nation. Regardless of generous endeavors by the administration of Botswana and benefactor offices, the utilization of PV solar systems for power generation in Botswana, especially inside disengaged groups, stays low.

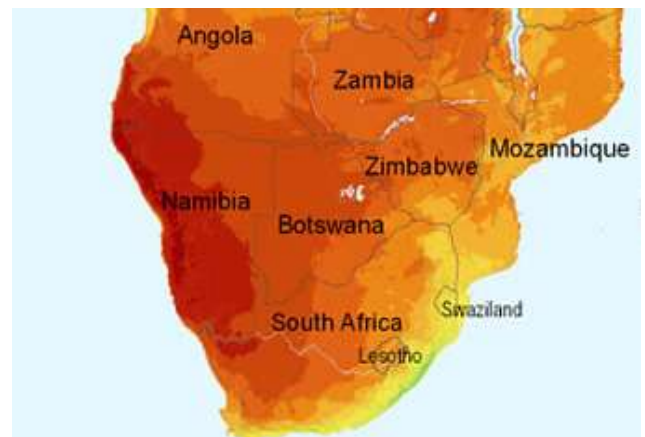


Fig.3- Global Irradiation map of Botswana [32]

Botswana has incredible sun powered conditions, with a normal of 320 clear, sunny days every year and an average global irradiation of 21 MJ m⁻²/day all through the nation. Sunlight hours in Botswana are between 9.9 hrs in summer to 8.2 hrs in winter. With 3,200 hours of daylight a year, sun power is seen as a characteristic answer for the force deficiencies of the nation and district. The spearheading concentrating sunlight based thermal power station venture in Jwaneng would deliver 100 MW. The sun oriented warm power industry is still at an early phase of business arrangement. The Government is included in the development of a 1.3 MW photovoltaic power plant in Phakalane, financed through a Japanese grant of P90 million. The plant was allotted in august of 2012. It is visualized that such photovoltaic force plants will in the end be recreated somewhere else in the nation. Government proceeds with its non-network provincial charge plan utilizing photovoltaic power which was kicked begun in 2006 by the Government and the UN.

6. Biomass & Bioenergy-

The Botswana National Development Plan 10 (NDP 10) communicates that there is potential for biofuel creation in Botswana using sweet sorghum and Jatropha as food stocks. The Government is starting now focusing on the formation of biodiesel. The draft national imperativeness approach communicates that by 2020, adjacent making of biodiesel will speak to 10% of the supply of diesel in the country [1]. There is an exploration venture in view of "Jatrofa" is additionally running under faculty of engineering & technology at University of Botswana. Jatropha flowers all year round, except in winter, producing seeds that contain up to 40 percent oil [30]. Biomass and Biofuel can be sub separated into taking after classifications-

Table-3 availability of Biomass and their types in Botswana

Biomass	Type
Straightforward Wood biomass	Taken to mean fuel wood, given that charcoal is an unimportant energy source in Botswana.
Wet biomass-	Municipal slime and creature waste.
Buildups	Agricultural, ranger service and urban squanders, including essential deposits as fallen trees, confined Poultry waste, optional deposits e.g. sawmill waste and tertiary deposits e.g. metropolitan strong waste).
Crops	Tree and rural products delivering biofuels such as biodiesel, ethanol and subordinates.

Biomass energy contributes essentially to Botswana's energy regulation and is assessed to represent 30% of the nation's essential energy supply and 38% of aggregate last energy utilization. More than 90% of this energy is devoured by family units, of which 75% is represented by country families. Thus, 90% of family biomass utilization is as fuel wood. Fuel wood is the most noteworthy woody biomass energy utilized as a part of nation, for family unit utilization, and particularly for families in country regions. Botswana's level of reliance on biomass power is essentially lower than most other African nations, where biomass regularly represents 80-90% of essential energy utilization. With a bovines masses of 2,220,000 in 2008 (Statistics Botswana, 2012), the volume of dairy creatures excrement may be adequate to run different stand-alone power-plants in creamer game-plan with sun arranged residences. The widespread use of biomass energy in the domestic sector nevertheless suggests that biomass, even in its traditional form, plays an important role in Botswana's socio-economy [EAD, 2006]. Right now, there are 15 known biogas plants in Botswana. Two of these plants are utilized for examination, 2 at wastewater treatment plants, and the rest are utilized for cooking and lighting at lodging and family unit scales. The feedstock utilized are

sustenance, agro-waste and sewage slurry.

7. Wind

In this region, Wind speed is generally low, at around 4-5 km/hr, for the majority of the year, with the exception of preceding neighborhood rainstorms. The twist for the most part originates from the east to north-east in the late spring however veers essentially toward the west to south west. From 1984 BRET venture report add up to yearly information from nine locales all through the nation were broke down for month to month and yearly normal wind speeds. The yearly normal wind speed shifted somewhere around 2.4 and 3.6 meters for every second. The utilization of wind energy power in Botswana is inclined toward pumping of water for watering system because of low normal wind speeds. According to [9] the wind speeds in the observation site at Kweneng district of Botswana is observed to be normal no less than 6m/s at a stature of 80m over the ground. These wind velocities are sufficient to drive cutting edge wind turbines that traverse statures of 50-100m. The undertaking will use 50 x 2MW huge wind turbines giving an introduced limit of 100MW. With the limit element of 0.24, the undertaking will deliver 210 GWh of power for each year.

8. Challenge in-front of Botswana –

Botswana does not have a devoted arrangement to react to energy sector and environmental change. Amid the 2013 money related year, BPC brought about a 37% (P989 million) increment in the expense of supply to P3.7 billion, from P2.7 billion in the earlier year.

Era, Transmission and Distribution costs constituted just about 93% of the aggregate working expense for 03, 2012. Throughout the years, Botswana has been accepting a steadily expanding power and diminishing recurrence in precipitation this is as per the Botswana water report arranged for UNECA in March 2005. Which demonstrates that environmental change exists and influences the measure of water the nation gets. Sporadic precipitation prompts low product yields, with the exception of where harvests are developed on subsiding overwhelmed zones. Water from profound Kalahari boreholes is frequently excessively salty for watering system. Agriculturists in the remote zones have not very many offices, for example, transport and phones, and supplies and advertising expenses are restrictively high. As per BPC annual report, 13 BPC gives a sample of the expense of coal era being at least BWP 1 for every kWh, while the purchaser pays BWP 0.43 per kWh, which implies the Government is required to give an appropriation of BWP 0, 57 for each kWh [16]. As per the Annual report of BPC 2014 [28], the total revenue increased by 14% to P2. 260 billion in 2014, compared to P1.984 billion in 2013 and the total loss for the year amounted to P1.373 billion compared to P2.125 billion loss reported in 2013. The level of utilization of petroleum items speaks to a noteworthy energy challenge for Botswana. The testing to control transport vehicles is all the more profound established as it touches on the estimation of fares versus imports and the unpredictability of the oil costs which has gigantic ramifications on the nation's import bill. Interrelated components adding to the high utilization of petrol and diesel, essentially by the vehicle segment. Coal power plants have additionally demonstrated to discharge unsafe nursery gasses which add to the atmospheres change Botswana is looking towards an intense circumstance because of it's drying out dams, little precipitation, little revive on surface water assets. Botswana additionally has its western geography secured by Sandoval bringing about little groundwater. In 1990 as per a water report, Groundwater bolstered 64% of the water utilization. Be that as it may, this time the utilization incorporates expanded mine operations and populace. Transport is the most noteworthy purchaser of petroleum items, particularly petrol and diesel. Non-Motorized Transport and the more extensive transport arrangement plan harbor further open doors for Botswana's Green Economy. The insights on proportion of autos to aggregate number of vehicles and the levels of utilization of petrol are an indication of an unsustainable advancement way. If there should arise an occurrence of biomass, the across the board utilization of fuel wood by poor family units, both country and urban, together with an ineffectively managed reaping administration, is required to bring about developing exhaustion of forests and to unfavorably influence rural efficiency [13].

9. Contribution & Strategies Framework-

There are mainly three strategy goals for New and Renewable Sources of Energy in Botswana. First to advance expanded utilization of photovoltaic (PV) charge in a methodical route with satisfactory coordination institutional, financing and technical standards. Secondly to advance utilization of solar based water heating system where appropriate and thirdly o exploit provincial and worldwide advancements in innovative research work (Republic of Botswana, 1997, p. 222). Botswana is likewise signatory to local endeavors, in the Southern African Development Community (SADC), to grow naturally amicable energy innovations. The nation's investment in the pilot Industrial Energy Conservation and the Industrial Energy Management ventures exhibits its readiness to helpfully investigate methods for using renewable energy sources economical. Botswana, has expanded quickly in light of populace and monetary development.

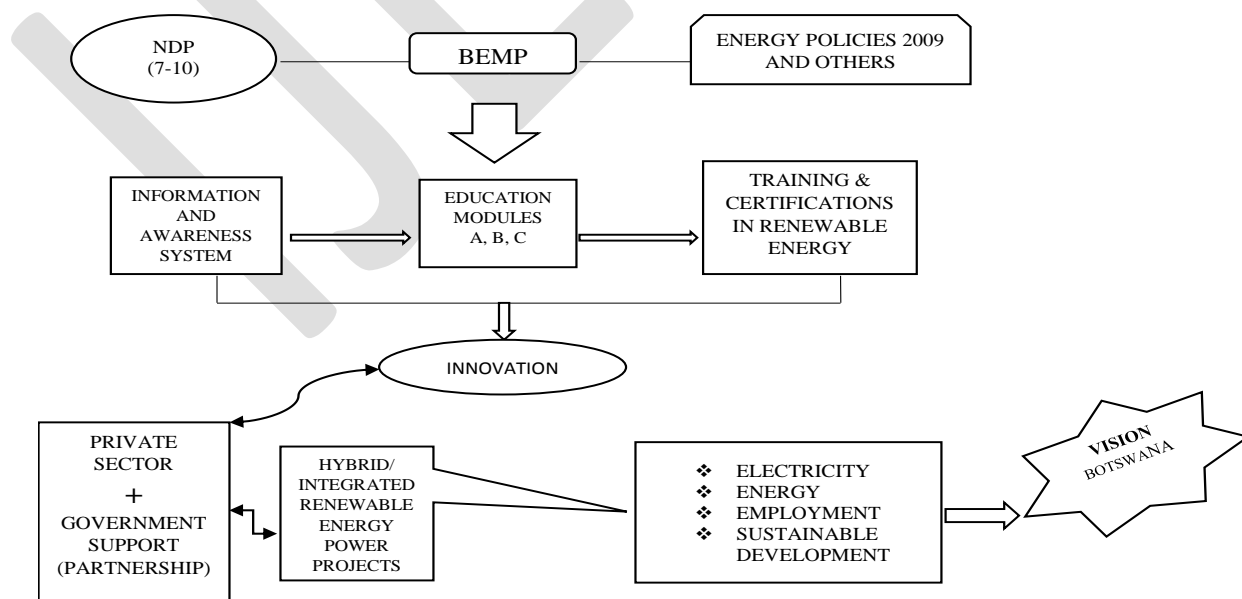


Fig.4- Suggested strategy towards vision Botswana

Despite the fact that, just like the case in whatever remains of sub-Saharan Africa, energy strategies in Botswana don't appoint satisfactory hugeness to renewable forms of energy at present, renewable energy contributes just around 1% to aggregate energy sector utilization. All NDPs Energy Sector Policy and Strategy, the Integrated Energy Planning additionally underscore that policy execution adequacy. Government organizations as Botswana Power Corporation, Energy Units in the Ministry of Mineral Resources and Water Affairs and so forth are included in data spread in the field of energy. Botswana's Energy Master Plan in any case contains approaches to manage the energies area towards accomplishing national social and financial objectives, it likewise suggests the advancement of proficient utilization of energy, the expansion of energy supplies, and the incorporation of social and ecological expenses in the cost of energy.

Figure 4 above clearly shows the strategy towards vision Botswana. Suggested education modules A, B & C stands for specially designed primary, secondary and upper level training course structures in academic curriculum focused on renewable energy sources. This approach will motivate the upcoming talents and produce a path towards the need, implementation and utilization of new and renewable sources of energy.

10. Conclusion-

At present, our current demand for electricity is 681 MW. Mmamabula power plant project is suspended and Marupule A is under refurbishment situation. Only Marupule B is in working condition [31]. Marope and Matshelagabedi are two main diesel power plants used in emergency situation. So, Botswana needs to tap its broad renewable potential to upgrade the nation's future energy security and movement. During 2005-14, UNDP and the Botswana government executed a GEF-financed project named renewable energy based rural electrification program for Botswana by BPC Lesedi (Pty) Ltd which was a joint endeavor between Botswana Power Corporation and the French energy organization, EDF International.

Another PV-biogas smaller than usual project was built up in Sekhutlane Village in Southern Botswana worked by BPC Lesedi. This experience can be used as an example for the advancement of the PPP model under this renewable project. There is proceeded with requirement for impartial dispersion of assets including clean energy. The declining expenses of renewables gives a chance to accomplish these destinations in a cost productive manner. There is deficient learning among different partners Government, privately owned businesses, ranchers, customer groups about the advantages of renewable energy sources and the accessible advancements. There is a misinterpretation of about cost and benefits of these resources. Better understanding, long term sustainable policies, and safe industrial and technological development with implementation in present policies are required to enhance the sector. Private-sector companies seeking Public Private Partnerships; PPPs should be encouraged. Such public and private partnership will increase the employment as well as fulfill the demand of power and energy in country. There is a need of regulated structures set up to permit partners to tackle joint obligation and the advancement of innovation. Without sponsorship no matter how you look at it at the national, locale and town level, the effective execution of plans prone to be unsuccessful.

ACRONYMS-

GDP	- Gross Domestic Product
EU/EC	- European Union- European Commission
UN	- United Nations
UNDP	- United Nations Development Program
JICA	- Japan International Cooperation Agency
KWp	- kilo watt peak
PV	- Photovoltaic
BPC	- Botswana Power Corporation
NDP	- National development program
BEMP	- Botswana Energy Master Plan
LPG	- Liquid Petroleum Gas
UNECA	-United Nations Economic Commission for Africa
GEF	- Global environment facility
WB	- World Bank

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STUDY OF EFFICIENT IMAGE PROCESSING ALGORITHM FOR SIDE SCAN SONAR IMAGES

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Abstract- This manuscript proposes an optional effective sonar image augmentation algorithm. The system essentially composes of two steps, together with noise minimization and image sharpening. The sonar image is first de-noised using filters, and then it is enhanced using unsharp masking and histogram equalization. The planned algorithm has been verified on many sonar images of different underwater structures, and shows its efficiency comparing to some well-known sonar noise reduction methods applying for sonar image processing.

Keywords: Sonar image processing, Filtering, Denoising

I. INTRODUCTION

The superiority of sonar images is repeatedly reduced by noise and/or blur. They therefore usually lead to mistaken analysis and reduce the ease for human, semi-automatic and automatic explanation. In reality, many efficient de-noising techniques have been introduced for sonar data such as median filters, local statistic methods, and wavelet transform etc. Median filters are utilized for de-speckling due to their robustness against the impulse noise while preserve image features. Lee filter form an output by computing a linear combination of the centre pixel intensity in a predefined size of filter window with the average intensity of the window. Kuan filter has the same formulation with Lee filter although the signal model supposition and derivations are different. These two filters achieve a balance between straightforward averaging in homogeneous regions and identity filter where the edges and point feature exist. Frost filter achieves a balance between averaging and all pass filter by forming an exponentially shaped filter kernel. This filter is measured as an adaptive Wiener filter that convolves the pixel values within a fixed size window with an exponential impulse response. The retort of the filter varies locally with the coefficient of variation.

The image is first changed into the wavelet domain. Then the wavelet coefficients that are slighter than a predefined threshold are measured as noise, and they should be removed. Thus the previous information on input data plays an imperative role in choosing the optimal threshold value. The image is changed into wavelet domain, and then the MAP filter, so-called the Bishrink filter, is utilized for noise suppression.

Though, most of the on top of mentioned methods focuses on the noise reduction. Thus ruling an alternative algorithm, which can offer noise reduction together with image de-blurring, is the main motivation of this study. In this study, an efficient Side scan Sonar image enhancement is presented. In the primary step, the sonar image is undergone noise reduction process by means of Wiener and median filters. Then the filtered image is de-blurred and enhanced contrast using unsharp masking process and histogram equalization.

II. THE PROPOSED IMAGE ENHANCEMENT ALGORITHM

The algorithm is summarized in Figure 1. On the other hand, in this study the input sonar images are assumed to be geometric and slant-range correction before applying the proposed algorithm. The algorithm principally consists of two steps, noise cancelling and image sharpening. The Wiener and median filters are utilized to suppress noise, and then the filter image will be de-blurred and enhanced using unsharp masking and histogram equalization.

Wiener filter is one of the well-liked techniques for taking away of blur in images owed to linear motion or unfocussed optics. The Wiener filtering executes an optimal tradeoff sandwiched between inverse filtering and noise smoothing. It can remove the noise and the de-blurring simultaneously, and the Wiener filtering is optimal in terms of the mean square error. In other words, it minimizes the overall mean square error in the process of inverse filtering and noise smoothing.

- No decrease in contrast crossways steps, since output values obtainable consist only of those present in the locality.

- Median filtering does not move borders, as can take place with predictable smoothing.

- □ since the median is fewer responsive than the mean to extreme values, those extreme values are more effectively removed.

Unsharp masking is one of the well-liked ways of image sharpening. In the unsharp masking process, an image is sharpened by ornamental the high frequency components of the image, which is mostly enhancing the edges. Thus, to boost sharpness in an image we require a good high-pass filter. Unsharp masking is done by adding up a portion of high- pass filtered image to the unique image. In more details, the unsharp masking procedure increases the sharpness of the edges in the image and thus reduces the blur or the tediousness in the image. It is believed that presentation of unsharp masking depends on the high-pass filter used, and there are many mask filters can be used such as Gaussian, Lapacian, Lapacian of Gaussian, Sobel, Prewitt.

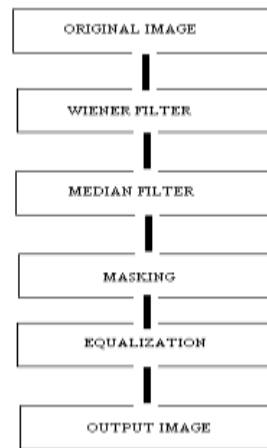


Fig. 1 Sonar image enhancement algorithm.

Histogram equalization is a method in image processing of contrast adjustment using the image's histogram. This method usually increases the global contrast of many images, especially when the usable data of the image is represented by close contrast values. Through this adjustment, the intensities can be better distributed on the histogram. This allows for areas of lower local contrast to gain a higher contrast. Histogram equalization accomplishes this by effectively spreading out the most frequent intensity values. The method is useful in images with backgrounds and foregrounds that are both bright or both dark. In many practical applications, histogram equalization can lead to better detail in photographs that are over or under-exposed. A key advantage of the method is that it is a fairly straightforward technique and an invertible operator. So in theory, if the histogram equalization function is known, then the original histogram can be recovered, and the calculation is not computationally intensive.

The sonar images of some underwater structures were recently collected in Korea in 2013 including the swimming pool, spillway, and floodgate. Some selected data are used to verify the performance of the proposed methods.

III. CONCLUSIONS

This study introduces an alternative effective algorithm for sonar image enhancement. The proposed algorithm consists of two steps including noise reduction and image enhancement. The Wiener and median filters are used for de- noising, the filtered image is then enhanced using unsharp masking and histogram equalization. The experimental results show that the proposed algorithm is efficient in terms of noise reduction, and sharpening side scan sonar images.

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NON LINEAR STATIC BEHAVIOR OF A IRREGULAR STRUCTURE ON PROGRESSIVE COLLAPSE DIFFERENT FAILURES OF COLUMNS

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Abstract Progressive collapse denotes an extensive structural failure initiated by local structural damage, or a chain reaction of failures following damage to a relatively small portion of a structure. Prediction of possible progressive collapse under specific conditions may provide very important information that could be used to control or prevent progressive collapse. Pushover analysis method is a nonlinear static analysis method that could be used in earthquake engineering to calculate the residual capacity of two frames designed for different seismic region to resist progressive collapse under a missing column scenario.

The present study describes the comparison between the irregular steel space frameworks with and without having considerable progressive collapse cases using nonlinear static analysis. Pushover analyses using various invariant lateral load patterns and modal pushover analysis were performed on steel moment resisting frames. The results revealed that the steel space frameworks with progressive collapse cases showed a large decrement in the maximum base shear and maximum displacement capacity compared to their irregular steel space frameworks without progressive collapse cases. The results of the pushover analysis also confirmed that the irregular steel space frameworks with progressive collapse cases have significantly improved stability in seismic zones over their counterparts without progressive collapse cases.

KEYWORDS: PUSHOVER, PROGRESSIVE COLLAPSE, BASE SHEAR, CAPACITY CURVE, ZONES, DISPLACEMENT

Introduction:

A simple computer-based push-over analysis is a technique for performance-based design of building frameworks. Push-over analysis attains much importance in the past decades due to its simplicity and the effectiveness of the results. The present study develops a push-over analysis for steel frame designed according to IS-800 (2007) and ductility behaviour of each frame.

Suitable capacity parameters and their acceptable values, as well as suitable methods for demands prediction will depend on the performance level to be evaluated. In light of these facts, it is imperative to seismically evaluate the existing building with the present day knowledge to avoid the major destruction in the future earthquakes. The buildings found to be seismically deficient should be retrofitted or strengthened.

Pushover Methodology:

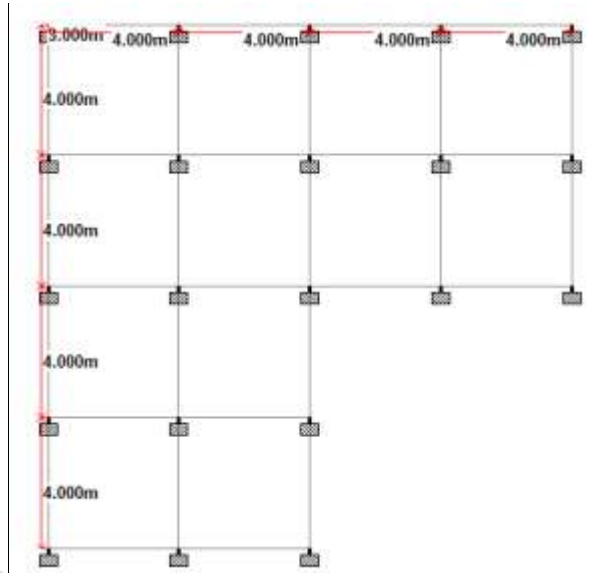
A pushover analysis is performed by subjecting a structure to a monotonically increasing pattern of lateral loads, representing the inertial forces which would be experienced by the structure when subjected to ground shaking. Under incrementally increasing loads various structural elements may yield sequentially. Consequently, at each event, the structure experiences a loss in stiffness. Using a pushover analysis, a characteristic non-linear force displacement relationship can be determined. **Structural modelling:**

The study in this thesis is based on nonlinear analysis of steel frames on different configurations of frames are selected such

as

IRREGULAR FRAMED STRUCTURE:

Case-(1): Irregular G+5 frame ,**Case-(2):** progressive collapse load case by removing a column (C1) at assumed corner joint, **Case-(3):** progressive collapse load case by removing a column (C2) at assumed exterior edge joint in Z direction, **Case-(4):** progressive collapse load case by removing a column (C3) at assumed exterior edge joint in Z direction, **Case-(5):** progressive collapse load case by removing a column (C4) at assumed exterior edge joint in X direction, **Case-(6):** progressive collapse load case by removing a column (C5) at assumed exterior edge joint in X direction.



View of RF modelled in STAAD.Pro

Results and Discussions:

Comparison of base shears and displacements for steel space framed structure with different progressive collapse conditions:

SEISMIC ZONE	BASE SHEAR (KN) FOR						
	(IRF)	(IRFC-1)	(IRFC-2)	(IRFC-3)	(IRFC-4)	(IRFC-5)	(IRFC-6)
Seismic zone	BASE SHEAR	BASE SHEAR	BASE SHEAR	BASE SHEAR	BASE SHEAR	BASE SHEAR	BASE SHEAR
	(kN)	(kN)	(kN)	(kN)	(kN)	(kN)	(KN)
SEISMIC ZONE II	2134.086	155.300	127.213	207.324	144.369	170.827	177.498
SEISMIC ZONE III	2141.703	248.472	210.068	213.587	238.107	259.435	246.817
SEISMIC ZONE IV	2346.673	248.612	306.721	213.60	238.208	259.485	246.824
SEISMIC ZONE V	2346.782	248.663	310.068	311.663	238.480	260.10	258.10

Comparison of Base shears at all seismic zones for various progressive Collapse cases

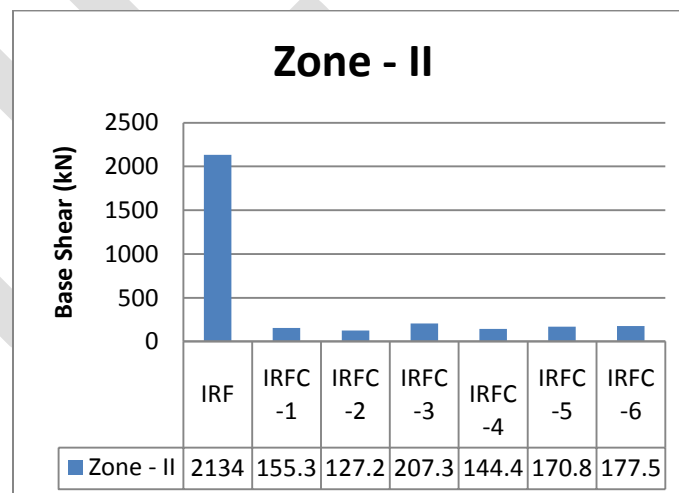
SEISMIC ZONE	DISPALCEMENT (mm) FOR						
	(IRF)	(IRFC-1)	(IRFC-2)	(IRFC-3)	(IRFC-4)	(IRFC-5)	(IRFC-6)
Seismic zone	DISPLACEMENT	DISPLACEMENT	DISPLACEMENT	DISPLACEMENT	DISPLACEMENT	DISPLACEMENT	DISPLACEMENT
	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)
SEISMIC ZONE II	50.274	7.028	5.632	7.852	5.871	6.524	6.779
SEISMIC ZONE III	54.411	7.560	6.166	5.350	6.158	6.500	6.184
SEISMIC ZONE IV	52.468	7.558	6.875	6.90	6.316	6.808	6.526
SEISMIC ZONE V	58.795	7.560	6.896	7.806	6.54	6.890	6.782

Comparison of Displacements at all seismic zones for various progressive Collapse cases

IRREGULAR FRAMED STRUCTURE:

Comparison between base shears and displacements from the capacity curves obtained from the pushover analysis at Seismic zone II:

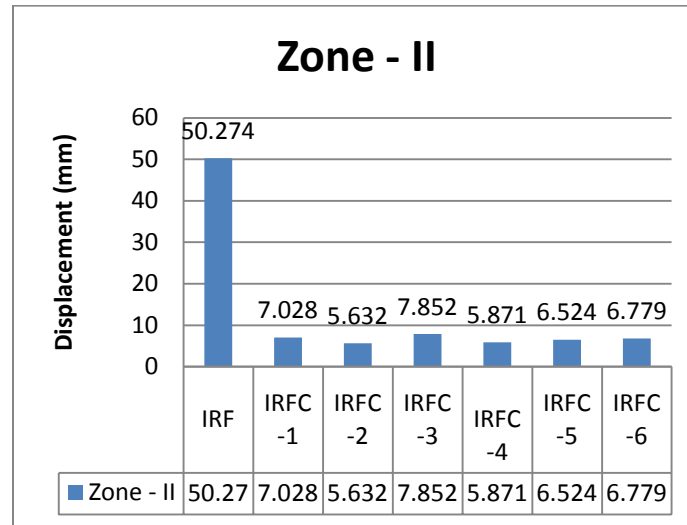
BASE SHEAR:



Comparison of Base shear at Seismic zone-II

It was observed that the base shear capacity of the Space frames IRFC-1, IRFC-2, IRFC-3, IRFC-4, and IRFC-5, IRFC-6 is reduced by 92.22%, 92.28, 92.4%, 92.04%, 92.21% and 92 % when compared to Irregular space frame IRF.

DISPLACEMENT:

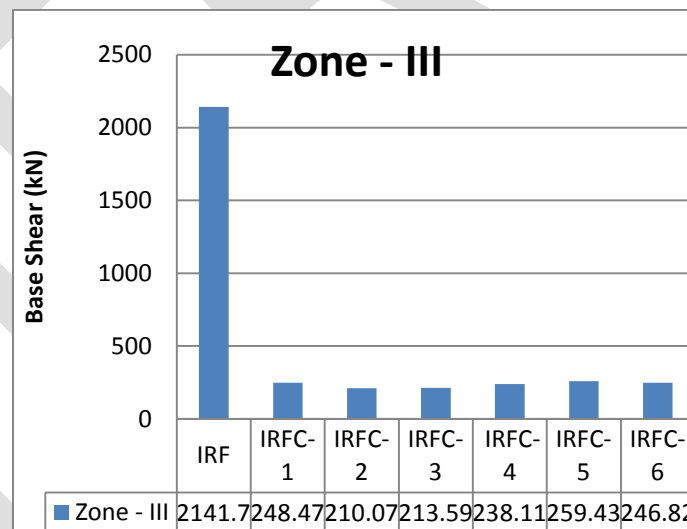


Comparison of displacements at Seismic zone-II

it is observed that the displacements of the Space frames IRFC-1, IRFC-2, IRFC-3, IRFC-4, IRFC-5, IRFC-6 is reduced by 89.8%, 90.003%, 89.1%, 89.8%, 89.9%, 89.6% when compared to Irregular space frame IRF.

Comparison between base shears and displacements from the capacity curves obtained from the pushover analysis at Seismic zone III:

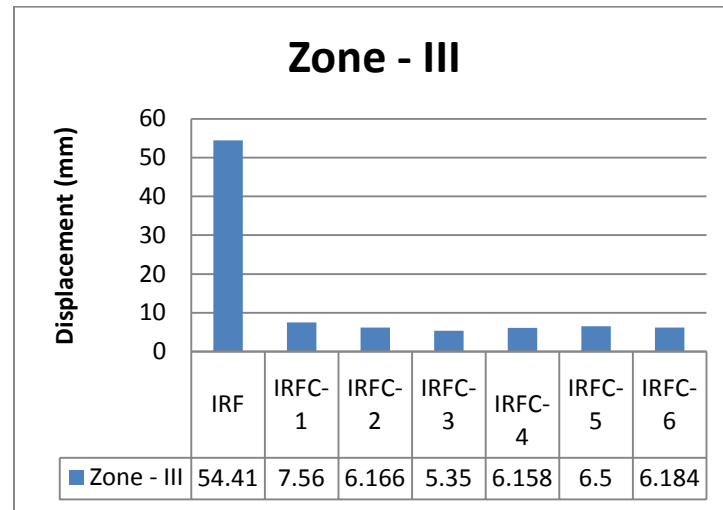
BASE SHEAR:



Comparison of Base shear at Seismic zone-III

It was observed that the base shear capacity of the Space frames IRFC-1, IRFC-2, IRFC-3, IRFC-4, IRFC-5, IRFC-6 is reduced by 91.9%, 92.2%, 92.2%, 92.3%, 92.2%, 92.2% when compared to Irregular space frame IRF.

DISPLACEMENT:

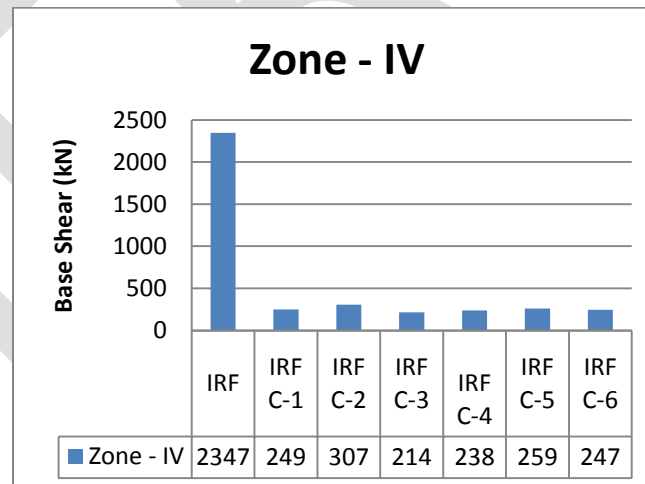


Comparison of displacements at Seismic zone-III

It was observed that the displacements of the Space frames IRFC-1, IRFC-2, IRFC-3, IRFC-4, IRFC-5, IRFC-6 is reduced by 89.5%, 89.6%, 89.7%, 89.9%, 89.9%, 89.8% when compared to Irregular space frame IRF.

Comparison between base shears and displacements from the capacity curves obtained from the pushover analysis at Seismic zone IV:

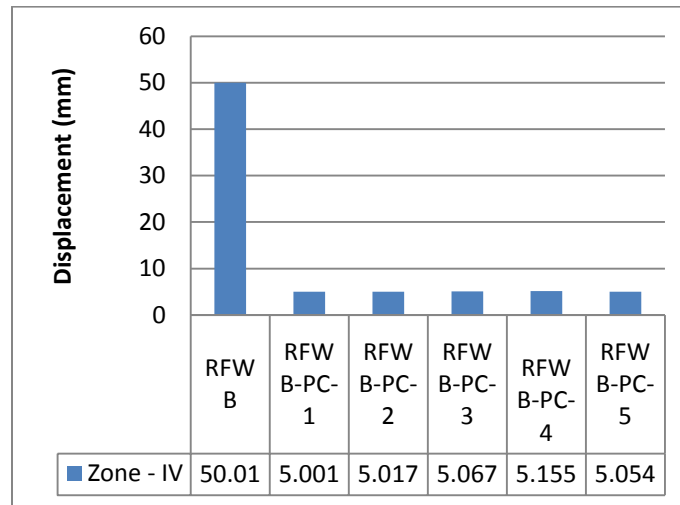
BASE SHEAR:



Comparison of Base shear at Seismic zone-IV

It was observed that the base shear capacity of the Space frames IRFC-1, IRFC-2, IRFC-3, IRFC-4, IRFC-5, IRFC-6 is reduced by 92.2%, 92.12%, 92.12%, 91.6%, 92.1%, 92.1% when compared to Irregular space frame IRF.

DISPLACEMENT:

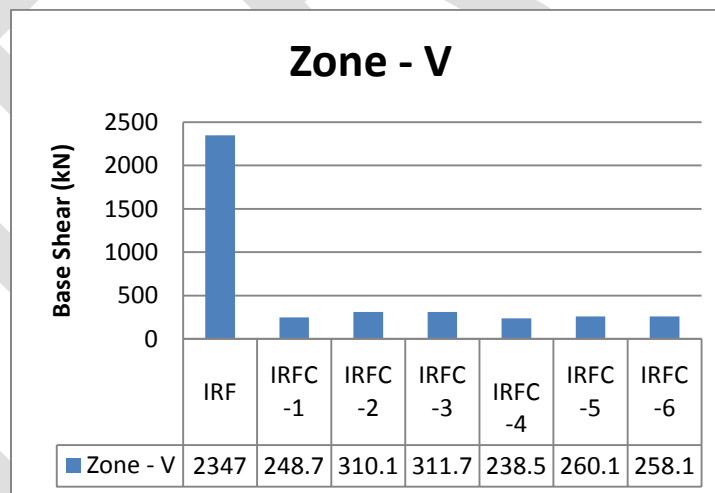


Comparison of displacement at Seismic zone-IV

It was observed that the displacements of the Space frames IRFC-1, IRFC-2, IRFC-3, IRFC-4, IRFC-5, IRFC-6 is reduced by 89.8%, 88.9%, 89.5%, 89% , 89.6% 89.6 % when compared to Irregular space frame IRF.

Comparison between base shears and displacements from the capacity curves obtained from the pushover analysis at Seismic zone V:

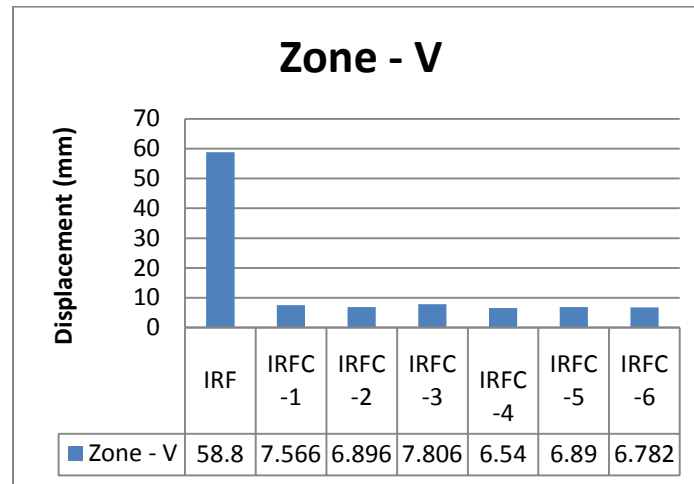
BASE SHEAR:



Comparison of base shear at Seismic zone-V

It was observed that the base shear capacity of the Space frames IRFC-1, IRFC-2, IRFC-3, IRFC-4, IRFC-5, IRFC-6 is reduced by 91.5%, 91.8%, 91.8%, 91.9% , 91.7%, 91.8 % when compared to Irregular space frame IRF.

DISPLACEMENT:



Comparison of displacement at Seismic zone-V

It was observed that the displacements of the Space frames IRFC-1, IRFC-2, IRFC-3, IRFC-4, IRFC-5, IRFC-6 is reduced by 88.9%, 89.17%, 89.26%, 89.3%, 89.29%, 89.27% when compared to Irregular space frame IRF.

Conclusion:

1. The maximum base shear and maximum displacement capacity of the Space frame with considering progressive collapse case is reduced by 92.4% and 90.093% when compared to Irregular space frame in Seismic zone II
2. The maximum base shear and maximum displacement capacity of the Space frame with considering progressive collapse case is reduced by 92.3% and 89.9% when compared to Irregular space frame in Seismic zone III
3. The maximum base shear and maximum displacement capacity of the Space frame with considering progressive collapse case is reduced by 92.2% and 89.8% when compared to Irregular space frame in Seismic zone IV
4. The maximum base shear and maximum displacement capacity of the Space frame with considering progressive collapse case is reduced by 91.9% and 89.27% when compared to Irregular space frame in Seismic zone V
5. Out of all the seismic zones compared the percentage change in reduction of both base shear and displacements is very minute in all progressive collapse load cases of same zones.

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An Efficient Security Scheme in WSN using Three Tier Security Architecture

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Abstract— The main issue while setting up the WSN network for node communication is security. This report describes the efficient mechanism for achieving the security between communications of nodes by creating three tier security architecture. This system implements three tier architecture with the use of two polynomial pools having sensor nodes, mobile sinks and some access points that are also sensor nodes, to get better security. Two pools are mobile polynomial pool and static polynomial pool. Mobile sinks and access point carries keys from common mobile polynomial pool were as, access points and sensor nodes carries keys from common static polynomial pool. The main aspect of the three tier architecture Authentication is Communication gets established from mobile sink to access point then from access point to sensor node, that is achieved by pairwise key predistribution methods and authentication of the nodes with the use of polynomial keys and Pailier cryptosystem algorithm. Here, Mobile sink replication attack is implemented against the network. The malicious node, it is blocked. If it wants to communicate within the network then it needs to capture large no of keys from both the pools for authentication. But as the sufficient and valid keys are not available with it, it cannot communicate with the other nodes in the network.

Keywords— Wireless Sensor Network, Pailier Cryptosystem Algorithm, Pairwise Predistribution Key Scheme, Mobile Sink, Common Mobile Polynomial, Common Static Polynomial, Mobile replication attack.

Introduction

In electronic technology recent advanced have paved the way for the development of a new generation of wireless sensor networks (WSNs) consisting of a large number of low-power, low-cost sensor nodes that communicate wirelessly. Such sensor networks can be used in a wide range of applications, such as, military sensing and tracking, health monitoring, data acquisition in hazardous environments and habitat is monitoring [9]. The sensed data often need to be sent back to the base station for analysis. However, when the sensing field is too far from the base station, transmitting the data over long distances using multi hop may weaken the security strength (e.g., some intermediate may modify the data passing by, capturing sensor nodes, launching a wormhole attack, a Sybil attack, selective forwarding, sinkhole, and increasing the energy consumption at nodes near the base station, reducing the lifetime of the network. Therefore, mobile sinks (MSs) (or mobile soldiers, mobile sensor nodes) are essential components in the operation of many sensor network applications. The Proposed system {Security in WSN using polynomial pool based mechanism} “is the combination of two pools. This scheme uses two separate polynomial pools: the mobile polynomial pool and the static polynomial pool. Polynomials from the mobile polynomial pool are used to establish the authentication between mobile sinks and stationary access nodes, which will enable these mobile sinks to access the sensor network for data gathering. Thus, an attacker would need to compromise at least a single polynomial from the mobile pool to gain access to the network for the sensor’s data gathering. Polynomials from the static polynomial pool are used to ascertain the authentication and keys setup between the sensor nodes and stationary access node.

Related Work

An Wireless sensor networks are one of the first real world examples of pervasive computing, the notion that small, smart and cheap sensing and computing devices will eventually permeate the environment [2]. Wireless sensor network (WSN) consists of a large number of ultra small sensor nodes. Each sensor node is an autonomous battery operated device with data processing capabilities, integrated sensors, limited memory and a short range radio communication capability. In application scenarios sensor nodes are randomly deployed over a region and collect data.

Wireless Sensor Networks are deployed for a wide variety of applications like military tracking, monitoring of environment, smart environments, patient tracking, etc. [1]. Security is extremely important when sensor nodes are deployed in hostile environments because they may be exchanging valuable or critical information about the environment and an adversary can use this information to his advantage or inject malicious information into the network. Apart from physical capture a malicious user can easily tap into

the wireless communication and listen to the traffic, inject misleading data into the network or impersonate as a node of the network. To provide security, encrypted and authenticated communication is required. Active research is being pursued for efficient setup of secure keys in wireless sensor networks. Setting up of keys for secure communication is a part of the Key Management problem.

In general network environments there are three types of key agreement schemes: trusted server scheme, self enforced scheme and pre-distribution scheme. The trusted server scheme has a trusted server between two nodes to negotiate a shared key between the nodes. This scheme is not feasible in sensor networks because there is no central server in most WSN. Self enforcing scheme uses public key algorithms such as Diffie-Hellman key agreement or RSA. Pre-distribution scheme uses secret keys to establish pairwise keys after they are deployed.

In the new security framework, a small fraction of the preselected sensor nodes (see Fig. 1), called the stationary access nodes, act as authentication access points to the network, to trigger the sensor nodes to transmit their aggregated data to mobile sinks.

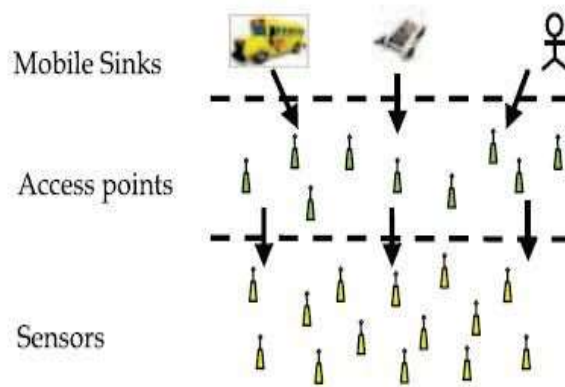


Fig 1: Three Tier Architecture of wireless sensor network.

A mobile sink sends data request messages to the sensor nodes via a stationary access node. These data request messages from the mobile sink will initiate the stationary access node to trigger sensor nodes, which transmit their data to the requested mobile sink. The scheme uses two separate polynomial pools: the mobile polynomial pool and the static polynomial pool. Using two separate key pools and having few sensor nodes that carry keys from the mobile key pool will make it more difficult for the attacker to launch a mobile sink replication attack on the sensor network by capturing only a few arbitrary sensor nodes. Rather, the attacker would also have to capture sensor nodes that carry keys from the Mobile key pool. Keys from the mobile key pool are used mainly for mobile sink authentication, and thus, to gain access to the network for data gathering. Although the above security approach makes the network more resilient to mobile sink replication attacks compared to the single polynomial pool-based key predistribution scheme [3].

Pairwise key establishment is another important fundamental security service. It enables sensor nodes to communicate securely with each other using cryptographic techniques.

The main problem is to establish a secure key shared between two communicating sensor nodes. However, due to the resource constraints on sensor nodes, it is not feasible for them to use traditional pairwise key establishment techniques such as public key cryptography and key distribution center (KDC).

Eschenauer and Gligor proposed a probabilistic key pre-distribution scheme recently for pairwise key establishment. The main idea is to let each sensor node randomly pick a set of keys from a key pool before the deployment so that any two sensor nodes have a certain probability to share at least one common key. Chan et al. further extended this idea and developed two key pre-distribution techniques: a q-composite key pre-distribution scheme and a random pairwise keys scheme. The q-composite key pre-distribution also uses a key pool but requires that two nodes compute a pairwise key from at least q predistributed keys that they share. The random pairwise keys scheme randomly picks pairs of sensor nodes and assigns each pair a unique random key. Both

schemes improve the security over the basic probabilistic key pre-distribution scheme. However, the pairwise key establishment problem is still not fully solved.

For the basic probabilistic and the q-composite key pre-distribution schemes, as the number of compromised nodes increases, the fraction of affected pairwise keys increases quickly. As a result, a small number of compromised nodes may disclose a large fraction of pairwise keys and also achieves significant security under small scale attacks at the cost of greater vulnerability to large scale attacks.

The problem of authentication and pair wise key establishment in sensor networks with MSs is still not solved in the face of mobile sink replication attacks. For the basic probabilistic and q-composite key pre distribution schemes, an attacker can easily obtain a large number of keys by capturing a small fraction of the network sensor nodes, making it possible for the attacker to take control of the entire network by deploying a replicated mobile sink, preloaded with some compromised keys to authenticate and then initiate data communication with any sensor node.

There is a tradeoff to be made between security and vulnerability that has to be considered based on the sensor network size and application.

The proposed scheme uses two separate polynomial pools: the mobile polynomial pool and the static polynomial pool [7]. Polynomials from the mobile polynomial pool are used to establish the authentication between mobile sinks and stationary access nodes, which will enable these mobile sinks to access the sensor network for data gathering. Thus, an attacker would need to compromise at least a single polynomial from the mobile pool to gain access to the network for the sensor's data gathering. Polynomials from the static polynomial pool are used to ascertain the authentication and keys setup between the sensor nodes and stationary access nodes. Prior to deployment, each mobile sink randomly picks a subset of polynomials from the mobile polynomial pool. In this scheme, to improve the network resilience to mobile sink replication attack as compared to the single polynomial pool based approach; intend to minimize the probability of a mobile polynomial being compromised if R_c sensor nodes are captured. As an adversary can use the captured mobile polynomial to launch a mobile sink replication attack, achieve this by having a small fraction of randomly selected sensor nodes carry a polynomial from the mobile polynomial pool. These preselected sensor nodes are called the stationary access nodes. They act as authentication access points for the network and trigger sensor nodes to transmit their aggregated data to the mobile sinks.

A mobile sink sends data request messages to the sensor nodes via a stationary access node. The mobile sink's data request messages will initiate the stationary access node to trigger sensor nodes to transmit their aggregated data to the requested sink. Each stationary access node may share a mobile polynomial with a mobile sink. All sensor nodes, including the stationary access nodes, randomly select a subset of polynomials from the static polynomial pool. The advantage of using separate pools is that mobile sink authentication is independent of the key distribution scheme used to connect the sensor network. This scheme is divided into two stages: static and mobile polynomial predistribution and key discovery between a mobile sink and a sensor node [8].

Static and mobile polynomial predistribution:

Stage 1 is performed before the nodes are deployed. A mobile polynomial pool M of size $|M|$ and a static polynomial pool S of size $|S|$ are generated along with the polynomial identifiers. All mobile sinks and stationary access nodes are randomly given K_m and one polynomial ($K_m > 1$) from M . The number of mobile polynomials in every mobile sink is more than the number of mobile polynomials in every stationary access node. This assures that a mobile node shares a common mobile polynomial with a stationary access node with high probability and reduces the number of compromised mobile polynomials when the stationary access nodes are captured. All sensor nodes and the preselected stationary access nodes randomly pick a subset of K_s and $K_s - 1$ polynomials from S . Fig. 2 show the key discovery between the mobile node and stationary node.

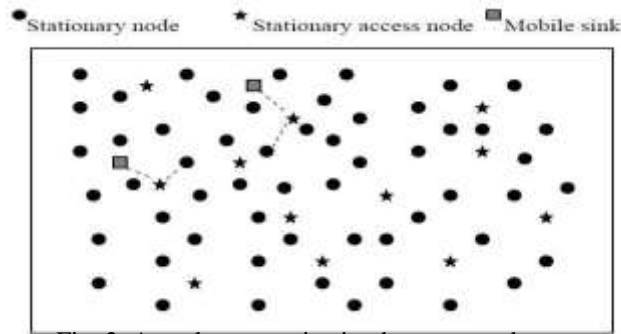


Fig. 2. Actual communication between nodes

Key discovery between mobile node and stationary node:

To establish a direct pairwise key between sensor node u and mobile sink v , a sensor node u needs to find a stationary access node a in its neighborhood, such that, node a can establish pairwise keys with both mobile sink v and sensor node u . In other words, a stationary access node needs to establish pairwise keys with both the mobile sink and the sensor node. It has to find a common mobile polynomial with the mobile sink and a common static polynomial with the sensor node. To discover a common mobile/static polynomial, a sensor node i may broadcast a list of polynomial IDs, or alternatively, an encryption list α , $E_{K_v}(\alpha)$, $v = 1, \dots, |K_{si}|$, where K_v is a potential pairwise key and the other node may have as suggested in [4] and [5].

When a direct secure path is established between nodes u and v , mobile sink v sends the pairwise key K_c to node a in a message encrypted and authenticated with the shared pairwise key $K_{v,a}$ between v and a . If node a receives the above message and it shares a pairwise key with u , it sends the pairwise key K_c to node u in a message encrypted and authenticated with pairwise key $K_{a,u}$ between a and u .

If the direct key establishment fails, the mobile sink and the sensor node will have to establish a pairwise key with the help of other sensor nodes. To establish a pairwise key with mobile sink v , a sensor node u has to find a stationary access node a in its neighborhood such that node a can establish a pairwise key with both nodes u and v . If node a establishes a pairwise key with only node v and not with u . As the probability is high that the access node a can discover a common mobile polynomial with node v , sensor node u needs to find an intermediate sensor node i along the path $u \rightarrow i \rightarrow a \rightarrow v$, such that intermediate node i can establish a direct pairwise key with node a .

The use of mobile sinks in WSN introduces a new security challenge. wireless sensor network with one mobile sink and a base station. Sensor nodes store the generated data in their buffers. The mobile sink traverses the network using random walk, periodically transmitting beacon signals. Sensor nodes that hear the mobile sink's beacon transmission begin transferring their aggregated data to the mobile sink. Since the mobile sink's beacon signal received by sensor nodes is not authenticated, an adversary can attack the network by placing a malicious mobile sink.

Problem Description

1) Algorithm and Analysis

Paillier Cryptography Algorithm:

The Paillier encryption scheme is composed of key generation, encryption, and decryption algorithms as follows [6]:

Key Generation: Choose two large prime numbers p and q randomly and independently of each other, such that $\gcd(pq, (p-1)(q-1)) = 1$

This property is assured if both primes are of equal length.

Compute

$$n = pq, \lambda = \text{lcm}(p-1)(q-1)$$

where lcm stands for the least common multiple.

Select random integer g where $g \in \mathbb{Z}_{n^2}^*$.

Ensure n divides the order of g by checking the existence of the following modular multiplicative inverse:

$$\mu = (L(g^\lambda \pmod{n^2}))^{-1} \pmod{n}$$

where function L is defined as,

$$L(u) = u - 1/n$$

Note that the notation $a=b$ does not denote the modular multiplication of a times the modular multiplicative inverse of b , but rather the quotient of a divided by b .

Finally, the public (encryption) key is (n, g) and the private (decryption) key is (λ, μ) .

If using p, q of equivalent length, a simpler variant of the above key generation steps would be to set

$$g = n + 1, \lambda = \phi(n), \mu = \phi(n)^{-1} \pmod{n}$$

$$\text{Where } \phi(n) = (p-1)(q-1).$$

Encryption: Let m be a message to be encrypted where $m \in \mathbb{Z}_n$.

Select random r where $r \in \mathbb{Z}_n^*$. Compute cipher text as

$$c = g^m \cdot r^n \pmod{n^2}$$

Decryption: Let c be the ciphertext to decrypt, where $c \in \mathbb{Z}_{n^2}^*$.

Compute the plaintext message as:

$$m = L(c^\lambda \pmod{n^2}) \mu \pmod{n}.$$

As the original paper points out, decryption is “essentially one exponentiation modulo n^2 ”.

The Paillier encryption scheme exploits the fact that certain discrete logarithms can be computed easily. For the implementation purpose all the no.’s are used as BigInteger, so there’s no limitations for no.’s here.

Paillier Example: An example of the Paillier encryption scheme with small parameters is shown as follows. For ease of calculations, the example will choose small primes, to create a small n . Let

$$p = 7; q = 11$$

then

$$n = p \cdot q = 7 \cdot 11 = 77$$

Next, an integer g must be selected from $Z_{n^2}^*$, such that the order of g is a multiple of n in Z_{n^2} . If we randomly choose the integer

$$g = 5652$$

Then all necessary properties, including the yet to be specified condition, are met, as the order of g is $2310 = 30.77$ in Z_{n^2} . Thus, the public key for the example will be

$$(n, g) = (77, 5652)$$

To encrypt a message

$$m = 42$$

Where $m \in Z_n$, choose a random

$$r = 23$$

Where r is a nonzero integer, $r \in Z_n$. Compute

$$\begin{aligned} c &= g^m r^n \pmod{n^2} \\ &= 5652^{42} \cdot 23^{77} \pmod{5929} \\ &= 4624 \pmod{5929} \end{aligned}$$

To decrypt the cipher text c , compute

$$\lambda = \text{LCM}(6, 10) = 30$$

Define $L(u) = (u-1)/n$, compute

$$\begin{aligned} k &= L(g^\lambda \pmod{n^2}) \\ &= L(5652^{30} \pmod{5929}) \\ &= L(3928) \\ &= (3928-1) / 77 \\ &= 3927 / 77 = 51 \end{aligned}$$

Compute the inverse of k ,

$$\begin{aligned} \mu &= k^{-1} \pmod{n} \\ &= 51^{-1} = 74 \pmod{77} \end{aligned}$$

Compute

$$\begin{aligned} m &= L(c^\lambda \pmod{n^2}) \cdot \mu \pmod{n} \\ &= L(4624^{30} \pmod{5929}) \cdot 74 \pmod{77} \\ &= L(4852) \cdot 74 \pmod{77} \\ &= 42 \end{aligned}$$

Result and Discussion

The Pailier Cryptosystem, with the pair wise key distribution scheme i.e. polynomial pool based key scheme used for the implementation of this project. For key generation means separately created mobile polynomial pool and static polynomial pool using above algorithm, so here main thing which the data transaction which done by encryption and decryption of the keys of mobile sink and sensor node, via the stationary access nodes, whenever any mobile sink needed the data, as it gets that request from particular base station, so mobile sink collects the data from sensor, but direct communication is not possible as this is three tier communication which is added for security purpose, so in this proposed scheme implementation contains mobile sink as a node which has factors as IP address of that sensor from which it needs the data, also it can save that file according to its specification, key fetching happens in this phase as key which is encrypted by sensor that should be decrypted by mobile sink using its keys, then only communication will be successful, also sensor contains all the data, so as it gets any request for the particular data, it select that data from its memory and start the fetching of the keys, i.e encryption of keys, then it forwards the data and wait for the particular stationary access node or mobile sink to catch the data, the mobile sink whose flag is on, and who has the ability to decrypt the encrypted data, he receives the data.

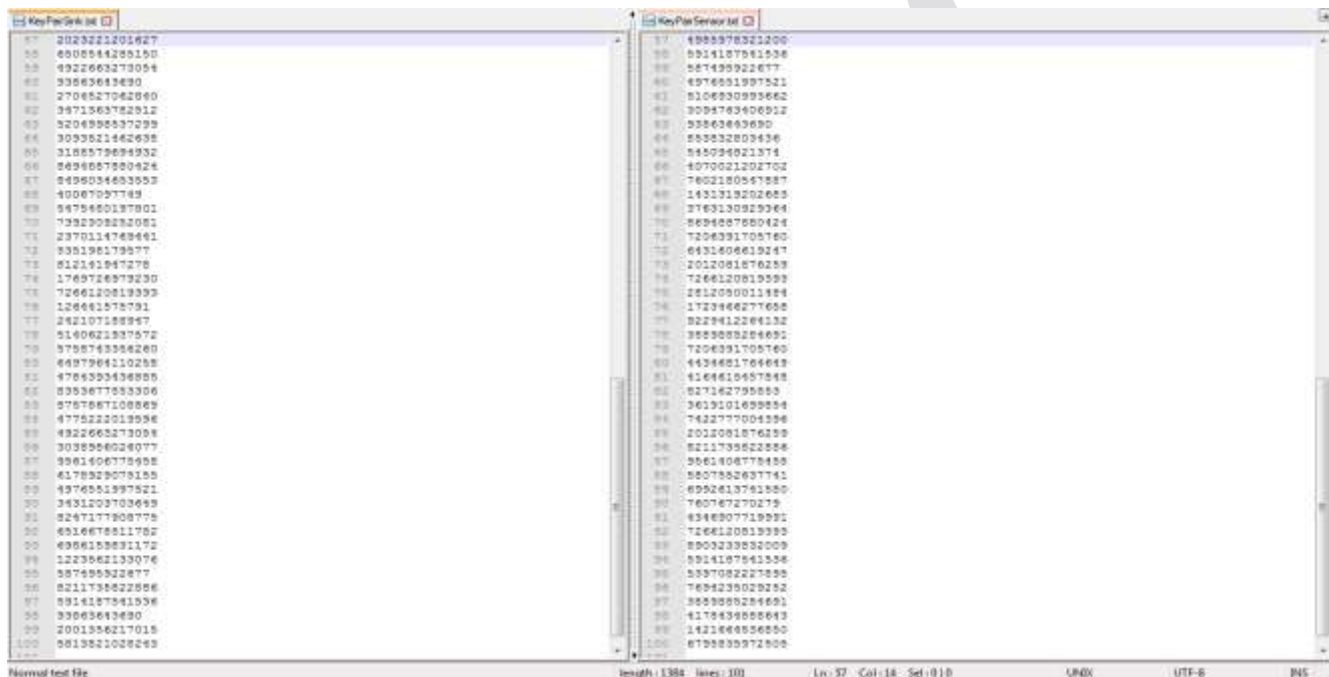


Fig 3: Key generation in mobile sink polynomial pool and static polynomial pool

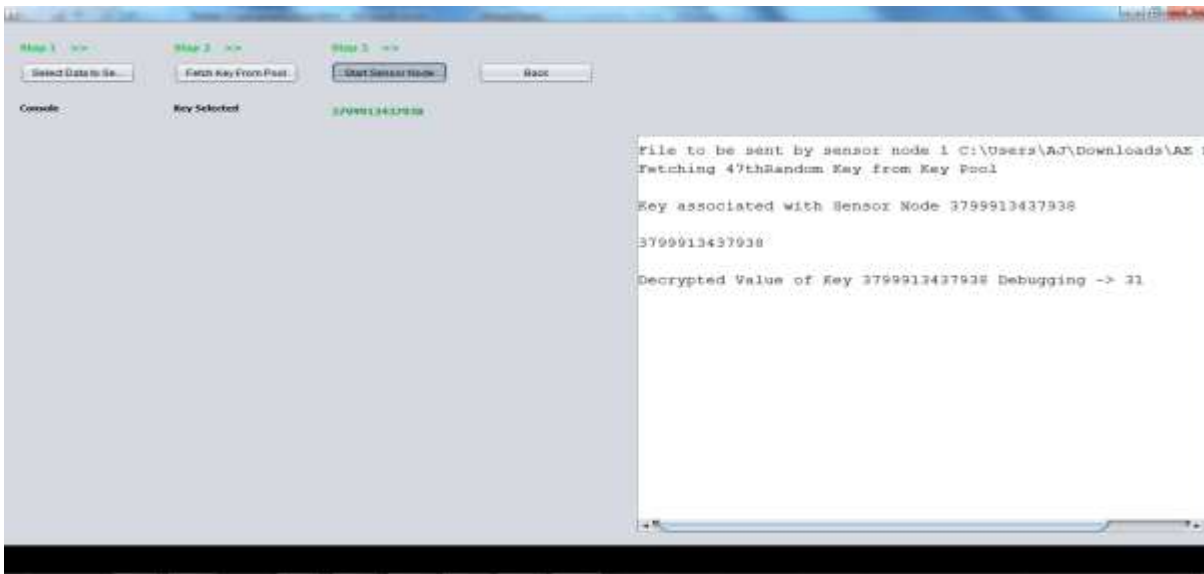


Fig 4: Sensor node fetching the key from static polynomial pool and ready to send the data to node

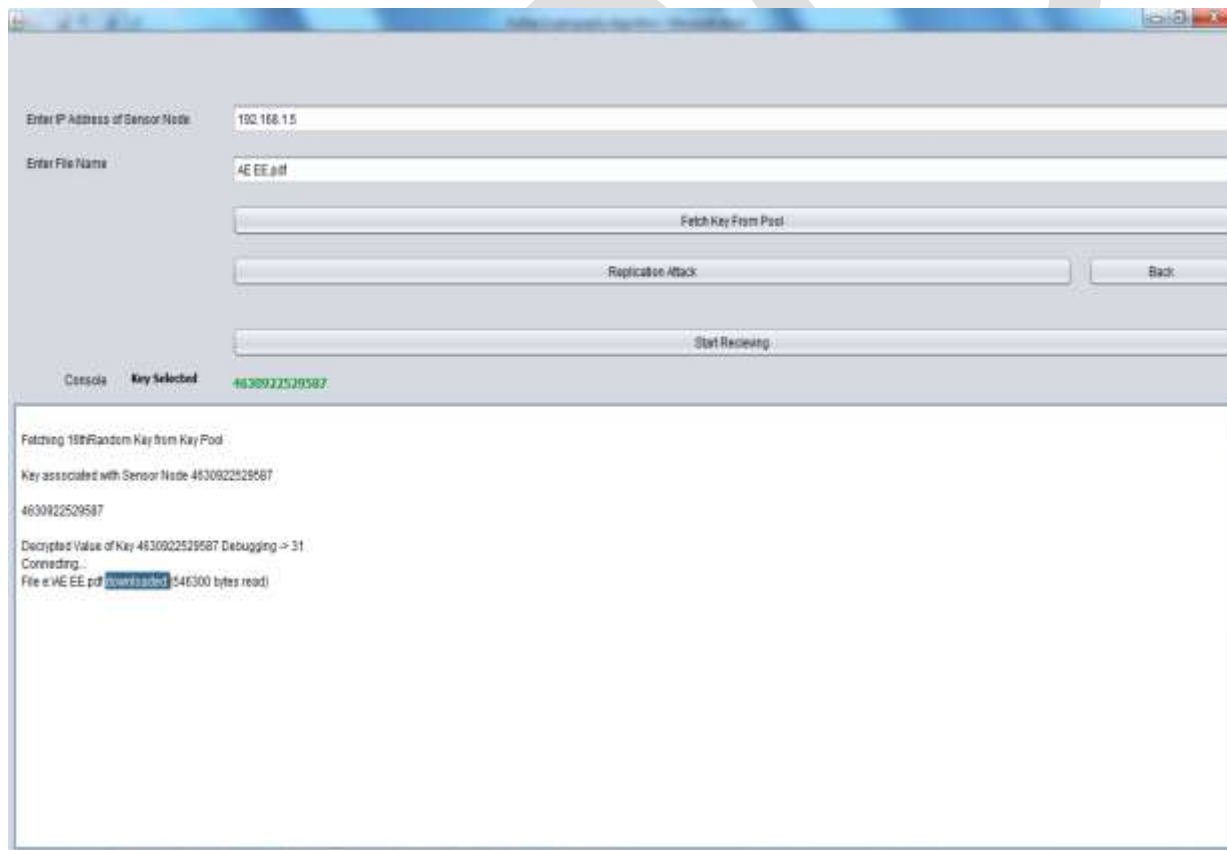


Fig 5: Mobile sink whose flag is on, ready to receive the data, by fetching the key from pool.

The mobile sink in the implementation contains a particular access, so it can check whether there is any mobile replication attack is there or not, as anyone sends the data, and it checks, is this the attack or not, first of all checks whether key matches or not, if not then it's not a valid node, and it will stop the particular transaction here.

Also, the results are calculated on the basis of key generation, encryption, decryption timing, as compared to other cryptosystems, its timing is very much less, mostly it's in milliseconds.

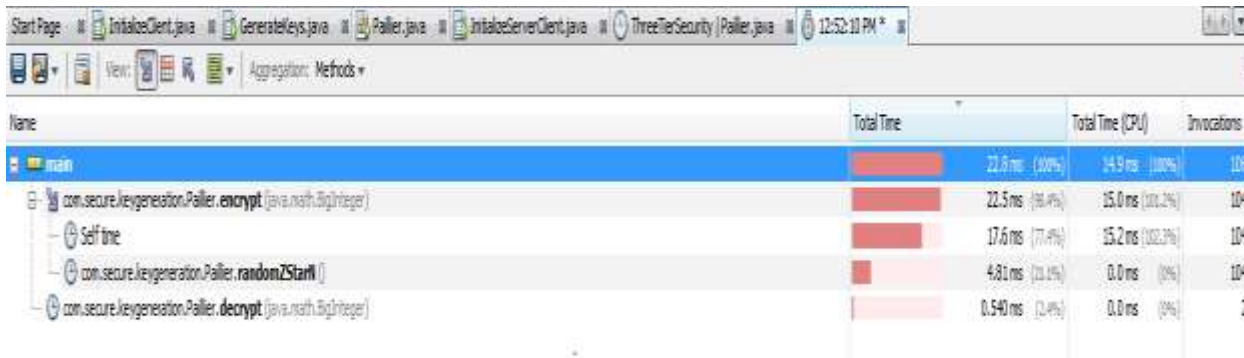


Fig 6: Computation time required for key generation, encryption & decryption.

S.No	Algorithm	Pack Size (KB)	Encryption Time(sec)	Decryption Time (sec)
1.	AES	153	3.0	1
	DES		1.6	1.1
	RSA		7.3	4.9
	Pallier Crypt.		1.2	0.7
2.	AES	118	3.2	1.2
	DES		1.7	1.2
	RSA		10.0	5.0
	Pallier Crypt.		1.1	0.5
3.	AES	868	4.0	1.8
	DES		2.0	1.2
	RSA		8.2	5.1
	Pallier Crypt.		1.5	0.9

Table 1: Difference in time taken in various systems for encryption and decryption.

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This paper could not be written to its fullest without prof. B.S.Sonawane, who is my guide, as well as one who challenged and encouraged me throughout my time spent studying under him. He would have never accepted anything less than my best efforts, and for that, I thank him.

Conclusion

The Three-Tier security architecture overcomes the drawbacks of existing system and gives the better resilience against the attackers. As two separate pools are used for the purpose of authentication the attackers would not be able to capture the node information. Using two separate key pools and few stationary access nodes which carry polynomials from the mobile pool in the network, an attacker may fail to gather sensor data,

Larger the pool size, lower the probability of two pairs of nodes sharing the same key. The number of keys to be assigned to each sensor does not depend on the size of the WSN which improve the network connectivity.

Based on the two polynomial pool-based key predistribution scheme with the Pailier Cryptosystem algorithm substantially improved network resilience to mobile sink replication attacks as compared to the single polynomial pool-based key predistribution approach. Also it is not increasing the communication overhead.

Analysis indicates that key generation, encryption and decryption time is very much less as compared to other cryptosystems, also system becomes resilient against denial of service attack or brute force attack, as adversary has to guess the original prime no. which used for pailier algorithm, which highly difficult because of there's huge no. of prime no. available.

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EXPERIMENTAL INVESTIGATION OF ROTATIONAL SPEED DEPENDENT HARDNESS AND TENSILE PROPERTIES OF FRICTION STIR WELDED DISSIMILAR AL-ALLOY (6063 & 6064)

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ABSTRACT - FSW of dissimilar al-alloy must be conducted in lower welding speed or in higher rotation speed to increase the heat input during the process. The effect of the tool rotation speed plays an important role in the amount of the total heat input applied during the process; however, this phenomenon is mostly analyzed qualitatively, and the conclusions have been made based on the resultant weld defects. Therefore, the optimum range of the rotation speed will be an important parameter to achieve high quality weld, since the variation of this parameter will affect the thermo mechanical condition for the microstructural changes in the specimen. This optimum range is affected by different parameters such as the thickness of work piece, type of alloy, geometry of the tool, and welding speed. In the present research work proposes, friction stir welding of dissimilar al-alloy plates with the thickness of 4mm in the constant traverse speed of 25 mm/min and 4 different rotation speeds. Vickers hardness tests will be conducted on the weld samples to identify RPM vs Hardness also tensile tests for the same is proposed to identify variation in tensile properties of the material.

KEYWORDS - Frictional stir welding, Al-Alloy (6063 & 6064), Vicker hardness tests, RPM, Hardness, Traverse speed, Thermo chemical

INTRODUCTION

The friction stir welding (FSW) was invented by The Welding Institute, UK, in 1991 for primarily welding of aluminum alloys. In FSW process, a non-consumable rotating cylindrical shouldered tool with a smaller pin is plunged into adjoining parent materials. Frictional heat generated by the tool shoulder causes the work piece materials to soften. Moreover, FSW involves a severe plastic deformation and dynamic recrystallisation in the nugget zone due to the

stirring action of the tool pin. Extensive studies on FSW of aluminum and its alloys have been reported in the literature; however, studies on dissimilar AL-Alloy are very limited. Welding is a fabrication process used to join materials, usually metals or thermoplastics, together. During welding, the pieces to be joined (the work pieces) are melted at the joining interface and usually a filler material is added to form a pool of molten material (the weld pool) that solidifies to become a strong joint. In contrast, Soldering and Brazing do not involve melting the work piece but rather a lower-melting-point material is melted between the work pieces to bond them together. Welding is a material joining process in which two or more parts are coalesced (joined together) at their contacting surfaces by a suitable application of heat and/or pressure. This is often done by melting the work pieces and adding a filler material to form a pool of molten material (the weld pool) that cools to become a strong joint, with pressure sometimes used in conjunction with heat, or by itself, to produce the weld. This is in contrast with soldering and brazing, which involve melting a lower-melting-point material between the work pieces to form a bond between them, without melting the work pieces. Many different energy sources can be used for welding, including a gas flame, an electric arc, a laser, an electron beam, friction, and ultrasound. While often an industrial process, welding may be performed in many different environments, including open air, under water and in outer space. Welding is a potentially hazardous undertaking and precautions are required to avoid burns, electric shock, vision damage, inhalation

of poisonous gases and fumes, and exposure to intense ultraviolet radiation. Until the end of the 19th century, the only welding process was forge welding, which blacksmiths had used for centuries to join iron and steel by heating and hammering. Arc welding and ox fuel welding were among the first processes to develop late in the century, and electric resistance welding followed soon after. Welding technology advanced quickly during the early 20th century as World War I and World War II drove the demand for reliable and inexpensive joining methods.

LITERATURE REVIEW

Dr. Muhsin Jaber Jweeg, et. al, (2012), 'Theoretical and Experimental Investigation of Transient Temperature Distribution in Friction Stir Welding of AA 7020-T53', Number 6 Volume 18 June 2012 Journal of Engineering. Finite element modelling of transient temperature distribution is used to understand physical phenomena occurring during the dwell (penetration) phase and moving of welding tool in friction stir welding (FSW) of 5mm plate made of 7020-T53 aluminum alloy at 1400rpm and 40mm/min.

Shrikant G.Dalu, et. al, (2013), 'Effect of Various Process Parameters On Friction Stir Welded Joint: A Review', International Journal of Research in Engineering and Technology eISSN: 2319-1163 | pISSN: 2321-7308. This paper is a review of research work in the last decade on friction stir welding.

R. Palanivel, et. al. (2011), 'Development of mathematical model to predict the mechanical properties of friction stir welded AA6351 aluminum alloy', Journal of Engineering Science and Technology Review 4 (1) (2011) 25-31. This paper presents a systematic approach to develop the mathematical model for predicting the ultimate tensile strength, yield strength, and percentage of elongation of AA6351 aluminum alloy which is widely used in automotive, aircraft and defence Industries by incorporating (FSW) friction stir welding process parameter such as tool rotational speed, welding speed, and axial force. FSW has been carried out based on three factors five level central composite rotatable design with full replications technique.

G. Ashok Kumar, et. al. (2013), 'Friction stir processing of intermetallic particulate reinforced aluminum matrix composite', Adv. Mat. Lett. 2013, 4(3), 230-234. Friction stir processing (FSP) is a novel solid state technique to refine the microstructure of metallic materials. The objective of this work is to apply FSP to change the morphology and distribution of intermetallic particles and achieve property enhancement. AA6061/8wt. % Al₃Zr composite was produced by the in situ reaction of molten aluminum and inorganic salt K₂ZrF₆.

R.Palanivel et.al.(2010), 'Influences Of Tool Pin Profile On The Mechanical And Metallurgical Properties Of Friction Stir Welding Of Dissimilar Aluminum Alloy', International Journal of Engineering Science and Technology Vol. 2(6), 2010, 2109-2115. The development of the Friction Stir Welding has provided an alternative improved way of producing aluminium joints, in a faster and reliable manner. In this study the effect of tool pin profile on the mechanical and metallurgical properties of dissimilar AA6351-AA5083H111 joints produced by FSW is analyzed..

Shude Ji, et.al. (2013), 'Design of Friction Stir Welding Tool for Avoiding Root Flaws', Materials 2013, 6, 5870-5877. In order to improve material flow behavior during friction stir welding and avoid root flaws of weld, a tool with a half-screw pin and a tool with a tapered-flute pin are suggested. The effect of flute geometry in tool pins on material flow velocity is investigated by the software ANSYS FLUENT. Numerical simulation results show that high material flow velocity appears near the rotational tool and material flow velocity rapidly decreases with the increase of distance away from the axis of the tool.

Dr.Ayad M. Takhakh, et.al. (2012), 'Experimental and numerical evaluation of friction stir welding of AA 2024-W aluminum alloy', Number 6 Volume 18 June 2012 Journal of Engineering. Friction Stir Welding (FSW) is one of the most effective solid states joining process and has numerous potential applications in many industries.

PROBLEM IDENTIFICATION

Friction Stir welding became the area of interest over the past decade, its increasing popularity is due to its method and effect of material joining. It has been the main joining process of almost all marine and aerospace industries worldwide. Since, from the birth of FSW lots of research are going on, in the stage of developments the research were focused on methods of welding, feasible materials for FWS, the machine structure for FSW, tools for FSW and their shapes were discussed in great details, in the mid phase of the research work the process parameters were went in all direction to find out optimum parameters to achieve best welding results were presented, in the recent past dissimilar alloys, different ferrous and non-ferrous alloys were into the focus of the FSW research, welding and their properties after welding is also of interest for many research works. SEM tests were performed to identify the microstructure of the FSW work pieces to evaluate the penetration of welding is also presented in many research papers, some authors produced articles and papers on FSW facilities and their limitation, the potentiality of FSW is growing and it is clustering into many branches quickly, major automotive are already moved into FWS for their structural welding process.

PROPOSED SOLUTION

In FSW process, a non-consumable rotating cylindrical shouldered tool with a smaller pin is plunged into adjoining parent materials. Frictional heat generated by the tool shoulder causes the work piece materials to soften. Moreover, FSW involves a severe plastic deformation and dynamic recrystallisation in the nugget zone due to the stirring action of the tool pin. Extensive studies on FSW of aluminum and its alloys have been reported in the literature; however, studies on dissimilar AL-Alloy are very limited. FSW of dissimilar al-alloy must be conducted in lower welding speed or in higher rotation speed to increase the heat input during the process. The effect of the tool rotation speed plays an important role in the amount of the total heat input applied during the process; however, this phenomenon is mostly analyzed qualitatively, and the conclusions have been made based on the resultant weld defects. Therefore, the optimum range of the rotation speed will be an important parameter to achieve high quality weld, since the variation of this parameter will affect the thermo mechanical condition for the microstructural changes in the specimen. This optimum range is affected by different parameters such as the thickness of work piece, type of alloy, geometry of the tool, and welding speed. In the present research work proposes, friction stir welding of dissimilar al-alloy plates with the thickness of 4mm in the constant traverse speed of 25 mm/min and 4 different rotation speeds.

METHODOLOGY

This chapter provides a comprehensive diagrammatic view of the research methodology of the project work. The methodology starts from objective formulation and moves towards literature review, where the scholarly reviews are taken for studying FSW parameters like speed, feed and plunge. The reviews provides research gap for research work which is formulated into objective of this research work, rotational speed plays an important role in FSW and is proposed for dissimilar al-alloy. The results will be evaluated for reporting and presentation.

CONCLUSION

The first phase of the research work end with the objective formulation which is followed by literature review on friction stir welding fundamentals, materials and their properties, operating parameters like speed, feed and depth of cut for arriving optimum welding characteristics, review provided the feasibility of problem identification and pushed to formulate research work with friction stir welding limitations, the research gap showed that the importance of welding rpm on material, since this is previously carried on pure materials only is it evident that carrying out FSW on dissimilar alloy to find out optimum rotational speed is vital and the corresponding mechanical properties like impact and tensile properties. In the next phase FSW welding of aluminium alloy (6063 and 6064) will be performed to identify the optimum rotating speed. A total of 6 experiments will be performed with the operating parameters of 600, 800, 1200 & 1400 RPM and at 25 mm/min as feed with 4 mm plates. The results of the FSW will be evaluated to find out the optimum rotating speed for performing FSW on dissimilar al-alloy.

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Design a Blacklist based Cloud E-mail Spam Filtering Service

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Abstract— E-mail service is one of the popular inventions in modern communication and technology. Users from every corner of the world are now connected via email services for sending messages, news and sharing confidential information. Emailing to friends and family, national and internationals, official and non-official purposes, connecting to other services – everywhere we use email services. Spamming is one of the major threats in digital world that causes a millions of technology forwarded users be suffered and felt untrusted. Users are not aware of spam; in most cases they have no idea of the pattern of spam as they appear as a normal text, links, images or could be anything attractive. Exploring those items leads to an instant lose of online identity and property before they can even guess about it. In this paper, we aim to identify spam characteristics, consolidate them and build a cloud based spam filtering service that act as a firewall to email messages and easily incorporated into any email service client.

Keywords— spam filter; blacklisting; cloud email; cloud API; spam properties; email client; cloud service.

INTRODUCTION

In modern life, the dependency on internet is increasing day by day. The majority of the people communicate with each other, store and share personal information in verities of online sites over the internet. Not every person is very technical; they know very little about internet technologies and very often they are not aware of what they are doing. As a result, people are experiencing unethical incidents around them. People with more emotion are suffering much more in the network than other groups [1]. Spamming is one kind of such deceptions that looks lucrative, plays with human minds and sympathy, and raise serious threats to the user identity and resources. Social networking sites such as Facebook, MySpace, Twitter and particularly E-mail services are consistently among the top 20 most-viewed web sites are attracted by spam [2]. In 2006, more than 70% of the total messages that are sent over the internet are spam [3]. In the end of 2016, though it has reduced in a reasonable amount, still spamming in email happens more than 60% of times (in Fig. 1) [4]. When user accesses the spam contents, they may lose their id, password and private information that could lead a serious damage to their private property. Therefore, detection and removal of spam content from the network is a serious matter of concern.

People around the world are taking huge benefits from various cloud services including E-mail service. It has become the essential part of our personal communication and business [5]. Users are more encouraged to store, share and communicate via Email because of the almost free of cost, high availability, reliability and high performance of the services. A typical example of Email service providers are Google, Yahoo, AOL, Hotmail and so on which provides millions of terabytes storage and effective spam filtering services with free of cost. However, these services are public and often not appropriate for personal business. Business organizations tend to use their own organizational E-mail ID from the hosting company. In this situation, the business owners are not interested to invest lots of money to implement their own spam filter service and eventually express their attention towards an external spam detection and removal agency that can take care of the spamming. In this paper, we aim to build a cloud based spam filtering service (SFS) and an Email client (EMC) that consumes the SFS in real time. A basic pricing model is also considered in SFS for clients like EMC.

