



[www.conferenceworld.in](http://www.conferenceworld.in)

**4<sup>TH</sup> INTERNATIONAL CONFERENCE ON  
INNOVATIVE TRENDS IN SCIENCE,  
ENGINEERING AND MANAGEMENT**

**ICITSEM-17**

**(C-DAC, MUMBAI) CENTRE FOR  
DEVELOPMENT OF ADVANCED COMPUTING,  
MUMBAI, MAHARASHTRA (INDIA)**

**17<sup>TH</sup> JUNE 2017**

---

**ISBN: 978-93-86171-47-4**

**4<sup>TH</sup> INTERNATIONAL CONFERENCE ON  
INNOVATIVE TRENDS IN SCIENCE,  
ENGINEERING AND MANAGEMENT**

**ICITSEM-17**

**Editors**

**DR. PIYUSH KUMAR PAREEK**

**DR. VILAS M.THAKARE**

---

---

*Publish By:*

*A.R. Research Publication*

## *Preface*

Conference World and AR Research Publication is fast growing group of academicians in Engineering, Sciences and Management. AR Research Publication is also known for fast reply and zero error work. Conference world has organized a various conferences at renowned places namely Delhi University; New Delhi, Jawaharlal Nehru University; New Delhi, PHD Chamber of Commerce and Industry New Delhi, YMCA New Delhi, India International Centre New Delhi Sri Venkateswara college of Engineering and Technology, Andhra Pradesh, Dhananjay Mahadik Group of Institutions (BIMAT), Shivaji University, Maharashtra, Vedant Engineering Kota and many more places across the country.

We are very pleased to introduce the proceedings of the 4<sup>th</sup> *International Conference on "Innovative Trends in Science, Engineering and Management"* (ICITSEM-17). As for previous conferences, the theme was the link between the information provided by conference world and the use made of this information in assessing structural integrity. These were the issues addressed by the papers presented at the conference. The level of interest in the subject matter of the conference was maintained from previous events and over 35 suitable papers were submitted for presentation at the conference.

Papers were well represented in the conference to arouse a high level of international interest. Three countries were represented in the final program from Europe, North America and Asia. In the event, the conference was highly successful. The presented papers maintained the high promise suggested by the written abstracts and the program was chaired in a professional and efficient way by the session chairmen who were selected for their international standing in the subject. The number of delegates was also highly gratifying, showing the high level of international interest in the subject. This is also indicated by the large number of countries, 01 represented by the delegates. This Proceeding provides the permanent record of what was presented. They indicate the state of development at the time of writing of all aspects of this important topic and will be invaluable to all workers in the field for that reason. Finally, it is appropriate that we record our thanks to our fellow members of the Technical Organizing Committee for encouraging participation from those areas. We are also indebted to those who served as chairmen, without their support, the conference could not have been the success that it was. We also acknowledge the authors themselves, without whose expert input there would have been no conference. Their efforts made a great contribution to its success.

Proceeding of the conference has been published with **ISBN: 978-93-86171-47-4**

*4<sup>th</sup> International Conference on "Innovative Trends in Science, Engineering and Management"* (ICITSEM-17) was organized at **(C-DAC, Mumbai) Centre for Development of Advanced Computing, Mumbai, Maharashtra (India) on 17<sup>th</sup> June 2017**

Total 73 papers were received for the conference and 35 papers were shortlisted by the committee.

All the accepted and presented papers of the duly registered authors will be published in the following international journals

- **International Journal of Advance Research in Science and Engineering**  
(IJARSE, ISSN- 2319-8354) [[www.ijarse.com](http://www.ijarse.com)]
- **International Journal of Advance Technology in Engineering & science**  
(IJATES, ISSN-2348-7550) [[www.ijates.com](http://www.ijates.com)]
- **International Journal of Science Technology and Management**  
(IJSTM, ISSN-2394-1537) [[www.ijstm.com](http://www.ijstm.com)]
- **International Journal of Innovative Research in Science and Engineering**  
(IJIRSE, ISSN- 2454-9665) [[www.ijirse.com](http://www.ijirse.com)]
- **International Journal of Electrical & Electronic Engineering**  
(IJEEE, ISSN-2321-2055) [[www.ijeee.co.in](http://www.ijeee.co.in)]

**Published by**

**AR Research Publication,**

3/186 Santpura Govindpuri Modinagar- 201201 . Dist: Ghaziabad

*4<sup>th</sup> International Conference on "Innovative Trends in Science, Engineering and Management"*  
(ICITSEM-17) (Vol-4) Copyright © 2017, by AR Research Publication (India)

No part of this publication may be reproduced or distributed in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise or stored in a database or retrieval system without the prior written permission of the publishers. The program listing (if any) may be entered, stored and executed in a computer system, but they may not be reproduced for publication.

This edition can be exported from India only by the publishers, AR Research Publication (India)  
ISBN: 978-93-86171-47-4

Managing Director: Gauri Sharma

Senior Researcher—Product Development: Ms. Pratima Singh

Head—Production (Higher Education and Professional): Satinder Kulkarni

Information contained in this work has been obtained by AR Research Publication (India), from sources believed to be reliable. However, neither AR Research Publication (India) nor its authors guarantee the accuracy or completeness of any information published herein, and neither AR Research Publication (India) nor its authors shall be responsible for any errors, omissions, or damages arising out of use of this information. This work is published with the understanding that AR Research Publication (India) and its authors are supplying information but are not attempting to render engineering or other professional services. If such services are required, the assistance of an appropriate professional should be sought.

Cover Design: Sumit Kumar

**4<sup>th</sup> International Conference on "Innovative Trends in Science, Engineering and Management" (ICITSEM-17) ISBN : 978-93-86171-47-4**

**Venue: (C-DAC, Mumbai) Centre for Development of Advanced Computing Juhu, Mumbai, Maharashtra (India)**

**Date: 17<sup>th</sup> June 2017**

**INDEX**

<b>S. No.</b>	<b>Paper ID</b>	<b>Paper Title</b>	<b>Author</b>	<b>Journal</b>	<b>Page No.</b>
1	206	A COMPARATIVE ANALYSIS OF MULTIPLE PATTERN MATCHING ALGORITHMS	Renuka S. Matkar, Yogeshwar. M. Kurwade, Dr. Vilas M. Thakare	IJSTM	01-10
2	207	DESIGN LIMITATIONS CHARACTERISTICS AND ANALYSIS OF SECURE MOBILE TRANSACTION AND PROTOCOLS	Narinder Bali, Raghav Mehra, Anita Gupta	IJATES	11-20
3	208	SYNTHESIS OF BENZIMIDAZOLONE-BENZTHIAZOLE AND ITS PIPERAZINE DERIVATIVES WITH PHARMACOLOGICAL ACTIVITY	Satish Batra, Mayank.R.Mehta	IJARSE	21-30
4	210	HOW DO EXTERNAL ENVIRONMENT INFLUENCE CHOICE OF BUSINESS MODEL	Bhavika Bali	IJSTM	31-36
5	213	A SURVEY: PRINCIPAL COMPONENT ANALYSIS (PCA)	Sumanta Saha, Sharmistha Bhattacharya(Halder)	IJARSE	37-45
6	215	WIRELESS CUSTOMER PREMISES EQUIPMENT FOR LANDLINE	Poncy Paul, Muhammed Riyas K,Chithra S Pillai, Sreeleja N Unnithan, Prasad R Menon, Likhil VD	IJEEE	46-53
7	217 A	APPLICATIONS OF SHEAR THINNING FLUID (STF) AS NANOTECHNOLOGY ON THE KEVLAR MATERIALS FOR BALLISTIC PROTECTIONS	Ms. Sapna K. Kungarani, Dr. Dharmendra C. Kothari, Prof. Prashant V. Thorat,	IJATES	54-61
8	217	APPLICATIONS OF MIMOSINE DERIVATIVES FROM LEUCAENA OR SUBABUL PLANTS AS THE NATURAL BIO-HERBICIDES	Mr. Ghanshyam V. Pund, Dr. Dharmendra C. Kothari, Prof. Prashant V. Thorat	IJARSE	62-70
9	218	PARAMETRIC STUDIES AND EFFECT ON PNEUMATIC JET MACHINING	Dr. Raju N.Panchal , Anant D.Awasare , Vahid M.Jamadar	IJARSE	71-75
10	219	STUDY OF DIELECTRIC AND PHOTOCATALYTIC ACTIVITY OF COMPOSITE OF POLYTHIOPHENE WITH PHOTOSUBSTITUTED COMPLEX OF POTASSIUM HEXACYANOFERRATE(III)	Syed Kazim Moosvi, Kowsar Majid	IJARSE	76
11	220	SYNTHESIS, CHARACTERISATION AND STUDY OF DIELECTRIC BEHAVIOUR OF PANI/[Co(NH <sub>3</sub> ) <sub>3</sub> (C <sub>4</sub> H <sub>4</sub> N <sub>2</sub> ) <sub>3</sub> ]Cl <sub>3</sub> COMPOSITE	Waseem Naqash, Kowsar Majid	IJARSE	77
12	221	SYNTHESIS AND CHARACTERIZATION OF AgX/Ag <sub>2</sub> MoO <sub>4</sub> HETEROSTRUCTURES WITH ENHANCED VISIBLE LIGHT ACTIVITY AND IMPROVED STABILITY	Owais Mehraj, Kowsar Majid	IJARSE	78
13	230	MULTI-BAND PATCH ANTENNA FOR THz APPLICATIONS	Varindra Kumar	IJATES	79-86
14	231	EFFECT OF CE ION DOPING ON THE MICROWAVE SHIELDING PROPERTIES OF Ni-Zn FERRITE/POLYTHIOPHENE	M. Abdullah Dar	IJARSE	87
15	232	5G WIRELESS COMMUNICATION TECHNOLOGY	Rajesh Yadav	IJATES	88-94

16	233	AN EXPERIMENTAL EVALUATION AND TESTING OF CEMENTITIOUS BASED COMPOSITES WITH CONDUCTIVE ADDITIVES OF CARBONYL-IRON AND SILICA-FUME FOR THE EFFICIENT USE OF MINERAL WASTE FOR DEVELOPMENT OF COST-EFFECTIVE BROADBAND RADAR WAVE ABSORBER	Rupali Rai	IJEEE	95-106
17	234	CRITICALITY OF HEAT TREATMENT ON THE PROPERTIES ENHANCEMENT OF MILD STEEL	Shubham Sharma, Shalab Sharma	IJATES	107-113
18	235	A REVIEW ON EXPERIMENTAL EVALUATION AND TESTING OF CEMENTITIOUS BASED COMPOSITES WITH CONDUCTIVE ADDITIVES AS RADAR ABSORBING MATERIAL	Rupali Rai	IJEEE	114-126
19	236	CO JOINING OF COMPRESSOR ADDER WITH 8x8 BIT VEDIC MULTIPLIER FOR HIGH SPEED	Neha Trehan, Er. Inderjit Singh	IJEEE	127-135
20	237	BIOI @MOF-235 HETEROSTRUCTURES AS AN EFFICIENT VISIBLE LIGHT DRIVEN PHOTOCATALYST	Feroz Ahmad Sofi, Kowsar Majid	IJATES	136
21	238	SYNTHESIS OF GRAPHENE OXIDE/NiO NANOCOMPOSITES: ROLE OF 2D GRAPHENE OXIDE IN THE ENHANCEMENT OF PHOTOCATALYTIC ACTIVITY FOR THE DEGREDEDATION OF ORGANIC POLLUTANTS .	Jahangir Ahmad, Kowsar Majid	IJARSE	137
22	241	OPTIMIZING CLOUD STORAGE WITH THE UTILIZATION OF DYNAMIC DEDUPLICATION TECHNIQUES	Madhu Ramteke, K.L. Sinha	IJARSE	138-147
23	242	TASK SCHEDULING USING HYBRID PSO IN CLOUD BASED ENVIRONMENT	Anjaneer Mourya , Bhupesh Kumar Dewangan	IJATES	148-157
24	239	AN APPLICATION OF MULTIRELATIONAL CLUSTERING WITH DOMAIN EXPERT GUIDENCE FOR VERIFYING SESSION FIXING IN CRICKET	K.Ananthapadmanabha, Dr.K.Udayakumar	IJATES	158-166
25	244	B. monnieri - MICROPROPAGATION USING VERMICOMPOST, ELUANT AND EXTRACTS OF VERMICOMPOST IN PLANT TISSUE CULTURE MEDIA	Suman Kashyap, Neera Kapoor, Radha D Kale	IJARSE	167-178
26	246	SECURITY IN WSN USING POLYNOMIAL AND SAMA TECHNIQUES	Deepika, Ms. Kusum Dalal	IJEEE	179-191
27	247	COMPARISON OF VARIOUS SOLAR TRACKING TECHNIQUE: REVIEW PAPER	Sarika, Prachi chaudhary	IJEEE	192-197
28	248	STRUCTURAL EQUATION MODELLING	Bhavika Bali	IJSTM	198-205