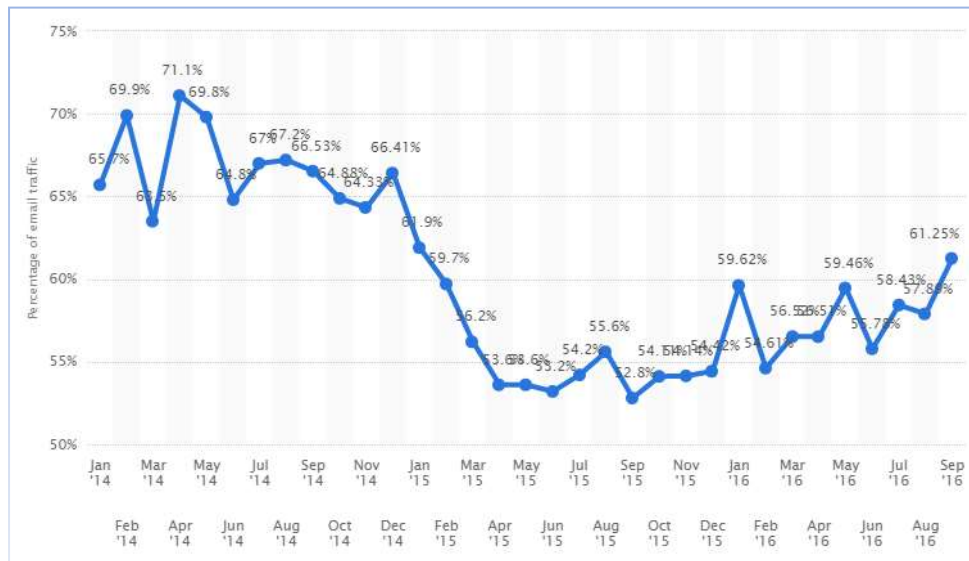


Fig. 1- Statista Spam statistics: spam e-mail traffic share 2016

In the remainder of this paper, at first we conduct a comprehensive survey on the characteristics of spam and email services. Then we investigate potential attack behaviors in Email server for understanding spam. After that we review existing solutions for removing identified behaviors and potential attacks. Later, we describe our proposed system architecture followed by the system implementation and performance measurement. Finally, we highlight the limitations of the proposed system and recommend various aspects to the future researchers.

SPAMMING IN EMAIL

Number of users in E-mail services is rapidly increasing day by day. More and more people store their information and communicate with one another by E-mail service. When benefits of E-mail service are widespread, unwanted messages are appearing problematic; often it contains unwanted advertisement messages. These unwanted messages are called spam [6]. In other words, spam is usually considered to be electronic junk mail or junk newsgroup postings. Some people define spam even more generally as unsolicited email. We often receive unwanted information from a variety of electronic systems mainly through emails, electronic boards and messengers, called spam [7].

Spamming attacks

Likejacking attacks

This attack refers to the action carried by the victim and initiated by the attackers. The idea behind this attack is to attract targeted users using interesting posts that motivate users to do some action on it. This often happens in advertising various products with offer. Users who click the links becomes the collaborator to the attacker inadvertently because the malicious scripts automatically re-posts the links, images or videos on their contacts' premise. A more popular version of this attack causes user profiles to "Like" a Facebook page without their consent [8]. Another popular example is an attacker in a web page designs overlay UI elements of like button on offer pages that says 'claim your free iPad' to attract users claiming the iPad. When user clicks to claim they are unintentionally click on like button and hence their friends and contacts see the attacker's page and they do the same mistakes [9].

Rogue application

Facebook allows developer to build applications for users to play games, to add custom profile settings and to do more stuff. It is an open platform for everyone to develop and submit applications for potential users. Cybercriminals take this advantage and create rogue applications that may be used for spamming post [8].

Attacks via Facebook chat

This is another media where spammer posts links to user message window with attachments or external links that either cause harms in their local machine if downloaded or they are taken to the attackers' page that exactly looks like the social media pages. Most of the time people are unaware of the web site URLs in the browser and provide sensitive information to the attackers [8].

Spammed tweets

Cybercriminals are enough smart to analyze alternative ways to post unethical but interesting posts to social networks such as Twitter. The shortened hashing technique for categorizing post types and text limit in posting cannot avoid the spammers their posts are short but convincing enough that the user follows the links that spammers posted. Free vouchers, job advertisement posts and testimonials for effective weight loss products are popular examples [8].

Properties of Spam in E-mail

According to the statistics [4], E-mail has been the primary area for the spammers to conduct their operation. We investigate various sources and consolidate common properties of spam.

Hidden recipient address

It is often seen that the recipient address in email signature is empty. Spammers do this in order to hide the fact that the mail was sent to a mass number of recipients, and most likely not to publish their email list to the original recipient [10].

Message contains many tags

Some spammers use lots of HTML comment tags to avoid content filters within the email body text. In this way, content filters unable to differentiate comments tags and spam words and so as the recipients [10].

HTML body in message

Many spammers lean to prepare HTML messages without the plain text body part and send that to recipients email. While reading the HTML version of the message, the images and other contents are visible automatically and allows user to click the contents for spreading spam [10].

Remote images in message

In order to avoid spam messages from being blocked by word filters, spammers include an image in their message that cannot be filtered for words. In addition, upon opening the email message the image is downloaded from the spammer's website. Since each message contains a unique ID, the spammer will know exactly which recipient has viewed the mail [10].

Different addresses in From and Reply-to field

This is a common property of spam emails. This kind of emails often comes from legitimate email addresses that are valid and never marked as spam. For example, an attractive email such as 'US DV Lottery Won' has arrived to recipient email address. People without reviewing the sender email address share their identity to the spammers. In such many cases, the sender names are written as the original name relevant to the subject but the email address is different that actually does not bear any identity of the sender or senders organization [10].

Number or character sequence in sender's address

In some cases we observe that sender email addresses contain numerical name or a sequence of unusual characters that does not resemble the usual human name or organizational syntax. For example, TerUndUcV@hotmail.com or son9348534@gmail.com both are valid email addresses. However, they do not bear any meaningful context rather it looks an automated script generated name [11].

Message body is based64 encoded

One encoding procedure, base64 is used sometimes by spammer to encode the message headers and body so that spam filters are unable to read the spam content and perform any filtering [11].

Invalid, repetition or empty data in address locations

Sometimes we see that the send and recipients have the same email address, sometime the recipient field is empty and sometimes there is email name only without the '@' sign. This resembles that the email was sent from an automated program and can be assumed that to be circulated for spamming [10].

Profitable offers

Another way of spamming is to send profitable offers to targeted users. Sharing assets from bank accounts, millions of dollar winning from an email draw etc has now become regular and greedy users are sharing their identity unconsciously without realizing that they cannot be that lucky.

In a survey, Red Earth Software analyzed the headers of 500 spam messages and found that the following spam characteristics were mostly found by their ratios [10]. Table 1 shows the kinds of spam behavior happens more and less frequently.

Table 1 - Percentage of Emails found based on kinds of Spam Characteristics

Spam characteristics	% of found E-mails
Recipient address not in To: or Cc: field	64%
To: field is missing	34%
To: field contains invalid email address	20%
No message ID	20%
Suspect message ID	20%
Cc: field contains more than 15 recipients	17%
From: is the same as the To: field	6%
Cc: field contains more between 5-15 recipients	3%
To: field contains more between 5-15 recipients	2%
To: field contains more than 15 recipients	1%
Bcc: field exists	0%
To: field is empty	0%
From: is blank or missing	0%

Anti-Spam Algorithms

Several studies have been conducted in detecting and removing spam from the network. Majority of the works have been related to text based filtering as contents are written in text very often. For example, emailing, posting data to social networks; URLs of web pages are also texts. We investigate available spam detection techniques are described following.

1. Naive Bayes spam filtering technique

Naive Bayes is popular statistical technique for e-mail spam filtering. It is used to identify features of spam e-mail. The technique is developed on stack of Bayesian classifier [12] which has the nature 'naive' that means it simplifies the computation involve in a particular classifying process. Bayesian classifier is based on Bayes' theorem. Naive Bayesian classifiers follows the effect of an attribute value on a given class is independent of the values of the other attributes. In spam detection technique, a sequence of words is considered in the place of attributes in Naive Bayes classifier. Naive Bayes classifiers try to correlate the sequence of tokens or words

for separating spam and non-spam e-mails and detect an email is spam or not based on the probability calculated from Bayesian inference [13].

The main advantage of Bayesian spam filtering is that it can be trained on a per-user basis and constantly self adapting. It's simple to implement and its false positive or negative rate is low. It has drawback too. It requires large number of data that need to be trained properly in order to make it work at their most effective outcome. The training leads more time.

2. Blacklist

Blacklist is the form of rule based filtering that uses one rule to decide which emails are spams. It involves lists of various kinds of information that is used to check the incoming content in a network. Some of the blacklist text types and sample values are presented in Table 2. Blacklist can be used for on both large scale and small scales spam filtering application. The main advantage of this technique is that it can block substantial amount of email though it blocks a range of blacklist items instead of individual item.

Table 2 – Sample blacklist items with categories

Blacklist Category	Sample values
gambling	fun, free, online, gold, gratuits, mobile, Samsung, casinos.
Hosting	managed, vps, web, joomla, dedicated, reseller, windows, linux, a2, wordpress
Injection	%url%, %BLOGTITLE%
Medication	viagra, cialis, propecia, Zolofit, clomid,
Merchandise	air max, air Jordan, Nike Huarache, jimmy , choo, jordan shoes, dre beats
Miscellaneous	#https?:\V[^\V]+\,pl
Polish Text	Strona, Warszawa, koszenia, ginekolog, pogrzebowe, notariusze, krakow
Services	Alternatefuel, online dating, reverse phone, lookup, cash advance, online divorce
Software	eMule, product key, cdkey, key sale, upgrade key
Trading	Anyoption, Optionbit, Optionfair, iOption, Onetwotrade
URLs	free-casino-bonus.com, womensclothescheap.com, familiecock.nl

3. Greylists

A relatively new spam filtering technique, Greylist takes the advantage of the fact that many spammers only attempt to send a batch of junk mail once. Under the Greylist system, the receiving mail assumes all the users as threat to the system and discards messages from unknown users in first attempt. It sends back a failure message to the originating server. If the mail server attempts to send the message second time- a step most legitimate server will take the Greylist assumes the message is not spam and allows it proceed to the recipient's inbox. At the same time the recipient's email or address will be added to Greylist as legitimate senders. Greylist filter requires less system resources than some other types of spam filters. However, they require more time in mail delivery that is problematic when we are expecting time sensitive messages.

4. Honeypot technique

In this approach, spammers who attempt to operate automated program on the sites or in email services are failed due to a loophole is created for them. They will find hosts and attempt to send mail through it, wasting their time and resources and potentially revealing information about themselves and the origin of the spam they're sending to the entity that operates the honeypot. In various sites, form applications are developed by developers where they put an additional field for the robots. As an instruction, human are said not fill the field, but robots fill the information and get trapped by the developer and simply blacklisted by their IP. The main advantage of this technique is that it is very simple to implement but applicable only small scale applications.

5. Pattern Detection Technique

Pattern detection approach consists of a large database of messages worldwide to detect spam patterns. This method works well when the message has no content or has only attachments. This method is more automated than most of other techniques because the service provider maintains the comparative spam database instead of the system administrator. The main advantage of this technique is that it is able to stop spam in real time before it gets to the end user.

6. URL filtering technique

Most spam or phishing messages contain an URL that they entice victims into clicking on. So a popular technique since the early 2000 consists in extracting URLs from messages and look them up in databases such as Spamhaus' Domain Block List (DBL).

SYSTEM ARCHITECTURE

In this study, we design and implement two systems: one is the spam checker that is analogous to CSP (Cloud Service Provider) and an E-mail client that is similar to vendor in cloud computing concept. They communicate via an Application Programming Interface (API). The overall structure has been presented in Fig. 2. The EMC has its own user and consumes the spam filtering service, SFS. So, the proposed system architecture two different systems: EMC and SFS. As a spam filtering technique we choose blacklist as it contains individual tokens that are compared to incoming text to detect spam. Also, it works real time with any existing codebase.

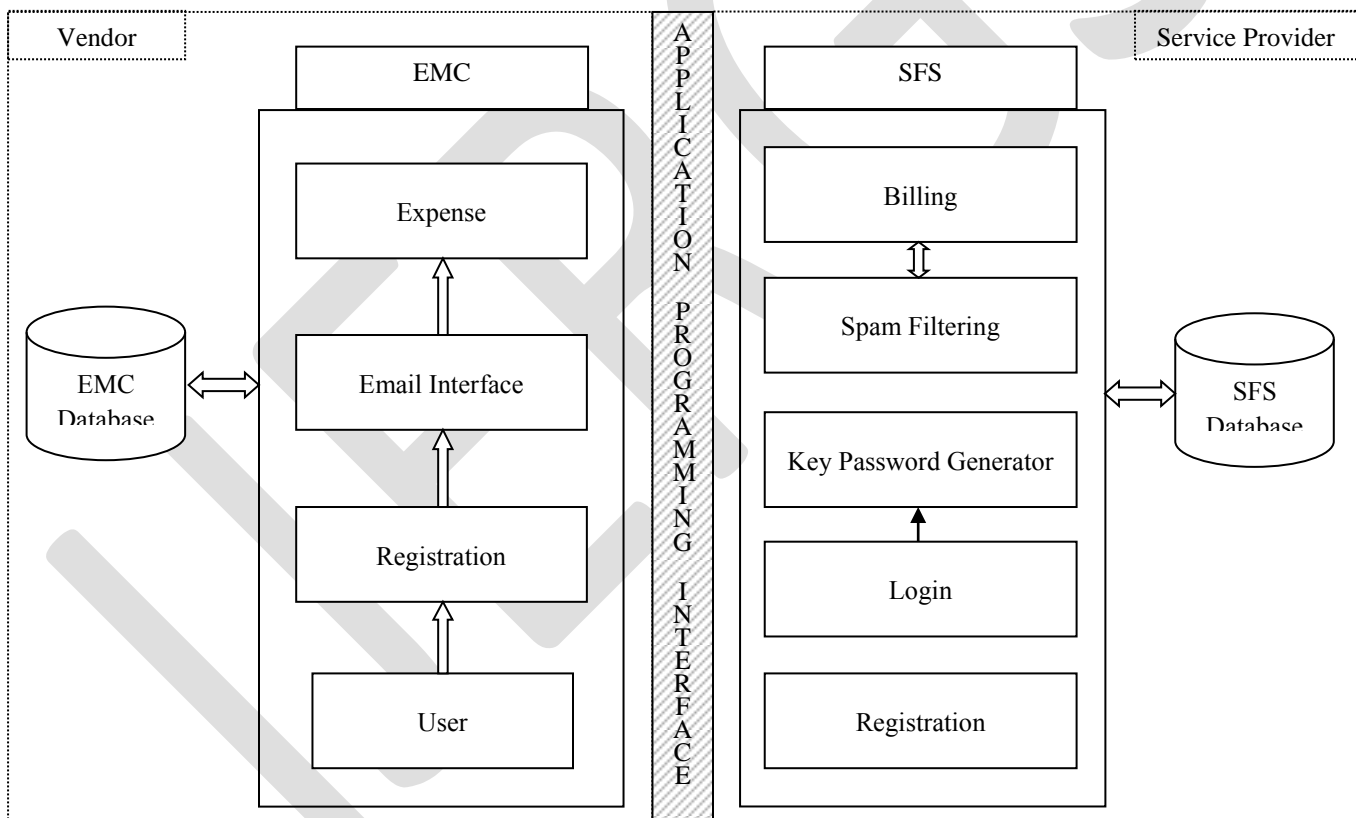


Fig. 2- Overall System Architecture

Spam Filtering Service (SFS)

In this service, we aim to build a system that securely provides spam filtering services to vendors. The system provides an API for the vendors to communicate and take services via secure channel. The API consists of four high level modules: registration, login, spam filtering and billing. Each module is connected to a database; we call this the SFS database.

At first, the system allows vendors to be registered using their credentials. Each of the potential vendors enters their details in a form and accesses the SFS vendor's profile. SFS enables vendors to generate a key-password combination from corresponding profile. The spam filtering module takes service request from the vendors via API authentication, process the request and provides a status of email whether it is spam or not. The authentication process of SFS is operated by this key-password combination. SFS generates a token against the authentication for each EMC that sends their first request to get the service. The token is a time period for which EMC are allowed to access the service without authenticating repeatedly for each request. The EMC only requires re-authenticating once the token expires. There is a billing section which keeps track of payments for each request from vendors depending on the pricing policy between SFS and EMC.

Email Client (EMC)

EMC is a cloud based E-mail messaging service that serves the communication platform among its users. EMC provides a registration form and uses its own database to store information of users who want a secure emailing service. For confidentiality and safety of the users EMC consumes a cloud based spam filtering service, SFS. EMC has three broad modules: registration, email interface, and expense details. The registration module allows user to sign up to EMC with their details information and credentials. EMC provides an email interface for sending and receiving messages via online. An expense details can also be monitored from the EMC that is directly obtained from SFS in real time via API.

Application Programming Interface (API)

SFS implements a RESTful (Representational state transfer) API for vendors to access the service. This API uses HTTP requests to complete operations such as GET, PUT, POST and DELETE data. In many cloud platforms including IBM cloud is using RESTful APIs [14]. The traditional RESTful requests are presented in Table 3.

Table 3 – RESTful Requests

Request Type	Description
HTTP GET	Requests are used to retrieve the representation of a resource or a list of resources.
HTTP POST	Requests are used to create new resources.
HTTP PUT	Requests are used to update existing resources.
HTTP DELETE	Requests are used to delete resources.

EMC requests SFS API for authentication using a GET request by sending the credentials and receiving a token. SFS verifies the EMC credentials and generate a token that expires after certain timeline. In next requests, EMC always uses this token to obtain other services. For example, once EMC has the verified token, it sends a POST request to SFS containing the token and email contents along with other relevant parameters. SFS verifies the token and process the spam filtering operation and return the response. SFS also measures the costing for processing the spam filtering. For this system, we consider a standard of \$0.0001 for each word to check. Users can view the expenses from the EMC interface that are retrieved from SFS via API GET request.

SYSTEM IMPLEMENTATION

Development Environment

We develop these systems in LAMP (Linux Apache MySQL PHP) stack. We use notepad++ IDE (Integrated Development Environment) for writing the source code and viewing the site in local PC. We use XAMPP v5.6.14 for the LAMP environment. As this has been developed in local PC we specify the site URL as <http://localhost/sfs/> where 'localhost' is any domain name such as <http://www.yourdomain.com/> and 'sfs' is the directory where the SFS web-service runs.

PHP is a server-side scripting language designed for web development but also used as a general-purpose programming language. MySQL is a freely available open source Relational Database Management System (RDBMS) that uses Structured Query Language (SQL). SQL is the most popular language for adding, accessing and managing content in a database. It is most noted for its quick processing, proven reliability, ease and flexibility of use. PHP and MySQL are used as the backend platform for the development. For the front end development, we use HTML5, CSS3, jQuery and Bootstrap v3.3.7.

SFS Development

The main objective of this system is to build an API with spam filtering engine. The API consists of several functional calls for various purposes. Any EMC can consume this service as web services. The response is in the form of JSON, a JavaScript notation for cross platform data exchange. To consume the web-service, a library package named cURL [15] is used in this study. The available API functional calls are shown in Table 4. A sample functional call for login module with description, corresponding API URL, cURL request sample and sample JSON response are following-

Vendor Login

Description: A vendor needs to login to SFS for accessing further operations. Vendor can login using the key and password from the SFS site.

Functional prototype:

```
function login($vendor_id, $key = null, $password = null){  
    //connect to db  
    //verify vendor against key, password and vendor id  
    //return token if successful  
}
```

API URL:

http://localhost/sfs/api/login

cURL request:

curl --user key:password http://localhost/sfs/api/login

API response:

```
{  
    "result": "success",  
    "token": "8f5f759e961bf53eebf8d90dbd8c2ba9"  
}
```

Table 4 – API Functional Call List

Functional Call	Description, parameters and URL
Spam Filtering	Request for spam filtering by vendors URL: http://localhost/sfs/api/filter_spam parameters: token, vendor_user_id, message method: POST response: result, is_spam, cost
Billing	Request for billing details for users in EMC URL: http://localhost/sfs/api/billings parameters: token, vendor_user_id, billing_priod method: GET response: result, charge_details

Proposed Spam Filtering Algorithm

We use blacklist technique in developing the SFS system. We collect a list of keywords from the web and make text files for each of the category mentioned in Table 2. The algorithm accepts the email message in real time and matches each word from the message with the keywords from the blacklist text files. We use regular expression for searching blacklisted keywords. For each service request we attach a cost factor for scanning the message through.

Algorithm SpamFilter(*vid*, *cid*, *cm*)

// *vid* is the vendor id, *cid* id client id, *cm* is client message
 // *blst* is blacklisted data in single file
 // *K* is blacklisted keywords
 // *M* is a Boolean value whether we have match or not
 // *W* is the number of words checked in the message
 // *P* is the total price for the spam filtering

```

1.  D ← blacklist directory
2.  for each blacklist file blst in D do
3.      K ← get keywords from blst
4.  endfor
5.  Cl ← 0 // Cl is the current line in blacklist file
6.  for each keyword k in K do
7.      Cl ← Cl + 1
8.      k ← remove space and comments before and
9.          after keyword k
10.     if empty(k) then
11.         continue to next line of K
12.     endif
13.     M ← find keyword k in cm
14.     W ← Total words in the message
15.     P ← W * 0.0001
16.     return R(M, P) // return result to the vendor
17. endfor
    
```

EMC Modules

Front End

Front end includes the registration page, login page and the email interface. We build the pages using the bootstrap library. These pages can be viewed from Fig. 3. At first unregistered user enters into mail service website. They click on register button and fill up registration form with their personal information. After submission user's information are inserted into EMC database.

cURL Script

We use cURL for consuming the SFS as a web-service. We build a prototype that we follow for requesting all the functional calls allowed by SFS API. The prototype is following-

```

$url = 'http://localhost/sfs/api/login; // url from functional call
// parameters with the request
$fields = array(
    'vendor_id' => urlencode($vendor_id),
    'vendor_key' => urlencode($key),
    'vendor_password' => urlencode($password),
);
foreach($fields as $key=>$value)
{ $fields_string .= $key.'='.$value.'&'; }
rtrim($fields_string, '&');

// configuring cURL
curl_setopt($ch,CURLOPT_URL, $url);
curl_setopt($ch,CURLOPT_POST, count($fields));
curl_setopt($ch,CURLOPT_POSTFIELDS, $fields_string);
    
```

```
// execute cURL
$result = curl_exec($ch);
curl_close($ch);

// Get response as an array
$response = json_decode($result);
```

This way any EMC can consume the SFS. It is noted that `json_decode()` is the function which decodes any JSON response from SFS to array format for easier processing in the EMC backend such as storing data in the local database or showing the data in real time in users profile.

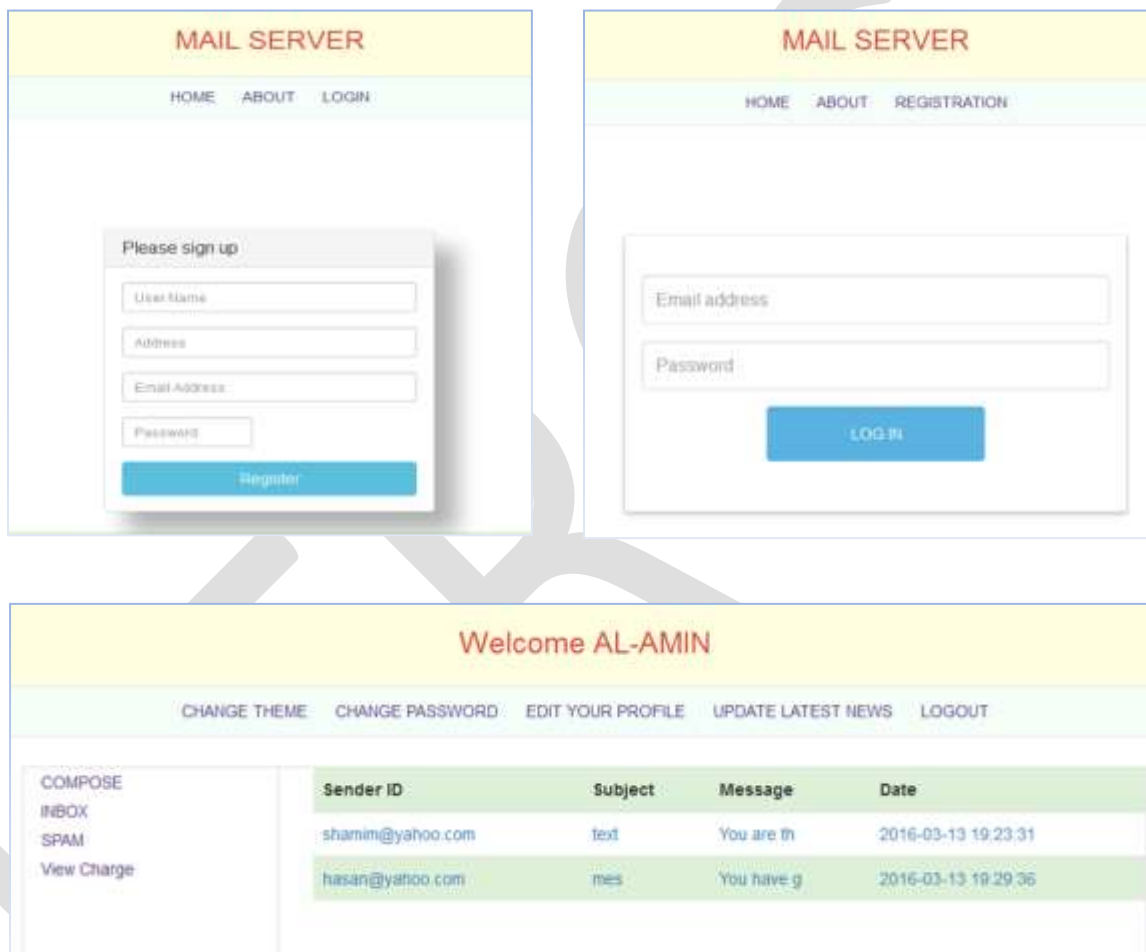


Fig. 3- Front End Pages

LIMITATIONS AND RECOMMENDATIONS

The execution of the SFS is flawless and any EMC client can incorporate this service easily into their system. They only require registering to the SFS site, generating the keyword and easy use of cURL. The SFS system also provides secure service to the EMC by generating tokens for certain amount of period. However, Email processing requires fast outcome in terms of spam filtering as E-mail communication is an instant and interruptible service. The performance of this system may degrade if there is a potential delay in retrieving of tokens after its expiration. From the security point of view the proposed system can be acceptable in this context. The pricing model is in very basic mode in this study which requires further attention. Perhaps, a pricing plan category can be considered and implemented based on the client's choices.

We recommend this spam filtering service as baseline to other services which can be built and extended from this proposed architecture. Other spam filtering technique can also be built on this stack. There are available anti-spam services in web. This architecture with blacklist anti-spam technique can be a model for some other individuals or organizations to build such important system.

CONCLUSION

E-mail sites have millions of users from all over the world. People with less technical knowledge are frequently attacked by spammer in these days. Much sensitive information is leaked away without any intention of the users. They are being trapped emotionally; curiosity and sometime greediness push them to the threat and throat of the spammers. In this paper, we investigate spam properties and consolidated them into one place that may add knowledge to the community and save them from losing their property. We study existing anti-spam techniques and build a service that protects users from unwanted activities in email. The system is designed based on the cloud concept so that service providers and email clients both can be benefitted. Our proposed architecture can help e-mail servers to improve their security and detect malicious messages and further protects user private contents to be hacked. Finally, we can't stop the spam completely but we can reduce.

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Static stress analysis of a wing bottom using Finite Element Method

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Abstract: Finite element method is widely used in the stress analysis of engineering structures. Aircraft is symbol of a high performance mechanical structure with a very high structural safety record. Rarely an aircraft will fail due to a static overload during its service life. As the aircraft continues its operation, fatigue cracks initiate and propagate due to fluctuating service loads. This project deals with the problem of identification of the critical location for fatigue crack initiation. Fatigue is a phenomenon by which the load carrying ability of a structure decreases when subjected to fluctuating loads. In a metallic structure fatigue manifests itself in the form of a crack which propagates. If the crack in a critical location goes unnoticed it could lead to a catastrophic failure of the airframe. In a structure like airframe, a fatigue crack will appear at the location of high tensile stress. Further these locations are invariably the sites of high stress concentration. Therefore, the first step in the fatigue design of an airframe is the identification of high tensile stress locations. This requires a global FEA of the structure. At the site of high tensile stress one has to identify one of the many stress concentrations present in that area. This is facilitated by a local refined FEA. This is followed by an estimation of the local stress at the highest stress concentrator. A wing panel with a large cutout in the bottom skin is considered for the analysis. Load corresponding to the level flight condition with maximum bending moment will be calculated. Local analysis near the cutout area will be carried out. Stress concentration factor and gradient stress field will be captured.

Keywords

Aircraft, Stress, wing bottom skin, large cutout, Fatigue crack, Stress concentration, Finite element method.

1. INTRODUCTION

Aircraft is symbol of a high performance mechanical structure, which has the ability to fly with a very high structural safety record. Aircraft experiences variable loading in service. Rarely an aircraft will fail due to static overload during its service life. The main lift generating components in the aircraft structure is the wings. About 80% of the lift load is taken by the wings. Another function of the wing is that they are also used as fuel tanks in commercial aircrafts. During flight, the lower part of the wing experiences a tensile stress and the upper part experiences a compressive stress. The current case considers the bottom or lower part of the wing, which experiences tensile stresses. In order to withstand the bending of the wing section due to transverse loads acting on the wing, the wing box is provided with integrated stiffeners. Cut out which is intended to provide passage for fuel access comprises of auxiliary holes around the small cut out. Discontinuities or flaws in any structure leads to high stress concentration at that region. Here, cut-out with auxiliary holes will be the critical region. These are probable locations for fatigue crack initiation. So stress analysis of that wing box is necessary.

2. OBJECTIVE

An aircraft wing is one of the major components. And the aircraft wing will be subjected to various loading cases. In that the most critical one will be lift loading condition. So if we solve the problem for lift load condition we can ensure the safety for all other load cases. So when lift load is acting on the wing, it will bend. When wing is subjected to bending, the upper surface will undergo compression and bottom surface will undergo tension.

3. FEA – FINITE ELEMENT ANALYSIS

The finite element method (FEM) is a numerical technique for solving problems which are described by partial differential equations or can be formulated as functional minimization. A domain of interest is represented as an assembly of finite elements. Approximating functions in finite elements are determined in terms of nodal values of a physical field which is sought. A continuous physical problem is transformed into a discretized finite element problem with unknown nodal values. For a linear problem, a system of linear algebraic equations should be solved. Values inside finite elements can be recovered using nodal values.

4. CONCEPTUAL DESIGN

The conceptual design of the fuel access cutout panel is modeled using commercially available modeling software CATIA V5. Model showing the fuel access cutout, which has skin, cutouts, holes, stiffeners. By using the NASTRAN and PATRAN software, meshing is done, and loads and boundary conditions are applied. Analysis is done, and hence we get the maximum stress located point.

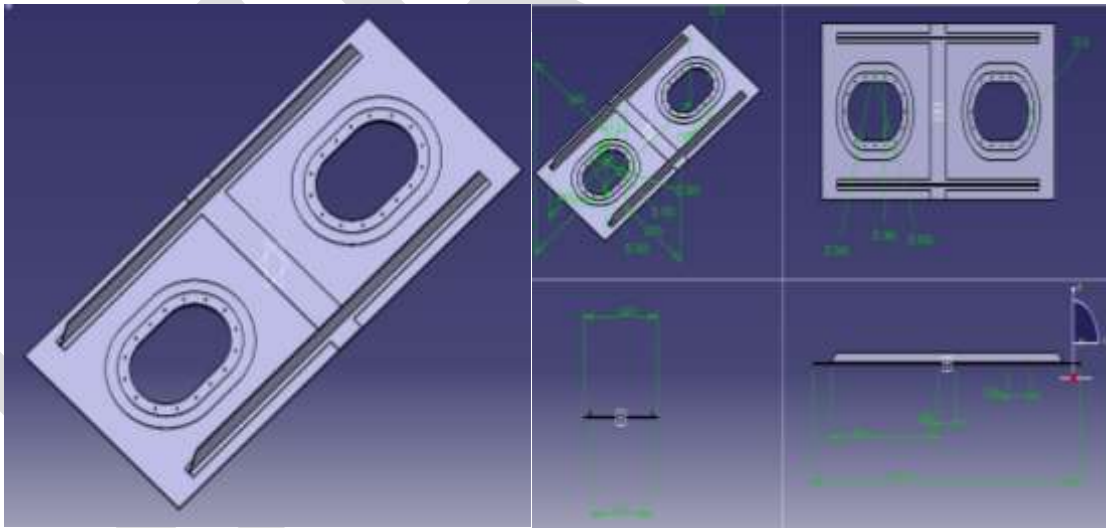


Fig.4.1 Conceptual design

5. COVERGENCE GRAPH

In order to determine the best element size which may give an accurate result will go for the convergence study. Here I selected the plate with hole in approximate dimensions, modeled, meshed, applied load and boundary conditions and analyzed.

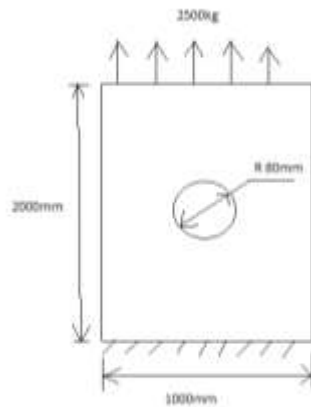


Fig.5.1 Plate with hole geometry

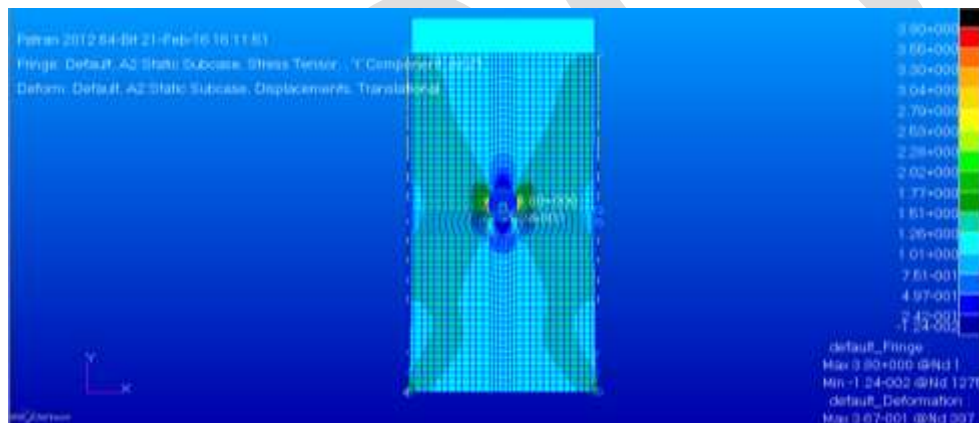


Fig.5.2 Analysis

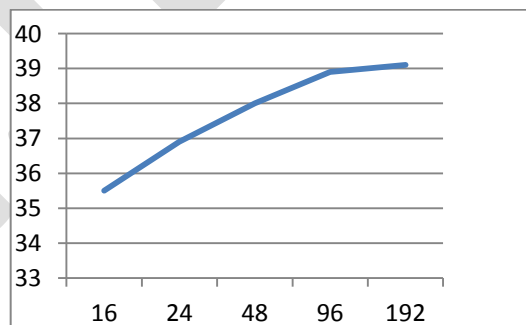


Fig.5.3 Convergence graph

X-axis - no. of elements near cutout Y-axis - max.stress (N/mm²)

6. RESULT OF CONVERGENCE GRAPH

From the convergence graph, for what element number the curve starts converging was identified. We can predict that the convergence element number will give us the exact value which we want. So I was selected 96 is the number of element which is to be maintained near my model cutout, because it initiates the curve to be converge.

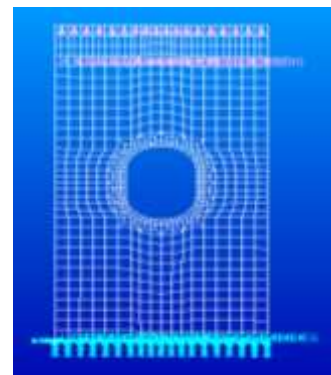
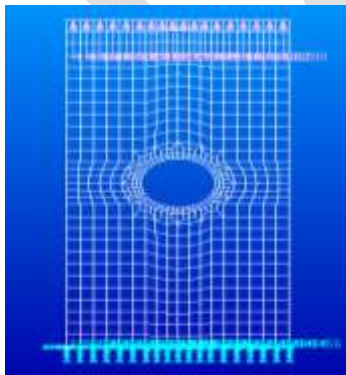
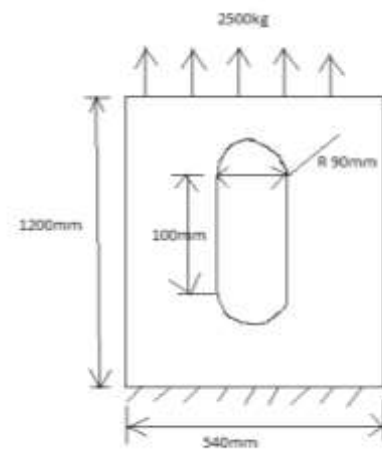
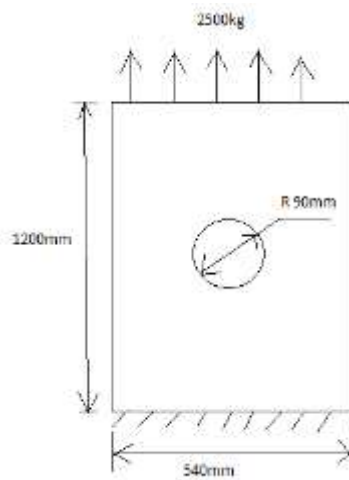
7. COMPARISON STUDY



Circular cutout



capsule cutout



8. ANALYSIS OF BOTH CUTOUTS

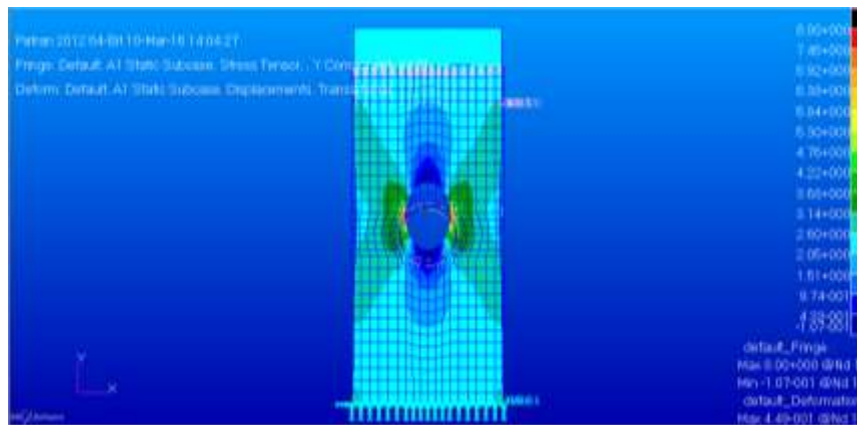


Fig.8.1 (a) Analysis of circular cutout

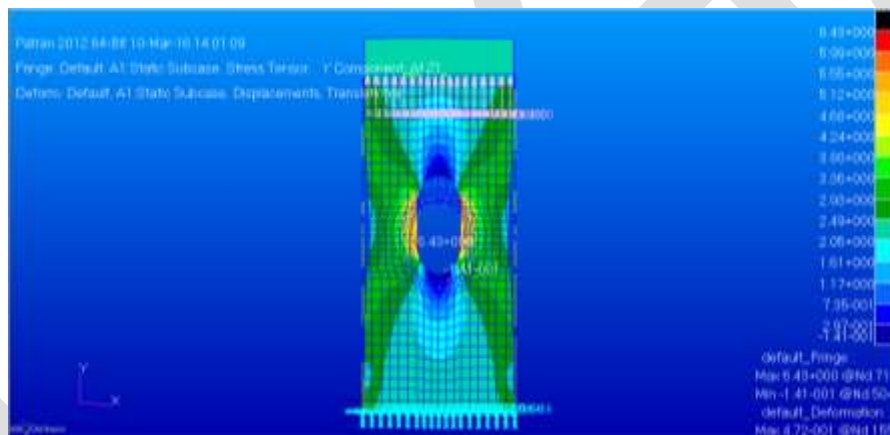


Fig.8.1 (b) Analysis of capsule cutout

9. ANALYSIS OF BOTH CUTOUTS

From the analysis, maximum stress for circular cutout is 8 N/mm² and maximum stress for capsule cutout is 6.43 N/mm². This shows the stress concentration in the capsule cutout is less than the circular cutout. So I selected the circular cutout for my model.

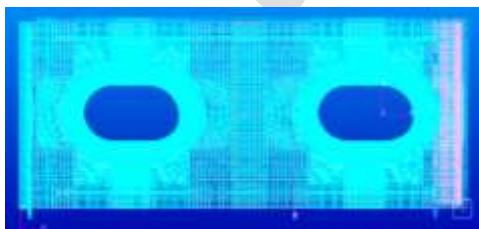


Fig.9.1 Loads and boundary conditions

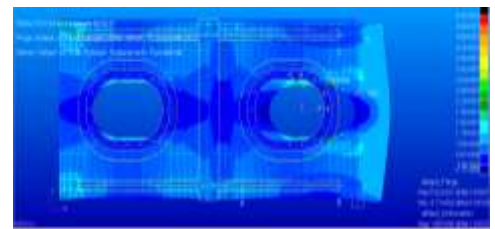


Fig.9.2 Analysis

ANALYSIS OF A MODIFIED MODEL

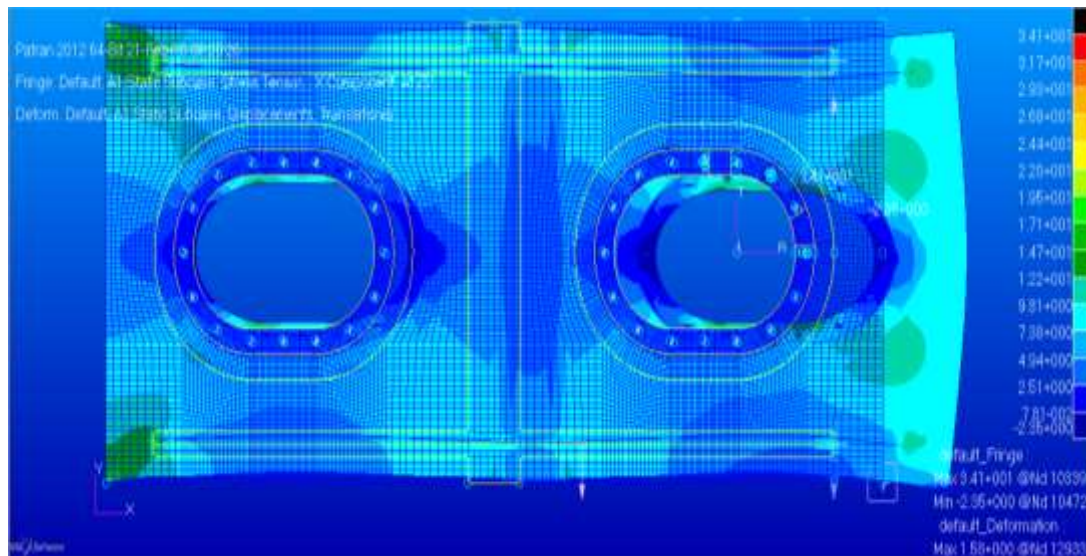


Fig.9.3 Analysis of a modified model

10. RESULTS AND DISCUSSIONS

The stress contour indicates a maximum stress of 34.1N/mm² at fuel access cutout of wing bottom skin as shown in the above figure. The maximum stress value obtained is within the yield strength of the material. The point of maximum stress is the possible location of crack initiation in the structure due to fatigue loading.

11. CONCLUSIONS

Stress analysis of the fuel access cutout of wing bottom skin is carried out and maximum tensile stress. FEM approach is followed for the stress analysis of the fuel access cutout of wing bottom skin .A validation for FEM approach is carried out by considering a plate with a circular hole. Maximum tensile stress of 34.1N/mm² is observed in the fuel access cutout of wing bottom skin. Several iterations are carried out to obtain a mesh independent value for the maximum stress. A fatigue crack normally initiates from the location maximum tensile stress in the structure.

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STRUCTURAL ANALYSIS AND CRITICAL DESIGN CRITERIA FOR FRONT END LOADING MACHINES BASED ON VECTOR MECHANICS

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Abstract - Mobile front end loaders are used throughout the world to perform important and dangerous manipulation tasks. The usefulness of these machines is greatly improved if they can utilize their mobile arms or links when they perform tasks. However the relative positions of the links influences the work efficiency of the machine. This project presents an approach to conduct structural analysis and design optimization of such machines based on vector mechanics. Based on the feedback and requirement was understood. The concepts are generated to design and analysis of the mechanism. A structural analysis is conducted to provide basic insights into the effects of the end load and crane configuration. The present research focuses on three major sections: static structural analysis, Kinematic analysis and Kinetic analysis for severe operating conditions. Results are correlated using empirical results.

Keywords – Structural Analysis, Static, Kinetic, Kinematic, DOF, Vector Mechanics, MATLAB, Front end loading machines.

INTRODUCTION

Mobile front end loading machines are used throughout the world to perform important and dangerous manipulation tasks. The usefulness of these machines is greatly improved if they can utilize their mobile arms or links when they perform the operations. However the relative positions of the links influences the work efficiency of the machine. In order to do this, these machines are designed in such a way that the whole structure of the machine is movable in many different ways, as are the various parts of the structure. There have been previous investigations of front end loaders. However, most previous work in this area has been limited to investigations of the front end loader's stability during its operation. In general, mobile front end loaders are designed as boom cranes because of their structural advantages. Therefore, the analysis in this project concentrates on links of the machine. However, the methods and results can also be adapted to other types of cranes and mobile lifting machines.

This project presents an approach to conduct static force analysis of such machines based on vector mechanics. Based on the feedback and requirement was understood. The concepts are generated to analysis of the mechanism.

The static analysis is done with considering the self weight of links. Static analysis gives insights to the vector mechanics approach. Kinematic analysis is the basic step for the dynamic analysis. Kinetic analysis gives the critical design criteria for the machines.

1 VECTOR MECHANICS

The present work uses vector mechanics based approach in all the sections. Hence the concept the vector mechanics is explained briefly in this section. This approach uses the concept of vector algebra to solve the problems of mechanics. Three dimensional problems can be solved in a simple manner. The problems which are difficult to solve by using scalar methods can be solved easily by using this method. In some situation, the problems in statics may involve many force and moments in and around different directions which are difficult to imagine. At that situation, the concept of vectors are very useful to solve the problem. A vector can be defined as mathematical quantity which has both direction and magnitude and obeys parallelogram law. The example below explains the application of vector mechanics.

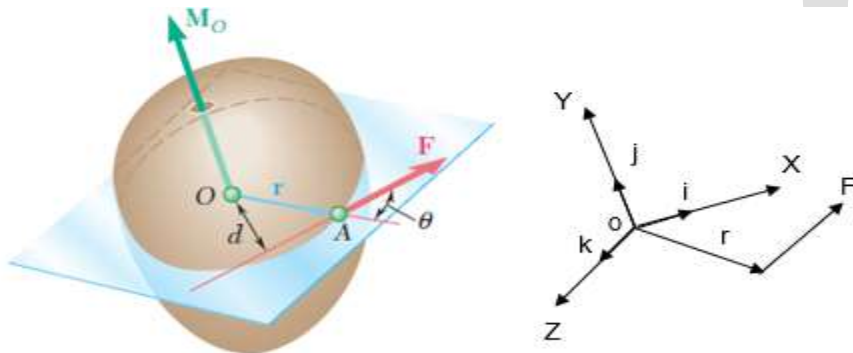


Figure 1 Moment of a force

It is needed to find the moment of a force F about point O . Normally, the moment is found out by multiplying force with perpendicular distance.

$$M_O = F \times d = \text{Force} \times \text{distance}.$$

This will give only magnitude of the moment of force about O . But in vector mechanics, the moment of a force about a particular point is defined as the cross product of position vector of point A with respect to point O and force. A coordinate system has to be taken at point O . Unit vectors in X , Y and Z directions are i , j and k respectively. The components of position vector r in X , Y , Z directions are l , m and n respectively. The components of force F in X , Y , Z directions are F_x , F_y , F_z respectively. Then moment of force F about point O is calculated as follows,

$$M_O = r \times F = (li + mj + nk) \times (F_x i + F_y j + F_z k) = (m F_z - n F_y)i + (n F_x - l F_z)j + (l F_y - m F_x)k$$

The final product gives the magnitude and direction moment of force.

In this section different cases regarding front end loading machines are solved and new approach has been established which will contribute to the design world. There are three sections which are 1) static analysis . 2) Kinematic analysis 3) kinetic Analysis

1) Static Analysis:

In this section , considered cases dealing with the equilibrium of structures made of several connected parts. These cases call for the determination not only of the external forces acting on the structure but also of the forces which hold together the various parts of the structure. From the point of view of the structure as a whole, these forces are internal forces.

2) Kinematic Analysis:

In this section, the kinematics of rigid bodies will be considered. Investigation of the relations existing between the time, the positions, the velocities, and the accelerations of the various parts forming a rigid body. As will see, the various cases of rigid-bodies related to the analysis.

3) Kinetic Analysis:

The relations existing between the forces acting on a rigid body, the shape and mass of the body, and the motion produced. has been understood in the above sections, assuming then that the body could be considered as a particle, i.e., that its mass could be concentrated in one point and that all forces acted at that point. The shape of the body, as well as the exact location of the points of application of the forces, will now be taken into account. It also is concerned not only with the motion of the body as a whole but also with the motion of the body about its mass centre.

Approach will be to consider rigid bodies as made of large numbers of particles and to use the results obtained in the particle level for the motion of systems of particles. Specifically, two equations, $\sum \mathbf{F} = m\mathbf{a}$, which relates the resultant of the external forces and the acceleration of the mass center G of the system of particles, and Equation,

$\sum \mathbf{M}_G = \dot{\mathbf{H}}_G$, which relates the moment resultant of the external forces and the angular momentum of the system of particles about G.

1.1 Static Analysis

Problem definition:

The telescoping arm ABC is used to provide an elevated platform for construction workers as shown in figure2 . The workers and the platform together have a specified mass and have a combined centre of gravity located directly above C. For the position different position of luffing and slewing angle, determine the force exerted at B by the single hydraulic cylinder BD and the force exerted on the supporting carriage at A. Write a Mat lab programme for the above problem and calculate the Von mises stresses.

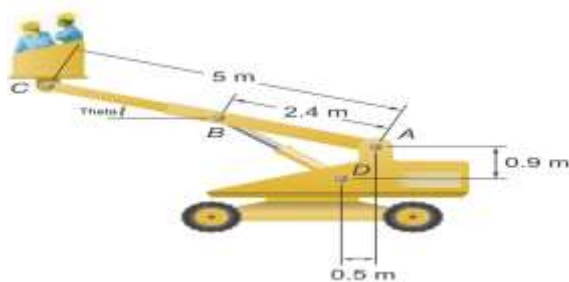


Figure 2 The telescopic boom

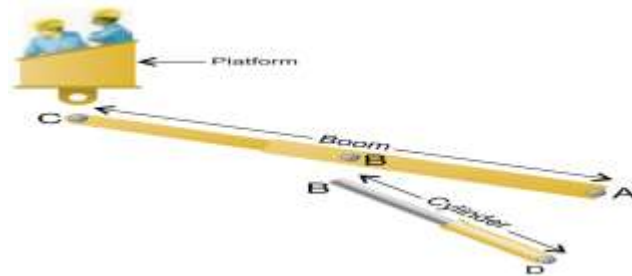
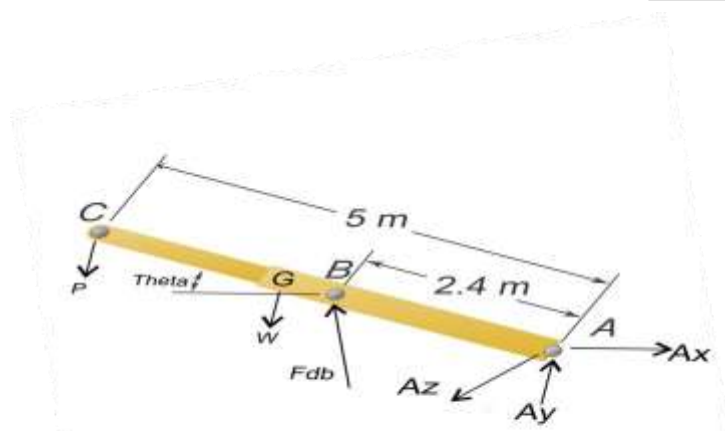


Figure 3 Problem Description

The telescopic boom machine has a boom which has the cylinder and plat form for the desired work. Boom has two degrees of freedom which are rotation about Z axis known as Luffing angle (θ). Rotation about Y axis is known as Slewing angle (α). All rotations are measured in degrees.

Cylinder which is shown in figure 3 is the actuator for the desired rotation of the boom.

Vector Mechanics approach: Free body diagram is as shown in figure4 below



\vec{F}_{db} is the cylinder force which acts in the direction of cylinder DB

\vec{A}_x , \vec{A}_y and \vec{A}_z are the rectangular components of hinge reactions at A.

\vec{W} is the weight of the boom and \vec{P} is the external load.

1.2 Kinematic and Kinetic Analysis

Problem Definition:

The arm AB of length 5 m is used to provide an elevated platform for construction workers. The arm AB is being raised or lowered at the constant rate ω_2 rad/s; simultaneously, the unit is being rotated about the Y axis at the constant rate ω_1 rad/s. Write the Mat lab programme to determine the velocity and acceleration of point B.

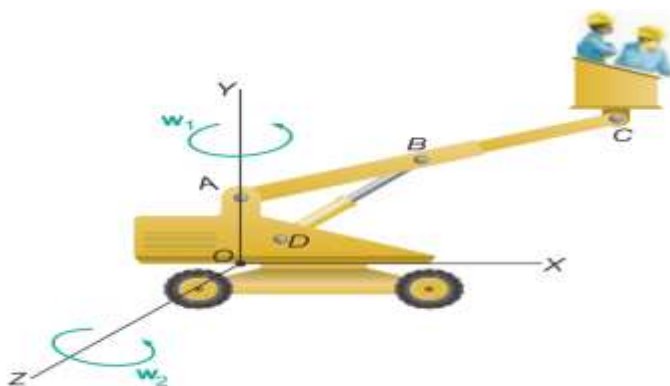


Figure 5 Problem description

Problem description: Telescoping boom is as shown in figure 5 . The kinematic analysis is done based on the vector mechanics To keep the plat form in required position the boom is rotated with rate so its necessary to do the kinematic analysis before moving to the kinetic analysis.

2 Force comparison with one of the commercial FEM software ANSYS

For one of the configuration and one of the problem , results are obtained from the vector mechanics approach and for the same configuration ANSYS based results.

Selected Configuration for the comparison: Load at the CG of the Platform is 10KN and luffing angle $\theta = 30^\circ$ and slewing angle $\alpha = 10^\circ$. Mass of the boom is 436.8 Kg for the shown length

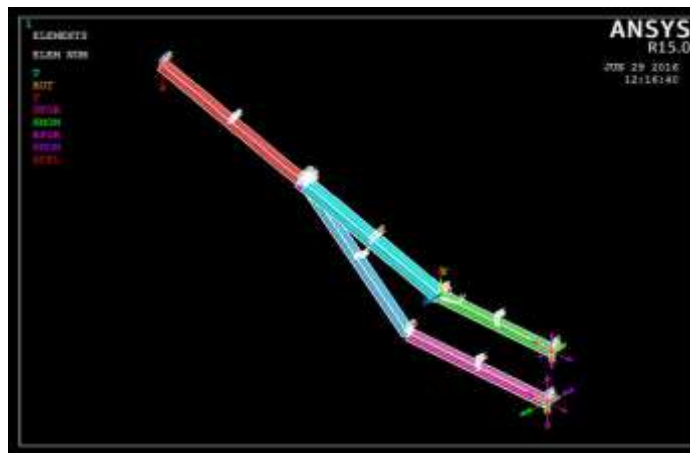
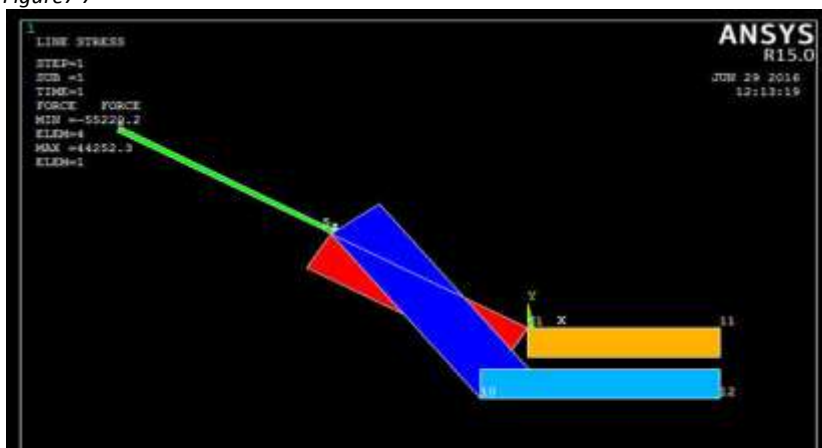


Figure 6

Figure7 7



Computation based on ANSYS is as shown figures 6 and 7. Figure 6 shows the configuration of machine and figure 7 shows force distribution

Forces in KN	Cylinder Force Fbd	Reaction at hinge A
Vector Mechanics	55.20	44.356
Ansys APDL	55.22	44.252
% Error	0	0.23

Table 1

Table 1 shows the comparison between vector mechanics and ANSYS results. Error is of 0%. Hence it is concluded that the methodology based vector mechanics approach is valid for the analysis.

Based on the vector mechanics methodology Mat Lab programme is written for all possible combinations of boom position.

Von Mises stress calculation:

For one of the configuration results are obtained from the vector mechanics approach and for the same configuration ANSYS based results are obtained.

Luffing angle $\theta = 0$ degree , slewing angle $\alpha = 10$, external load $P = 10$ KN weight of the boom $W = 4.285$ KN . Section thickness is 20 mm .

Forces in

Global coordinates

- $F_{ax} = 51.968$ KN
- $F_{ay} = -10.693$ KN
- $F_{az} = -9.163$ KN
- $F_{dbx} = -51.968$ kN
- $F_{dby} = 24.978$ KN
- $F_{dbz} = 51.968$ kN

Local coordinates

- $F_{ax} = 49.587$ KN
- $F_{ay} = -10.693$ KN
- $F_{az} = -18.047$ KN
- $F_{dbx} = -49.587$ KN
- $F_{dby} = 24.978$ KN
- $F_{dbz} = 18.048$ KN

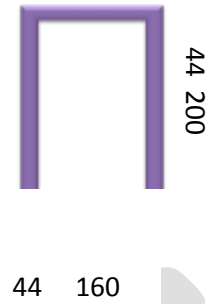
Material used is steel A36, material details are given in the Appendix A, case2.

Section details : Cross section is as shown in figure

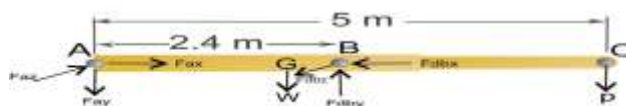
Width = 160 mm

Height = 200 mm

Thickness = 20 mm



Free body diagram for stress calculation is as shown in figure 8.



Shear force and Bending moment diagram are as shown in figure 9

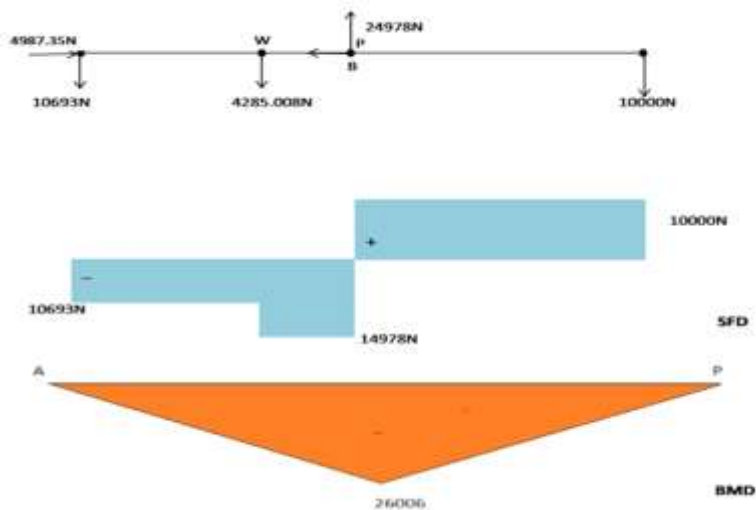


Figure 9

Figure 10 shows the ANSYS computation results

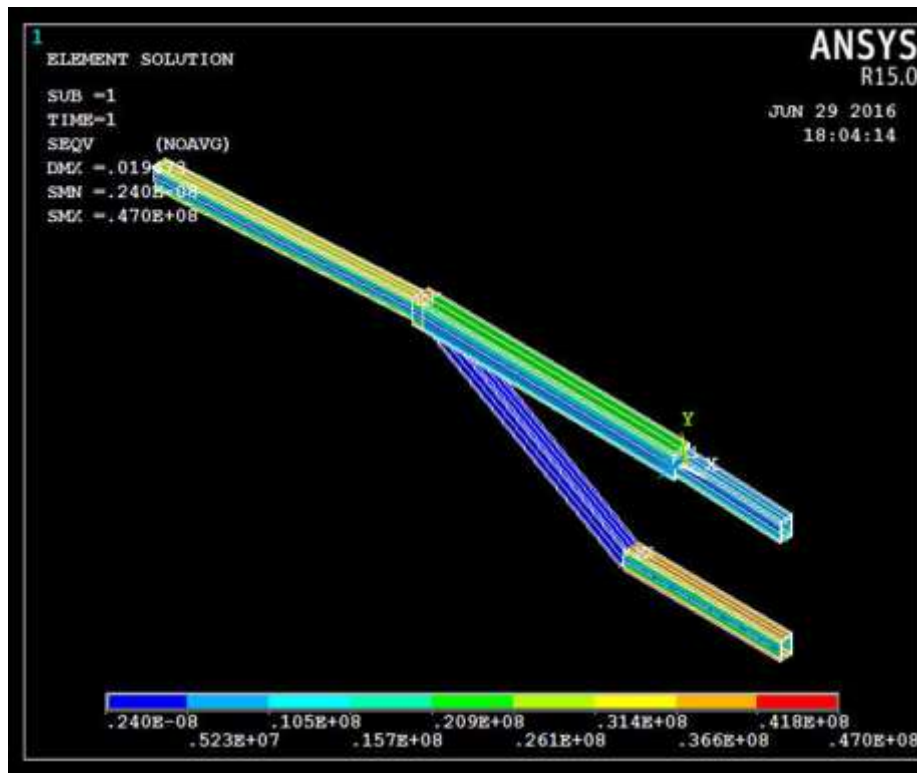


Figure 10

Stress comparison with one of the commercial FEM software ANSYS :

	Von mises stress in Mpa
Vector mechanics	47.71
ANSYS APDL	47

Table 2

Stress comparison with one of the commercial FEM software ANSYS :

	Von mises stress in Mpa
Vector mechanics	47.71
ANSYS APDL	47

Table 2

Table 2 shows the comparison between vector mechanics and ANSYS results. Error is of 1.48%. Hence it is concluded that the methodology based vector mechanics approach is valid for the analysis.

3 RESULTS

Effect of variables on cylinder force and Von mises stress :

Figure 11 shows the graph of luffing angle in CCW direction v/s cylinder force. As luffing angle increases force on cylinder decreases .

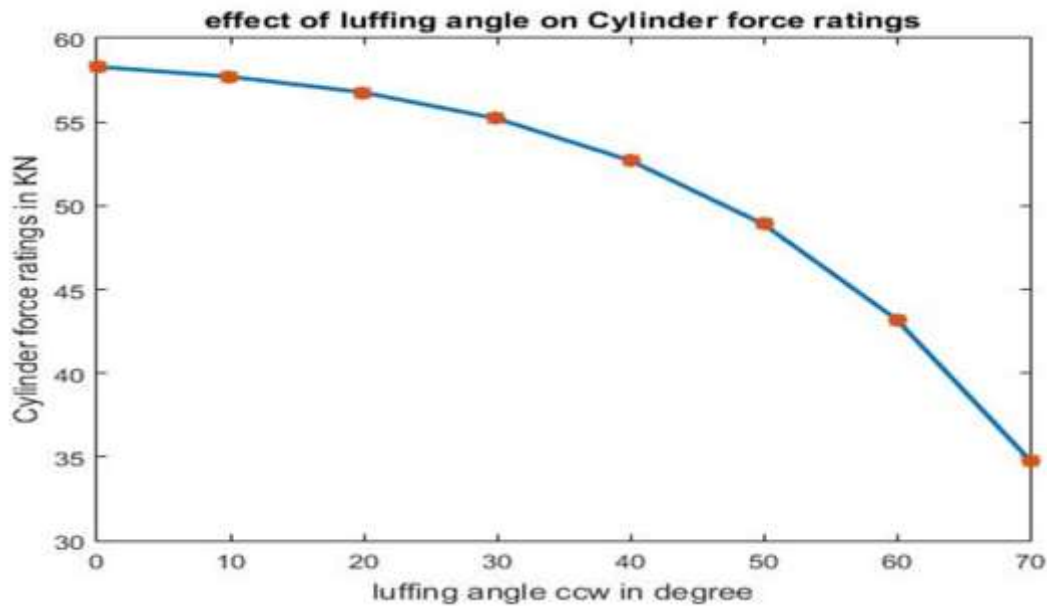


Figure 12 shows the graph of luffing angle in CW direction v/s cylinder force .As luffing angle increases force on cylinder also increases

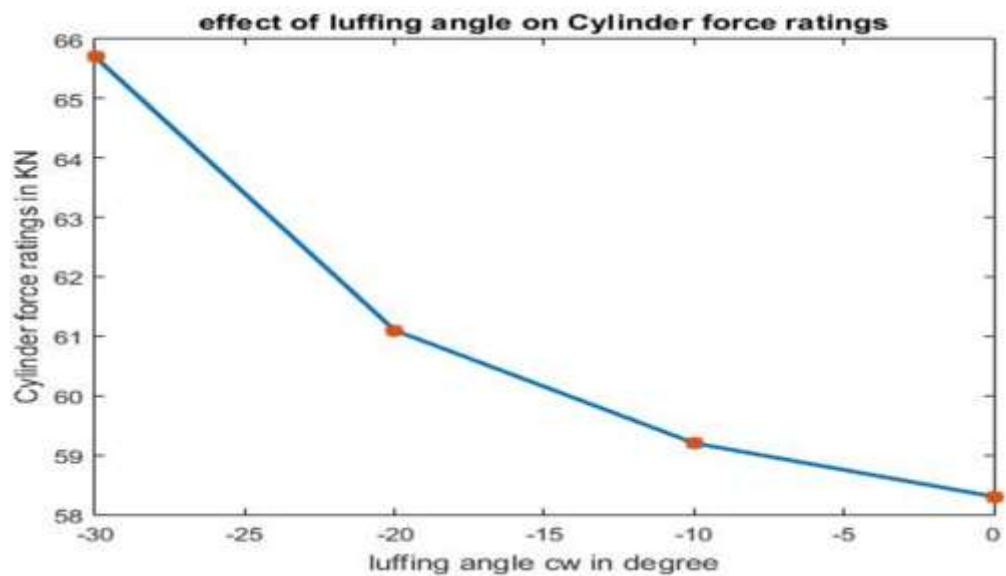


Figure 12

Figure 13 shows the graph of slewing angle v/s cylinder force .As slewing angle increases force on cylinder remains constant

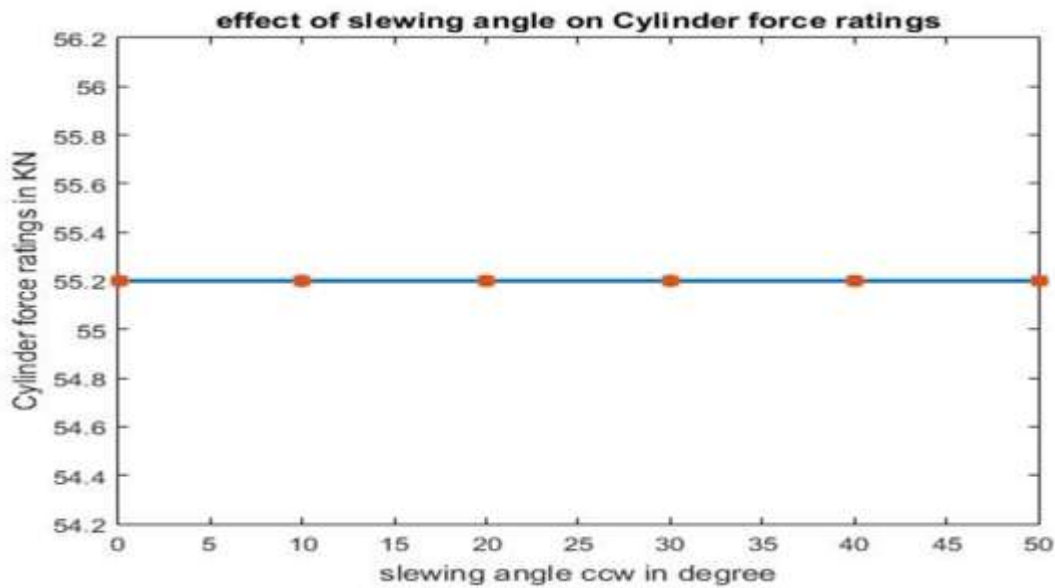


Figure 13

Figure 14 shows the graph of external load v/s cylinder force .As load increases force on cylinder also increases.

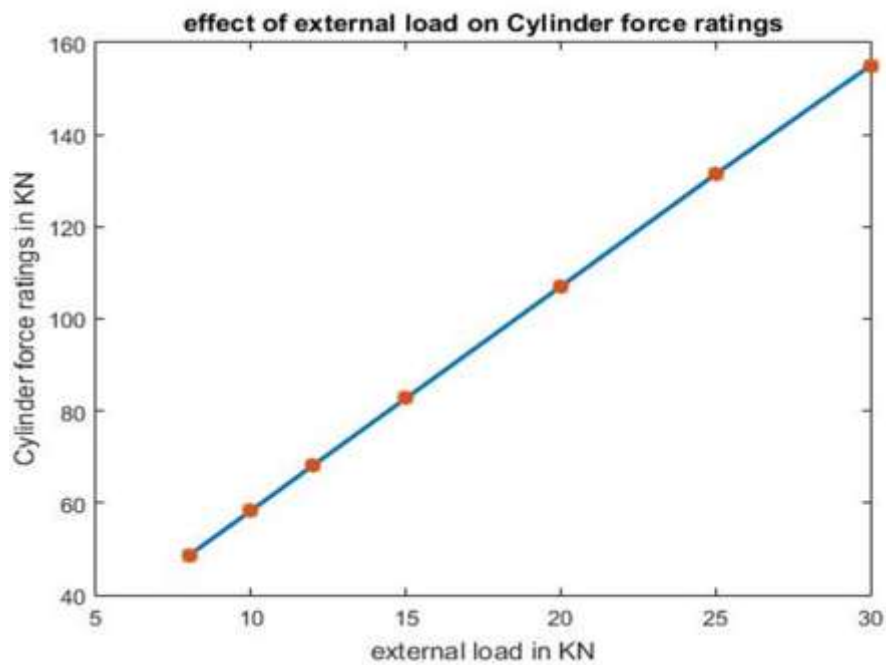


Figure 14

Figure 15 shows the graph of luffing angle v/s Von mises stress. As luffing angle increases ,Von mises stress increases upto 40° ,after that it decreases.

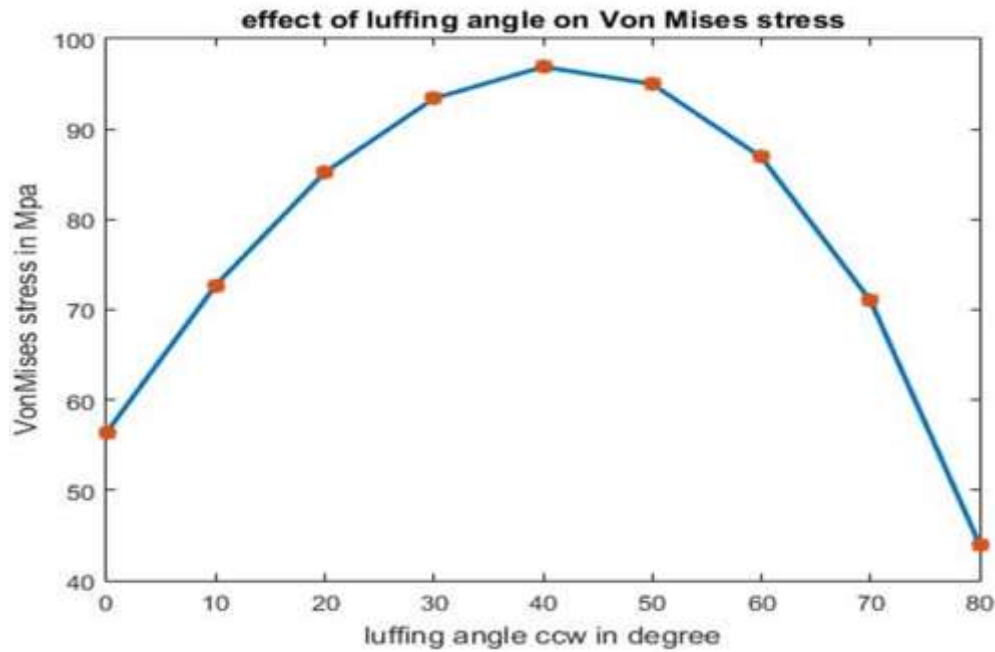


Figure 15

Figure 16 shows the graph of slewing angle v/s Von mises stress. As slewing angle increases ,Von mises stress increases upto 10° ,after that it decreases.

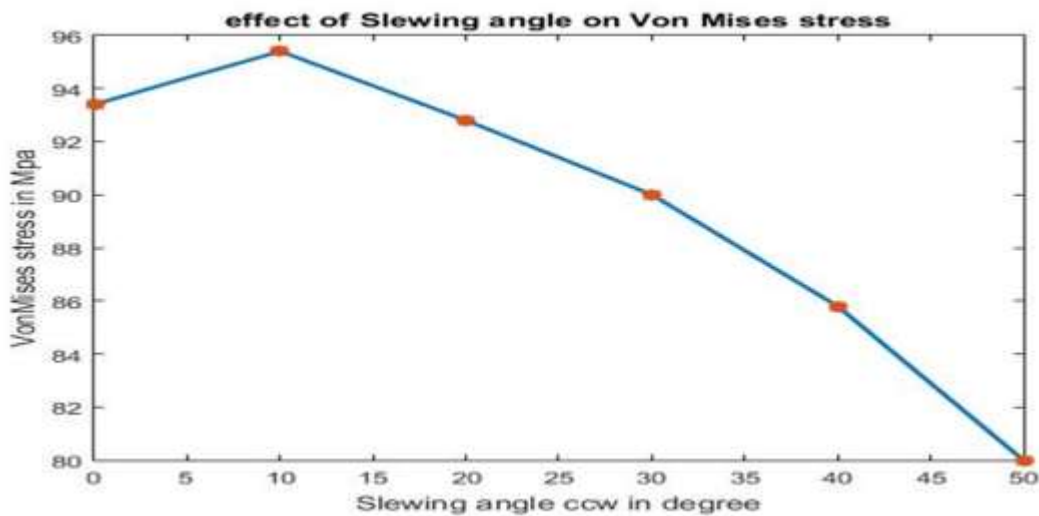


Figure 16

Figure 17 shows the graph of external load v/s Von mises stress. As load increases ,Von mises stress also increases .

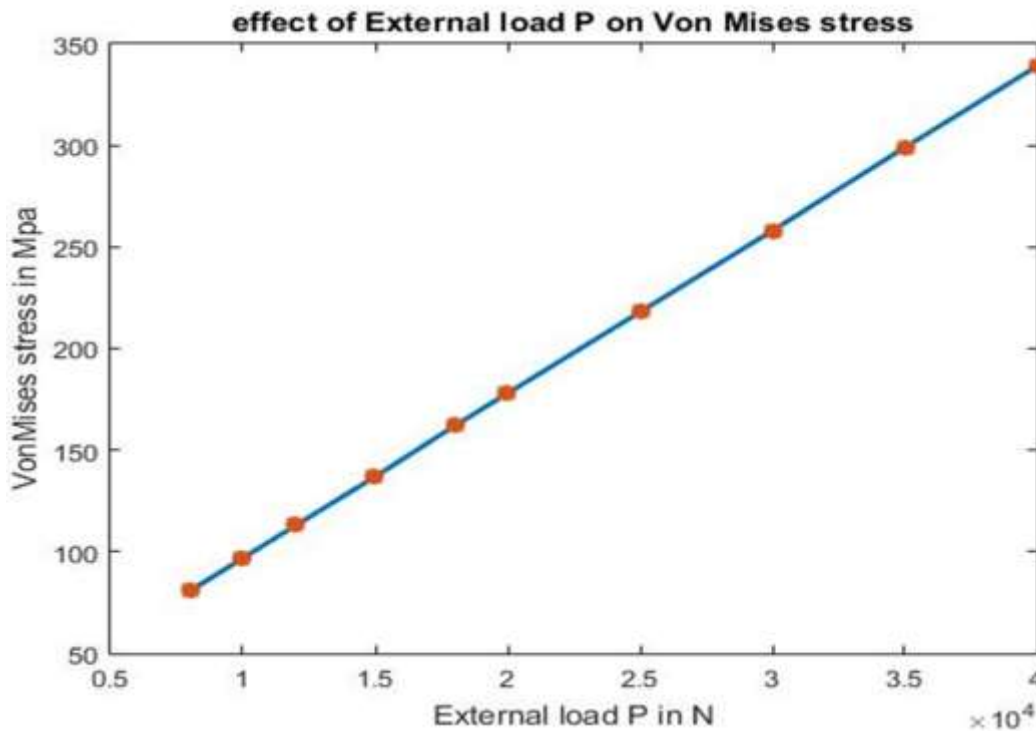


Figure 17

The results are shown for the one of the calculation and configuration of the static problem

4 CONCLUSION

The Vector mechanics approach for the structural analysis and critical design criteria of front end loading machines is an off spring of conventional scalar method. For three dimensional analysis vector method is the best suitable option. From the analysis it is concluded that vector mechanics approach yields accurate results within less time than that of the FEM. However the FEM is the bench mark for the initial development of vector mechanics methodology.

Front end loading machines are critical to analyse because of their complex vehicle integrity. The efforts are made to overcome this complexity in this methodology. Results obtained are useful in the Adaptive Design.

Mat Lab programming which is outcome of the vector mechanics calculation for the analysis helps to reduce the calculation time and we can conclude that both Vector mechanics and Mat lab programming can replace the FEM package for the initial stages of the adaptive design.

Optimization can be increased to higher level by using the exact dimensions and by writing the 3D Mat Lab programming.

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Energy Audit of a Boiler and Waste Heat Recovery System in Thermal Power Plant

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Abstract— At present the installed power generation capacity in India is 303083 MW. Based on the availability of fuel in India, approx 70% of the power generation from using pulverized coal firing in thermal power plant. In recent years, India's energy consumption has been increasing at a relatively very fast rate due to economic development and population growth. Currently world electricity demand is growing at the rate of 2.6 percent per year and it is projected to double by 2030 .the energy demand is increasing day by day, but available energy lacks in supply due to lacks of fossil fuels availability. Hence there is no option for proper and efficient utilization and conservation of energy. In this paper the main focus is given to on energy conservation opportunity by using the energy audit technique in a thermal power plant of 210MW capacity as well as use waste heat recovery system in a thermal power plant to recover the energy of exhaust gas stream with high temperature has the high potential of waste heat. Energy Audit defines the performance of each and every equipment and compared it with the base case. A well done energy audit and energy management helps to recognize the pattern of energy , form of energy consumption and amount of energy consumption so that identify possible area of energy conservation in thermal power plant.

Keywords— Energy audit, Thermal Power Plant, Boiler efficiency, Waste Heat Recovery System, Energy Conservation.

1. INTRODUCTION

Bokaro Thermal Power Station, Damodar Valley Corporation India is located at Bokaro Jharkhand. It is one of DVC's major coal fired power plants, located on the bank of the Konar River. The power plant is one of the coal based power plants of BTPS. The plant has an installed capacity of 3X210 MW. The first unit was commissioned in March, 1986. During November 1990, the second unit was commissioned and August 1993, the third unit was commissioned. Electricity is produced in BTPS by burning of pulverized coal and generates the super heated steam which is further fed to Steam Turbine to rotate the generator rotor to produce electricity at 50 Hz frequency and 15.75 kV voltages in all units. Then this 15.75 kV voltage is stepped up through individual step up transformer to 220 kV and fed to the grid. There are two other step down transformers in each unit i.e. Unit Auxiliary Transformer (UAT) which step down the voltage level to 6.6 kV and fed to the auxiliaries superheated steam is generated in steam generators at 535 °C and 130 kg/cm² and same is fed to steam turbine through control valve. From different stages of turbine extractions are taken and used for HP Heaters and LP Heaters. At the last stage of LP turbine the exhaust steam is taken into the condenser to maintain the vacuum or back pressure to the turbine [1]. The overall performance for all the 3 units of Plant is shown in Table 1.

Table 1: Overall Year Wise consumption history and Performance review of Thermal Plant of BTPS unit-1

Sl. No	Parameter	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15
1	Generation(MU)	3451.64	3518.16	3436.21	3356.52	3106.98	1737.68	1634.38
2	PLF(%)	62.54	63.74	62.26	60.65	56.3	31.49	29.61
3	BD (MU)	1.78	0.31	3.4	41.51	200.89	131.863	59.497
4	Deemed PLF %	62.58	63.75	62.33	61.4	56.94	33.88	30.69
5	APC %	10.57	10.75	11.54	11.68	11.19	12.5	11.96232
6	DM %	7.71	2.92	3.08	2.82	2.97	3.56	3.47
7	Availability %	76.8	75.34	78.59	85.57	75.45	42.6	37.04
8	Partial loading%	18.57	15.38	20.77	29.12	25.38	26.08	20.04
9	Outage Hr	4834.6	4568.62	4662.34	3813.42	5199.11	8675	5960.58

10	No of Outage	152	105	12	99	84	55	49
11	Heat rate	3025.27	2878.14	2815.77	3010.1	2864.52	3002	2775
12	SOC (ml/kwh)	2.799	1.68	1.39	1.547	1.429	1.47	1.3264
13	SCC (kg/Kwh)	0.754	0.785	0.851	0.909	0.907	0.907	0.822

Seven year energy consumption data at table 1 is used for calculating the average energy consumption of various sources. The power generation at various year in (MU) shown in fig 1.

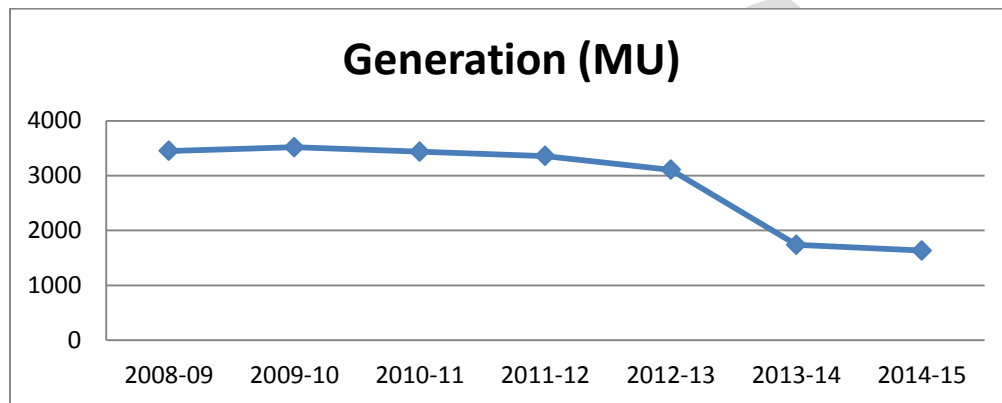


Fig.1.Graph shows power generation at various years in (MU)

1.1Need of Energy Audit

The energy audit outcome recommended energy conservation measures shall be implemented by designated consumer after technical and financial feasibility study. Main goal of energy management is to ensure effective and efficient use of ensuring to maximize profits and enhances competitive position. It also aims to minimize the environmental effects [2]. As per the energy conservation Act, 2001, energy audit is defined as “the verification, monitoring and analysis of use of energy including submission of technical report containing recommendations for improving energy efficiency with cost benefit and action plan to reduce energy consumption” [3].

1.2 Energy audit methodology

Boiler and Air preheater operational data collection were carried out with calibrated instruments. The required parameter for energy audit analysis of different system or utilities was measured and the power consumption was measured. For energy audit data collection the standard formulas as per PTC standards and CEA, BEE guidelines for Energy Auditing of power plants were used. In this project, the study is mainly targeted at identifying, sustainable and economically viable energy cost saving opportunities in boiler section of Unit-I, of Bokaro Thermal Power Station, Bokaro Jharkhand. The study shows that, there is a significant cost saving opportunities and recommendations have been made to realize this potential. It is true that there is no exact methodology, which can be its own method for conducting energy audit. It can be classified in to two types:

1.2.1 Preliminary Energy Audit or Walkthrough audit

A preliminary energy audit or walkthrough audit study typically done in three days and it can be divided into three steps:

Step-1: Identifies the quantity and cost of various energy forms used in the plant.

Step-2: Identifies energy consumption at the Boiler house and APH.

Step-3: Relates energy input to production, thereby highlighting energy wastage in major equipment like Boiler and APH/ processes.

After followed by above three steps, set of observation and recommendations for immediate low-cost action, and Identification of major areas Projects [15].

1.2.2 Detailed Energy Audit

A comprehensive audit provides a detailed energy project implementation plan for a facility, since it evaluates all major energy using systems. This type of audit offers the most accurate estimate of energy savings and cost. It considers the interactive effects of all

projects, accounts for the energy use of all major equipment, and includes detailed energy cost saving calculations and project cost. In a comprehensive audit, one of the key elements is the energy balance. This is based on an inventory of energy using systems, assumptions of current operating conditions and calculations of energy use. This estimated use is then compared to utility bill charges. Detailed energy auditing is carried out in three phases: Phase I, II and III.

Phase I - Preparation

Phase II - Execution

Phase III –Reporting.

2. Power generation at thermal power plant

In BTPS the coal is transported from the mines by railway and is unloaded at the site by track hoppers or wagon tippler and passed through the primary crusher and the secondary crusher mill for crushing. The crushed coal is stored in the bunker and fed into coal mills for pulverization. The pulverized coal is further fed into the boiler furnace for firing and producing superheated steam. The other raw material use in the station is water which is drawn from the canal. The water after de-mineralization in DM plant is used as make up water for the power cycle. The water is also required for the cooling process and other purposes in the plant. The steam from the boiler passes through the turbine fitted with condenser for driving the generator for power generation. Power generated is evacuated /transmitted through the transmission lines to the power grid. The used steam from the turbine is taken into the condenser, where it is condensed with the help of recycled water from the cooling tower. The warm water from here is cooled in the cooling towers. the ash is produced after the burning of pulverized coal in the boilers and is collected in the bottom ash hopper, and ESP's hoppers, Air pre-heaters, economizers and chimneys of respective units (and also in the mechanical collectors). This ash is transported to the ash dykes in slurry form.

3. Boiler Efficiency Calculations (BTPS, DVC Unit-1 at 100%MCR)

In order to calculate the boiler efficiency by indirect method, all the losses that occur in the boiler must be established. These losses are conveniently related to the amount of fuel burnt. In this way it is easy to compare the performance of boiler of Bokaro Thermal Power Station unit-1 with different ratings. The purpose of the energy audit of a boiler is to determine actual performance and efficiency of the boiler and compare it with design values. It is an indicator for tracking day-to-day and season-to-season variations in boiler efficiency for energy efficiency improvements.

4. Boiler and APH parameters for efficiency calculation

Table 2 Boiler and APH Parameters

Parameter	Symbol	Unit	Values
Moisture	M	%	12.11
Ash	A	%	33.13
Volatile matter	VM	%	16.74
Fixed Carbon	FC	%	38.02
Carbon	C	%	45.189
Hydrogen	H	%	2.175
Nitrogen	N	%	1.551
Sulphur	S	%	0.628
Oxygen	O	%	5.218
Moisture	M	%	12.110
Ash	A	%	33.130
Gross Calorific Value	GCV	Kcal/Kg	4271.05
Total Combustibles	U	Kg/kg	0.03253
CV of Carbon	CVc	KJ/kg	33720.56
O ₂ at AH Outlet	O ₂	%	5.08

CO ₂ at AH Outlet	CO ₂	%	13.77
CO at AH Outlet	CO	ppm	675.00
		%	0.0675
N ₂ at AH Outlet N ₂ =100-O ₂ -CO ₂ -CO	N ₂	%	81.083
Air heater outlet gas temp.	T _g	°C	139.500
Carbon to Hydrogen Ratio	C/H		20.78
Instantaneous specific heat of flue gas at T _g (From fig. 7 of ASME PTC-4.1	C _p	BTU/lb/°F	0.235
		KJ/kg/°C	0.983945
AH secondary air inlet temp.	T _s	C	28.20
AH primary air inlet temp.	T _p	C	36.70
Secondary air flow	Q _s	T/hr	603
Primary air flow	Q _p	T/hr	191
Instantaneous specific heat of flue gas at T _r (From fig. 7 of ASME PTC-4.1	C _p	BTU/lb/°F	0.23
		KJ/kg/°C	0.963
Mean specific heat of dry flue gas	C _{pg}	KJ/kg/°C	0.973
Enthalpy of vapour at partial pressure & at T _g	H _{tg}	KJ/kg	2753.450
Enthalpy of saturated liquid at T _a	H _{ta}	KJ/kg	111.940
Enthalpy of saturated vapour at T _r	H _{sv}	KJ/kg	2556.200
Ambient temp. (Dry bulb)	T _a	°C	26.70
Ambient temp. (Wet bulb)		°C	21.60
Weight of water vapour per kg of dry air (From psychometric chart)	W _{wv}	Kg/kg air	0.014
Weight of Nitrogen in dry gas $WN_2 = 28.02 * N_2 * (Cb + 12.01 * S / (100 * 32.07)) / (12.01 * (CO_2 + CO))$	WN ₂	Kg/kg coal	5.765
Nitrogen in Fuel	N	%	1.551
Weight of dry air $Wa = (WN_2 - N / 100) / .7685$	Wa	Kg/kg coal	7.482
Carbon in fuel	C	%	45.189
CV of carbon monoxide	CV	KJ/kg	23627.644
Temp. of fly ash	T _{fa}	°C	139.50
Specific heat of fly ash	C _{pf}	BTU/lb/°F	0.206
		KJ/kg/°C	0.8625
Temp. of Bottom ash	T _{ba}	°C	830.00
Specific heat of Bottom ash	C _{pb}	BTU/lb/°F	0.265
		KJ/kg/°C	1.1096
Radiation loss		%	1

Figure 2 and 3 are shown below which represent proximate and ultimate analysis of coal.

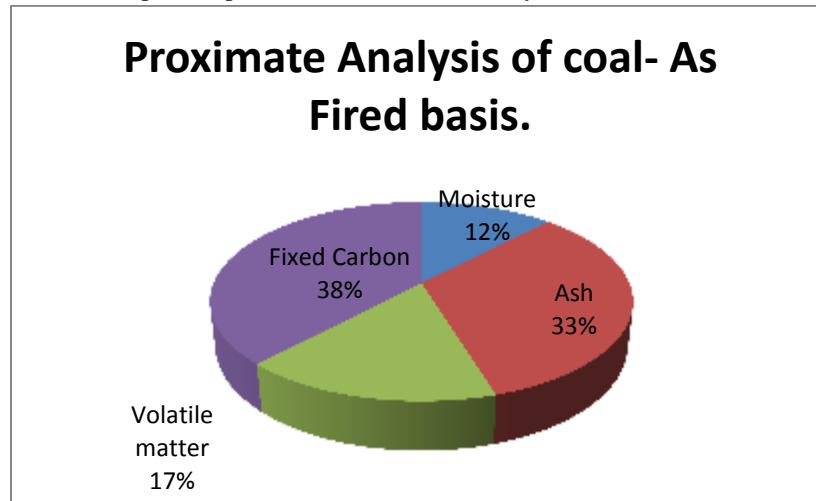


Fig.2 Pie chart of Proximate Analysis of coal - As fired basis

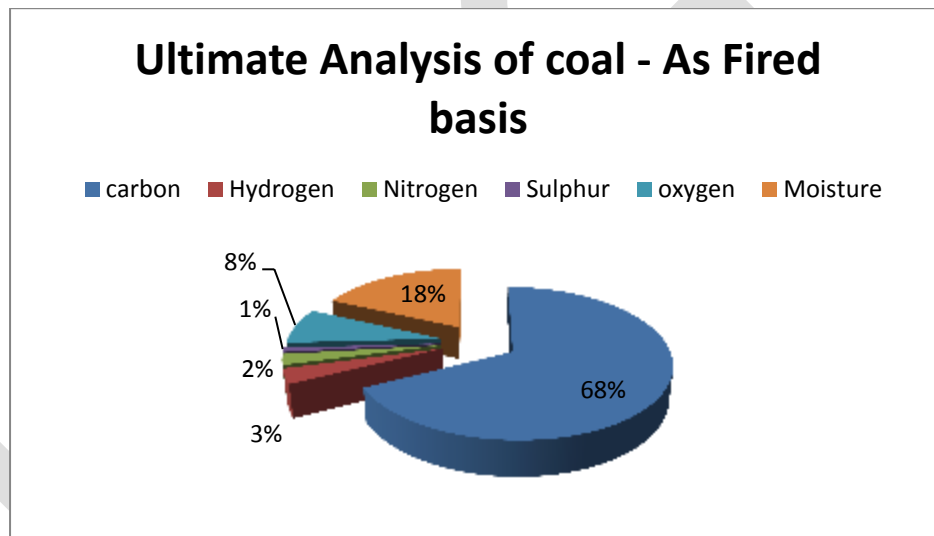


Fig.3 Pie Chart of Ultimate Analysis of coal - As fired basis

4.1 The efficiency of boiler calculated by using the following Equation

Correction factor

$$X = \frac{100 - TM}{100 - IM}$$

Conversion formula for proximate analysis to ultimate analysis:

$$\%C = 0.97 \times FC + 0.7(VM + 0.1 \times A) - M(0.6 - 0.01 \times M).$$

$$\%N = 2.10 - 0.020 \times VM.$$

$$\%H = 0.036 \times FC + 0.086(VM - 0.1 \times A) - 0.0035 \times M^2(1 - 0.02 \times M)$$

$$\%O = 100 - (\%C + \%H + \%N)$$

Where,

C- Carbon content. **A**- Ash. **H**- Hydrogen. **O**- Oxygen. **VM**-Volatile Matter. **TM**- Total moisture. **FC**- Fixed carbon.

4.1.1 Unburnt carbon loss calculation (Z_1)

Some amounts of unburnt carbon will be left in the ash and this constitutes a loss of potential heat in the fuel. To assess these heat losses, samples of ash must be analyzed for carbon content.

$$\begin{aligned}\text{Unburnt Fly Ash} \quad \quad \quad \text{UF} &= \frac{\text{CF}}{100-\text{CF}} \times \frac{\text{DF}}{100} \times \frac{\text{A}}{100} \\ \text{Unburnt Bottom Ash} \quad \quad \quad \text{UB} &= \frac{\text{CB}}{100-\text{CB}} \times \frac{\text{DB}}{100} \times \frac{\text{A}}{100} \\ \text{Total Unburnt Combustibles Ash} \quad \quad \quad \text{U} &= \text{UF} + \text{UB}\end{aligned}$$

$$\text{Unburnt Carbon Loss} \quad \quad \quad Z_1 = \text{U} \times \text{CVc}$$

4.1.2 Dry gas loss calculation (Z_2)

This is the greatest boiler loss and can be calculated with the following formula

$$\text{Carbon burnt per KG of Fuel} \quad \quad \quad C_b = \frac{C}{100-U}$$

Weight of dry gas

$$W_g = (44.01 \times \text{CO}_2 + 32 \times \text{O}_2 + 28.02 \times \text{N}_2 + 28.01 \times \text{CO}) \times (C_b + \frac{12.01}{32.07} \times \frac{S}{100}) / (12.01 \times (\text{CO}_2 + \text{CO}))$$

$$\text{Reference air temperature} \quad \quad \quad T_r = (T_s \times Q_s + T_p \times Q_p) / (Q_s + Q_p)$$

$$\text{Heat loss due to dry flue gas} \quad \quad \quad Z_2 = W_g \times C_{pg} \times (T_g - T_r)$$

4.1.3 Loss due to moisture in fuel calculation (Z_3)

Moisture entering the boiler with the fuel leaves as a superheated vapor. This moisture loss is made up of the sensible heat to bring the moisture to boiling point, the latent heat of evaporation of the moisture, and the superheat required bringing this steam to the temperature of the exhaust gas. This loss can be calculated with the following formula

$$\text{Loss due to moisture in fuel} \quad Z_3 = M/100 \times (H_{tg} - H_{ta})$$

4.1.4 Loss due to hydrogen in fuel calculation (Z_4)

$$\text{Loss due to hydrogen in fuel} \quad \quad \quad Z_4 = H/100 \times 8.936 \times (H_{tg} - H_{ta})$$

4.1.5 Loss due to moisture in fuel (Z_5)

$$\begin{aligned}\text{Weight of Nitrogen in dry gas} \quad \quad \quad W_{N_2} &= 28.02 \times N_2 \times (C_b + 12.01 \times S / (100 \times 32.07)) / (12.01 \times (\text{CO}_2 + \text{CO})) \\ \text{Weight of dry air} \quad \quad \quad W_a &= (W_{N_2} - N/100) / .7685 \\ \text{Loss due to moisture in air} \quad \quad \quad Z_5 &= W_{wv} \times W_a \times (H_{tg} - H_{sv})\end{aligned}$$

4.1.6 Heat loss due to carbon monoxide (Z_6)

$$\text{Loss due to carbon monoxide} \quad \quad \quad Z_6 = \text{CO} \times \text{CV} \times (C/100 - U) / (\text{CO}_2 + \text{CO})$$

4.1.7 Sensible heat loss in fly ash (Z_7)

$$\text{Sensible heat loss in fly ash} \quad Z_7 = A/100 \times \text{DF}/100 \times C_{pf} \times (T_{fa} - T_r)$$

4.1.8 Sensible heat loss in bottom ash (Z_8)

$$\text{Sensible heat loss in bottom ash} \quad Z_8 = A/100 \times \text{DB}/100 \times C_{pb} \times (T_{fa} - T_r)$$

4.1.9 Radiation loss (Z_9)

The other heat losses from a boiler consist of the loss of heat by radiation and convection calculated by following formula.

$$\text{Radiation loss } Z_9 = \% \text{ loss} / 100 \times \text{GCV} \times 4.186$$

Loss Calculation (In Amount)

$$\text{Total losses } Z = Z_1 + Z_2 + Z_3 + Z_4 + Z_5 + Z_6 + Z_7 + Z_8 + Z_9$$

Loss Calculation (In Percentages)

$$\text{Loss in \%} = \frac{\text{Loss in KJ/Kg}}{\text{GCV in KJ/Kg}} \times 100$$

$$\text{Total losses } Z = Z_1 + Z_2 + Z_3 + Z_4 + Z_5 + Z_6 + Z_7 + Z_8 + Z_9$$

$$\text{Boiler Efficiency} = 100 - \text{Total losses (Z)}$$

BOILER RESULTS

4.2 Loss tabulation of boiler

Table 3 various losses in boiler (In Amount)

Parameter	Symbol	Unit	Values
Unburnt Carbon Loss	Z_1	KJ/kg	1096.922
Dry flue gas loss	Z_2	KJ/kg	821.103
Loss due to Moisture in Fuel	Z_3	KJ/kg	319.887
Loss due to Hydrogen in Fuel	Z_4	KJ/kg	513.342
Loss due to Moisture in Air	Z_5	KJ/kg	20.660
Loss due to Carbon monoxide	Z_6	KJ/kg	48.334
Sensible heat loss in fly ash	Z_7	KJ/kg	24.976
Sensible heat loss in bottom ash	Z_8	KJ/kg	58.797
Radiation loss	Z_9	KJ/kg	178.786
Total losses $Z = Z_1 + Z_2 + Z_3 + Z_4 + Z_5 + Z_6 + Z_7 + Z_8 + Z_9$	Z	KJ/kg	3082.807

Table 4 various losses in boiler (In percentage)

Parameter	Symbol	Unit	Values
Unburnt Carbon Loss	Z_1	%	6.1442
Dry gas loss	Z_2	%	4.5993
Loss due to Moisture in Fuel	Z_3	%	1.7918
Loss due to Hydrogen in Fuel	Z_4	%	2.8754
Loss due to Moisture in Air	Z_5	%	0.1157
Loss due to Carbon monoxide	Z_6	%	0.2707
Sensible heat loss in fly ash	Z_7	%	0.1399
Sensible heat loss in bottom ash	Z_8	%	0.3293
Radiation loss	Z_9	%	1.0014
Total losses $Z = Z_1 + Z_2 + Z_3 + Z_4 + Z_5 + Z_6 + Z_7 + Z_8 + Z_9$	Z	%	17.268
Boiler Efficiency		%	82.73

Design efficiency		%	85.94
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Pie chart of boiler losses distribution of BTPS, Unit-1.

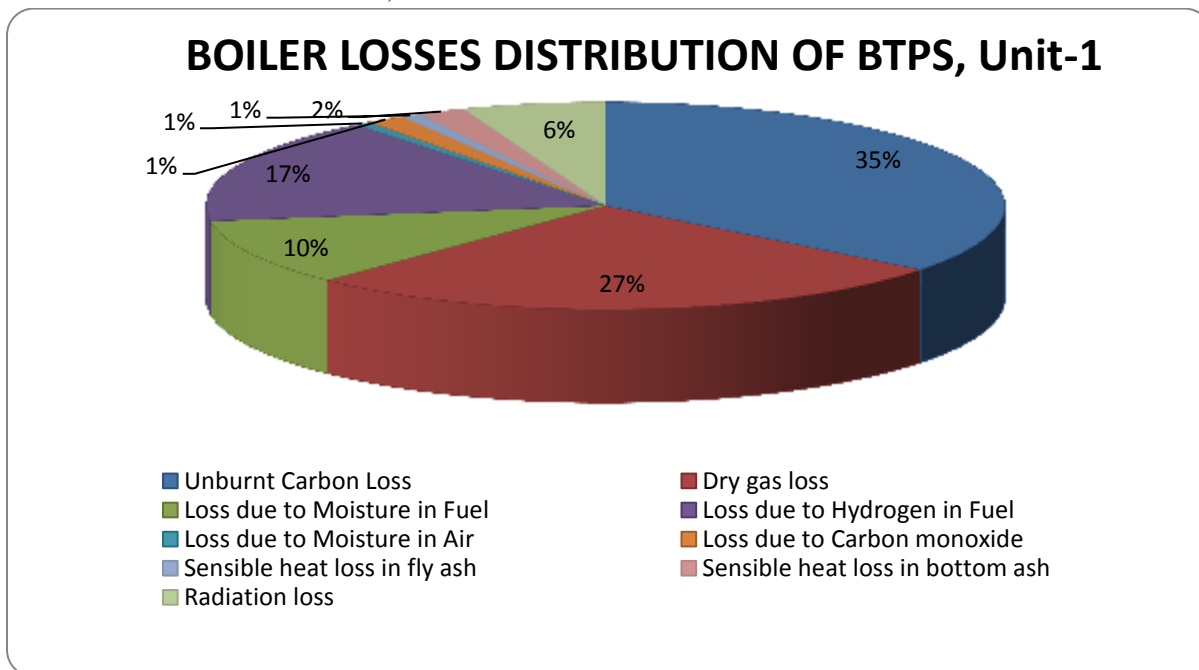


Figure 4 Pie charts of Boiler losses distribution of BTPS, Unit-1

AIR PREHEATER (APH)

5. APH performance

Regenerative type APH performance data is collected and calculated it.

Table 5 APH data

Sl. No.	Particulars	Units	Unit-I
1	O ₂ at APH inlet(A)	%	5.49
2	O ₂ at APH outlet(A)	%	10
3	O ₂ at APH inlet(B)	%	4.67
4	O ₂ at APH outlet(B)	%	9.1
5	O ₂ at ID Outlet	%	11.5
6	Flue gas inlet temp. at APH	°C	293.00
7	Flue gas exit temp (A) at APH (Test Value)	°C	132.00
8	Flue gas exit temp (B) at APH (Test Value)	°C	129.00
9	Air exit temp (A)	°C	262.7
10	Air exit temp (B)	°C	255.21
11	Reference Air in temp.	°C	30.24
12	O ₂ at APH inlet (Design value)	%	3.9
13	Flue gas exit temp (A) at APH (Design Value)	°C	142

5.1 The performance of air APH can be calculated by using the following equation

Air Pre-Heater Leakage: - The leakage of the high pressure air to the low pressure flue gas side due to the differential pressure , increased seal clearances in hot condition , seal erosion, improper seal settings.

Air Pre-Heater Leakage Determination

$$\text{APH Leakage in \%} = \frac{(\text{AH O}_2 \text{ out \%}) - (\text{AH O}_2 \text{ in \%})}{(21) - (\text{AH O}_2 \text{ out \%})}$$

Or

$$\text{APH Leakage in \%} = \frac{(\text{AH CO}_2 \text{ out \%}) - (\text{AH CO}_2 \text{ in \%})}{(\text{AH CO}_2 \text{ out \%})}$$

Air Pre-Heater X-Ratio Determination

X-Ratio: -The ratio of heat capacity of flue gas passing through the air heater to the heat Capacity of air is passing through the air heater.

$$\text{APH X-Ratio} = \frac{(\text{Flue gas inlet Temp.0C}) - (\text{flue gas out Temp.0C})}{(\text{Air out Temp.0C}) - (\text{Refrence air inTemp.0C})} \text{ No unit}$$

X-Ratio depends:

- Moisture in coal, air infiltration, air and gas mass flow rates.
- Leakage from the setting.
- Specific heats of air and flue gas.

Gas side efficiency:

The ratio of gas temperature drop across the air heater, to the air temperature head.

$$\text{APH Gas Side effectiveness} = \frac{(\text{Flue gas inlet Temp.0C}) - (\text{flue gas out Temp.0C})}{(\text{Flue gas inlet Temp.0C}) - (\text{Refrence air inTemp.0C})}$$

APH RESULTS

Table 6 APH Results

Sl. No.	Particulars	Units	Unit-I
1	APH Leakage (A)	%	41.01
2	APH Leakage (B)	%	37.25
3	Gas side effectiveness (A)	%	57.4
4	Gas side effectiveness (B)	%	62.1
5	X-Ratio (A)	%	64.93
6	X-Ratio (B)	%	69.34

CONCLUSION

The conclusions drawn from the energy audit of a boiler and waste heat recovery system of Bokaro Thermal Power Plant Unit-1 of 210MW capacity are listed below:

- Total un-burnt carbon loss due to bottom and fly ash is 6.1442%. These losses can be reduced by crushing of coal to maintain the average particle size in the range of 70 to 74 micron. The classifier in mills should be cleaned and checked on monthly basis.
- Dry gas loss is found as 4.5993% is more than the design value of 3.52%. It can be reduced by controlling excess air supply. To reduce losses due to excess air, it is required to continuously monitor excess air and this is done by either portable equipment like an Orsat flue gas analyzer or a Permanent Probe Type Sensor.
- Heat loss due to moisture present in fuel is found 1.7918%. So, moisture of coal should be reduced before use. The moisture can be removed by primary air coming from Air Pre Heater .The dry coal increases boiler efficiency.
- Heat loss due to radiation cannot be completely eliminated. Due to age factor of Rock wool insulation it can be reduced by replaced by new Rock wool insulation surfaces.

- Air leakage (or air-ingress) in Air-pre heater (A) and (B) is 41.01% and 37.23% respectively. Air leakage cannot be completely eliminated but it can be controlled or minimized by replacing new seals, gaskets and joints of Air Pre- heater assembly to reduce air ingress. So, boiler efficiency and overall power plant efficiency will be improved.
- The flue gas exit temperature from APH (A) and (B) is 132°C and 129°C respectively against the design value of 142°C. Flue gas exit temperature of Air Pre-heater should be in range of 140 to 160°C, so that it will not corrode the chimney walls or metal components in its path.
- Oxygen content in flue gases at inlet of APH (A) and (B) is 5.49% and 4.67% respectively, about 1% higher than the design value of 3.9%. It indicates that the insufficient quantity of air causing incomplete combustion of coal in furnace. So, these excess oxygen contents can be reduced by improving radial and axial seals of APH by overhaul or replace the same if found damaged for reducing air-ingress percentage, which in turn reduces auxiliary power consumption in Induced Draught fan and Forced Draught fan. Every 4°C reduction in flue gas temperature increases efficiency of boiler by 1%.
- Cleaning of heat transfer element of APH and boiler water tube (Risers), whenever the unit is shut down, to increase rate of heat transfer.

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Artificial Neural Networks for e-NOSE

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Abstract- Electronic nose is a new and promising technology which is rapidly becoming a valuable tool for the organoleptic evaluation of food parameters related to taste and smell and could replace human sensory panels in quality control applications, where the objective, rapid and synthetic evaluation of the aroma of many specimens is required. An electronic nose is generally composed of a chemical sensing system (e.g., **sensor array or spectrometer**) and a pattern recognition system (e.g., **artificial neural network**). We are developing electronic noses for the automated identification of volatile chemicals for environmental and medical applications. In this paper, we briefly describe neural networks, electronic nose & show some results from a prototype electronic nose.

Keywords- e-Nose, ANN, Spectrometer, SOM, olfaction, chemical sensor, Fuzzy Art.

INTRODUCTION

All the electronic noses developed so far are based on the same working principle: an array of chemical sensors mimicking the olfactory receptors, matched with a suitable data processing method, allows to retrieve quantitative and qualitative information on the chemical environment. A sensor comprises a material whose physical properties vary according to the concentration of some chemical species. These changes are then translated into an electrical or optical signal which is recorded by a device. Contrary to physical senses some aspects of the human taste and olfaction physiological working principle are still unclear. Because of these intrinsic difficulties toward the understanding of the nature of these senses, only sporadic research on the possibility of designing artificial olfactory systems was performed until the end of the eighties.[1]

1 Why use neural networks?

Neural networks, with their remarkable ability to derive meaning from complicated or imprecise data, can be used to extract patterns and detect trends that are too complex to be noticed by either humans or the computer techniques. A trained neural network can be thought of as an "expert" in the category of information it has been given to analyze. This expert can then be used to provide projections given new situations of interest and answer "what if" questions.[3]

2 Pattern Recognition:

An important application of neural networks is pattern recognition. Pattern recognition can be implemented by using a feed-forward neural network that has been trained accordingly. During training, the network is trained to associate outputs with input patterns. When the network is used, it identifies the input pattern and tries to output the associated output pattern. The power of neural networks comes to life when a pattern that has no output associated with it, is given as an input. In this case, the network gives the output that corresponds to a taught input pattern that is least different from the given pattern.[7]

3. HOW DOES AN ELECTRONIC NOSE WORK?

The two main components of an electronic nose are the sensing system and the automated pattern recognition system. The sensing system can be an array of several different sensing elements (e.g., chemical sensors), where each element measures a different property of the sensed chemical, or it can be a single sensing device (e.g., spectrometer) that produces an array of measurements for each chemical, or it can be a combination. Each chemical vapor presented to the sensor array produces a signature or pattern

characteristic of the vapor. By presenting many different chemicals to the sensor array, a database of signatures is built up. This database of labeled signatures is used to train the pattern recognition system. The goal of this training process is to configure the recognition system to produce unique classifications of each chemical so that an automated identification can be implemented. [2]

STRUCTURE OF A GENERIC CHEMICAL SENSOR

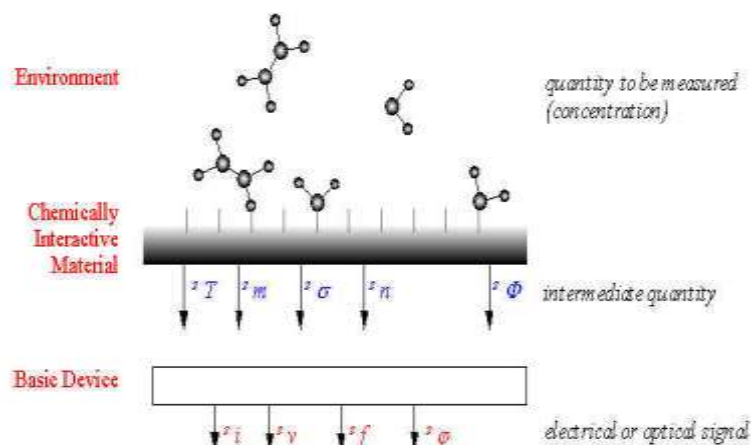


Fig.1 Structure of A Generic Chemical Sensor

The quantity and complexity of the data collected by sensors array can make conventional chemical analysis of data in an automated fashion difficult. One approach to chemical vapor identification is to build an array of sensors, where each sensor in the array is designed to respond to a specific chemical. With this approach, the number of unique sensors must be at least as great as the number of chemicals being monitored. It is both expensive and difficult to build highly selective chemical sensors. A chemical compound is identified by a pattern of the outputs given by the different sensors, thanks to pattern recognition methods.[4]

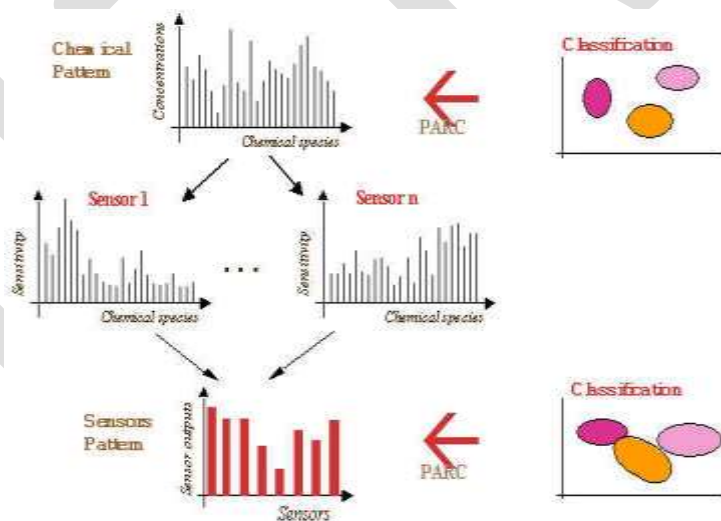


Fig.2 Vector quantizers (LVQs); hamming networks; Boltzmann machines; and Hopfield networks.

Artificial neural networks (ANNs), which have been used to analyze complex data and to recognize patterns, are showing promising results in chemical vapor recognition. When an ANN is combined with a sensor array, the number of detectable chemicals is generally greater than the number of sensors. Also, less selective sensors which are generally less expensive can be used with this approach. Once the ANN is trained for chemical vapor recognition, operation consists of propagating the sensor data through the network. Since

this is simply a series of vector- matrix multiplications, unknown chemicals can be rapidly identified in the field. Electronic noses that incorporate ANNs have been demonstrated in various applications. Some of these applications will be discussed later in the paper. Many ANN configurations and training algorithms have been used to build electronic noses including back propagation-trained, feed-forward networks; fuzzy ART maps; Kohonen's self-organizing maps (SOMs); learning.[10]

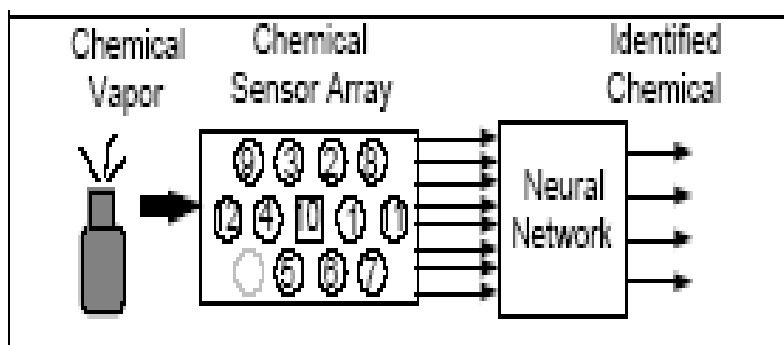


Fig. 3 illustrates the basic schematic of an electronic nose.

The sensors used in an electronic nose can be either mass transducers (such as Quartz microbalance or QMB) or chemo-resistors (based on metal-oxides or conducting polymers); some arrays comprise both types of sensors. Currently extensive research is being carried out on the exploitation of metallo-porphyrins as coating material for QMB: the main feature of such sensors is the dependence of the sensing properties (selectivity and sensitivity) on the nature of the substituents of the porphyrin. This flexibility makes this class of compounds of interest for electronic nose applications.



Fig. 4 Sensors used in e-Nose

PROTOTYPE ELECTRONIC NOSE:

One of our prototype electronic noses, shown in Figure 2, is composed of an array of nine tin oxide vapor sensors, a humidity sensor, and a temperature sensor coupled with an ANN. Two types of ANNs were constructed for this prototype: the standard multilayer feed-forward network trained with the back propagation algorithm and the fuzzy ART map algorithm. During operation a chemical vapor is blown across the array, the sensor signals are digitized and fed into the computer, and the ANN (implemented in software) then identifies the chemical. This identification time is limited only by the response time of the chemical sensors, which is on the order of seconds. This prototype nose has been used to identify common household chemicals by their odor.[8]



Figure 2: Photograph of the prototype electronic nose

Fig. 5 Prototype e-Nose

Figure 6 illustrates the structure of the ANN. The nine tin-oxide sensors are commercially available, Taguchi-type gas sensors. (Sensor 1, TGS 109; Sensors 2 and 3, TGS 822; Sensor 4, TGS 813; Sensor 5, TGS 821; Sensor 6, TGS 824; Sensor 7, TGS 825; Sensor 8, TGS 842; and Sensor 9, TGS 880). Exposure of a tin-oxide sensor to a vapor produces a large change in its electrical resistance. The humidity sensor (Sensor 10: NH-02) and the temperature sensor (Sensors 11: 5KD-5) are used to monitor the conditions of the experiment and are also fed into the ANN.

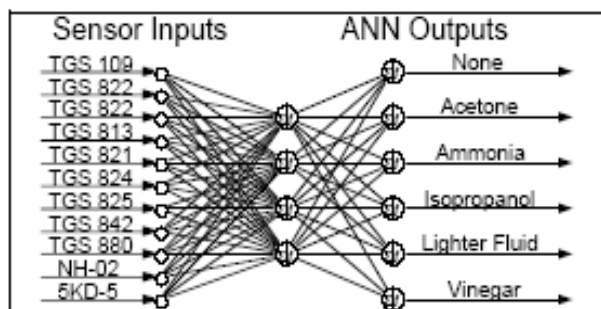


Figure 3: Structure of the backpropagation ANN used in the prototype to identify household chemicals

Fig. 6 Structure of ANN

Although each sensor is designed for a specific chemical, each responds to a wide variety of chemicals. Collectively, these sensors respond with unique signatures (patterns) to different chemicals. During the training process, various chemicals with known mixtures are presented to the system. By training on samples of various chemicals, the ANN learns to recognize the different chemicals.

DATA ANALYSIS

Vector v are the base of the PC space, vectors u are the projection of experimental data in the PC space scalars s are the singular values, they are considered as a measure of the particular contribution to the systematic variance of the respective principal component.

1 Principal component analysis:

The data of an electronic nose experiment are represented in a multidimensional space (the sensor space), whose dimension is equal to the number of sensors in the array. A single measure is an n-dimensional vector.



Fig. 7 Sensor Space

Let X be the data matrix, and let us consider the Singular Value Decomposition of X : Vector v are the base of the PC space, vectors u are the projection of experimental data in the PC space scalars s are the singular values, they are considered as a measure of the particular contribution to the systematic variance of the respective principal component.

2 Self Organizing Map and other neural models:

SOM belongs to the category of competitive learning methods and is based on unsupervised learning. This last aspect means that the SOM algorithm does not require any additional information but the sensors output. SOM is a network formed by N neurons arranged as the nodes of a planar grid.

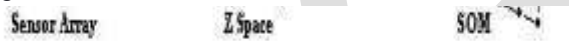


Fig. 8 Structure of SOM

APPLICATIONS FOR NEURAL NETWORKS

Neural networks are applicable in virtually every situation in which a relationship between the predictor variables (independents, inputs) and predicted variables (dependents, outputs) exists, even when that relationship is very complex and not easy to articulate in the usual terms of "correlations" or "differences between groups." A few representative examples of problems to which neural network analysis has been applied successfully are:[13]

- * Detection of medical phenomena
- * Stock market prediction.
- * Monitoring the condition of machinery.
- * Industrial process control.
- * data validation
- * target marketing

Electronic Noses for Medicine:

Because the sense of smell is an important sense to the physician, an electronic nose has applicability as a diagnostic tool. An electronic nose can examine odors from the body (e.g., breath, wounds, body fluids, etc.) and identify possible problems. Odors in the

breath can be indicative of gastrointestinal problems, sinus problems, infections, diabetes, and liver problems. Infected wounds and tissues emit distinctive odors that can be detected by an electronic nose. Odors coming from body fluids can indicate liver and bladder problems. Currently, an electronic nose for examining wound infections is being tested at South Manchester University Hospital. A more futuristic application of electronic noses has been recently proposed for telesurgery. While the inclusion of visual, aural, and tactile senses into telepresent systems is widespread, the sense of smell has been largely ignored. An electronic nose will potentially be a key component in an olfactory input to telepresent virtual reality systems including telesurgery. The electronic nose would identify odors in the remote surgical environment. These identified odors would then be electronically transmitted to another site where an odor generation system would recreate them.

CONCLUSION

The computing world has a lot to gain from neural networks. Their ability to learn by example makes them very flexible and powerful. Furthermore there is no need to devise an algorithm in order to perform a specific task; i.e. there is no need to understand the internal mechanisms of that task. Perhaps the most exciting aspect of neural networks is the possibility that some day 'conscious' networks might be produced. There are a number of scientists arguing that consciousness is a 'mechanical' property and that 'conscious' neural networks are a realistic possibility.

ANNs are used experimentally to implement electronic noses. Electronic noses have several potential applications. The electronic nose would identify odours in the remote surgical environment. These identified odours would then be electronically transmitted to another site where a odor generation system would recreate them. Because the sense of smell can be an important sense to the surgeon, telemell would enhance telepresent surgery. The major differences between electronic noses and standard analytical chemistry equipment are that electronic noses can produce a qualitative output, often easier to automate and

can be used in real-time analysis.

Further work involves in comparing neural network sensor analysis to more conventional techniques, exploring other neural network paradigms, and evolving the preliminary prototypes to field systems. Finally, I would like to state that even though neural networks have a bright prospective we will only get the best of them when they are integrated with computing, AI, fuzzy logic and related subjects.

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Design and Vibration analysis of the crank Shaft of the power loom system in the textile industry

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ABSTRACT- Crank shaft of Power loom system in textile machinery is a critical component which transmits the power from motor to machinery at a required speed and controls the complete operation. If crank shaft of the system fails then entire process will stop hence it is important to design the power loom system for continues operation. A crank shaft of length 1806 mm length is to be redesigned to transmit the power for a given conditions. This work focus on calculation of physical properties such as stress, deflection and modal frequencies for the existing component using the FEA package and modal frequencies are further validated by experimental results using FFT analyser. Existing component is to be redesigned and remodelled using modelling software for different dimensions of crank web and diameter of the shaft then static structural and dynamic analysis of modelled components is to be carried out using the FEA package for safer work.

Key words: Crankshaft, crank pin, FEA, FFT analyzer, bending moment, von mises stresses, deflection

1. Introduction

The textile industry plays very important role in Indian economy. It ranks second after the agriculture. Besides the industrial production, it provides employment to millions of the people of the country and gives a handsome earning of foreign exchange through export. It is also source of livelihood in villages and remote areas. Millions of people in our country depend upon it. The rapid growth and development of this industry is remarkable.

The Indian textile industry is consisted of the following three groups

- i) Mill Sector
- ii) Handloom Sector
- iii) Power loom Sector

The power looms are one of the most important equipment in producing of cotton terry towels and bed sheets. The power looms are used for weaving the dyed yarn to towels and bed sheets

The basic purpose of any loom is to hold the warp threads under tension to facilitate the interweaving of the weft threads. A loom is a tool used for weaving yarn into textiles.

A power loom, yet another type of loom, is a mechanized tool that uses a drive shaft for power. Invented by Edmund Cartwright in Great Britain in 1784, the power loom allowed manufacturers to create textiles much more quickly than with hand-driven looms. This improvement helped the power loom become one of the defining machines of the industrial revolution. A loom works by holding lengthwise threads, called the warp, under tension. The vertically-oriented threads are attached to two or more harnesses which move up and down, separating warp threads from each other and creating a space called the shed. Another thread, called the weft, is wound onto spools called bobbins, which are placed in a shuttle and passed through the shed, which creates the weave. In the early 20th century, the shuttle less loom, also known as the rapier loom, was invented. This type of power loom moves the weft through the shed using jets of air or water, steel rods, or a dummy shuttle that leaves a trail of yarn rather than using a weft

A crankshaft is a mechanical part able to perform a conversion between reciprocating motion and rotational motion. In order to do the conversion between two motions, the crankshaft has "crank throws" or "crankpins", additional bearing surfaces whose axis is offset from that of the crank. Crank shaft of Power loom system in textile machinery is a critical component which transmits the power from motor to machinery at a required speed and controls the complete operation. If crank shaft of the system fails then entire process will stop hence it is important to design the crank shaft of power loom system for continues operation.

2. Literature Review

Shin-Yong Chen, Chieh Kung, Jung-Chun Hsu et al [1] in their research paper "Dynamic Analysis Of a Rotating Composite Shaft" One of the key factors in designing a motor built-in high speed spindle is to assemble the motor rotor and shaft by means of hot-fit. Presented in this paper is a study of the influence of a hot-fit rotor on the local stiffness of the hollow shaft. Dynamic analyses of the rotor-hollow shaft assembly using contact elements are conducted. The normal contact stress state between the rotor and the hollow shaft is obtained through the use of contact elements with friction effects included. The normal contact stress, considered as the pre-stress between the rotor and the hollow shaft, is then adopted for subsequent modal analyses. In this study, the modal analysis results are verified by a modal testing experiment

Neepa M. Patel et al [2] have analyzed that to increase the productivity of clothes without selvege, shuttle loom is necessary, which produce clothes at lower cost. The only drawback of shuttle loom is its low speed, current shuttle looms are running at 120 ppm (pick per minute), and due to this its productivity is less. Therefore, in this paper kinematic and dynamic analysis has been done for present and proposed mechanism, to design high speed Beat-up mechanism, which is 3rd primary operation of shuttle loom. Basically beat-up mechanism is the reciprocating motion of the reed which is used to push every weft thread to the fabric fell

C. AZOURY et al [2] presents a report on the experimental and analytical modal analysis of a crankshaft. The effective material and geometrical properties are measured, and the dynamic behavior is investigated through impact testing. The three-dimensional finite element models are constructed and an analytical modal analysis is then performed to generate natural frequencies and mode shapes in the three-orthogonal directions. The finite element model agrees well with the experimental tests and can serve as a baseline model of the crankshaft.

Ms. Shweta Ambadas Naik [4] carried out a review study on failure analysis of a crank shaft. In this paper, the stress analysis and modal analysis of a 4-cylinder crankshaft are discussed using finite element method. The review of existing literature on crankshaft design and optimization is presented. The materials, manufacturing process, failure analysis, design consideration of the crankshaft are reviewed here

R. J. Deshbhratar, and Y. R. Suple et al [3] have analyzed 4-cylinder crankshaft and model of the crankshaft were created by Pro/E Software and then imported to ANSYS software. The maximum deformation appears at the centre of crankshaft surface. The maximum stress appears at the fillets between the crankshaft journal and crank cheeks, and near the central point. The edge of main journal is high stress area. The crankshaft deformation was mainly bending deformation under the lower frequency. And the maximum deformation was located at the link between main bearing journal and crankpin and crank cheeks. So this area prone to appear the bending fatigue crack.

Abhishek Choubey, and Jamin Brahmabhatt et al [4] have analyzed crankshaft model and 3-dimensional model of the crankshaft were created by SOLID WORKS Software and imported to ANSYS software. The crankshaft maximum deformation appears at the centre of crankpin neck surface. The maximum stress appears at the fillets between the crankshaft journals and crank cheeks and near the central point journal. The edge of main journal is high stress area.

Rinkle garg and Sunil Baghl et al. [5] have analyzed crankshaft model and crank throw were created by using Pro/E Software and then imported to ANSYS software. The result shows that the improvement in the strength of the crankshaft as the maximum limits of stress, total deformation, and the strain is reduced. The weight of the crankshaft is reduced. Thereby, reduces the inertia force. As the weight of the crankshaft is decreased this will decrease the cost of the crankshaft and increase the I.C engine performance.

Sanjay B Chikalthankar et al [6] investigated stresses developed in crankshaft under dynamic loading. In this study a dynamic simulation was conducted on crankshaft. Finite element analysis was performed to obtain the variation of stress magnitude at critical locations. The pressure-volume diagram was used to calculate the load boundary condition in dynamic simulation model, and other simulation inputs were taken from the engine specification chart. This load was then applied to the FE model, and boundary conditions were applied according to the engine mounting conditions. The analysis was done for different engine speeds and as a result we get critical engine speed and critical region on the crankshaft. Stress variation over the engine cycle and the effect of torsional load in the analysis were investigated. Results obtained from the analysis are very useful in optimization of this crankshaft.

Sagar R Dharmadikari, et al [7] made modest attempt to review the optimization of Genetic Algorithm and ANSYS in their research report "Design and Analysis of Composite Drive Shaft using ANSYS and Genetic Algorithm". Drive shaft is the main component of drive system of an automobile. Conventional steel is substituted by composite material which has high specific strength and stiffness. The finite element analysis is used in this work to predict the deformation of shaft. Natural frequency using Bernoulli – Euler and Timoshenko beam theories was compared. The frequency calculated by Bernoulli – Euler theory is high because it neglects the effect of rotary inertia & transverse shear. Hence the single piece High Strength Carbon / Epoxy composite drive shaft has been proposed to design to replace the two piece conventional steel drive shaft of an automobile.

K. Thriveni Dr. B. Jaya Chandraiah et al [8] made an attempt in this paper to study the Static analysis on a crankshaft from a single cylinder 4-stroke I.C Engine. The model of the crankshaft is created using CATIA-V5 Software. Finite element analysis (FEA) is performed to obtain the variation of stress at critical locations of the crank shaft using the ANSYS software and applying the boundary conditions. Then the results are drawn Von-mises stress induced in the crankshaft is 15.83 Mpa and shear stress is induced in the crankshaft is 8.271 Mpa. The Theoretical results are obtained von-mises stress is 19.6 Mpa, shear stress is 9.28 Mpa. The validation of model is compared with the Theoretical and FEA results of Von-mises stress and shear stress are within the limits. Further it can be extended for the different materials and dynamic analysis, optimization of crank shaft.

Ashwani Kumar Singh et al [9] conducted statics analysis on a nickel chrome steel and structural steel crank shafts from a single cylinder four stroke engine. Finite elements analysis was performed to obtain the variation of stress magnitude at critical locations.

Three dimensional model of crankshaft was created in Pro/E software .The load was then applied to the FE model and boundary condition where applied as per the mounting conditions of the engine in the ANSYS Workbench

Abhishek Sharma et al [10] in the present research work vibration analyses have been focused to detect crankshaft fault at the early stage, followed by the literature review of the shaft and the experimental methodologies. A simulation for the study of crankshaft is carried out by acquiring its fault signal and its fast Fourier transform is plotted to show the characteristics frequencies and its harmonics. A comparison of simulated data is also made to validate the experiment based condition monitoring.

Momin Muhammad Zia Muhammad Idris et al [11] this paper presents results of strength analysis done on crankshaft of a single cylinder two stroke petrol engine, using PRO/E and ANSYS software. The three dimensional model of crankshaft was developed in PRO/E and imported to ANSYS for strength analysis. This work includes, in analysis, torsion stress which is generally ignored. A calculation method is used to validate the model. The paper also proposes a design modification in the crankshaft to reduce its mass. The analysis of modified design is also done

3.Problem identification

Crank shaft of Power loom system in textile machinery is a critical component which transmits the power from motor to machinery at a required speed and controls the complete operation. If crank shaft of the system fails then entire process will stop hence it is important to design the power loom system for continues operation. There is requirement from industry Dhayafule Textiles for the vibration analysis of the crank shaft of a power loom

4. Objectives

This work comprises the following objectives for safe design of existing power loom system.

- To select critical component i.e. crank shaft of power loom system from textile industry.
- To model the existing crank shaft of power loom system then numerical analysis will be carried out in FEA
- To experimentally analyze the existing component using FFT analyzer
- To compare the results and remodel the component
- If the component undergoes failure then the component is redesigned, static structural and modal analysis will be carried out

5. Failed Component



Figure 1 Failed component

6. Experimental Setup

The schematic diagram of the complete experimental setup is shown in following



Figure 2 Experimental set up

7. Experimental results

The natural frequencies obtained from the experimentation are listed below in table 1

Table 1

Sl No	Mode	Modal Frequency in Hz
1	1	65.918
2	2	70.1532
3	3	71.125
4	4	78.776
5	5	338.101
6	6	342.843
7	7	350.359
8	8	366.877
9	9	615.127
10	10	658.241
11	11	694.890

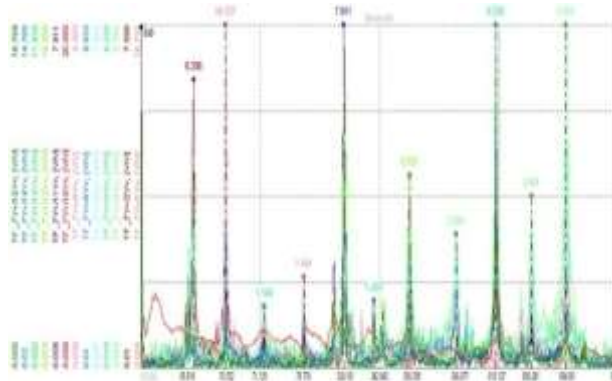


Figure 3 Graph of experimental results

8. Design Procedure for Crankshaft

The following procedure may be adopted for designing a crankshaft.

1. First of all, find the magnitude of the various loads on the crankshaft.
2. Determine the distances between the supports and their position with respect to the loads.
3. For the sake of simplicity and also for safety, the shaft is considered to be supported at the centres of the bearings and all the forces and reactions to be acting at these points. The distances between the supports depend on the length of the bearings, which in turn depend on the diameter of the shaft because of the allowable bearing pressures.
4. Now calculate the distances between the supports.
5. Assuming the allowable bending and shear stresses, determine the main dimensions of the crankshaft.

Geometric properties, Material properties of crank shaft

Table 2

Material	Cold drawn Steel 1018
Length	1806mm
Diameter	40 mm
Modulus of elasticity	210Gpa
Density	7850
Poisson's ratio	0.3

Operating frequency of the crank shaft

$$f = \frac{\omega}{2\pi}$$

$$N = 120 \text{ rpm}$$

$$\omega = \frac{2\pi N}{60}$$

$$f = 2 \text{ Hz}$$

8.1 Force acting on the crank shaft

A) Weight of slay = 600 N

B) Downward force acting by pulley

$$\frac{p_1}{p_2} = e^{\mu\theta}$$

$$M_t = (p_1 - p_2)R_1$$

$$M_t = \frac{60 \times 10^6 (\text{kW})}{2\pi n}$$

$$\frac{p_1}{p_2} = e^{0.24\pi} = 2.125$$

$$p_1 = 2.125 p_2$$

$$M_t = \frac{60 \times 10^6 \times 0.746}{2\pi \times 120} = 59364.79 \text{ N-mm}$$

$$(2.125p_2 - p_2)228.6 = 59364.79$$

$$p_2 = 490.5201 \text{ N} \quad p_1 = 230.883 \text{ N}$$

$$W_1 = mg = 10.8 \times 9.8 = 105.84 \text{ N}$$

Therefore the total downward force is given by

$$(p_1 + p_2 + W) = (490.520 + 230.883 + 278.3) = 1000 \text{ N}$$

C) Force acting by a gear

$$p_t = \frac{2M_t}{d_1}$$

$$p_r = p_t \tan \alpha$$

$$p_t = 492.034 \text{ N}$$

$$p_r = 178.5 \text{ N}$$

D) Force acting by a Sprocket

Speed $N = 120 \text{ rpm}$

Number of teeth = 12

$$V = \frac{z_1 P N}{60 \times 10^3} = 1.29 \text{ m/sec}$$

$$P = \frac{N \times \text{power}}{V} = 75 \text{ N}$$

8.2 Layout of the crankshaft

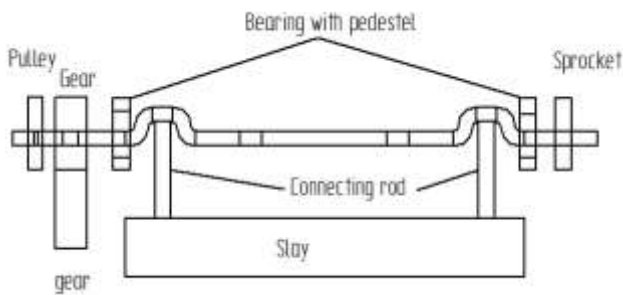


Figure 4 Layout of the crank shaft



Reaction Forces

Let the reaction at C and F be V_c and V_f respectively, taking moments about C we have,

$$61200 + 737400 - 1331V_f - 111075 - 1077000 - 22312.5 - 225000 = 0$$

$$440212.5 = 1331V_f$$

$$V_f = 330.73 \text{ N}$$

$$330.73 + V_c + 75 = 2378.5 \text{ N}$$

$$V_c = 1972.77 \text{ N}$$

8.3 Bending moment of vertically acting forces

Bending moment at A, 0

Bending moment at B, 1,00,000 N-mm

Bending moment at C, 2,47,312.5 N-mm

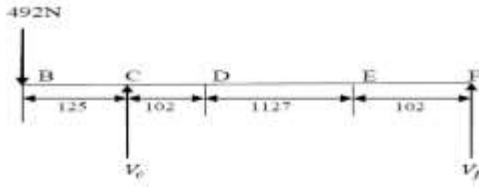
Bending moment at D, 166296.96 N-mm

Bending moment at E, -52645.33 N-mm

Bending moment at F, -11250 N-mm

Bending moment at G, 0

8.4 Bending moment of horizontally acting forces



Let the reaction at C and F be V_c and V_f respectively, taking moments about C we have,

$$1331V_f = -61500$$

$$V_f = -46.205 \text{ N}$$

$$V_c = 538.205 \text{ N}$$

Bending moment at B, 0

Bending moment at C, 61500 N-mm

8.5 Resulting bending moment at

$$A=0$$

$$B = \sqrt{0 + 100000^2} = 1,00,000 \text{ N}$$

$$C = \sqrt{24731.5^2 + 61500^2} = 254844.50 \text{ N-mm}$$

$$D = \sqrt{166296.96^2} = 166296.96 \text{ N-mm}$$

$$E = \sqrt{(-52645.33)^2} = 52645.33 \text{ N-mm}$$

$$F = \sqrt{(-11250)^2} = 11250 \text{ N-mm}$$

The material of the shaft is cold drawn Carbon steel 1018

$$S_{yt} = 345 \text{ MPa}$$

$$S_{ut} = 414 \text{ MPa}$$

Permissible shear stress

$$0.30S_{yt} = 0.3(345) = 103.5 \text{ N/mm}^2$$

$$0.18S_{ut} = 0.18(414) = 74.52 \text{ N/mm}^2$$

The lower of the two values is 74.52 N/mm^2 and there are keyways on the shaft

$$\tau_{max} = 0.75(74.52) = 55.89 \text{ N/mm}^2$$

$$d^3 = \frac{16\sqrt{(k_b M_b)^2 + (k_t M_t)^2}}{\pi \tau_{max}}$$

$$d^3 = \frac{16\sqrt{(2.5 \times 254844.50)^2 + (2.5 \times 59364.79)^2}}{\pi \times 55.89}$$

$$d = 38.80 \text{ mm}$$

The diameter of the shaft is obtained by considering the loads acting on the shaft

8.9 Design of Crank pin

$$(M_b)_c = \left[\frac{\pi d^3}{32} \right] \sigma_b$$

$$\sigma_b = 75 \text{ N/mm}^2 \text{ (allowable bending stress for crank pin)}$$

$$d = 40 \text{ mm}$$

$$(M_b)_c = (R_1)_v b_1$$

$$(M_b)_c = 1972.77 \times 102$$

$$= 201222.54$$

$$\sigma_b = \frac{201222.5432}{\pi d^3}$$

$$\sigma_b = 32.025 \text{ N/mm}^2$$

The bending stress obtained is less than the allowable bending stress for the crank pin hence the diameter assumed for the crankpin is safe.

9 Boundary conditions

- All degree of freedom of the Component at a distance of 226 mm from left side and 151 mm from right hand side end were arrested (Bearing locations)
- A load of 1000N is acting at a distance of 50mm from right side (Pulley location)
- A load of 492 N (tangential) and 178.5 N (downward) acting at a distance of 126 mm from right hand side (Gear location).
- A load of 75N (upward) acting at a distance of 51 mm from left hand side (sprocket location).

- A load of 600 N (downward) acting at middle of crankpin as shown in figure.

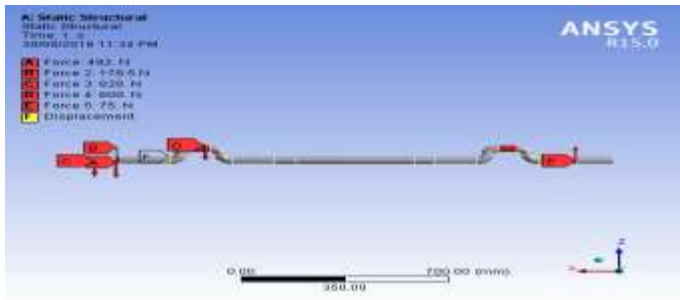


Figure 5 Boundary Condition

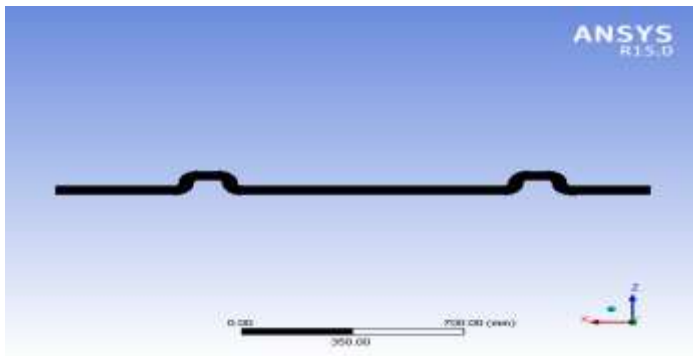


Figure 6 Meshing of crank shaft 40 mm diameter

10. Static structural Analysis of the existing component with diameter 40 mm and crank web 44mm

A) Von-Mises stress

The maximum stress occurred in the component is 71.293MPa

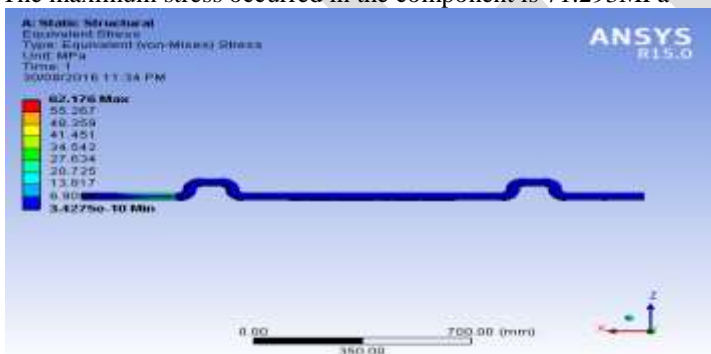


Figure 7 Von Mises stress of crank shaft 40 mm diameter

B) Deflection

Deflection occurred in the component is 0.32239mm

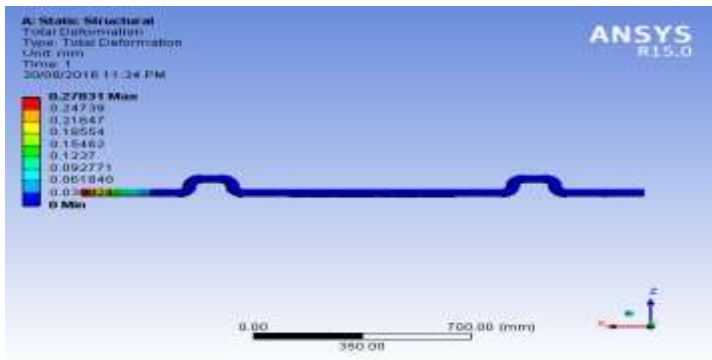


Figure 8 Deflection of crank shaft 40 mm diameter

Table 3

Model	Material	Weight in kgs	Max Deflection in mm	Von-mises Stress in Mpa
Existing Crank shaft 40 mm diameter with crank web 44mm	Cold drawn steel	20.658	0.3223	71.29
Crank shaft 40 mm diameter with crank web 46mm	Cold drawn steel	20.953	0.3141	73.14
Crank shaft 38 mm diameter with crank web 42mm	Cold drawn steel	18.334	0.3946	90.29
Crank shaft 38 mm diameter with crank web 44mm	Cold drawn steel	18.820	0.3843	76.922
Crank shaft 42 mm diameter with crank web 48mm	Cold drawn steel	23.115	0.4335	63.20
Crank shaft 42 mm diameter with crank web 46mm	Cold drawn steel	21.992	0.4335	77.11
Crank shaft 44 mm diameter with crank web 48mm	Cold drawn steel	25.452	0.4647	49.027

Static structural analysis for different diameters with different web radii are carried, the results are shown in the table 3. From the above results table it can be observed that the diameter of crank shaft is 40 mm with web diameter is 44 mm and weight of the component is around 20.658 kg. After static structural analysis it was observed that the maximum stress and deflection values are 71.29 MPa and 0.3223 mm respectively.

After redesigning and modeling the component for different diameters and weights, it is observed that the crank shaft of diameter 44 mm with 48 mm crank web having a weight of 25.452kg, the stress and deflection values are 49.027 MPa and 0.4647 mm. The stress obtained from modified component is less than the existing component. Hence it can be considered as safer design.

Table 4

Sl No	Mode	Modal Frequency for Φ 40mm crank shaft with web 44	Modal Frequency for Φ 38mm crank shaft with web 42mm	Modal Frequency for Φ 42mm crank shaft with web 48mm	Modal Frequency For Φ 44mm crank shaft with web 48mm
1	1	67.818	48.046	51.674	53.882
2	2	68.848	48.909	52.741	54.767
3	3	72.177	71.795	74.258	78.918
4	4	73.225	72.9	75.626	80.156
5	5	333.19	258.71	285.15	292.63
6	6	339.9	259.65	285.29	293.22

From the above table 4 it is observed that the minimum frequency obtained from the existing component is around 67.818Hz, which is greater than the operating frequency of 2Hz hence the component is more safer.

After redesigning and modelling the component for different diameter and weights it is observed that the crank shaft of diameter 44 mm having a weight 25.452 kg, the minimum frequency obtained is 53.882 Hz, which is also greater than the operating frequency, which is found to be safer design.

The dynamic results obtained from the numerical analysis are validated with the experimental results by using FFT analyzer.

11. Conclusions

In this work the component is designed by considering the loads acting on it. Static and dynamic analysis of the component is carried out by using FEA. In the existing crank shaft high stresses were found at the crank web region due to sudden change in cross section area, which was the main cause for failure of the crank shaft for failure.

Then the existing crank shaft is modelled for different diameters with different web radii then numerical analysis is carried out using FEA software. It is observed that the crank shaft of diameter 44 mm has the stress 49.027 MPa which is lesser than the stress occurred in the existing component and modal frequency 53.882Hz value which is greater than the operating frequency for a weight of 25.452 kg. Hence this component is considered as safe.

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AUTOMATIC DETECTION OF SMILING FACE AND NEUTRAL FACE

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ABSTRACT— Facial feature points, such as the corners of the eyes, corners and outer mid points of the lips and nostrils, are generally referred to as facial salient points. Detection of facial feature points is often the first step in computer vision applications such as face identification, facial expression recognition, face tracking and lip reading etc. Facial features generally include salient points which can be tracked easily, like corners of the eyes, nostrils, lip corners etc. Currently, most of the applications for facial expressions tracking are manually giving points as initial feature points for tracking. Detection of facial features like eye, pupil, mouth, nose, nostrils, lip corners, eye corners etc., with different facial expression and illumination is a challenging task. In the present work, human eye detection is the first step in facial feature detection, since the face has a nice facial geometry, which can be estimated, based on the eyes position. In this work, we propose expression identification based on fully automatic detection of facial features and deals with the development of a technique that can perform the classification of given a frontal face input image, identify the features and classify the face into either neutral or smiling.

KEYWORDS- Face detection, Feature extraction, ROI, Expression classification, Shi-Tomasi's corner detection, Ada-boost algorithm, Haar-like features.

INTRODUCTION

Human eye detection is the first step in facial features detection as the face has a nice facial geometry, which can be estimated, based on the eyes position. Eye detection using AdaBoost algorithm gives an estimated location of the face and eyes. AdaBoost algorithm uses a set of weak cascaded classifiers, makes the classification accuracy greatly improved through extensive studies. However, for some cases, the detection fails when it is detecting the features like eye, nose and mouth in the whole face image. It can be improved by providing the estimated search regions for eyes and nose. The use of mouth detection cascade is often found to be inaccurately detecting the mouth even after estimated search region is provided. Mouth detection using the concept of facial geometry is used in this work and the method has been tested on number of faces including a set of faces from database (FEI Face Database) and also some real images.

OVERVIEW OF THE PROPOSED METHOD

Human eye detection is the first step in facial features detection. It is because; the face has a nice facial geometry, which can be estimated, based on the eyes position. Eye detection using AdaBoost algorithm gives an estimated location of the face and eyes. AdaBoost algorithm uses a set of weak cascaded classifiers, makes the classification accuracy greatly improved through extensive studies. However, for some cases, the detection fails when it is detecting the features like eye, nose and mouth in the whole face image. It can be improved by providing the estimated search regions for eyes and nose. The use of mouth detection cascade is often found to be inaccurately detecting the mouth even after estimated search region is provided. Mouth detection using the concept of facial geometry is used in this work and the method has been tested on number of faces including a set of faces from database (FEI Face Database) [1].

Eye corners are having sharp edge information. In the proposed work, the eye corners within the Eye ROI (Region of Interest) are detected using Shi-Tomasi's corner detection algorithm. The main downside of that method is that it needs to train the algorithm with the template patches. Lip muscles are highly deformable and subjected to change. The Shi-Tomasi feature corner detection algorithm takes care of the features which can be tracked easily [7]. Samples of smiling faces as well as faces wearing glasses are used to test the accuracy of detection the relevant features. Nostrils are detected by thresholding the gray scale image of nose and then finding the contours within the region. The center of the bounded rectangular region (bounding the contour) is the nostril. The methodology for detecting lip corner points is also explained in detail in the following chapter. The algorithm is tested with various frontal face images with different illumination. It is found to be highly accurate in spite of varying lighting conditions. The algorithm is also tested against different lips pose like, mouth closed and mouth open (smiling face) and found to be detecting accurately [2].

IMPLEMENTAION DETAILS

In our proposed approach, initially we detect the face using Viola and Jones' Boosting algorithm and a set of Haar-like cascade features. The eye search area is minimized by assuming the eyes' estimated position to be at the upper part of the face. Haar-like features cascade is used for the eye detection. It locates the rectangular regions containing eyes. Given the eyes ROI, an algorithm (shi-Thomasi's corner detection) is used to locate the eye corners. Next, the nose is detected using haar-like features. Having known the eyes corners, and the position of the nose, mouth location estimation is carried out based on the facial geometry. The next step is to locate the lips corners points, which are considered as good features for tracking lips movement. Finally, nostrils are detected from the nose ROI.

The block diagram of the proposed method is given bellow [1]:-

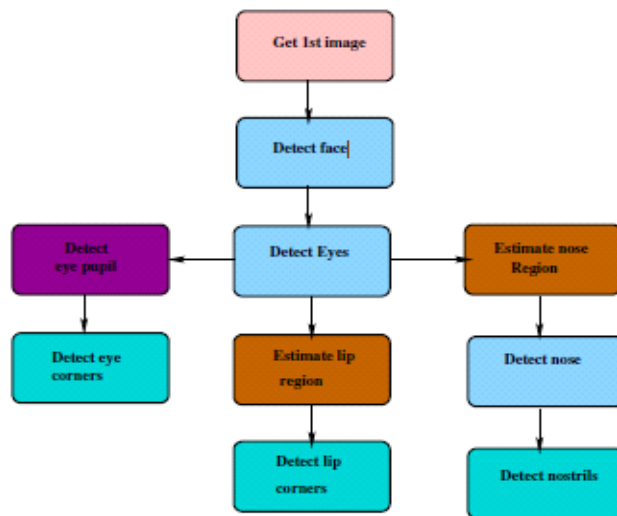


Figure.3.1: System Design

Automatic facial features detection approach

- **Face detection**

Viola and Jones' face detection algorithm is based on the Haar-like features. The four types of rectangular box are used to extract the features. The shaded area of the rectangular region is subtracted from the white area of the rectangle.

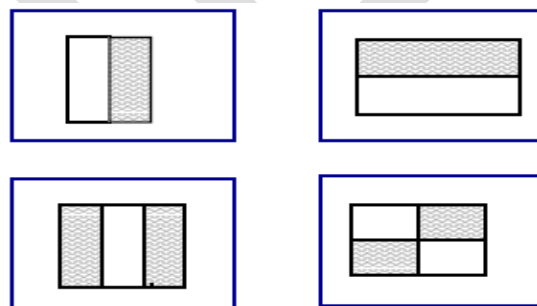


Figure 3.2.1: Haar-like features

These are the four types of Haar-like features, which is used for features detection. Upper two rectangles gives edge features, below left gives line features and the right one gives rectangle features [3].

• Eye detection

Here, eyes are detected from the face ROI using eye detection cascade of boosted tree classifiers with haar-like features. To improve the accuracy of eye detection, approximate location of eyes in the face is estimated.



Figure 3.2.2: Estimated eye region

The eye corners are more stable than other eye features. But, accurate detection of eye corners is difficult. Also the eyes have eye lashes, which make the detection of eyes corners and pupil even more difficult [1].

• Eye Corners Detection

In the proposed work, eye corners are detected as follows[7].

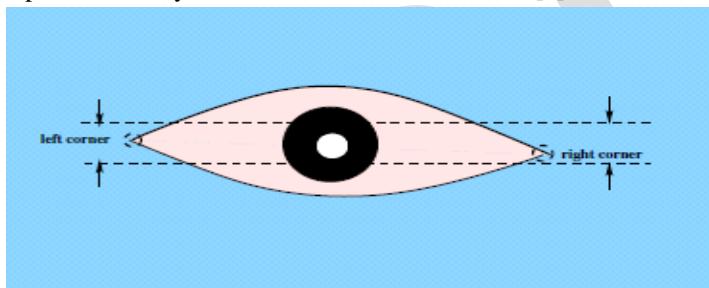


Figure 3.2.3: Estimated eye

- 1) Get the ROI image of the eye.
- 2) Extract the gray scale image of the ROI.
- 3) Using Shi-Tomasi's Good Features to Track method, obtain all the good corner features within the ROI.
- 4) Get the coordinate of the pupil detected in subsection 1 as (x_0, y_0) . Considering each coordinates of the corners as (x_i, y_i) , obtain the difference vectors $(x_0 - x_i)$ and $(y_0 - y_i)$. Positive and negative values across x direction and y-direction will obtain.
- 5) Corners with positive difference are in the left of the pupil and those of negative difference are at the right of the pupil.
- 6) The eye corners usually are near to y-coordinate of the eye pupil and also mostly found slightly below the pupil. So taking a constrain in the y-direction (different along y direction in the range of $(+3\sigma - 8)$), find the greatest $+ve$ value and $-ve$ value of the x vector.
- 7) The greatest $+ve$ value gives the left most corner point and the greatest $-ve$ value gives the right most corner point.
- 8) Resultant two extreme points are the required corner points of the eyes.

• Nose Detection

Nose is detected within the face region by using haar-like cascaded features and AdaBoost classification algorithm. To improve the nose detection accuracy, estimated region of nose is calculated in the given face image [1].

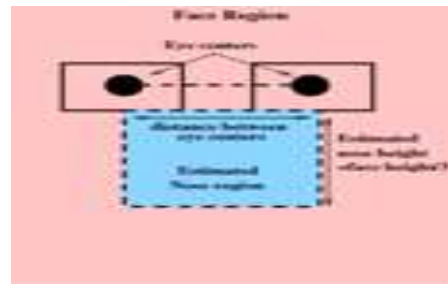


Figure 3.2.4: Estimated nose region

Nose position estimation is done as follows:

- 1) Get both the eyes ROI after eye detections are done.
- 2) Obtain the eyes center as $(x1, y1)$ and $(x2, y2)$ (centroid of the rectangle).
- 3) Obtain initial position of the rectangular region for nose as (x_{n0}, y_{n0}) . Where, x_{n0} = is the x coordinate of the center of eye1. And y_{n0} is the y coordinate of the initial point of eye1 + eye1 height.
- 4) The width of the nose rectangle is the difference $d = (x2 - x1)$.
- 5) The height is given by 1/3 of the face height.
- 6) The estimation of nose can also be one for tilted face by calculating the angle between two eye centers.
- 7) Angle θ can be given as $\tan^{-1} (y2 - y1 / x2 - x1)$.

- Nostril Detection

Nostrils are relatively darker than the surrounding nose regions even under a wide range of lighting conditions. After nose is detected, the nostrils can be found by searching for two dark regions [7].



Figure 3.2.5: Estimated nostrils

The methods of obtaining two nostrils are given below:

- 1) Get the nose ROI after it is detected using haar-like cascaded features.
- 2) Extract gray scale image of the ROI.
- 3) Threshold the gray image. We have used a conventional thresholding method here.
- 4) Use morphological operations like erosion technique to remove the particles, small dis-joint parts etc.
- 5) Obtain rectangles bounding the contours. Find the centroid of both the rectangles.
- 6) The resultant centroids are the two nostrils.

- Mouth Detection

The proposed method of mouth detection uses a simple fundamental of facial geometry. From the facial geometry, we can easily observe that, the approximate width of the lips is same as the distance between two eyes centers. The mouth y -location starts after the nose tip. X -locations can be given as two eye centers x -locations. The height of the mouth is estimated at 3/4 of the nose height detected. The height can also be taken as equivalent to the height of the nose to avoid the elimination of lower lips edges, especially when a person is smiling [1].

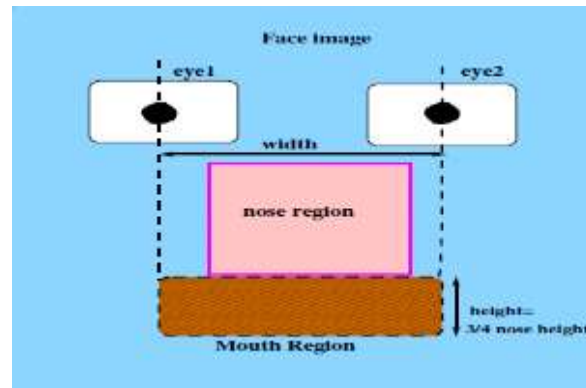


Figure 3.2.6: Estimated mouth region

- Mouth Corners Detection

We used Shi-Tomasi's corner detection method for detecting all the good/trackable features within the lip region. It is observed that, the threshold image of the mouth ROI contains a nice pattern from which the lip corner points can be detected easily [7].

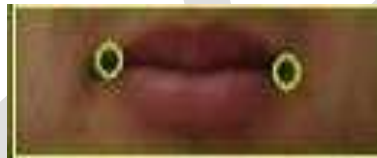


Figure 3.2.7: Estimated mouth corners

The proposed method for detecting lips corners is given below:

- 1) Get the detected mouth ROI, which is done as stated in section E.
- 2) Extract gray-level image.
- 3) Threshold the gray-image. It gives nice edge information for a closed mouth and a contour region for an open mouth.
- 4) Using Shi-Tomasi's corner detection method, obtain all the corner points in the threshold image.
- 5) Considering the midpoint of the lip as (x_{l0}, y_{l0}) obtain the difference $dx = x_{l0} - x_{li}$ and $dy = y_{l0} - y_{li}$. The obtained $-ve$ difference will give the points at the left and $+ve$ one will give those of are at the right.
- 6) Obtain the points at both extremes. Resultant points are the corners of the lips.