# A COMPARATIVE ANALYSIS OF MULTIPLE PATTERN MATCHING ALGORITHMS

Renuka S. Matkar<sup>1</sup>, Yogeshwar. M. Kurwade<sup>2</sup>, Dr. Vilas M. Thakare<sup>3</sup>

<sup>1,2,3</sup>SGBAU, Amravati, Maharashtra (India)

## ABSTRACT

*Multiple pattern matching algorithm is a type of string searching algorithm. From a given finite set of strings (patterns), it can locate all patterns' locations simultaneously in a text string. Pattern matching plays an important role in many computer related fields, such as information retrieval, intrusion detection, data compression, content filtering, gene sequence comparison and computer virus signature matching. It is a basic problem in computer science. There are many multiple pattern matching algorithms but to provide the better results, a comparative study of all of them is necessary. The comparative analysis gives us the clear idea to choose the best algorithm for pattern matching problem. In this paper, the comparative analysis of the most widely used multiple pattern matching algorithms is given. This paper analyzes and discusses about the widely used multiple string pattern matching algorithms and also proposes a new multi pattern matching algorithm using frequently used groups. The mostly used algorithms discussed in this paper are: the Aho-Corasick algorithm, the Commentz-Walter algorithm, and the Wu-Manber algorithm. The comprehensive analysis and discussion also helps for the better understanding of the pattern matching problem. A theoretical and experimental result of the algorithm is presented in this paper. The paper is concluded with the solution for the multi-pattern matching problem with a new algorithm.*

***Index Terms: Algorithms, Frequently Used Groups, Pattern Matching, String Matching, String Searching***

## I. INTRODUCTION

String pattern matching or searching is the act of checking for the presence of the constituents of a given pattern in a given text where the pattern and the text are strings over some alphabet. Pattern matching plays an important role in many computer related fields, such as information retrieval, intrusion detection, data compression, content filtering, gene sequence comparison and computer virus signature matching. [1][2][3]. Pattern matching algorithms belong to computationally intensive algorithms. It can be classified into single pattern matching and multi-pattern matching according to the number of matching patterns. Single-pattern matching came first, and there are some classic algorithms such as the Knuth-Morris-Pratt (KMP) algorithm and the Boyer-Moore (BM) algorithm, which offer some lessons and inspirations for the development of later multi-pattern matching algorithm [1]. Multi pattern matching algorithm can find all occurrences of multiple patterns with only once scanning. It is more complex to implement but a wider range of applications than single-pattern matching algorithm. In a multiple pattern matching, from a given finite set of strings (patterns), it can locate all patterns' locations simultaneously in a text string. Multiple pattern matching algorithms can be used in data

mining area to find selected interesting patterns, security area to detect certain suspicious keywords or even biological field for DNA searching [2]. Pattern matching is one of the major issues in the area of computational biology. Biologists search database for important information in different directions. Pattern matching will continue to grow and need changes from time to time. The analysis of Protein and DNA sequence data has been one of the most active research areas in the field of computational molecular biology. Pattern Discovery is one of the fundamental problems in Bioinformatics. It can be used in Protein structure and function prediction [3]. The pattern matching algorithm is the core algorithm of the entire anti-virus software. Combining the advantages of fast calculation of hash function and parallel pattern matching of automata, it has significant performance advantages in the circumstance of virus signature matching [4]. Multiple string pattern matching problems has been a topic of intensive research that has resulted in several approaches for the solution such as multiple keyword generalization of Boyer Moore algorithm, Boyer-Moore-Horspool algorithm, Aho-Corasick algorithm, Commentz-Walter algorithm, Fan-Su algorithm, Wu-Manber algorithm, and Set Backward Oracle Matching (SBOM) algorithm. The most popular and widely used solutions for the multi-pattern matching problem are: Aho-Corasick algorithm, Commentz-Walter algorithm, and Wu-Manber Algorithm [5].

This paper mainly presents the analysis of mostly used algorithms for multiple string pattern matching problems: the Aho-Corasick algorithm, the Commentz-Walter algorithm, and the Wu-Manber algorithm. Experimental results of these algorithms are included for the analysis and discussion about multiple pattern matching problems. This paper also discusses the main theoretical results for each of the algorithm. The performance of each algorithm is shown against the length of pattern and the number of pattern in a pattern set. This paper covers the comprehensive analysis and discussion of these selected algorithms as a state-of-the-art along with some experimental results. A comprehensive study on all the existing algorithms of multiple pattern matching problems is a very demanding material in the research area of multiple pattern matching problems. In short, this paper provides the best solution on any type of pattern matching problem in easier manner.

## II. BACKGROUND

Along with the rapid development of computer technology, people's lives are increasingly dependent on computers. The rapid development of the Internet increases the freedom of application. But at the same time, because of its inherent openness, universality and freedom, it requires a higher demand of information security. Pattern matching algorithms can be classified into single pattern matching and multi-pattern matching according to the number of matching patterns. Single-pattern matching appeared first, and there are some classic algorithm such as the Knuth-Morris-Pratt (KMP) algorithm and the Boyer-Moore (BM) algorithm, which offer some lessons and inspirations for the development of later multi-pattern matching algorithm. The basic need of pattern matching is proposed in [1].

Multiple pattern matching problem is a basic problem in computer science. As a solution, many algorithms are generated. Aho-Corasick algorithm, a variant of the Knuth-Morris-Pratt algorithm, was the first algorithm to solve the multiple string pattern matching problems in linear time based on automata approach. Commentz-Walter presented an algorithm for the multi-pattern matching problem that combines the Boyer-Moore technique with the Aho-Corasick algorithm. Commentz-Walter combines the filtering functions of the single pattern matching Boyer-Moore algorithm and a suffix automaton to search for the occurrence of multiple

patterns in an input string. Wu-Manber algorithm is a simple variant of the Boyer-Moore algorithm that uses the bad character shift for multiple pattern matching. Mostly used algorithms for multiple pattern matching are discussed in [2].

Brute-force algorithm performs a checking, at all positions in the text between 0 and n-m, whether an occurrence of the pattern starts there or not. The Boyer-Moore Algorithm works with a backward approach, the target string is aligned with the start of the check string, and the last character of the target string is checked against the corresponding character in the check string. The Index based Pattern Matching using Multithreading method performs pre-processing to get the index of the first character of the pattern in the given text. By using this index as the starting point of matching, it compares the Text contents from the defined point with the pattern contents. An improved approach for multi pattern matching using index base method is proposed in [3].

IAC: an improved multi-pattern matching algorithm based on AC algorithm. AC algorithm is a string searching algorithm invented by Alfred V. Aho and Margaret J. Corasick. AC algorithm constructs a finite state machine consisting of Goto, Failure and Output Functions. Goto Function is graph (tree). An improved approach for existing AC algorithm is presented in [4].

Solutions to different problems were proposed by Commentz Walter in 1979 [5] and Navarro Raffinot [5] in 2002. Both offered sub linear time solutions for single pattern matching. Recently, Khancome and Boonjing proposed searching techniques which used shift table algorithms at their core. Now-a-days, clustering and hash based technology to prevent intrusion detection system is used on widespread. The recent applications of pattern matching are proposed in [5].

This paper is organized as follows: Section I describes a brief introduction to multiple pattern matching. Section II briefly describes the background of multiple pattern matching algorithms specifically Aho-Corasick, Commentz-Walter, and the Wu-Manber algorithm. Section III outline the experiment methodology for new multi pattern matching algorithm using frequently used groups, Section IV presents the experimental results on the multiple pattern matching algorithms, Section V presents the analysis and discussion on pattern matching problem based on the experimental results and existing works, and Section VI gives the conclusion of this paper.

### III. PREVIOUS WORK DONE

S.Nirmala Devi et al. (2012) [4] and Dr.S.P Rajagopalan et al. (2012) [4] proposed the Index based Pattern Matching using Multithreading method performs pre-processing to get the index of the first character of the pattern in the given text. By using this index as the starting point of matching, it compares the Text contents from the defined point with the pattern contents. Raju Bhukya et al. (2012) [4] and DVLN Somayajulu et al. (2011) [4] proposed IBSPC. In IBSPC indexes has been used for the DNA sequence. After creating the index the algorithm will search for the pattern in the string using the index of least occurring character in the string.

Raju Bhukya et al. (2010) [3] and DVLN Somayajulu et al. (2010) [3] proposed IFBMPM. In IFBMPM to search some pattern P in text S, it start the search from the indexes stored in the row of index table which corresponds to the first character of the pattern P. If any character mismatches in its position, we skip the search and go for the next index which corresponds to the first character of the pattern P according to the indexes stored in index table for matching.

Reverse Colussi et.al. (2009) [1] proposed RC algorithm in which comparisons are done in specific order given by the preprocessed phase. The time complexity of preprocessing phase is  $O(m^2)$  and searching phase is  $O(n)$ . When several pattern strings need to match, using Single pattern matching has low efficiency. Corasick M.J et.al (2008) [1] proposed many pattern matching algorithm with high efficiency to solve this problem, which is called for short AC algorithm. In the preprocess stage, AC algorithm form several pattern strings waiting for matching, according to their features into Tree finite state automata, and decide the next situation according to matching characters.

Y. H. Cho et. al. (2008) [2] proposed a hash-based pattern matching co-processor where memory is used to store the list of substrings and the state transitions. Dharmapurikar *et al.* (2007) [2] proposed a pattern matching algorithm which modifies the AC algorithm to consider multiple characters at a time. Furthermore, the content addressable memories (CAM) is also widely used for string matching because it can match the entire pattern at once when the pattern is shifted past the CAM.

The Aho–Corasick (AC) algorithm (1975) [5] is the most popular algorithm which allows for matching multiple string patterns. Aldwairi *et al.* (2005) [5] proposed a configurable string matching accelerator based on a memory implementation of the AC FSM.

## IV. EXISTING METHODOLOGY

### *Multiple Pattern Matching Algorithms*

#### *A. Aho-Corasick algorithm*

Aho-Corasick algorithm is a variant of the Knuth-Morris-Pratt algorithm. It was the first algorithm to solve the multiple string pattern matching problems in linear time based on automata approach. Aho-Corasick algorithm serves as a basis for the UNIX tool fgrep. It consists of two parts. In the first part a finite state pattern matching machine is constructed from the set of keywords and in the second part, the text string as input is applied to the pattern matching machine. The machine gives signals whenever it finds a match for a keyword (pattern). The pattern matching machine consists of a set of states and each state is represented by a number. The behavior of the pattern matching machine is explained by following three functions: a goto function  $g$ , a failure function  $f$ , and an output function output [1].