EXPERIMENTAL RESULT

Experiment is operated on more than 30 frontal face images of FEI database and also on few badly illuminated frontal face images. The database images used are of size 260×360 . The experiment is also performed on different resolution images, like figure 1 shows the detection results of an image of size 640×480 . The image is not well illuminated. It is observed that the algorithm is working well even in bad illuminated image.

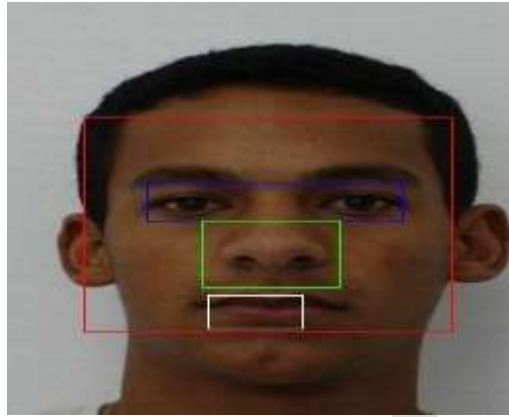


Figure 1: Region detection of bad lighting condition

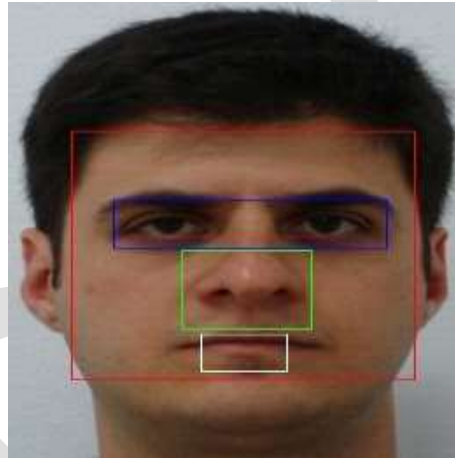


Figure 2: Region detection of good lighting condition

Figure 1 shows the experimental results of few frontal images from FEI database. The experimental result shows the accuracy of the methods used in the proposed work. Some results, for two different expressions (both on smiling and on neutral faces) are shown below. In both cases, it is found to be accurately detecting the features. We can observe in the figure 2 that, the eye pupils are getting detected even for very small eye images.

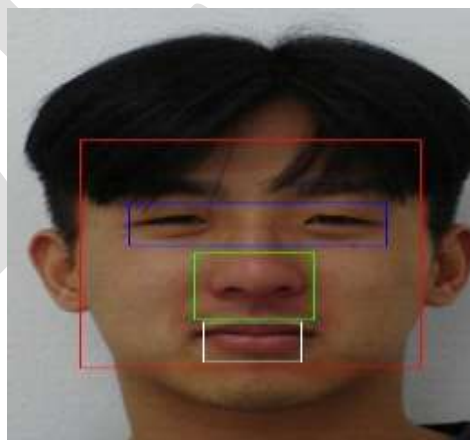


Figure 3: Face detection



Figure 4: Corner detection

Some images of faces wearing spectacles are also found to be detecting eye features accurately. It is observed that even in presence of glass, eye feature detecting accurately. Fig 4 shows the Feature point extraction:

In both cases it is found to be accurately detecting the features. Finally Figure 5th is the image from the database.



Figure 5: Expression detection

Proposed system is tested over 30 frontal face images with two different facial expression (neutral face and smiling face). The results obtained are found to be 60% accurate for lip, lip corners, nose and nostrils detection. The eye corners are giving approximately 70% accurate results. The results obtained are found to be 85% accurate for expression detection (neutral and smiling face).

CONCLUSION

This paper focuses on the recognition of two major facial expressions: neutral and smiling. This work used a robust algorithm for automatic and accurate detection of different facial features. An improvement over AdaBoost detection of eyes, mouth and nose are done by estimating the probable region for each features. Geometrical interpretation of location of facial features, used in the algorithms is described with pictorial descriptions. It is observed that, with the use of facial geometry, the accuracy of features (eyes, nose and mouth) detection is greatly improved over that of using only AdaBoost algorithm in whole face image. The proposed lip detection algorithm is found to be accurately detecting the lips corners for both neutral face images and smiling face images.

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Low Actuation Radio Frequency Micro Electro-Mechanical Shunt Switch

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Abstract— The research work has been done on RF MEMS Switch. High switching speed and very low actuation voltage switch is designed. The switch is designed on substrate of hafnium oxide material which has high dielectric constant. The serpentine flexures are added to provide switch higher flexibility. To get low actuation voltages, low switching speed and remove the problems of stiction, by adding cylindrical perforation. The Fixed-Fixed RF MEMS switch is designed by adding perforation and supported with various shapes of meanders. The Fixed-Fixed RF MEMS switch is Shunt switch which is employed for high frequency application. The Proposed switch provides low actuation voltage, high switching speed and removes the fringing field effect.

Keywords—fixed fixed beam; cylindrical perforation; actuation; stiction; material

INTRODUCTION

MEMS are the Micro Electronic mechanical system or in general terms it is also known as Microelectronic mechanical switch. RF MEMS Switch is further divided into two categories of switch Shunt RF MEMS Switch and Series RF MEMS Switch. For low frequency application Series RF MEMS Switch is used i.e. Cantilever Beam while for high frequency application Shunt RF MEMS Switch is used i.e. Fixed-Fixed Beam. A beam which has both anchored ends is known as Fixed-Fixed Beam [1]. RF MEMS switch is a probable substitute of PIN diode, varactor diode and the mechanical switches for RF applications due to its extremely a lesser amount of power consumption and enhanced high frequency performance [2]. This is due to their high electrical isolation, low insertion loss, excellent linearity, ultra wide band frequency, low noise performance and no bias current need [3]. The Radio Frequency MEMS switch design has been optimized through advance in beam design with serpentine flexures and perforated Fixed Fixed beam. The RF MEMS Switch model is designed and simulated to measure spring constant of switch, pull in voltage and capacitance of switch. The concept of perforation is used to remove sacrificial layer and reduce effect fringing field. Its reduced switching time and also affects the capacitance of the switch [2]. RF MEMS switch have different actuation methods to represent their characteristics such as actuation method are electromagnetic, electrothermal, piezoelectric and electrostatic. Similarly it is classified on base of electrical configuration series and shunt and mechanical structures configuration as cantilever beam and fixed Fixed beam and flat by their material as metallic and carbon allotropes. These switches from a contact outlook are classified in capacitive contacts and DC contact. DC contacts are used for DC up to a few GHz applications. The stiction problem is created in between metal and metal due to increasing ohmic resistance in DC contact switch. This predicament can be shortening by using a lean layer of dielectric between the makes a capacitive contact and metallic contact layers [4].

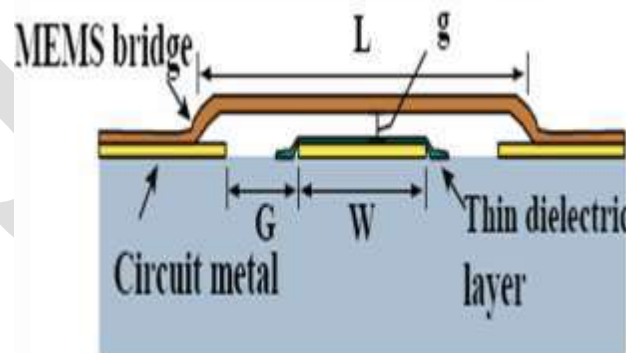


Fig.1 Fixed-Fixed Beam Structure

PRINCIPLE OF MEMS SWITCH

Micro electro mechanical switches work based on mechanical movement and electrical force both to attain ON state and OFF states. The Fixed-Fixed beam or shunt switch consists of a thin metal membrane perched over the center conductor of a Coplanar Waveguide (CPW) and fixed at both ends to the ground conductor by anchors. The center electrode provides RF capacitance and electrostatic actuation between the ground electrode and beam. The transmission line will not affect on signal when switch capacitance is low. The

electrostatic force is developed when dc voltage is applied between beam and electrodes. The developed electrostatic force and high capacitance attract the beam toward ground electrodes so that the membrane will change its position or deflect downwards by decreasing the gap height between electrodes. The increasing electrostatic pressure on the membrane gives more deflection. The membrane will pull down towards the core conductor with a convinced pull-down voltage and will make short circuit [5]

ELECTROSTATIC ACTUATION

The projected switch is used electrostatic actuation mechanism to design the membrane. As electrostatic actuation mechanism power dissipation is almost zero. The load of membrane shifts towards the electrode and it has connected with meanders which bring lower down the spring constant k . The load of the voltage is spread on the beam due to ribs around the edges of the membrane. The residual stress component can be discarded through computation due to the stiffness of the membrane. The actuation voltage V_{in} of a RF MEMS switch is given by [6-7]. The switch relies on the elastic recovery force of flexures instead of the force of a membrane to pull it upwards, because the membrane is stiff around the edges [7]. Capacitive switches are two state capacitors. The distinctive switch is a metal bridge suspended above a Co-Planar Waveguide signal line with both ends of the bridge anchored to ground. The switch is snapped down when a voltage more than electrostatic pull-in voltage is applied between beam and electrode. In the down state incident signals are reflected due to the pattern of a low impedance path through the dielectric and the switch beam to ground. The stage of isolation depends on the relative value of the shunt impedance to the characteristic impedance of the transmission line [8].

CONTACT AND MATERIAL

The material for RF MEMS switch depends on properties of material as melting point, resistivity, hardness and process difficulty. The resistivity of a sputtered metal film is about twice its bulk resistivity. A various types of materials are available to be used in RF MEMS switches. Some of the most common materials used for both cantilever and fixed-fixed beam switches are gold, aluminum, platinum, molybdenum, nickel, and copper. [9]

DESIGN OF RF MEMS SWITCH

The Fixed-Fixed RF MEMS switch at both ends is fixed above free gap. The HfO_2 material has assets of high dielectric constant as compared to other oxide materials. The Fig.2 shows the 3D structure of cylindrical perforated switch A. The dimension of beam is shown in Table.1. The serpentine flexures provide the greater flexibility and high switching speed which supported to join the ground electrode. As membrane width increases then it decreases the efficiency of actuation switch which will effect on the maximum deflection [10]. The simulation is done by software in 3D axis geometry. When applied voltage reaching the pull-in Voltage levels the gap between ground electrode and beam reduced, collapses to zero thus it forms closed contact and used as a switch [11].

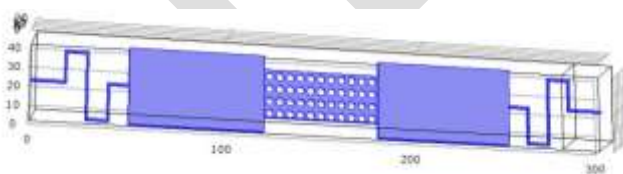


Fig.2 3D structure of switch A

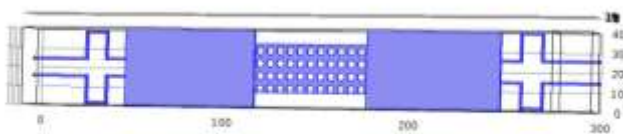


Fig.3 3D Structure of Switch B

SIMULATION OF RF MEMS SWITCH

The simulation is done by using COMSOL MULTIPHYSICS Software. The signal transmission of a switch is controlled by the capacitance value between the movable beam and the transmission line. When the applied electrostatic actuation voltage is zero, the movable beam is suspended over a CPW transmission line and the switch is in the on-state [12]. The pull in voltages of various switches have different. The 24.1 volt is maximum voltage or pull in voltage where it shows maximum deflection or maximum displacement of z- component. The cylindrical perforated MEMS switch with supported various meanders reduces squeeze film switching speed increases flexibility and damping. The maximum displacement of switch A is $-0.0399 \mu\text{m}$ as shown in Fig.4. The Fig.5 represents the 3D structure of simulated switch B $-0.1151 \mu\text{m}$ at 24.1 volt. The each geometry provides various displacements at applied voltage. The graph between capacitance and applied is shown in Fig.6 and Fig.7 respectively switch A and switch B.

DIMENSION OF SWITCH

Parameters	Block-1	Block-2	Block-3
Length	70 μm	90 μm	70 μm
Width	40 μm	25 μm	40 μm
Height	2 μm	2 μm	2 μm

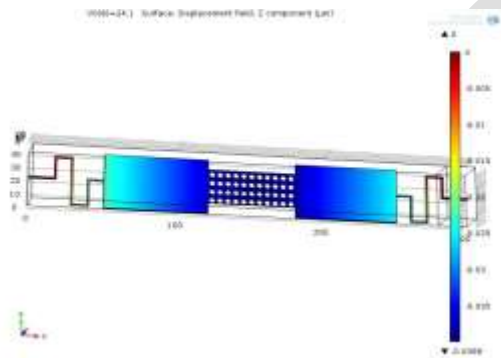


Fig. 4 Simulated Switch A at 24.1 volt

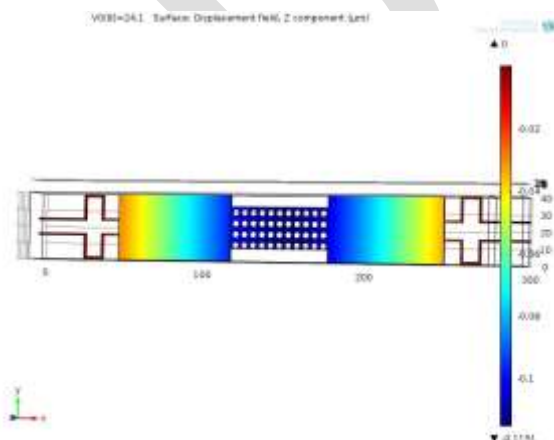


Fig.5 Simulated Switch B at 24.1 volt

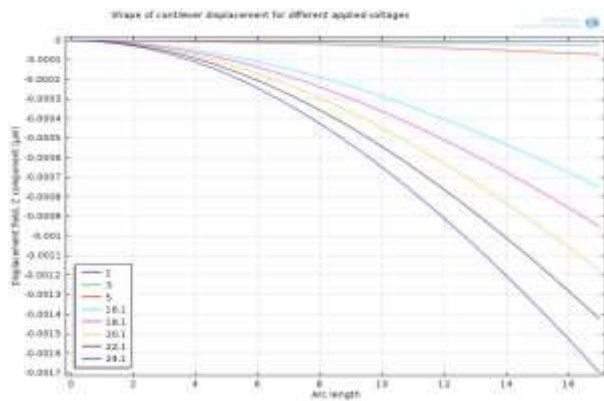


Fig. 6 Graphical representation of Switch A

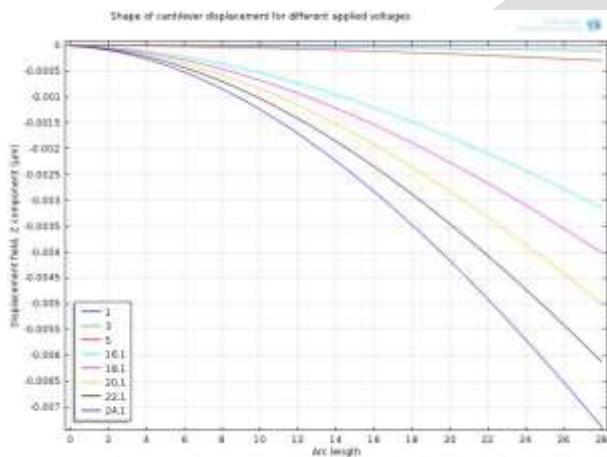


Fig.7 Graphical representation of Switch B

RESULT AND DISCUSSION

In Fixed- Fixed RF MEMS switch is designed to the reduce switching time, increases flexibility, increases switching speed and reduce power dissipation. The various types of supported meanders RF MEMS switches which provides different types of z component displacement at various applied voltages. The comparisons of switches are shown in the Table 2 The perforation increases the switching speed and reduces fringing fields.

APPLIED VOLTAGE WITH DISPLACEMENT

Voltage	Switch A	Switch B
1	6.7011e-5	0.1151
3	6.0329e-4	1.6168e-3

5	1.6769e-3	4.502e-3
16.1	0.0176	0.0485
18.1	0.0222	0.062
20.1	0.0275	0.0774
22.1	0.0334	0.0951
24.1	0.0399	0.1151

CONCLUSION

The two switches are designed and simulated both it. As result seen the switch B have provide large displacement at 24.1 so that switch is better for low power consumption application. The switch can be used for high frequency application.

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FINGER PRINT CLASSIFICATION WITH NEURAL NETWORK FOR PERSONAL AUTHENTICATION

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Abstract— Finger print classification with neural network for personal authentication, which uses the WHT transform over the entire finger print image as feature detector and a constructive one hidden layer feed forward neural network as a finger print classifier proposed technique is applied to a database consisting of images of 96 having Twelve man finger print images. Images of 72 are used for network training, and the remaining images of 24 are used for cross validation. It is demonstrated that the best recognition rates are 100% for the training as well as cross validation for 11 men finger print images except 1 men finger print image 50% for C.V and 88.88 for Train . Furthermore, The Average Classification Accuracy of GFF Neural Network comprising of one hidden layers with 7 PE's organized in a typical topology is found to be superior (100 %) for Training . Finally, optimal algorithm has been developed on the basis of the best classifier performance. The algorithm will provide an effective alternative to traditional method of facial captured image analysis for deciding the Human emotion.

Keywords— Neural solution, MatLab, Microsoft Excel, Finger print scan images.

INTRODUCTION

With the advent of electronic banking, e-commerce, and smartcards and an increased emphasis on the privacy and security of information stored in various databases, automatic personal identification has become a very important topic. Accurate automatic personal identification is now needed in a wide range of civilian applications involving the use of passports, cellular telephones, automatic teller machines, and driver licenses. Traditional knowledge-based (password or Personal Identification Number (PIN) and token-based (passport, driver license, and ID card) identifications are prone to fraud because PINs may be forgotten or guessed by an imposter and the tokens may be lost or stolen. Therefore, traditional knowledge-based and token-based approaches are unable to satisfy the security requirements of our electronically interconnected information society (see Figure 1.1). As an example, a large part of the annual \$450 million Mastercard credit card fraud is due to identity fraud[7]. A perfect identity authentication system will necessarily have a biometric component. Eventually, a foolproof identity authentication systems will have all the three components (knowledge-based, token-based, and biometrics). In this thesis, we have only focused on the biometrics component of an automatic identification system in general, and a fingerprint-based biometric identification system in particular.

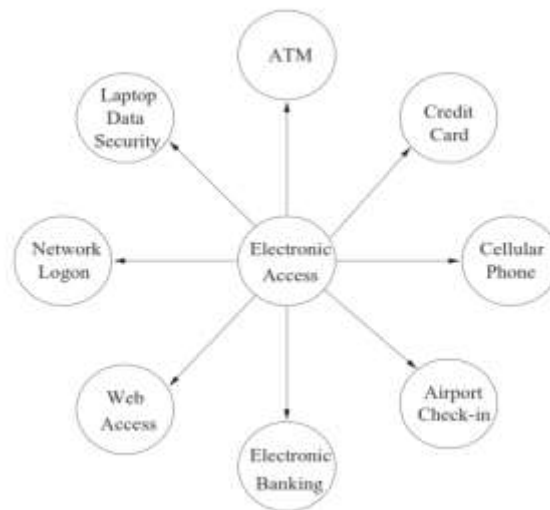


Figure 1: Various electronic access applications in widespread use that require automatic authentication

Fingerprints

Fingerprints are the ridge and furrow patterns on the tip of the finger[8] and have been used extensively for personal identification of people[9] . Figure 1.2 shows an example of a fingerprint. The biological properties of fingerprint formation are well understood and

fingerprints have been used for identification purposes for centuries. Since the beginning of the 20th century, fingerprints have been extensively used for identification of criminals by the various forensic departments around the world [10]. Due to its criminal connotations, some people feel uncomfortable in providing their fingerprints for identification in civilian applications. However, since fingerprint-based biometric systems offer positive identification with a very high degree of confidence, and compact solid state fingerprint sensors can be embedded in various systems (e.g., cellular phones), The availability of cheap and compact solid state scanners [11] as well as robust fingerprint matchers are two important factors in the popularity of fingerprint-based identification systems. Fingerprints also have a number of disadvantages as compared to other biometrics. For example, approximately 4% of the population does not have good quality fingerprints, manual workers get regular scratches on their fingers which poses a difficulty to the matching system, finger skin peels off due to weather, fingers develop natural permanent creases, temporary creases are formed when the hands are immersed in water for a long time, and dirty fingers can not be properly imaged with the existing finger print sensors. Further, since fingerprints can not be captured without the user's knowledge, they are not suited for certain applications such as surveillance.

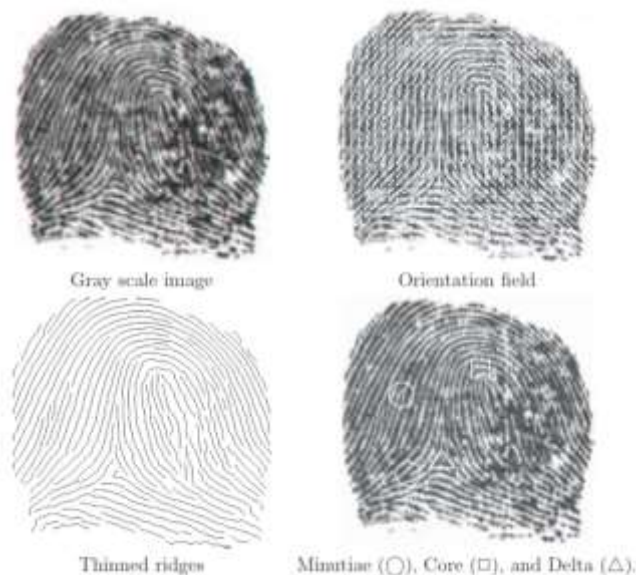


Figure 1.2: Orientation field, thinned ridges, minutiae, and singular points.

1) Neural Networks

Following Neural Networks are tested:

a) Feed-Forward Neural Networks

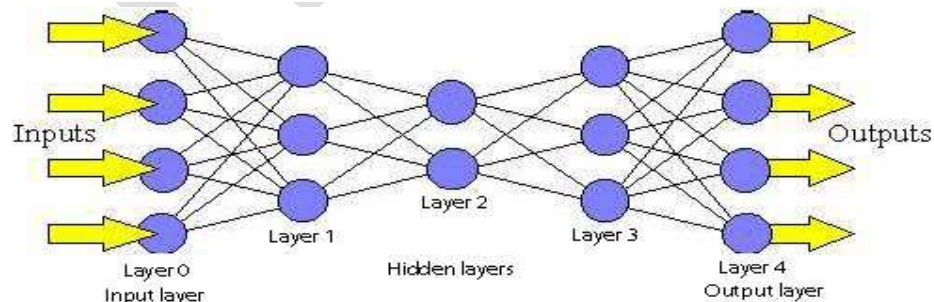


Figure 1.3: A feed-forward network.

Feed-forward networks have the following characteristics:

1. Perceptrons are arranged in layers, with the first layer taking in inputs and the last layer producing outputs. The middle layers have no connection with the external world, and hence are called hidden layers.
2. Each perceptron in one layer is connected to every perceptron on the next layer. Hence information is constantly "fed forward" from one layer to the next., and this explains why these networks are called feed-forward networks.
3. There is no connection among perceptrons in the same layer.

A single perceptron can classify points into two regions that are linearly separable. Now let us extend the discussion into the separation of points into two regions that are not linearly separable. Consider the following network: [10]

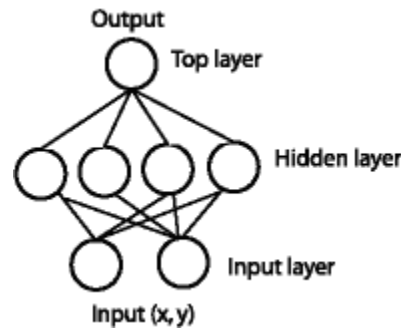


Figure 1.4 A feed-forward network with one hidden layer.

2) Learning Rules used:

a) Momentum

Momentum simply adds a fraction m of the previous weight update to the current one. The momentum parameter is used to prevent the system from converging to a local minimum or saddle point. A high momentum parameter can also help to increase the speed of convergence of the system. However, setting the momentum parameter too high can create a risk of overshooting the minimum, which can cause the system to become unstable. A momentum coefficient that is too low cannot reliably avoid local minima, and can also slow down the training of the system.

3) Simulation Results

The GFF neural network has been simulated for 96 finger print images out of which 72 were used for training purpose and 24 were used for cross validation.

The simulation of best classifier along with the confusion matrix is shown below :

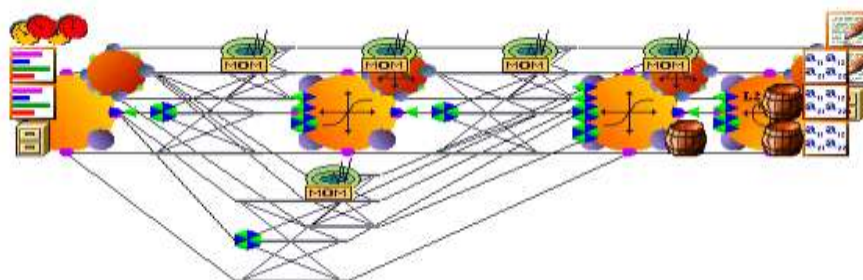


Figure1.5: The Best Neural network with maximum accuracy

4) Results

<i>Best Networks</i>	<i>Training</i>	<i>Cross Validation</i>
Hidden 1 PEs	49	7
Run #	2	1
Epoch #	1000	615
Minimum MSE	0.004017875	0.023769675
Final MSE	0.004017875	0.02399354

Table1: Processing Element Training Data Set

Test on Cross validation (CV):

Output /Desired	MAN12	MAN11	MAN10	MAN9	MAN8	MAN7	MAN6	MAN5	MAN4	MAN3	MAN2	MAN1
MAN12	2	0	0	0	0	0	0	0	0	0	0	0
MAN11	0	2	0	0	0	0	0	0	0	0	0	0
MAN10	0	0	2	0	0	0	0	0	0	0	0	0
MAN9	0	0	0	2	0	0	0	0	0	0	0	0
MAN8	0	0	0	0	2	0	0	0	0	0	0	0
MAN7	0	0	0	0	0	2	0	0	0	0	0	0
MAN6	0	0	0	0	0	0	2	0	1	0	0	0
MAN5	0	0	0	0	0	0	0	2	0	0	0	0
MAN4	0	0	0	0	0	0	0	0	1	0	0	0
MAN3	0	0	0	0	0	0	0	0	0	2	0	0
MAN2	0	0	0	0	0	0	0	0	0	0	2	0
MAN1	0	0	0	0	0	0	0	0	0	0	0	2

Table 2: Confusion matrix on CV data set

<i>Perfor mance</i>	<i>Man12</i>	<i>Man11</i>	<i>Man10</i>	<i>Man9</i>	<i>Man8</i>	<i>Man7</i>	<i>Man6</i>	<i>Man5</i>	<i>Man4</i>	<i>Man3</i>	<i>Man2</i>	<i>Man1</i>
MSE	0.008	0.002	0.029	0.001	0.004	0.002	0.029	0.024	0.044	0.04	0.01	0.008
NMSE	0.115	0.033	0.386	0.020	0.053	0.027	0.37	0.32	0.58	0.59	0.22	0.10
MAE	0.06	0.036	0.079	0.036	0.053	0.037	0.10	0.10	0.11	0.12	0.07	0.063
Min Abs Error	0.01	0.0003	0.006	0.002	0.001	0.0001	0.002	0.004	0.008	0.002	0.002	0.002
Max Abs Error	0.38	0.129	0.764	0.063	0.163	0.10	0.62	0.42	0.83	0.65	0.47	0.305
r	0.96	0.987	0.83	0.99	0.97	0.98	0.79	0.84	0.68	0.65	0.88	0.945
Percent Correct	100	100	100	100	100	100	100	100	50	100	100	100

Table 3: Accuracy of the network on CV data set

Test on Training:

Output /Desired	MAN12	MAN11	MAN10	MAN9	MAN8	MAN7	MAN6	MAN5	MAN4	MAN3	MAN2	MAN1
MAN12	6	0	0	0	1	0	0	0	0	0	0	0
MAN11	0	6	0	0	0	0	0	0	0	0	0	0
MAN10	0	0	6	0	0	0	0	0	0	0	0	0
MAN9	0	0	0	6	0	0	0	0	0	0	0	0
MAN8	0	0	0	0	5	0	0	0	0	0	0	0
MAN7	0	0	0	0	0	6	0	0	0	0	0	0
MAN6	0	0	0	0	0	0	6	0	0	0	0	0
MAN5	0	0	0	0	0	0	0	6	0	0	0	0
MAN4	0	0	0	0	0	0	0	0	6	0	0	0
MAN3	0	0	0	0	0	0	0	0	0	6	0	0
MAN2	0	0	0	0	0	0	0	0	0	0	6	0
MAN1	0	0	0	0	0	0	0	0	0	0	0	6

Table 3: Confusion matrix on Train data set

Performance	Man12	Man11	Man10	Man9	Man8	Man7	Man6	Man5	Man4	Man3	Man2	Man1
MSE	0.018	0.0006	0.001	0.0009	0.001	0.00	0.001	0.001	0.001	0.001	0.001	0.001
NMSE	0.237	0.008	0.01	0.01	0.01	0.012	0.020	0.014	0.025	0.023	0.018	0.015
MAE	0.064	0.021	0.03	0.02	0.03	0.026	0.034	0.028	0.040	0.036	0.033	0.029
Min Abs Error	0.005	0.0005	0.001	0.001	0.002	0.0006	0.0001	2.98026E-05	0.00028	0.0002	0.0007	0.0003
Max Abs Error	1.055	0.055	0.06	0.05	0.07	0.055	0.055	0.055	0.055	0.083	0.070	0.055
r	0.90	0.99	0.99	0.99	0.99	0.995	0.99	0.995	0.993	0.99	0.993	0.994
Percent Correct	100	100	100	100	83.33	100	100	100	100	100	100	100

Table 4: Accuracy of the network on Train data set

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CONCLUSION

From the results obtained it concludes that the GFF Neural Network with MOM (MOMENTUM) and hidden layer 1 with processing element 7 gives best results 11 finger print identify 100% only man8 finger print is identify 83.33% in Training as well as in Cross Validation it gives 11 finger print identify 100% only man4 finger print is identify 50%.

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Steganography By Use Binary Operations

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Abstract- Steganography is the art and science of hiding messages or other secret information in a bunch of carrier information. This paper presents a new idea of robust steganography using Adding operation between image-pixel LSB (Least Significant Bit) value and secret message- character ASCII-binary value and use two keys in the extraction of secret text to enhance the power of concealment and the difficulty of breaking.

Keyword: Steganography , Binary operation, Hiding information , LSB , Image Steganography, 24 Bit Color Image

1. Introduction

The idea of information hiding is nothing new in the history. As early as in ancient Greece there were attempts to hide a message in trusted media to deliver it across the enemy territory. In the modern world of digital communication (2) , there are two ways to do that .

The first method is to encipher the message in such a way that no one else can read it. In this case, the encryption is obvious, and when intercepted, it is clear that the sender and the receiver are communicating secretly and people may be able to tell that a secret message is being transmitted; they just can't read it. This technique is called cryptography (1).

The second method is to hide the fact that a message is being transmitted. Steganography is an extremely useful method for covert information transmission (3). Steganography is the data hiding technique which allows hiding secret message or image within a larger image or message such that the hidden message or an image is undetectable (4). Cryptography provides the means for secure communications; steganography provides the means for secret communication. Steganography combined with cryptography would be the most secure way to go(1). Because the existence of an encrypted communication draws attention to it, hiding it in another le uppers up your .

2. Types of Steganography

The steganography is having following types as shown in fig.1

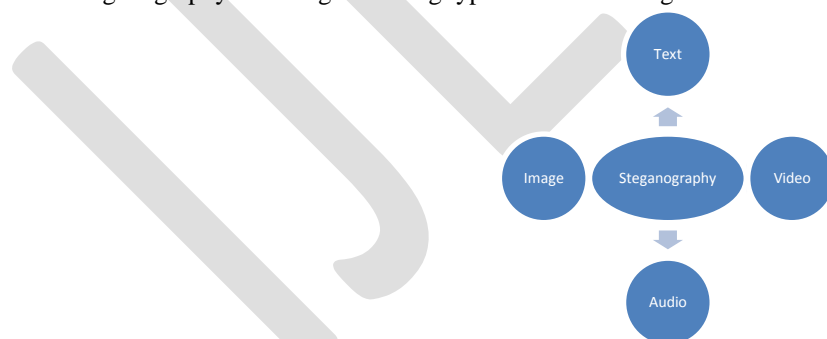


Fig. 1: Types of Steganography.

In the first type of Steganography, the cover media will be the “text cover”. The basic advantage of preferring text steganography is that, it requires less memory and Steganography simple communication. The message is embedded in cover text file by using some embedding algorithm, so that the “stego text” or “cipher text” is formed. This stego text is then sent to the receiver side through transmission channel. This stego text is processed by the extraction algorithm by using “secret key” or “stego key”. Among four types of steganography, image steganography is the most popular technique. We take the detail look on this in the next

section. The next technique is hiding the secret message by using Audio file as cover media. In the video steganography, we use the video file as cover media to embed the secret message (8).

3-Techniques of Image Steganography

There have been a large embedding techniques proposed number of steganography in the literature. These techniques modify the cover-image with different approaches as well as constrains. But all embedding techniques share the important goal of maximizing the capacity of the stego channel. In other words their aim is to embed at highest possible rate while remaining undetectable to steganalysis attack. All the popular data hiding methods can be divided into two major classes: spatial domain embedding and transform domain embedding(9). Next we will review them .

A. Spatial Domain Spatial domain techniques embed information in the intensity of the original image pixels directly. Basically least significant bit (LSB) method is used where it replaces the least significant bit of original pixel with the message bit (10).

B. Transform Domain Transform domain also known as frequency domain where images are first transformed then the message is embedded in the image. Discrete cosine transformation (DCT) technique is used in JPEG images to achieve compression. DCT is a lossy compression transform where the cosine values cannot be generated as original, because DCT alter values to hide the information(9).

3-1. Least Significant Bit

The LSB based technique is mainly uncomplicated and simple approach through which message bits are embedded within the least significant bits of cover image (7). In the LSB steganography method and for the purpose of covering the secret messages, the least significant bits of the cover-image are exploited. Thus, this method is considered one of the most common techniques that include the standard LSB replacement [6]. Consider the following cover-image and secret message in bits. The LSB replacement alternates the last bits of the cover image with each bit belong to the messages that are required to be hidden (5).

3-1.1. LSB Method For 24 Bit Color Image

In the case of 24 bit color image each pixel is composed of RGB values and each of these colors requires 8-bit for its representation. [R (8 bits), G (8 bits) , B (8 bits)].

Example:

The letter 'A' has an ASCII code of 65(decimal), which is 1000001 in binary.

It will need three consecutive pixels for a 24-bit image to store an 'A':

Let's say that the pixels before the insertion are:

10000000.10100100.10110101, 10110101.11110011.10110111, 11001111.10110011.00110011

Then their values after the insertion of an 'A' will be:

10000001.10100100.10110100, 10110100.11110010.10110110, 11100110.10110011.00110011

4- Binary Operation

Binary arithmetic is essential part of all the digital computers and many other digital system. The arithmetic of binary numbers means the operation of addition, subtraction, multiplication and division. Binary arithmetic operation starts from the least significant bit i.e. from the right most side.

4-1.Binary Addition

There are four steps in binary addition, they are written below

$$0 + 0 = 0$$

$$0 + 1 = 1$$

$$1 + 0 = 1$$

$$1 + 1 = 0 \text{ (carry 1 to the next significant bit)}$$

In fourth case, a binary addition is creating a sum of $(1 + 1 = 10)$ i.e. 0 is written in the given column and a carry of 1 over to the next column.

5. The Proposed Scheme

The new proposed system adding the secret text in image, use addition operation to insert secret text to LSB in pixels of image .

We use in our case an 24-bit image and use Math lab in execute the system and use two keys.

5.1- The Proposed Scheme Operation

The Add secret text of new system has many operations:

- 1- Input the secret text to be hidden that can be done by open new file and entered directly.
- 2- Convert secret text to Ascii system than to binary system , each letter consists 8 bit .
- 3- Input image (cover) to system
- 4- Save header of Image in a file and save the palette value of body in another file.
- 5- Save palette file in array and save binary secret text in another array.
- 6- Add the first bit in first letter from secret text which consists of 8 bit to first pixel in image by adding bit-text to first LSB in palette of image , if LSB equal 1 and bit-text equal 1 the result equal 0 With the neglect of the rest
And if LSB equal 0 and text equal 1 the result equal 1 and so on.
- 7- Save the locations of the bits which change values in array.
- 8- Every letter in secret text need two pixels and two colors from third pixel .
- 9- We use two keys in this system the key length of text and the length of array which content the location of bits which change values .
- 10- Save the two keys in end the palette of image by replaces LSB in palette with keys .

5.2- The Algorithm of The Proposed System

The following steps describe the algorithm:

Algorithm 1: Input the Secret text

Input : Secret text

Output : Binary Array

Step1- input text

Step2- convert text to ASCII system

Step3 – convert ASCII system to binary number

Step 4- save binary number in Array1

Step5 : End

Algorithm 2: Input the Image

Input : Image

Output : Array of binary code

Step1- Open Image (the bmp-file) Operation

This operation will open the bmp file and save header in a file and save the palette value of body in another file.

Step2- save the value of pixel palette in array2

Step3-End

Algorithm 3: Adding array1 of binary to array2 of pixels

Input : Array of binary code, Array of pixels

Output : Array of Adding two arrays , Array of locations bits that change

Step1- for i= 1 to length of the secret text

Step2-add the first bit from array1 to eight bit in array2

Step3 – If change the bit in palette then

 Array3 = location of bit

 endif

Step 3 – Shift seven bits

Step4- next i

Step5 : End

Algorithm 4: Hide the key1 , key2 and array3 in end palette

Input :key1, key2,array3

Output : array2 after hide

Step1 : Replace the LSB in last two pixels in palette with key1

Step 2: Replace the LSB in before last two pixels palette with key1

Step 3: for j= end of palette -4 to (end of palette -4)-length of array3

 Two LSB in array2[j] = array3

 Next j

Step4 :end

Algorithm 5: extract the image again

Input : array2 after adding

Output :image

Step1 : Back array2 to Platte file

Step2 : Back header to Platte file

Step3 : This change is unnoticeable because the number of bits that change is small and in LSB.

Step4 : End

6-Extracting The Secret

The Extracting secret text of new system has many operations

- 1- Save header of Image in a file and save the palette value of body in another file.
- 2- Save the palette value in array4
- 3- Extract the keys from the end array4
- 4- Depending on the key extract the secret text by if the LSB change the text secret 1 else the secret text 0

6-1. The Algorithm of The Extracting

Algorithm1: Split the image

Input : image after hiding secret text

Output : Array4

Step1- Open Image (the bmp-file) Operation

This operation will open the bmp file and save header in a file and save the palette value of body in another file.

Step2- save the value of pixel palette in array4

Step3-End

Algorithm 2: Extracting the keys and array3

Input: Array4

Output: keys ,array3

Step1: Read array4

Step2: key1= LSB in last two pixels in palette

Step3: key2= LSB before two pixels in palette

Step4: for j= end of palette -4 to (end of palette -4)-length of array3

array3 = Tow LSB in array2[j]

Step5: End

Algorithm 3: Extracting The secret text

Input : array3, keys ,array4

Output : secret text

Step1: for I=1 to key1

Read LSB in array4

If location of LSB in array3 then

Secret text = 1

Else

Secret text = 0

End if

Next I

Step2 : convert secret text from binary to ascii

Step 3: convert ascii to text

Step 4 : print secret text

Step 5: end

7. Experimental Results

The proposed system has been built using Math Lab and can run on Pentium 3 computer and above, the setting of screen must be 800 X 600.

The results of the proposed system has been illustrated in the following

Example:



Fig2:image1

We add text1 “ this is nice picture” in Image1



Fig.3: Image1 adding secret text1

8-Experimental Results And Performance Analysis

Use PSNR Function to Test the results

Signal to Noise Ratio (PSNR) is generally used to analyze quality of image, sound and video files in dB (decibels). PSNR calculation of two images, one original and an altered image, describes how far two images are equal.

MSE: Mean-Square error.

x: width of image.

y: height.

$x*y$: number of pixels (or quantities).

This function displays the PSNR (peak signal-to-noise ratio) between two images. The answer is in decibels (dB).

PSNR is very common in image processing. A sample use is in the comparison between an original image and a coded/decoded image. Typical quoted PSNR figures are in the range +25 to +35dB.

The syntax for this file is $\text{PSNR}(A,B)$, where A and B are MATLAB Intensity Images, with matrix-elements in the interval [0,1]

$$PSNR(dB) = 10 * \log\left(\frac{255^2}{MSE}\right)$$

$$MSE = \sum_{i=1}^x \sum_{j=1}^y \frac{(A_{ij} - B_{ij})^2}{x * y}$$

.PSNR formula.

the PSNR (Peak Signal to Noise Ratio) value of the image is calculated using the equation and if the PSNR value is greater than 35dB, the cover image is within acceptable degradation levels.

$$PSNR = 10 \times \lg((2n-1)^2 / MSE) \quad (3)$$

Where n means the number of bits per sample value, the MSE represents mean square error between the host image and the cover image.

By using Matlab we input fig.(2) and fig.(3) to function PSNR the results equal 30.100 db and this value acceptable.

9. Conclusion

The proposed system proved to be a good system used to hide a text in image by Adding Binary value of text to value of LSB in palette with this operation will change small number from LSB.

- In the proposed system change small number from LSB that's unnoticeable
- The proposed system proved to be easy to use and efficient in terms security and help to save text in image.
- We can develop the system encodes the secret hide text before and this is what it will do in the future.

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Image Compression Using Wavelet Transform: A Literature

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Abstract:- With the development of good quality of image capturing device, it produces high resolution of images but they requires huge amount of storage space which creates problem during transmission and storage. Hence, the reduction of image size is necessary which will lessen the storage and improve the transmission capacity. Image processing plays an important role in image processing which reduces the image size efficiently without degrading the quality of image. Image compression is classified into categories namely: lossy and lossless image compression. There are various image compression techniques such as Run Length Encoding, DWT, DCT etc. In this paper, a comprehensive review on literature study of image compression by various authors is presented and also discusses the different compression techniques with their merits and demerits.

Keywords: - Image Compression, Lossy Compression, Lossless Compression, DCT, DWT

INTRODUCTION

Image compression is diminishing the size of a graphical file without degrading the quality of the image to an unsatisfactory level. The reduction in file size allows more images to be stored in a given amount of disk or memory space. It also reduces the time required for images to be sent over the Internet or downloaded from Web pages. The objective of image compression is to reduce the irrelevance and redundancy of image data. Image compression may be lossy or lossless. In case of lossless compression we can obtain the exact replica of original image by decompression. Lossless technique is used for the compression of binary data such as executables, documents etc. The binary data need to be exactly reproduced when decompressed. Run length coding, entropy encoding, LZW coding are the generally used loss less compression methods. But in most cases images need not be reproduced exactly, an approximation of the original image is enough. The error between the original and the compressed image is tolerable. This type of image compression is considered as lossy compression. Chromo sub sampling, transform coding are the generally used lossy techniques [1]. Two fundamental components of compression are redundancy and irrelevancy reduction. Redundancy reduction aims at removing duplication from the signal source (image/video). Irrelevancy reduction omits parts of the signal that will not be noticed by the signal receiver, namely the Human Visual System (HVS). In general, three types of redundancy can be identified:

Irrelevant Information

Most 2-D intensity arrays contain information that is ignored by the human visual system and extraneous to the intended use of the image. It is redundant in the sense that it is not used. Image compression research aims at reducing the number of bits needed to represent an image by removing the spatial and spectral redundancies as much as possible.

Coding

A code is a system of symbols (letters, numbers, bits, and the like) used to represent a body of information or set of events. Each piece of information or events is assigned a sequence of code symbols, called a code word. The number of symbols in each code word is its length. The 8-bit codes that are used to represent the intensities in the most 2-D intensity arrays contain more bits than are needed to represent the intensities.

Spatial and Temporal Redundancy

Because the pixels of most 2-D intensity arrays are correlated spatially, information is unnecessarily replicated in the representations of the correlated pixels. In video sequence, temporally correlated pixels also duplicate information.

In this paper, we present the comprehensive review of image compression technique and earlier work done by various researchers in this area using wavelet transform. The organization of the remaining section of paper is done as follows: Section II presents different image file format. In section III describes the related work done in the field of image compression. In section IV, various image compression techniques is discussing and last section gives overall conclusion of the research and future work.

IMAGE FILE FORMAT

There are various types of image file format which is described below:

JPEG

JPEG is short for Joint Photographic Experts Group, and is the most popular among the image formats used on the web. JPEG files are very 'lossy', meaning so much information is lost from the original image when you save it in JPEG file. This is because JPEG discards most of the information to keep the image file size small; which means some degree of quality is also lost.

As shown above, image compression is not that evident at first glance. But if you take a closer look, the JPEG image is not as sharp as the original image. The colors are paler and the lines are less defined and the picture is noisier. If you zoom in there are JPEG artifacts like any other JPEG files.



Fig.1.1 : JPEG Medium Compressed File

Pros of JPEG:

- 24-bit color, with up to 16 million colors
- Rich colors, great for photographs that needs fine attention to color detail
- Most used and most widely accepted image format
- Compatible in most OS (Mac, PC, Linux)

Cons of JPEG:

- They tend to discard a lot of data
- After compression, JPEG tends to create artifacts
- Cannot be animated
- Does not support transparency

GIF

GIF, short for Graphics Interchange Format, is limited to the 8 bit palette with only 256 colors. GIF is still a popular image format on the internet because image size is relatively small compared to other image compression types.



Fig.1.2: GIF image type

GIF compresses images in two ways: first, by reducing the number of colors in rich color images, thus reducing the number of bits per pixel. Second, GIF replaces multiple occurring patterns (large patterns) into one. So instead of storing five kinds of blue, it stores only one blue.



Fig.1.3: GIF image type

GIF is most suitable for graphics, diagrams, cartoons and logos with relatively few colors. GIF is still the chosen format for animation effects.

Compared to JPEG, it is lossless and thus more effective with compressing images with a single color, but pales in detailed or dithered pictures. In other words, GIF is lossless for images with 256 colors and below. So for a full color image, it may lose up to 99.998% of its colors.

One edge of the GIF image format is the interlacing feature, giving the illusion of fast loading graphics. When it loads in a browser, the GIF first appears to be blurry and fuzzy, but as soon as more data is downloaded, the image becomes more defined until all the data has been downloaded.

Pros of GIF:

- Can support transparency
- Can do small animation effects
- 'Lossless' quality—they contain the same amount of quality as the original, except of course it now only has 256 colors
- Great for images with limited colors, or with flat regions of color

Cons of GIF:

- Only supports 256 colors
- It's the oldest format in the web, having existed since 1989. It hasn't been updated since, and sometimes, the file size is larger than PNG.

BMP

The Windows Bitmap or BMP files are image files within the Microsoft Windows operating system. In fact, it was at one point one of the few image formats. These files are large and uncompressed, but the images are rich in color, high in quality, simple and compatible in all Windows OS and programs. BMP files are also called raster or paint images.

BMP files are made of millions and millions of dots called 'pixels', with different colors and arrangements to come up with an image or pattern. It might be an 8-bit, 16-bit or 24-bit image. Thus when you make a BMP image larger or smaller, you are making the individual pixels larger, and thus making the shapes look fuzzy and jagged.

BMP files are not great and not very popular. Being oversized, bitmap files are not what you call 'web friendly', nor are they compatible in all platforms and they do not scale well.



Fig.1.4: BMP image type

Pros of BMP:

- Works well with most Windows programs and OS, you can use it as a Windows wallpaper

Cons of BMP:

- Does not scale or compress well
- Again, very huge image files making it not web friendly
- No real advantage over other image formats

TIFF

TIFF was created by Aldus for 'desktop publishing', and by 2009 it was transferred to the control of Adobe Systems. TIFF is popular among common users, but has gained recognition in the graphic design, publishing and photography industry. It is also popular among Apple users.



Fig.1.5: TIFF image type

The TIFF image format is easy to use with software that deals with page layout, publishing and photo manipulation via fax, scanning, word processing, etc. TIFF is very flexible, it can be lossy or lossless. TIFF is a rich format and supported by many imaging programs. It is capable of recording halftone image data with different pixel intensities, thus is the perfect format for graphic storage, processing and printing. This makes TIFF the superior raster image format.

Pros of TIFF:

- Very flexible format, it supports several types of compression like JPEG, LZW, ZIP or no compression at all.
- High quality image format, all color and data information are stored
- TIFF format can now be saved with layers

Cons of TIFF:

- Very large file size—long transfer time, huge disk space consumption, and slow loading time.

PNG

PNG or (Portable Network Graphics) is a recently introduced format, so not everyone familiar with it. But PNG has been approved as a standard since 1996. It is an image format specifically designed for the web. PNG is, in all aspects, the superior version of the GIF. Just like the GIF format, the PNG is saved with 256 colors maximum but it saves the color information more efficiently. It also supports an 8 bit transparency.



Fig.1.6: PNG image type

PNG was actually created for the intent to replace the GIF as an image format that doesn't require a patent license. PNG can support 24 bit RGB color images, grayscale images, both with and without alpha channels. RGB cannot support CMYK color spaces, and is not designed for print graphics.

Pros of PNG:

- Lossless, so it does not lose quality and detail after image compression
- In a lot ways better than GIF. To start, PNG often creates smaller file sizes than GIF
- Supports transparency better than GIF

Cons of PNG:

- Not good for large images because they tend to generate a very large file, sometimes creating larger files than JPEG.
- Unlike GIF however, it cannot be animated.
- Not all web browsers can support PNG.

RELATED WORK

Remya George, Manimekalai. M.A.P (2014). Proposed a novel image compression technique based on EZW (Embedded Zero Tree Wavelet Coding) algorithm is presented. EZW algorithm encodes the image to compress it into a bit stream of high accuracy. The proposed technique uses 6 symbols instead of 4 symbols used in Shapiro's EZW algorithm. This approach can produce higher PSNR and compression ratio than EZW algorithm, without affecting the computing time. In this approach the total no of bits required is also less than EZW algorithm.[1]

G. Bhoopathi, S. Arockiasamy (2011). Proposed a technique for image compression using modified Self-Organizing Map (SOM) based vector quantization. Self-Organizing Feature Map (SOFM) algorithm is a type of neural network model which consists of one input and one output layer. Each input node is connected with output node by adaptive weights. By modifying the weights between input nodes and output nodes, SOFM generate codebook for vector quantization. If the compression is performed using Vector Quantization (VQ), then it results in enhanced performance in compression than any other existing algorithms. Vector Quantization is based on the encoding of scalar quantities. The experimental result shows that the proposed technique obtained better PSNR value and also reduces Mean Square Error.[3]

Aldjia Boucetta and Kamal Eddine Melkemi (2012). Described a color image compression technique based on Discrete Wavelet Transform (DWT) and Genetic Algorithm (GA). High degree of correlation between the RGB planes of a color image is reduced by transforming them to more suitable space by using the GA. This GA would enable us to find T1T2T3 representation, in which T1 energy is more maximized than that of T2 and T3. The result of the proposed method is compared with previous similar published methods and the former is found superior in terms of quality of the reconstructed image. Further, proposed method is efficient in compression ability and fast in implementation.[4]

Ashwaq T. Hashim, Suhad A. Ali (2016). It is concerned with the design and implementation of a compression method for color image. This method based on Differential Pulse Code Modulation (DPCM), Discrete Cosine Transform (DCT), Discrete Wavelet Transform (DWT) and Quadtree Coding Scheme. As a first step the DPCM technique is used to isolate blocks of an image into correlated and uncorrelated blocks. The isolated correlated blocks have been compressed using DCT based compression method then each block has been embedded with zeros on the original image. Each uncorrelated block has been compressed using DWT based method and put the compressed block in its location on the original image. Then, the result (i.e., the zeros blocks and compressed blocks with DWT) coded using Quadtree spatial coding. The output from DWT based and DCT based passed through shift coding stage to gain a possible further compression. The performance results of proposed hybrid algorithms produces better quality of image in terms of Peak-Signal-to-Noise Ratio (PSNR) with a higher Compression Ratio (CR) compared to standalone DCT or DWT. The PSNR values of the reconstructed images after applying proposed system are ranged from 30.62 to 40.95dB and CR on average, have been reduced to be around 1:19.6 of the size of the original image.[5]

G. Panda, Saroj K. Meher (2015) proposed a novel hybrid approach which would offer higher compression ratio than the WT alone keeping the quality of reproduced image identical in both cases. This is achieved with the incorporation of a second image compressor in sequence with WT so that the overall compression becomes better than the individual method. The second compressor used in the paper is based on Artificial Neural Network (ANN). The WT is employed to achieve the first stage of compression, which is followed, by a second stage of compression using the ANN technique. In the ANN technique both multi layered ANN (MLANN) and the radial basis function (RBF) networks have been proposed. The compression performance has been assessed in terms of peak-signal-to-noise-ratio (PSNR) and energy retained in the reconstructed image. Through computer simulation it has been demonstrated

that the combined approach offers high rate of compression maintaining identical reconstructed image quality compared to its WT counterpart.[6]

C.Vimalraj, S.Stebilin Blessia , S.Esakkirajan (2012) this scheme consists of three operations, which are the transform, quantization and entropy encoding operations. Wavelet Transform and Wavelet Packet Transform are efficient tools to represent the image. Wavelet Packet Transform is a generalization of Wavelet Transform which is more adaptive than the Wavelet Transform because it offers a rich library of bases from which the best one can be chosen for a certain class of images with a specified cost function. Wavelet Packet decomposition yields a redundant representation of the image. In this work, Singular Value Decomposition is used as a tool to select the best basis. After selecting the best tree, the coefficients of the best tree are quantized using dead zone quantization. To reduce the number of bits required to transmit the indexes of the codeword, a lossless Huffman algorithm was implemented as the final stage of the encoding process. To reconstruct the compressed image, the operations are reserved. The simulation result reveals that, the quantity of the image is good even though the compression ratio is increased due to reduction in Wavelet Packet sub-bands.[7]

U. S. Ragupathy, D. Baskar, A. Tamilarasi (2008). The wavelet based Set Partitioning In Hierarchical Trees (SPIHT) algorithm gives better compression. For best performance in image compression, wavelet transforms require filters that combine a number of desirable properties, such as orthogonality and symmetry, but they cannot simultaneously possess all of these properties. The relatively new field of multiwavelets offer more design options and can combine all desirable transform features. But there are some limitations in using the SPIHT algorithm for multiwavelet coefficients. This paper presented a new method for encoding the multiwavelet decomposed images by defining coefficients suitable for SPIHT algorithm which gives better compression performance over the existing methods in many cases.[8]

K. Kalaivani B. E, C. Thirumaraiselvi M.E, R. Sudhakar(2013). An algorithm based on Kohonen's self organizing maps is proposed in this paper for quantising the image data. This algorithm uses its roots in neural networks based on neighbourhood relationships. Wavelet transform is also a cutting edge technology in the field of image compression. This provides substantial improvement in picture quality at high compression ratios. Experimental results obtained demonstrate the effectiveness of the proposed algorithm.[9]

Murat CANAYAZ, Ali KARCI (2015). A new approach can be using at image compression process will be introduced. Firstly, image subjected to discrete wavelet transform for extracting feature. Then multi-level threshold values will be finding with Shannon entropy in the obtained image. The maximum value of objective function will be obtained with the help of cricket algorithm at the threshold values finding step. This algorithm is a meta-heuristic algorithm that based on population. The threshold values that obtained through algorithm using to compressing the images will be provided. At the end of the study, the image compression ratio, the proposed approach running on a standard test image will be given.[10]

IMAGE COMPRESSION TECHNIQUES

Digital Data Compression can also be made potential as most of the real world data is very superfluous. It is basically defined as a system that dwindle the size of data by applying unusual methods that can be either be Lossless or Lossy [11]. It is an imperative application in the areas of data transmission and data storage although the large ability storage devices are existing these days. Therefore, we need a proficient way to accumulate and broadcast dissimilar types of data such as text, image, audio and video to reduce execution time and memory size. There are two types of data compression techniques:

- Lossless Data Compression
- Lossy Data Compression

Lossless Data Compression

Lossless compression means when the data is decompressed, the result is a bit-for-bit perfect match with the original one.

The name of lossless means no data is lost, the data is only saved more efficiently in its compressed state, but nothing of it is removed [12]. Lossless data compression methods may be categorized according to the type of data they are designed to compress. Compression algorithm algorithms are basically used for compression of text, images and sound. The example of lossless compression is RLE, Predictive Coding and Multi-resolution Coding etc.

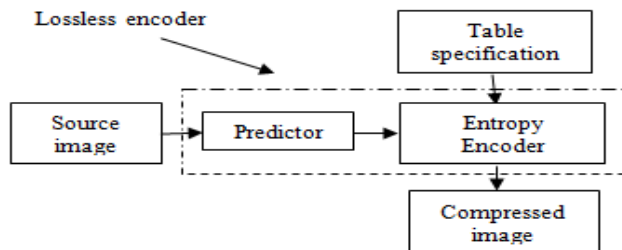


Fig.1.7: Lossless Compression[17]

Run Length Encoding

Run length coding replaces data by a (length, value) duo, where “value” is the recurring value and “length” is the quantity of repetitions. This method is especially winning in compressing bi-level images since the happening of a long run of a value is unusual in usual gray-scale images. A resolution to this is to decay the gray-scale image into bit planes and compress individual bit-plane separately. Efficient run-length coding technique is one of the variations of run length coding [13].

Predictive Coding

Lossless predictive coding (PC) predicts the value of every pixel by utilizing the values of its adjoining pixels. Consequently, each pixel is encoded with a prediction error somewhat than its actual value. Usually, the errors are a lot minor compared with the actual value so that fewer bits are obligatory to store them. DPCM (differential pulse code modulation) is a predictive coding based lossless image compression scheme. It is too the base for lossless JPEG compression. A variation of the lossless predictive coding is the adaptive prediction that divides the image into blocks and calculates the prediction coefficients separately for every block to attain high prediction performance. It can to be combined with other scheme to get a hybrid coding algorithm with superior performance.[14]

Multi-Resolution Coding

HINT (hierarchical interpolation) is a multi-resolution coding method based on sub-samplings. It begins with a low-resolution edition of the actual image, and interpolates the pixel values to consecutively generate superior resolutions. The errors among the interpolation values and the real values are stored, along with the first low-resolution image. Compression is attained since both the low-resolution image and the error values can be stored with lesser bits than the actual image. Laplacian Pyramid (LP) is an additional multiresolution image compression scheme developed by Burt and Adelson. It consecutively constructs inferior resolution editions of the actual image by down sampling so that the number of pixels reduces by a factor of two at every scale. The differences amongst consecutive resolution versions jointly with the lowest resolution image are stored and utilized to wholly reconstruct the actual image. But it cannot attain elevated compression ratio because the number of data values is improved by 4/3 of the actual image size. In general, the image is reversibly altered into a set of dissimilar resolution sub-images in multiresolution coding. Generally, it decreases the entropy of the image. Some kinds of tree representation could be worn to get more compression by exploiting the tree formation of the multiresolution methods.[14]

Lossy Data Compression

Lossy compression technique is especially suitable for natural images such as photos in application where minor loss of fidelity is acceptable. Lossy scheme is widely used must application. Fig shows the outline of lossy compression technique. Transformation is applied to the original image. The discrete wavelet transform cut the images into block of 64 pixels (8*8) and process each block independently, shifting and simplifying the colors so that there is less information to encode. Then the quantization process result in loss of information. In the quantization the value in each block are divided by a quantization coefficient.

This is the compression step where information loss occurs. Pixels are changed only in relation to the other pixel with their entropy coding is applied after quantization. The reduced coefficients are then encoded usually with entropy coding. The decoding is a reverse process. In the decoding process firstly entropy encoding is applied to compress data to get the quantized data after that dequantized is applied to it and finally the inverse transformation is applied to get the reconstructed image by this scheme the decompress image is not identical to the original image but reasonable close to it. This scheme provides much higher compression ratio than lossless scheme. There are the following major performance consideration of lossy scheme include: Compression ratio, Signal to noise ratio and Speed of encoding and decoding Lossy compression technique include following scheme such as Transformation coding, Vector Quantization, Fractal coding, Block truncation coding, Sub band coding etc.[15]

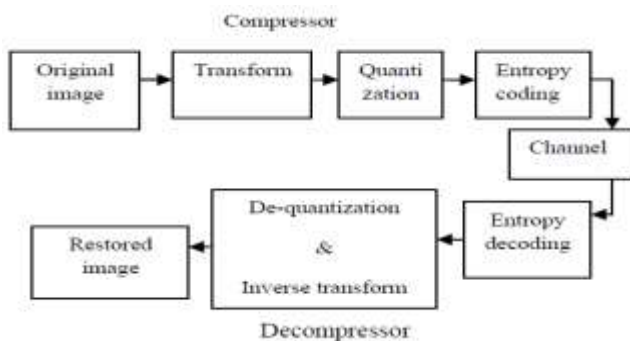


Fig. 1.8: Lossy Image compression

Transform Coding

Transformation coding (TC) is a lossy compression technique resulting in a lower quality copy of original signal. This scheme is used for „natural“ data like audio signal or biomedical image. In transformation coding less bandwidth is required. In this coding scheme transform such as DFT (discrete Fourier transform) and DCT (discrete coding transform) are used to change the pixel in the original image into frequency domain coefficients. These coefficients have several desirable properties; one is the energy compression property that results in most of the energy of the original data being concentrated in only a few of the significant coefficients are selected and remaining is discarded. The selected coefficients are further quantization and entropy encoding. DCT coding has been the most common approach to transform coding and also adopted in the JPEG image compression standard.

Vector quantization

In vector quantization (VQ) a dictionary of fixed-size vectors, is to be developed, called code vectors. A vector is usually a block of pixel values. So image is then partitioned into non-overlapping blocks (vector) called image vectors. Subsequently, for each in the dictionary is determined and its index in the dictionary is used as the encoding of the original image vector. Thus each image is represented by a sequence of indices that can be further entropy coded.

Fractal Coding

In fractal coding (FC) decompose the image into segments by using standard image processing techniques such as edge detection, color separation, and spectrum and texture analysis. Then each segment is looked up in a library of fractals. The library actually contains codes called iterated function system (IFS) codes, which are compact sets of numbers. Using a systematic procedure, a set of codes for a given image are determined, such that when the IFS codes are applied to a suitable set of image blocks yield an image that is a very close approximation of the original. This scheme is highly effective for compressing images that have good regularity and self-similarity.

Block truncation coding

The principle applied here is that the image is divided into non overlapping blocks of pixels. The mean of the pixel values in the block (threshold) and reconstruction values are determined for each block. Then a bitmap of the block is created by replacing all pixels whose values are greater than or equal (less than) to the threshold by zero or one. Then for each segment (group of 1s and 0s) in the bitmap the renovation value is strong-minded. This is the average of the values of the corresponding pixels in the original block.

Sub Band Coding

In the sub band coding the image is analyzed and find the components containing frequencies in different bands, the sub bands. Then the quantization and coding are performed for each sub-band. The main advantage of this coding is that quantization and coding for each sub-band can be designed separately.

Discrete Cosine Transform

A discrete expresses a finite sequence of data points in terms of a sum of cosine functions oscillating at different frequencies. Discrete Cosine Transform is a lossy compression technique which is widely used in area of image and audio compression. DCTs are used to convert data in the summation of series of cosine waves oscillating at different frequencies. There are very similar to Fourier Transforms, but DCT involves use of Cosine functions and real coefficients, Fourier Transforms use both sine and cosine functions are much more efficient as fewer functions are needed to approximate a signal. Both Fourier a spatial domain into a frequency domain and their respective functions converting thing back.[16]

Table 1: Advantages and Disadvantages of Compression Techniques

Methods	Advantages	Disadvantages
RLE	This technique is simple to implement and does not necessitate much CPU horsepower and also reduces the amount of hardware required.	RLE compression is only proficient with files that contain lots of repetitive data. It only support for white or black regions of image data compression.
PC	It provide effective and accurate output parameter which is efficient to operate	It makes the low bit rate speech coder a practical reality. But this model is also inaccurate in many circumstances, creating annoying artifacts.
LP	It requires less computation cost to implement it. It is efficient to compute: indeed pyramid filtering is faster than the equivalent filtering done with a fast Fourier transform. It is very fast algorithm	It provides the inherent oversampling and complex in designing
TC	This compression technique is more robust under transmission and decoding errors and also very efficient at very low bit rates. This scheme also provides higher compression avoiding blocking artifacts.	It is shift sensitivity, poor directionality and requires more storage and bandwidth.
VQ	Simple decoder No-coefficient quantization	Slow codebook generation Small bpp
FC	Good ,mathematical Encoding-frame	Slow Encoding
SBC	It is advantageous to choose the representative. It provides the shorter codeword length, even though its associated distortion might be slightly larger. Since there are more bits	it is unstructured due to this behaviour it require more time in execution and computation cost is more

	remaining, the resulting overall distortion will be smaller.	
DCT	It is real valued, battery energy compaction, and coefficient are nearly correlated.	Truncation of higher spectral coefficients results in blurring of the images, especially wherever the details are high and Coarse quantization of some of the low spectral coefficient introduces graininess in the smooth portions of the images

CONCLUSION

Image compression is the serious issue now days due to the development in multimedia technology whose image, audio/ video size of is very large. So reduction of size is very essential which reduce the storage cost and improves transmission of such data. Various techniques have been developed for the size reduction of this multimedia file format. In this, we presented the various image file format and different image compression techniques with advantage and disadvantages. Some are helpful in reducing the compression ratio but all are not much suitable in reducing the size of multimedia file and also degraded the quality of images. In future need to design hybrid compression technique which uses the effective feature of lossy and lossless compression both and comparatively reduces the huge size of multimedia file.

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Combination between Steganography and Cryptography in Information Hiding by Using Same Key

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Abstract- Steganography and cryptography are two popular ways of sending vital information in a secret way. One hides the existence of the message and the other distorts the message itself. In my algorithm I try combine between steganography and cryptography and use same key in both ways this mean the key that use in cryptography also use in steganography.

We use transportation cipher to encrypt text by using specific key and same key that using in cryptography, again use in steganography and use LSB method in steganography with key in new technique.

Keywords: Cryptography, Steganography, Information Hiding, LSB, Transposition Cipher

1-Introduction

Cryptography and steganography are well known and widely used techniques that manipulate information (messages) in order to cipher or hide their existence respectively. Steganography is the art and science of communicating in a way which hides the existence of the communication (9).

Cryptography scrambles a message so it cannot be understood; the Steganography hides the message so it cannot be seen. To enhance the embedding capacity of image steganography and provide an imperceptible stegoimage for human vision, we propose a framework for hiding large volumes of data in images by combining cryptography and steganography while incurring minimal perceptual degradation and to solve the problem of unauthorized data access (1).

Steganography also can be implemented to cryptographic data so that it increases the security of this data – the propose algorithm is a very secure technique for cryptography and the Steganography methods, which use frequency domain, are highly secured. Even if we combine these techniques straight forwardly, there is a chance that the intruder may detect the original message. Therefore, our idea is to apply both of them together with more security levels and to get a very highly secured system for data hiding.

.As we know that-

- Hiding data is better than moving it shown and encrypted.
- To hide data in a popular object that will not attract any attention.
- In case the data is extracted, it will be encrypted. But still there is a chance that the intruder can break the code (10).

So our final goal of the Algorithm is to develop a new system which is highly secured and even if somebody retrieves the message from stego image it becomes a meaningless for any existing cryptographic techniques (2).

We use transposition cryptography and LSB (least significant bits) method in hide in image in new methods to hide text in image.

In this method we first encrypt a message using transposition cipher method and then embed the encrypted message inside an image using LSB embedding method according specific key. Hiding data using LSB modification alone is not highly secure

2- Transposition Cipher

The proposed method depicts a typical cryptographic system based on classical encryption techniques i.e. substitutions and transpositions and they are regarded as building blocks for encryption (1). Transposition technique changes the order of the letters in a message [9]. Instead of replacing characters with other characters as in the case of substitution technique, this cipher just changes the order of the characters. Transposition does not alter any of the bits in the plaintext, but instant moves the position around within it (1). Letter frequencies are preserved in the cipher text. The cipher text is the disguised form of the information. Such cipher text could be transmitted across a network or stored within a file system with the objective of providing confidentiality [10]. Here the text to be encrypted is arranged in a number of columns. The message is broken in to $N \times N$ matrix.

Often the transposition method is of a geometrical nature. In this transposition cipher method, the plaintext is written row wise in a matrix of given size, but is read out column wise in a specific order depending on a key.

Key is something the sender and the recipient agree on beforehand. Key tells the size of the matrix. To encrypt plaintext the transposition cipher writes the message in a rectangle, row by row, and reads the message off, column by column, but permutes the order of the columns based on the key. Both the length of the rows and the subsequent arrangement of the columns are defined by either a keyword or numerical key. In a regular columnar transposition cipher, any extra spaces are filled with nulls and in an irregular columnar transposition cipher, the spaces are left blank.

Write the plaintext in rows of width l and read it off by columns. Take the columns in a order defined by a key. (If you take the columns in their natural order—without using a key—, then the procedure amounts to a path transposition. The Scytale corresponds to such a columnar transposition with a trivial key).

Example: $l = 5$,

Keyword = A P P L E

Key = 1 4 5 3 2

Plaintext = T H I S I

S A C O L

U M N A R

T R A N S

P O S I T

I O N

Ciphertext: TSUTPI ILRST SOANI HAMROO ICNASN.

Written in blocks of five:

TSUTP ILRS TSOAN IHAMR OOICN ASN

The legitimate receiver of the message knows the key, its length l , and the message length r ($= 28$ in the example). He calculates r/l , rounds this quotient up to the next integer m ($28/5 \rightarrow 6$), and then writes down the ciphertext in columns of length m in the order given by the key. He fills the first $r \bmod l$ ($= 3$ in the example) columns completely, and leaves blank the last positions of the remaining columns.

3. LSB Based Image Steganography

An image is the most common type of digital media used for steganography [7]. Digital images often have a large amount of redundant data and for this reason it is possible to hide message inside image file [8]. To a computer, an image is a collection of numbers that constitute different light intensities in different areas of the image. This numeric representation forms a grid and the individual points are referred to as pixels. These pixels make up the image's raster data. Image steganography is about exploiting the limited power of the human visual system (HVS) [2]. If any specific color is viewed closely it has been observed that single digit modifications to the contribution level are imperceptible to the human eye (i.e. a pixel with a value of (255, 255, 0) is indistinguishable from (254, 255, 0)) in RGB color representation.

3.2 Data Embedding Procedure

The encrypted message to be hidden is converted into its ASCII equivalent character and subsequently into binary digit. For an example if the character "t" is an encrypted character of the message then as ASCII value for "t" is 116 and binary value for it is 1110100.

As image comprises of pixel contribution from red, green and blue components and each pixel has numbers from the color components (for 24-bit bitmap image each of red, green and blue pixel has 8 bit) (3). At 8 bit of the color number, if we change least significant bits, our visual system cannot detect changes in pixel and thus it is possible to replace message bits with image pixel bit. For example if we consider the pixel value 10111011, and we want to store the information in the least significant bit, at the worst situation the pixel changes to 10111010, examinations shows that HVS cannot distinguish this alteration [5]. So we embed the encrypted data into least significant bits of color. If we change the LSB in a byte of an image, we either add or subtract one from the value it represents [6]. In order to hide the encrypted message, data is first converted into byte format and stored in a byte array. The message is embedded into the LSB position of each pixel. Suppose our original pixel has bits:

(r7 r6 r5 r4 r3 r2 r1 r0, g7 g6 g5 g4 g3 g2 g1 g0, b7 b6 b5 b4 b3 b2 b1 b0) In addition, our encrypted character (bytes) has some bits: (c7 c6 c5 c4 c3 c2 c1 c0).

Then we can place the character bits in the least significant of selected pixel, next character bits in the next lowest pixel, and so on. (r7 r6 r5 r4 r3 r2 r1 r0, g7 g6 g5 g4 g3 g2 g1 g0, b7 b6 b5 b4 b3 b2 b1 b0).

4. Proposed Method

To enhance the embedding capacity of image steganography and provide an imperceptible stego-image for human vision, we propose a framework for hiding large volumes of data in images by combining cryptography and steganography while incurring minimal perceptual degradation and to solve the problem of unauthorized data access. Steganography also can be implemented to cryptographic data so that it increases the security of this data [4].

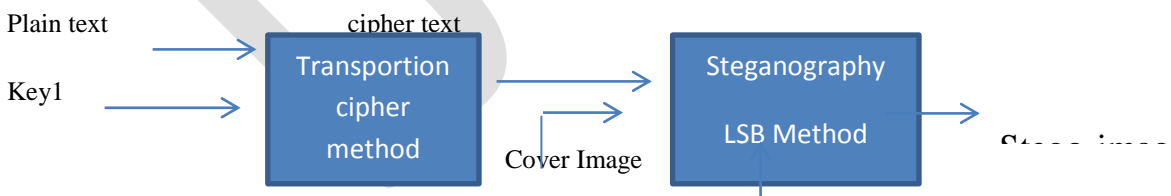


Fig1:Diagram of Proposed System

4-1. Operations of Proposed System

- 1- Chose key to encrypt plain text

- 2- Encrypt the plain text by using transportation cipher according to chosen key
- 3- Convert encrypt- text to Ascii code and then to binary
- 4- Chose the properly cover to hide encrypt text .
- 5- Start hiding crypt text in LSB in image according the key that use in transposition cipher.
- 6- If the key be for example 4512 that's mean the first bits from first character in crypto text will hide in lsb in pixel four and second bit from first character will hide in Lsb in pixel five and so on.

4-2.The algorithm of the proposed method

The following steps describe the algorithm:

Algorithm 1: Split the cover image

Input : plain text , key

Output : Array of binary code

Step1- input plain text , input key

Step2- Divide the plain text into four characters, four characters

Step3- Order of the letters in the form of a matrix divided every four letters are row

Step 4- Pull the columns matrix in accordance with the key then the encrypted text appears

Step 5- Convert the encrypted text to Ascii code then to binary code

Step6 – Save the binary code of encrypted text in array1

Step7 – Save key in array3

Step7-End

Algorithm 2: Split the cover image

Input : Image

Output : Array of binary code

Step1- Open Image (the bmp-file) Operation

This operation will open the bmp file and save header in a file and save the palette value of body in another file.

Step2- save the value of pixel palette in array2

Step3-End

Algorithm3: Hide encrypted text in the cover image

Input :Array1 , Array2 , key (array3)

Output : array4 (encrypt text binary inside palette of image)

Step1- Input key (array3), array1, array2

Step2- For I =1 to length of array1

Read Array1[I]

For j = 1 to 4

Read key (array3[j])

For m= 1 to length of array2

Read Array2[m]

$P = \text{array3}[j] * m - 2$

Array2[p] = Array[I]

Array2[p+1] = Array[I+1]

Next m

Array4[m] = Array2[m]

Next j

Next I

Step3: end

Algorithm4: Extracting the Stego-image

Input :Array4

Output : Stego-image

Step1- Input array4

Step2- back header to palette (array4)

Step3: end

5- Extracting The Plain text

5.1. Operations of Extracting

- 1- This operation will open the stego-image file and save header in a file and save the palette value of body in another file.
- 2- Save the palette in array
- 3- According to key we start extraction the encrypt text
- 4- According to same key back plain text from encrypt text.

5.2- The Algorithms of Extracting

The following steps describe the algorithm:

Algorithm 1: split stego-Image

Input : Stego-image

Output : Array of binary code

step1- Open the stego-image file by reading the header and getting the palette of the file

Step2- Save palette in array5

Step3- end

Algorithm 2: extraction plain text

Input : Array5, key

Output : Plain text

step1- For I =1 to length of array4

 Read Array5[I]

 For j = 1 to 4

 Read key (array3[j])

$P = \text{array3}[j] * i - 2$

$\text{Array6}[p] = \text{Array5}[I]$

$\text{Array6}[p+1] = \text{Array}[I+1]$

Next j

Next I

Step 2 – Save array6 to file

Step3 – covert file to Ascii and the to characters

Step 4 – according to key rearrange the characters

Step5- print the plain text

Step6- end

Conclusion

Although its simplicity, but its implementation is not easy, and breaking it is very difficult due to the use of the key in the hiding in LSB.

- In the proposed algorithm, we use the key in cryptography and then use same key in steganography a smart way cannot be expected.
- Combination of cryptography and steganography give great strength to the algorithm against breakage, even if one of them break is difficult to break the other.
- The proposed system proved to be easy to use and efficient in terms security and help to save secret text.

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ECOFRESH: FOR BETTER INDOOR AIR QUALITY

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Abstract- People are more bothered about outdoor pollution and remaining inside the buildings gives them a false sense of security because a growing body of scientific evidence proves that the air within our air-conditioned workspaces can be more seriously polluted than the outdoor air even in the largest and most industrialized cities. Research shows that people spend 80% to 90% of their time indoors. Research also indicates about the detrimental effects of poor indoor environment on the productivity of an office and on the health of its occupants. Thus, for most people health problems may be more due to indoor air pollution rather than outdoors. This paper deals with the indoor air quality, its causes and the efforts made to revive the standards as required for a person. This paper highlights about the device made called ECO-FRESHENER and its testing under normal outdoor conditions. Result shows of 83.02% as air supply efficiency and 84.32% as exhaust air efficiency with 1.157 ton of refrigeration (TR). Total operating cost of the eco-freshener in one month (8 hours a day) comes out to be Rs. 532.44. It reduces the size of air conditioning systems used in hotels, supermarkets, offices etc. and saves the energy cost as well.

Key words: IAQ, enthalpy recovery wheel, Eco fresh, cmm, HVAC, Tonnage, Supply air efficiency,

1. INTRODUCTION

The very fast rate of development in urban areas and industry over the last few decades has led to the rise of countless buildings. These buildings, houses, numerous offices, educational institutions, shopping complexes, hospitals, hotels, theaters etc. are largely air conditioned. Unknowingly, these structures of stone and cement have become an integral part of our lives, as we spend the greater portion of our productive hours within the four walls of 'closed' space.

Air conditioned buildings create an environment inside the closed space. The technocrats are satisfied after getting control over temperature, humidity and maintenance of ventilation (sufficient to overcome human odor). But what is the reason behind these astounding findings? Why our places of work proving to be health hazards? The answer is INDOOR AIR POLLUTION which in turn leads to poor INDOOR AIR QUALITY (IAQ i.e. the nature of the air that circulates within the areas where we work) [1, 2, and 3].

2. INDOOR AIR QUALITY

Pure air comprises of oxygen, carbon dioxide, nitrogen and water. All these components together help in the perpetuation of life on earth. Besides these other substances also occupy space in air due to both natural processes and human activities such as pollen, fungal spores, bacteria, viruses, dust particles and gasses from combustion processes (i.e. smoking and others). The type and proportion of substances may vary in the air over time and from place to place. In heart patients, it causes chest pain. At high levels, it results in impaired vision and co-ordination, headaches, dizziness, confusion, nausea and respiratory irritation. These symptoms disappear with the removal of the source.

Growing concern for the deteriorating indoor air quality and extravagant energy cost has forced ASHRAE to revise standards [4, 6, 7 and 12] for IAQ. In 1983 it laid down 5cfm (cubic feet per minute) of fresh air intake per person as its standard. This standard was

revised due to decrease in indoor air quality. The current ASHRAE STD. (standard 62-1989) for ventilation is a minimum of 15cfm to 20cfm of fresh air intake per person in a conditioned room. But what measures are being taken to follow and maintain this standard? Do we really believe that the ventilation system fitted in the air-conditioners is sufficient to control indoor air pollution and maintain a good IAQ? How can we provide for a better IAQ without increasing energy costs? These are some of the questions which will be discussed here.

3. CAUSES FOR POOR IAQ

Following factors have been identified:

- (a) Presence of indoor air pollution sources materials which are supposed to be essential requirements for an office, create inside air pollution. Depending upon the type of substance, its exposure time and concentration the effect (long or short term) may be felt by individuals. Short term effects include phellmonia, respiratory infections and allergic asthma. Long term effects of indoor air pollution include cancer, birth defects, immunological problems, nerve damage. Asbestos is one of them which is widely used as roofing material, floors and tiles. After getting damaged or disintegrated, its microscopic fibers are released into the indoor air causing long term effects such as chest and abdominal cancer and lung infections. Smokers are at a greater risk of developing asbestos.
- (b) Poorly designed and maintained ventilation systems:

Proper circulation of fresh air from outside to inside and polluted air from inside to outside makes the room as a cool environment and pollution free.