The function of goto function  $g$  is that it maps a pair consisting of a state and an input symbol into a state or message fail. The failure function  $f$  maps a state into a state. The failure function is visited whenever the goto function reports fail. The output function of certain states indicates that a set of keywords has been found. The construction of Aho-Corasick automaton machine takes running time in the sum of the lengths of all keywords linearly. This involves building of the keyword tree for the set of pattern and then converting the tree to an automaton also called as pattern matching machine by defining the functions  $g$  (goto function),  $f$  (failure function), and output function for naming states with the keywords matched. The memory or space requirements of the Aho-Corasick algorithm can be very large depending on the pattern set and also the length of each pattern in a pattern set. The matching process simply steps through the input characters one at a time and then checks if there is any matching. Each step in pattern matching machine happens in constant time. The Aho-Corasick matcher always operates in  $O(n)$  running time [1].

The good suffix rule is used as a formula in AC algorithm.

$$l) \text{ shift}(j) = \min (s | (p(j + 1 \dots m) = p(j - s + 1 \dots m - s)))$$

Where, assuming shift  $j$  is the distance which  $P$  skips to right,  $m$  is the length of pattern string  $P$ ,  $j$  is the current matched character position,  $s$  is the distance between and  $t$  or the distance between  $X$  and  $p$ ".

## **B. Commentz-Walter algorithm**

From combination of the Boyer-Moore technique with the Aho-Corasick algorithm, Commentz-Walter presented the Commentz-Walter algorithm. It combines the filtering functions of the single pattern matching Boyer-Moore algorithm and a suffix automaton to search for the occurrences of multiple patterns in an input string. Commentz-Walter used a tree in his algorithm which is similar to that of Aho-Corasick' pattern matching machine but is created from the reversed patterns. The Commentz-Walter algorithm consists of two phases: 1) pre-processing phase and matching phase. The pre-processing phase of algorithm is responsible for creating a pattern tree by using the reversed pattern. The matching phase of the Commentz-Walter algorithm is the combination of two ideas. One is from the idea Aho-Corasick' finite automata technique and another one is from the Boyer-Moore shifting technique (in right-to-left matching). In this algorithm a match is conducted by scanning backwards through the input string. When the mismatch occurs, some number of characters about the input string is known and this information is then used as an index. This index is used in a pre-computed table to determine a distance which later helps to shifting before occurring the next match attempt [2].

For calculating the shift distance, bad character of shift left rule is used as shown in below:

$$\text{Bad char of shift } l(a, b, c) = \min \begin{cases} m + 1 \\ m + 2 \\ m + 3 \end{cases}$$

Where,  $\min(m+1)$ ,  $(m+2)$ ,  $(m+3)$  are the minimum shift distances.

## **C. Wu-Manber algorithm**

Wu-Manber algorithm is a simple variant of the Boyer-Moore algorithm. It uses the bad character shift rule for multiple pattern matching. After making a UNIX based tool `agrep`, this algorithm was proposed in [3]. It was used for searching many patterns in files. To improve the performance, a unique idea was created, that is, their algorithms looks at block of text instead of a single character. So, they consider both pattern and text as blocks of size  $B$  instead of single characters. Hash value is also known as a "message digest". The mathematical expression:

$$h = H(M)$$

Where,  $H()$  is a one-way hash function,  $M$  is an input with arbitrary length, and  $h$  is the fixed length hash value.

## **D. Boyer-Moore algorithm**

These are some principles to realize the BM algorithm: 1) at the beginning of matching, align pattern strings  $P$  and text  $T$  from left to right, but the matching operation starts from right to left.

2) If the character and position in P matches with the character in text T, T and P will move a position toward left at the same time and then make comparison.

3) If the matching fails, two offset functions Badchar and Goodsuffix in preprocessing will work out the distance in which pattern string P moves toward right, and align T and P again to match. Here are the specific definitions of functions Badchar and Goodsuffix [4].

a) Use Badchar to move: Work out the deviant of every character in the T character collection. If character C in T appears many times in P, the last position can be used to work out the deviant, the mathematical formula is as follows:

$$\text{Badchar}(c) = \begin{cases} m, \text{ any } c \text{ not in } P_m \text{ and } c \neq P_j (1 \leq j \leq m-1) \\ m-j, \text{ here } j = \text{MAX}\{j | c = P_j, 1 \leq j \leq m-1\}, \\ c \in P \end{cases}$$

## E. Hash Algorithm

Hash algorithm converts the input of any length to a smaller output of fixed length through the hash function, and the output value is called the hash value. The hash value is a unique and extremely compact numerical representation of a piece of data. This conversion is a compressed mapping, that is to say, the space occupied by hash value is much smaller than that of the input. It's statistically impossible to produce two inputs with the same hash value.

That is to say, given M, it's computationally difficult to find M' to meet  $H(M) = H(M')$  which we called weak collision resistant. Also, it's computationally difficult to find any pair of

M and M' to meet

$$H(M) = H(M')$$

This is called as strong collision-resistant.

## V. ANALYSIS AND DISCUSSION

A linear time algorithm for multiple patterns matching problem which is proposed by Aho and Corasick is optimal in worst case but Boyer and Moore demonstrated an algorithm where they showed that it is possible to skip a large portion of the text while searching for certain patterns. Eventually, the approach by Boyer-Moore is working faster than linear algorithm in the average case [1].

The Commentz-Walter algorithm is the combination of idea of Boyer and Moore technique with Aho-Corasick algorithm for multiple pattern matching problems which is greatly faster than the Aho-Corasick algorithm in practice. It uses the idea of Boyer Moore technique to skip a large portion of the text while searching and as a result it leads to faster than linear time algorithms in the average case [2].

Wu-Manber algorithm is the most efficient algorithm under some situations such as long random patterns, low matching rate, and low memory requirement. The performance of Commentz-Walter algorithms declined with increasing number of pattern in a pattern set (pattern set size). The performance of Commentz-Walter algorithm improved approximately linearly with increasing length of the shortest keyword/ pattern in the pattern set [3].

There is another algorithm proposed by Baeza-Yates which also combines the idea of Boyer-Moore-Horspool algorithm (which is a slight variation of the classical Boyer-Moore algorithm) with the Aho-Corasick algorithm. Where, However, Aho-Corasick performance does not suffer great loss when comparing with others because it is a linear time searching algorithm in worst case. Independent from the pattern set size, searching time

complexity for Aho-Corasick algorithm is  $O(n)$  but when pattern set size increase, the memory consumption increased drastically and also the time consumption increased [4].

The Aho-Corasick and Commentz-Walter algorithms consume lots of memory because both these algorithms use the automata data structure in the preprocessing stage where Wu-Manber algorithm consumes much less memory than these two algorithms [5].

**Table 1: Comparative analysis of the existing methodologies**

Methodology/ Algorithm	Advantages	Disadvantages
1. Aho-Corasick algorithm	1. As it is a native algorithm, it used as a linear solution to many problems. 2. Use of simpler approach	1. It operates in $O(n)$ times, so more execution time than other approaches. 2. More no. of comparisons.
2. Commentz-Walter algorithm	1. Efficient than the existing algorithms. 2. Improved approach provides high throughput.	1. Running time also increases with the number of pattern increases. 2. Less efficient in space complexity.
3. Wu-Manber algorithm	1. Long random patterns are used. 2. Low matching rate and low memory requirement	1. As worst case complexity is $O(n)$ . It takes more number of comparisons. 2. Complex mechanism
4. Boyer-Moore algorithm	1. Suitable for larger strings 2. Simple algorithm is used	1. Worst case complexity is $O(n)$ therefore takes more time to compare. 2. More memory consumption
5. Hash algorithm	1. Takes less execution time because average case complexity $O(n/2)$ . 2. needs no preprocessing	1. It has a minimum length problem. 2. Therefore, not suitable for larger strings

## VI. PROPOSED METHODOLOGY

There are many multiple pattern matching algorithms but to provide the better results, a comparative study of all of them is necessary. The comparative analysis gives us the clear idea to choose the best algorithm for pattern matching problem. In this paper, the comparative analysis of the most widely used multiple pattern matching algorithms is given. The proposed methodology focuses on the analysis and discussion of multi pattern matching algorithms. There are several multi pattern matching algorithms in use. But it is always cumbersome to select the best one.

For the particularities in pattern matching algorithms and current situation of pattern matching algorithm study, this paper proposes a new type of multi-pattern matching algorithm based on finite state automata, which is

combined with frequently matching hash values. The characteristic of the algorithm is using multi-path searching algorithm to match in parallel. One path uses traditional FSA to do multi-pattern matching. The rest paths, try to quickly compare with the frequently matching hash values.

This paper gives the detailed analysis of the most widely used multi pattern matching algorithms. The mostly used algorithms discussed in this paper are: the Aho-Corasick algorithm, the Commentz-Walter algorithm, and the Wu-Manber algorithm. Also, it proposes a new multi pattern matching algorithm which uses frequently used groups. The comprehensive analysis and discussion also helps for the better understanding of the pattern matching problem. Pattern matching is a basic problem in computer science.

The proposed algorithm combines hash technology and multi-pattern matching, and proposes a new type of multi-pattern matching algorithm with automata based on frequently matching hash values. Due to combining the advantages of fast calculation of hash function and parallel pattern matching of automata, it has significant performance advantages in the circumstances of virus signature matching.

Also, in some practical applications where a certain rate of false negative is accepted, we can design these automata to be simpler. The following nodes after the specific node (such as node 'd', 'i+d', 'j+d' in Figure 2) can be removed from the automata. In this way, we can get both time and space performance advantages. This can decrease the possibility of state space explosion of original AC algorithm. The rate of false negative depends on the sum of all entries probabilities in Frequently Used Groups (FUG).

According to the pattern set, construct a FSA similar to AC's, where each node store the pointer (ptr\_goto) to Goto, the pointer (ptr\_failure) to Failure, and a pointer (ptr\_freq) to frequently used group (call FUG for short). After applying pattern matching, a new automata based on Frequently Used Groups is shown in fig. 2.

The algorithm works as shown below:

New multi pattern algorithm based on Frequently Used Groups
Step 1: Initialize
Step 2: Construction of Frequently Used Groups (FUG) a) Get the most likely matched patterns when searching to a specific node of the automata.
Step 3: Calculate the hash values of these pattern
Step 4: store it in the FUG to which this node point to.
Step 5: Set the length of hash value be len_hash.
Step 6: Set an integer value int_depth, which represents for the depth of current automata node.
Step 7: Insert the corresponding FUG to the node whose depth is equal to int_depth.
Step 8: Finally, we get a new automata.
Step 8: Finish

In step 1, initialize the values to the already constructed finite state automata. On basis of that different pointers are set to different nodes. In step 2, frequently used groups are constructed. For the construction, the most likely

matched patterns are collected when searching to a specific node of the automata. In step 3, hash values of all the patterns are calculated by applying hash function or a message digest. In step 4, hash values are stored into FUG to which the node points to. In step 5, the length of hash value is set to len\_hash.

In step 6 an integer value int\_depth, which represents for the depth of current automata node is set to current depth. Step 7 inserts the corresponding FUG to the node whose depth is equal to int\_depth. Finally, we get a new automaton as shown in fig. 2.