In normal working of window air- conditioning which is designed for minimum or no fresh air intake, the inside air gets laden with hazardous pollutants which play with the occupant's health. The growing concern for the deteriorating indoor air quality and extravagant energy costs has forced ASHRAE to revise standards for IAQ.

IAQ Enhancers

Source control:

Source control eliminates air pollutants before they enter inside our air-conditioned space. Although source control is the most effective way of dealing with an air quality problem, it's usually not the cheapest way and it's often impractical.

Filtration:

Air filters and air cleaners actually remove particulates found in our indoor air.

Central system air- filters or air- cleaners are installed in return air duct work, just ahead of the heating and cooling equipment. Whenever the blower motor runs, dirty air is pulled into the return air ducts and passes through the air cleaner before it's heated or cooled. In the process, a portion of airborne particulates is removed.

Ventilation/Dilution:

Sometimes it's not enough to simply clean the indoor air. If the air-conditioned space is well insulated, we need to replace the stale air inside with fresh air.

Today, new buildings are built energy-tight out of necessity. Many are sealed up to save on energy costs, with one air exchange in ten hours not uncommon. The result is greatly reduced the air exchange, stale air and humidity trapped inside. In the optimum health range of 40 to 50 percent relative humidity, bacteria and fungi are eliminated and viruses, dust mites, respiratory infections,

allergic reactions and asthma are significantly reduced. Optimum humidity levels also go a long way towards reducing the effects of various chemical interactions.

The ventilation system extracts stale air from indoor spaces and replaces it with fresh outdoor air. In the process, it recovers most of the energy used to heat or cool the air being exhausted. Combined with an efficient air cleaner, it's an excellent way to ensure a continuous supply of fresh and clean indoor air.

4. ENERGY RECOVERY PROCESS

Two types of energy recovery systems are available:

- (a) Sensible energy recovery.
- (b) Total energy (enthalpy) recovery

Sensible Energy:

In this process, only sensible heat is removed. Two different streams of air are passed through an air to air heat exchanger. Due to temperature difference the heat flows from hotter air to cooler air. The heat transferred depends upon the effectiveness/efficiency of the heat exchanger.

Enthalpy recovery:

In this process, total energy transfer takes place. Generally, a rotating wheel is used. One stream of air passes through one half of the wheel and other stream passes through another half.

Process happens in two stages. Sensible heat is transferred through metallic substrata and latent heat by condensation of moisture on an adsorbing media. The heat transfer depends upon the effectiveness/ efficiency of the heat exchanger.

5. RECOVERY DEVICES

ASHRAE equipment handbooks refer to six types of air to air heat exchange devices. Distinction is made between the sensible heat only and the total heat exchangers. These devices are given as below:

1. Rotary energy exchangers
2. Coil energy recovery loop
3. Twin-tower enthalpy recovery loop
4. Heat pipe heat exchangers
5. Fixed pipe heat exchangers
6. Thermosyphon heat exchangers.

Because of their ability to transfer both sensible and latent heat, the enthalpy devices are more effective in energy recovery. It is found that under summer design conditions, the total heat device typically recovers nearly three times as much energy as the sensible heat device. Under winter conditions, it recovers over 25% more.

After getting compared, it is found that the enthalpy wheel has the highest effectiveness and the least pressure drop at any face velocity. In other enthalpy device, the twin tower loop- has the highest pressure drop for the same effectiveness. Since it uses a liquid heat transfer medium (a halogen salt solution, usually lithium chloride) velocities need to be kept low, usually below 400 fpm, and the equipment tends to be large and cumbersome. The technology has therefore, gone into disuse, leaving the enthalpy wheel as the most appropriate choice for energy recovery in comfort ventilation. This paper deals with the details of enthalpy wheel.

Enthalpy wheel

Fig. 1(a), (b) shows the photograph of the experimental setup of the eco-freshener used, Fig.2 gives the structural diagram of enthalpy wheel which is usually 10 to 25 cm deep packed with a heat transfer medium that has numerous small air passages, or flutes which are parallel to the direction of air flow. The flutes are triangular or semi-circular in cross section. The structure, commonly referred to as the honeycomb matrix, is produced by interleaving flat and corrugated layers of a high conductivity material, usually aluminium, surfaced with a desiccant. Stainless steel, ceramic, and synthetic materials may be used, instead of aluminium, in specific applications. The flutes in most wheels' measure between 1.5 mm to 2.0 mm in height. The surface area exposed to air flow in a wheel lies between 1570 to 3150 sq.m/cu.m depending on configuration. In a typical installation as shown in Fig.1, the wheel is positioned in a duct system such that it is divided into two sections. The eco-freshener with wheel can be mounted either on ceiling or on wall. Its principle of operation is shown in Fig3.

Pore openings in this sieve allow only molecules smaller than 3A in diameter, 5000 times smaller than that of a human air, to pass into the fresh air supply. Water molecules 2.8A in diameter, can enter and exit the sieve, but pollutants larger in size are excluded. Only eco-fresh provides strict separation of the air flows, preventing carry-over of bacteria and dust particles from the exhaust air of the supply side. Purge section and labyrinth sealing system combine to limit cross contamination to 0.04% of the exhaust air by volume.

6. APPLICATION

Enthalpy wheels integrated commonly to recover energy and cut down size of air-conditioning systems in hotels, auditoriums, super markets etc., are generally avoided while designing systems for hospitals of both problems i.e. due to fear of cross contamination and bacterial carryover.

Eco-freshener reduces the energy required to heat, cool, humidify or dehumidify the air by as much as 90%. Its design reduces the operating cost of the UVAC system to the extent that initial investment is typically returned in energy cost savings in about 6 months existing system.

Specification of ecofreshener

1. Blower motor- power 75w, speed=1350 rpm-02 Nos.
2. Heat recovery wheel-U-150D-01 No.
3. Filters-16x6x2 - 02 Nos.
4. HRW motor-power 5KW , speed=1400rpm-01 No.
5. Blowers-150mm dia-02 Nos.

7. OBSERVATIONS

1. Supply Room Conditions

DBT: 27 ° C

WBT: 21.67 ° C

AH: 207.23 gm /Kg

2. Exhaust Room Condition

DBT: 29° C

WBT: 23.33° C

AH: 268.95 gm/ Kg

Supply Air Cut-out = 10.16 X 15.24 Cm

$$= 154.83 \text{ Sq. Cm}$$

Velocity from Blower = 5.28 m/s

CMM = Area x Velocity

$$= 154.83 \times 10^{-4} \times 5.28 = 0.08175 \text{ m}^3/\text{s}$$

$$= 4.905 \text{ m}^3/\text{min}$$

Exhaust air cut –out = 30.48 x 5.08 cm

$$= 154.83 \text{ Sq. Cm}$$

Velocity from Blower = 5.28 m/s

CMM = Area x Velocity

$$= 154.83 \times 10^{-4} \times 5.28$$

$$= 0.08175 \text{ m}^3/\text{s}$$

$$= 4.905 \text{ m}^3/\text{min}$$

8. EFFICIENCY CALCULATIONS FOR HEAT RECOVERY WHEEL (HRW)

A) Supply Air Efficiency

SAE = [Supply air CMM (enthalpy difference) x 100] / [Exhaust air CMM (enthalpy difference)]

$$= [4.905 (95.249 - 74.432) \times 100] / [4.905 \times (95.249 - 70.175)]$$

$$= \underline{83.02 \%}$$

B) Exhaust Air Efficiency,

$$\begin{aligned} \text{EAE} &= [\text{supply air CMM (enthalpy difference)} \times 100] / [\text{Exhaust air CMM (enthalpy difference)}] \\ &= [4.905(91.318 - 70.175) \times 100] / [4.905(95.249 - 70.175)] \\ &= \underline{84.32 \%} \end{aligned}$$

9. TONNAGE REQUIRED FOR COOLING THE 4.90 CMM (Ambient Air) THROUGH SPLIT CONDITIONER

Temperature of outside air = 35 ° C at 253.5 gm / Kg

Enthalpy = 95.249 KJ /Kg (From psychometric chart)

If we cool air through split A/C dew point, is 12. 22°C. At this temperature

Enthalpy of cold air is 52.290 KJ / Kg.

Tonnage required for 4.905 CMM {i.e. 4.905×1.2 (standard value of density of air in kg/m^3)}

$$= [(95.249 - 52.290) \times 4.905 \times 1.2] / 210 = 1.204 \text{ TR}$$

NOTE: To cool the 4.905 CMM fresh air tonnage required is

$$= 1.204 \text{ TR}$$

Therefore, the operating cost of the compressor is as follow:

$$\text{Total tonnage required} = 1.204 \times 3.5$$

$$= 4.214 \text{ KJ/sec}$$

So, Cost = 4.214 x 4.5 (where Rs.4.5 is the unit rate of electricity bill)

$$= 18.96 \text{ Rs.KW /hr. say Rs.19 KW/hr.}$$

For 08 working hours = 19x8

$$= 152 \text{ Rs. /Day}$$

For 01 month = 4560 Rs.

10. OPERATING COST TO COOL 4.905 CMM THROUGH ECOFRESH HEAT RECOVERY WHEEL (HRW)

Supply motor-1/4 H.P = 0.1865 KW

Exhaust motor-1/4 H.P = 0.1865 KW

Bed motor -120 W = 0.12 KW

$$\text{TOTAL KW} = 0.373 + 0.12$$

$$= 0.493$$

To operate through the system for 01 hour

$$= 0.493 \times 4.5$$

$$= 2.2185 \text{ Rs.}$$

For 08 hours $= 2.2185 \times 8$

$$= 17.748 \text{ Rs. /Day}$$

For 01 month $= 17.748 \times 30$

$$= 532.44 \text{ Rs.}$$

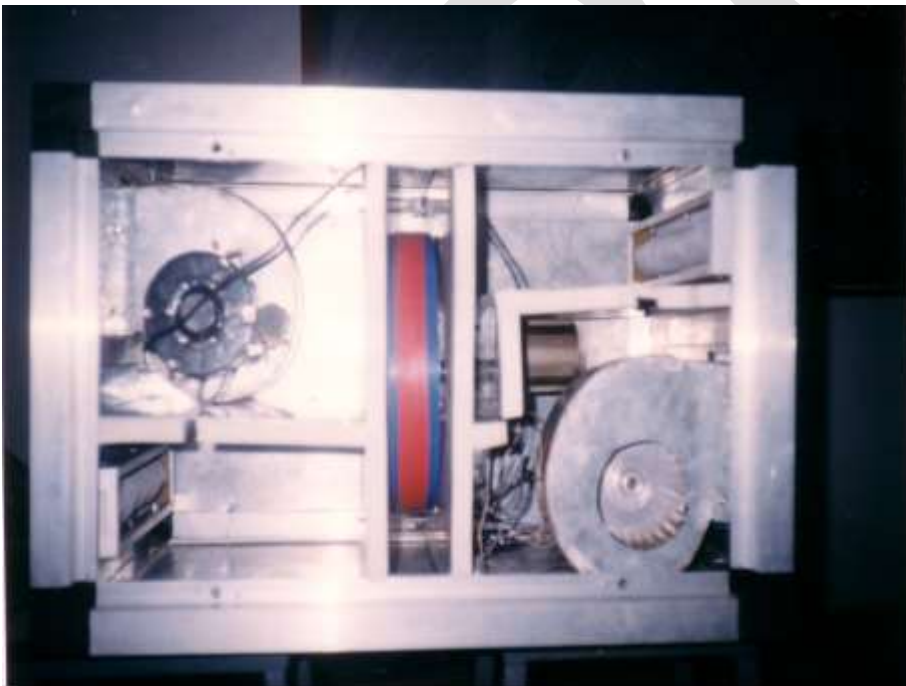
Total electricity bill required to cool 4,905 cmm for 01 month is Rs. 532.44

11. CONCLUSION

With increased concern for IAQ and the consequent need to take more fresh air in, energy recovery from exhaust has become an important area of attention in HVAC. Among recovery devices, the enthalpy wheel is the most effective and energy saving, particularly in tropical climates, can be substantial. Recent development in the wheel technology has minimized the risks of cross contamination and has made them safe for use in critical application. A wheel has to be evaluated for many considerations other than just its effectiveness and pressure drop. The wheel seal is structurally rigid with minimum deflection under the air pressures of the system. The sealing and purging arrangements must be effective. The type of desiccant used may also be critical in many applications. Exhaust air energy recovery technology provides a valuable opportunity for engineers to reduce the first costs and operating costs of buildings. Owners benefit not only in these initial and annual savings, but may also receive incentives for operating a “green” building in some areas. Use of energy recovery reduces the use of non-renewable resources and promotes a cleaner environment. Therefore, whether mandated by state or local building codes, or not, proper application of energy recovery wheels and heat recovery in general is a win-win proposition. And finally, the cost of installing a wheel must be justified by savings.

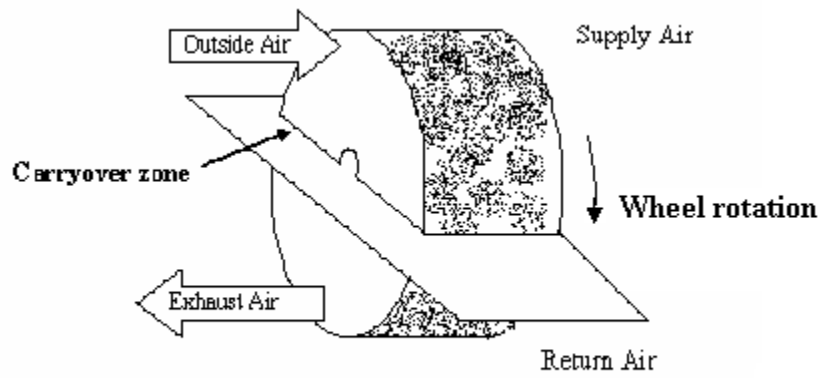


(a)

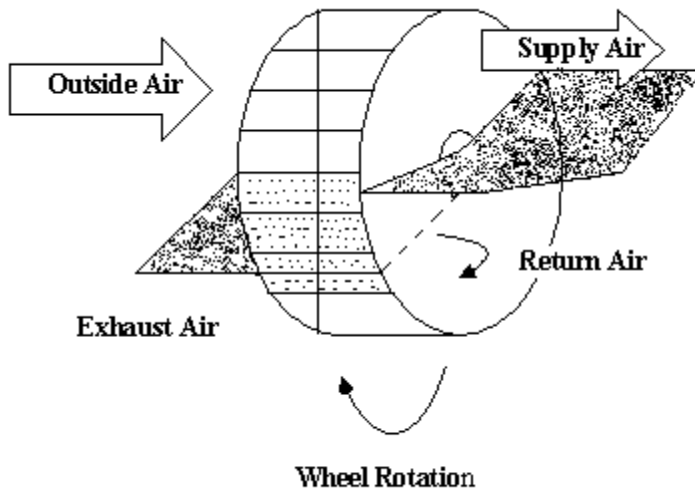


(b)

Fig. 1 (a),(b) - Experimental set- up of ecofreshner



(a)



(b)

Fig. 2 (a) , (b) - Structural diagram of recovery wheel with purge section

Exhaust Air

Return Air

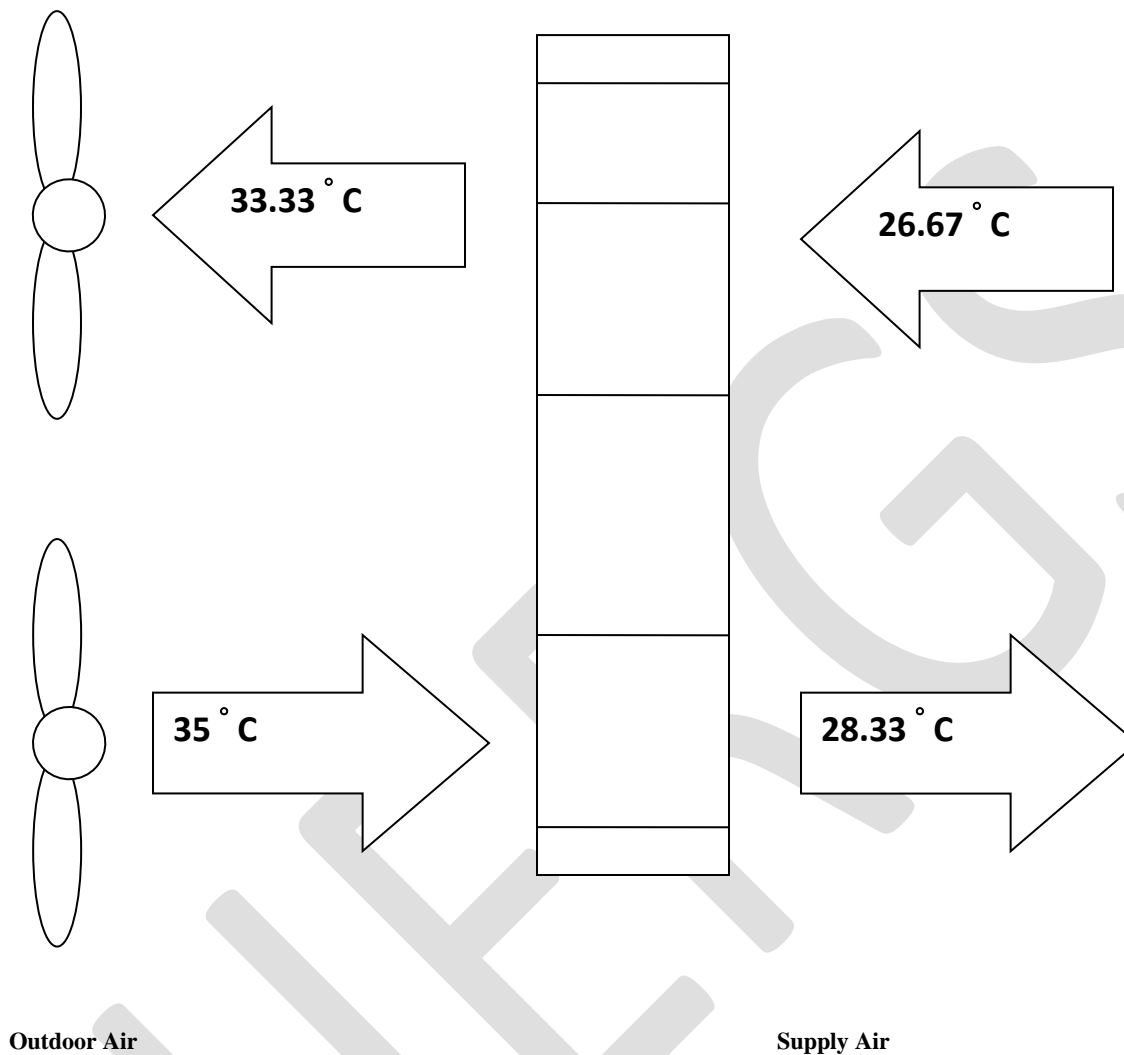


Fig. 3: Principle of operation of recovery wheel

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Forensic Discrimination of Voices using Multi-Speech Techniques

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ABSTRACT: Physiological and behavioral characteristics of voice help us to discriminate one voice from another. Uniqueness in the resonant frequencies proves that voice is unique. It has always been challenging to distinguish voices of same loudness and same pitch. In this paper, voice comparison is made on the basis of Spectrographic analysis using Multi-Speech. This technique uses Linear Predictive Coding and accordingly the formant frequencies are compared. The comparison is made purely on the basis of matching of formant frequencies of vowels.

Keywords: Forensic Science, Speech analysis, Voice analysis, Sound, Resonant frequency, Formant.

INTRODUCTION

Forensic Science Laboratory, Mumbai receives number of cases for voice analysis. **We get audio recordings in two different sets, one which is recorded at the time of crime scene and the other which is taken by police from suspects. Generally recording were provided in cases such as** bribery, obscene telephone calls, kidnapping for ransom, , bomb threat calls, call girl rackets terrorist to claim credit for a terrorist action, false telephonic message etc. It becomes difficult to distinguish speakers of same loudness and pitch.

The auditory analysis (Critical Listening) and the spectrographic analysis of two sets of audio recordings are conducted to identify the similarity or dissimilarity between the voices.

In this paper, four speakers are considered to demonstrate voice recognition and to distinguish speakers of same loudness. The study begins with following steps.

RELATED WORK

To provide the solution for the above problem there are different methodologies suggested by various people we are going to discuss some of them below.

M. Yuan, T. Lee, P. C. Ching, and Y. Zhu[1] Propose a paper Speech recognition on DSP: Issues on computational efficiency and performance analysis. In this paper provides a thorough description of the implementation of automatic speech recognition (ASR) algorithms on a fixed-point digital signal processor (DSP). It is intended to serve as a useful self-contained reference for DSP engineers to follow when developing similar applications. It is based a detailed analysis of hidden Markov model (HMM) based ASR algorithms. The computationally critical steps are clearly identified, and for each of them, different ways of optimization for real-time computation are suggested and evaluated. The trade-off among computational efficiency, memory requirements and recognition performance is illustrated quantitatively via three example systems, one for the recognition of isolated Chinese words and the other two for the recognition of English and Chinese digit strings, respectively. The paper also discusses about other techniques that can be implemented to further improve the recognition performance in real-world applications.

B.Burchard., R. Roemer, and O. Fox[2] publish a Paper on A single chip phoneme based HMM speech recognition system for consumer applications which describes a phoneme based HMM speech recognition system for use in localized and mobile consumer appliances. Unlike other systems this combined hardware/software approach does not need external components like memories etc. It is a real time application system.

Chadawan I., Siwat S. and Thaweesak Y.[4] Proposes a system Speech Recognition using MFCC which describes an approach of speech recognition by using the Mel-Scale Frequency Cepstral Coefficients (MFCC) extracted from speech signal of spoken words. Principal Component Analysis is employed as the supplement in feature dimensional reduction state, prior to training and testing

speech samples via Maximum Likelihood Classifier (ML) and Support Vector Machine (SVM). Based on experimental database of total 40 times of speaking words collected under acoustically controlled room, the sixteen-ordered MFCC extracts have shown the improvement in recognition rates significantly when training the SVM with more MFCC samples by randomly selected from database, compared with the ML.

Partly motivated by the above work U. C. Pazhayaveetil [5] proposes Hardware implementation of a low power speech recognition system. In this paper presents the design, simulation and measurement results of a Hidden Markov Model (HMM) based isolated word recognizer IC with double mixtures. Table look-up technique is employed in this design. The chip operates at 20 MHz at 3.3 V. The recognition time is 0.5 s for a 50-word speech library. The speech IC has been verified with 467 test speech data and the recognition accuracy is 93.8%. A reference software recognizer using the same algorithm and speech library has a recognition accuracy of 94.2%. The new speech IC that uses a table look up to reduce the complexity of the circuit has approximately the same recognition accuracy as an ideal software recognizer.

P. Li and H. Tang[6] Proposes a Design a co-processor for output probability Calculation in speech recognition CHMM (Continuous Hidden Markov Model) based speech recognition algorithm, Output Probability Calculation (OPC) is the most computation-intensive part. To reduce power consumption and design cost, this paper presents a custom-designed co-processor to implement OPC. The standard SRAM interface of the co-processor allows it to be controlled by various micro-controllers. The co-processor has been implemented in standard-cell based approach and manufactured in 0.18 μ m UMC technology. Tested with a 358-state 3-mixture 27-feature 800-word HMM, the co-processor operates at 10MHz to meet real-time requirement. The power consumption of this co-processor is 1.6mW, and the die size is 1.18mm².

MATERIALS AND METHODS

The following procedures are used for voice analysis.

A) Critical Listening: This is the first step performed to assess and describe the general impression of voices to be compared: loud, dull, deep, distinct, bright, hoarse, monotonous, strong, constrained, casual, snuffling, uneducated, etc. The observation is made based on above characteristics and is noted in the observation sheet.

B) Segregation of Voice Samples: Audio recording which was taken from police contained more than two speakers namely complainant, suspects, witnesses. It was essential to separate out the audio of different speakers. The segregated recording of four speakers is taken for this study and is shown in fig 1.

C) Noise reduction: The segregated samples are then filtered with band pass filtering techniques having pass band of 400Hz to 4000Hz. This step is very important as background noise is minimized to great extent.

D) Spectrographic test using Multi-Speech: Spectrographic test is conducted for detailed examination of resonances. Thus the third step of voice analysis performed is spectrographic test. The spectrographic test is divided in three parts: a) Amplitude vs. Time analysis (waveform analysis) b) Frequency vs. Time analysis (formant analysis) c) Energy vs. Frequency (LPC analysis).



Amplitude vs. time of Speaker I Amplitude vs. time of Speaker II Amplitude vs. time of Speaker III Amplitude vs. time of Speaker IV

Fig 1 Segregated speech of four Speakers (waveform pattern)

Using multi speech, spectrographs of Speaker I, Speaker II, Speaker III and Speaker IV are produced (see Fig 2 and Fig 3). The formant frequencies (see table 2 and table 3) are then noted and voices are compared. The voice comparison is made based on the matching of formant frequencies.

A SPECTROGRAPHIC RESULT (SEE FIG 2) OF SPEAKER I AND SPEAKER II SHOWS THE SIMILARITY BETWEEN THEIR VOICES AS THE FORMANT FREQUENCIES ARE MATCHING (SEE TABLE 2).

Word: /JaUdhar/

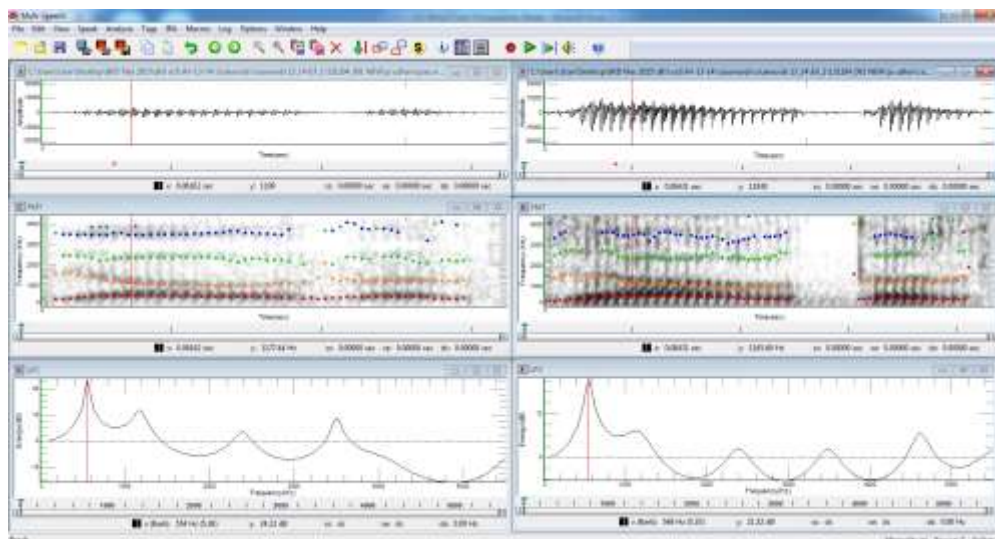


Fig 2: Spectrographic results showing similarities in speech data of speaker I (left side) and speaker 2 (right side) based on formants matching, f1, f2, f3, f4.(Analyzed in Tape Authentication and Speaker Identification Division, Forensic Science Laboratory, Mumbai, Maharashtra State)

Also the following spectrographic result (see fig 3) of speaker 3 and speaker 4 shows the dissimilarity between their voices as the formant frequencies are not matching.(see table 3).

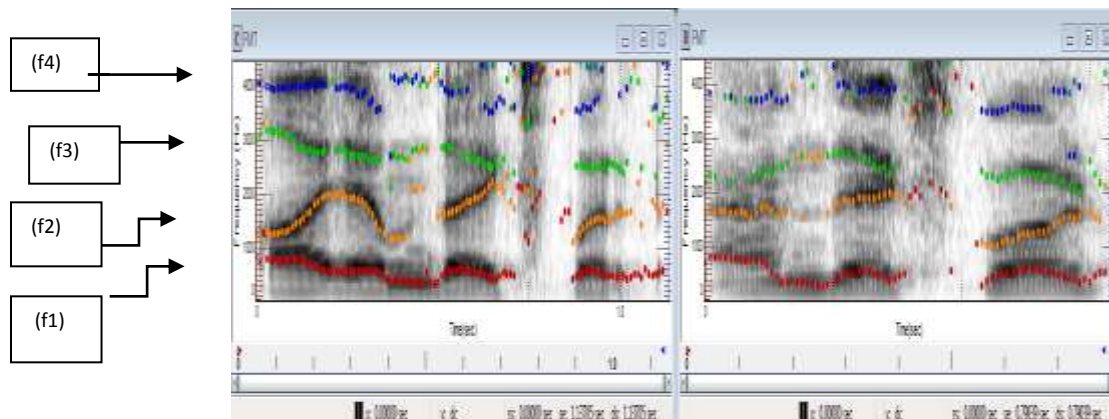
Word: *I am the expert*



Amplitude vs. time of speaker3 Amplitude vs. time of speaker 4

Fig. b

Figure 3: Spectrographic results showing dissimilarities between speaker 3(left side) and speaker 4 (right side)**a)** waveform pattern **b)** Formant pattern (f1), (f2), (f3), (f4).(Analysed in Tape Authentication & Speaker Identification Division, Forensic Science Laboratory, Mumbai, Maharashtra state.)



The analysis is done with following configuration.

TABLE 1
FORMANT ANALYSIS CONFIGURATION

Analysis	Framing	Display	Colour
Filter order: 12	Frame Length: 25msec	Frequency display: Linear	F1: Red
Pre-emphasis: 0.900 Range(0-1.5)	Frame Advance: 5msec	Formants with bandwidth <500Hz	F2: Orange
Analysis method: Autocorrelation	-	Only voiced frames	F3: Green
Window Weighting: Blackman	-	% Nyquist: 0 to 80 %	F4: Blue

OBSERVATIONS

In the auditory analysis, it is observed that the sounds produced by speaker 1 and speaker 2 have low loudness whereas those of speaker 3 and speaker 4 have high loudness. Also the speakers 1 and 2 are quite uneducated whereas speaker 3 and 4 are educated.

The voice comparison can also be made based on waveform pattern (see fig 1) and formant pattern (see fig 2 and fig 3). The formant frequency pattern f2 of speaker 3 is curved (see fig3) and that of speaker 4 is flattened. It shows that two speakers are different. Also formant frequency pattern f1 and f2 of speaker 1 and speaker 2 are similar. It shows that two speakers are same. Hence speakers of same loudness can be distinguished based on formant pattern.

RESULTS & DISCUSSION

The formant frequencies have been observed and also the bandwidth is noted. The formant frequencies of speaker 1 and speaker 2 are shown below.

TABLE 2 : LPC RESULTS

Speaker 1		Speaker 2	
Formants (Hz)	Bandwidth (Hz)	Formants (Hz)	Bandwidth (Hz)
554.82	28.50	548.30	68.14
1177.10	125.49	1165.58	307.88
2380.77	178.72	2380.85	276.04
3494.28	89.64	3472.17	267.71
4033.24	592.82	4594.72	193.13

The formant frequencies of speaker 1 and speaker 2 are matching with following tolerance band. (f1)-10Hz, (f2)-20Hz, (f3)-40Hz, (f4)-80Hz. Hence two speakers are similar. The formant frequencies of speaker 3 and speaker 4 are shown below.

TABLE 3 : LPC RESULTS

Speaker 3		Speaker 4	
Formants (Hz)	Bandwidth (Hz)	Formants (Hz)	Bandwidth (Hz)
664.03	71.03	820.83	123.06
1493.76	3662.21	1666.96	152.40
1854.88	66.98	2231.01	649.52
2773.79	91.75	3816.25	407.35
4009.99	71.61	4829.88	232.77

The formant frequencies of speaker 3 and speaker 4 are not matching. Hence two speakers are different (Not Similar).

Thus, two musical sounds may differ from one another in three ways. They may differ in loudness, pitch and quality or timbre.

A) Loudness: Loudness is the characteristic by virtue of which we distinguish two sounds of same frequency. It depends upon the intensity of vibration. The energy of particle performing vibrations is proportional to the square of amplitude and frequency ($E \propto A^2 n^2$). Hence for given frequency, intensity depends upon the square of the amplitude of vibration. Thus it shows that greater is the extent of vibration i.e. amplitude, the louder is the sound it gives out. As the sound propagates through medium, there is a decrease in the amplitude i.e. sound becomes less loud. It also depends upon the following factors: i) the density of air. ii) The velocity and direction of wind. iii) The sensitivity of the ear, as the sensitiveness varies with pitch. iv) Loudness decreases with distance. v) Loudness can be increased by resonance in the presence of sounding resonators or boxes.

B) Pitch: Pitch of note is the characteristic that differentiates the notes. Pitch of note is the frequency of vibrations of the source and is equal to the number of vibrations performed by the source per second.

The greater is the frequency, the higher is the pitch and when the pitch is higher, the sound is said to be shrill. Notes of lower pitch are flat. Male voice is flat while that of female is shrill on account of higher pitch.

C) Quality or timbre: It is the characteristic that distinguishes two sounds of same pitch and loudness.

CONCLUSIONS

Thus we can compare voices of two unknown speakers using Multi speech techniques. Two musical sounds may differ from one another in three ways namely loudness, pitch and quality or timbre. Two speakers can speak with same loudness and pitch but the third characteristic of sound i.e. The formant frequency plays very important role in distinguishing human voice.

ACKNOWLEDGEMENT

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DISPERSION COMPENSATION IN OFC USING FBG

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Abstract: The process of communicating using fiber optics involves the following basic steps: The optical signal is created using a transmitter, the signal is relayed along the fiber, the signal is ensured that it does not become too distorted or weak, the optical signal is received and converting it into an electrical signal. The chromatic dispersion in optical fiber is a phenomenon caused by the different wavelengths which depends on its group refractive index which causes Pulse broadening as they propagate in OFC. Though EDFAs (Erbium doped fiber amplifiers) compensate the transmission losses, Chromatic dispersion is not compensated using EDFAs. One of the applicable and important components in optical communication system is Fiber Bragg Grating (FBG). For different lengths of grating, Chirped FBG is studied as a dispersion compensator in any optical communication system. The simulator used is OPTISYSTEM 7.0 simulation software. All the simulations are done in OPTISYSTEM 7.0 at 10 Gbits/sec and 210 km of transmission fiber. The simulated transmission system has been analyzed on the basis of different parameters such as BER, Q-factor, Output power, Gain, Noise Figure and Eye height.

Keywords: Fiber Bragg Grating (FBG), BER, eye diagram, Q-factor, EDFA, Dispersion, Gain, ISI.

1. INTRODUCTION:

Fiber optic communication is a method of transmitting information from one place to another by sending light through an optical fiber. The optical fiber is always used in telecommunication system because of its characteristics which include small size or dimension, low loss and low interferences from outside environment. The light forms an electromagnetic carrier wave that is modulated to carry information. The basic optical communication system consists of three elements which are light source that convert electrical signal into optical signal, optical fiber which acts as a transmission medium and photo detector or light detector that converts the optical signal into electrical signal at the receiver side[1]. The goal of every communication system is to increase the transmission distance and speed. Like other communication systems the optical communication systems also faces problems such as dispersion, attenuation, losses which degrade its performance. Among them the dispersion affects the system most and it is difficult to overcome as compared to other losses. Thus it is important to incorporate an effective dispersion compensation technique[4] in optical communication systems that lead to performance enhancement of the transmission system.

The optical amplifiers (EDFA) have resolved the problem of optical fiber losses and made the long distance transmission possible without electronic regenerators but the dispersion is not compensated. Dispersion is defined as the pulse spreading in an optical fiber. When different wavelengths of light pulses are launched into the optical fiber, these pulses travelled with different speeds due to the variation of refractive index with wavelengths. The light pulses tend to spread out in time domain after travelling some distance in fiber and this is continued throughout the fiber length. This phenomenon is known as dispersion. Since each pulse spreads and overlap with its neighbouring pulse, becoming indistinguishable at the receiver end[7]. This effect is known as inter symbol interference (ISI). Dispersion limits the information carrying capacity at high transmission speeds, reduces the effective bandwidth and increases the bit error rate (BER). In single mode fiber (SMF), the performance is primarily limited by chromatic dispersion (CD) and polarization mode dispersion (PMD). CD occurs because of the wavelength dependency of refractive index of fiber and the fiber has some inherent properties like birefringence that lead to PMD. In order to improve the overall system performance affected by dispersion, FBG dispersion compensation technique is proposed and analyzed[8].

2. FIBER BRAGG GRATING (FBG) OPERATION

Principle: One of the most advanced techniques being used in the dispersion compensation methods is FBG. FBG is a piece of optical fiber with the periodic variation of refractive index along the fiber axis. This phase grating acts like a band rejection filter reflecting wavelengths that satisfy the Bragg condition and transmitting the other wavelengths[2]. The reflected wavelength changes with grating period. Thus, FBG is very simple and low cost filter for wavelength selection that improves the quality and reduces the costs in optical networks. The equation relating the grating periodicity, Bragg wavelength and effective refractive index of the transmission medium is given by:

$$\lambda_B = 2n\gamma \quad \text{----- (1)}$$

In this equation, λ_B , n and Λ are the bragg wavelength, refractive index of core and grating period respectively.

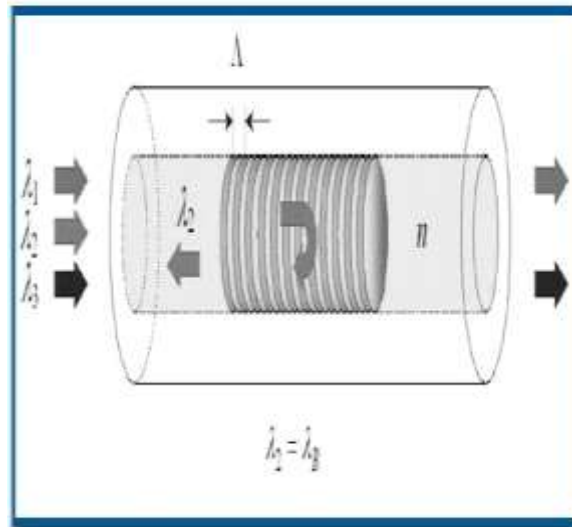


Fig 1: Principle of Uniform FBG

A chirp is variations in the grating period created along the FBG. As shown in Fig.2 when a signal enters into chirp, different wavelengths are reflected from different parts of grating. Thus, a delay related to the wavelength of the signal is produced by grating[3].

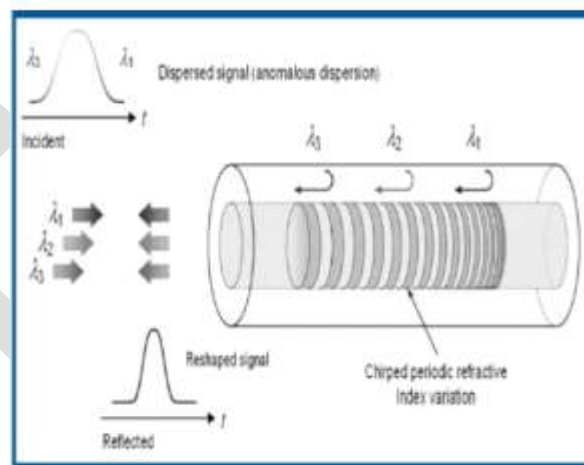


Fig2: A chirped FBG principle

3. DESCRIBING THE COMPONENTS AND SIMULATOR

3.1 Components Description:

All the simulations are done in OPTISYSTEM 7.0 simulator software. It is an advanced, innovative and powerful software simulator tool used for design, testing and optimization of virtually any type of optical link. We use the parameters in Table 1 in order to simulate the optical transmission system. The model of the simulated system is as shown in Fig.3. In the simulation, the transmitter section consists of data source, modulator driver (NRZ), laser source and Mach-Zehnder (M-Z) modulator. We use the continuous wave (CW) laser with frequency 193.1 THz and output power of 15 dbm, which is externally modulated at 10 Gbits/sec with a non-return to zero (NRZ) pseudo random binary sequence in a M-Z modulator with 30 db extinction ratio. Two EDFAs are used as optical amplifiers in the system with gain of 40 db and 10 db with noise figure 4 db. The single mode fiber (SMF) of length 210 km is used as the transmission medium. The FBG is used as the dispersion compensator[9]. At the receiver side, the PIN diode is used as a

photodetector, which converts the optical signals into electrical, having 1 A/W responsivity and 10 nA of dark current. Then the electrical signal is filtered by low pass Bessel filter and 3R regenerator is used for regeneration.

Table 1: Simulation parameters

Parameters	Value
Fiber Length	210Km
Bit Error Rate	$10e^{-9}$
Frequency of CW Laser	193THz
Input Power	15dB
Attenuation	0.2dB

3.2. Optisystem simulator

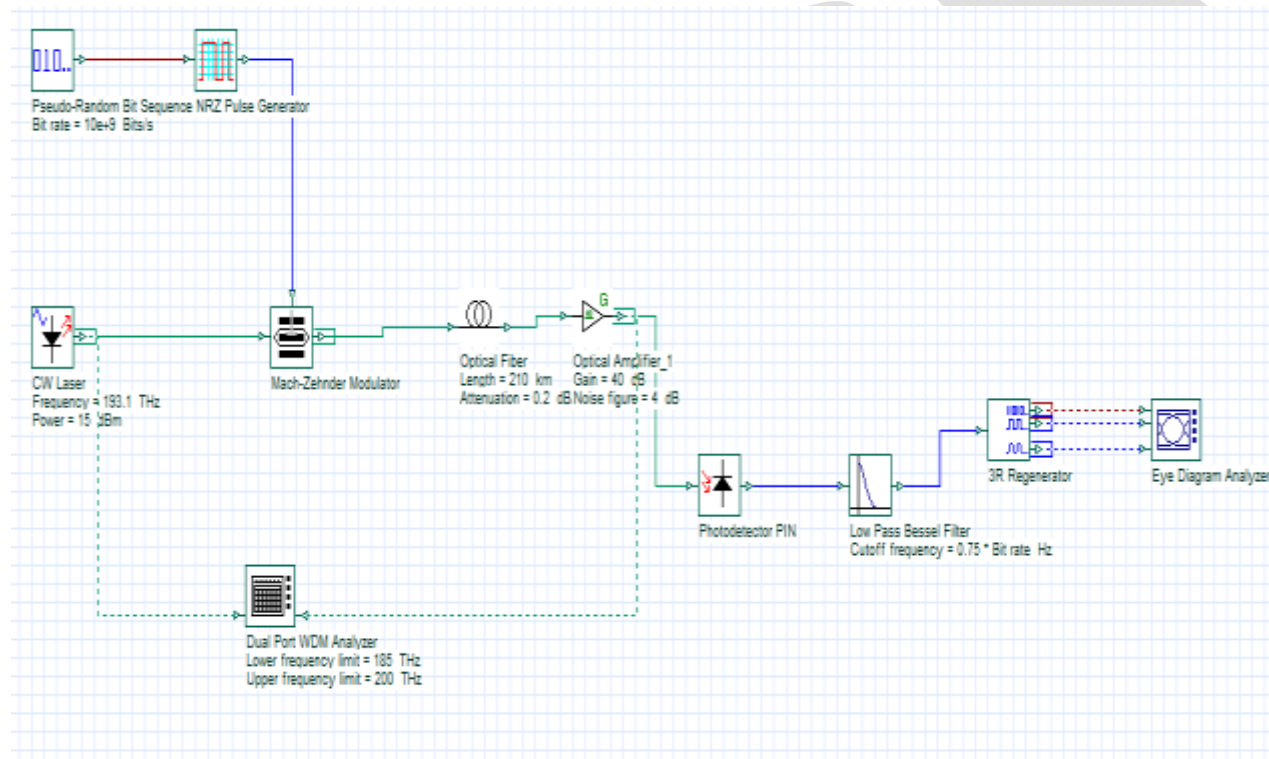


Fig 3: Model of Simulation using OptiSystem

Optisystem is an innovative optical communication system simulation package or the design, testing and optimization of virtually any type of optical link in the physical layer of the broad spectrum of optical networks, from long-haul systems to local area networks (LANs) and metropolitan area networks (MANs). A system level simulator is based on the realistic modeling of fiber optical communication systems.

4. SIMULATED RESULTS:

The simulation and optimization of the design is done by Optisystem 7 simulation software. The eye diagrams and results of output power, Signal power (dBm) at receiver, Q-Factor, Gain, noise Figure by using different values of input power (dBm) and variable length of FBG (mm).

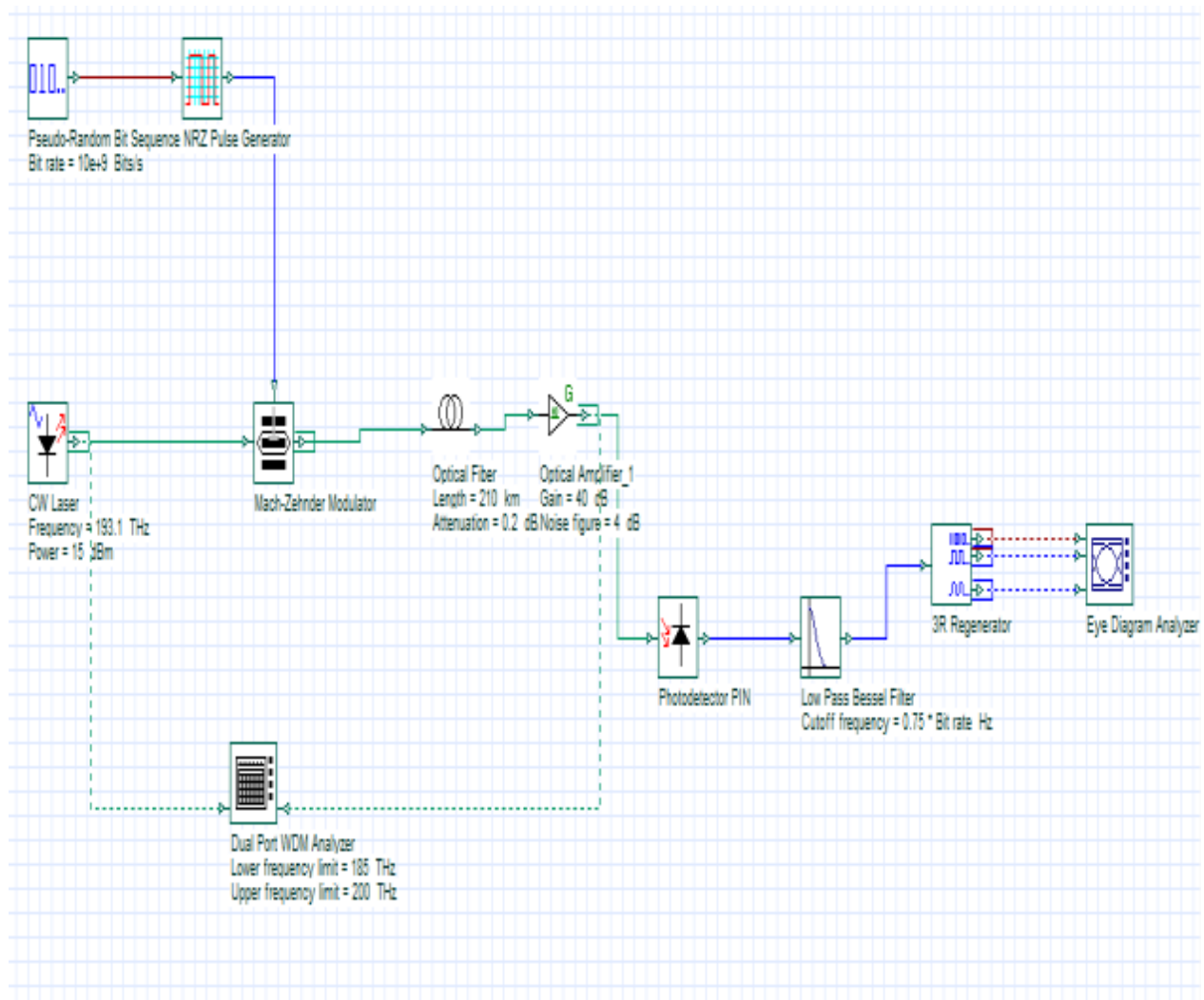


Fig 4: Layout of optical system without Dispersion compensator

4.1 Observations:

Table 2: Observations without FBG

Input power (dBm)	Output power (dBm)	Gain	Noise figure	Q-Factor	BER
15	5.09	9.9	53.9	2.68	0.003

In the eye diagram the eye opening is less and the interference between pulses is more. So the Q-factor is low and the bit error rate is high.

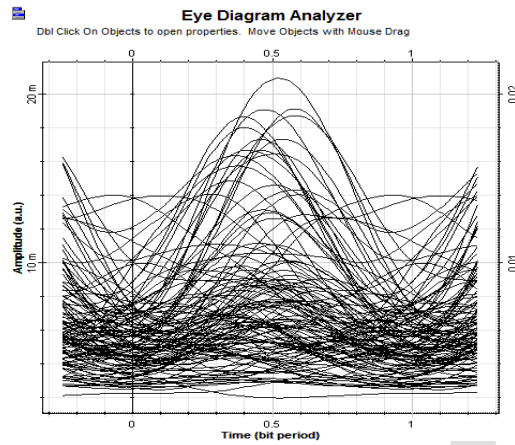


Fig 6: Eye diagram for optical system without FBG

4.2 Optical system with chirped FBG:

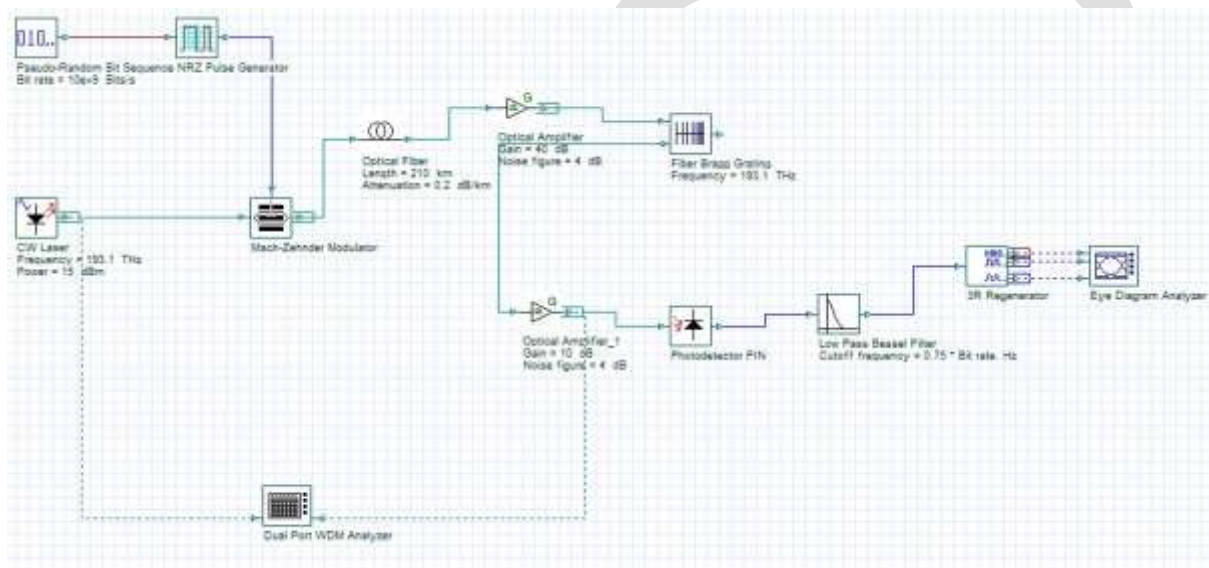


Fig 5: Layout of optical system with chirped FBG

4.2.1 Observations with varying input power:

Here we can observe that the gain is constant even the input power increases but change in the output power. The noise figure is constant because the noise will occur in fiber in this case the fiber length is made constant[6]. The Q-factor and bit error rates are improved by change in input power.

Table 3: Observations by varying input power

Input power (dBm)	Output power (dBm)	Gain	Noise figure	Q-Factor	BER
5	9.52	4.53	49.82	4.54	2.24E-06
10	14.34	4.536	49.82	6.21	1.94E-10
15	19.48	4.489	49.87	7.40	5.14E-14

4.2.2 Observations with varying Fiberbragg length (Chirped FBG):

Table 4: Observations by varying Fiber bragg length.

FBG length (km)	Output power (dBm)	Gain	Noise figure	Q-Factor	BER
70	19.48	4.48	50.51	3.71	9.06E-05
75	19.56	4.56	49.74	4.79	6.17E-07
80	19.48	4.48	49.87	7.40	5.18E-14

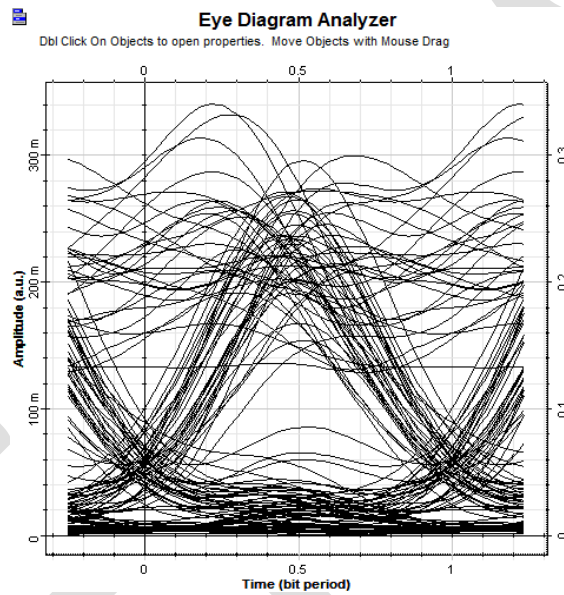


Fig 7: Eye diagram for optical system with chirped FBG of length 70mm

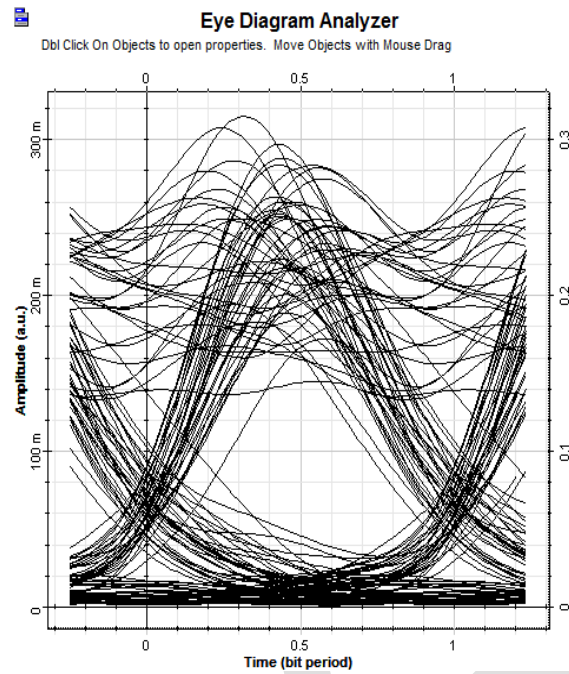


Fig 8: Eye diagram for optical system with chirped FBG of length 75mm

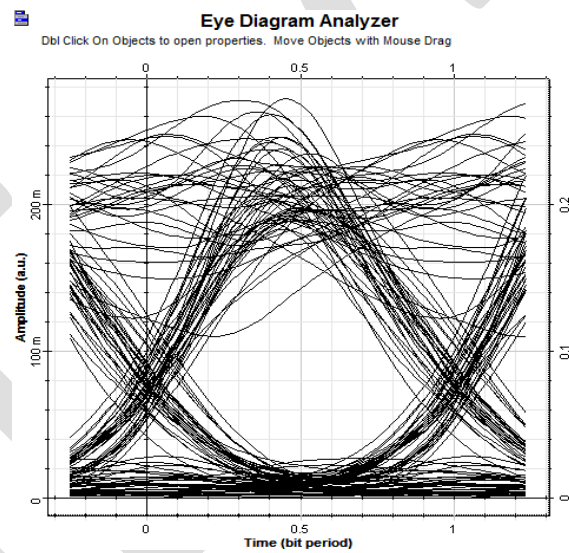
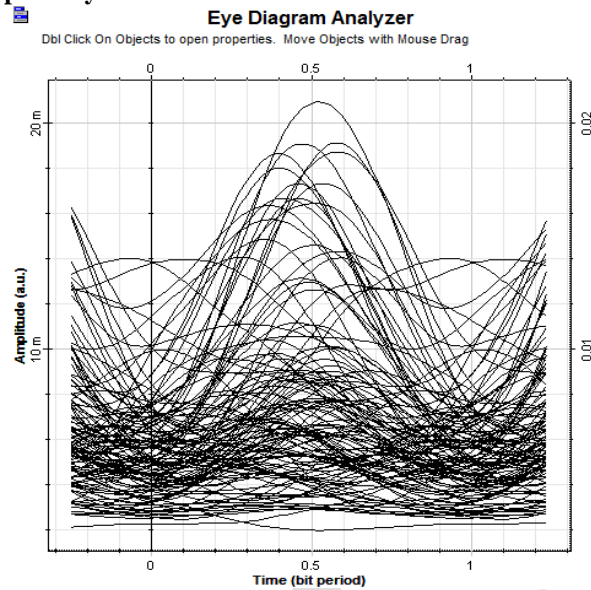


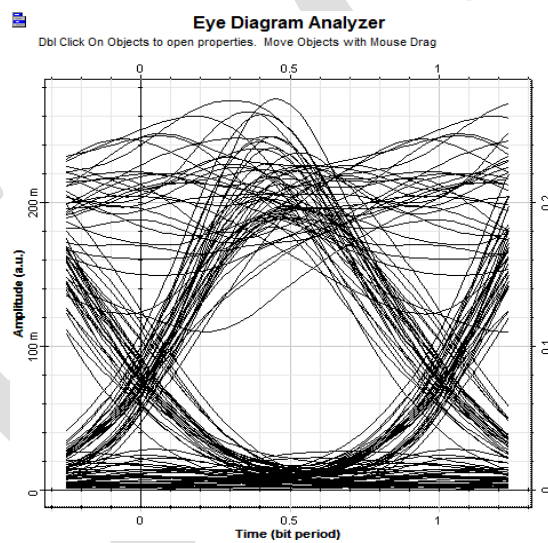
Fig 9: Eye diagram for optical system with chirped FBG of length 80m

From the above three eye patterns for different lengths of FBG as the length increase the better the eye opening and interference is also less. So the Q-factor is increases and the bit error rate is decreases.

4.3 Comparison of eye diagrams of optical systems:



(a) Without FBG



(b) With chirped FBG

Fig 10: Comparison of eye diagrams

On comparing these eye diagrams we can observe that the eye opening is large in the case of chirped FBG[5] which denotes the high Q-factor and results low bit error rate. It also seems that the interference of pulse is more in without FBG and with uniform FBG. In the eye diagram

5. CONCLUSION

In this paper, we have simulated an optical transmission system. As soon as we observed dispersion, we decide to compensate it. For this purpose, we employed chirped FBG and simulate it. The system has been studied for the different lengths of grating and apodization functions. We have analyzed that the 80 mm grating length gives better results for 210 km of optical fiber at 10 Gbits/sec. For a long distance optical communication system the dispersion in optical fiber limits the performance. By the use of fiberbragg grating the dispersion is compensated. The use of fiberbragg grating enhances the bit error rate and the Q-factor. We can conclude that

the chirped fiberbragg grating gives better Q-factor and Bit error rate than the uniform fiberbragg grating. In future this can be used for long distance optical communication with high data rates and low loss.

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The Load Capacity for the System of Rotating Discs under the Second Order Rotatory Theory of Hydrodynamic Lubrication

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Abstract: The system of the lubrication of discs can be made kinematically equivalent to gears if they have the same radius at their contact line and rotate at same angular velocities as the gears. For the system of discs, we will take the origin at the surface of disc of radius R on the line of centers of the two discs. In the present paper, there are some new solutions with the help of geometrical figures, derivation for the expression for the load capacity, calculated tables and graphs for the load capacity in the view of second order rotatory theory of hydrodynamic lubrication. The analysis of equation for load capacity, tables and graphs reveal that the load capacity are not independent of viscosity and increases slightly with viscosity. Also the load capacity increases with increasing values of rotation number. The relevant tables and graphs confirm these results in the present paper.

Keywords: Load capacity, Lubricating discs, Reynolds equation, Rotation number, Taylor's number, Viscosity.

1. Introduction:

The concept of two dimensional classical theories of lubrication [3], [7] was given by Osborne Reynolds [8]. In the wake of an experiment by Beauchamp Tower [9], he had given a differential equation that was said as Reynolds Equation [8]. The basic mechanism and formation of the fluid film was observed by that experiment by considering some assumptions that the film thickness of fluid is much smaller than its axial and longitudinal dimensions and if lubricant layer is to produce pressure between the bearing and the shaft then the layer will vary the thickness of the fluid film.

After some period Osborne Reynolds again revised his own differential equation that was the much improved version and was said as: Generalized Reynolds Equation [4], [7]. The differential equation depends on viscosity, density, film thickness, transverse and surface velocities. The concept of the rotation [1] of the fluid film about an axis, which lies across the fluid film, gives some excellent solutions in the lubrication problems of the fluid mechanics. The origin of rotation was observed by some theorems of vorticity in the rotating fluid dynamics. The rotation induces component of vorticity in the direction of rotation of fluid film and effects arising from it are predominant, for large Taylor's Number, it results in streamlines becoming confined to the plane transverse to direction of rotation of the fluid film.

The latest extended version of the Generalized Reynolds Equation [4], [7] is known as the Extended Generalized Reynolds Equation that takes into account of effects of uniform rotation about an axis, which lies across the fluid film and depends on rotation number M [1], which is the square root of the classical Taylor's Number. The generalization of the theory of hydrodynamic lubrication is said as the Rotatory Theory of Hydrodynamic Lubrication [1], [2]. The concept of the Second Order Rotatory Theory of Hydrodynamic Lubrication [2], [5] was given by retaining terms containing up to second powers of M and by neglecting higher powers of M .

The lubrication of discs can be made kinematically equivalent to gears if they have the same radius at their contact line and rotate at the same angular velocities as the gears. For the system of discs, we will take the origin at the surface of disc of radius R on the line of centers of the two discs. The geometry of the system of discs is given by the figure (1.1) and figure (1.2).

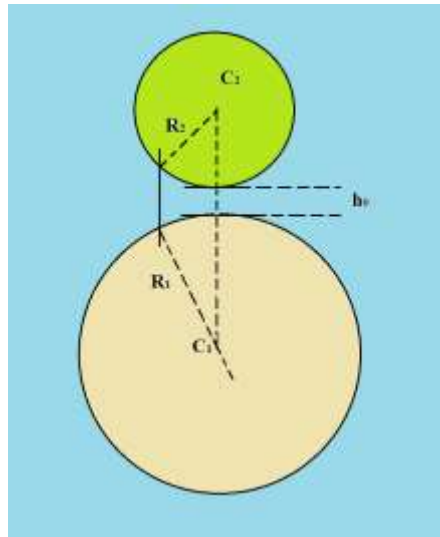


Figure- (1.1) (Geometry of system of discs)

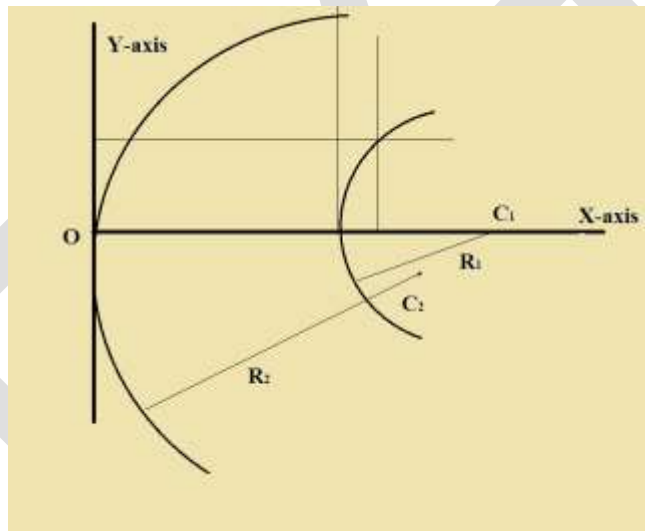


Figure- (1.2) (Film thickness of system of discs)

The film thickness 'h' is given by

$$h = h_0 \left[1 + \frac{y^2}{2h_0} \left(\frac{1}{R_1} + \frac{1}{R_2} \right) \right] \quad (1.1)$$

$$\left(\frac{1}{R_1} + \frac{1}{R_2} \right) = \frac{1}{R} \quad (1.2)$$

$$\tan \theta = \frac{y}{\sqrt{2Rh_0}} \quad (1.3)$$

$$h = h_0 \sec^2 \theta \quad (1.4)$$

Let us suppose that the disc is stationary at the lower surface transverse to the fluid film where sliding is absent and $U = +U$ (constant). Suppose the variation of pressure in x -direction is very small as compared to the variation of pressure in y -direction. So the terms containing pressure gradient $\partial p / \partial x$ can be neglected in comparison to the terms containing $\partial p / \partial y$ in the differential equation of pressure, hence P may be taken as function of y alone.

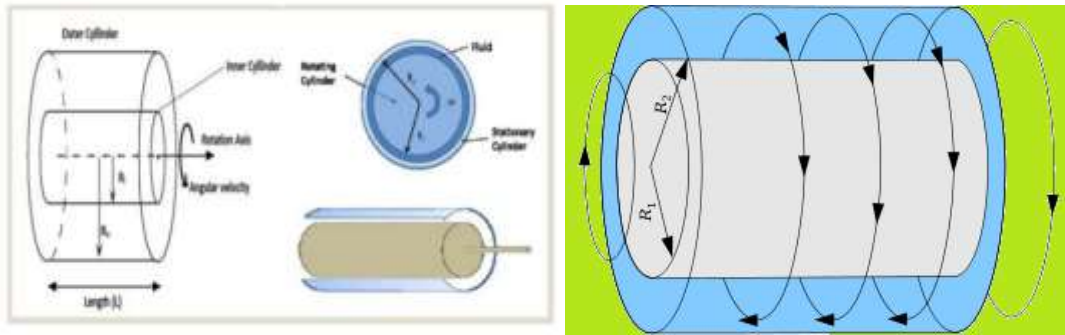


Figure- (1.3) (System of rotation of discs [11], [12])

2. Governing Equations and Boundary Conditions:

The Extended Generalized Reynolds Equation [4] for the second order rotatory theory of hydrodynamic lubrication is given by equation (2.1).

$$\begin{aligned} & \frac{\partial}{\partial x} \left[-\sqrt{\frac{2\mu}{M\rho}} \frac{1}{M} \left(\frac{\sinh h \sqrt{\frac{M\rho}{2\mu}} - \sin h \sqrt{\frac{M\rho}{2\mu}}}{\cosh h \sqrt{\frac{M\rho}{2\mu}} + \cos h \sqrt{\frac{M\rho}{2\mu}}} \right) \frac{\partial P}{\partial x} \right] + \frac{\partial}{\partial y} \left[-\sqrt{\frac{2\mu}{M\rho}} \frac{1}{M} \left(\frac{\sinh h \sqrt{\frac{M\rho}{2\mu}} - \sin h \sqrt{\frac{M\rho}{2\mu}}}{\cosh h \sqrt{\frac{M\rho}{2\mu}} + \cos h \sqrt{\frac{M\rho}{2\mu}}} \right) \frac{\partial P}{\partial y} \right] \\ & + \frac{\partial}{\partial x} \left[-\frac{h}{M} + \sqrt{\frac{2\mu}{M\rho}} \frac{1}{M} \left(\frac{\sinh h \sqrt{\frac{M\rho}{2\mu}} + \sin h \sqrt{\frac{M\rho}{2\mu}}}{\cosh h \sqrt{\frac{M\rho}{2\mu}} + \cos h \sqrt{\frac{M\rho}{2\mu}}} \right) \frac{\partial P}{\partial y} \right] - \frac{\partial}{\partial y} \left[-\frac{h}{M} + \sqrt{\frac{2\mu}{M\rho}} \frac{1}{M} \left(\frac{\sinh h \sqrt{\frac{M\rho}{2\mu}} + \sin h \sqrt{\frac{M\rho}{2\mu}}}{\cosh h \sqrt{\frac{M\rho}{2\mu}} + \cos h \sqrt{\frac{M\rho}{2\mu}}} \right) \frac{\partial P}{\partial x} \right] \\ & = -\frac{U}{2} \frac{\partial}{\partial x} \left[\rho \sqrt{\frac{2\mu}{M\rho}} \left(\frac{\sinh h \sqrt{\frac{M\rho}{2\mu}} + \sin h \sqrt{\frac{M\rho}{2\mu}}}{\cosh h \sqrt{\frac{M\rho}{2\mu}} + \cos h \sqrt{\frac{M\rho}{2\mu}}} \right) \right] \\ & \quad - \frac{U}{2} \frac{\partial}{\partial y} \left[-\rho \sqrt{\frac{2\mu}{M\rho}} \left(\frac{\sinh h \sqrt{\frac{M\rho}{2\mu}} - \sin h \sqrt{\frac{M\rho}{2\mu}}}{\cosh h \sqrt{\frac{M\rho}{2\mu}} - \cos h \sqrt{\frac{M\rho}{2\mu}}} \right) \right] - \rho W^* \end{aligned} \quad (2.1)$$

Where x , y and z are coordinates, μ is the viscosity, U is the sliding velocity, P is the pressure, ρ is the fluid density, and W^* is fluid velocity in z -direction. The Extended Generalized Reynolds Equation for the second order rotatory theory of hydrodynamic lubrication, in ascending powers of rotation number M can be written as equation (2.2). For the case of pure sliding $W^* = 0$, so we have the equation as given:

$$\begin{aligned} & \frac{\partial}{\partial x} \left[-\frac{h^3}{12\mu} \left(1 - \frac{17M^2\rho^2h^4}{1680\mu^2} \right) \rho \frac{\partial P}{\partial x} \right] + \frac{\partial}{\partial y} \left[-\frac{h^3}{12\mu} \left(1 - \frac{17M^2\rho^2h^4}{1680\mu^2} \right) \rho \frac{\partial P}{\partial y} \right] + \frac{\partial}{\partial x} \left[-\frac{M\rho^2h^5}{120\mu^2} \left(1 - \frac{31M^2\rho^2h^4}{3024\mu^2} \right) \frac{\partial P}{\partial y} \right] \\ & \quad - \frac{\partial}{\partial y} \left[-\frac{M\rho^2h^5}{120\mu^2} \left(1 - \frac{31M^2\rho^2h^4}{3024\mu^2} \right) \frac{\partial P}{\partial x} \right] \\ & = -\frac{\partial}{\partial x} \left[\frac{\rho U}{2} \left\{ h - \frac{M^2\rho^2h^5}{120\mu^2} \left(1 - \frac{31M^2\rho^2h^4}{3024\mu^2} \right) \right\} \right] - \frac{\partial}{\partial y} \left[\frac{M\rho^2U}{2} \left\{ -\frac{h^3}{12\mu} \left(1 - \frac{17M^2\rho^2h^4}{1680\mu^2} \right) \right\} \right] \end{aligned} \quad (2.2)$$

$$\begin{aligned} & \frac{\partial}{\partial y} \left[-\frac{h^3}{12\mu} \left(1 - \frac{17M^2\rho^2h^4}{1680\mu^2} \right) \rho \frac{\partial P}{\partial y} \right] + \frac{\partial}{\partial x} \left[-\frac{M\rho^2h^5}{120\mu^2} \left(1 - \frac{31M^2\rho^2h^4}{3024\mu^2} \right) \frac{\partial P}{\partial y} \right] \\ & = -\frac{\partial}{\partial x} \left[\frac{\rho U}{2} \left\{ h - \frac{M^2\rho^2h^5}{120\mu^2} \left(1 - \frac{31M^2\rho^2h^4}{3024\mu^2} \right) \right\} \right] - \frac{\partial}{\partial y} \left[\frac{M\rho^2U}{2} \left\{ -\frac{h^3}{12\mu} \left(1 - \frac{17M^2\rho^2h^4}{1680\mu^2} \right) \right\} \right] \end{aligned} \quad (2.3)$$

Taking $h=h(y)$, $U=+U$, $P=P(y)$

(2.4)

$$\frac{d}{dy} \left[-\frac{h^3}{12\mu} \left(1 - \frac{17M^2\rho^2h^4}{1680\mu^2} \right) \rho \frac{dP}{dy} \right] = -\frac{\partial}{\partial y} \left[\frac{M\rho^2U}{2} \left\{ -\frac{h^3}{12\mu} \left(1 - \frac{17M^2\rho^2h^4}{1680\mu^2} \right) \right\} \right] \quad (2.5)$$

For the determination of pressure distribution in the positive regions, the boundary conditions are as follows:

(i) $P=0$ at $h=h_0$ or $P=0$ at $y=0$ or $P=0$ at $\theta=0$

(ii) $P=dP/d\theta=0$ at $y=y_1$ or $\theta=\gamma$ (say)

(2.6)

Where is determined by putting $\theta=\gamma$ and $P=0$ in the equation of pressure.