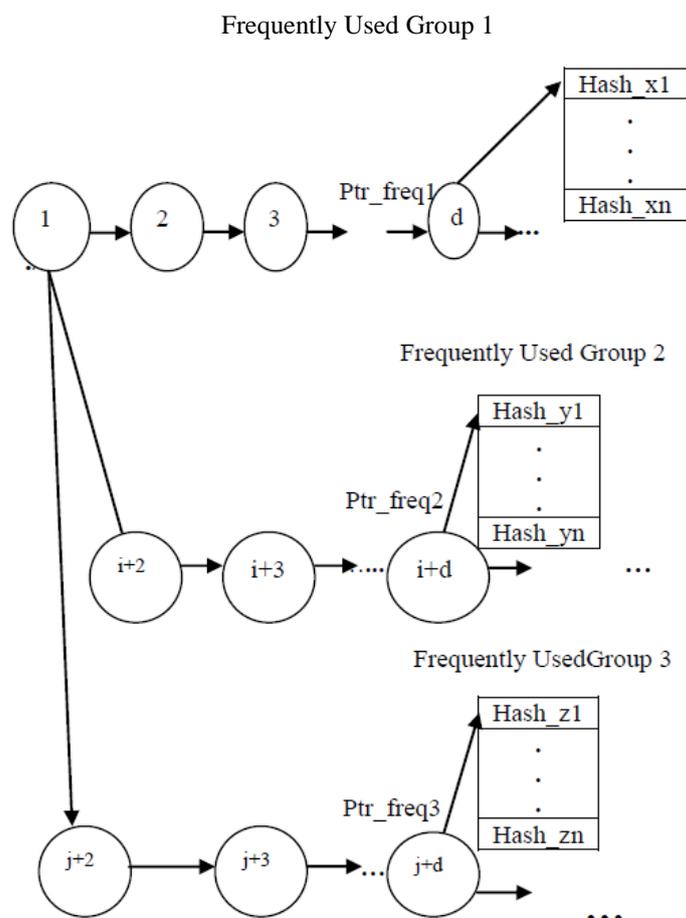


Fig. 2 New automata based on Frequently Used Groups

## VII. POSSIBLE OUTCOMES AND RESULT

Results of the proposed algorithm can be shown in two cases:

### A. Worst Case

In the worst case, we can't find any matched pattern in the input text sequence, so that the proposed algorithm is equivalent to the original AC algorithm. It needs to compare n nodes of the automata in order, and the time complexity is O(n), where n is the total length of the text sequence.

### B. Average Case

The average case, a matched pattern can be found in the input text sequence. As the analysis above, the time complexity of original AC algorithm is O(n). Even if we improve the original one to adapt them to circumstance

of virus signature matching, end the algorithm after a matched pattern is found. The time complexity is only up to  $O(m)$ , where  $m$  is the length of the signature.

On the basis of comparative analysis, following results can be drawn. In Aho-Corasick algorithm, if the number of pattern is increases, the running time is also increase. The running time of Commentz-Walter algorithm is also increases with the number of pattern increases. In Wu-Manber algorithm, if the number of pattern is increases, the running time is also increase. But the performance of this algorithm is better than the Aho-Corasick algorithm.

## VIII. CONCLUSION

This paper combines hash technology and multi-pattern matching, and proposes a new type of multi-pattern matching algorithm with automata based on frequently matching hash values. Due to combining the advantages of fast calculation of hash function and parallel pattern matching of automata, it has significant performance advantages in the circumstance of virus signature matching. The Aho-Corasick algorithm considers as a classic solution. On the other side, Commentz-Walter algorithm seems to be the first sub-linear running time algorithm for multiple-pattern matching problems in average case by using a sifting technique where a large portion of the text is skipped while searching. The Wu-Manber algorithm has excellent average case performance because of the successful use of shifting operation as a block of characters.

## IX. FUTURE SCOPE

In the future improvement, the theory of machine learning can be added to make the FUG be dynamically changing. That is, through long-term learning of the history of matching, dynamically change the entries in FUG to adapt to complex applications. This can further improve the probability of successfully matching in the FUG, so as to improve the overall performance of the algorithm.

## REFERENCES

- [1] Akinul Islam Jony, "Analysis of Multiple String Pattern Matching Algorithms" International Journal of Advanced Computer Science and Information Technology (IJACSIT), Vol. 3, No. 4, ISSN: 2296-1739, pp. 344-353, August 2014.
- [2] Yu He, Weitong Huang, "IAC: A Real-time Multi-pattern Matching Algorithm Based on Aho-Corsick Algorithm", 2013 International Conference on Computational and Information Sciences, DOI 10.1109/ICCIS.2013.203, pp. 754-757
- [3] Dr. S.P Rajagopalan Dr.V.Anuradha, S. Nirmala Devi, "Index Based Multiple Pattern Matching Algorithm Using Frequent Character Count in Patterns", International Journal of Advanced Research in Computer Science and Software Engineering, Volume 3, Issue 5, ISSN: 2277 128X, pp. 140-145, May 2013.
- [4] Raju Bhukya, DVLN Somayajulu, "Index Multiple Pattern Matching Algorithm using DNA Sequence and Pattern Count", IEEE Transaction on Information Technology and Knowledge Management, Volume 4, No. 2, pp. 431-441, July-December 2011
- [5] S.Nirmala Devi, Dr.S.P Rajagopalan, "An Index Based Pattern Matching using Multithreading", International Journal of Computer Applications (0975 – 8887) Volume 50 – No.6, July 2012

# **DESIGN LIMITATIONS CHARACTERISTICS AND ANALYSIS OF SECURE MOBILE TRANSACTION AND PROTOCOLS**

**Narinder Bali<sup>1</sup>, Raghav Mehra<sup>2</sup>, Anita Gupta<sup>3</sup>**

<sup>1,2</sup> *Department of Computer Sciences, Bhagwant University, Ajmer, Rajasthan (India)*

<sup>3</sup> *Govt. College for Women, Parade Ground, Jammu, J&K (India)*

## **Abstract**

*Today, new technologies that allow cellular (mobile) phones and other handheld devices to access the Internet have made wireless business transactions possible. This phenomenon is known as mobile commerce or M-Commerce. What must be done to secure financial transactions via mobile commerce? Due to the advent of the Internet, electronic business transactions have exploded around the globe. Generally speaking, M-Commerce creates more security concerns than traditional E-Commerce. Mobile payment is defined as any payment transaction involving the purchase of goods or services that is completed with a wireless device. In this paper let us have a brief survey on security issues when designing, implementing, and deploying secure m-payment systems with a focus on threats, vulnerabilities and risk. The first problems come from the limitation of wireless environments that are primarily from mobile devices which have connection cost, low bandwidth, and low reliability. The second problem is the lack of sufficient security of existing mobile payment systems mainly due to improper protocol design and deployment of lightweight cryptographic operations. . .*

**Keywords-** *cryptographic operations, micropayment protocol, m-payment, , mobile devices.*

## **I. INTRODUCTION**

M-Commerce is a subset of electronic commerce where the Internet-enabled HWDs and wireless networking environment are necessary to provide 'location independent connectivity'. It is predicted that M-Commerce services would be the next biggest growth area in the telecommunications market, represent-in the fusion of two of the current consumer technologies: wireless communications and E-Commerce .Generally speaking, The discipline of M-Commerce includes reference to the infrastructures and electronic technologies necessary for wireless data and information transfer in the form of text, graphics, voice, and video. Mobile payment system provides attractive opportunities to, merchants financial and users. These opportunities were simplicity and ease of a-payment transaction for the user and they also enable merchants to access customer information and target specific customer through various incentive programs such as discount coupons and reward programs.. According to orange Mobile Payment (Danish Company) the entire transaction should take not more than 10 seconds. In order to provide a secure and comprehensive m-payment, the payment scenario should be designed so that it performs fast and simple for the end-use, but secure and comprehensive for the provider. An efficient payment scenario takes efficient steps in performance.

## 1.1 Mobile Commerce

Two main areas in which e-commerce grew significantly in recent years are Internet banking and conducting business on the Internet. With Internet banking, the way customers make use of banking services has changed. They do not have to go to ATM (Automatic Teller Machine) terminals or stay in-line at a bank branch to withdraw or transfer money between accounts, but simply log on to a bank's website which provides. Internet technology offers extensive ranges of services such as electronic mails, file transfers, etc., and one of the most popular services offered on the Internet is "Electronic Commerce" (or e-commerce).

## 1.2 Applications of M-Commerce

In France, some 35 million Smart cards are in circulation and every year they process over three billion transactions. Wireless banking refers to purchasing over Internet-enabled HWDs like wireless application protocol (WAP) phones or PDAs. Interactive TV is enhanced TV where additional content is added to an existing broadcast format that the viewer can query, request or even interact live with the program. Smart Cards with an embedded integrated microchip can be used as prepaid phone cards, ATM cards, or public transportation cards. They can be biometrically enhanced to include voice recognition, iris and face scans, and finger print authentication. It has reserved channels and bandwidth for data applications such as weather, news, games, or commerce. It also offers services like Video on Demand (VOD) or Personal Video Recording (PVR). Companies are providing facilities to track stocks on HWDs. Aspiro, a Swedish company, allow its customers to check stock prices or look at their portfolios and even trade using WAP phones or PDAs. Accessing information using WAP mobile phones and PDAs is significantly becoming popular for business-to-business (B2B) and business-to-consumer (B2C)

## II. WIRELESS APPLICATION PROTOCOL (WAP)

WAP-enabled phones can access interactive services such as information, location-based services, corporate information and inter-active entertainment. WAP is targeted at various types of HWD and Bluetooth enabled mobile phones. WAP is "an open, global specification that empowers mobile users with wireless devices to easily access and interact with information and services instantly." WAP is currently the only publicly available solution for wireless communication and enables M-Commerce where Internet data moves to and from wireless devices

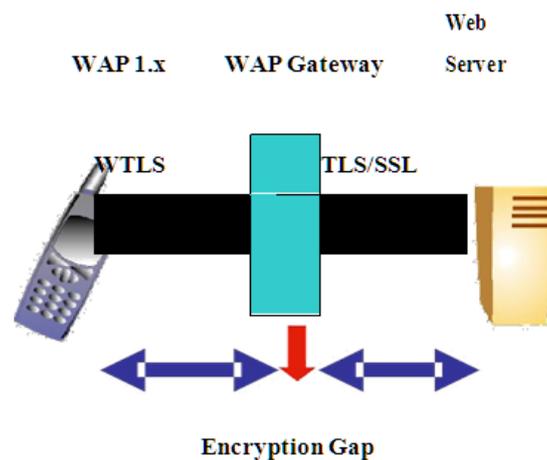
### 2.1 WAP Security

WAP 1.x security uses the Wireless Transport Layer Security (WTLS) protocol. This protocol is the WAP equivalent of Secure Socket Layer (SSL) and it provides authentication, encryption and integrity services. WTLS has three levels, all have privacy and integrity: (i) Class-I has no authentication (anonymous), (ii) Class-II has server authentication only, and (iii) Class-III has both client and server authentication. WTLS supports some familiar algorithms .

Since Web- and WAP-based protocols are not directly interoperable, a component known as the WAP gateway is needed in order to translate Web-based protocols to and from WAP-based protocols. The WAP gateway is software which runs on the computer of the Mobile Service Provider (MSP). Thus sensitive information is translated into original unencrypted form at the WAP gateway. This problem is known as WAP gap.

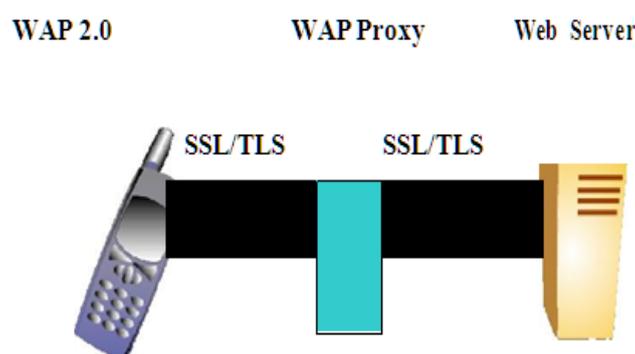
Public key cryptography (PKC) is used to exchange a symmetric or private key using certificate and then all

transmission is encrypted. A short key size of 40 bits is used because of power limitation. A tamper-proof component, known as WIM (Wireless Identity Module) is designed as part of the WAP architecture to store private data, such as key pairs, certificates, and PIN numbers within the mobile device. In practice, a WIM is implemented using a smart card. Wireless Markup Language (WML) is used in WAP 1.x technology. Figure 1 shows WAP gap model.



**Figure 1 WAP Gap Model (not a full end-to-end security)**

WAP 2.0 security uses TLS (Transportation Layer Security) instead of WTLS due to requiring end-to-end security with all IP based technology in order to overcome the WAP gateway security breaches. It is a Public Key Infrastructure (PKI) enabling protocol that provides the services such as authentication by using digital signatures and public key certificates, confidentiality by encrypting data, etc. This protocol uses RSA, RC4, 3DES, and SHA-1 algorithms for encryption. Wireless PKI (WPKI) is released for the first time. Figure 2 shows the WAP proxy model.



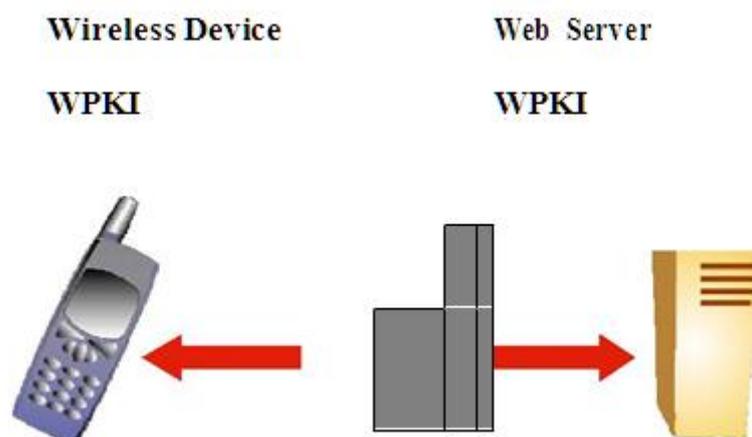
**Figure 2 WAP Proxy Model (end-to-end security)**

## 2.2 PKI/WPKI

PKI systems and WTLS are at the heart of today's mobile security technology. In a WAP environment WTLS must be translated at the WAP gateway into SSL, the Internet standard. A PKI is a set of policies, processors, software,

hardware, and technologies that use PKC and certificate management to secure communication. PKI's trusted services enable the secure transfer of information and supports a wide variety of M-Commerce applications. PKI must ensure the following: (i) confidentiality, achieved by cryptography, (ii) authentication, achieved by digital certificates, (iii) integrity, achieved by digital signatures, and (iv) non-repudiation, achieved by digital signatures and certificates.

PKI consists of the following components: (i) Certificate Authority (CA)- responsible for issuing and revoking certificates, (ii) Registration Authority (RA)-binding between public key and the identities of their holders, (iii) Certificate Holders- people, machine or soft-ware agents that have been issued with certificates and can use them to sign digital documents, (iv) Verification Authority (VA, Clients)- validate digital signatures and their certificates from a known public key of a trusted CA, and (v) Repositories- stores that make available certificates.



**PKI Portal**

**Figure 3 Wireless PKI**

The private keys are stored in WIM or SWIM. Two main components of WPKI are the PKC and the key certification management. In order to perform globally, worldwide PKI legislation is required.

### III. CRYPTOGRAPHY

The two types of cryptography currently available are (a) symmetric or secret-key and (b) asymmetric or public key cryptography (PKC). In secret-key cryptography, two devices must share their secret key in order to communicate securely. Thus two concerns arise: How to exchange the secret key securely; and if  $n$  HWDs must communicate with each other, a total number of  $O(n^2)$  secret keys must be exchanged. The management of such a number of secret keys should consider the scalability issues.

#### 4 Elliptic Curve Cryptography (ECC)

What is really needed is a public key algorithm that achieves a high level of security using short keys. Algorithms based on mathematical objects known as elliptic curves offer interesting possibilities. Elliptic curve discrete logarithm problems (ECDLP) is defined as “give a base point  $P$  and the  $kP$  lying on the curve, find the value of  $k$ ”. For suitable curves and base points, this is a very hard problem. From cryptographic point of view, a new cryptographic system needs to be defined based on elliptic curves. Any standard system that relies on the discrete logarithm problem has a direct analogy based on the ECDLP. For example, Elliptic Curve DSA (ECDSA) has

already been standardized. Diffie-Hellman key exchange can be easily implemented in an elliptic curve system.

**Table 1 EEC Key Size compared to RSA**

ECC Key Size (bits)	Traditional RSA Key Size (bits)	Key Size Ratio
109		1:5
131		1:6
163		1:6
283		3:11
409		7:19
571		15:27

Recently, ECC has been deployed on Smartcards without coprocessors . Weimerskirch et al implemented ECC on a Palm OS device. Their study showed that the normal transaction, such as a key exchange or signature verification, can be done in less than 2.4 seconds while signature generation can be done in less than 0.9 seconds.

Table 2 shows the three major industry-standard PKC systems that can be considered secure, efficient, and commercially available .

**Table 2 Three Major Industry-Standard PKC**

PKC	Mathematical Problem	Algorithm
Integer Factorization	Given a number n, find its prime factors	RSA, Rabin-Williams
Discrete Logarithm	Given a prime n, and numbers g and h, find x such that $h = g^x \text{ mod } n$	ElGamal, Diffie-Hellman, DSA
EC discrete Logarithm	Given an elliptic curve E and points P and Q on E, find x such that $Q = xP$	EC-Diffie-Hellman, ECDSA

## 4.1 Problems with Elliptic Curve System

The true difficulty of the ECDLP is not yet fully under-stood . Recent research has shown that some elliptic curves that were believed suitable for ECC are, in fact, not appropriate. For example, if the order of the base point P is equal to the prime number p then it turns out that the ECDLP can be solved efficiently. Such curves are known as anomalous curves. For a given curve and base point, it is trivial to generate public and private keys (the private key is simply a random integer k and the public key is the point kP on the curve). However, it is an extremely difficult problem to generate a suitable curve and base point in the first place.

The main problem is how to count the number of points on the curve. Having done this, it is then necessary to select a suitable base point P, which must have a large order to ensure the difficulty of the ECDLP. But the order of P must divide the number of points on the curve. Having found the number of points on the curve, it is quite likely that a suitable base point cannot be found. Users may use random curves or special curve generating soft-ware, such as the “Elliptic Curve Generation Bureau” created by Zaxus.

## 4.2 Digital Certificates and Digital Signature

In a PKC, a message is encrypted using a public key and is decrypted using a secret key. However, there is no inherent way of knowing the person who has the corresponding secret key. This is where the idea of certificates arises. Certificates confirm that the public key given in the certificate belongs to a private key held by the legitimate person, not by an imposter. To trust a certificate means to trust the party who issued the certificate, not the person for whom the certificate is issued. To protect a certificate from being modified one uses digital signatures. The message can only be created from the ciphertext by the private key holder. This provides authorization and non-repudiation. That is the basis for digital signature.

How to protect private keys? The private key is stored in a Smart card, where all crypto operations with it are performed. The Smart card access gets restricted by the use of a PIN. The place where a user’s private credentials are stored is called Personal Security Environment (PSE).

## V. WIRELESS LAN (WLAN) SECURITY

### 5.1 IEEE 802.11b

The WLAN standard IEEE 802.11b provides a mechanism for authentication and encryption. It provides a maximum of 11 Mbps wireless Ethernet connections using the band at 2.4 GHz. 802.11b security features consists of security framework called Wired Equivalent Privacy (WEP) . WEP is based on RC4, a symmetric stream cipher. It has a pseudo-random number generator, whose output is XORed to the data. WEP can use 40 or 128 bits key size. However, using a 128 bits key size, 802.11b throughput drops much due to heavy calculations. In August 2001, RC4 was announced to be broken and can be cracked in less than half an hour. Consequently, WEP can be broken. WEP with 40 bits key size can be broken in real time.

### 5.2 Bluetooth

Bluetooth technology, developed by Ericsson in 1998, is used to connect different HWDs and provides a method for authenticating devices. Device authentication is provided using a shared secret between the two devices. The common shared secret is called a link key, generated from PIN. This link key is established in a special communication session called pairing. All paired devices share a common link key. There are two types of link keys: (i) unit keys and (ii) combination keys . The link key is a 128-bit random number.

## VI.CHARACTERISTICS OF WIRELESS NETWORKS

Wireless networks have the following characteristics:

Wireless networks have lower bandwidth than fixed networks.

Connections over wireless networks are less reliable since packet losses occur more frequently than that of fixed networks. Packets need to be retransmitted which may result in high latency.

Connection cost of wireless networks is higher compared to that of fixed networks. Data transmitted over wireless networks is easily eavesdropped.

From the above limitations, mainly due to poor performance, performing payment transactions over wireless networks is time-consuming. Moreover, performing payment transactions on low computational capability mobile devices will spend longer time to complete each transaction.

## VII. BACKGROUND AND RELATED WORK

This section provides the background and related works of the mobile payment.

### • 7.1 Primitive Payment Transaction

The primitive mobile payment is composed of three basic steps Payment—Client makes a payment to the merchant, Value Subtraction—Client requests to the payment gateway for his debit, and Value Claim—Merchant requests to the payment gateway to credit transaction amount into his account.

### 7.2 Mobile Payment Components

Mobile payments the components from the existing researches related to mobile payment protocols.. Fun, Beng, Roslan and Habeeb stated that mobile payment protocols are composed of five principals which include client, merchant, issuer (client's financial institution), acquirer (merchant's financial institution) and payment gateway (PG. Kungpisdan, Srinivasan and Le also defined that five parties on mobile payment protocols are client, merchant, payment gateway, issuer and acquirer Fun, Beng and Razali stated that the components of mobile payment scheme consist of seven main actors: Financial Service Providers (FSPs), Payment Service providers (PSPs), Payee, Payer, Mobile Network Operator (MNOs), Device Manufacturers, and Regulators. Singh and Shahzad stated that the components of mobile payment protocol consist of three participants: payee, payer and financial institution

### 7.3 Review and Comparison of Mobile Payment Protocol

Dowling stated that the components of mobile payment protocols are composed of four parts: customer, merchant, payment service provider and trust third party (TTP)

The number of components mentioned above by researchers is different due to the design of payment protocols. However, we conclude that the components of mobile payment protocols, in general, consist of only three main parts: buyer, payment channel and seller.

## VIII. TECHNOLOGY OF MOBILE PAYMENT

We studied and assessed technologies in mobile payment systems from the existing researches as described below P. Pukkasenung and R. Chokngamwong

- SMS—Short Messaging Service is a text messaging service used to send and receive short text messages. The maximum length of messages is less than 160 alphanumeric characters, to and from mobile phones.

# 4<sup>th</sup> International Conference on Innovative Trends in Science, Engineering and Management

(C-DAC, Mumbai) Centre for Development of Advanced Computing, Mumbai, Maharashtra (India)

(ICITSEM-17)

17<sup>th</sup> June 2017, [www.conferenceworld.in](http://www.conferenceworld.in)

ISBN: 978-93-86171-47-4

- WAP—Wireless Application Protocol is a technology which provides a mechanism for displaying internet information on a mobile phone.
- NFC—Near Field Communication is the communication between contactless smart cards and mobile phones.
- RFID—Radio Frequency Identification is a method of identifying an item wirelessly using radio waves
- Smart Card—Smart cards and plastic cards normally appear in the same shape as credit cards are embedded with a chip or microprocessor that can handle and store 10–100 times more information than traditional magnetic-stripe cards.
- Internet—the internet is a publicly accessible, globally interconnected network. It uses the internet protocol to enable the exchanging and sharing of data among computers in the network
- USSD—Unstructured Supplementary Services Data is a mechanism of transmitting information via a GSM network. Unlike SMS, it offers a real-time connection during a session
- IVR—Interactive Voice Response is a telephony technology where the users can interact with the database of a system without any human interaction
- Magnetic—Data is stored in a magnetic stripe on a plastic card. It is read by swiping the card in a magnetic card reader.