3. Pressure Equation:

The solution of the differential equation under the boundary conditions imposed is given by

$$P = -\sqrt{\frac{Rh_0}{2}} M\rho U \left[\frac{17M^2\rho^2h_0^4}{1680\mu^2} F(\theta) - \tan \theta F(\gamma) \right] \quad (3.1)$$

Where $F(\theta)$ is given by

$$F(\theta) = \tan \theta \left[\frac{1}{9} \sec^8 \theta + \frac{8}{63} \sec^6 \theta + \frac{48}{315} \sec^4 \theta + \frac{192}{945} \sec^2 \theta + \frac{384}{945} \right] \quad (3.2)$$

4. Load Capacity:

The load capacity is given by

$$\begin{aligned} W &= \int_{\gamma}^0 P dy \\ &= \int_{\gamma}^0 P \sec^2 \theta \sqrt{2Rh_0} d\theta \\ &= \sqrt{2Rh_0} \int_{\gamma}^0 P \sec^2 \theta d\theta \end{aligned} \quad (4.1)$$

$$W = Rh_0 M\rho U \left[\frac{17M^2\rho^2h_0^4}{1680\mu^2} \int_{\gamma}^0 F(\theta) \sec^2 \theta d\theta - \int_{\gamma}^0 \tan \theta \sec^2 \theta d\theta \right] \quad (4.2)$$

$$\begin{aligned} W &= -\frac{17M^3\rho^3h_0^3UR}{1680\mu^2} \left(\frac{1}{10} + \frac{1}{90} \sec^{10} \gamma + \frac{1}{63} \sec^8 \gamma + \frac{8}{315} \sec^6 \gamma + \frac{16}{315} \sec^4 \gamma + \frac{192}{945} \tan^2 \gamma \right) \\ &\quad - \frac{Rh_0 M\rho U}{2} \tan^2 \gamma \end{aligned} \quad (4.3)$$

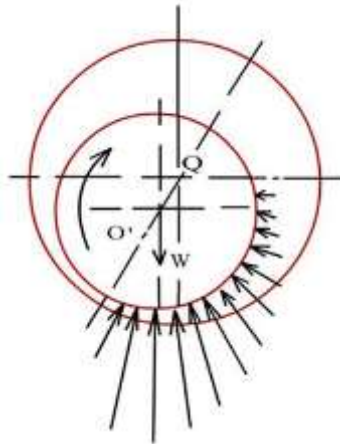


Figure-4.1 (Load capacity [10])

5. Calculation tables and graphs:

By taking the values of different mathematical terms in C.G.S. system the calculated tables and graphical representations are as follows:

5.1 Table:

$$U = 80, \rho = 1.0, R = 3.35, h_o = 0.0167, \mu = 0.0002, \theta = 30^\circ, \gamma = 60^\circ$$

S.NO.	M	W
1.	0.1	6.2844159
2.	0.2	46.2472872
3.	0.3	153.5670693
4.	0.4	361.9222176
5.	0.5	704.9911875
6.	0.6	1216.452434
7.	0.7	1929.984414
8.	0.8	2879.265581
9.	0.9	4097.974391
10.	1.0	5619.7893

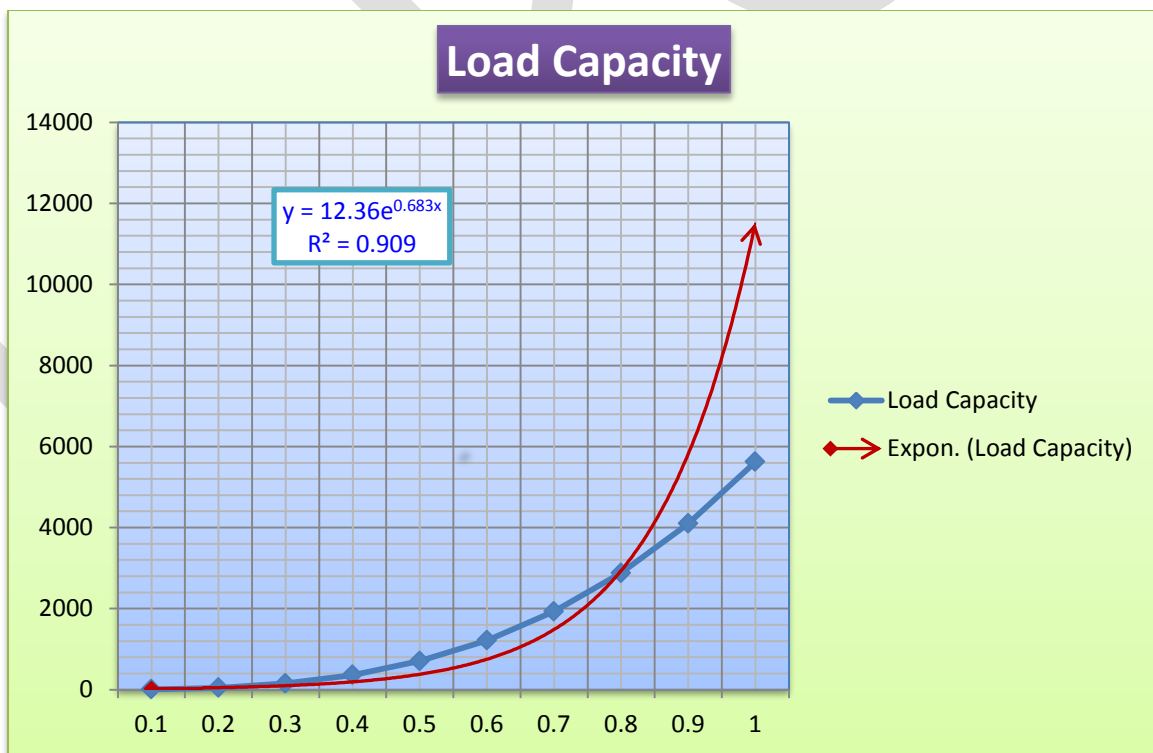


Figure-5.1 (Variation of load capacity with respect to rotation number M with exponential trendline)

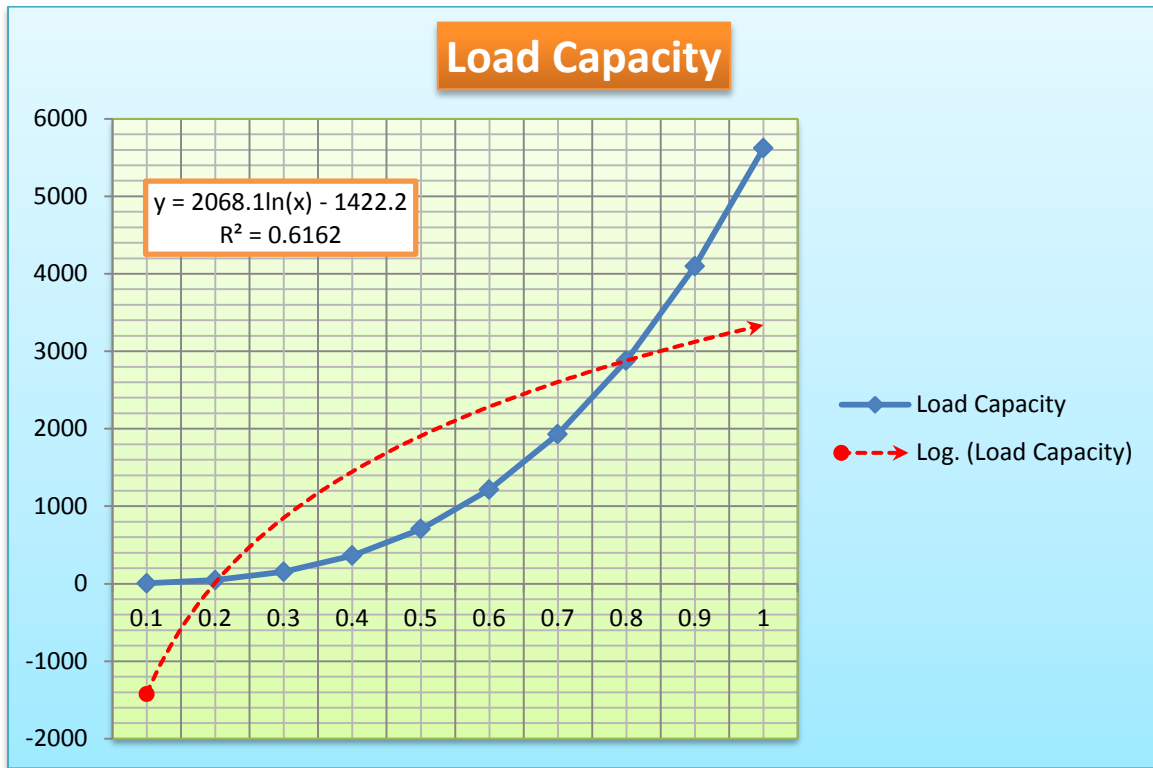


Figure-5.2 (Variation of load capacity with respect to rotation number M with logarithmic trendline)

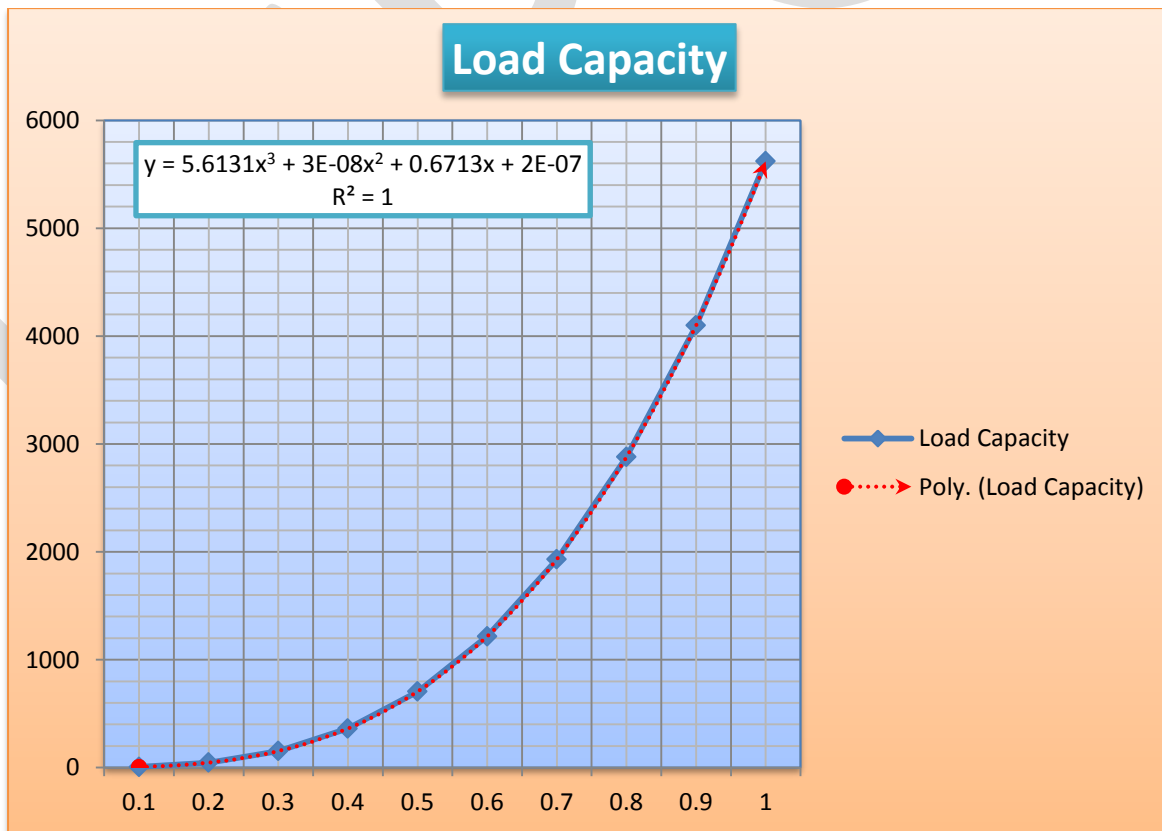


Figure-5.3 (Variation of load capacity with respect to rotation number M with third degree polynomial trendline)

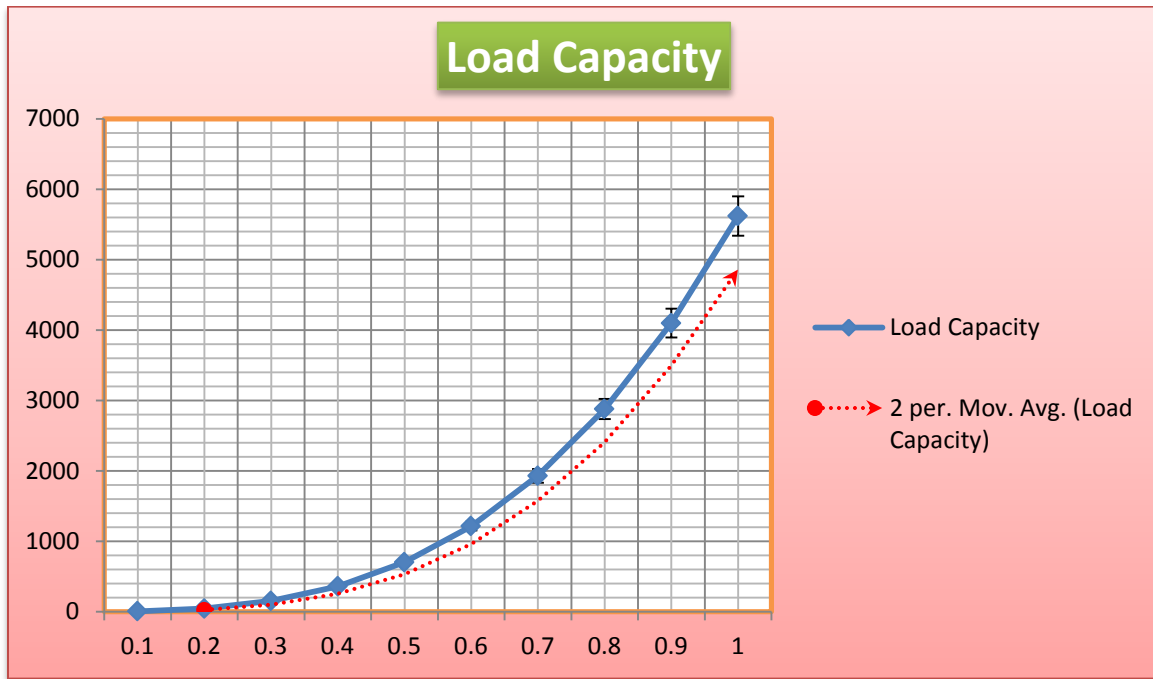


Figure-5.4 (Variation of load capacity with respect to rotation number M with 2-period moving average trendline with 5% error bars)

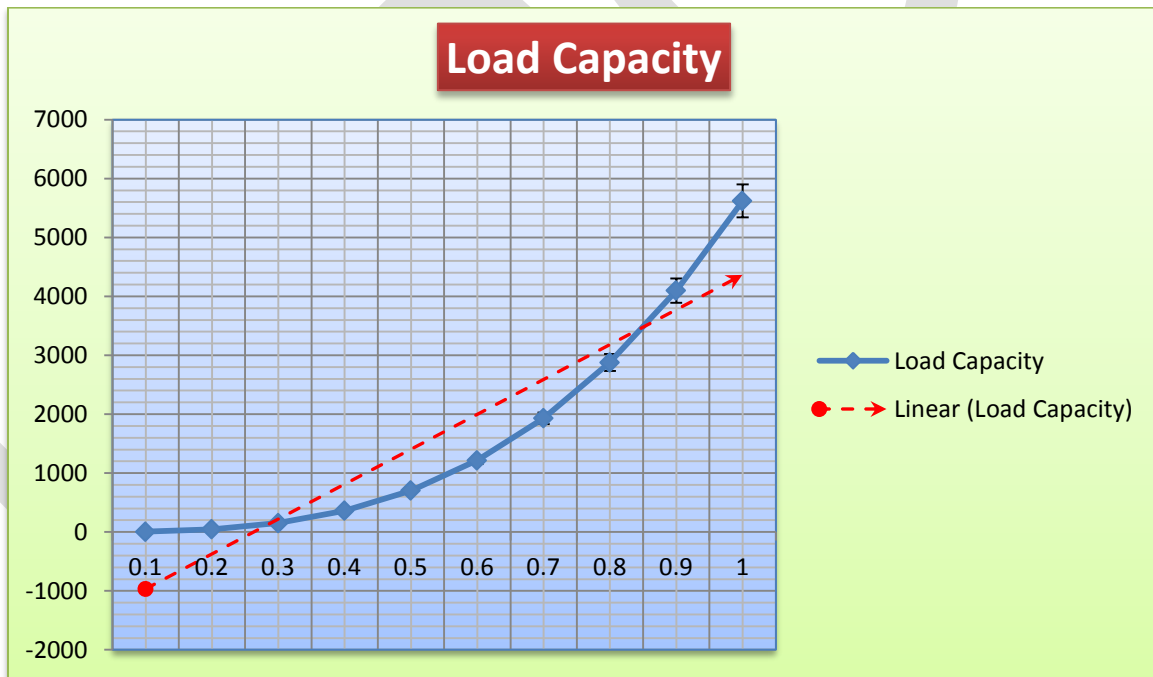


Figure-5.5 (Variation of load capacity with respect to rotation number M with linear trendline with 5% error bars)

6. Results and Discussion:

The variation of load capacity with respect to rotation number M is shown by the table and graphs. The figure-5.1 shows the exponential trendline by $y = 12.36 e^{0.683x}$ with $R^2 = 0.909$. The figure-5.2 shows the logarithmic trendline by $y = 2068 \log_e x - 1422$ with $R^2 = 0.616$. The figure-5.3 shows the third degree polynomial trendline by $y = 5.613 x^3 - 3E-08x^2 + 0.671x + 2E-07$ with $R^2 = 1$. The figure-5.4 shows the variation of load capacity with respect to rotation number M with two periods moving average trendline with 5% error bars. The figure-5.5 shows the variation of load capacity with respect to rotation number M with linear trendline with 5% error bars.

7. Conclusion:

The derived equation of load capacity is given by equation (4.3). The calculated values of the load capacity against rotation number M is shown in the table and graphical representation for the variation of load capacity is also shown by figure-5.1 to figure-5.5. The comparisons of the load capacity have been done with the help of geometrical figures, expressions, calculated tables and graphs for the lubricating discs in the second order rotatory theory of hydrodynamic lubrication. The analysis of equations for load capacity, tables and graphs show that load capacity is not independent of viscosity and increase with increasing values of rotation number.

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Green lean manufacturing: Way to sustainable productivity improvement

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ABSTRACT--The aim of this paper is to get insight into the concept of green lean manufacturing to precisely comprehend the idea of green lean manufacturing, and diverse practices in the course of extensive literature survey. This paper also gives the reasonable idea of associations between leanness and business agility, subsequently the effect of business agility on the productivity of the manufacturing organization in particular. Ever since 1990, the thought of lean manufacturing has been a catchphrase and many industries across the globe implemented the philosophy effectively. This gives me an opening to look at the various procedures of lean practices worldwide in detail. The foundation of lean philosophy is to deliver the product at a least possible cost on time as demanded by the customers, using effective waste removal process to maximize the value of the product and also make sure the quality of the product in accordance to the needs and wants of the customers. The leanness makes the production system agile, which in turn, could become the appropriate long term strategy for the sustainable competitive advantages. Business agility is the organizations' capability to respond aptly to the fickle needs and wants of the consumers, which is endlessly becoming formidable in globalized world. Business agility has turned into a barometer of long term success for many organizations worldwide. Green lean manufacturing is the promising philosophy with intent of improving the productivity, by constantly enhancing the efficiency & effectiveness of the business. Finally the literature review helps in assessing the research gap and research problem. Consequently the preparation of research hypothesis and research design, with the objectives of addressing the core issue while conducting a study on it.

KEYWORDS--Lean Manufacturing, Business Agility; Productivity; Green Manufacturing, Interpretive Structural Modeling; Fuzzy Comprehensive Analysis; Analytical Hierarchical Programming.

INTRODUCTION

SMEs have been major contributory in transforming manufacturing sectors worldwide. The contribution of SMEs' to Indian GDP is more than 30% and providing employment to nearly 50% of employable population. Despite such major influence and tremendous potential to boost Indian economy, SMEs' are struggling for their existence after globalization in particular. Indian automotive SMEs' are no exception. Due to the short product life cycle, fast changing customers taste and technological advancement, Indian automotive SMEs' are facing stiff competition both in and out of the country. Due to long product development time, poor inventory and other waste management their product cost is escalating, profit margin is fast diminishing and they are on the doorstep of becoming uncompetitive. In other words we can say they are fat and inefficient organizations, consuming lots of resources without appreciable value addition. They must strive to become lean. For their own existence they must learn and implement green lean manufacturing to create maximum value of the products by consuming lesser amount of vital resources.

Lean manufacturing is a philosophy widely acknowledged by many organizations worldwide ever since the early 1990s. Lean manufacturing can be best described as waste elimination process from the system,[1]. Anything, process or product-services, which does not value to your product is waste,[2]. Value should be in the eyes of the customer. Customers will value more the end product if and only if it matches to their requirements, delivered on time at a least possible cost. The idea of lean manufacturing strives towards maximizing the value of your end product in the eyes of the customers by incessantly refining the quality of the end product and elimination of the all kind of surpluses in the system,[1]. The top management plays a dynamic role in transformation to lean, they must unite the people and create awareness what will happen during the course of implementation and what is anticipated of them. [2] While implementing lean philosophy change in the system will be both social and technical in nature. Implementation of lean philosophy will bring about the drastic cultural and environmental change in the system,[3]

The concept of Lean manufacturing arrived to India in the mid 1990's from Japan and United States of America, but it was generally the large scale sector exploited the philosophy to gain sustainable competitive edge. Now, medium and small sectors enterprises want to reap the same benefits. After been studying Lean manufacturing conceptually, a curiosity started to grow in my mind how the philosophy actual works out in large Indian companies and how it could be implemented in a small & medium scale enterprises, automotive industry in particular. The lean philosophy encapsulates more than hundred variables which need to be concentrated upon for the successful implementation of the philosophy. As far as SMEs' are concerned, it's not viable to implement complete

philosophy because of the resource constraints; instead they can concentrate upon some important factor. That is why the present study explores the process of implementing green lean manufacturing through extensive literature survey.

Literature Survey

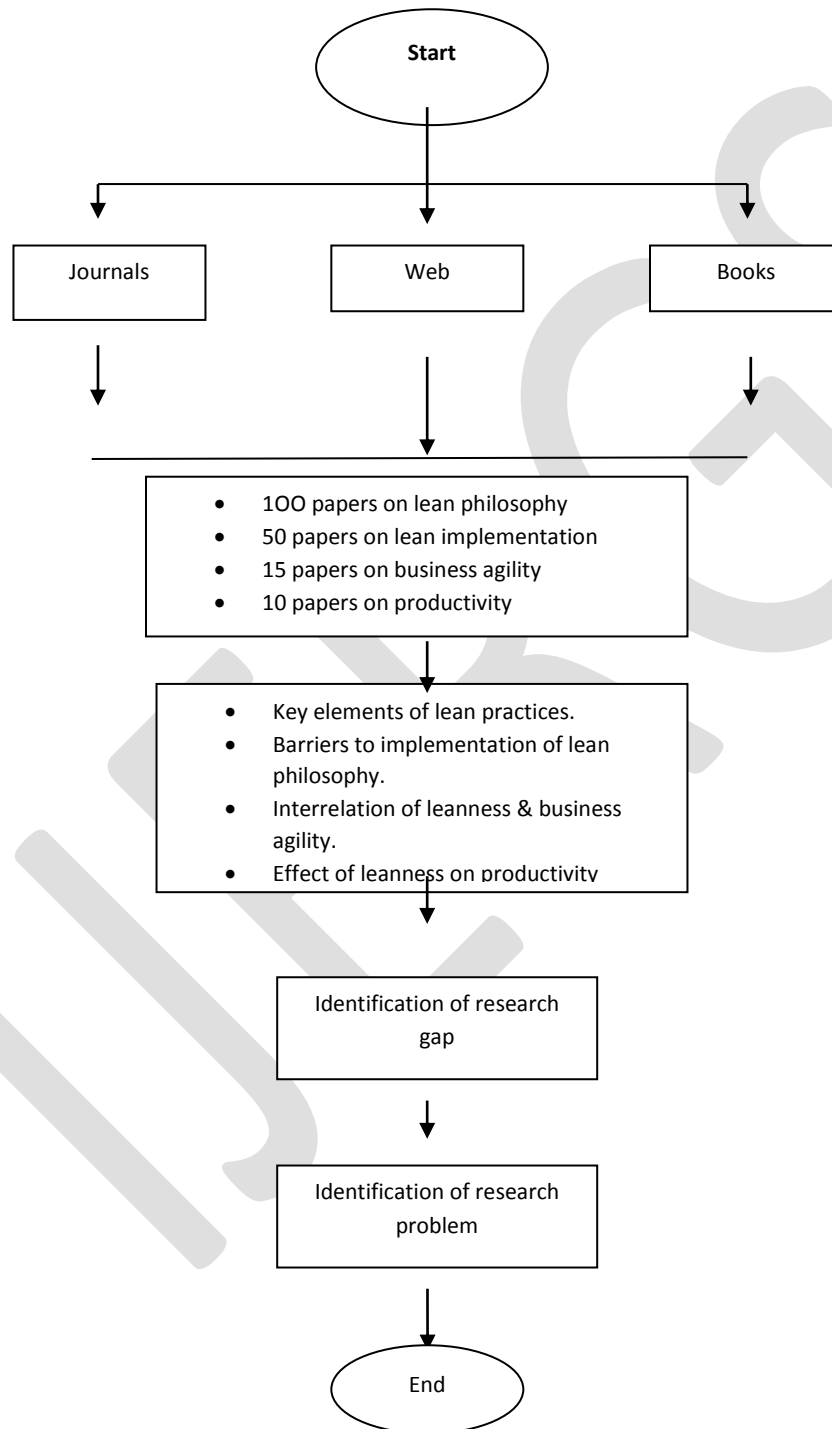


Figure 1: Flow chart of literature survey

1. Evolution of lean philosophy

The philosophy of lean manufacturing is being used mostly in the automotive industry. Toyota Motor Company, is the pioneer in lean manufacturing techniques and has been exploiting the techniques since World War II. They are the leader in successfully practicing the tools and techniques of lean philosophy. The many concepts of lean philosophy is not new, can be found in work of Deming, Taylor & Skinner but not well understood until Toyota implemented them successfully. In the early 1980's, U.S. auto giant like GM and Ford were in watershed. Their market share was fast diminishing and Japanese were gaining. The Japanese automakers were producing better quality cars with lesser defects and lower cost resulted in enhanced customer. In spite of 1973 oil crisis Toyota continued to increase its earnings and captured more market. Till now Toyota is one of the world's most popular automakers that have continuously outclassed their rivals in terms of quality at lower cost and reliability, faster delivery, and after sales service etc. Japanese production systems have been increasingly researched by global academic world. It's a lean philosophy which made Toyota market leader worldwide surpassing older arch rivals like General Motors & Ford. However there are some doubt regarding the relevance and efficacy of the philosophy but numerous cases exists demonstrating the change in manufacturing practices in quest of becoming leaner.

Massachusetts Institute of Technology started a five years study on future of automobile in 1985 with reference to the transition from mass production to lean production in the International Motor Vehicle Program, which becomes a corner stone of the worldwide transition from mass production to, Lean Production. The outcomes were published in the book "The Machine that Change the World", [4]. According to the book, Lean Manufacturing equally efficient in all manufacturing set up, regardless of what they produce and size, and not limited to car manufacturing only, resulting in dramatic improvements in productivity.

However the book was not immune to criticism at various levels, like lean manufacturing was unreasonably glorified without any documentary evidence of its application in all industrial set up, [5]. Another criticism was workers in lean manufacturing setup works in tight compartment without any intrinsic motivation and autonomy, [6]. Lean production system was theoretical, highly superficial and infeasible where the actual was suppressed by what you supposed to be, [7].

There are numerous LM techniques put into practice by different organization worldwide, [8]. The paybacks those can be realized by executing LM manufacturing practices and techniques are cost reductions, reduction in manufacturing lead time results in on-time delivery, less inventory in the manufacturing line and increased availability of machines, [9, 10]. Additionally lean philosophy render's a superior method of waste elimination which results in greater value addition, [11]. Numerous literature available most emphatically suggest that LM philosophy is beneficial to all regardless the type of business and its size, [12, 13].

Studying the present literature delivers a preliminary point in describing lean production. Furthermore, it aids in highlighting the mix-up in the theoretical and the functioning space surrounding lean production and reap a set of operational procedures those can characterize it. While conducting review, I started with the initial publications linked to Japanese manufacturing/production systems, and finished with the current publications connected to lean production. I experienced the initial Japanese books were more accurate in defining TPS and recognizing its primary elements, [14, 15]. Articles concentrated more on defining and describing definite elements of the system rather than the entire picture.

This absence of difference amongst the system and its elements was further intricate by the general point of reference used in its description. Lean production is usually defined from either from a philosophical view point connected to guiding principles and primary objectives, [1, 16] or from the real-world point of view such as set of management practices, tools, or techniques those can be evident, [10, 17]. This dissimilarity in orientation does not essentially indicate divergence, but it does weaken the theoretical clarity.

Definitions of leanness are:

The term "lean" is defined as doing more with a less amount of resources to generate equivalent output to traditional mass production system at a least cost in line with the demands of the customers, [11].

Lean manufacturing is methodology generating value by elimination of all kind surpluses, developing responsive system, improving quality, and increasing effectiveness of all employees, (Massachusetts Institute of Technology).

National Institute of Standards and Technology (NIST) defined lean manufacturing as: “A logical move towards identifying and eliminating all kinds waste through continuous improvement, and making pull of products from the supply chain by the customer.

Lean manufacturing is synchronized integrated comprehensive methodology that includes a broad array of management tools, such as total quality management, total productivity management, JIT, team work, cellular layout, and suppliers management, in pursuit of a stream lined production that can deliver right kind of product, at right place and time at a minimum possible cost by eliminating all kinds of waste in the system,[10].

Lean manufacturing is a continuously self-evolving system, manufacturing system well built on the basis process and quality control supported by healthy work environment in order to deliver quality product at a minimum possible cost by eliminating all kinds of waste, which generate value to customers, society, and economy as a whole.

Lean manufacturing is a philosophy driven with top down approach to create requisite understanding and confidence towards the philosophy in order to reap maximum benefits out of it, [18].

Thus the essence of lean philosophy is to create customer responsive self-evolving productive system, which aim at continuously improving the quality and reduction in cost, delivery time of the product by elimination all kinds of non-value added activities (material handling, changeover, waiting, movement and defects etc.), through fostering conducive work culture with proper training and education to ensure total involvement.

In nutshell the salient features of evolution of philosophy of lean manufacturing can be expressed with the help of following table:

1927 Before	&	Henry Ford published his philosophy of mass production known as Ford production system in 1927.
1945-78 in Japan	in	<ul style="list-style-type: none"> Detailed study of FPS by Toyota motor company and changed the concept from mass production to mass customization known Toyota production system (TPS). Salient points of TPS are cost reduction through elimination of all kinds of waste from the system, Continuous improvements in the quality of products as defined by the customers, quality assurance, production according to the needs and wants of the customers, and at a pace consensus with the customers demand known as JIT system. The details of TPS was published by Ohno publishers in the book “Toyota Production System” in 1978 in Japanese.
1973-78 Migration of TPS from Japan to USA		<ul style="list-style-type: none"> 1973 oil crisis forced USA to think over alternative production system. Started to generate interest on TPS, followed by numerous publications. TPS was published in English in book “Beyond large scale production”. Auto giants such as GM forged alliance with Toyota in 1984.
1988-2000, TPS to Lean		<ul style="list-style-type: none"> TPS redefined as lean manufacturing system, [19]. Details of lean concept has been described in the book “The machine that changed the world” by Womack, Jones, and Roos in 1990, [4]. No specific definition of the concept yet. Guiding principles to implement lean philosophy was published in book “Lean thinking”, [11].
2000 to present	to	<ul style="list-style-type: none"> Many researchers, practitioners, and consultants tried to define the lean concept through empirical investigation but still no specific definition yet. Toyota Motor Company projected to become number 1 auto maker in North America in 2006.

Table1: Evolution of Lean Philosophy

2. Identification of various lean practices and its function

Problem undertaken is related to implementation of lean manufacturing in Indian automotive SMEs. The research starts with identification of factors affecting implementation of lean manufacturing through literature survey.

Five vital lean factors were suggested those could make a difference between life and death of the organization,[1] -----

Specify value from the eyes of the customer. Customers 'need and want' is essential right from product design to process design so that the value of the end product can be maximized in the eyes of the customers. Do not manufacture anything which is of convenience to you without listening the voice of the customers.

After the value has been established, map the Value Stream which starts right from the procurement to the end product delivered to the customer and thereafter after sales service, safe disposal of product etc. We need to ensure that value is being added to the product at every stage in the value chain. Value stream mapping is all the activities that process the product. Typical process can be design, planning, production, delivery or after sales service. Value stream mapping gives you the better insight into your business operations.

The principle of flow is essential to add the value to a product as it moves from one stage to another in the value stream by elimination of all kind waste and ensure all the following stages are without any bottlenecks, delays or interruptions. Each stages of value stream should occur sequentially. Principle of flow results in up to 50% enhancement in the productivity

Do not produce anything to store, it's a waste. Produce at a rate synchronized to customers' demand. Customer must pull a product from your value chain rather than you push the product downstream towards the customer. This is known as pull production system or just in time production system. Pull production system results in no stock pileup which is actually a waste seriously compromising the profitability of the organization.

Strive for perfection. Perfection is no way related only quality of end product. Perfection has got broader meaning. It means produce in accordance to customers' requirements, the rate at which customer and at a minimum possible cost by continuously eliminating the all kind of waste in the system.

Few organizations have applied the five principles in hurry without giving any deeper thought to the implementation of the philosophy. Any structure changes should take by changing the attitude of the employees and envisioning the broader picture before the implementation. All the elements of the philosophy must be implemented rather implementing selective few to reap the benefits,[12].

Manufacturing leanness is basically a process optimization to achieve continuous process improvement to create optimum value from the process. Manufacturers can use diverse lean tools and concepts to diminish wastes and thereby increases the value. The lack of an effective plan, methodology, comprehension of lean performance and its measurement are vital factors causing the failure of the lean manufacturing application. Prevailing methods of choosing the suitable lean strategy depends upon the manufacturers' common sense rather than rational justification.

Now days, numerous business are keen to implement lean manufacturing in order to improve their performance to beat intense competition in global market where uncertainty is widespread,[20]. Commitment of suppliers to deliver required quantity of quality raw materials, parts and subassemblies was a critical success factor for the successful implementation of lean manufacturing,[21.] Participation of both top management and employees is essential in performance measures,[22]. Material handling is the important cost factors contributing about 30% to 70% of total operating expenses. Material handling is non value added activity and escalation of cost of material handling is a result of poor layout and selection of inappropriate material handling equipment,[1]. Poor layout design leads to several defects like excessive work in process inventory, and lower machine utilization,[23, 24]. Cellular layout an important component of lean manufacturing was studied in detail with reference to small scale industry,[25]. A number of lean manufacturing practices like JIT(Just in Time), total quality management, total preventative maintenance, and human resource management, pull, one piece flow, low setup cost, total productive maintenance and employees involvement were studied I detail,[25-26-27].

Visual card system such as KANBAN control has been exercised to reduce in process inventory and over production,[28]. Standardization manufacturing processes is essential for efficient, to provide relatively safer work environment and to reduce waste in the systems,[29]. Standardization results in reduction in unnecessary variety and outcome are reduced complexity and chance of error. Complexity can be reduced by reduction in number of parts, sub-assemblies, process simplification and using standard equipment with the necessary features only. Significance of communication and support of management in implementation of lean manufacturing have been studied,[30].

I also discovered numerous literatures, where operational tools were used to measure the elements of lean manufacturing and notice overlaps and confusions amongst the different measures. These operational measures are based on questionnaire administered survey,

where each of the survey questions denotes various lean tools. Generally these tools are referred as variables. These variables may explain the same element of lean manufacturing. Therefore it's become imperative to device some multivariate interdependency statistical analysis so that the overlap amongst these variables can be minimized. Factor analysis could be the ideal choice. Factors are latent variables. Variables explaining the same element can be put to gather under a single factor. Though many literatures are available, however I found only a few researches categorically measure the lean manufacturing. One of such practices is combining total productive maintenance, total quality management, and human resource management to measure lean manufacturing,[10]. These practices are internal to organization to manage its manufacturing operation. On the contrary the other study measures lean manufacturing conservatively using set up time, small batch size, and JIT production only,[16].

Following table provide the comprehensive list of various lean tools cited----

Lean Tools	Function
JIT	Customer pulls the product from the value chain
Kaizen	Continuous improvement
VSM	Waste reduction from Value Stream Mapping (lead time reduction)
Material Requirement Planning	Schedule of production plan to deliver particular end item on specified date
Kanban	Movement of parts based on cards
5S	Sorting, Set in order, Shine, Standardize and Sustain
Waste elimination	Elimination of non-value added activities
Andon	Caution of pending problems in the system.
Visual Management (VM)	Visual Control for excellent management
Poka Yoke	Fool Proofing.
Heijunka	Workflow leveling by volume & variety.
Takt Time	Rate of customer demand.
One Piece Flow	Single piece flow as per customer demand
Total Productive Maintenance (TPM)	Preventive, predictive & autonomous maintenance
Cellular manufacturing	Both volume & variety
Single Minute Exchange of Dies (SMED)	Set up time reduction
Team Work & Employees Empowerment	Working to gather and involvement in decision making
Problem Solving Techniques	Cause & Effect analysis, Fishbone Diagram
Standard Operating Procedure (SOP)	Use of reliable Methods

Table 2: Function of various lean elements

The following figure illustrates the basics & principle of lean philosophy,[30].

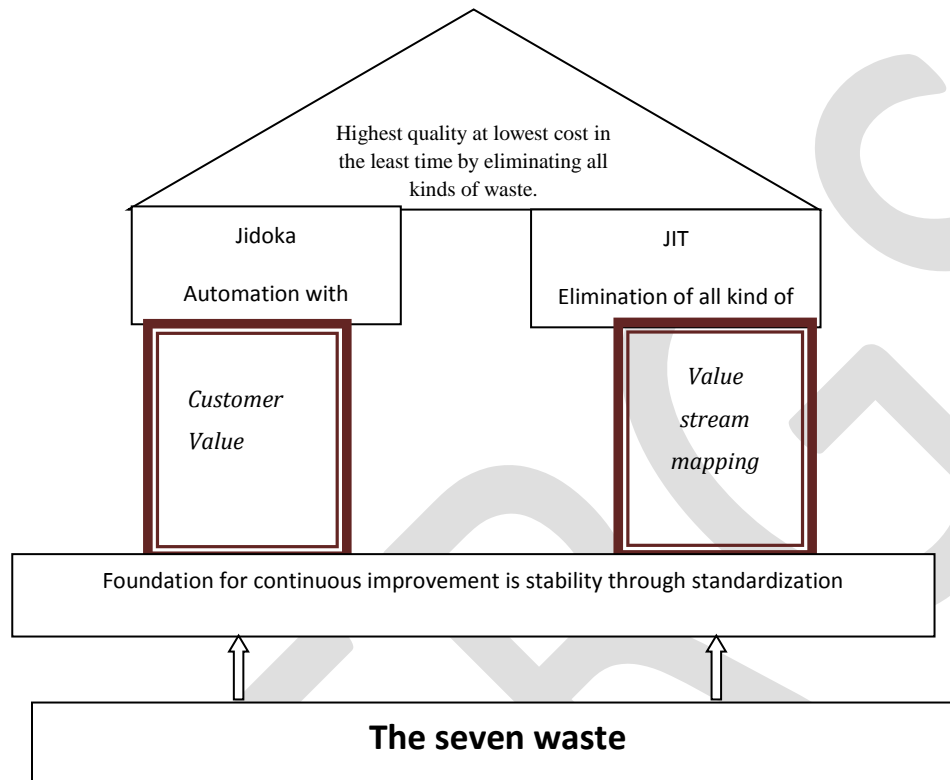


Figure 2: Basics & principles of lean philosophy

3. Lean implementation in small and medium scale enterprises

The literature suggests that it's not feasible for SMEs to apply all LM tools simultaneously due to the lack of expertise and financial constraints,[31]. Therefore sequential implementation starting from easiest and cheapest was suggested for the sustainable improvements in SMEs,[32]. Sequential implementation results in less financial burden and reduced complexities which makes the implementation feasible and manageable. SMEs should implement the most beneficial, feasible, and comparatively easy lean method to reap the maximum benefits as a stepping stone by winning the confidence of the employees, so that resistance to change can be minimized,[33]. Through the extensive literature survey, I managed to gather total 42 lean element with a varying degree of importance and feasibility. The most cited LM practices are a reduction in set up time, kanban control mechanism, small batch size, supplier management, preventive maintenance, multi skilled employees, even workload, total employees involvement, TQM, training, education, teamwork, production smoothing, continuous improvement, 5S and standardization,[34]. Most of the literatures find the frequently applied lean practices are reduced set up time, kanban control, and small batch size. These practices are feasible in most of the work environment and give you the maximum benefits of lean philosophy,[34].

A typical steps of lean implementation cycle are: Identification of value, value stream mapping, flow production system, pull production system, and finally seek perfection, [35].

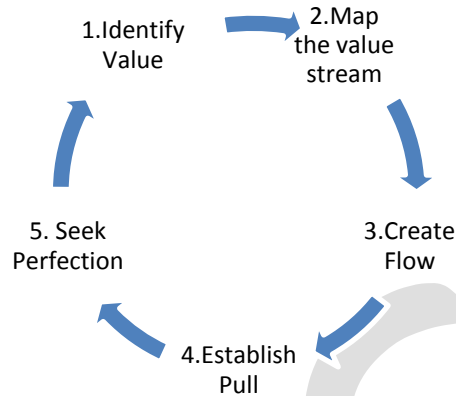


Figure 3: Lean Implementation

The following are the measures of lean manufacturing identified through the literature survey----

1	Maintaining strategic relation with the supplier	[36]
2	set up time, small batch size, and JIT production	[16]
3	Attitude of workforce	[4]
4	Comparative cost payback	[37]
5	Customer determined rate of production	[12]
6	Reducing resistance to change by winning confidence of the employees	[2, 33]
7	Efficient scheduling to cut down waiting time	[4, 38]
8	Statistical quality control & assurance	[14]
9	Increased equipment availability through total productive maintenance	[24]
10	standardization to reduce variety, complication in processing	[12, 29]
11	Capable leadership	[39]
12	Proficient application of novel competitive technology	[40]
13	Team-based cultures	[39].
14	Use of Kanban for better visibility in value chain	[25, 41]
15	Improved ergonomics & safety	[25]
16	Involvement of management, workers & suppliers in decision making.	[29]
17	Flexibility of machines, employees, and reduction in lead time	[42]
18	Optimum use of cubic space available	[23]
19	Striving towards zero defects	[27]
20	Cellular Manufacturing	[23, 25]
21	Total quality management	[43]
22	Elimination of all kinds of waste for maximum value addition	[1]

23	Customer driven quality initiative	[28].
24	Ability and competency of sales workforce	[1]
25	Timely availability of quality of raw material	[10-45]
26	Drive commitment to eliminating problems	[3]
27	Reduction in both in process and end items inventory	[12]
28	Whole hearted commitment of top management	[44]
29	Reduction in unnecessary cost of material handling & transportation	[4]
30	Reduction of total lead time & imparting flexibility to business	[46]
31	Adherence to delivery schedule	[47]
32	Mass customization	[44]
33	Enhanced safety standards leading to higher productivity	[48]
34	Proper training & education to reduce resistance in lean implementation.	[49]
35	Flexible machinery and workers	[50, 51]
36	Maximizing manufacturing productivity through total productive maintenance	[52]
37	Equipment reliability & efficiency	[53]
38	Involvement of customers in quality planning process	[54]
39	departure from the “you operate, I maintain” philosophy	[48].
40	Optimising planning and scheduling	[53]
41	Automation with a Human Touch	[55].
42	Strategic relationship with the suppliers	[12]

Table 3: Measures of lean manufacturing

4. Business Agility

Both agility and leanness emphasize optimum quality product. They also aim at minimization of total lead time taken from the moment customer places the order to the product finally delivered to customer. The ultimate objective of the lean philosophy is to increase customer responsiveness by elimination of all kinds of waste in the system. Reduction in total lead time is sufficient condition for achieving leanness; however degree of leanness is one of the necessary conditions to achieve business agility. Thus leanness is an essential ingredient of business agility. Minimization of total lead time is necessary to impart agility to the organizations due to extremely fickle demand which is difficult to predict [56].

Though, there is no clear demarcation between business agility and leanness in the literature available. But one thing is sure, agile manufacturing is a broader tem, which includes both firms' internal and external environment, though lean philosophy is mostly related to firms' internal environment. Both business agility and leanness are essential for sustainable competitiveness and development,[10, 27, 41, 44, 46]. The purpose of this research is to investigate the effect of leanness on the agility of the business. Organizations exploit wide range of practices to upgrade their operational capabilities. Lean manufacturing and agile manufacturing has become buzzword which guarantees you sustainable development. The verbal meaning of lean is something which is not fat and agile means nimble, obviously the lean will be more agile, the same is true in case of business also,[17]. Actually the business agility and leanness are subset of each other,[10, 57]. Though many authors describe agility and leanness differently but ultimately they explain the same dimensions,[46]. One of the differences between the two could be, leanness emphasizes the elimination of all kinds of waste from the system, whereas agility refers to your response to fickle business environment, such as changing taste and demands of the customers,[58]. The basic characteristics of leanness and agility mostly overlap, such as TQM, TPM, SMED, 5S, and continuous improvements etc.

The term agile manufacturing was first put forth by group of researchers at Iaccoca Institute, Lehigh University in 1991,[59]. An agile manufacturing system is capable of responding to unpredictable demand, changing market, and overall environment quickly and effectively in due time,[60, 61]. Exploiting these changes as opportunities, such as quick launching of new product and switching between the products are also referred as agility,[51, 62, 63].

However, there is a lack

5. The impact of element of lean manufacturing on productivity

Productivity is the multiplier effect of efficiency and effectiveness. To become productive one need to produce right kind of product (Effectiveness) rightly (Efficiency). Thus the productivity encapsulates both product quality & quantity. In order to become productive you need to produce right kind of product in right quality at right time at a minimum possible cost. Improving the quality by continuous reduction in, avoidable delay, rework, cost, error, and machine down time & reliability,[4, 64, 65]. Apart from these, motivational level and job skills of the worker also affect productivity. Involvement of customers in quality process planning reduces rework, scrap, and lead by more than 50%, thereby increasing the productivity significantly,[54]. Prevalence of quality culture in the organization also helps in boosting productivity. Productivity is actually an outcome of raw material, conversion process, and outcome,[66].

6. Green lean manufacturing

No manufacturing process can be effective unless it take care of the society and environment as a whole. Lean manufacturing is the methodology of continuously improving the quality of the product by removing all kinds of waste in the system. Any productive manufacturing process utilizes minimum amount of energy, and often releases lesser amount pollutant or waste into the environment,[67]. The Green manufacturing is the technology to reduce emission through the use of renewable source of energy without generation of any waste,[68]. Though, only in recently studies lean manufacturing is linked with environmental safety. Both green practices and lean manufacturing are zero defect process, can be coined as green lean manufacturing. The objective of green lean manufacturing is to reduce the overall cost including the cost to the society, while maintaining all the contemporary performance parameters, [69,70]. Green techniques and lean manufacturing works synchronously by drawing wisdom from Mother Nature, which is actually both effective & efficient in imparting value by elimination of all kinds of waste. Hence the green lean manufacturing can be the most productive methodology,[71]. Though the waste described by the lean philosophy and green practices are different but all the 8 lean waste is having a significant impact on the environment. Waste can be reduced by judicious use of all vital resources including the energy and fuel leading to lower emission in the environment,[68]. The 8 type of waste describe by TPS are over processing, over production, waste of waiting, waste of inventory, waste of defectives, waste of movement, product complexities, and unused potential of employees. Waste can be reduced by judicious use of all vital resources including the energy and fuel leading to lower emission in the environment,[71].

The following table describes the effect of lean waste on environment,[72].

Defect	Description	Effect on environment
Over processing	Incorporating features not demanded by the customer	<ul style="list-style-type: none"> Excess processing Use of more fuel & energy results in greater emission in environment
Over Production	Production of end items to store in anticipation of demand	Excess use of material, leading to higher fuel and energy consumption results in greater emission in the environment
Waste of waiting	Delay because of equipment downtime, bottleneck, under capacity utilization	More energy consumption because of heating, cooling, and lighting leading to higher fuel consumption subsequent more emission.
Waste of inventory	Pile up work in process inventory	Excess use of raw material leading to higher fuel consumption, spoilage, and space results in more emission
Waste of making defective product	Defect can be anything which does add value to the product	<ul style="list-style-type: none"> More rework leading to higher fuel consumption and subsequent greater emission to environment. Results in scrap need to disposed of, leading to environmental pollution
Waste of movement	Unnecessary movement of man and material	Leading to higher fuel consumption and more emission to environment.
Complexity	More parts, subassembly, and number of steps of process	Waste of energy, fuel leading to higher emission
Unused potential of employees	Not using the suggestions and creativity of employees	Dearth of ideas to reduce the waste

Table 4: Relationship between lean waste & green practices

Taking care of environment is the integral part of the lean philosophy,[73]. Lean target all kinds of waste leading lesser emission in the environment. Lean philosophy actually coincidentally and unconsciously safe guards the environment. The main objective of lean philosophy is to acquire production efficiency by optimum use of material, reuse of the material, and energy. Thus lean philosophy actually unconsciously protects the environment by judicious use of all input leading to lesser use of energy, hence lesser emission. But in the recent past energy use has become a part KAIZEN continuous improvement in quest of acquiring energy efficiency to reduce emission in the environment,[73].

Lean philosophy aims at fostering an operational and cultural climate within the organization that is highly encouraging to minimization of waste and subsequent prevention of pollution. Green lean philosophy significantly improves the productivity by continuously increasing efficiency and effectiveness of the organization.

7. Interpretive Structural Modeling (ISM) (Adapted From [74])

ISM is an interactive modeling technique. In this technique, a set of diverse, directly and indirectly related elements are structured into an inclusive methodical model,[75, 76]. The model so formed exhibits the structure of a complex issue or problem in a cautiously designed outline implying graphics as well as words,[77]. Interpretive structural modeling (ISM) is a well-recognized methodology for spotting associations amongst specific items, which define a problem or an issue. For any composite problem under deliberation, a number of factors may be related to an issue or problem. However, the direct and indirect associations among the factors describe the circumstances far more precisely than the individual factor taken into separation. Therefore, ISM gives insights into combined perceptive of these associations. ISM starts with an identification of variables, which are pertinent to the problem or issue, and then expands with a group problem solving technique. Then a contextually relevant subordinate relation is chosen. Having decided on the element set and the contextual relation, a structural self-interaction matrix (SSIM) is developed based on pair wise assessment of variables. In the next step, the SSIM is transformed into a reachability matrix (RM) and its transitivity is checked. Once transitivity embedding is complete, a matrix model is obtained. Then, the partitioning of the elements and an extraction of the structural model called ISM is obtained. In this approach, a methodical application of some basic concepts of graph theory is used in such a way that theoretical, conceptual and computational influence are exploited to explain the complex pattern of contextual relationship amongst a set of variables. ISM is proposed for use when desired to utilize methodical and rational thinking to approach a complex issue under deliberation. Interpretive Structural Modeling is a computer-aided method for developing graphical demonstrations of system composition and structure. ISM had its foundation in Warfield's perception of them need, when attempting to combine science to policy, for "a set of communication tools which have both a scientific and lay character serving as a linkage device between science and the public, and having sense for all who are involved" and which, in particular, are competent of communicating a generic intellect of the elements and their relations which describe system structure.

It is a modeling technique for portraying the specific relationship and overall structure in a diagraph model. It helps to oblige order and direction on the intricacy of associations amongst various elements of a system. It is largely intended as a group learning procedure, but individuals can also use it,[78].

7.1 MICMAC (Cross-Impact Matrix Multiplication Applied to the Classification analysis) analysis

MICMAC analysis is usually done in order to classifying the factors into four different categories. This classification is based on the driving power and dependency power of the factors. The classification helps in identification of key process enablers.

8. About Fuzzy Comprehensive Analysis (Adapted From, [79])

Fuzzy comprehensive evaluation system is based on mathematics used for complete evaluation of objects in a real world situation that are vague and difficult to define by using the thinking and methods of fuzzy mathematics. Fuzzy mathematics was first noticed in 1965, and pioneer is professor Chad (LAZadeh) who possesses substantial expertise in the area of automatic control mechanism. Like any other concept the fuzzy mathematics also kept evolving for near 38 years. Over the years fuzzy mathematics has witnessed a rapid advancement both in theory and practical. Fuzzy comprehensive analysis is based multi criteria decision making. Through the fuzzy evaluation information about the priority of various alternatives can be served as a reference for decision makers to make decision. You need to select the suitable appraisal indicators, these indicators can be from a different point of view, reflecting different aspects of the evaluation index system of evaluating objects. Fuzzy comprehensive evaluation needs the use of the indicator system comprises of multiple index. Evaluation should follow the principles of purpose, objectivity, comprehensiveness, sensitivity and mutual independence, the comparability and should be easy to operate. In the fuzzy comprehensive evaluation, the importance of weighing the value of different projects is called the weight,[80].

9. Analytical Hierarchical Programming (AHP)

The Analytic Hierarchy Process (AHP) is the most popular method used for multi criteria decision making, put forth by Saaty (1977). In the recent time AHP has been applied by many researcher mainly due to the its clarity and mathematical characteristics. The AHP may be a useful tool to ease out the process of decision making in complex situation involving multi level hierarchical objectives and different alternatives. The pertinent data are extracted by applying a set of pair-wise comparisons. These comparisons give you the weight of the decision criteria and measures of relative performances of each of the alternative. Apart from this, AHP provides mechanism for improving consistency.

The AHP algorithm helps in disintegration of the original problem into series of related sub problems. These sub problems comparatively easier to understand, hence can be better subjectively evaluated. Subjective evaluations are quantified by assigning numerical values, which subsequently rank each alternative on numerical scale.

10. Research Gap

- Though numbers of articles and research papers have been published since 1980 by the various researchers and practitioners on lean manufacturing. There is no consensus amongst researches over the comprehensive list of lean measures .Number of measures of leanness also been suggested but the relationship amongst these measures are confusing and confounding because of their interdependency. Therefore the relative importance of these measures is difficult to adjudge.
- No clear demarcation put forth that proposes, what are the industry specific measures should be taken achieve leanness? Or all the measures should be taken care of, regardless of type and size of industry.
- Similar sort of confusion exists in measures of agility & leanness due to overlapping natures of elements of leanness & agility.
- Moreover I, do not find any literature which explain the relationship between the productivity and agility of the manufacturing organization.
- More than 60 % Indian GDP comes from small & medium scale enterprises. Most of these organizations are using obsolete technologies, suffering from syndrome of non-judicial application all vital resources including excess inventory. Due to this they are the major source of pollution in the country. Production process which pollutes the environment is not at all effective, which is the essential ingredient of the productivity. I decided to target Indian SMEs' automotive sector which is the substantial part of SMEs in India, for the purpose of the current study.

This study will be a sincere effort to fill all the above mentioned gaps meticulously and thoroughly examine the various lean practices in the Indian SMEs' automotive sector and its applicability in improving the productivity.

10. Problem Identification

- Measures of green leanness found through literature survey are not categorical and often confusing in nature. These variables are appears to be different however intend to measure the same element of lean manufacturing. There are high degree of interdependency amongst the different measures of leanness. Therefore it's very difficult to develop the model of lean manufacturing and subsequent measurement of leanness. In this research an attempt will be made to classify these variables and put them under different groups. This groups will be almost independent and useful in measuring green leanness. Therefore measuring their relative importance will be easier to measure.
- Since the target industry selected for the research is small & medium scale enterprises related to auto sectors in India. Since there can be lack of expertise, finance, and other vital resources, it's not possible for the SMEs' to implement all the measures of leanness. So it's imperative to identify a few vital lean measures which SMEs' afford to implement to reap the maximum benefits.
- Business agility is a important ingredient of success by beating the cut throat competition. Problem is to find out the interrelation of business agility and green leanness.
- Development of index of agility for small & medium scale enterprises related to auto sector in India.
- To substantiate the fact business agility leads to enhancement in the productivity.

11. Research objectives:

My research objectives are divided into six categories and will be found, answering to the following specific research question-----

RQ1: How green leanness can be comprehensively defined?

RQ2: What are the drivers of green lean manufacturing? Do these drivers independently explain the leanness of the organization?

RQ3: How do these drivers affect the leanness of small & medium scale auto sector in India? And what are the relative importance these drivers specific to India SMEs' auto sector?

RQ4: How to find sustainable green lean practices those Indian SMEs' can afford to implement.

RQ5: How these lean practices related to the agility of SMEs' auto sector in India?

RQ6: How to develop the index of agility to measure agility of Indian SMEs' auto sector?

RQ7: How business agility enhances the productivity of SMES'.

RQ8: How to develop house of productivity for Indian SMEs' automotive sector ?

12. Research Hypothesis:

Based on extensive literature survey the following research hypothesis is developed:

H1: There is high degree of interdependency amongst the measures of green lean manufacturing and correlation matrix not an identity matrix.

Furthermore the ultimate goal of this study is to make Indian SMEs' auto sector agile by imparting green leanness to the system. Therefore for the purpose of the study I need to hypothesize some kind of relationship between agility and leanness.

H2: There is positive relationship between agility and green leanness, while leanness explains the agility of the business.

H3: Agile organizations are more productive in nature.

13. Frame work of research:

Sampling frame consist of all the manufacturing who have some expertise in implementing lean philosophy and lean implementation experts both in India & outside India. The sampling procedure will be convenient sample. Sample will consist of variety of manufacturing organizations both with respect to type and its size. Sufficient diversity in the sample will be maintained to mitigate biasness due to convenient sampling. Size of sample will be around 200. Elements of sample are mostly consist of operations managers who are having hands on experience of implementing lean philosophy and understanding of vital success parameters affecting lean implementation .

Extensive exploratory study will be conducted using questionnaire administered survey, where in the responded from the sample selected will be asked to rate their perceptions on 42 identified lean practices. Since the population size is limited, all questions in the survey are closed ended in nature in order to gather maximum response. The survey questionnaire was developed based on an extensive literature review,[27]. Questionnaire will be based on five points likert scale, wherein the perceive importance will ranges from 1 to 5 (Where 1 means “Not Important” & 5 means “Most Important”). Questionnaire will be frame using the various lean practices, majority of them found through the extensive literature survey to ensure the reliability and validity of measures of lean manufacturing. These lean practices mostly make use of firm’s organizational and operational performance to measure leanness. Opinion of lean experts will also be taken while using the various lean measures to test its validity of measuring research objectives.

14. Data Analysis

- Analysis of primary data found through the survey starts measuring the relationship amongst them. Interrelationship will be adjudged with the help of correlation matrix. If correlation matrix is not an identity matrix, means there are high degree of interdependency amongst the different measures of leanness. In other words we can say they are overlapping in nature and mostly intend to measure the same thing. This gives an opportunity to reduce data by putting the variables having high coefficient of correlation under on head, known as factor. Factors are the hidden variables which need to discover through the statistical analysis known as factor analysis. Factor analysis is multivariate interdependency analysis. These factors are independent in nature and give you the fair idea about their individual explaining power of leanness. SPSS will be used for extraction of factors and subsequent statistical analysis.
- The most important factors are selected instead of original 42 lean practices which measure the leanness. This results in significant reduction in data. Thereafter relationship between factors extraction and leanness will be analysed. Independent nature of factors extracted facilitates the use of multivariate dependency technique such as multiple regression. Leanness will be taken as dependent variable and factors extracted as independent of explanatory variables. Multiple regression helps in identifying the most important factors, which are critical for explaining leanness of the organization, which one of the objectives of the study.
- Literature survey suggests that the relationship between the leanness and business agility is often confusing and confounding, because of their overlapping characteristics. In most of the real world situation the relationship amongst the variables are vague and difficult to define. But one thing is sure the business agility is broader term which encapsulates leanness. In this research an attempt will be made to develop the index of agility in order to quantify the same. Fuzzy comprehensive analysis could be the ideal choice because it is most suitable for multi criteria decision making in the uncertain environment. Due to vague and confusing criteria in assessment of the agility, a precision appraisal may be unfeasible. Therefore in most of the literature the agility has been assessed linguistically because numerical evaluation in impractical. Informal procedure of using linguistic terms and subsequent associated functions is attribute of fuzzy logic. The linguistic term and associated membership function were found from the literature survey and it is customize in line to the needs of present study.
- Business agility affects the productivity of the organizations. Therefore almost all the factors influencing business agility will also affect the productivity. So it is imperative to quantify the factors of productivity. Literature survey suggest, analytical hierarchical programming could be the ideal choice in this situation.

15. Research Design:

Broad Research Question	Specific Research Question	Methodology
How can we increase the productivity of Indian SMEs' automotive sector using lean practices?	How green leanness can be comprehensively defined?	Literature review
	What are the drivers of green lean manufacturing? Do these drivers independently explain the leanness of the organization?	Literature review Survey, Interview with the experts, and Factor analysis
	How do these drivers affect the green leanness of small & medium scale auto sector in India? And what are the relative importance these drivers specific to India SMEs' auto sector? How to find sustainable green lean practices those Indian SMEs' can afford to implement?	Literature review, Multiple regression, Interpretive Structural Modelling and MICMAC analysis.
	How these green lean practices related to the agility of SMEs' auto sector in India? How to develop the index of agility to measure agility of Indian SMEs' auto sector?	Literature review, Expert Opinion, Fuzzy comprehensive analysis
	How business agility enhances the productivity of SMEs'?	Expert Opinion and Analytical hierarchical programming for quantification of factors of productivity.
	How to develop house of productivity for Indian SMEs' automotive sector?	Using Outcome of Analytical Hierarchical Programming.
	Substantiating index of agility and measures of productivity	Case Study

Table 5: Research Design

Conclusion

A comprehensive literature on lean philosophy is available since 1990, sighting numerous lean practices worldwide. Literature sighted different lean practices along with the relative importance of them. Some of the vital practices are, overcoming employees' resistance through proper training and education, commitment from top management, total employees involvement, improved ergonomics and relation with suppliers, reduced inventory and total lead time etc. Most of the lean practices found are overlapping in nature and difficult to adjudge their individual contribution in explaining leanness. Similar overlapping is found in variables explaining business agility and leanness. Green lean philosophy is an emerging concept and need of an hour for the sustainable development.

Despite offering many benefits for sustainable development, green lean philosophy is not easy to implement. There are many barriers to lean implementation some of them are, lack of awareness about lean philosophy, expertise required, and availability of finance etc. Literature review opens opportunities to new research to determine the industry specific green lean practices, there after its effect on business agility and productivity of manufacturing organizations, Indian SMEs' automotive sector in particular.

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RECHARGING OF WSN NODES BASED ON POLLING MAC PROTOCOL FOR LIFETIME MAXIMIZATION AND RELIABILITY

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Abstract--Wireless Sensor Networks are described with the help of Medium Access Control (MAC) protocol which supports the recharging of wireless sensor nodes. The technique used by MAC protocol is round robin scheduling. For simplicity it uses 1 limited services.

Wireless sensor nodes work by sensing and hence they are likely to run out of energy. For recharging they may request energy from the radio frequency devices. To reduce this outage of energy, we have derived a collaborative protocol in which when any node hears the energy request from any other node, it will repeat the request until the master node responds to it in the form of a recharging pulse. The performance of the proposed protocol can be determined with the help of probabilistic energy expenditure model. The results of collaborative protocol have shown that it can lead to an uninterrupted operation of network under varying values of various parameters.

Index terms -- Medium Access Control, round robin scheduling, collaborative protocol, probabilistic energy expenditure model, wireless sensor nodes, radio frequency devices, master node.

1. INTRODUCTION :

The technology of sensor nodes is considered as a yet another revolution in wireless technologies. The parameters of major concern of such sensor nodes include the node size, its low power consumption, better sensing ability, low cost communication, long battery life and its recharging. A WSN needs to be highly efficient and reliable to be used in harsh and challenging environments. Compared to the traditional charging methods which are accomplished with the help of cord, wireless charging methods introduce many benefits as follows:

- Initially, it improves user friendliness since the overhead of using(connecting) cables is vanished. Devices with different brands and different models can use the same charger.
- It also provides the design and fabrication of smaller devices with or without the attachment of batteries.
- It makes the devices more durable.(Eg.: water proof and dustproof)
- It adds on the flexibility of devices, especially those for whom replacing their batteries for charging is dangerous, costly or infeasible.
- Lastly, wireless charging is more flexible and efficient as it provides power to only those who request for it.

In this paper, where we have used MAC protocol for both data communication and recharging, nodes are not able to send data during recharging, however, the sensing process is still carried on. The ARQ procedure in MAC protocols ensures reliability in transmission of data packets via sending several erroneous packets several times. It, in turn, ensures reliable recharging in the following way:

- The probability of the master node to hear the recharging request is increased by setting a particular threshold.
- It also makes path for other nodes that they can overhear the request and can rely on it. This also will increase the probability that the recharging request will not be left unheard.
- And lastly, the master node is also made to send the recharging pulse after a certain interval of time even if no node has asked for the same.

1.1 MAC Protocol:

Similar to all other shared medium networks, the technique which supports the successful and efficient operation of wireless network is the Medium Access Control (MAC). The basic job of MAC protocol is to avoid collisions. It takes care that the nodes should not transmit at the same time and if they do so, there should be no interference or collision in between them which may lead the network to a standstill. Many MAC protocols have been developed for wireless networks such as Time Division Multiple Access (TDMA), Code Division Multiple Access (CDMA) and contention protocol such as IEEE 802.11. In order to design a good MAC protocol for

wireless sensor networks, the attributes which are taken into consideration are energy efficiency, prolonged network lifetime, scalability, throughput and bandwidth utilization.

2. LITERATURE SURVEY :

Table 1

Sr no	Title	Author	Publication	Year	Approach
1	RF-based Power Transmission for Wireless Sensors Nodes	Guocheng Liu , Nezih Mrad , George Xiao , Zhenzhong Li and Dayan Ban	Institute for Micro structural Science National Research Council Canada	Nov 2011	A power and data transmission system for strain gauge sensors used for SHM and other applications.
2	Improving the Lifetime of Wireless Sensor Nodes Batteries by using SEMD (Single Energy Multi Data) and MEMD (Multi Energy Multi Data) Transmission Modes	Aarti Sharma and Dr. B.K. Sharma	International of Journal of Electronics and Communication Engineering.	2013	The power patterns of different one dimensional and two dimensional topologies are simulated and analyzed.
3	Development Of Algorithm For Improving The Lifetime Of Wireless Sensor Nodes Batteries Using Matlab	Aarti Sharma, B.K. Sharma	International of Journal of Industrial Electronics and Electrical Engineering	Feb.- 2014	Multi hop charging
4	A Polling MAC with Reliable RF Recharging of Sensor Nodes	Mohammad Shahnoor Islam Khan, Jelena Mi sić and Vojislav B. Mi sić	Wireless Communications and Networking Conference	2015	Modeled a simple MAC protocol which provides reliable wireless in- band recharging of sensor nodes in a network

3. EXISTING ARCHITECTURE

The wireless sensor networks consist of sensor nodes powered by a rechargeable RF energy source and a master node that is present with unlimited energy. This master node may communicate with existing nodes in the network by sending poll packets to them. The node in the Network listens to the poll packet by only the targeted node receives it. This poll packet may contain data if it is available or else it is sent as a null packet. However, this packet may get lost in the network due to noise or any other interference due to this the node may have to repeat the recharge request for a certain number of times. Hence, a threshold is set of each and every node (except master node) in the network so that it can repeat the recharge request for a certain number of times. This case can prove as useless if the master node does not receive the recharge request after certain times of retransmission. Due to this the node may completely lose all its energy and stop operating. This condition is known as energy outage. Once this condition occurs, the node will be completely isolated from the network and as a result it will not be able to participate in subsequent activities of network. This energy outage situation can be avoided by collaborative relaying of recharge request by the neighbour nodes in the network as well as by making the master node to participate in proactive recharging. This is done using MAC protocol. In this the nodes will be able to listen the poll packets sent by master node as well as the response data packets sent by each and every node in the network.

In a network if any node sends a recharge request to master node of request other nodes will also come to know about this recharge request by reading the header of such packet. If the master node does not reply with the recharging pulse the other nodes that overheard the request may relay the request. Since the request is sent by multiple nodes, the master will eventually receive the request of will emit the recharge pulse in response.

4. PROPOSED ARCHITECTURE:

During recharging, we may assume that RF pulse is sent in the same RF band used for communication. This may disturb the pattern of regular communication in the network. The polling cycle is known as recharge cycle when recharge occurs. Clearly, the node that is located at the longest distance from the master node will receive least amount of energy as the recharge pulse has to cover long distance. Hence, if the node that is situated at the greatest distance from the master node is crucial in network i.e. if it is performing the most important task in the network and if gets out of energy then the whole working of network will be stopped. Hence, our proposed system determines the recharging of nodes based on their priority. This priority is determined on the basis the role of node in the network and the number of times it is used for any job, so that if the node of least requirement faces energy outage then also the network will not be interrupted. Hence, whenever the master node receives recharge request from any node in the network, it will first determine its priority and will respond accordingly.

CONCLUSION AND FUTURE WORK :

In this proposed system, we have introduced a technique for efficient recharging of WSN nodes based on a polling MAC protocol and replace it with priority based MAC protocol so that the nodes which are more important in the network and require frequent recharges can be polled faster and overall network efficiency can be improved. In future, we will be exploring the networks and other optimal charging techniques which will help the network to minimize energy outage and packet waiting timing.

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Effect of addition of NaCl on the functional properties of BMJ24 Jeewanu prepared under anoxygenic conditions (PUAC) in the water and in phosphate buffer of pH 6, 7 and 8 under anoxygenic conditions.

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Abstract— The present form of cell as we see it today has undergone evolution of 3.2 billions of years. According to Bahadur and Ranganayaki the earliest living cells was very simple in structure and were full of the properties of biological order. Bahadur in 1967 suggested that the way in which the systems organize themselves with properties of biological order is very important feature of the study of origin of life. Jeewanu, the autopoietic eukaryotes were prepared by Bahadur in 1967.

It was observed that when a mixture of Jeewanu and water is exposed to sunlight, water is split up into H_2 and O_2 . But due to the nitrogenase like activity of Jeewanu, the produced hydrogen is utilized in the fixation of nitrogen. The hydrogen produced by the splitting of water is also utilized in the reduction of inorganic carbon. Khare prepared boron molybdenum Jeewanu in 1989 which showed significant water splitting. NaCl is a common constituent of the living cells.

An attempt has been made in this paper to study the effect of NaCl addition to the PEM on the functional properties of BMJ24 Jeewanu prepared under anoxygenic conditions (PUAC) in water and in phosphate buffer of pH 6, 7 and 8 under oxygenic conditions.

Keywords— Jeewanu, pH, BMJ24, PEM, NaCl, autopoietic, eukaryotes, exposure, Mineral solution, sunlight, PUAC, phosphate buffer, anoxygenic condition, pyrogallol.

INTRODUCTION

The present form of cell as we see it today has undergone evolution of 3.2 billions of years. According to Bahadur and Ranganayaki the earliest living cells was very simple in structure and were full of the properties of biological order. (Bahadur, K and Ranganayaki, S, 1964). [1] To tackle the problem of origin of life, it is essential to know how this earliest cells were synthesized under natural conditions. The molecular or the Chemical Evolution Theory given by Haldane (1929) [2] and Oparin (1924) [3] is the basis of the modern approach to the problem of 'Origin of life'. Bahadur in 1967 suggested that the way in which the systems organize themselves with properties of biological order is very important feature of the study of origin of life. (Bahadur, 1967). [4] The problem of origin of life in investigated basically in order to find out the natural condition under which the replicating, self-sustaining systems were produced. (Blum, 1961, Bahadur and Ranganayaki, 1966). [5,6]

The origin of life can be approached the best way if life and the living systems are considered in the light of functional properties. (Bahadur and Ranganayaki, 1980). [7]

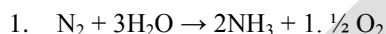
It was observed that when a mixture of Jeewanu and water is exposed to sunlight, water is split up into H_2 and O_2 . But due to the nitrogenase like activity of Jeewanu, the produced hydrogen is utilized in the fixation of nitrogen. Kumar in 1982 estimated the fixed nitrogen of the exposed mixture and thus confirmed the fixation of nitrogen by Jeewanu chemically. (Kumar, 1982). [8] The hydrogen produced by the splitting of water is also utilized in the reduction of inorganic carbon. (Smith et al, 1981). [9] They observed that on exposure to light from a mercury lamp, the aqueous mixture of Jeewanu, $NaHCO_3$ and water shows the appearance of ^{14}C in the organic material.

When the Jeewanu water mixture is kept in Warburg's flask, which is attached to the manometer filled with mercury and the entire apparatus is exposed to sunlight and kept in shade after some time, it is observed that the pressure in the flask is changed. Three reactions take place in the flasks: (i) splitting of water (ii) fixation of nitrogen (iii) loss of fixed nitrogen and the change in the pressure of the flasks might be due to the resultant of the gases evolved and fixed by these reactions. Reaction (i) is photochemical and stops as soon as light is cut off. Reaction (ii) and (iii) are ionic in nature in presence of molybdenum Jeewanu which has nitrogenase like material and takes place both in light and shade. Although third reaction is slower than the second reaction and takes place all the time during the nitrogen fixation but can be observed in shade only after all the hydrogen set free is utilized in the fixation of nitrogen and is stopped as the pressure of the Warburg's flask increases.

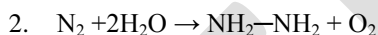
In light, Jeewanu splits water molecule to hydrogen and oxygen and this increases the pressure in the Warburg's flasks. The hydrogen produced is very active and combines with nitrogen of the air of the overhead space of the mixture of Warburg's flasks. In presence of molybdenum Jeewanu having nitrogenase like activity, the ionic reaction of combination of hydrogen and nitrogen takes place both in light and shade. The increase in pressure due to the water splitting is completely stopped in shade and so the combination of hydrogen and nitrogen is more prominently observed in shade.

When kept in shade, a decrease in the pressure of the flasks is observed. This can be explained in the following manner:

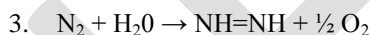
When nitrogen combines with hydrogen, it can do in three ways (i) one volume of nitrogen combines with three volumes of hydrogen to give ammonia, (ii) one volume of nitrogen combines with two volumes of hydrogen giving hydrazine or (iii) one volume of nitrogen combines with one volume of hydrogen to produce diimine.



(Ammonia)



(Hydrazine)



(Diimine)

In these reactions, from one volume of nitrogen 1.5, 1 and 0.5 volume of oxygen will be produced. When ammonia is formed, there will be an increase of 1.5 volumes of gas in the mixture per one volume of nitrogen combined, and so an increase in pressure of the Warburg's flask will be observed. In the formation of hydrazine, as one volume of nitrogen combines with one volume of hydrogen leaving one volume of oxygen, there is no change in the volume of the gas in the flask and thus no change in the pressure of the flask will be observed. But when diimine is formed, there will be a decrease of 0.5 volume of gas in the overhead space of the flask, as only half volume of oxygen will be left. Thus decrease of pressure can be observed only if nitrogen combines with hydrogen to produce diimine when the hydrogen needed is coming by the splitting of water molecules.

Yogesh Khare (1989) prepared boron molybdenum Jeewanu and reported that addition of sodium borate in the PEM in which Jeewanu are prepared, decreased the size of the Jeewanu and increased their number. (Khare, Y, 1989). [10]

Sodium chloride is widely distributed in nature. About 2.8% sodium chloride is found dissolved in sea water and it is a common constituent of the living cells. Blood contains 350-550 mg of sodium chloride per 100 ml. sodium chloride regulates the osmotic pressure of the body fluids. It participates in a number of reactions resulting in the formation of HCl in the stomach. In the present section, the effect of addition of sodium chloride on the pH and the blue colour intensity caused by the formation of Mo^{4+} in the PEM of BMJ24 has been investigated.

Bahadur and Ranganayaki (1970) have observed that the organo- molybdenum microstructures are able to split water into hydrogen and oxygen in presence of sunlight and fix molecular nitrogen. [11]

It was observed that addition of sodium chloride in the PEM of BMJ24 Jeewanu, produced particles of larger size and the hydrogen ion formation increased with period of exposure. (Srivastava, D., 1991) [12].

Effect of variation in the concentration of mineral solution, formaldehyde and ammonium molybdate on pH and colour intensity of the PEM of 1.531211 SMJ38 Jeewanu before and after exposure to sunlight was studied by Srivastava, D. [13] - [17]

Effect of irradiation of 1.5312211SMJ29 Silicon Molybdenum Jeewanu PEM with clinical mercury lamp and sunlight on the morphology of the silicon molybdenum Jeewanu was studied by Srivastava. [18]

Effect of addition of Methanol and Ammonium Molybdate to(0+15):30:10:20:10:10 SMJ8 Jeewanu on the morphology, pH and colour intensity of the PEM of the Jeewanu both before and after Exposure to Sunlight up to a Total of 32 Hours was studied by Srivastava, D. [19,20]

Variation in the blue colour intensity and the pH of the PEM of 1.531211SMJ29 silicon molybdenum Jeewanu when the PEM is irradiated with clinical mercury lamp and sunlight” was studied by Srivastava, D. [21]

Srivastava, D., “Study of the effect of addition of Sodium Chloride on the pH and blue colour intensity of the PEM of the BMJ24 Jeewanu” was studied by Srivastava, D. [22]

Study of the effect of NaCl addition on the functional properties of BMJ24 (PUOC) in water and in phosphate buffer of pH 6, 7 and 8 under oxygenic conditions was studied by Srivastava, D. [23]

Study of the effect of NaCl addition to the PEM on the functional properties of BMJ24 Jeewanu prepared under oxygenic conditions (PUOC) in water and in phosphate buffer of pH 6, 7 and 8 under anoxygenic conditions was studied by Srivastava, D. [24]

Study of the effect of addition of NaCl on the functional properties of BMJ24 Jeewanu prepared under anoxygenic conditions (PUAC) in the water and in phosphate buffer of pH 6, 7 and 8 under oxygenic conditions was studied by Srivastava, D. [25]

This paper deals with the study of the effect of addition of NaCl on the functional properties of BMJ24 Jeewanu prepared under anoxygenic conditions (PUAC) in the water and in phosphate buffer of pH 6, 7 and 8 under anoxygenic conditions.

EXPERIMENTAL

The following solutions were prepared:

- 1) 4% (w/v) ammonium molybdate
- 2) 3% (w/v) diammonium hydrogen phosphate
- 3) **Mineral solution:** This was prepared by dissolving 20.0 mg each of potassium sulphate, calcium acetate, magnesium sulphate, zinc sulphate, manganese sulphate and 10.0 mg of copper sulphate in 80 ml of double distilled water. One salt was dissolved completely before adding another salt. In a separate test tube, 50 mg of ferrous sulphate was dissolved in 10.0 ml of distilled water. To this, 0.1 ml of 6NH₂SO₄ was added to avoid hydrolysis. Both solutions were mixed. The total volume of the mineral solution was made to 100 ml by adding distilled water.
- 4) 36% formaldehyde
- 5) 3% (w/v) sodium chloride solution,
- 6) 5% (w/v) sodium borate solution

Each solution, except formaldehyde, was sterilized in an autoclave at 15 lbs for 15 minutes.

Two clean, dry and sterilized coming conical flasks of 250 ml capacity were taken and labeled from 1 and 2.

To each flask, 15 ml of ammonium molybdate, 30 ml of diammonium hydrogen phosphate, 10 ml mineral solution, 20 ml of 36% formaldehyde and 10 ml of sodium borate were added. Then, to flask 2, 10 ml sodium chloride was also added. The total volume of flask 1 was 85 ml and the total volume of the flask 2 was 95 ml.

In a test tube, alkaline pyrogallol solution was prepared by mixing 0.15 ml of 30% aqueous solution of sodium hydroxide and 0.15 ml of 20 % aqueous solution of pyrogallol. This pyrogallol solution was divided into two test tubes and one test tube was kept in each of the two flasks labeled 1 and 2 in a standing position taking care that the alkaline pyrogallol and the mixture of the flask do not get mixed up.

The flask number 1 and 2 were tightly plugged with rubber cork. Each flask was shaken carefully and exposed to sunlight for a total of 24 hours giving 4 hours exposure daily. In the mixture of flask 1 and 2 the Jeewanu were prepared under anoxygenic conditions (PUAC). After 24 hours of exposure, the contents of each flask was filtered, dried and weighed and the yield was recorded.

PROCEDURE:

Nine clean and dry Warburg's flasks of total volume 14.5 ml and bottom area 9.5 sq.cm. were taken and labeled as 1 to 9. Flask 1 was treated as control having only 5.0 ml distilled water. 0.3 ml distilled water was kept in the side lobe. Flask number 2, 3, 4 and 5 were filled with 20.0 mg of 1.531201 BMJ24 (PUAC) Jeewanu without NaCl in its PEM and 4.0 ml distilled water respectively. In the remaining flasks labeled 6, 7, 8 and 9, 20.0 mg of 1.531211 BMJ24 (PUAC) Jeewanu with NaCl in its PEM and 4.0 ml of distilled water was added.

In the side lobe of each flask 0.3 ml of distilled water was added. Then, in flask 2 and 6, 1 ml distilled water, in flask 3 and 7, 1 ml phosphate buffer solution of pH 6, in flask 4 and 8, 1 ml phosphate buffer solution of pH 7, in flask 5 and 9, 1 ml phosphate buffer solution of pH 8 were added respectively. These flasks were attached to their respective manometers filled with mercury. The whole apparatus was then exposed to sunlight for half an hour. The pressure changes of the Warburg's flasks were recorded after every five minutes. Then the whole apparatus was brought in shade for half an hour, readings were taken at every five minutes intervals. The whole process was repeated twice in a day.

The readings of the control flask having water alone were subtracted from each reading at that time to account for the pressure difference due to the change in the temperature.

Working under anoxygenic condition

Before the commencement of the observations under anoxygenic conditions, the oxygen in the overhead space of the Warburg flask was completely absorbed in pyrogallol and alkali mixture. For this, 0.3 ml alkaline pyrogallol was kept in the side lobe of the Warburg flask after keeping the necessary contents in the flask. The side lobes of the experimental flasks were covered with the black cloth of same size and same material. The same procedure was adopted for the control Warburg flask also to record the pressure due to temperature variation. The side lobes of the Warburg flasks were covered with black cloth to avoid the photochemical decomposition of alkaline pyrogallol.

The tap of the manometers were closed. The pressure in the Warburg flasks decreased as the oxygen in it was absorbed in the alkaline pyrogallol kept in the side lobe. When the pressure became constant, the outer tap of the manometer was opened to allow the pressure of the Warburg flask to come up to the atmospheric pressure. The air which came in consisted of oxygen too and this oxygen was again allowed to be absorbed.

The process of opening the tap and allowing the air to go into the flask to nullify the pressure decrease in the flask was repeated several times till the oxygen of the overhead space of the Warburg flask was absorbed and there was no decrease in the pressure of the flask even after allowing the mixture to stand overnight. This gave indication that there was no oxygen left in the overhead space of the mixture. The side lobes of all the Warburg flasks were covered with the same size of black cloth to avoid photochemical decomposition of alkaline pyrogallol solution and to provide similar condition in all the Warburg flasks. Only at this stage, the experiments were started.

Always a Warburg flask containing only corresponding amount of water with alkaline pyrogallol in the side lobe was kept as a control along with the experimental flasks. In the control flask, no Jeewanu sample was kept. This control was kept near the experimental flask and its readings were taken simultaneously along with the reading of the experimental mixture. The atmospheric pressure was recorded by a barometer during the experiment.

Preparation of alkaline pyrogallol

0.15 ml of 30% aqueous solution of sodium hydroxide and 0.15 ml of 20% aqueous solution of pyrogallol were mixed and thus the alkaline pyrogallol was prepared.

OBSERVATIONS

TABLE – 1

Effect of sodium chloride on the amount of solid material formed in the two PEM.

S.N.	Type of PEM of BMJ24	Amount of solid material formed in the PEM in g
1	PEM without NaCl (PUAC)	0.6890
2	PEM with NaCl (PUAC)	0.6390

It was observed that the amount of solid material formed in the PEM without NaCl (PUAC) was slightly more.

The readings of the Warburg's flasks were as follows:

TABLE – 2

Pressure changes in Warburg's flasks (in cm of mercury), containing 1.531201 BMJ24 (PUAC) without NaCl in the PEM and 1.531211 BMJ24 (PUAC) with NaCl in the PEM, in water and in phosphate buffer of pH values 6, 7 and 8 under anoxogenic conditions

Time in minutes	1.531201 BMJ24 (PUAC) without NaCl				1.531211 BMJ24 (PUAC) with NaCl			
	water	pH of phosphate buffer			water	pH of phosphate buffer		
		6	7	8		6	7	8
Sunlight								
5	-0.6	-1.3	+0.2	+0.5	-0.5	+1.0	+0.4	+0.7
10	-0.4	-0.8	+0.3	+0.2	-0.5	+0.5	+0.3	0.0
15	+0.2	-0.7	+0.9	+0.5	+0.1	-0.4	+0.9	-1.5
20	-0.4	-0.2	+0.5	+0.3	+1.0	+0.1	+0.5	-2.0
25	-0.2	-0.3	+0.4	+0.2	+0.1	0.0	0.0	-2.8
30	-1.5	-0.2	+0.5	+0.3	+1.2	+0.1	+0.4	-3.1
Shade								
5	-0.1	-0.7	-0.3	-0.5	-0.1	-0.4	-0.9	-3.6
10	+1.5	-0.8	-0.1	0.0	+1.7	-0.6	-0.9	-3.6
15	+1.2	-0.4	-0.4	-0.6	+1.1	-0.3	-0.9	-3.5
20	+1.7	-0.6	-0.8	-0.9	+1.6	-0.4	-1.2	-4.3
25	+1.8	-0.6	-0.9	-0.4	+1.7	-0.4	-1.2	-1.0
30	+1.7	-0.6	-1.0	-0.2	+1.7	-0.4	-1.1	-3.7
Sunlight								

5	+2.2	0.0	-0.6	-0.6	+2.0	-0.8	-0.6	+3.8
10	+2.0	-0.4	-0.1	-0.2	+1.9	-0.6	+0.1	-3.8
15	+2.5	-0.2	+0.4	+0.7	+2.2	-0.3	+0.6	-3.1
20	+2.3	-0.2	+0.8	+0.5	+2.1	-0.3	+0.5	-3.1
25	+2.4	-0.5	+0.8	+0.9	+2.2	-0.6	+0.3	-2.7
30	+3.8	-0.5	+0.9	+0.3	+3.5	-0.7	+1.8	-3.5
Shade								
5	+3.7	0.0	-0.6	-0.3	+3.6	-0.1	-0.9	-4.4
10	+3.2	-0.5	-0.8	-0.9	+3.2	-0.3	-1.1	-4.9
15	+3.1	-1.0	-0.9	-0.1	+3.1	-0.6	-1.0	-4.4
20	+3.3	-1.0	-0.7	-0.1	+3.1	-0.4	-0.9	-4.2
25	+3.1	-0.8	-1.0	-0.2	+2.8	-0.2	-1.0	-4.2
30	+3.0	-0.7	-1.2	-0.2	+2.7	-0.2	-1.3	-4.5

CONCLUSION

Under anoxygenic conditions 1.531211 BMJ24 Jeewanu (PUAC) produced in the PEM having NaCl showed slightly less water splitting and also slightly less nitrogen fixation as compared to 1.531201BMJ24 Jeewanu (PUAC) without NaCl.

There was not much change in the trend of the reaction when phosphate buffer of pH 6 and 7 were added but on addition of phosphate buffer of pH 8, the mixture having 1.531211 BMJ24 Jeewanu (PUAC) produced in the PEM having NaCl showed maximum fixation of nitrogen.

Under oxygenic conditions 1.531211 BMJ24 Jeewanu (PUAC) produced in the PEM having NaCl showed better water splitting but under anoxygenic conditions, it showed better nitrogen fixation. The mixture having 1.531201 BMJ24 Jeewanu (PUAC) produced in the PEM without NaCl showed better fixation of nitrogen in shade under oxygenic conditions and better water splitting in sunlight under anoxygenic conditions.

Thus, in general, the most efficient particle for water splitting was 1.531201 BMJ24 Jeewanu (PUAC) produced in the PEM without NaCl under anoxygenic conditions as indicated by the maximum increase of 3.8 cm in pressure and the particles showing best nitrogen fixation was 1.531211 BMJ24 Jeewanu (PUAC) prepared in the PEM having NaCl, in presence of phosphate buffer of pH 8 as indicated by the maximum decrease of 4.9 cm in pressure in Warburg's flasks.

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Increasing Productivity In Automobile assembly Line Industry by Transforming Man Machine System And Inventory

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Abstract- Assembly line belongs to Backbone of the modern Automobile industry, after various studies it came to know that assembly lines can produce better lead time and customer satisfaction. The assembly line is one of the key components of the modern automobile Revolution. The principles of the assembly line allowed manufacturers to produce greatly increased amounts of products at lower cost and indirectly made for easier maintenance of products after their assembly. While the ideas behind assembly line manufacturing are a vital part of the way, in which products are being made and assembled today, it is also interesting to consider the disadvantages of these types of production systems. By transforming this methodology in any assembly line you can get better productivity or efficiency. In this thesis I am work to increase the efficiency of the automobile sector assembly line. This methodology has two major parts. The First part is Man- Machine system and in this we are implementing Work Measurement, Method Study and Time Study. The second part is inventory management we are implementing the Inventory management system to reach the higher productivity. The concept of the man-machine system works between labors and machines and in between raw materials and finished goods. Simultaneously I am going to implement the inventory management system to produce effect of the overall plant efficiency. Using Work measurement, a technique designed to establish the time for a worker to carry out a specified manufacturing task at a defined level of performance. It is concerned with the length of time, and it takes to complete a work task assigned to a specific job. By applying work measurement, it can show clearly existing result. Method study is the process of subjecting work to systematic, critical scrutiny to make it more effective and more efficient. It is one of the keys to achieving productivity improvement. It can improve the productivity of the implemented method. Another field the time study will improve the efficiency of the implemented method Time study is a tested method of work measurement, In this thesis the use of time study is to suggest a methodology for a qualified worker to perform specified work under stated conditions and at a defined rate of working. By this implementation we can improve the implemented method and that will increase the productivity.

Keywords - work study, work measurement, time study, Just-in-time , man-machine system, inventory management, operations management.

INTRODUCTION –

Assembly lines are designed for the one by one operation in organization, in this work the motion of workers is minimized in the operation area. All parts or assemblies are handled either by conveyors or motorized vehicles such gravity. Machines such as overhead cranes do heavy lifting. Each worker typically performs one simple operation.

REMAINING CONTENTS –

Assembly Line –

An assembly line is a production of goods process (most of the time called a progressive assembly) in which parts (usually interchangeable parts) are added as the semi-finished assembly moves from workstation to workstation where the parts are added in particular order until the final assembly is obtained. By mechanically moving the parts to the assembly work and moving the semi-finished assembly from work station to work station, a finished job can be assembled faster and with less worker than by having workers carry parts to a stationary piece for assembly. A manufacturing tool, first made popular by Ford in his manufacturing of automobiles. The principle of an assembly line is that each worker is given one very specific job, which he or she simply repeats, and then the process moves to the next labor who does his or her job, until the task is completed and the product is obtained. It is a way to mass produce goods quickly and efficiently. All workers do not have to be human; robotic workers can make up an assembly line as well.

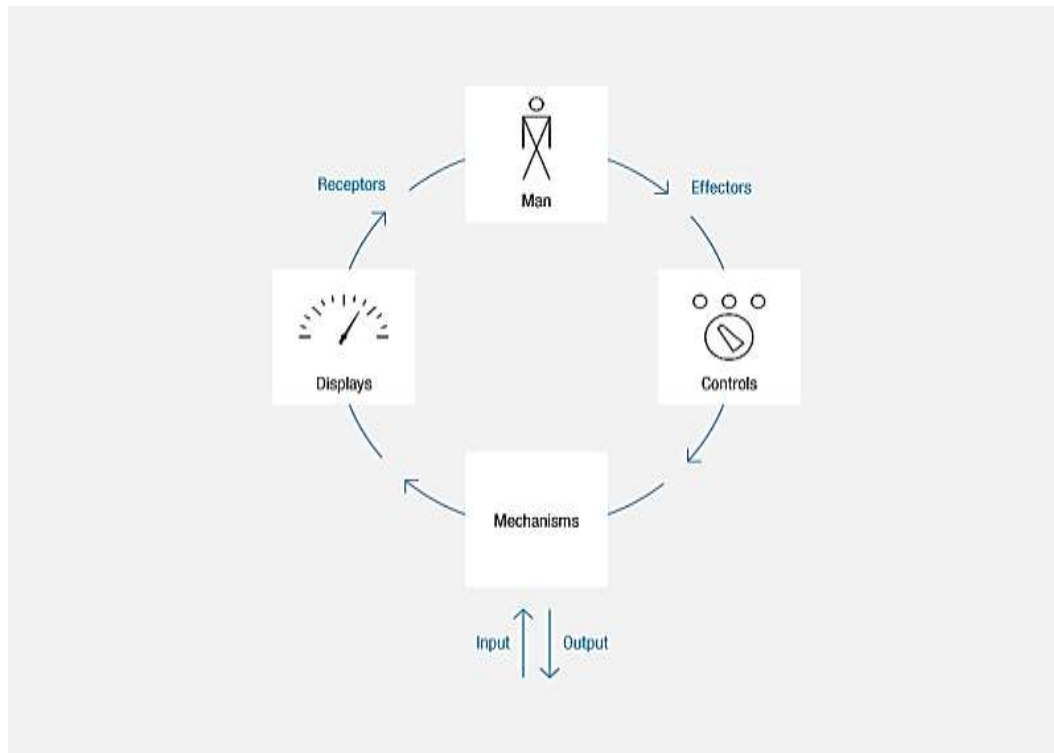
Man/Machine System –

Human-machine system is a human operator (or a group of operators) and a machine are integrated. This term can also be importance the view of such a system as a single entity that interacts with external environment .

Generally a system consists of hand tools and other tools which are coupled by a human operator who controls the operation. Operators of such systems use their own power.. The system could range from a person with a hammer to a person with a strength giving exoskeleton. Human machine system engineering is different human-computer interaction and technical engineering in that it focuses on complex, that often are partially automated (such as flying an airplane). it also studies human problem environments

The area of human-machine movements is yet to be extensively explored. How body-structure can be extended through machine mechanisms points to how the body can perform beyond its biological form and functions as well

as beyond the local space it inhabits. How human movement is transfer into machine motion and then can be both expressed and



extended into performance on the web promises new possibilities in both conceptual approach and **Fig:1-Man Machine System**

aesthetic application. For example, incorporating virtual camera views of the performing human-machine system enriches the choreography and intensifies the artistic result. The Machine is a hybrid human-robot walking machine. Designed by artist James (who has also created other such systems), it is an exoskeleton with six robotic legs that are controlled by the single worker.

Time Study-

A time and motion study (or time-motion study) is a business efficiency technique combining the Time Study work. It is a major part of scientific management. After its first introduction, time study developed in the direction of establishing standard times, while motion study evolved into a technique for improving work methods. The two techniques became integrated and refined into a widely accepted method applicable to the improvement and upgrading of work systems. This integrated approach to work system improvement is known as methods engineering and it is applied today to industrial as well as service organizations, including banks, schools and hospitals.

Time study is a direct and continuous observation of a task, using a timekeeping device (e.g., decimal minute stopwatch, computer-assisted electronic stopwatch, and videotape camera) to record the time taken to accomplish a task and it is often used when: there are repetitive work cycles of short to long duration, wide variety of dissimilar work is performed, or process control elements constitute a part of the cycle. The Industrial Engineering Terminology Standard defines time study as "a work measurement technique consisting of careful time measurement of the task with a time measuring instrument, adjusted for any observed variance from normal effort or pace and to allow adequate time for such items as foreign elements, unavoidable or machine delays, rest to overcome fatigue, and personal needs."

Inventory Management-

In any business or organization, all functions are interlinked and connected to each other and are often overlapping. Some key aspects like supply chain management, logistics and inventory form the backbone of the business delivery function. Therefore these functions are extremely important to marketing managers as well as finance controllers. Inventory management is a very important function that determines the health of the supply chain as well as the impacts the financial health of the balance sheet. Every organization constantly strives to maintain optimum inventory to be able to meet its requirements and avoid over or under inventory that can impact the financial figures.



Figure 2- Inventory Management

Inventory is always dynamic. Inventory management requires constant and careful evaluation of external and internal factors and control through planning and review. Most of the organizations have a separate department or job function called inventory planners who continuously monitor, control and review inventory and interface with production, procurement and finance departments.

Defining Inventory-Inventory is an idle stock of physical goods that contain economic value, and are held in various forms by an organization in its custody awaiting packing, processing, transformation, use or sale in a future point of time. Any organization which is into production, trading, sale and service of a product will necessarily hold stock of various physical resources to aid in future consumption and sale. While inventory is a necessary evil of any such business, it may be noted that the organizations hold inventories for various reasons, which include speculative purposes, functional purposes, physical necessities etc. From the above definition the following points stand out with reference to inventory: All organizations engaged in production or sale of products hold inventory in one form or other. Inventory can be in complete state or incomplete state. Inventory is held to facilitate future consumption, sale or further processing/value addition. All inventoried resources have economic value and can be considered as assets of the organization.

Types of Inventory -

Inventory of materials occurs at various stages and departments of an organization. A manufacturing organization holds inventory of raw materials and consumables required for production. It also holds inventory of semi-finished goods at various stages in the plant with various departments. Finished goods inventory is held at plant, FG Stores, distribution centers etc. Further both raw materials and finished goods those that are in transit at various locations also form a part of inventory depending upon who owns the inventory at the particular juncture. Finished goods inventory is held by the organization at various stocking points or with dealers and stockiest until it reaches the market and end customers. Besides Raw materials and finished goods, organizations also hold inventories of spare parts to service the products. Defective products, defective parts and scrap also forms a part of inventory as long as these items are inventoried in the books of the company and have economic value.

We like clearly Inventory Management. We think it's easy to use, and we know that it will help you become more productive. But no matter how good we think it is, it will fail to help you if you don't do some very basic things. The purpose of this section of the Inventory Basics Guide is to walk you through the absolute basic attributes of a pretty good inventory management system and to instruct you in detail about how to implement our recommendations. We say "pretty good" because there are no perfect ways to create the elements of an inventory management system, but there are lots of bad ways. You may be able to improve on our recommendations or your enterprise may have to do things differently, but if you follow our recommendations, you'll wind up with a pretty good system.

INPUT	PROCESS	OUTPUT
Raw Materials	Work In Process	Finished Goods
Consumables required for processing. Eg : Fuel, Stationary, Bolts & Nuts etc. required in manufacturing	Semi Finished Production in various stages, lying with various departments like Production, WIP Stores, QC, Final Assembly, Paint Shop, Packing, Outbound Store etc.	Finished Goods at Distribution Centers through out Supply Chain
Maintenance Items/Consumables	Production Waste and Scrap	Finished Goods in transit
Packing Materials	Rejections and Defectives	Finished Goods with Stockiest and Dealers
Local purchased Items required for production		Spare Parts Stocks & Bought Out items
		Defectives, Rejects and Sales Returns
		Repaired Stock and Parts
		Sales Promotion & Sample Stocks

Table 1- Inventory Systems

Proposed Methodology –

This Methodology is one of the theoretical systematic, analysis of the methods applied to a field of study. It comprises the principles associated with a branch of knowledge and theoretical analysis of the body of methods. Typically, it encompasses concepts such quantitative or qualitative techniques and as [paradigm](#), theoretical model, phases methodology is the general research strategy that outlines the way in which research is to be done and, among other things, identifies the methods to be used in it. These methods, described in the methodology, define the ways of data collection or, sometimes, how a specific result is to be calculated. By transforming this methodology in any assembly line you can get better efficiency or productivity. In this thesis I am working to increase the efficiency of the automobile sector assembly line. This methodology has two major parts. The First part comprises of Man- Machine system and in this we are implementing Work Measurement, Method Study and Time Study. The second part comprises of inventory management we are implementing the Inventory management system to reach the higher productivity. The concept of the man-machine system works between workers and machines and in between raw materials and product. Simultaneously I am going to implement the inventory management system to increase the efficiency of over all plant. Using Work measurement, a technique designed to establish the time for a worker to carry out a specified manufacturing task at a defined level of performance. It is concerned with the length of time, and it takes to complete a work task assigned to a specific job or function. By applying work measurement, it can show clearly existing result. Method study is the process of subjecting work to systematic manner, critical scrutiny to make it more efficient and more effective. It is one of the keys to achieve productivity improvement. It can improve the productivity of the implemented method. Another field the time study will improve the efficiency of the implemented method. Time study is one of the tested method of work measurement, in this thesis the use of time study is to suggest a methodology for a qualified worker to perform specified job under stated conditions and at a defined rate of working. By this implementation, we can improve the implemented method and that will increase the rate of productivity.

This system has two major parts

Part 1: Implementation of Work measurement, Method and Time study.

Part 2: Implementation of the Inventory Management.

This two major parts of the implementation is lead to improve the efficiency and productivity of the overall plant.

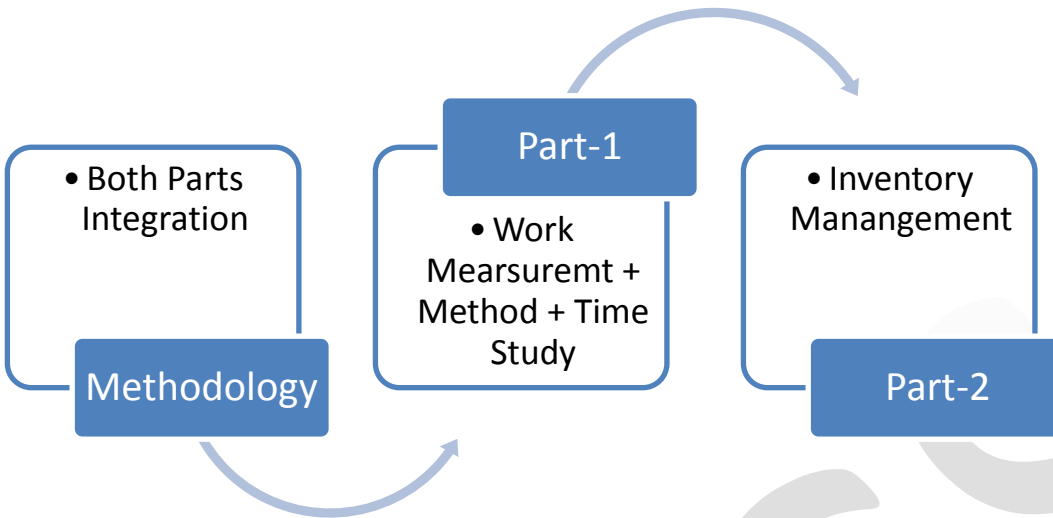


Figure 3- Proposed Methodology

This methodology can become efficient. My proposed method I am paying attention multi skilled operator who will operate the multiple CNC and VMC machines at a time.

Most of the time in filed we can easily see the operator inputs the code and starts the machine in CNC and VMC machines operations runs for the hours according to function. There is no work which will completes in minutes.

So what will the labor will do in that time when operation is running. At that time most of the labor starts machine and do all the wastage works which is not productive work for the company. The time counts in hours and the time is running under nonproductive work till the all operation is not done.

My proposed method is to transform non productive work into productive work and for the purpose it suggest to hire a multi skilled machine

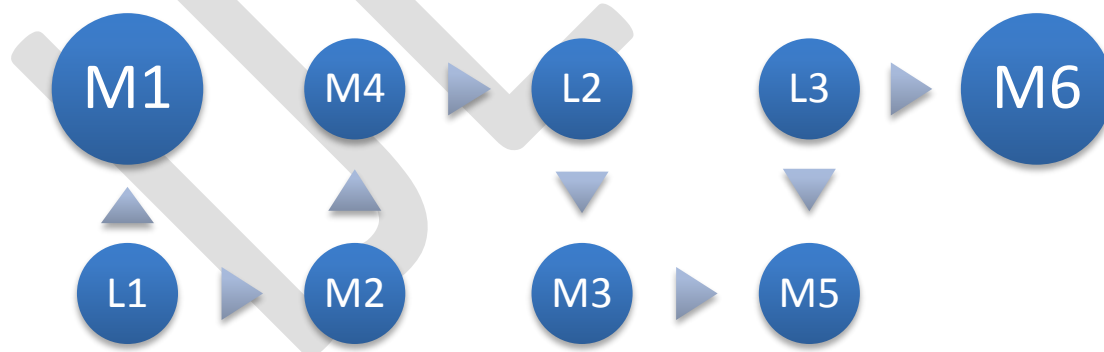


Figure 4- Machine Distribution

operator. Which input codes in all CNC and VMC machines and take care of two or more machine at same time.

That will save money for the company by which company will pay only for the 1 labor for the two or more machines. It can convert the module of the assembly line and proposed methodology will able to convert nonproductive work into productive work and saving company's money on more workers.

ACKNOWLEDGMENT-

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CONCLUSION-

This thesis objective is to increase the efficiency of the automobile sector assembly line. This methodology has two major parts. For the purpose two parts methodology is being prepared, The First part is Man- Machine system and in this, Work Measurement, Method Study and Time Study is implemented. In second part Inventory, management system is implemented to reach the higher productivity. But for achieving the purpose following barriers are to be overcome: Over (or Under) Producing Due to a Change in Demand, Diminishing Returns on Lean Manufacturing Efforts, Lack of Real-Time Information, Unbalanced Station Workloads, WIP or Manufacturing Cycle Time, Lengthy Changeover Time, Late Product Launches on New Assembly Lines, Low Production Quality, Late Product Launches on Existing Assembly Lines. To overcome the related barriers required suggestion and steps are provided in the proposed methodology. Which are in brief; Protect company against theft, Establish an approved stock list for each warehouse, Assign and use bin locations, Record all material leaving your warehouse, Process paperwork in a timely manner, Set appropriate objectives for your buyers, Make sure every employee is aware of the cost of bad inventory management, Ensure that stock balances are accurate and will remain accurate, Determine the most advantageous replenishment path for each item in each warehouse, Distributive purchasing, Central Warehousing, Cooperative Purchasing, Transfer excess stock to a branch that needs the material, Return the stock to the vendor, Lower the time of items with excess inventory, Substitute surplus inventory for lower cost items that are still popular After implementing the proposed methodology the result shows this methodology Increasing Productivity in Automobile Assembly Line Industry by Transforming Man-Machine System & Inventory Management can be perform more efficient and productive this result can easily conclude that this new and improved methodology created slightly differentiate results. This is better than existing technologies and methodology.

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INTELLIGENT QUERYING FOR MATERIALS MANAGEMENT USING DECISION SUPPORT SYSTEM

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ABSTRACT- Every day we, as humans, make many decisions which can have immediate or long-term effects on our lives. A decision in general may be defined as the selection by the decision-maker of an act, considered to be the best according to some pre-designated standard from the available options. To make a perfect decision by an organization, it needs a suitable Decision Support System. DSS are interactive computer-based systems which help decision makers utilize data and models to solve unstructured problem. This project deals with the development of a DSS for a Pump Industry. It implements the Decision Analysis theory to solve the decision-making problem. It can support the managers understand the problems in addition to providing solutions.

A DSS couple the intellectual resources of individuals with the capabilities of the computer to improve the quality of the decisions. The objective of this project is to develop an application for decision support system using Operations Research approach in the area of business with the help of computers. Various problems and the corresponding solutions are studied and analyzed. These are the core data for this DSS. A knowledge based system is developed for analyzing these data and to make an optimal decision. The system is developed using the software, Microsoft Visual Basic 6.0 and MS ACCESS. The industrial data are stored in the database and they are effectively retrieved by the technique called Data mining. It implements the method of intelligent search to discover information within the data ware house. The resulting data is used in the development of decision trees, which is used to calculate the probability of success rate. Using the optimization techniques of OR, databases and programming languages, this system supports decisions concerning daily operations of the industry. It improves the firm's ability to make rapid and better-informed decisions.

Keywords: Decision Support Systems, Data Mining, Operations research, Decision Analysis, Decision trees, MS ACCESS

1. INTRODUCTION

Today organizations are facing many problems regarding their business. They are handling large volume of data and a number of transactions. To succeed in this competitive world the organization should be able to take optimal decisions at the right time. This process is aided by a Decision Support System. A decision in general may be defined as the selection by the decision-maker of an act, considered to be the best according to some pre-designated standard from the available options. To make a perfect decision by an organization, it needs a suitable decision support system. DSS are interactive computer-based systems which help decision makers utilize data and models to solve unstructured problem. This paper deals with the development and implementation of a DSS for a Pump Industry. It implements the Decision Analysis theory to solve the decision-making problem. It can support the managers understand the problems in addition to providing solutions.

A DSS couple the intellectual resources of individuals with the capabilities of the computer to improve the quality of the decisions. It is a computer based support system for management decision makers who deal with semi-structured problems. DSS applications are systems and subsystems that help people make decisions based on data that is culled from a wide range of sources. They are not single information resources such as a database or a program that graphically represents sales figures, but the combination of integrated resources working together.

Here the DSS is developed for a Pump industry situated at Coimbatore. It is mainly developed for Materials Management and in fixing the lead time. Materials management covers all aspects of materials, cost, materials supply and utilization. It covers the whole range of functions involved in converting raw materials and ancillary supplies into finished products. It is concerned with the planning and programming of materials and equipments, market research for purchase; pre-design value analysis, procurement of all materials including capital goods, raw materials, components and assemblies, finishing materials, packing and packaging materials, stores control and inventory control; transportation of raw material and material handling; value analysis, disposal of scrap, surplus and salvage and operation research for materials.

The objective of this paper is to develop an application for decision support system using OR approach in the area of business with the help of computers. Various styles and the problems regarding the styles are studied and analyzed. These are the core data for this DSS. A knowledge based system is developed for analyzing these data and to make an optimal decision. The system is developed using the software, Microsoft Visual Basic 6.0 and MS Access. The industrial data are stored in the database and they are effectively retrieved by the technique called Data mining. It implements the method of intelligent search to discover information within data ware houses. The resulting data is used

in the development of decision trees. Decision analysis theory is used for constructing the decision tree. Decision analysis is a technique which helps to find the best decision to take in certain types of problems with particular characteristics. A decision-tree is a graphic display of various decision alternatives and the sequence of events. When probabilities of various events are known, they are written along the corresponding branches. Multiplying the probabilities along the branches results in the joint probabilities for the corresponding act-event sequence. Depending upon the probability of success rate the system decides whether the decision is optimal or not.

Using the optimization techniques of OR, databases and programming languages, this system supports decisions concerning daily operations of the industry. It improves the firm's ability to make rapid and better-informed decisions.

2.LITERATURE SURVEY

Ganapathy, S., Narayanan, S. and Srinivasan, K. (2003) studied the supply chain logistics planning and developed a model. Their study dealt with a simulation based decision support for supply chain logistics. Their model featured a decision support system that aided humans in making decisions and studied the role of a decision support system in enhancing the performance of the supply chain logistics system. The model was object oriented in nature which helped the rapid prototyping of the different components of the system.

Raj Gopal, K. and Sudhakara Reddy, A. (2004) made a study on productivity measurement and monitoring models of a SSI unit. They had developed a DSS for the SSI unit for generation of dynamic planning.

Retzlaff-Roberts, D.L and Amini, M. (2004) studied the supply chain management and cycle time reduction at the University of Memphis. They developed a DSS which examined the problem for a major international manufacturer of medical diagnostic equipment. A decision support tool was developed to assist the organization in deciding where service parts should be inventoried and in what quantity to minimize total inventory and logistics cost while meeting a demanding customer service requirement. An application of DSS to the time table scheduling using goal programming model states that DSS is an integral part of decision maker's approach to "Problem Finding". The DSS with the computer base blends operations research to help the management in solving the problems.

Lehmann, H. and Lehner, F. (2005) made a study on Holistic Perspectives of information sharing and knowledge exchange. The aim of their study is to provide a review from a predominantly European perspective that allows an overall evaluation of the state of the literature on this subject. They illustrated with a set of models – selected predominantly for their link to empirical research. They summarized and evaluated with their potential for providing a basis for future research.

Adelina, G.A and Venkataramanaiah, S. (2004) studied the process involved in a food processing industry and developed a database for productivity analysis. Their study focused on the process measurement, evaluation and improvement of labor productivity through human resource planning in a food processing industry. A suitable database was designed to comprehensively and accurately deal with the productivity data for future reference and comparative analysis. Their study has shown 35% average man power productivity growth.

Moole, B.R and Korrapati, R.B. (2004) developed a model for forecasting in inventory management using probabilistic multidimensional data model. An algorithm using mathematical concept based on set theory, probability axioms and the Bayesian framework, as well as algebra to manipulate data and a framework to modify data, were developed and a decision support system model for business in the area of inventory management was presented. The DSS model is in continuous process improvement and it has made significant progress over prior models.

The study shows that there is an immense need for further study in respect of materials management for effective planning and decision making.

3. MANUFACTURING INFORMATION SYSTEMS

Manufacturing management uses the computer both as a conceptual system and as an element in the physical production system. The evolution of the computer as a conceptual manufacturing system is easiest to handle the inventory problems. Initially there were systems that keyed on reorder points. Then came the MRP concept-first applied as material requirements planning and then as manufacturing resource planning. The MRP systems are one approach to inventory management. Another is Just-In-Time (JIT). JIT is unique among modern production concepts in that it does not rely heavily on computer technology.

The manufacturing information system consists of three input subsystems and four output subsystems. The accounting information system captures data in real time, describing the utilization of the physical resources. The industrial engineering subsystem provides production standards that facilitate management by exception. The manufacturing intelligence subsystem enables management to stay current on activities of its labor unions and suppliers.

This input data is transformed into information by the output subsystems. The production subsystem enables management to both build and operate manufacturing facilities. The inventory subsystem uses mathematical formulae for when to reorder and how much. The quality subsystem is based on the fundamentals of total quality management (TQM), and it enables the firm to achieve product quality by monitoring the flow of materials, beginning with its receipt from suppliers, through the production process, and ending with consumption or use by the firm's customers. The cost subsystem permits management to control the cost of these production activities by means of information feedback.

4. COMPUTERS AS AN INFORMATION SYSTEM

The term manufacturing information system describes the CBIS subsystem that provides information concerning the production operation. The output from the manufacturing information system is used to both create and operate the physical production system. After the first computers were successfully applied in the accounting area, they were given the task of managing the firm's inventory. The simplest approach is a reactive one waiting for an item balance to reach a particular level, which then triggers a purchase order or a production process. The item level that serves as the trigger is called the reorder point (ROP) and a system that bases the purchasing decision on the reorder point is called a reorder point system. Much has been accomplished in the use of computer-controlled machines in the production area. These machines can do jobs that were formerly done by workers. The machines cost less than the workers and are capable of performing better. Attempts to automate the factory initially met with resistance from organized labor. Overtime, however, resistance has diminished as it has become clear that a firm must take advantage of computer technology if it is to survive in the world market.

The manufacturing information system encompasses all of the applications of the computer in the manufacturing area as a conceptual system. A model of such a system is illustrated in the following figure:

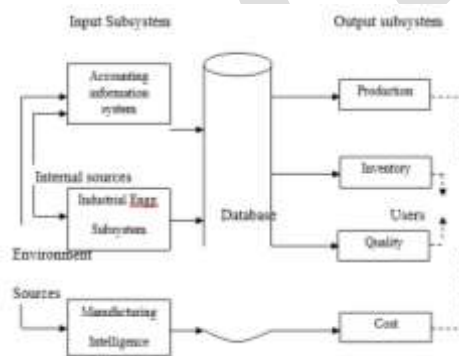


Figure 1. A Model of a Manufacturing Information System.

The accounting information system gathers internal data describing the manufacturing operation and environmental data that describe the firm's transactions with its suppliers. The industrial engineering subsystem is like the marketing research subsystem in so far as it consists primarily of special data-gathering projects. The two subsystems are dissimilar in that the industrial engineering subsystem gathers data from inside the firm rather than from the environment. The manufacturing intelligence subsystem gathers data from the environment. Suppliers and labors are the special responsibility of manufacturing.

The four output subsystems measure separate dimensions of the production process. The production subsystem measures the process in terms of time - tracking the work flow from one step to the next. The inventory subsystem measures the volume of the production activity as the inventory is transformed from raw materials into work-in-process and finally into finished goods. The quality subsystem measures the quality of the materials as they are transformed. The cost subsystem measures the costs that are incurred in the production process.

5. MATERIALS MANAGEMENT

Materials management covers all aspects of materials, cost, materials supply and utilization. It covers the whole range of functions involved in converting raw materials and ancillary supplies into finished products. It is concerned with the planning and programming of materials and equipments, market research for purchase; pre-design value analysis, procurement of all materials including capital goods, raw materials, components and assemblies, finishing materials, packing and packaging materials, stores control and inventory control; transportation of raw material and material handling; value analysis, disposal of scrap, surplus and salvage and operation research for materials.

Materials management can be defined as a body of knowledge which helps the manager to improve the productivity of capital by reducing materials costs, preventing large amounts of capital being locked up for long periods and improving the capital turnover ratio. The prime objective is to supply the user department with the required quantity at a constant rate with uniform quality, so that production or service rendered is not held up. Materials management objective should be balanced and responsibility for achievement should be delegated to a materials manager who has authority to do the job. The materials manager should always reevaluate the objective when business conditions change.

6. MANAGEMENT INFORMATION SYSTEMS

6.1 The Decision Support Role

The business decision-making support function goes one step further. It becomes an integral part -- even a vital part -- of decision-making. It allows users to ask very powerful "What if..." questions: What if we increase the price by 5%? What if we increase price by 10%? What if we decrease price by 5%? What if we increase price by 10% now, then decrease it by 5% in three months? It also allows users to deal with contingencies: If inflation increases by 5% (instead of 2% as we are assuming), then what do we do? What do we do if we are faced with a strike or a new competitive threat? An organization succeeds or fails based on the quality of its decisions. The enhanced ability to explore "what if" questions is central to analyzing the likely results of possible decisions and choosing those most likely to shape the future as desired. "Business decision-making support function" is a phrase likely to quicken the pulse of no one but an accountant, but, in fact, it is all about turned wonderful dreams into solid realities.

6.2 The Communication Decision Support System Role

Information systems can support a company's competitive positioning. Here are three levels of analysis:

1. The supports for help in piloting the chain of internal value. They are the most recent and the most pragmatic systems within the reach of the manager. They are the solutions to reductions of costs and management of performance. They are typically named "Business Workflow Analysis" (BWA) or of "Business Management Systems p2p". Tool networks, they ensure control over piloting the set functions of a company. The real-time mastery in the costs of dysfunctions cause distances from accounts, evaluation and accounting that are presented in the evaluation and qualitative reports.

2..All successful companies have one (or two) business functions that they do better than the competition. These are called core competencies. If a company's core competency gives it a long term advantage in the marketplace, it is referred to as a sustainable competitive advantage. For a core competency to become a sustainable competitive advantage it must be difficult to mimic, unique, sustainable, superior to the competition, and applicable to multiple situations. For a small or medium business a nice alternative is a MSP or a Managed Service Provider such as Virtual IT Solution. This is a cost effective solution compared to paying for a IT staff or local technicians. Other examples of company characteristics that could constitute a sustainable competitive advantage include: superior product quality, extensive distribution contracts, accumulated brand equity and positive company reputation, low cost production techniques, patents and copyrights, government protected monopoly, and superior employees and management team. The list of potential sustainable competitive advantage characteristics is very long. However, some experts hold that in today's changing and competitive world, no advantage can be sustained in the long run. They argue that the only truly sustainable competitive advantage is to build an organization that is so alert and so agile that it will always be able to find an advantage, no matter what changes occur.

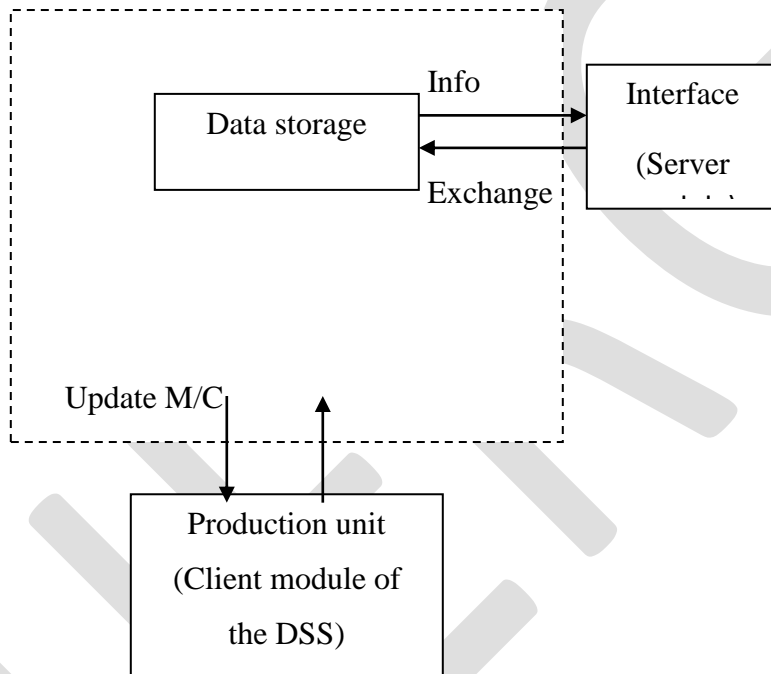
3. Information systems often support and occasionally constitute these competitive advantages. The rapid change has made access to timely and current information critical in a competitive environment. Information systems, like business environmental scanning systems, support almost all sustainable competitive advantages. Occasionally, the information system itself is the competitive advantage. One example is Wal-Mart. They used an extranet to integrate their whole supply chain. This use of information systems gave Sam Walton a competitive advantage for two decades. Another example is Dell Computer. They used the internet to market custom assembled PC's. Michael Dell is still benefitting from this low-cost promotion and distribution technique. Other examples are eBay, Amazon.com, Federal Express, and Business Workflow Analysis.

6.3 The Performance Monitoring Role

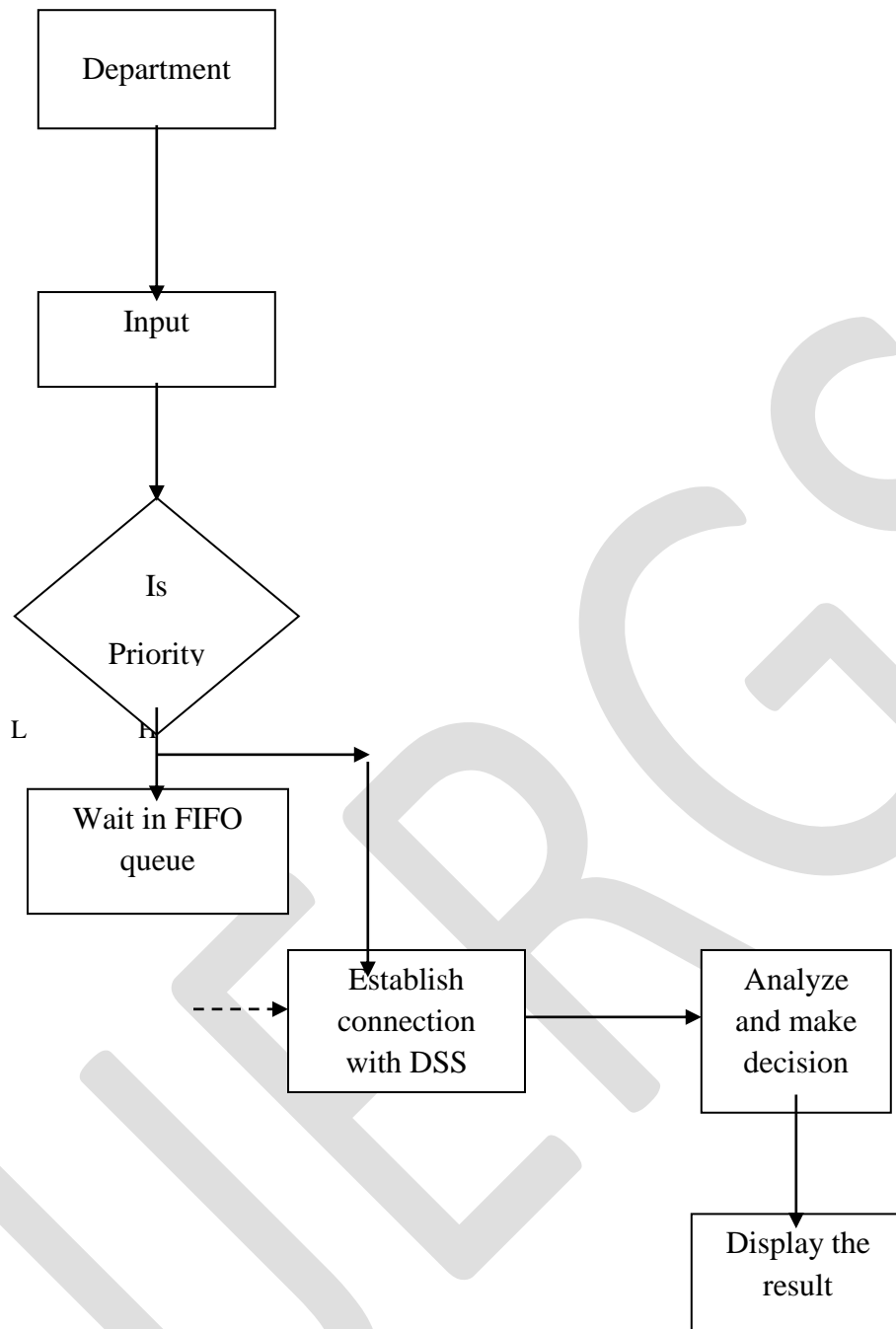
MIS are not just statistics and data analysis. They have to be used as an MBO (Management by objectives) tool. They help

- To establish relevant and measurable objectives
- To monitor results and performances (reach ratios)
- To send alerts, in some cases daily, to managers at each level of the organisation, on all deviations between results and pre-established objectives and budgets.

Businesses today are recording volumes of data reaching terabytes in size. Millions of transactions among retail chains, utility companies, banks, and insurance companies take place each day. Representative financial transactions of the International Technology Group (ITG) report indicate that a telecommunications company receives over 80 million transactions a month, or approximately 2.6 million transactions per day (ITG, 2000). It would be humanly impossible to interpret these transactions to find, for example, which class of customers makes more long distance calls. Similarly, a representative retail chain with 63 supermarkets selling 19,000 products can record a staggering 3.6 million transactions per day (SUN-Microsystems, 1999). Even a small percentage of waste or fraud will result in a loss of millions of dollars and, consequently, higher prices to customers. At same time, manual inspection of these data is not possible, as they are imprecise and change continuously. Decision Support Systems (DSS) are used to support managerial decisions. Usually DSS involves analyzing many units of data in heuristic fashion (Inmon, 1990). To make optimal decisions using large volumes of data, managers of large enterprises need decision support Systems that interpret huge volumes of uncertain data as well as handle data modifications.



Figures 2: The DSS Model



Figures 3: Flowchart of the decision process

7. MASTERS AND ITS APPLICATION

There are totally five master created to execute the project application in successful manner. There are given below,

- Supplier/Customer Master.
- Item Master.
- Machineries Master.
- Bill of Materials (BOM).

- Routing.

The Visual Basic is started with Password entry screen (Fig: 5)

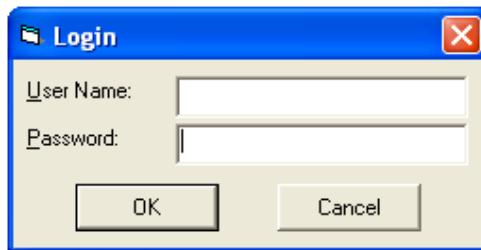


Figure 4: Password entry screen

After enter the assigned respective user's USERNAME and PASSWORD, the master list of form will be opened by selecting the respective menu. The menu selection screen is shown below.



Figure 5: Start-up Screen.

The start-up screen includes the three menus in menu bar. There are

- **Master Menu.**

The Menu is used to select the particular application to perform the operation. Master menu is contains both master form and operational forms.

- **Report Menu.**

The Reporting menu is used to get the report easily and also used to take the print out easily. It is perform as a Quick operation.

- **Exit Menu.**

It is used for close the window.

The title bar having the VB Logo in lift side top corner and Minimize, Maximize and close button is available in right side top corner.

The menu options are provided to perform the project operation. The menu file list is shown below.



Figure 6: Main Master Menu Screen

Menu file's lists are:

- Supplier / Customer Master.
- Item Master.
- Machineries Master.
- Receipt Entry.
- Bill of Materials (BOM).
- Inventory Master.
- Order Booking.
- Routing.
- Calendar / Machine Time.
- Machine Utilization.
- Performance History.

The above parameters are explained below briefly.

7.1 SUPPLIER / CUSTOMER MASTER:

The Supplier/Customer is used to create the database with their mandatory profile. Supplier profile is updated with system after supplier passed the necessary supplier performance appraisal. The evaluation is carried out in Performance History. The Supplier/Customer Master is shown below.

Figure 7: Supplier/Customer Master Screen.

The Supplier/Customer Master is having the following field while creating the master data. There are,

- **Sup / Cus Name (Supplier/Customer Name):**
The Supplier or Customer Name is entered in this column.
- **Sup / Cus Code (Supplier/Customer Code):**
The separate code is assigned for each supplier as well as customer for identification.
- **TIN No:**
Tax Identification number is to be entered in this column (if required).
- **CST No:**
Central sales Tax number is to be entered in this column (if required).
- **Date:**
Date of the CST No issued.
- **Phone No:**
- **Contact Person:**
- **Address:**
The address of the customer or supplier is entered for further mailing communication
- **Type:**
This master is contains two types. There are customer based Master and Supplier based Master.
The Customer based master is further classified into three categories, like,
 1. Dealer.
 2. Distributor.
 3. End User.

The type assignment is useful for retrieval the data for analysis.

- **Payment Terms:**
The payment terms are assigned from 0 to 100%.
- **Details:**
The provided column is useful for specify the details are remarkable points about the customers / Suppliers.

7.2 ITEM MASTER:

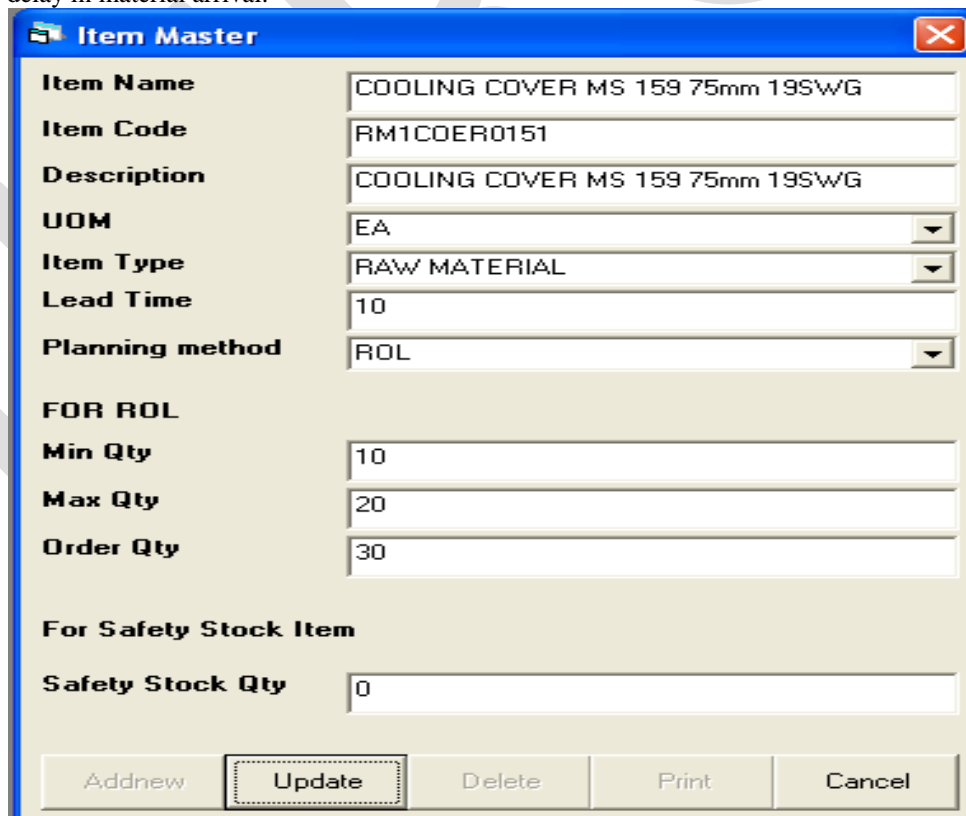
The Item master is developed for assigning the item code against each item with necessary details like ROL Qty and Safety stock concepts. The item master is included the following field while new item code.

- Item Name
- Item Code
- Description
- UOM (Unit of Measurement).
Each item is classified with respective measuring parameter like EA- Each, Kgs – Kilograms, PKT – Packets, LTS – Litres.
- Item Type.
The item type is classified as like Raw materials, Rough casting, Consumables, Work in progress and Finished Goods.
- Lead Time.
The lead time is time taken for processing the procurement of product. It includes the preprocessing time (Indent, Quotation and PO Release time), processing time and Post processing time (Gate entry, Store receipt entry and Inspection and clearance time).
- Planning Method.
The planning method is nothing but how this item is planned for further replenishment. It is divided into two categories like Re-order level and safety stock. The Re-Order level and Safety stock is fixed based on the following considerable parameter.
 - Past particular periods consumption.
 - Upcoming months projected forecast quantity.
 - Class of the product (ABC Class).
 - Considering what are all the difficulties finding this item procurement process.

Generally the ROL Quantity is arrived based on the below formula.

ROL = Qty consumed per day X Lead time of the product.

If necessary, buffer stock also added with ROL Quality. It is done to play the production activities within the safety margin to avoid the unexpected delay in material arrival.



The screenshot shows a software window titled "Item Master" with a close button (X) in the top right corner. The window contains several input fields and buttons. The fields are organized into sections: "Item Name" (COOLING COVER MS 159 75mm 19SWG), "Item Code" (RM1COER0151), "Description" (COOLING COVER MS 159 75mm 19SWG), "UOM" (EA), "Item Type" (RAW MATERIAL), "Lead Time" (10), "Planning method" (ROL), "FOR ROL" (Min Qty: 10, Max Qty: 20, Order Qty: 30), and "For Safety Stock Item" (Safety Stock Qty: 0). At the bottom, there are five buttons: "Addnew", "Update" (which is highlighted with a dashed border), "Delete", "Print", and "Cancel".

Figure 8: Item Master screen.

7.3 MACHINERIES MASTER.

The Master of machineries is created to develop a data base for company asset properties. It is very useful for identify the specific machine if number of machine are available in same specification while production scheduling. It having the following filed in master form.

- Resource code
- Description
- UOM
- Hour rate.
- Resource Sl.No
- Purchased on.

The hour rate is fixed for each machine based on the labour and machineries cost. It is widely helps to production and Sales Managers while product cost calculation. The resource code is mainly taken into account for Machine utilization calculation form. The machineries master form is shown below.

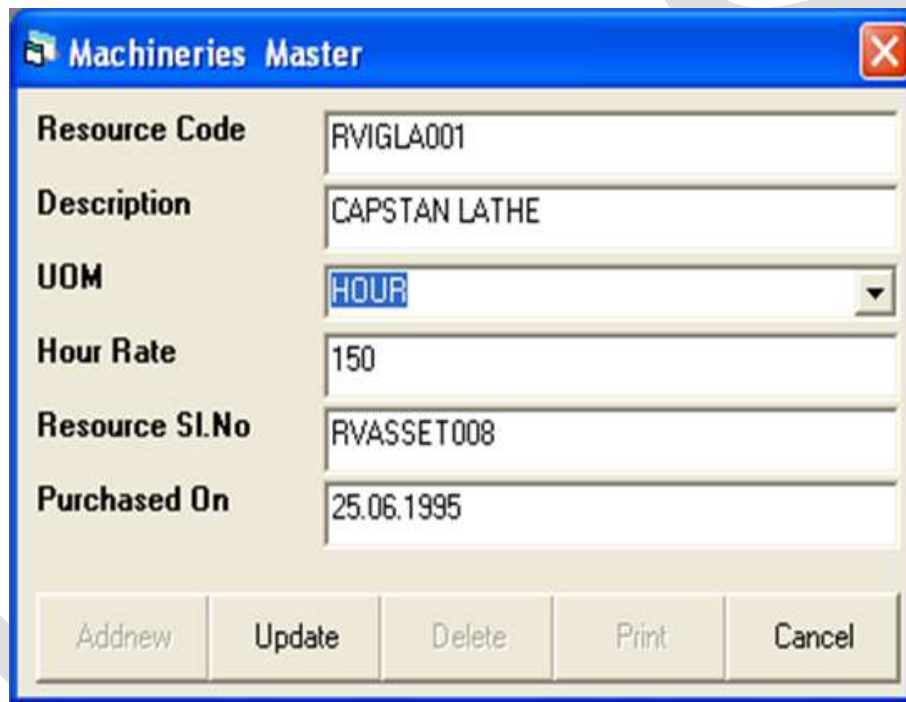


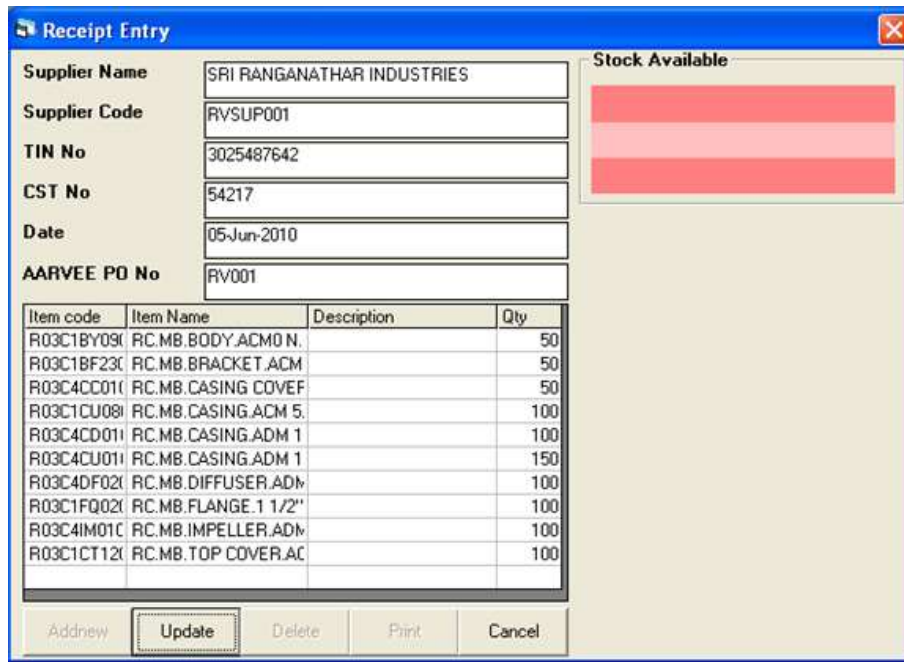
Figure 9: Resource Master Screen

7.4 RECEIPT ENTRY:

The receipt entry is made against the Purchase order released by us. It is the process will covers the activities of verification of purchased product and adding the receipt items stock with inventory master. The receipt entry is made against the following parameter.

- Supplier Name.
- PO No / Date
- Item Code
- Line item qty.

The receipt master screen is shown below.



Receipt Entry

Supplier Name: SRI RANGANATHAR INDUSTRIES
 Supplier Code: RVSUP001
 TIN No: 3025487642
 CST No: 54217
 Date: 05-Jun-2010
 AARVEE PO No: RV001

Stock Available

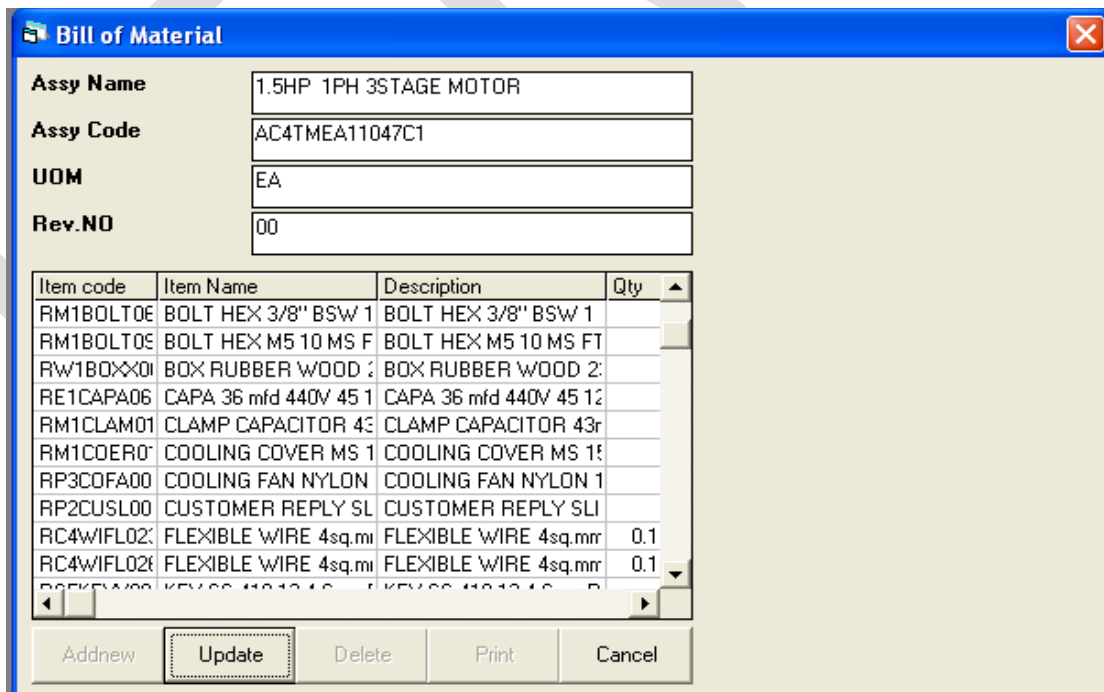
Item code	Item Name	Description	Qty
R03C1BY09	RC.MB.BODY.ACM0 N.		50
R03C1BF23	RC.MB.BRACKET.ACM		50
R03C4CC01	RC.MB.CASING COVEF		50
R03C1CU08	RC.MB.CASING.ACM 5.		100
R03C4CD01	RC.MB.CASING.ADM 1		100
R03C4CU01	RC.MB.CASING.ADM 1		150
R03C4DF02	RC.MB.DIFFUSER.ADM		100
R03C1FQ02	RC.MB.FLANGE.1 1/2"		100
R03C4IM01	RC.MB.IMPELLER.ADM		100
R03C1CT12	RC.MB.TOP COVER.AC		100

Buttons: Addnew, Update, Delete, Print, Cancel

Figure 10: Receipt Entry Screen.

7.5 BILL OF MATERIALS:

The Bill of Materials is a back bone of every product. The Bill of materials is normally released by engineering department. It contains the specification of materials and quantity required for manufacturing one unit. In this project the finished product item code is created in bill of materials creating stage itself. Here the created item code is used for routing process and order booking process. The bill of materials is subjected subsequent revision. The revision takes while item code or change or MOC is change or required quantity changes. The bill of materials screen is shown below.



Bill of Material

Assy Name: 1.5HP 1PH 3STAGE MOTOR
 Assy Code: AC4TMEA11047C1
 UOM: EA
 Rev.NO: 00

Item code	Item Name	Description	Qty
RM1BOLT0E	BOLT HEX 3/8" BSW 1	BOLT HEX 3/8" BSW 1	
RM1BOLT0E	BOLT HEX M5 10 MS F	BOLT HEX M5 10 MS FT	
RW1BOX00	BOX RUBBER WOOD 2	BOX RUBBER WOOD 2	
RE1CAPA06	CAPA 36 mfd 440V 45 1	CAPA 36 mfd 440V 45 12	
RM1CLAM01	CLAMP CAPACITOR 43	CLAMP CAPACITOR 43r	
RM1COER0	COOLING COVER MS 1	COOLING COVER MS 15	
RP3COFA00	COOLING FAN NYLON	COOLING FAN NYLON 1	
RP2CUSL00	CUSTOMER REPLY SL	CUSTOMER REPLY SLI	
RC4WIFL02	FLEXIBLE WIRE 4sq.mi	FLEXIBLE WIRE 4sq.mrr	0.1
RC4WIFL02	FLEXIBLE WIRE 4sq.mi	FLEXIBLE WIRE 4sq.mrr	0.1

Buttons: Addnew, Update, Delete, Print, Cancel

Figure 11: Bill of Materials Screen

The bill of Materials updation is done by engineering department only. All other user can be use the viewing option.

7.6 ROUTING:

The Routing is nothing but designing the sequence of operation for processing the product. Routing is not only created for machining component, it includes the special process like NDT (Non-destructive testing), Welding, Painting and Assembly operation. The Routing is include to set up the setting time of process component and running time of component for completion of that particular process. The Routing data is play as a vital role in Machine capacity calculation. Because after finalizing the sequence of operation, machine is selected for performing that particular operation. The

Routing screen is shown below.

The screenshot shows a 'Routing' window with a header section and a table of operations.

Header Section:

- Assy Name: 1.5HP 1PH 3STAGE MOTOR
- Assy Code: AC4TMEA11047C1
- UOM: EA
- Rev.NO: 00
- Date: 02-Jun-2010

Table:

Ope_Seq	Operation Name	Resource	Description	UOM	Cycle Time	Setting	Date Effe From	Curr_Date
10	T1:MC.MB.IMPELLER AL	RVIGLA001	CAPSTAN LATH	HOOR	7.5	30	02-Jun-2010	02-Jun-2010
20	T1:MC.MB.IMPELLER AL	RVICLA001	CENTRE LATH	HOOR	6.0	15	02-Jun-2010	02-Jun-2010
30	KW:IMC.MB.IMPELLER A	RVISLT001	SLOTTING MACH	HOOR	1.6	15	02-Jun-2010	05-Jun-2010
40	IMPELLER BALANCING	RVHBA001	ABRO HORIZON	HOOR	3.3	30	02-Jun-2010	05-Jun-2010
50	TURNING COVER CASIN	RVICLA001	CENTRE LATHE	HOOR	7.5	15	05-Jun-2010	05-Jun-2010
60	D1:CASING COVER	RVIDRL003	DRILLING - SLOV	HOOR	1.5	15	05-Jun-2010	05-Jun-2010
70	T2:CASING COVER	RVICLA001	CENTRE LATHE	HOOR	4	15	05-Jun-2010	05-Jun-2010
80	D2:CASING COVER	RVIDRL001	DRILLING - HIGH	HOOR	2.3	10	05-Jun-2010	05-Jun-2010
90	T1:DIFFUSER	RVICLA001	CENTRE LATHE	HOOR	4.6	15	05-Jun-2010	05-Jun-2010
100	T2:DIFFUSER	RVICLA001	CENTRE LATHE	HOOR	4.0	15	05-Jun-2010	05-Jun-2010
110	DRILLING DIFFUSER	RVIDRL003	DRILLING - SLOV	HOOR	4.0	10	05-Jun-2010	05-Jun-2010
120	T1:DEL CASING	RVIGLA003	ENTERPRISE LA	HOOR	2	55	05-Jun-2010	05-Jun-2010
130	T2:DEL CASING	RVINCT010	MAZAK NEXUS	HOOR	1	90	05-Jun-2010	05-Jun-2010
140	DRILLING DEL CASING	RVIMDL001	MULTI DRILLING	HOOR	1	15	05-Jun-2010	05-Jun-2010

Buttons: Addnew, Update, Delete, Print, Cancel

Figure 12: Routing Screen.

7.7 CALENDAR / MACHINE TIME:

Every month planning department personnel has to identify the available working hours of each machine. This is the basic input of machine capacity calculation.

Available Working day/month = Calendars days – Week off days – declared leave days.

Normally all the companies are following with 22.5 hours of working per day.

Available working minutes / Month = (Available working day / month) X Available hours per day X 60.

The Calendar / Machine Time form is shown below.

The screenshot shows a 'Calendar / Machine time' window with the following fields:

- Resource Code: RVIGLA001
- Description: CAPSTAN LATHE
- Month: 01-Jun-2010
- No of Avl Work Days: 26
- Avl Min Per Day: 1350
- Avl Machine Time: 35100

Buttons: Addnew, Update, Delete, Cancel

Figure 13: Calendar / Machine Time Screen.

The Available Machine is calculated automatically based on the above said formula.

7.8 MACHINE UTILIZATION:

The Machine Utilization is calculated for checking whether can we able to ship the materials with in the customer requested date or not? The month wise machine utilization and available hours is checked at any time for giving the actual firm shipment date of product. It is happened after analyzing the every machine assigned load prior. The response time for each customer is very important for growth. The Machine Utilization is arrived based on the order booking item and quantity. It is basically linked with routing master and Machine time master. The Machine utilization screen is shown below.

The Machine Utilization screen displays a table with the following data:

Resource	Avl Min	Reserved Min	Balance Min
RVIDUR001	35100	0	35100
RVICFM001	35100	0	35100
RVICGR001	35100	0	35100
HVICLA001	35100	205.5	34894.5
RVICUB001	35100	0	35100
RVIDRL001	35100	21.5	35078.5
RVIDRL003	35100	52.5	35047.5
HVIGLA001	35100	67.5	35032.5
HVIGLA002	35100	36.5	35063.5
HVIGLA003	35100	65	35035
HVIHBA001	35100	46.5	35053.5

Figure 14: Machine Utilization Screen

If found any one of the machine remaining time is zero, the machining outsourcing decision also made to fulfill the order at stipulated span of time.

7.9 PERFORMANCE HISTORY:

The supplier performance is evaluated as per the parameter mentioned in performance history screen. The supplier is selected which one is having the maximum mark out of three. Normally all the companies are taking the three suppliers for selection process. After the evaluation only they will select the supplier and add its profile supplier master screen for further procurement process. The performance evaluation screen is shown below.

The Performance History screen displays evaluation scores for three suppliers (A, B, and C) across various criteria. The scores are as follows:

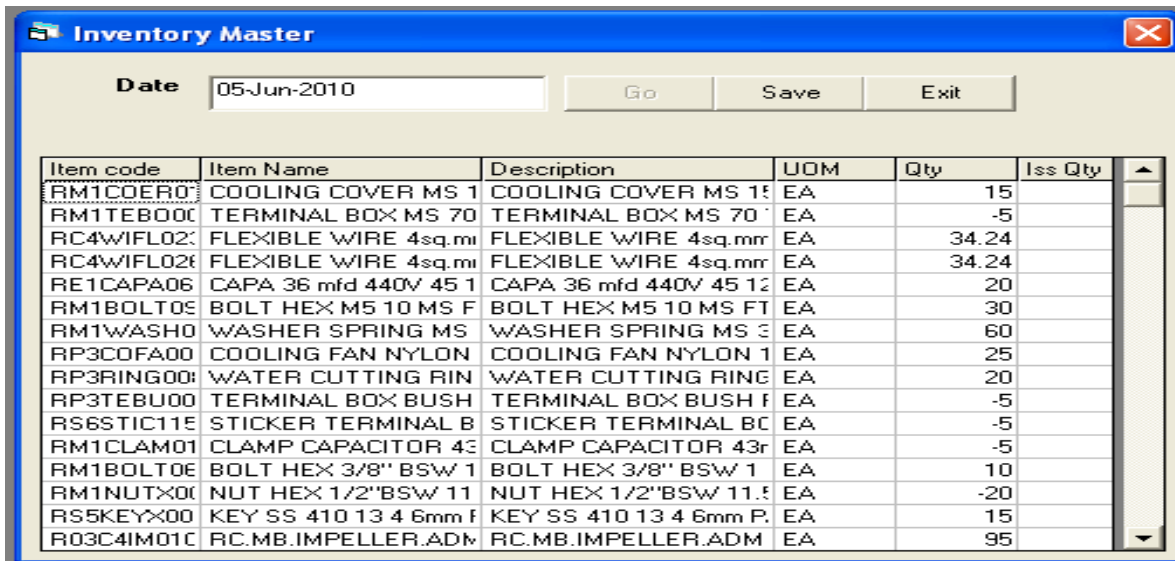
	Supplier A	Supplier B	Supplier C
Quality	4.9	3.7	5.6
Delivery	5.5	8.9	4.9
Price	4.9	8.9	7.9
Repair Service	8.2	8.6	4.9
Technical Capability	5.9	7.2	7.0
Production Facilities and Capacity	4.2	4.6	8.3
Financial Position	5.8	8.8	4.0
Management and organization	6.8	4.8	6.5
Reliability	6.9	5.8	5.7
Flexibility	5.2	5.2	5.4

A pop-up message box indicates: "Supplier B is the highest".

Figure 15: Supplier Performance History Screen

7.10 INVENTORY MASTER:

The Inventory master is used for known the on-line stock of all the materials. It is used to issue the materials while production of final product and maintenance consumables items. The inventory screen is shown below.



The screenshot shows the 'Inventory Master' window. At the top, there is a 'Date' field set to '05-Jun-2010' and three buttons: 'Go', 'Save', and 'Exit'. Below this is a table with the following columns: Item code, Item Name, Description, UOM, Qty, and Iss Qty. The table contains 20 rows of inventory items.

Item code	Item Name	Description	UOM	Qty	Iss Qty
RM1COER0	COOLING COVER MS 1	COOLING COVER MS 1	EA	15	
RM1TEB00	TERMINAL BOX MS 70	TERMINAL BOX MS 70	EA	-5	
RC4WIFL02	FLEXIBLE WIRE 4sq.m	FLEXIBLE WIRE 4sq.m	EA	34.24	
RC4WIFL02	FLEXIBLE WIRE 4sq.m	FLEXIBLE WIRE 4sq.m	EA	34.24	
RE1CAPA06	CAPA 36 mfd 440V 45 1	CAPA 36 mfd 440V 45 1	EA	20	
RM1BOLT05	BOLT HEX M5 10 MS F	BOLT HEX M5 10 MS FT	EA	30	
RM1WASH0	WASHER SPRING MS	WASHER SPRING MS	EA	60	
RP3COFA00	COOLING FAN NYLON	COOLING FAN NYLON	EA	25	
RP3RING00	WATER CUTTING RIN	WATER CUTTING RING	EA	20	
RP3TEBU00	TERMINAL BOX BUSH	TERMINAL BOX BUSH	EA	-5	
RS6STIC11	STICKER TERMINAL B	STICKER TERMINAL B	EA	-5	
RM1CLAM01	CLAMP CAPACITOR 43	CLAMP CAPACITOR 43r	EA	-5	
RM1BOLT0E	BOLT HEX 3/8" BSW 1	BOLT HEX 3/8" BSW 1	EA	10	
RM1NUTX00	NUT HEX 1/2"BSW 11	NUT HEX 1/2"BSW 11	EA	-20	
RS5KEYX00	KEY SS 410 13 4 6mm F	KEY SS 410 13 4 6mm P.	EA	15	
RO3C4IM01	RC.MB.IMPELLER.ADM	RC.MB.IMPELLER.ADM	EA	95	

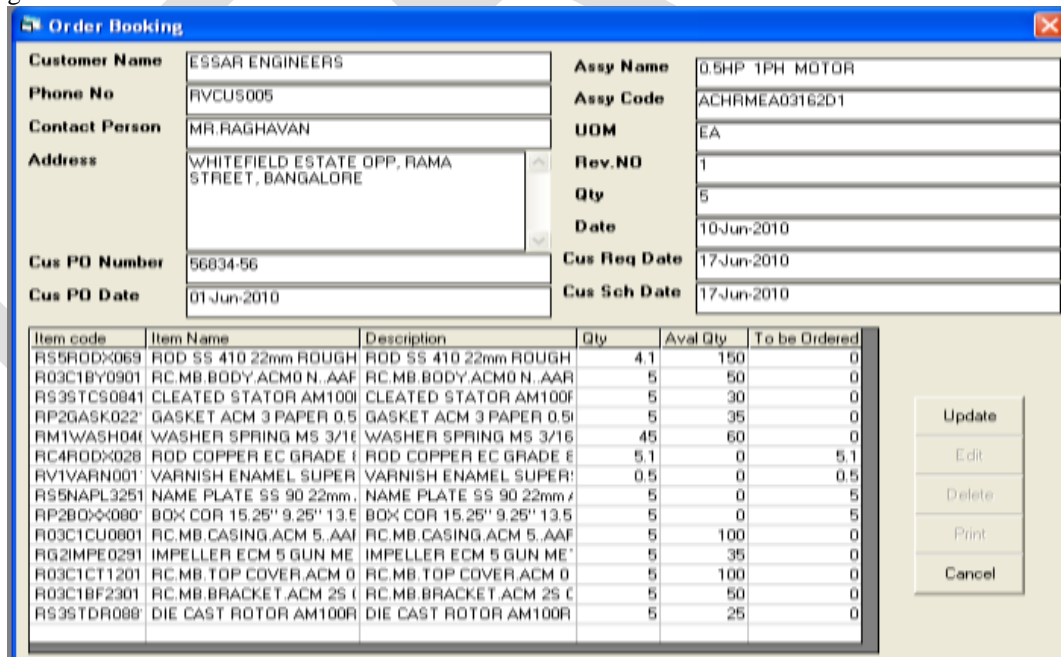
Figure 16: Inventory Master Screen.

7.11 ORDER BOOKING:

The Order Execution is play a major role in all industries. For every order Sales and planning personnel have to do some frame work for successful completion of the order. While order booking the following things has to be verified.

- The customer master is already available or not. If it is not created, customer profile has to be updated in Customer master.
- The ordered item code availability.
- Availabilty of BOM and Routing for requested item.
- Verify the feasibility of completion of order within the requested date for creating Schedule date in order booking form.

The order booking form is shown below.



The screenshot shows the 'Order Booking' window. It is divided into two main sections. The top section contains customer and assembly details, and the bottom section contains a table of items to be ordered.

Customer Details:

- Customer Name: EESSAR ENGINEERS
- Phone No: RVCUS005
- Contact Person: MR.RAGHAVAN
- Address: WHITEFIELD ESTATE OPP. RAMA STREET, BANGALORE
- Cus PO Number: 56834-56
- Cus PO Date: 01-Jun-2010

Assembly Details:

- Assy Name: 0.5HP 1PH MOTOR
- Assy Code: ACHRMEA03162D1
- UOM: EA
- Rev.NO: 1
- Qty: 5
- Date: 10-Jun-2010
- Cus Req Date: 17-Jun-2010
- Cus Sch Date: 17-Jun-2010

Item Table:

Item code	Item Name	Description	Qty	Aval Qty	To be Ordered
RS5RODX069	ROD SS 410 22mm ROUGH	ROD SS 410 22mm ROUGH	4.1	150	0
RO3C1BY0901	RC.MB.BODY.ACM0 N.AAF	RC.MB.BODY.ACM0 N.AAR	5	50	0
RS3STCS0941	CLEATED STATOR AM100R	CLEATED STATOR AM100F	5	30	0
RP2GASK022	GASKET ACM 3 PAPER 0.5	GASKET ACM 3 PAPER 0.5	5	35	0
RM1WASH04	WASHER SPRING MS 3/16	WASHER SPRING MS 3/16	45	60	0
RC4RODX028	ROD COPPER EC GRADE	ROD COPPER EC GRADE	5.1	0	5.1
RV1VARN001	VARNISH ENAMEL SUPER	VARNISH ENAMEL SUPER	0.5	0	0.5
RS5NAPL3251	NAME PLATE SS 90 22mm	NAME PLATE SS 90 22mm	5	0	5
RP2BOX0080	BOX COR 15.25" 9.25" 13.5	BOX COR 15.25" 9.25" 13.5	5	0	5
RO3C1CU0801	RC.MB.CASING.ACM 5.AAF	RC.MB.CASING.ACM 5.AAF	5	100	0
RG2IMPE0291	IMPELLER ECM 5 GUN ME	IMPELLER ECM 5 GUN ME	5	35	0
RO3C1CT1201	RC.MB.TOP COVER.ACM 0	RC.MB.TOP COVER.ACM 0	5	100	0
RO3C1BF2301	RC.MB.BRACKET.ACM 25 C	RC.MB.BRACKET.ACM 25 C	5	50	0
RS3STD0098	DIE CAST ROTOR AM100R	DIE CAST ROTOR AM100R	5	25	0

On the right side of the table, there are buttons: Update, Edit, Delete, Print, and Cancel.

Figure 17: Order Booking Screen

The shortage materials are identified while order booking for initiating the requestion raising and PO Release. The Available stock quantity is taken from inventory master. The required materials are retrieved from BOM Master.

8. SYSTEM IMPLEMENTATION

The developed materials management system is useful to run the organisation for making decision and proper handling of inventory status. Initially company has to work on data feeding activities. The available supplier and customer master, item master are to be created in Visual basic system. Then company subsequently take the time study in proper manner to create routing and proper available machine selection. The Bill of materials creation is needed for every final product code.

System implementation is one of the major part in organisation. Because all working people in the companies are fully molted with existing traditional system eventhough if it is hand written. They don't bother about the new system benefits. Initially people want to train-up and taking the necessary preliminary training session to understand the new system benefits.

The system implementation is done as per the following steps. There are,

1. Study the process and product requirement.
2. Develop a software system regarding the requirement study.
3. Initiative the members to understanding sytem benefits.
4. Conduct the necessary train-up session to implement the system in successful manner.
5. Data feeding to be done which is already available in company.
6. Assign the user responsibilty in system screen.

9. CONCLUSION

Now a days all medium sacle industries are facing problem in business interm of data storage and data transcation. To succeed this competitive world the organisation should be able to take the optimal decision in right time. Based on this point only the project is deveopled to identify the needs and delivery the data in successful maner.

The developed system has a following benefits for organisation in various manner.

- Reduction of manual entry in stores, Order executioon, Bill of materilas and machinery list and cycle time updation.
- Store large amount of data.
- Subsequent back-up will be available in server at any time.
- Take the decision in supplier selection, Capital budget allotment based on the inventory level.
- Take the decision of Make or Outsource in Machining side.
- Check the availability of machine hours to identify the whether customer request date is applicable or ammendable in order booking stage.

10. FUTURE ENHANCEMENT

The project has been enhanncement in future in following aspects.

- Integration of Puschase module with existing system.
- Integration Finance and Account Module with exsting system.
- Integration of Human resource module with existing system.
- Integration of Planning strategy with existing system.

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CFD ANALYSIS OF THERMAL BEHAVIOR WITHIN A SCRAPED SURFACE HEAT EXCHANGER (SSHE)

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Abstract: This paper deals with Computational Fluid Dynamic (CFD) analysis of 3D model of an SSHE is developed in order to study the fluid flow and heat transfer with a steady state laminar, non-isothermal flow of pure glycerine, which can be treated as a newtonian fluid. The variation of the local heat transfer coefficient based on the inner wall temperature and bulk fluid temperature as a function of the main process parameters, namely, rotational Reynolds number (Re_{rot}), axial Reynolds number (Re_{axi}) and dimensionless clearance, is obtained. The results have shown that viscous dissipation has a significant effect on the cooling of glycerine. The local heat transfer coefficient increases slightly when the tip clearance increases. Larger increases of the same occurred with higher rotational Reynolds number and axial Reynolds number. A correlation of the average Nusselt number is obtained in terms of the rotational and axial Reynolds numbers. This is expected to be useful in the design of SSHEs handling highly viscous fluids.

Keywords: Scraped surface heat exchanger, Newtonian fluid, Inner wall temperature, Bulk fluid temperature,

Local heat transfer coefficient, Nusselt number, dimensionless tip clearance

1. INTRODUCTION

SCRAPED SURFACE HEAT EXCHANGER (SSHE) is a device which consists of an annular gap with a cylindrical rotor and stator as shown in Fig 1. Scraping means removal of fluid from the boundary. This breaks the thermal and hydrodynamic boundary layers at the surface and thereby enhances the heat transfer. Specifically an SSHEs is used for the thermal treatment of high-viscous fluids. SSHE is widely used in food industry for sterilizing or cooling highly viscous fluids such as mayonnaise, cream cheese, peanut butter and ice cream. As the treated fluids in SSHE are highly viscous, fouling problems may occur and reduce significantly the thermal efficiency of SSHE. The presence of rotating blades in the annulus makes it possible to avoid the possible fouling problem on the heat exchanger surface, and improve the heat transfer treatment received by the product. A short discussion of the previous studies of authors who attempted to focus on the heat transfer and basic flow patterns in SSHE is presented here. Trommelan et al. [1] was the first person to describe the fluid flow and heat transfer mechanisms for the design and operating conditions of the SSHE. The presence of blades in the annulus makes the fluid flow more complex compared to the Coutte-Taylor flow configurations with a blade clearance of $1\mu m$. Penny and Bell [2] suggested that the clearance between the edge of the scraper blade and the stator wall is not constant, but it is dependent on the operating conditions of the SSHE. De Gode et al. [3] studied the freezing of water-ethanol slurries using an ice generator with a blade clearance of 3 mm and 1 mm, to examine the heat transfer coefficient on the exchanger surface. Toh and Murikami [4] studied the shape of two scraper blades, one curved and another, perpendicular to the wall. Bott and Ramero [5] numerically studied an SSHE to compare the overall heat transfer coefficient with different numbers of scraper blades like 2, 4 and 6. The study shows that increasing the number of scraper blades increases the power consumption and that there are no advantages in increasing the number of scraper blades beyond four. Yataghene et al. [6] conducted a numerical study of the fluid flow and heat transfer within a SSHE, using $130\mu m$ clearance of the blade gap with pure glycerin fluid and examined the mixing time for the exit temperature of the SSHE. Harrod [7] studied the SSHE using a newtonian fluid (water). One of the key purposes of the paper was to model the heat transfer for both laminar and vertical rotational flow, to find the transition between laminar and vertical flow. D'Addio [8] analyzed the thermal behavior of a new kind of SSHE with an alternate scraper blades arrangement, namely, A-SSHE, during the heating and cooling of hazelnut paste, which is a high viscous fluid. He determined the heat transfer coefficient by varying rotational Reynolds number ($5 < Re < 250$), axial Reynolds number (0.06, 4) and Prandtl number (6800, 60000). Stranzinger et al. [9] studied the flow pattern in SSHE, using experimental flow visualization (PIV technique) in a simplified geometry (blades fixed on the stator) and numerical simulation based on finite volume method (FVM). Hartel [10] gave a review of the SSHE in which particular attention was given to the crystallization process of ice cream. He concludes that the mechanical energy dissipated can reach 50% of the calorific energy evacuated by the cooling fluid. More recently viscous heating within SSHE was investigated by Fayolle et al. [11]

both experimentally and numerically. They found that for Newtonian fluid with high viscosity, the effect of viscous heating was very important.

All though work is reported in the literature on the topic of heat transfer in a SSHE, the conjugate heat transfer due to finite wall thickness of the stator has not received much attention. Moreover issues like inner wall temperature, bulk fluid temperature and local heat transfer coefficient for the thermally fully developed flow and the effect of the clearance between the tip of the blade and the stator wall have not been clearly addressed.

The objective of the present work is to create a 3D model of an SSHE and study the fluid flow and heat transfer in steady state laminar non-isothermal flow of pure glycerine (newtonian fluid) with temperature dependent viscosity. The clearance between tip of the blade and the stator is taken as $\delta_{\text{gap}} = 2\text{mm}$, and $65\mu\text{m}$. The relevant dimensionless numbers for the present study are the Rotational Reynolds numbers (Re_{rot}), axial Reynolds number (Re_{axi}) and the dimensionless clearance. The four rotational Reynolds numbers (Re_{rot}) investigated are 26.39, 79.17, 158.39, 237.61 and the axial Reynolds numbers (Re_{axi}) are 0.6, 1.21, 1.82, and 2.43. Parametric study is done by keeping the rotational Reynolds number constant and varying the axial Reynolds number (Re_{axi}), and repeating the same procedure as above for different (Re_{rot}). Thus for each clearance, 16 simulations are to be performed and for three different clearances, 48 simulations are to be carried out. The local heat transfer coefficient for the heat exchanger surface is based on the inner wall temperature and bulk fluid temperature for each cross section of the SSHE. The parameters for which thermally developed flow occurs are examined.