## IX. SECURITY PROPERTIES

A secure mobile payment system must have the following properties

- Confidentiality—The system must ensure that private or confidential information will not be made available or disclosed to unauthorized individuals.
- Integrity—The system must ensure that only authorized parties are able to modify computer system assets and transmitted information.
- Authentication—The system must ensure that the origin of a message is correctly identified, with an assurance that the identity is not false.
- Non-repudiation—The system must ensure that the user cannot deny that he/she has performed a transaction and he/she must provide proof if such a situation occurs.
- Availability—The system must be accessible for authorized users at any time.
- Authorization—The system must verify if the user is allowed to make the requested transaction.

## X. PERFORMANCE ASPECT

Protocol's performance is analyzed by counting the number of operations needed for encoding and decoding. This includes operations related to data transmission between three parts. which consist of public encryption-decryption, signature verifications, symmetric key encryption-decryption, a hash function, keyed-hash function and key generations. The researchers presented secure mobile payment protocols providing a high level of security and low computation, cost and power.

## XI. CONCLUSION

M-Commerce security is a very crucial issue that needs further research to introduce efficient and effective

solutions. In this article, various security concerns were expounded. ECC certainly appears to provide a viable alternative to RSA. There are potential advantages, especially when used in devices with limited processing capability and memory. Typical applications include M-Commerce using handheld wireless devices. There are, however, some problems and issues that are inhibiting the widespread adoption of ECC. These include (i) the real security of such systems is still not well understood, (ii) difficulty of generating suitable curves, and (iii) relatively slow signature verification. Time will tell its future.. All protocols provided four main security properties: confidentiality, integrity, authentication, and non-repudiation. As a conclusion, to discover the best secure mobile payment protocol, the protocol standard must be the same all over the world and the communities and industries must be adopting the standard. In this paper we proposed a secure payment protocol, considering the restrictions of mobile networks in developing countries. The proposed protocol not only satisfies the convenience and ease of use that is generally required for mobile users in small payments, it also provides the transaction security level and non repudiation property that is necessary for macro payments. Although the proposed technique has been optimized for the current GSM network, but its modular design enables it to accept future improvements of the mobile network technology and infrastructure, such as EMS and MMS, with minimum change in the protocol structure

## REFERENCES

1. Fun TS, Beng LY, Razali MN (2013) Review of mobile macro-payments schemes. J Adv Comput Netw 1(4).
2. Singh A, Shahazad KS (2012) A review: secure payment system for electronic transaction. Int J Adv Res Comput Sci Softw Eng 2(3)
3. Ahamad SS, Udgata SK, Nair M (2014) A secure lightweight and scalable mobile payment framework. In: FICTA 2013. Advances in intelligent system and computing, vol 247. Springer International Publishing, Switzerland
4. Mathew M, Balakrishnan N, Pratheeba S (2010) A study on the success potential of multiple mobile payment technologies. In: Technology management for global economic growth (PICMET), Proceedings of PICMET '10
5. Smart Card Alliance (2008) Proximity mobile payments business scenario: research report on stakeholder perspectives
6. [www.deloitte.com/assets/DcomChina/Local%20Assets/Documents/Industries/Financial%20services/cn\\_gfsi\\_Tr endsProspectsChinaMobilePaymentIndustry\\_041212.pdf](http://www.deloitte.com/assets/DcomChina/Local%20Assets/Documents/Industries/Financial%20services/cn_gfsi_Tr endsProspectsChinaMobilePaymentIndustry_041212.pdf), Retrived on 27<sup>th</sup> January, 2016.
7. Li Y, Wang Y Secure electronic transaction. [http://people.dsv.su.se/~matei/courses/IK2001SJE/li-wang\\_SET.pdf](http://people.dsv.su.se/~matei/courses/IK2001SJE/li-wang_SET.pdf)
8. Kungpisdan S, Srinivasan B, Le PD (2003) Lightweight mobile credit-card payment protocol. Lect Notes Comput Sci 2904:295–308
9. Fun TS, Beng LY, Likoh J, Roslan R (2008) A lightweight and private mobile payment protocol by using mobile network operator. In: Proceedings of the international conference on computer and communication engineering 2008 May 13–15, Kuala Lumpur, Malaysia, 2008
10. Alizadeh Dizaj MV, Moghaddam RA, Momenebellah S (2011) New mobile payment protocol: Mobile Pay Center Protocol 2 (MPCP2) by using new key agreement protocol: VAM. In: 3rd international conference on electronics computer technology (ICECT)

## 4<sup>th</sup> International Conference on Innovative Trends in Science, Engineering and Management

(C-DAC, Mumbai) Centre for Development of Advanced Computing, Mumbai, Maharashtra (India)

(ICITSEM-17)

17<sup>th</sup> June 2017, [www.conferenceworld.in](http://www.conferenceworld.in)

ISBN: 978-93-86171-47-4

11. Isaac JT, Zeadally S (2012) An anonymous secure payment protocol in a payment gateway centric model. In: The 9th international conference on mobile web information system (MobiWIS). Elsevier
12. Sekhar VC, Sarvabhatla M (2012) Secure lightweight mobile payment protocol using symmetric key techniques. In: International conference on computer communication and informatics (ICCCI), pp 1–6, 10–12 Jan 2012
13. Tripathi DM, Ojha A (2012) LPMP: an efficient lightweight protocol for mobile payment. In: 3rd national conference on emerging trends and applications in computer science (NCETACS)
- 13"certicom," [Online]. Available: <http://www.certicom.com/index.php/an-introduction-to-the-uses-of-eccbased-certificates>. [Accessed 01 01 2013].
- 14."RSA Laboratories," RSA, [Online]. Available: <http://www.rsa.com/rsalabs/node.asp?id=2129>. [Accessed 10 12 2012].
- 15.Sekhar VC, Sarvabhatla M (2012) Secure lightweight mobile payment protocol using symmetric key techniques. In: International conference on computer communication and informatics (ICCCI), pp 1–6, 10–12 Jan 2012
16. Christopher Hall and Tiffany Smith, "Mobile Payments Security 101", . Robin Arnfield, Tom Harper, Kathy Doyle, Will Hernandez, Published by Networld Media Group @ 2015, Networld Media Group, 2015.
- 17.Green, Mr Jeremy Swinfen. Cyber Security: An Introduction for NonTechnical Managers. Ashgate Publishing, Ltd., 2015.

# SYNTHESIS OF BENZIMIDAZOLONE-BENZTHIAZOLE

## AND ITS PIPERAZINE DERIVATIVES WITH PHARMACOLOGICAL ACTIVITY

Satish Batra<sup>1</sup>, Mayank.R.Mehta<sup>2</sup>

<sup>1</sup>Department of Chemistry, PAHER University, Udaipur, Rajasthan, (India)

<sup>2</sup>Department of Chemistry, Shri P H G Muni.Arts and Science College, Kalol, Gujarat, (India)

### ABSTRACT

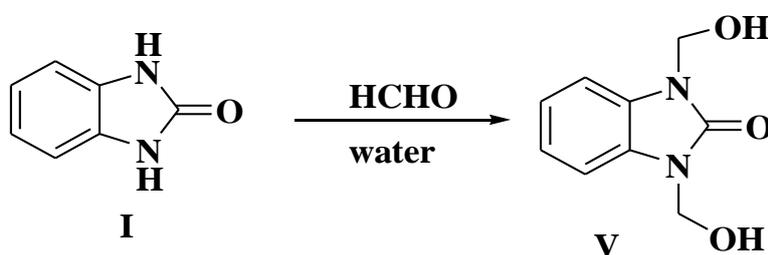
*Benzimidazole and Benzothiazole derivatives have its own biological activity such antimicrobial ,antiviral, anticancer antiulcer antifungal etc.Due to numerous significance value a novel series of Benzimidazolone –Benzothiazole derivatives were synthesized and checked its biological activities. It was observed that some of novel compounds show good antimicrobial activity. Investigation of antimicrobial activity of the compound was done by using Gram Positive and Gram negative bacteria and minimum inhibition concentration (MIC) values were determined.*

**Keywords:** Antimicrobial, Antifungal activity and Benzimidazolone –Benzothiazole

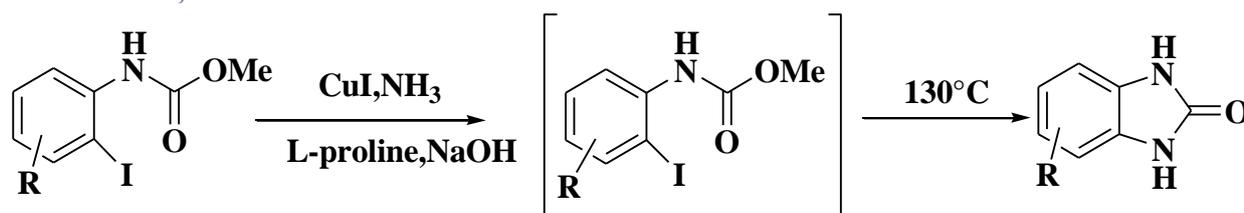
### I.INTRODUCTION

Heterocycles are in the center of research due to their versatile application<sup>1</sup>. The benzimidazolone ring structure is of particular interest especially within the realm of medicinal chemistry because of their different biological activity and clinical applications<sup>2-4</sup>. They exhibit a wide variety of interesting biochemical and pharmacological Properties including antagonize neurotransmitters<sup>5-7</sup>, inhibit aldose reductase show antiulcer and antisecretory properties enhance pulmonary surfactant secretion and modulate ion channels Benzimidazolin-2-one **I** has been an important intermediate in the synthesis of a number of biologically active benzimidazole derivatives.

1,3-bishydroxymethyl benzimidazolone **V** has been obtained by the N-hydroxymethylation of **I**



X.Diao,Y.Wang,Y.Jiang,D.Ma usedCuI/l-proline catalyzed coupling reaction for synthesis of benzimidazolone by aqueous ammonia with 2-iodoacetanilides and 2-iodophenylcarbamates affords aryl amination products at room temperature, which undergo in situ additive cyclization under acidic conditions or heating to give substituted 1H-benzimidazoles and 1,3-dihydrobenzimidazol-2-ones, respectively

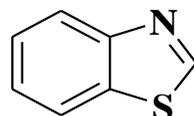


While heterocycles like benzothiazole A number of heterocyclic derivatives containing nitrogen and sulphur atom serve as a unique and versatile scaffolds for experimental drug design benzothiazoles are bicyclic ring system with multiple applications. In the 1950s, a number of 2-aminobenzothiazoles were intensively studied, as the 2-amino Benzothiazole scaffold is one of privileged structure in medicinal chemistry.

Thiazole is structurally related to thiophene and pyridine, but in most of its properties it resembles to the latter. Thiazole (A) was first described by Hantzsch and Waber in 1887



(A)



(B)

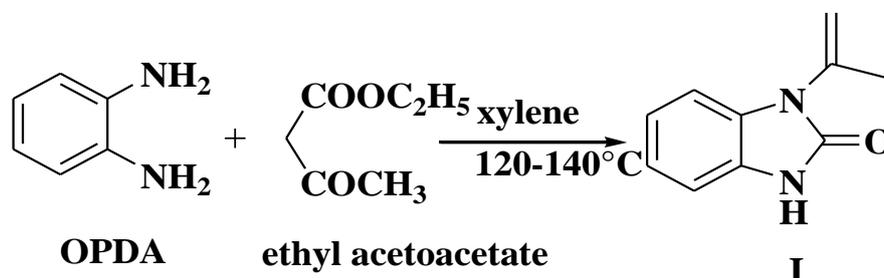
Popp confirmed its structure in 1889. The numbering in thiazole starts from the sulphur atom. The basic structure of benzothiazole (B) consist of benzene ring fused with 4, 5 position of thiazole

## II. EXPERIMENTAL DETAILS

### 2.1. Materials and Procedures

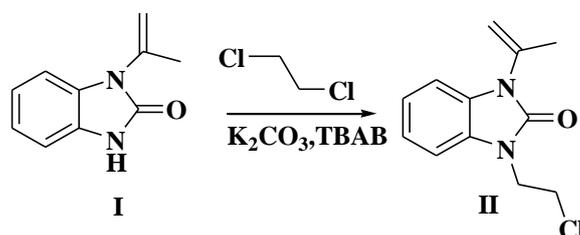
Melting points were determined in open capillaries with the help of VEGGO melting point apparatus and IR spectra (KBr) were recorded on SHIMADZU IR spectrophotometer. <sup>1</sup>H NMR spectra were recorded by Bruker WM 400 FT instrument using D<sub>2</sub>O as solvent and tetramethylsilane (TMS) as internal reference standard. All chemical shifts ( $\delta$ ) are in ppm. The purities of the compounds were checked by thin layer chromatography (TLC) on silica gel-G plates. The major chemicals were purchased from Aldrich Chemical Corporation.

#### 2.1.1 Preparation of 1-(prop-1-en-2-yl)-1H-benzo[d]imidazol-2(3H)-one (I)



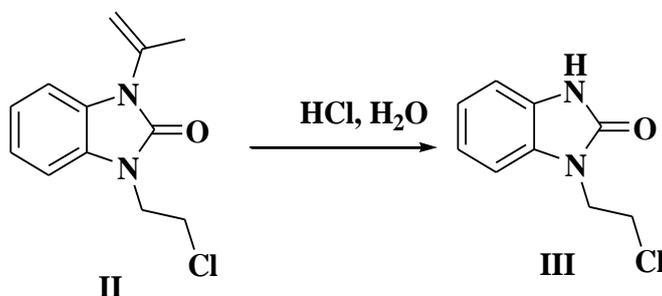
To solution of OPDA (o-phenylene diamine) 10 g in 50 ml xylene in ethylacetoacetate 13.4 g (1.03 mole) in xylene 10 ml solution added at 140-150 °C in 3.0 hrs. Reaction monitored by TLC. Reaction filter out at cooled temperature and the cryatlised by Sodium hydroxide 20% solution. Solid separate out by filtration. It the purified by RO water at neutral pH by acetic acid to get pure Compound ( I) and dry it 55-60°C yield 52.0%

2.1.2 Preparation of 1-(2-chloroethyl)-3-(prop-1-en-2-yl)-1H-benzo[d]imidazol-2(3H)-one (II)



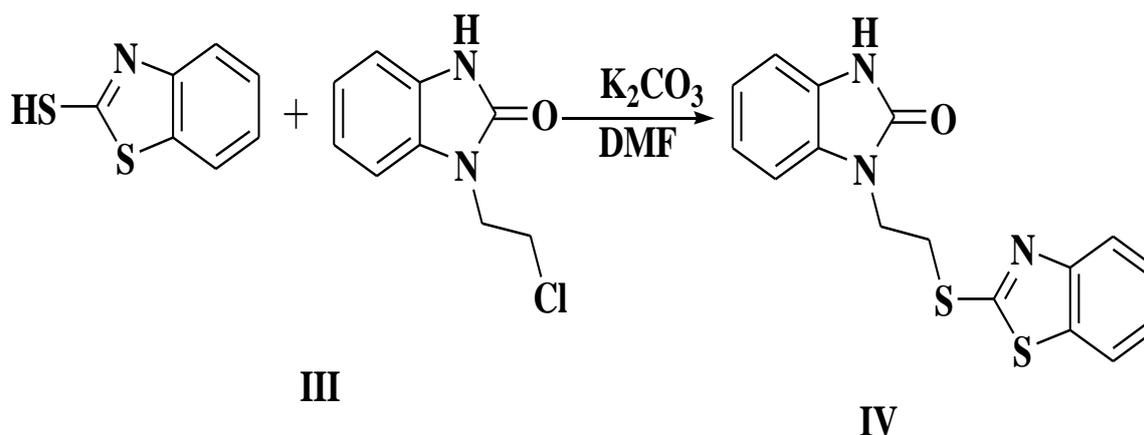
To solution of Compound (I) 10 g in 1,2 dichloroethane 120 ml and anhydrous powder potassium hydroxide 10.7 g (1.9 moles) and catalytic amount of tetra butyl ammonium bromide were heated to reflux for 2-3 hrs. Reaction monitored by TLC. Wash the organic layer at cooled temperature. Concentrate the organic layer by vacuum. Thick oil residue of compound (II) will be obtained. Yield 92.0%

2.1.3 Preparation of 1-(2-chloroethyl)-3-(prop-1-en-2-yl)-1H-benzo[d]imidazol-2(3H)-one (III)



To solution of Compound (II) in 100 ml water with hydrochloric acid 200 ml were heated to 55-60°C for 2-3 hrs. Reaction monitored by TLC. Cool the reaction mass and solid separate out by filtration and wash with water till neutral pH to get compound (III). Dry the product at 60-70°C. Yield 84%

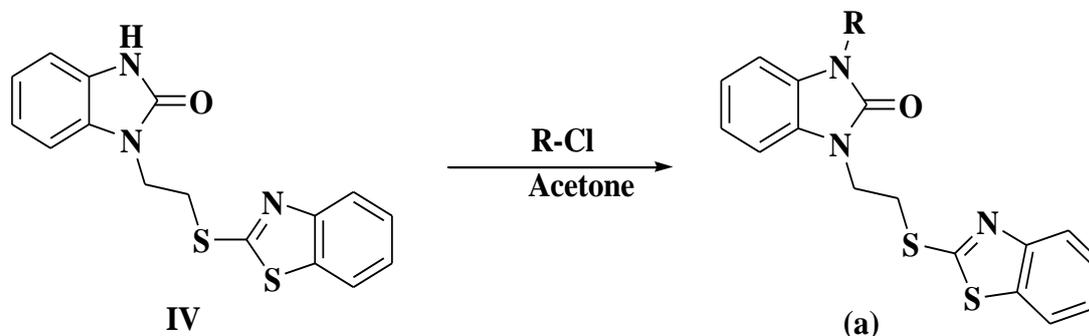
2.1.4 Preparation of 1-(2-(benzo[d]thiazol-2-ylthio)ethyl)-1H-benzo[d]imidazol-2(3H)-one (IV)



Condensation of compound -III 10 g with mercapto Benzothiazole 11.0 g (1.3 mol) in DMF by Potassium carbonate 5.0 gm heat to 80-85°C for 4.0 hrs. Reaction is monitored by TLC. Reaction mass concentrated by vacuum and extracted by Methylene dichloride 150 ml. Wash the organic layer with RO water. Now concentrate the organic layer

by vacuum and isolate the product by acetone 50 ml .Separate out the product by filtration dry the product at 60-65°C  
 .% yield 84%

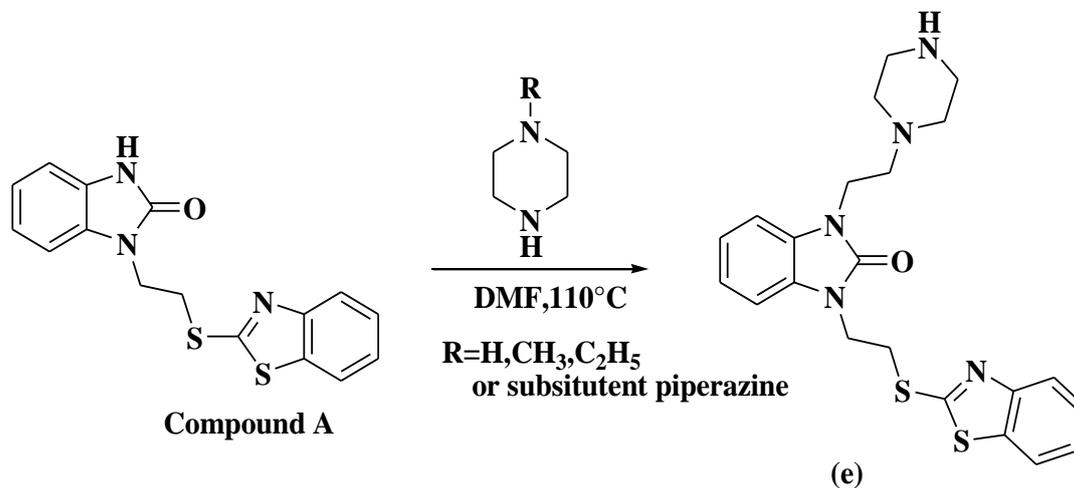
**2.1.5 Preparation of Ethyl 3-(2-(benzo[d]thiazol-2-ylthio) ethyl)-2,3-dihydro-2-oxobenzo[d]imidazole-1-carboxylate(a)**



**R= ClCOOC<sub>2</sub>H<sub>5</sub>, C<sub>6</sub>H<sub>5</sub>Br, CH<sub>3</sub>COCl, C<sub>2</sub>H<sub>4</sub>Cl<sub>2</sub>  
 or halogenated aromatic or non aromatic compound**

To solution of Compound IV 10 gm in acetone 150 ml, Potassium carbonate 4.0 gm and ethyl chloroformate 5.0 ml (1.03 mol) or other halogenated aromatic or non aromatic compound were heated at reflux for 4.0 hrs and reaction monitored by TLC. Remove the salt by hot filtration. Reaction concentrated by vacuum, Isolated the product in isopropyl alcohol 150 ml at chilling condition .Separate out the product by filtration dry at 60-65°C Yield : 68.0 %

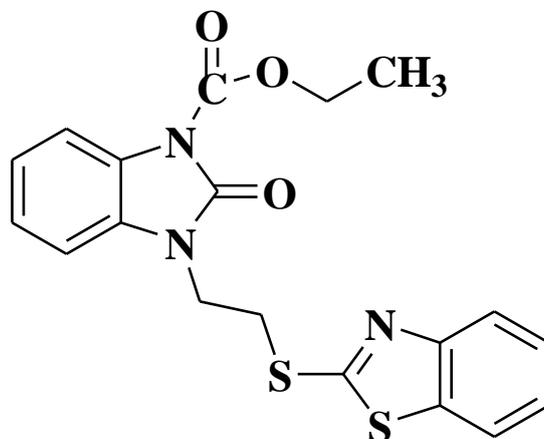
**2.1.6 Preparation 1-(2-(benzo[d]thiazol-2-ylthio)ethyl)-3-(2-(piperazin-1-yl)ethyl)-1H-benzimidazole-2(3H)-one(e)**



To solution of compound A 5.0 g with powder potassium carbonate 3.5g (2.0 moles) ,piperazine 1.28 g (1.17 moles) or substituted piperazine and catalytic amount of potassium iodide in DMF 50 ml were heated at 105-110°C for 6.0 hours. Reaction monitored by TLC. Reaction mass concentrated by vacuum .Methylene dichloride 75 ml and water 75 ml were added to residue .Organic layer separate out and concentrate by vacuum .Thick residue was crystallized in acetone .Solid separate out by filtration and dry it 60-65°C Yield 76 %

III.CHARACTERIZATION STUDIES

3.1 Characterization of ethyl 3-(2-(benzo[d]thiazol-2-ylthio)ethyl)-2,3-dihydro-2-oxobenzo[d]imidazole-1-carboxylate



<sup>1</sup>HNMR:-

S.No	Chemical shift (δ ppm)	Multiplicity	Proton assignment	No. of protons
1	7.97-7.07	Multiplet	Aromatic – <u>H</u>	8
2	4.41-4.36	triplets	Ester – <u>CH</u> <sub>2</sub>	2
2	4.28-4.22	Multiple	N- <u>CH</u> <sub>2</sub>	2
3	3.73-3.70	triplets	S- <u>CH</u> <sub>2</sub>	2
5	1.37-1.33	triplets	Ester- <u>CH</u> <sub>3</sub>	3