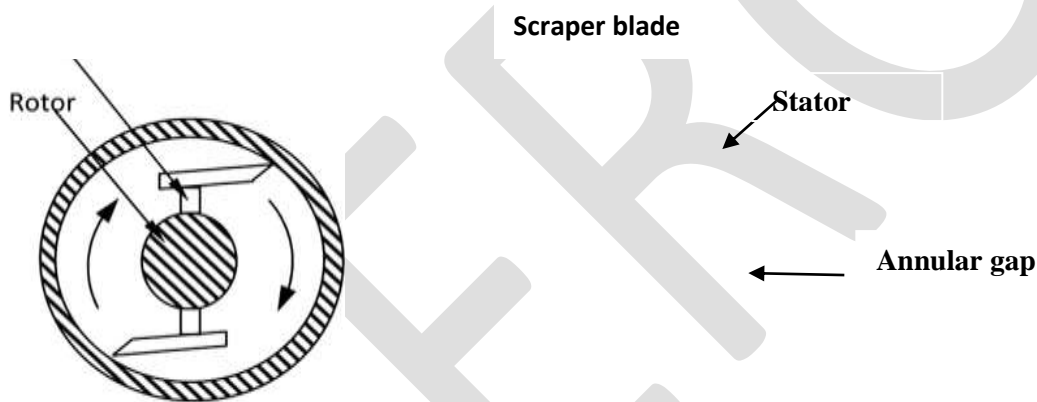


Fig 1: Transversal cross-section of SSHE [6]

2. MATHEMATICAL FORMULATION

2.1 The physical model and coordinate system

A 3D model of SSHE is created in Gambit (Ver. 2.4.6). In view of the geometry, the Cartesian co-ordinate system is chosen to describe the geometry, where X, Y and Z axis are taken in the horizontal, vertical and axial directions of the SSHE respectively. The model is shown in Fig. 2.

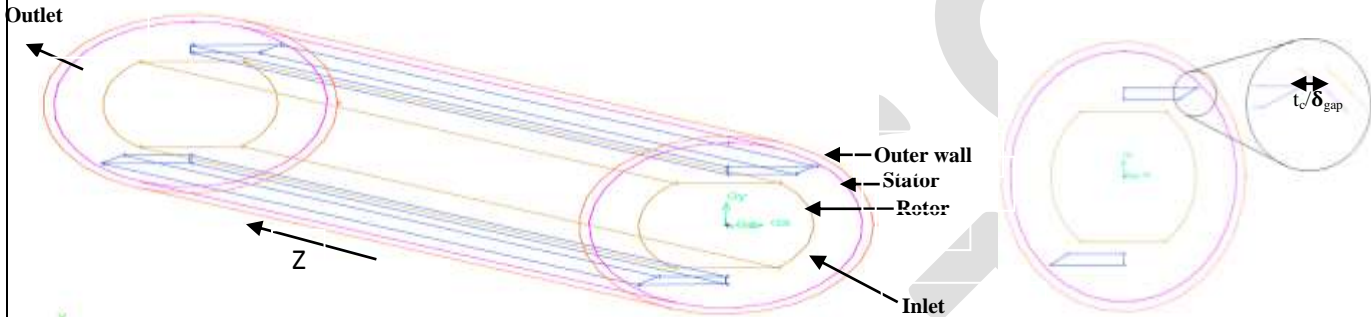


Fig 2: 3D model of SSHE with 2mm clearance

The SSHE consists of a rotor with two fixed scraper blades. The stator surface represents the wall heat exchanger, where a constant wall temperature is applied to the outer wall. In this study the three different clearances between the tip of the blade and stator wall are 2 mm and 65 μm . Other dimensions of the SSHE device are: stator diameter (D_s) = 0.065m, rotor diameter (D_r) = 0.040m, stator length (L_s) = 0.6m, number of blades (n) = 2, area of cross section = $2.945 \times 10^{-3} \text{ m}^2$, and number of blades (n) = 2.

3. GRID INDEPENDENCE STUDY

A commercially available meshing tool is used to generate good quality hexagonal grids. A structured mesh overlaying the hexahedral elements is generated with the Gambit (Ver. 2.4.6) software meshing tool. The mesh density is increased near the wall and especially in the clearance region to ensure accuracy there, as greater temperature changes in the fluid are expected to occur in these regions. The mesh is highly concentrated at the tip of the blades and ensured there were at least 4 mesh points across the tip of the clearance. This was done by performing a number of simulations with different mesh sizes, starting from a coarse mesh and refining it until physical results were no more dependent on the mesh size. The hexahedral cells were retained to have good discretization accuracy. Four mesh refinements of 663600, 831600, 979200 and 1248000 cells were tested and compared with a physical parameter of bulk temperature of the fluid for each cross section of SSHE as shown in Fig 4. For good accuracy of the results, the case with 979200 cells can be employed as this gives no significant difference compared to that with 1248000 cells. A fine mesh of 979200 cells is chosen for further analysis as shown in Fig. 3.

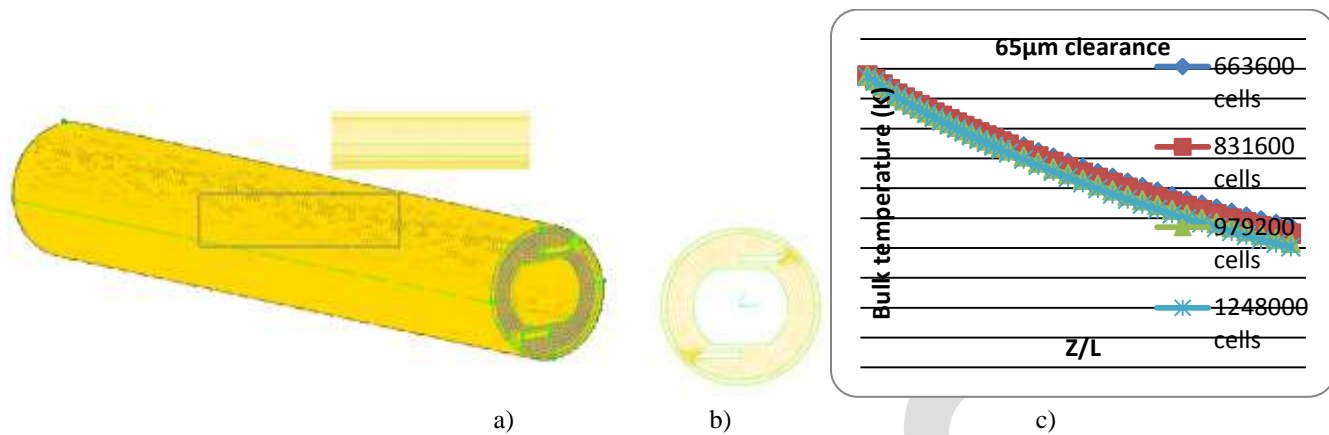


Figure 3: a) Computational of physical domain of a SSHE and used grid, all physical domains was meshed with hexahedral cells of (1279200) b) SSHE Transverse cross section of the mesh topology of physical c) Variation of bulk fluid temperature for different mesh cells for 65µm clearance.

4. GOVERNING EQUATIONS

In this section the governing equations are stated for the heat transfer and fluid flow including viscous dissipation in the SSHE. Steady state, non-isothermal, incompressible flows have been considered. The flow is assumed to be laminar in the entire computing fluid domain with rotation Reynolds number lower than 250 and axial Reynolds number lower than 4. The conservation equations for continuity, momentum and energy for incompressible flows have been solved in dimensional form. It is pertinent to use the rotating reference frame formulation to solve the continuity, momentum and energy equations. The principal reason for employing moving reference frame is to render a problem which is unsteady in the stationary (inertial) frame steady with respect to the moving frame.

In the rotating reference frame, the continuity equation in steady state for the relative velocity is written as:

$$\nabla \left(\vec{v}_r \right) = 0 \quad (1)$$

The momentum equation is written as:

$$\nabla \left(\vec{v}_r \vec{v}_r \right) + \left(2 \vec{\omega} \times \vec{v}_r \right) + \left(\vec{\omega} \times \vec{\omega} \times \vec{r} \right) = -\nabla p + \nabla \cdot \vec{\tau}_r \quad (2)$$

Momentum equation contains two additional acceleration terms: the coriolis acceleration $\left(2 \vec{\omega} \times \vec{v}_r \right)$ and the centripetal acceleration

$$\left(\vec{\omega} \times \vec{\omega} \times \vec{r} \right)$$

Energy equation for the fluid in steady state for rotating frame is expressed as:

$$\underbrace{\nabla \left(\vec{v}_r \cdot H_r \right)}_{\text{Forced heat convection}} = \underbrace{\nabla (k \nabla T)}_{\text{Heat conduction}} + \underbrace{\nabla \left(\vec{\tau}_r \vec{v}_r \right)}_{\text{Viscous heating}} \quad (3)$$

Forced heat convection Heat conduction Viscous heating

In the present work we will neglect the effects of gravity; however, it is straightforward to include it in the axial pressure gradient if the SSHE is mounted with the axis vertical. The stator wall (heat exchange surface) was taken into account with 5 mm thickness. The energy equation has been solved in the fluid and the conduction equation in steady state applicable to solid regions is:

Energy equation for solid:

$$\nabla \cdot (\rho_{steel} C_{psteel} (-\omega \times r) T) = \nabla \cdot (k_{steel} \nabla T) \quad (4)$$

The system of non-dimensionalisation is:

$$Re_{axi} = \frac{v_{in} d_{equ} \rho}{\eta} \quad Re_{rot} = \frac{\omega d_{equ} \rho}{\eta} \quad Pr = \frac{\eta c_p}{k}$$

5. BOUNDARY CONDITIONS

We have examined in this work the fluid cooling process occurring in an SSHE. For the fluid flow, the momentum equation (Eq. 3) boundary conditions are specified as follows: On the stator: $v = \omega \times r$. At the rotor and scraper blade: $v = 0$. Flow at inlet: v_{in} m/s. Outflow: zero velocity gradient $\partial v / \partial n = 0$. The fluid (glycerine) is introduced at the SSHE inlet with the temperature of $T_{inlet} = 288K$, and was cooled with the constant outer wall temperature $T_w = 278K$. The temperature difference between the wall heat exchanger and fluid inlet was $\Delta T = 10K$. Adiabatic conditions were assumed for the rotor and scraper blade. Zero temperature gradient is assumed at the outlet.

ANSYS Fluent code uses the finite volume method for discretization. The governing steady-state equations for mass and momentum conservation are solved with a segregated approach. In this approach, the equations are sequentially solved with implicit linearization. Volume-faces advective fluxes were approximated using a second-order upwind interpolation scheme. Because of the effect of the viscosity variation due to heat transfer, a coupling between velocity and temperature fields must be considered. The pressure-velocity coupling is implemented using iterative correction procedure (SIMPLEC algorithm). For the energy equation too, a second-order upwind interpolation scheme is used.

6. CODE VALIDATION

The problem is solved using Fluent CFD code. In order to check for the accuracy and correctness of the code, the results of Yataghene [9] are reproduced. The problem deals with the CFD analysis for various rotational velocities with a constant volumetric flow rate. The dimensionless exit temperature is calculated using Eq. (7) for pure glycerin by varying rotational velocities in the range 3-10 rev/s. Fig. 4 shows the comparison of the results of Yataghene[9] and the present Fluent results. From this we can comment that the variations are almost identical except that the present results show slightly higher values. This level of agreement is considered satisfactory. It may be noted that when increasing the rotational velocities, the temperature is increases due to viscous dissipation of the fluid.

$$\theta = \frac{T_{out} - T_{wall}}{T_{in} - T_{wall}} \quad (5)$$

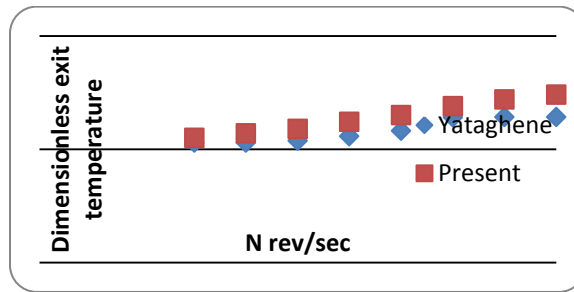


Fig 4: Comparison of temperature contours

7. RESULTS and DISCUSSION

In order to obtain the performance characteristics of 3D model of SSHE for the fluid flow and heat transfer, a parametric study is carried out by varying the clearance between the tip of the scraper blade and the stator wall, the angular velocity of the rotor and the axial velocity of the fluid entering the SSHE. The dimensionless parameters corresponding to the above dimensional parameters are the dimensionless tip clearance, the rotational Reynolds number (Re_{rot}) and the axial Reynolds number (Re_{axi}). Contour plots are constructed to depict the flow and temperature distributions. Graphs are plotted to show the variation of inner wall temperature, bulk temperature and the local heat transfer coefficient. The local heat transfer coefficient is calculated with Eq. (8) with respect to the axial distance. Correlations are obtained for the average Nusselt number based on the average heat transfer coefficient in terms of the process parameters.

$$h = \frac{q_w}{T_{in,w} - T_{bulk}} \quad (6)$$

7.1 Flow and temperature distributions

Figs. 5 (a, b) show the temperature contours for the axial position corresponds to the near-exit section ($Z=0.55$ m) of the SSHE, for various dimensional clearances. The color code gives information about the temperature limits, the blue color corresponding to 278 K and the red color corresponding to 288 K. In Fig (5a), corresponding to 2 mm clearance, the hot fluid is more located in the core and the extent of cooled fluid is very less. Hence higher blade clearance does not produce effective cooling of the fluid. When we observe Figs. 5 (b) for 65 μ m clearance, better cooling process of the fluid takes place with a proper distribution of the cooling temperature is achieved with decreasing the tip of the clearance and there is good heat removal at the boundary surface.

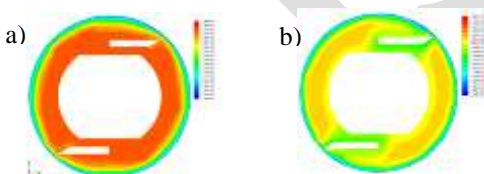


Fig. 5 Temperature contours of SSHE cross section in case of $Z=0.55$ m a) 2 mm clearance b) 65 μ m clearance
 $Re_{rot}=237.13$ and $Re_{axi}=0.0188$

7.2 Axial variations of temperature difference and local heat transfer coefficient

The inner wall temperature and bulk fluid temperature distributions along the SSHE axial distance are shown in Figs. 6 (a, b) at different values of axial Reynolds number, rotational Reynolds number and also for different dimensionless tip clearances. For 2 mm clearance with a rotational Reynolds number (Re_{rot}) of 158.39, the inner wall temperature is very high at the inlet section and the temperature of the inner wall gradually decreases along the axis of the SSHE. When comparing the two curves of the inner wall temperature and the bulk fluid temperature at different axial Reynolds number (Re_{axi}), it can be seen that these two lines are almost parallel to each other and we can say that the temperature difference is uniformly distributed to the fluid. At the tip clearances of 65 μm , the scraper blades continuously remove the boundary layer surface and better cooling occurs with the inner wall and bulk temperatures decreasing with axial distance along the SSHE. When increasing the rotational Reynolds number, the inner wall temperature and bulk fluid temperature increase due to viscous dissipation, which in turn decreases the viscosity of the fluid.

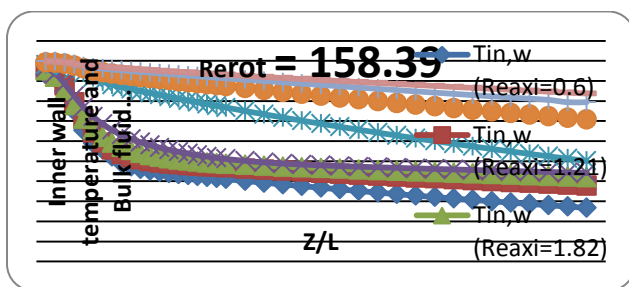


Fig. 6(a) Inner wall temperature and bulk fluid temperature

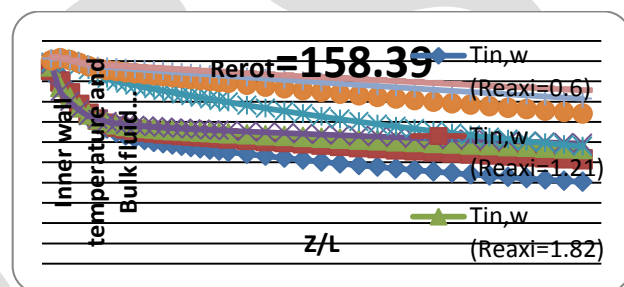


Fig. 6(b) Inner wall temperature and bulk fluid temperature for 65 μm clearance with different axial Reynolds number

The local heat transfer coefficient based on inner wall temperature and bulk fluid temperature calculated using Eq. (8) along the axial distance of SSHE is shown in Figs. 7 (a, b) for different Reynolds numbers and also for different tip clearances. The general variation of local heat transfer coefficient reveals that it is of high value near the inlet section of the exchanger because of the thickness of the boundary layer is very small. It decreases continuously due to the increasing thermal boundary layer thickness. When the dimensionless tip clearance decreases (i.e., 65 μm as against 2 mm clearance), better local heat transfer coefficient is achieved and improvement in the performance of the SSHE is obtained. It can be observed in Fig. 8(a) (2 mm clearance) that the local heat transfer coefficient is less compared to the other clearance. This is because the scraper blades only brush against but not scrape the exchanger surface. When tip clearance decreases, the scraper blades remove the boundary layer and result in higher values of local heat transfer coefficient. A thermally fully developed flow of the fluid is also achieved.

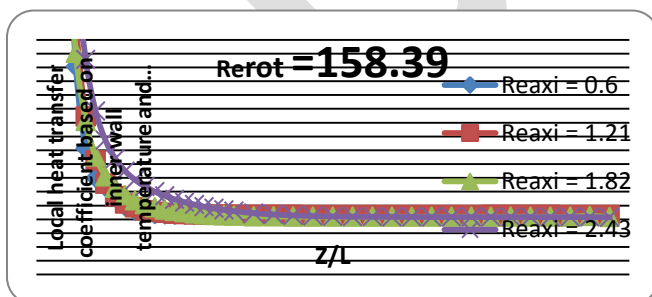


Fig. 7(a) Local heat transfer coefficient based on inner wall temperature and bulk fluid temperature for 2 mm clearance with different axial Reynolds number

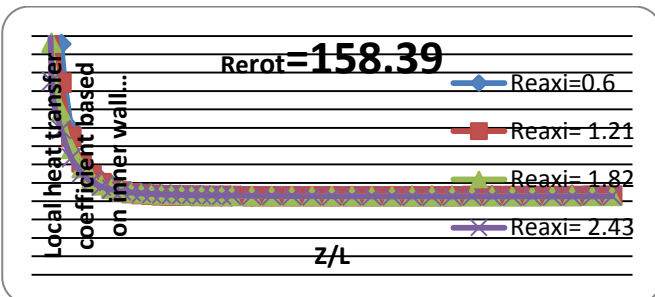


Fig 7(b) Local heat transfer coefficient based on inner wall temperature and bulk fluid temperature for 65 μm clearance with different axial Reynolds number

7.3 Correlations for average Nusselt number

The following correlation has been established for average Nusselt number by using the Eq. (9) under several operating conditions of SSHE.

$$Nu_{avg} = \frac{\bar{h}d_{equ}}{k} \quad (7)$$

In obtaining the heat transfer correlation, the rotational and axial Reynolds numbers are taken as parameters. The Prandtl number variation does not occur because results are obtained for only a single fluid, namely, glycerine.

The correlation obtained using multiple regression analysis is:

$$Nu = a Re_{rot}^b Re_{axi}^c \quad (8)$$

where a, b and c are the constants of the correlation. In order to determine the constants a, b and c of the model several numerical simulations were carried out. Figs. 8 (a, b) show the parity plots between computed and correlated Nusselt number in which 16 data points pertaining to one dimensionless clearance are shown for each plot. Although not presented, similar plot is also obtained for the remaining clearance. The correlation constants are given in Table 1:

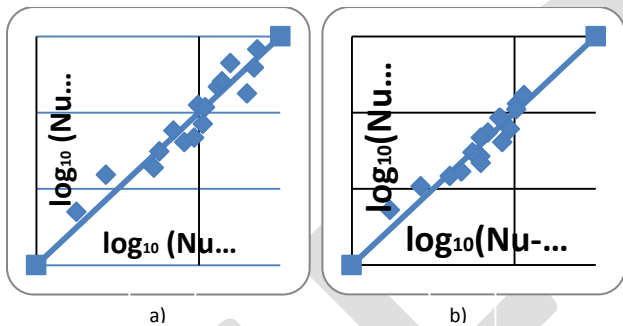


Table 1: Correlation constants

Correlation constants	2 mm Clearance	65 μm Clearance
a	51.62	58.40
b	0.06	0.10
c	0.15	0.19
R ²	0.94	0.95

Fig. 8 Parity plots between computed and correlated values of Nusselt number for a) 2 mm clearance b) 65 μm clearance

According to obtained results it appears that the increase of the rotating speed improves the efficiency of the SSHE for all considered dimensionless clearances.

8. CONCLUSIONS

A 3D CFD model is employed to examine the thermal performance of an industrial scraped surface heat exchanger device. A parametric study is done and the following conclusions are reached:

- 1) The difference between inner wall temperature and bulk fluid temperature increases due to viscous dissipation of the fluid.

- 2) The local heat transfer coefficient based on inner wall temperature and bulk fluid temperature increases along the length of the SSHE in the axial direction with decreasing tip clearance.
- 3) In case of 2 mm clearance, the local heat transfer coefficient is very less compared to other clearance because the scraper blade only brushes but does not to scrape the surface. For 65 μ m clearance, the scraper blades scrape the boundary layer at the surface and this increases the local heat transfer coefficient.
- 4) The local heat transfer coefficient increases with increasing rotational Reynolds number; this improves the performance of the SSHE.
- 5) A heat transfer correlation is obtained for the average Nusselt number in terms of the rotational and axial Reynolds numbers, which are the process parameters.

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Influence of Social Networking in the Work place on Individual Job Performance: Special reference to the Financial Sector in Batticaloa District

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Abstract- Social networking site is all about awareness and connection, and presently the social networking seems to be the tool that affects the job performance of employee in the workplace. The new media is growing so fast that it makes it imperative for employees to embrace the medium. The purpose of the study is to investigate the influence of collaborative technology such as social networking to employee job performance in the workplace. The study evaluate the relationship between social networking and employee performance and examines whether social networking are capable of increasing the levels of employee productivity and satisfaction. It was discovered that the use of social networks at work helped employees improve their performance. Thus, organizations should comprehend about social networking while setting appropriate policies at workplace.

Keywords: Job performance and Social Networking

1. INTRODUCTION

1.1 Background of the Study

Social networking has become one of the most significant business developments of the 21st century as they have added another side to the way people communicate all over the world. Social networking is an online medium of interaction which let people build relations, share ideas, communicate information and bounding society in sentimental stream. Furthermore, social media depends on mobile and web-based technologies to create highly interactive platforms through which individuals and communities share, co-create, discuss, and modify user-generated content. The way to use and respond to social networks is neither a good thing, nor a bad thing, it's just a different thing.

Meanwhile Job performance has been a concern for organizations and researchers. Job performance refers to "behaviors or actions that are relevant to the goals of the organization in question" (McCloy, Campbell, & Cudeck, 1994). Successful organizational communication and knowledge management among organizational members play a key role on promoting employees' job performance. For decades, researchers have been looking for different ways to enhance employee job performance.

Every organization is using social network sites for their professional purposes. So it becomes the need and it's the time for organizations to design workforce according to changing environments. Organization's productivity and profits are based on its employee's performance, and its employees are strongly connecting to social networks. However, like other emerging technologies, social networking, and their usage by employees, have been controversial. This study provides explanatory insights into the capabilities of social networking and its effect on individual job performance of the employees in Finance sector.

1.2 Problem Statement

In the last five years the rapid growth of social media that has been observed is indicative of its importance and its integration into the daily lives of many people in Sri Lanka. According to Warnakula, W.M.S.S, and Manickam, B. (2014) the majority of the employees

visit Social networking sites during office hours in Sri Lanka. There is considerable debate among academics and business practitioners on the value of usage of social networking site use in the workplace. Some claim that usage of social networks sites in the workplace is a waste of time while others believe it leads to improvements in job performance. This study attempts to resolve this controversy by examining the use of social networking sites in the workplace and its effect on individual job performance.

Meanwhile several studies have been conducted on social networking site use covering several topics ranging from ethical issues (Clark & Roberts, 2010) to privacy and security ones (Dinh, 2011; Dwyer et al., 2007; Patel & Jasani, 2010). There are very few researches have yet examined whether the use of social networking sites in the workplace has any potential benefits for businesses in terms of job performance. Therefore, this study attempts to fill this gap in the literature of social networking sites by examining whether the use of social networking sites in the workplace contributes to individual job performance in financial sector.

It is necessary for the managers to determine as to whether social networking in workplace influences individual job performance in their business. As far as the researcher knows no research has been conducted so far in Sri Lanka to examine whether social networking in workplace leads to individual job performance with special reference to Sri Lankan Financial Sector. Thus there exists a clear knowledge gap. This knowledge gap becomes a problem to managers regarding social networking usage of employees. Researcher examines this problem in this study and attempts to fill this knowledge gap and attempts to resolve the controversy by examining the use of social networking sites in the workplace and its effect on individual job performance.

Therefore, the following research problem is advanced in this study,

Does social networking in workplace influences individual job performance with special reference to financial sector?

1.3 Research Questions

1. What is the level of social network usage among the employees of financial sector?
2. What is the level of Individual job performance of financial sector?
3. What is the relationship between usage of social network in workplace and individual job performance of financial sector?
4. Whether the social networking in workplace influences individual job performance of financial sector?

1.4 Research Objectives

1. To assess the level of social network usage in workplace of financial sector
2. To assess the level of Individual Job Performance in financial sector
3. To determine the relationship between social networking in workplace and Individual Job Performance.
4. To identify the influence of social networking in workplace on the Individual Job Performance of financial sector.

2. LITERATURE REVIEW

2.1 The Concept Social Network

“Online Social Network” or “Social Media” is an umbrella term for a broad range of internet-based tools that allow content to be created (incl. conversations) by people using highly-accessible and scalable publishing technologies. There are a variety of online social networking sites available for the people such as Face book, LinkedIn, My Space and YouTube, and Twitter.

Face book – A social networking service where users create personal profiles, add other users as friends and exchange messages, including automatic notifications when they update their own profile. Additionally, users may join common-interest user groups, organized by common characteristics (e.g. workplace).

LinkedIn – A business-related social networking site mainly used for professional networking. Users maintain a list of contact details of people with whom they have some level of relationship, called connections. This list of connections can then be used to build up a contact network, follow different companies and find jobs, people and business opportunities.

Twitter- Twitter is an online social networking and micro blogging service that enables users to send and read short 140-character text messages, called “*tweets*”. Registered users can read and post tweets, but unregistered users can only read them. Users access Twitter through the website interface, SMS, or mobile device app.

YouTube – A video-sharing website on which users can upload, share, and view videos. A wide variety of user-generated video content is displayed, including film and TV clips as well as amateur content such as video blogging. Media corporations including the BBC also offer some of their material via the site. Most videos enable users to leave and exchange comments.

Social network site is a web based service which allows people to sign up in a bounded system, articulating group of people within the same system so as to share personal or academic related information (Boyd and Ellison, 2007). With the improvement of technologies and devices, an online social network has been considered as a salient system.

Social media is the social interaction among people in which they create, share or exchange information and ideas in virtual communities and networks (Ahlqvist 2008). Andreas Kaplan and Michael Haenlein defined social media as “a group of Internet-based applications that build on the ideological and technological foundations of Web 2.0, and that allow the creation and exchange of user-generated content” (Kaplan & Haenlein 2010). Furthermore, social media depend on mobile and web-based technologies to create highly interactive platforms through which individuals and communities share, co-create, discuss, and modify user-generated content.

2.1.1 Dimensions of Social Network Usage

Usefulness

Usefulness is defined as the degree to which an individual believes that using a particular system would enhance his or her job performance. Usefulness is the perception that a given technology will help a user achieve his or her work goals. Usefulness refers to the external benefits to the user-system interaction which are improving the job performance. In other words, individuals will use a system only if they perceive its use would assist them achieve the desired performance.

Ease of Use

Ease of use refers to how much mental effort is expended in the use of the system, in which the user assesses the ease of use through the interaction with the system rather than through the outcome of the interaction with the system. Perhaps a person that is strong on innovativeness might be a reflection of open-mindedness for new applications, including Social Networks, deeming them easy to use. (Venkatesh&Bala, 2008). Vankatesh (2000) concluded in his study that the technology acceptance model will be useful because it is perceived by the user to be easy.

Subjective Norms

Subjective norm refers to social pressure to use (or refrain from using) a technology. It results from an agreed-upon understanding of what constitutes acceptable behavior (normative beliefs), and a person's degree of motivation to comply with those beliefs (Davis, Bagozzi, and Warshaw, 1989). Subjective Norm was not part of the original Technology Acceptance Model, but was added later to help explain the influence that coworkers and other employees have on the behavior of an individual.

2.2 The Concept of Job Performance

Job performance has been associated with the ability of the individual employees realizing their respective work goals, fulfilling expectations as well as attaining job targets and/or accomplishing a standard that are set by their organizations. This could mean that job performance as a construct can be defined in different ways due to the different stages and complexities of the job.

Task performance

Almost all frameworks mentioned task performance as an important dimension of individual work performance. Task performance can be defined as the proficiency (i.e. competency) with which one performs central job tasks. Other labels sometimes used for task performance are job-specific task proficiency, technical proficiency, or in-role performance. It includes for example work quantity, work quality, and job knowledge.

Contextual performance

Although task performance has been the traditional focus of research, researchers have come to believe that individual work performance is more than meeting prescribed work goals. In both generic and job-specific frameworks, one or more dimensions of

contextual performance have been included. Contextual performance can be defined as individual behaviors that support the organizational, social and psychological environment in which the technical core must function.

Adaptive Performance

Adaptive performance is defined as the extent to which an individual adapts to changes in a work system or work roles. It includes, for example, solving problems creatively, dealing with uncertain or unpredictable work situations, learning new tasks, technologies and procedures, and adapting to other individuals, cultures or physical surroundings

Counterproductive work behavior

Attention for counterproductive work behavior (CWB), defined as behavior that harms the well-being of the organization, has increased in recent years. It includes behaviors such as absenteeism, being late for work, engaging in off-task behavior, theft, and substance abuse. Almost half of the generic individual work performance frameworks incorporated one or more dimensions of counterproductive work behavior.

2.3 The Potential of Social Media on Job Performance

Several studies have been conducted on the potential relationship of social media and job performance, examining a variety of important aspect. For instance, North (2010) explored the benefits as well as the risks of the use of social networking sites in the workplace and concluded that employees believe that social networking site use in the workplace is worthwhile. This finding is not surprising, given that one of the primary objectives of using social media is to maintain and strengthen our network ties, which means that we can develop new relationships as well as to maintain existing relationships. Ellison et al. (2007) found a strong association between the intensity of use of Facebook and social capital and that using this social media can help certain users to deal with low self-esteem and low life satisfaction. The same study found that the ability of employees to access Facebook at work was a great incentive for the retention and organizational commitment of new hires as they can be socially connected with family, friends, and other co-workers in the workplace. Furthermore, Bennett et al. (2010) report that the benefits of social media use in the workplace can include enhanced collective knowledge, improved knowledge, increased productivity, and improved morale. In sum, the use of social networking sites by employees could lead to benefits to the employees' job performance.

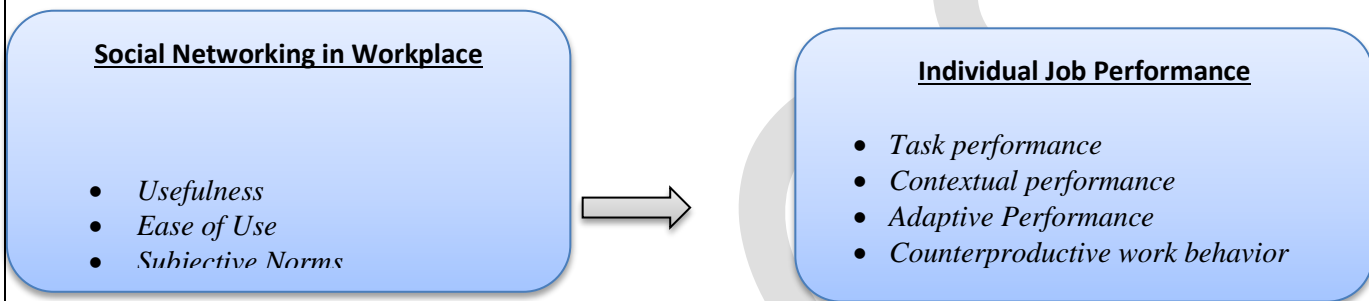
On the other hand, some studies suggest that the use of social media in the workplace might lead to loss in employees' productivity. Indeed, it was found that full Facebook access in the workplace results in a 1.5 percent drop in productivity (Nucleus 2009). Social media use can be argued to lead to distraction, reducing individuals' task performance. For instance, in an academic setting, students, using social networking sites while studying, reported to have lower performance than their peers (Kirschner & Karpinski 2010). In addition, by blurring the boundaries between life and work realms, social media use by organizational members might cause home and leisure issues to interfere with job responsibilities, thereby resulting in diminished job performance (Allen et al. 2000; Kossek & Ozeki 1999).

3. CONCEPTUALIZATION AND METHODOLOGY

3.1 Conceptual Frame Work

Conceptual framework is an important aspect to understand the concept of research study. The main theme of the study was to establish the link between social networking in work place and individual job performance. The research has been conceptualized within a framework to clear cut picture of study.

Figure 1: Conceptual Frame Work



[Source: MOQBEL, M., (2012) Linda K, Claire, M. B., Vincent, H., et al (2011)]

The figure 1 depicts the relationship between social networking in work place and individual job performance. As commonly known, conceptual framework connects constructs and variables (Mbengue & Derumez, 2001). According to figure 1, social networking in work place and individual job performance are the constructs. Social networking in work place is considered as independent variable and Individual job performance is considered as dependent variable. Meanwhile individual job performance can be measured in terms of Task performance, Contextual performance, Adaptive performance and Counterproductive work behavior as suggested by Linda K, Claire, M. B., Vincent, H., et al (2011). Hence above conceptual framework establishes links between the social networking in work place and with the variables of individual job performance.

3.2 Hypothesis for the Study

Several studies have focused on social networking sites, but they rarely touch on the effects of social networking sites on job performance. For instance, North (2010) examined the use of social networking sites in the workplace by prospective and current employees. He found that although some participants find social networking site use to have aspects, he believes that its use at work is worthwhile.

This leads to the following hypothesis:

Hypothesis 1: Social networking usage is positively associated with job performance.

Measurement and scaling are important to investigate the accurate data. Measurement refers to conveying numbers to the objects based on the pre-specified instructions (Malhotra, 1996:271). There are four type of measurement such as nominal, ordinal, interval, and ratio. This study is to investigate influence of Social Networking in the Work place on Individual Job Performance in financial sector employees and statistical analyses are made according to employees' responses. For that reason, this study focuses on primary

data and it uses two measurements such as nominal and ordinal scaling. Demographic factors are based on nominal scaling and rest of the variables such as Social networking usage and Individual Job Performance are measured on ordinal scaling. Because 5-point scale technique is carried out to measure them.

3.3 Research Design

Sampling

The sampling process involved a range of an adequate number of elements from the population grounded on data collected from a subset; an inference of the characteristics of the entire population could be made (Churchill & Iacobucci, 2004; Emory & Binks, 1976; Sekaran, 2000; Zikmund, 2000).

Study Population

Sekaran (2000) stated as “A population is considered to be any group of people, events, or things that are of interest to the researchers and that they wish to investigate”. A study population is the aggregate of all the elements that share some common set of characteristics and that comprise the universe for the purpose of the research. The geographical boundary of research is Batticaloa district. The total number of employees working in the financial sector in Batticaloa district is around 800 from 60 branches of Banking, Insurance and other financial Institutions.

Sampling Method

In this study, Simple Random Sampling technique is carried out. Simple Random Sampling is each element in the population has a known and equal probability of selection. Every element selected independently of every other element and sample is drawn by a random procedure from a sampling frame. Based on percentage of the total number of employees of financial sector in Batticaloa district, 260 staffs are randomly selected for data collection based on the sampling table by Krejcie & Morgan, 1970.

3.4 Data Collection

For the purpose of this study, structured questionnaire was used to collect the required information. Questionnaires were issued by researcher for the employees of financial institutions through personal visit to the financial sector Institutions. The questionnaire comprised three main sections: Section 1 – demographic factors, Section 2 – study information about social networking usage and Section 3 – study information individual job performance. For study variables, data were collected through closed ended statements with a degree of agreement measured with 5 point Likert's scale of 1-5 from every employee's point of view.

In this study, the independent variable, social networking usage measured with 15 statements. Correspondingly, the dependent variable, individual job performance was measured with 20 statements.

3.5 Data Analysis and Evaluation

Data analysis and evaluation are based on the research problem and research objectives. In this study, Univariate and Bivariate analyses were carried out using the SPSS software package to evaluate the findings.

The statistical tools used for this study are described as under:

- Mean
- Standard Deviation
- Pearson coefficient correlation
- Regression Analysis

4. DATA PRESENTATION AND ANALYSIS

4.1 Analysis of Reliability

A reliability test for each independent and dependent variables of the study was performed which showed that Cronbach's' alpha coefficients were above 0.60 for all four independent variable and dependent variable. Therefore, all items considered in this study are to be reliable, which suggests that the internal reliability of the instrument is satisfactory.

Table 1- Reliability Analysis

Variables	Cronbach's Alpha value
Social Network Usage	0.835
Job Performance	0.779

(Source: Survey Data)

4.2 Research Information

Research information considers a main independent and dependent variables of financial sector. For this study, Social Network usage is selected as important independent variable. Under these variable appropriate dimensions also considered to analysis based on research objectives.

4.2.1 Level of Social Network Usage in Workplace of Financial Sector

Table 2- Descriptive Statistics of Social Network Usage

	N	Minimum	Maximum	Mean	Std. Deviation
Usefulness	260	1.50	5.00	3.6298	.75023
Ease of Use	260	1.00	5.00	3.4564	.87937
Subjective Norms	260	1.00	5.00	3.6596	.71221
Social Network Usage	260	1.61	5.00	3.5819	.67984
Valid N (list wise)	260				

(Source: Survey Data)

The independent variable of Social Network Usage has high level in employees of financial sector in Batticaloa District (Mean = 3.582). In addition, most of the respondents expressed the common opinion regarding the independent variable of Social Network Usage (SD = 0.679). It is also noted that about 56.2% percent of respondents have high level of attribute, 37.3% of percent of respondents have moderate level of attribute and while only about 6.5% claim a low level in the independent variable of Social Network Usage, respectively (see Table 3).

Table 3- Percentage of Social Network Usage

Level of Social Network		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	High Level	146	56.2	56.2	56.2
	Low Level	17	6.5	6.5	62.7
	Moderate Level	97	37.3	37.3	100.0
	Total	260	100.0	100.0	

(Source: Survey Data)

This Social Network Usage includes three dimensions which are Usefulness, Ease of use and Subjective norms. That two dimensions show high level of Social Network Usage in financial sector. They have the mean values 3.629, and 3.659, respectively (see Table 2). And the dimension, Ease of Use shows the moderate level in financial sector. Among 260 respondents, the Usefulness and Subjective norms have contributed to Social Network Usage, rather than Ease of use.

4.2.2 Level of Individual Job Performance in financial sector

Table 4- Descriptive Statistics of Job Performance

	N	Minimum	Maximum	Mean	Std. Deviation
Task Performance	260	1.40	5.00	3.7169	.63843
Contextual Performance	260	1.60	5.00	3.5854	.64090
Adaptive Performance	260	1.00	5.00	3.4785	.68317
Counterproductive Work Behaviour	260	1.00	5.00	3.9962	.90258
Job Performance	260	1.90	4.95	3.6942	.56165

	N	Minimum	Maximum	Mean	Std. Deviation
Task Performance	260	1.40	5.00	3.7169	.63843
Contextual Performance	260	1.60	5.00	3.5854	.64090
Adaptive Performance	260	1.00	5.00	3.4785	.68317
Counterproductive Work Behaviour	260	1.00	5.00	3.9962	.90258
Job Performance	260	1.90	4.95	3.6942	.56165
Valid N (list wise)	260				

(Source: Survey Data)

The dependent variable of Job Performance has high level in employees of financial sector in Batticaloa District (Mean = 3.694). In addition, most of the respondents expressed the common opinion regarding the dependent variable of Job Performance (SD = 0.562). This Job Performance includes four dimensions which are Task performance, Contextual performance, Adaptive performance and Counterproductive work behavior.

Three dimensions show high influence of Job Performance in financial sector and one shows the moderate level. They have the mean values 3.716, 3.585, 3.478 and 3.996, respectively (see Table 4). Among 260 respondents, the Counterproductive work behavior has contributed to Job Performance, rather than other dimensions.

Table 5- Level of Job Performance

Level of Job Performance

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid High Level	172	66.2	66.2	66.2
Low Level	6	2.3	2.3	68.5
Moderate Level	82	31.5	31.5	100.0
Total	260	100.0	100.0	

(Source: Survey Data)

It is also noted that about 66.2% percent of respondents have high level of attribute, 31.5% of percent of respondents have moderate level of attribute and while only about 2.3% claim a low level in the dependent variable of Job Performance in financial sector in Batticaloa District, respectively (see Table 5).

4.2.3 Correlation Analysis - Relationship between Social Network Usage in workplace and Individual Job Performance.

Correlation measure how variables or rank orders are related. Pearson's correlation coefficient is a measure of linear association. In this study, the Pearson's correlation coefficient with two-tailed test of significance was considered since the data was quantitative and normally distributed variables. This analysis was made to investigate the relationship between the following variables.

The table 6 shows the Pearson's correlation between Social Network Usage and Job Performance of financial sector in Batticaloa District. The significance is at 0.01 level (2-tailed), and coefficient of correlation (r) is falls between "0.3 to 0.49". It is found as a Moderate positive influence (0.461**) correlation (see Table 6, Correlation between Social Network Usage and Job Performance).

Table 6- Correlation between Social Network Usage and Job Performance

Correlations

		Job Performance	Social Network Usage
Job Performance	Pearson Correlation	1	.461**
	Sig. (2-tailed)		.000
	N	260	260
Social Network Usage	Pearson Correlation	.461**	1
	Sig. (2-tailed)	.000	
	N	260	260

**. Correlation is significant at the 0.01 level (2-tailed).

(Source: Survey Data)

This table shows that each interaction of variable between independent and dependent variable with the significant level of 0.001 This indicates that the correlation was significant and relationships are linearly correlated. Therefore, we can conclude that there is a moderate positive relationship between Social Network Usage and Job Performance of financial sector in Batticaloa District.

4.2.4 Regression Analysis - Influence of social network usage on the Individual Job Performance

Regression analysis is used to predict the value of a variable based on the value of more than two variables. The variable used to predict is called the dependent variable. The variables using to predict the value of the dependent variable are called the independent variables.

The "R Square" statistic indicates that the one independent variable in the regression model account for 21.2 % of the total variation in Job performance. In other words, 21.2% of the variation in Job performance is explained by Social Network Usage (see in Table 7).

Table 7- Simple Regression Model

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.461 ^a	.212	.209	.49944

a. Predictors: (Constant), Social Network Usage

(Source: Survey Data)

The "Adjusted R Square" 20.9% indicates that it is an adjustment of the R-squared that penalizes the addition of extraneous predictors to the model. The Adjusted R^2 statistic is typically smaller than the R^2 statistic because it downward adjusts the R^2 statistic when additional variables of limited significance are added to a model. It is a common practice to say that one regression model "fits" the data better than another regression model if its adjusted R^2 statistic is higher.

The Sig. for the model is 0.000 which is significant at 0.001 level is shown in table 8. Accordingly, the model is good fit for the data.

The unstandardized constant statistic 2.331 units show that the model would predict if all of the four independent variables were zero (see in Table 8).

The b coefficient for Social Network Usage is 0.381. This means that on average, if go up by 1 point on the Social Network Usage Scale then the Job Performance will improve by 0.381.

Table 8- Coefficient of Determinations

Coefficients^a

Model	Unstandardized Coefficients		Standardized Coefficients	T	Sig.
	B	Std. Error	Beta		

1 (Constant)	2.331	.166		14.005	.000
Social Network Usage	.381	.046	.461	8.339	.000

a. Dependent Variable: Job Performance

(Source: Survey Data)

According to the p-values, Social Network Usage is significant at 0.001. This means there is a significant influence of Social Network Usage on Job Performance in this sample (see in Table 8).

Based on this Table 8, the equation for the regression line is:

$$Y = 2.331 + 0.381 (\text{Social Network Usage})$$

According to the regression analysis Social Network Usage significantly impact the Job Performance of employees in financial sector in Batticaloa District.

4.2.5 Test of Hypothesis

Hypothesis testing is a method for testing a claim or hypothesis about a parameter in a population, using data measured in a sample. In this method, test some hypothesis by determining the likelihood that a sample statistic could have been selected, if the hypothesis regarding the population parameter were true.

H_0 : Social network usage is not positively influence job performance.

H_1 : Social network usage is positively influence job performance.

Table 9- Hypothesis Test

ANOVA^b

Model	Sum of Squares	df	Mean Square	F	Sig.
1 Regression	17.345	1	17.345	69.534	.000 ^a
Residual	64.357	258	.249		
Total	81.701	259			

ANOVA^b

Model	Sum of Squares	df	Mean Square	F	Sig.
1 Regression	17.345	1	17.345	69.534	.000 ^a
Residual	64.357	258	.249		
Total	81.701	259			

a. Predictors: (Constant), Social Network Usage

b. Dependent Variable: Job Performance

(Source: Survey Data)

Based on the table 5.31 for the linear regression ($F(1, 258) = 69.534, p < 0.001$), the independent variable "Social Network Usage" is significantly influence dependent variable "Job Performance ". Since the probability of the F statistic ($p < 0.001$) was less than the level of significance (0.005). Thus, fail to accept the null hypothesis and conclude that Social network usage is positively influence job performance.

5. CONCLUSIONS & RECOMMENDATIONS

5.1 Conclusions

In this changing world, adaptability is becoming the most important capability for employees and the organization as well. In other word, adaptability is the key factor to employees' job performance (Pulakos et al. 2000). While most existing studies mainly explore how social media influence employees' job performance in the perspective of work-life balance and wasted time, it is necessary to incorporate the impact of social media on job performances. Therefore, in this study, a mechanism based on job performance theory is studied.

In the mechanism, social media is expected to play a positive role in promoting knowledge sharing and strengthen network ties, thus enhancing individuals' adaptability to changing environment. Besides, a good adaptability ensures that employees can perform effectively in the workplace.

Several studies have been conducted on the potential relationship of social media and job performance, examining a variety of important aspect. For instance, North (2010) explored the benefits as well as the risks of the use of social networking sites in the workplace and concluded that employees believe that social networking site use in the workplace is worthwhile. This finding is not surprising, given that one of the primary objectives of using social media is to impact employees job performance, which means that we can develop new relationships as well as to maintain existing relationships.

Ellison et al. (2007) found a strong association between the intensity of use of Facebook and social capital and that using this social media can help certain users to deal with low self-esteem and low life satisfaction. The same study found that the ability of employees

to access Facebook at work was a great incentive for the retention and organizational commitment of new hires as they can be socially connected with family, friends, and other co-workers in the workplace.

Furthermore, Bennett et al. (2010) report that the benefits of social media use in the workplace can include enhanced collective knowledge, improved knowledge, increased productivity, and improved morale. In sum, the use of social networking sites by employees could lead to benefits to the employees' job performance.

5.2 Recommendations

Exploring the presented issue has a large implication for the financial sector in Sri Lankan context. Especially it carries interest for HR departments who have concern for employee's performance. First, financial institutions should focus on employee's behavior towards using social networks. Financial institutions can design their training programs according to habits of using social networks of employee's. For example, financial institutions can make Facebook page and use it for training purpose. HR department can update its policies, new training programs, meeting schedules, training tools, inspirational quotes on Facebook training page.

Secondly, financial institutions' HR department can use Facebook or other social network profiles of employees to screen out required skills for newly launched/planned project. Financial institutions can use these social networks to enhancing skills/ abilities, knowledge/qualification, productivity/outcomes and motivation level of employees. Financial institutions can create the right directions of usage of social networks by employees.

On the other hand, financial institutions should develop right attitude in its employees for using social networks. It should be taken as positive and ethical medium of social communication. Financial institutions' employees should take social networks as a constructive medium for learning new things, ideas, creating social contacts, having emotional catharsis instead of destructive medium or behaving below morality. At social networks employee are representator/ symbol of these organizations. Their below morality activity or behavior can spoil the image of the organizations in spectator's point of view. So, financial institutions can avail social networking platforms for developing and enhancing employee's performance.

Importantly, there can be some unknown factors too which can affect impact of using social networks on employee performance. Which suggest grounds like positive or negative behavior of employee, lazy attitude of employee, wrong perception while reading status updates, etc. These variables can provide ground for further investigations. This model assists financial institutions for designing employee training programs and making training program more interesting, attractive and matching to young generation's behavior.

5.3 Implications and Future Research

The results of this study have several implications for academics and practitioners. The findings of this study indicate that engaging in the use of social networking sites in the workplace shares a relationship with job performance. From a theoretical point of view, this study contributes to the social networking usage and job performance literature. In the previous social networking site literature, few studies were found to analyze the relationship between those latent variables.

It is clear that innovative behavior and job satisfaction are extremely important predictors of job performance. Social networking site use intensity's influence on job performance was mediated by both innovative behavior and job satisfaction. Therefore, some parts of

the proposed model are confirmed. This study demonstrates that social networking site use intensity should be used as an important predictor of innovative behavior, job satisfaction, and job performance. This is an encouraging step pointing to the need for further testing of the proposed model in future longitudinal studies.

This study collected cross-sectional data at a single point in time through a one-time issuance of the survey instrument. To more holistically explore the relationship between social networking site use intensity and its association with job performance, a longitudinal study design is worth investigating. This longitudinal study would allow researchers to better track the growth of participants' use of social networking sites which in turn could offer greater insight into the association between social networking site use and job performance and other work-related outcomes.

From a practical point of view, this study conveys several implications to organizations and human resource departments, in particular. It is reasonable to conclude that professionals in charge of human resource departments would benefit from understanding the associations elicited by this study. In particular, this study has great practical implications for organizations since understanding relationships between social networking site usage and job performance can help reveal the underlying rationale for organizations to either allow or disallow the use of social networking sites in the workplace.

As the findings suggest, the social interaction of employees with coworkers, friends, and family members through social networking sites provides them with social support which enhanced their job satisfaction, organizational commitment, innovative behavior, and job performance. This suggests that organizations should help employees to socially interact and socialize with coworkers, family members, and friends while in the workplace using social networking sites.

The results suggest that, in order to obtain better work-related outcomes and ultimately job performance, employees should involve themselves in social networking site use, a main source of social support. Establishing a social support network with people from different backgrounds through social networking sites would help employees become happier at work, become more innovative and committed to their organizations, and perform better. In sum, this study suggests that organizations should add the adoption of the use of social networking sites in the workplace to their arsenal of practices that enhance job satisfaction, organizational commitment, innovative behavior, and job performance.

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DEVELOPMENT OF AN INTEGRATED AND CONVENIENT METHODOLOGY FOR CHECKING LEVELLING SYSTEMS

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Abstract - Each level and its accompanying rods constitute an integral levelling system. The check of a levelling system is essential in order to ensure the credibility of the geodetic applications where is used. A convenient and cost effective methodology for checking levelling systems is presented through this work. The methodology is based on a **low cost innovate comparator** which constitutes the basic tool. Using this **comparator** the levelling systems, which provide accuracy minor or equal to $\pm 1\text{mm/Km}$, can be checked within 30 minutes. The process, which should be followed as well as the applied statistical tests are analyzed. These tests respond both for the proper operation of the system and the achievement of its nominal accuracy. Additionally the manufacture of the comparator as well as the selection of the used materials is presented. Moreover the calibration methodology of the comparator is described in detail. Finally the results of four levelling systems that were checked are evaluated. It is proved that both tests are necessary as there are cases that a levelling system achieves the nominal accuracy although it doesn't operate properly due to a systematic error. So, useful conclusions are elicited about the convenience and the use of the methodology.

Keywords— digital level, rods, checking, particular comparator, calibration, standard values, measured values, Least Square Method

INTRODUCTION

Digital levels and rods are considered as a unified system for height differences determination and for this reason a contemporary check is suggested [1]. Today the measurements by using such systems are emerged by a way that constitutes "black box" for the most users.

The uncertainty of height difference measurement by using digital level depends mainly on the effect of aging of the CCD camera [2] [3] and the accuracy of the horizontal plane definition by the line of sight.

Also rods have a significant contribution to the levelling result. They are usually deformed because of bad use and maintenance. Some reasons for rods' distraction are the temperature changes (thermal expansion coefficient) [4], blows that cause its distortion, attrition of the rod's base plate (error of the zero) and damage on the bar code. So the measurements, which are taken by the digital process, may have additional errors. Thus some times the provided uncertainty is larger than the nominal one.

Specialized metrological laboratories worldwide use special comparators with interferometers in order to check mainly invar rods. This facility has the ability to shift accurately the rod electronically, as the level is set opposite, at several distances, in order to take readings. There are two types of comparators, for horizontal and vertical setup of the rod. At the horizontal comparators, mirrors are used for the readings acquisition. Such comparator operates in Germany (Unibw) [5], [6]. At the vertical comparators, the check of both the rods and the system is carried out. Such comparator operates at the metrological laboratory of Technical University in Graz (Austria), [7]. Also the Finish Geodetic Institute (FGI) performs automatic calibration of levelling rods by means of vertical comparator from 1996 and systems' calibration from 2002. Similar comparator also operates at Technical University in Ostrava, in Japan (Geographical Survey Institute) and in Slovenia (University of Ljubljana) [8] [9].

The cost of this comparator is hundreds of thousands Euros and for this reason they are very rare and they are used mainly for checking high accuracy levelling systems (greater than $\pm 1\text{mm/Km}$) [5], [6] as it is unprofitable for checking levelling systems, for basic construction works (minor or equal to $\pm 1\text{mm/Km}$). So, the majority of levelling systems of the worksites are remained unchecked for years.

Thus a low cost and easy to use comparator would be useful in order to help professionals to check their own levelling system. Additionally, the check procedure should be as easy as possible, quick and probably self -applicable. This facility will have major contribution to the reliability of the provided measurements to a plethora of infrastructure works.

Thus, this paper presents a simple and quick checking methodology for levelling systems. The methodology is based on a low cost innovative particular comparator, which simplifies the process.

Initially the comparator is calibrated in order to produce the **standard values** of a number of height differences between particular planar surfaces, which are defined by the steps of its body.

The main idea is to utilize these standard values and the **measured values** of the same height differences, which are provided by the leveling system being checked, in order to apply the check.

CHECKING METHODOLOGY

The main goal of the methodology is the assessment of both the proper operation of a levelling system (accreditation) and its nominal accuracy according to the manufacturer specifications. The proposed methodology is composed by the following steps:

- The rod is put by turns on each step i ($i=0$ to 11) of the comparator, where ten readings r are taken by the level, which is put at 10 meters distance. The mean value r_i of these readings is calculated.
 - The ΔH_i between all the successive comparator's steps are calculated $\Delta H_i = r_{i+1} - r_i$.
- The linear equation (1) is applied by means of the least squares method as there are formed eleven height differences.

$$\Delta H_i = m \cdot \Delta H_{ist} + b \quad (1)$$

where ΔH_i are the **measured values** by the leveling system **being checked**

ΔH_{ist} are the **standard values**, which have been obtained from the calibration of the comparator.

m is the scale of the leveling system, which shows the identification degree between the measured values and the standard values.

b is the constant displacement on the Y axis namely the **systematic error**.

$\hat{\sigma}_0$, is the **standard error** of the adjustment which represents the random error of the leveling system

Thereinafter the appropriate statistical tests are carried out. The first statistical test [10], [11], [12], deals with the proper operation (accreditation) of the leveling system. By using the factors m and b (equation 1) the corrected measurements ($\Delta H'_i$) of the leveling system being checked are calculated using the following equation:

$$\Delta H'_i = \frac{\Delta H_i - b}{m} \quad (2)$$

So the residuals v_i are calculated as the differences between the measured values and the corrected values:

$$v_i = \Delta H'_i - \Delta H_i \quad (3)$$

The detection of gross or systematic errors is performed by the comparison of the residuals v_i to their standard errors. So the variance-covariance matrix (V_v) of the residuals must be calculated in order to obtain the σ_{v_i} .

If the inequality of the equation 4 is true, then at that specific area of the rod a malfunction is detected, causing incorrect measurements.

$$v_i \geq Z_p \cdot \sigma_{v_i} \quad (4)$$

where $Z_p = 1.96$ for confidence level ($p = 95\%$)

The second statistical test [10], [11], [12], is essential in order to prove if the leveling system works according to its nominal accuracy as provided by the manufacturer. The following assumptions are examined by using the standard error of the adjustment σ_0 .

$$H_0 \rightarrow \hat{\sigma}_0 \leq \sigma_0 \cdot \sqrt{\frac{\chi^2_{1-\alpha, r_b}}{r_b}} \quad \text{or} \quad H_1 \rightarrow \hat{\sigma}_0 \geq \sigma_0 \cdot \sqrt{\frac{\chi^2_{1-\alpha, r_b}}{r_b}} \quad (5)$$

Where: σ_0 : the standard error of the single measurement of a leveling system as it is

provided by the manufacturer.

r_b : the freedom degree

$\chi^2_{1-\alpha, r}$: The value, which is provided by suitable statistical tables of χ^2

distribution for confidence level $p = 1 - \alpha$.

So the null hypothesis (H_0), indicates that the estimated standard error of the adjustment ($\hat{\sigma}_0$), is less than or equal to the nominal value (σ_0). So, it is accepted for a given confidence level. If the alternative hypothesis (H_1) is valid, then the leveling system does not operate according to the manufacturer's specifications.

THE PARTICULAR COMPARATOR

The determination of standard values of some settled height differences requires a particular comparator. After a thorough investigation and study of many parameters, the comparator was manufactured as it is described in the following paragraphs.

Materials as wood (melamine) and glass as well as screws of aluminum for the connection of the wooden surfaces and metal screws for its stabilization are used. The shape of the comparator is drawn as the Greek letter "II" having twelve steps (fig.1). It is 1.20m in height, 13cm in length and 7cm in width. These dimensions are appropriate in order that a rod be put there. It has special wooden rails clothed with glass, engraved in concrete place. An independent piece of glass, of 8mm in width, is placed like a shelf in the concrete rails in order to put on the rod (fig.2). Thus the structure permits the vertical placement of a rod during the measurements. The dark shadow parts in figures 1 and 2 present the glass surfaces, which cover the timber in order to be frictionless during the shelf placement [13]. The vertical placement of the comparator and its stabilization on a wall was achieved by the simultaneous use of a portable overall level and the use of two total stations. The total stations are placed at perpendicular positions in relation to the comparator in order to align their vertical cross hairs to its edge. Additionally modern digital constructional laser was used. A built-in level is also placed on the comparator's body, in order to be continuously checked for its verticality. The installation hall of the comparator must ensure the required free space upwards, for the easy rod placement, stability conditions and adequate lighting for capturing the readings.

The step interval decided to be about 10cm as this distance is close to the length of the CCD projection of the code at sighting distance of 3m [5] for some level's models. Moreover this step size permits a convenient check process as it reduces the measurements and it minimizes the needed time. Thus, twelve steps have been created.

At the right side of the comparator special screws are allocated in order to support the rod and to stabilize it at the vertical position during the measurements.

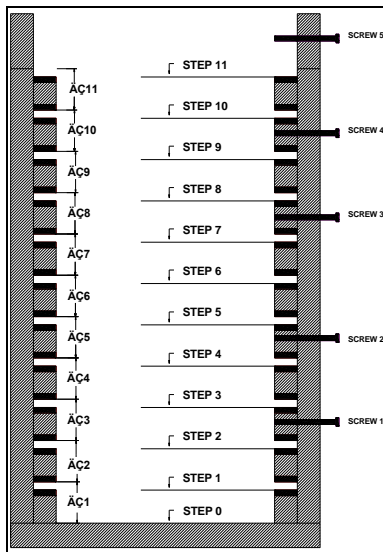


Fig 1. Diagram of the comparator's façade

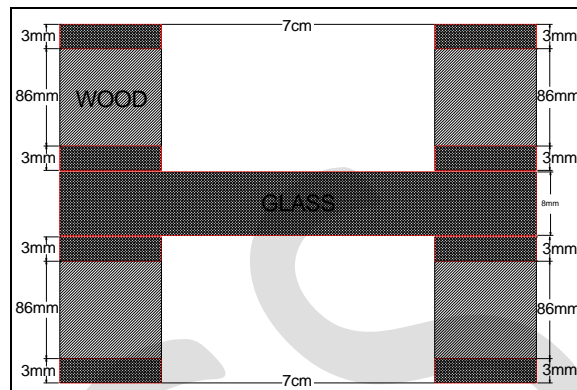


Fig 2. Enlargement of one comparator's step

The comparator, in order to be used for this check, must be unalterable over time and well structured. So, to select the materials that could be used for its manufacturing, two main parameters were examined. These are the thermal expansion of the materials and the bending arrow of each step due to the rod's weight.

The thermal expansion of several materials is given by the equation 6, which calculates the change of a material length dl in relation to the temperature change dT .

$$dl = a \cdot 10^{-6} \cdot l \cdot dT \quad (6)$$

Where: $a \cdot 10^{-6}$: thermal expansion coefficient (grad^{-1})

l : length of the material specimen (m)

dT : temperature change ($^{\circ}\text{C}$)

Figure 3 presents the influence of the temperature change on one meter of each material namely the thermal expansion coefficient ($a \cdot 10^{-6} \text{ grad}^{-1}$) for temperature raise from 2°C to 50°C . Wood (melamine) and Pyrex glass have the minor expansion coefficient $6.6 \cdot 10^{-6}$ and $3.2 \cdot 10^{-6}$ respectively so they have insignificant change of the order of 0.2mm for 50°C temperature change. Also these materials have low cost and for this reason are advantageous and prepossessing.

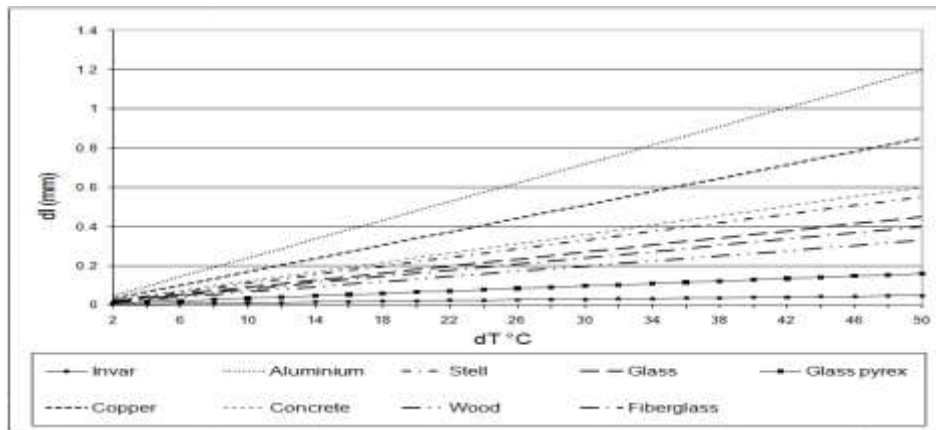


Fig 3. The change of 1m of several materials length in relation to the temperature change

The second parameter, which is examined, is the deformation of a material piece, which will be used as seating surface of the rod. Namely the bending arrow of the seating surface due to the rod's load, which could be considered as distributed load, must be calculated. Equation 7 presents the maximum deformation y_{\max} [14].

$$y = \frac{q \cdot x^2}{24EJ} \cdot (1-x)^2, \text{ for } x = \frac{1}{2} \Rightarrow y_{\max} = \frac{q \cdot l^4}{384 \cdot E \cdot J} \quad (7)$$

Where: y_{\max} Maximum bending arrow

x : distance from the left edge (m)

l : the length of the material piece (m)

q : distributed Load over the entire surface (kN/m)

E : elasticity modulus (kN/m²)

J : moment of inertia (m⁴)

Figure 4 presents the maximum deformation of several materials caused by rod of about 30Nt ($\approx 3\text{kg}$) as distributed load on a seating surface, which is 130mm in length, 70mm in width and 8mm thick. It's obvious that this deformation is negligible of about 0.2 μm for the most of materials including glass, which additionally is the cheaper.

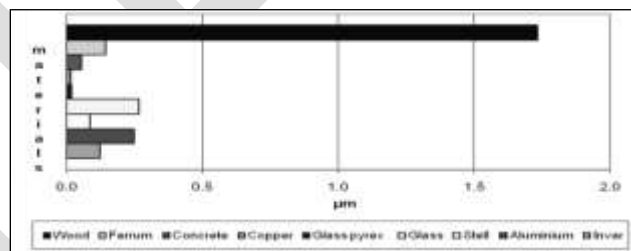


Fig 4. Bending arrow of a seating surface due to the rod's load (distributed load)

The results of the above research show that wood and glass are the most convenient manufacturing materials, as they ensure the maintenance of the comparator's shape and dimensions.

CALIBRATION OF THE COMPARATOR

The calibration of the comparator aims to the accurate calculation of the **standard values** ΔH_{ist} of the eleven height differences, between the twelve steps.

A crucial investigation was carried out in order to calculate the optimum number of readings, which should be taken on each step as well as the appropriate distance between level and rod. Thus an independent experiment was realized as follows. The results are applied both to the calibration procedure and to the check procedure.

Up to 15 readings were taken on an invar rod by using a first order leveling system, from three different positions at distances 5m, 10m and 20m between level and rod.

For each position, 13 separate mean values and their standard errors are calculated taking into consideration each time a different number of measurements (from 3, 4,... to 15).

Figure 5 illustrates the standard error of each mean value on the y axis. The x axis illustrates the number of readings that participate to each calculation. The standard error is reduced, when more readings are used and becomes practically changeless, after the use of ten readings. So the results show that the optimum number is 10 readings. Also the standard error increases as the distance became longer. Therefore was selected the distance of 10m as the difference between 5m and 10m is negligible.

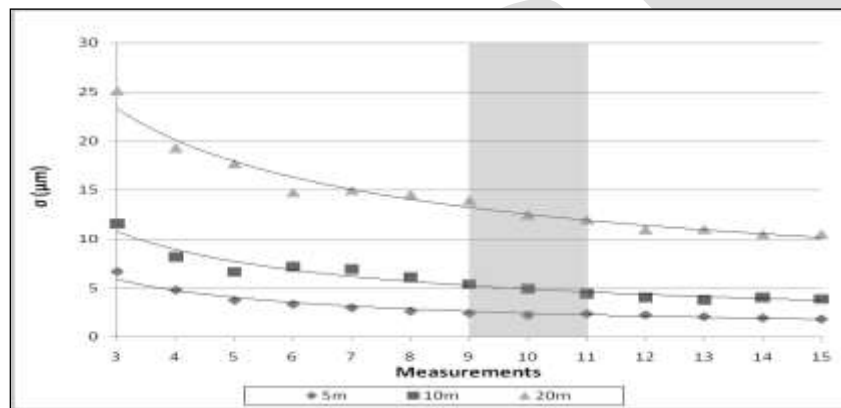


Fig.5 The mean value standard error's change in relation to the number of readings

So the comparator's calibration procedure is as following. Ten repeatable readings are taken on each step. The mean value C_k ($k = 0$ to 11) of the 10 measurements and the standard deviation σ_{C_k} according to the law of propagation of error, are calculated. Moreover a bilateral statistical test according to distribution F was applied between all the steps in order to examine if the values are of equal weight or not. So exemplarily, the ratio $f = \frac{\sigma_{C_k}^2}{\sigma_{C_{k+1}}^2}$, is created. The null hypothesis is true, namely the readings on steps k and $k+1$ is of the same uncertainty, when the following equation is fulfilled:

$$F_{V_{1-1}, V_{2-1}}^{1-a/2} \leq f \leq F_{V_{1-1}, V_{2-1}}^{a/2} \quad (8)$$

Thereafter 55 height differences δH_l are formed (apart from the single ones) as the combination of the 12 steps per two as it is given by the equation 9 and it is illustrated by the figure 6:

$$\delta H_{l, (l = 1, \dots, 55)} \begin{cases} \delta H_{0-k} = C_0 - C_k, k = 2, \dots, 11 \\ \delta H_{1-k} = C_1 - C_k, k = 3, \dots, 11 \\ \dots \\ \delta H_{9-k} = C_9 - C_k, k = 11 \end{cases} \quad (9)$$

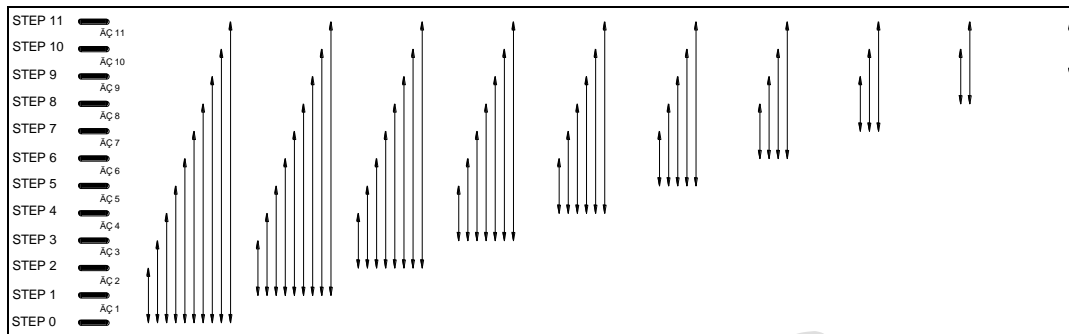


Fig.6 The 55 formed height differences δH_i

In the case that equation 8 is valid for all the steps, then using the 55 equations of the δH_i an equal weight adjustment is carried out in order to calculate the unknowns, which are the single height difference ($\Delta H_{i_{st}}$, $i=1, 2, \dots, 11$) between every pair of the comparator's steps (X_1^{11}). Otherwise, if they are considered unequal weighted and a weight matrix (P_{55}^{55}) is created by using the standard deviations of every single height difference by applying the law of propagation of error according to equation 10.

$$\sigma_{\delta H_i}, (i=1, \dots, 55) \begin{cases} \sigma_{\delta H_{0-k}} = \sqrt{\sigma_{c_k}^2 + \sigma_{c_0}^2}, K=2, \dots, 11 \\ \sigma_{\delta H_{1-k}} = \sqrt{\sigma_{c_k}^2 + \sigma_{c_1}^2}, K=3, \dots, 11 \\ \dots \\ \sigma_{\delta H_{9-k}} = \sqrt{\sigma_{c_k}^2 + \sigma_{c_9}^2}, K=11 \end{cases} \quad (10)$$

Then the LSA is used in order to ensure the reliability of the results. So, the standard system $A^T P \hat{x} = A^T P l$ is formed, where A_{11}^{55} is the matrix of the coefficient of the unknowns. The mathematical model of the adjustment is created by the **55 linear height differences equations** is illustrated in equation 11.

$$\begin{aligned} \Delta H_2 + \Delta H_1 &= \delta H_{0-2} \\ \dots \\ \Delta H_5 + \Delta H_4 + \Delta H_3 + \Delta H_2 + \Delta H_1 &= \delta H_{0-5} \\ \dots \\ \Delta H_{11} + \Delta H_{10} &= \delta H_{9-11} \end{aligned} \quad (11)$$

The adjustment has 44 degrees of freedom (55 measured height differences – 11 unknown height differences) and it provides the **standard values** of the eleven height differences $\Delta H_{i_{st}}$ ($i=1$ to 11) and their uncertainties' via the variance - covariance matrix and the standard error $\hat{\sigma}_0$.

Two calibration procedures are carried out in 2011 and in 2015 (~ 4 year span), by using a calibrated first order Leica DNA03 digital level and an invar rod, in order to assess the repeatability of the **standard** values, namely the stability and the maintenance of the comparator over time.

Then the differences $\delta_{\Delta H_{ist}}$ between the two periods are calculated (equation 12), and their standard errors $\sigma_{\delta_{\Delta H_{ist}}}$ (equation 13).

$$\delta_{\Delta H_{ist}} = \Delta H_{i_{st2015}} - \Delta H_{i_{st2011}} \quad (12)$$

$$\sigma_{\delta_{\Delta H_{ist}}} = \sqrt{\sigma_{\Delta H_{i_{st2015}}}^2 + \sigma_{\Delta H_{i_{st2011}}}^2} \quad (13)$$

So, the following statistical hypotheses are created for confidence level 95%.

$$H_0 \rightarrow \delta_{\Delta H_i} \leq \sigma_{\delta_{\Delta H_{ist}}} \cdot Z_p^{95\%} \quad \text{or} \quad H_1 \rightarrow \delta_{\Delta H_i} > \sigma_{\delta_{\Delta H_{ist}}} \cdot Z_p^{95\%} \quad (14)$$

So, for the null hypothesis (H_0), the differences between the two epochs is not statistically significant, while if the alternative hypothesis is true (H_1), the comparator would not be stable.

The differences $\delta_{\Delta H_{ist}}$ fluctuate from 0.01mm to 0.09mm, as the permitted differences $\sigma_{\delta_{\Delta H_{ist}}} \cdot Z_p^{95\%}$, fluctuate from ± 0.04 mm to ± 0.20 mm. So, the standard values of the height differences are successfully passed the test and it is proved that they are repeatable.

The basic concept of the comparison between values, which are measured by an instrument under check, with the corresponding values, which are provided by a higher order instrument, is valid for several metrological checks. The main rule is that the standard instrument should be about 10 times of greater precision than the instruments or the systems, which have to be tested [15].

Therefore according to the results, the comparator is relevant for the check of leveling systems of nominal accuracy of ± 1 mm and more. Such a test is recommended to be carried out once a year in order to ensure the standard values and minimizes their determination uncertainty.

EXPERIMENTAL APPLICATION

Four leveling systems of different brands, which provide nominal accuracy ± 1.0 - 1.5 mm/km for 1km double run leveling, were checked [13], [16], by using the comparator, which was established in a laboratory hall.

Pass ✓ Fail ✗	m	σ_m	b	σ_b (mm)	σ_0 (mm)	P. O	N. A	m	σ_m	b (mm)	σ_b (mm)	σ_0 (mm)	P. O	N. A
	1 st leveling system							2 nd leveling system						
1 st Part	1.00049	± 0.00012	-0.05	± 0.07	± 0.11	✓	✓	1.0007	± 0.00005	-0.08	± 0.03	± 0.05	✓	✓
2 nd Part	1.00039	± 0.00012	0.04	± 0.07	± 0.09	✓	✓	1.0003	± 0.00014	0.17	± 0.08	± 0.11	✗	✓
3 rd Part	1.00029	± 0.00015	0.02	± 0.09	± 0.12	✓	✓	1.0007	± 0.00016	-0.11	± 0.09	± 0.13	✓	✓
4 th part	1.00042	± 0.00014	0.22	± 0.07	± 0.09	✗	✓	1.0002	± 0.00014	0.07	± 0.07	± 0.09	✓	✓
	3 rd leveling system							4 th leveling system						
1 st Part	0.99981	± 0.00022	0.14	± 0.15	± 0.23	✓	✓	0.9993	0.00018	0.85	± 0.12	± 0.19	✗	✓
2 nd Part	0.99996	± 0.00022	0.13	± 0.15	± 0.23	✓	✓	0.9994	0.00028	0.41	± 0.19	± 0.29	✓	✓
3 rd Part	0.99958	± 0.00021	0.66	± 0.14	± 0.22	✗	✓	1.0000	0.00026	0.00	± 0.18	± 0.27	✓	✓
4 th part	0.99986	± 0.00022	0.78	± 0.15	± 0.24	✗	✓	0.9997	0.00016	0.46	± 0.11	± 0.17	✗	✓

Table 1. Checking results

All the rods are telescopic, made by fiber – glass and each one could be divided in four parts. The proposed methodology is carried out separately for each part of the rod.

Additionally the statistical tests are applied as given by equations 4 and 5. It is remarkable that, although some of the leveling systems do not meet the conditions of the first statistical test for the proper operation (P.O), their performances are conformed to the nominal accuracy (N.A) according to the specifications, which are set by the manufacturer. Table 1 presents the results.

DISCUSSION

The main advantage of the proposed methodology is the two separate statistical tests that were carried out.

The first test inquires the accordance of the system being checked with the standard system. Thus the system under check is accredited and probable systematic errors are detected.

The second test is about the system's operation in accordance with the manufacturer's nominal accuracy. As it is proved by the experiments a rod's part pass the second test although it fails to the first one.

Therefore only the second test is not enough as cannot detect the systematic errors of the system. These errors aren't also detected via the ISO tests, which only check the internal accuracy of the system [17].

Also the methodology calculates the residuals v_i for every 10cm segment on the rod's body and so it detects the exact damaged area. It is worth to mention that the methodology can be applied by reducing the magnitude of the step to 5cm or 2cm or even 1cm. This decision induces augmentation of the measurements and also of the time needed to end the procedure.

Moreover by the calculation of the system's scale and the systematic error, it is feasible to determine, the corrected measurements of the system if it has been used to a field work.

The option to check separately each part of the rod is very convenient as each part is short and light enough to be put and to be stabilized at the vertical position on each step of the comparator.

The Least Square Adjustment allows a robust solution providing qualitative and quantitative results with reliability, which could not be achieved by the simple calculation of the differences between the standard and measured values.

Besides, by this procedure the standard error of the single measurement of a system is calculated. In general this information does not be given by the manufacturer as the error of the double running leveling of 1km is registered in the specifications.

The manufacturing of the comparator is very simple and cheap by using common materials. The materials, which were used, are not influenced by the temperature changes or the weight of the rod.

The calibration procedure is reliable and may be repeated in stated time intervals in order to eliminate the uncertainty of the **standard** values of the determined high differences. It is proved by the repeatable calibrations that the differences of the standard values do not exceed the $0.1 \text{ mm} \pm 0.05 \text{ mm}$ so the comparator remains practically invariant over time so, it is relevant for the check of leveling systems of nominal accuracy minor or equal to $\pm 1 \text{ mm}$.

Once the comparator has built and the **standard** values have been calculated the application of the methodology is cost effective and easy to process by any user. This aspect also coincides with the ISO point of view, which is that the procedure is established and organized so as to be self-applicable by any user without the need of any specialized laboratory or personnel, in order to facilitate and to eliminate the check's cost.

CONCLUSIONS

The proposed methodology leads to a fast, easy and total check of levelling systems, both for the proper operation and the nominal accuracy. This is achieved by:

- The manufacturing of the particular comparator.
- The calibration of the comparator by using a first order invar levelling system in order to calculate the **standard** values of the height differences between the comparator's steps.
- The acquisition of the **measured** values of the same height differences by the levelling system being checked.
- The elaboration of the standard and measured values by means of a least square adjustment.
- The two statistical tests, which answer for the proper operation and the nominal accuracy of the levelling system being checked.

The diagram of the figure 7 illustrates the main points of the checking methodology.

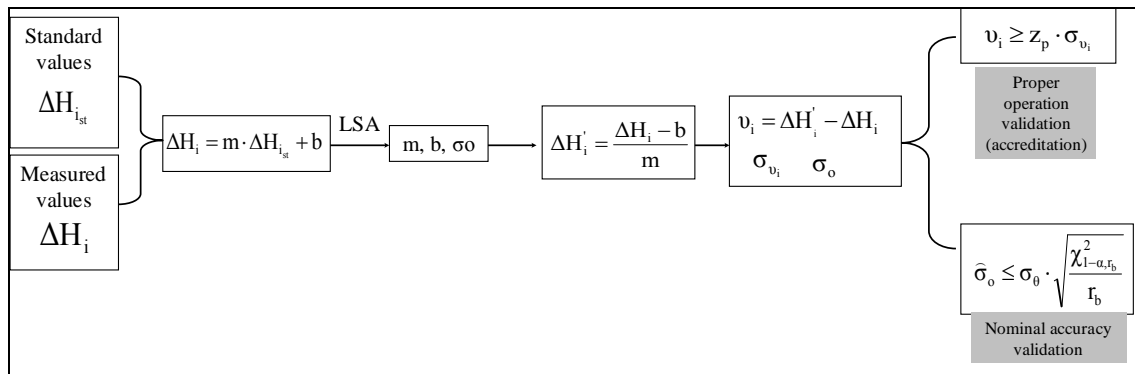


Fig.7 The main stages of the checking methodology.

The process for the check of a system with three meters length rod lasts about 30 minutes.

Consequently this simple comparator consists a cost effective facility and it is worth to be used for checking ordinary levelling systems, as the use of a high performance invar comparator is unpractical and valueless for construction levelling systems of nominal accuracy minor or equal to $\pm 1\text{mm/km}$.

The previous mentioned advantages make the proposed methodology efficient, easy and convenient to be used.

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