CNMR:-

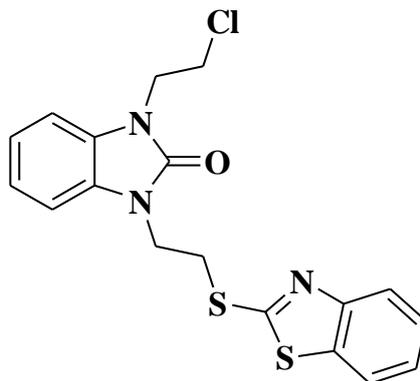
In CNMR Carbonyl carbon of shows the specific value appear at 165.61 δ ppm, Aromatic carbon appear at 152.51-108.44 δ ppm and the Aliphatic carbon appear at range 63.06 -13.98 δ ppm,

Mass:-

No	m/z (Theoretical)	m/z (Observed)	Relative intensity	Ion
1	399.49	399.0	42%	(M <sup>+</sup> ) C <sub>19</sub> H <sub>17</sub> N <sub>3</sub> O <sub>3</sub> S <sub>2</sub>

Melting point:- 162-167°C

3.2 Characterization of 1-acetyl-3-(2-(benzo[d]thiazol-2-ylthio)ethyl)-1H-benzo[d]imidazol-2(3H)-one



<sup>1</sup>HNMR:-

S.No	Chemical shift ( $\delta$ ppm)	Multiplicity	Proton assignment	No. of protons
1	8.01-7.05	Multiplet	Aromatic - <u>H</u>	8
2	4.32-4.28	triplets	N- <u>CH</u> <sub>2</sub>	2
3	4.17-4.14	triplets	S- <u>CH</u> <sub>2</sub>	2
4	3.89-3.86	triplets	Cl- <u>CH</u> <sub>2</sub>	2
5	3.72-3.69	triplets	N- <u>CH</u> <sub>2</sub> -CH <sub>2</sub> -Cl	2

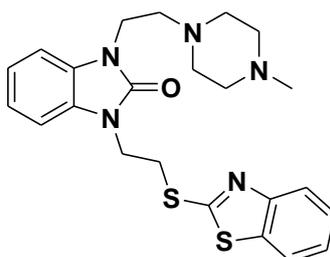
CNMR:-

In CNMR Carbonyl carbon of shows the specific value appear at 153.24  $\delta$  ppm, Aromatic carbon appear at 165.76, 152.46-108.16  $\delta$  ppm and the Aliphatic carbon appear at range 42.21-30.89  $\delta$  ppm,

Mass:-

No	m/z (Theoretical)	m/z (Observed)	Relative intensity	Ion
1	389.92	389.0	42%	(M <sup>+</sup> ) C <sub>19</sub> H <sub>16</sub> ClN <sub>3</sub> OS <sub>2</sub>

3.3 Characterization of 1-(2-(benzo[d]thiazol-2-ylthio)ethyl)-3-(2-(4-methylpiperazin-1-yl)ethyl)-1H-benzo[d]imidazol-2(3H)-one



**<sup>1</sup>H NMR:-**

S.No	Chemical shift (δ ppm)	Multiplicity	Proton assignment	No. of protons
1	8.03-7.07	Multiplet	Aromatic - <u>H</u>	8
2	4.30-4.27	Multiplet	N- <u>CH<sub>2</sub></u> - <u>CH<sub>2</sub></u> -S	4
			N- <u>CH<sub>2</sub></u> - <u>CH<sub>2</sub></u> -N	4
3	3.83-3.44	Multiplet	Piperazine - ( <u>CH<sub>2</sub></u> ) <sub>4</sub>	8
4	2.82	singlet	N- <u>CH<sub>3</sub></u>	3

**CNMR:-**

In CNMR Carbonyl carbon of shows the specific value appear at 153.24 δ ppm, Aromatic carbon appear at 165.76, 152.46-108.16 δ ppm and the Aliphatic carbon appear at range 55.19-31.03 δ ppm,

**Mass:-**

No	m/z (Theoretical)	m/z (Observed)	Relative intensity	Ion
1	453.62	453	42%	(M <sup>+</sup> ) C <sub>23</sub> H <sub>27</sub> N <sub>5</sub> OS <sub>2</sub>

Melting point:- 182-188°C

## IV. ANTIMICROBIAL ACTIVITY TEST

The synthesized novel compounds were tested by Broth Dilution Method (It is one of the non automated in vitro bacterial susceptibility tests). The bacterial strains used were Staphylococcus aureus MTCC 96 (all Gram-positive) and Escherichia coli MTCC 442, S. Pyogenus MTCC 443 and Pseudomonas aeruginosa MTCC 441 (all Gram-negative).

For testing the antifungal activity of the synthesized compounds the fungal strains Candida albicans MTCC 227 and Aspergillus niger The inhibition zones of synthesized compounds were determined using by Broth Dilution Method. In this method, Each synthesized drug was diluted obtaining 2000 microgram /ml concentration, as a stock solution.

Primary screen; In primary screening 1000 micro/ml, 500 micro/ml, and 250 micro/ml concentrations of the synthesized drugs were taken. The active synthesized drugs found in this primary screening were further tested in a second set of dilution against all microorganisms.

Secondary screen: The drugs found active in primary screening were similarly diluted to obtain 200 micro/ml 100 micro/ml, 50 micro/ml, 25 micro/ml, 12.5 micro/ml, 6.250 micro/ml, and concentrations.

Reading Result:- The highest dilution showing at least 99 % growth inhibition is taken as MIC. The result of this is much affected by the size of the inoculums. The test mixture should contain 10<sup>8</sup> organism/ml.

This is often used to determine the smallest amount of antibiotic necessary to inhibit a test organism. This amount is known as the minimum inhibitory concentration (MIC). A set of tubes with different concentrations of a particular

antibiotic are prepared. The tubes are inoculated with the test organism, incubated, and examined for growth of bacteria. Growth is seen to diminish as the concentration of antibiotic increases, and eventually an antibiotic concentration may be observed at which growth fails to occur. This is the Minimum Inhibitory Concentration-MIC Zone of inhibition

The principle used here is that antibiotic will diffuse from a paper disc or small cylinder into an agar medium that contains test organisms. Inhibition is observed as a failure of the organism to grow in the region of the antibiotic. A common application of this method is the Kirby Bauer test, developed in the 1960s.

The procedure is used to determine the sensitivity of an organism isolated from a patient to a series of antibiotics. The results serve a guide to physician to prescribe a drug. The results serve a guide to physician to prescribe a drug. An agar medium such as Mueller Hinton medium is inoculated with the organism and poured to the plate. Paper discs containing known concentrations of antibiotics are applied to the surface, and the plate is incubated. The appearance of a zone of inhibition surrounding the disc is indicative of sensitivity. By comparing the diameter of the zones to a standard table, one may determine if the test organism is susceptible, or resistant to the antibiotic. If the organism is susceptible, it is likely to be killed in the blood stream of the patient if that concentration of the drug is reached. Resistance indicates that the antibiotic will not be effective at that concentration in the blood stream.

The data on antimicrobial activity of compounds are shown in below table with standard

ANTIBACTERIAL ACTIVITY TABLE				
MINIMAL INHIBITION CONCENTRATION				
Compound No	<i>E.COLI</i>	<i>P.AERUGINO</i> SA	<i>S.AUREUS</i>	<i>S.PYOGENUS</i>
R=	MTCC 442	MTCC 441	MTCC 96	MTCC 443
[MICROGRAMM/ML]				
COOC <sub>2</sub> H <sub>5</sub>	200	250	100	125
CH <sub>2</sub> COOC <sub>2</sub> H <sub>5</sub>	125	200	200	250
CH <sub>3</sub> CO	50	200	62.5	100
Piperazine	62.5	125	250	200
N-methyl piperazine	50	25	50	50

Standards drugs table

MINIMAL INHIBITION CONCENTRATION				
DRUGS	<i>E. COLI</i>	<i>P. AERUGINOS</i>	<i>S. AUREUS</i>	<i>S. PYOGENU</i>
		A		S
	MTCC 442	MTCC 441	MTCC 96	MTCC 443
[MICROGRAMM/ML]				
GENTAMYCIN	0.05	1	0.25	0.5
AMPICILLIN	100	--	250	100
CHLORAMPHENI COL	50	50	50	50
CIPROFLOXACIN	25	25	50	50
NORFLOXACIN	10	10	10	10

ANTIFUNGAL ACTIVITY TABLE			
MINIMAL FUNGICIDAL CONCENTRATION			
S.R.NO	Compound No	<i>C. ALBICANS</i>	<i>A. NIGER</i>
	R=	MTCC 227	MTCC 282
[MICROGRAMM/ML]			
1	COOC <sub>2</sub> H <sub>5</sub>	1000	>1000
2	CH <sub>2</sub> COOC <sub>2</sub> H <sub>5</sub>	500	500
3	CH <sub>3</sub> CO	250	>1000
4	Piperazine	500	1000
5	N-methyl piperazine	500	500

MINIMAL FUNGICIDAL CONCENTRATION			
S.R.NO	DRUGS	<i>C. ALBICANS</i>	<i>A. NIGER</i>
		MTCC 227	MTCC 282
[MICROGRAMM/ML]			
1	NYSTATIN	100	100
2	GRESEOFULVIN	500	100

## V. RESULTS AND DISCUSSION

With the purpose of finding new chemical entities when benzimidazolone condensed with benzothiazole will be show the enhanced antimicrobial activity as compared to standard drug. But the synthesized novel compound show negative results

## VI. CONCLUSIONS

Benzimidazolone-Benzothiazole nucleus has been reported to possess several medicinal properties such as antibacterial, antiviral, anticancer, anticonvulsant, anthelmintic, antidepressant, antiasthmatic and antidiabetic activity etc. however; more experimental and clinical researchers should be conducted to support its therapeutic use. In conclusion, synthesis at different position of benzimidazole makes a wide variety of compounds. Given its broad spectrum of pharmacological activity benzimidazole presents itself as a novel nucleus

## VII. ACKNOWLEDGMENTS

We are thankful to all analytical labs of Saurashtra University, Rajkot and Micro care laboratory, Surat for providing analysis support to analyzed newly synthesized compound

## REFERENCES

- [1] J. Vora, D. R. Patel, N.V.Bhimani and P. V. Ajudia, Synthesis, characterization and biological evaluation of triazole and fused triazole derivatives. *Journal of the Chilean Chemical Society*, 56(3), (2011), 71-73
- [2] Javier Capilla, Clara Yustes, Emili Mayayo, Belkys Fernandez, Montserrat Ortoneda, F. Javier Pastor, and Josep Guarro, Antimicrobial agents and chemotherapy. 47(6), (2003), 1948-1951
- [3] Latifeh Navidpour, Hamed Shafaroodi, Khosrou Abdi, Mohsen Amini, Mohammad H. Ghahremani, Ahmad Reza Dehpour, Abbas Shafiee, *Bioorganic & Medicinal Chemistry*, 14(8), (2006), 2507
- [4] A.Foroumadi, S.Mansouri, Z.Kiani, A.Rahmani, *European Journal of Medicinal Chemistry*, 38, (2003), 85
- [5] Jabali J Vora, Dinesh R Patel, Nilesh V Bhimani and Parag V Ajudia *Der Pharma Chemica*, 2010, 2(5) 178-183
- [6] N. Eric, G. Joel, B. Thierry, J. Marie, C. Francois, V. Angela, D. Chantal, Alex, *Journal of medicinal chemistry* 1993, 36(9), 1175.
- [7] A.M. Monforte, P. Logoteta, S. Ferro, L. D. Luca, N. Iraci, G. Maga, E. D. Clercq, C.Pannecouque, Chimirri, *Bioorganic . Medicinal chemistry*, 2009, 17(16), 5962

# **HOW DO EXTERNAL ENVIRONMENT INFLUENCE CHOICE OF BUSINESS MODEL**

**Bhavika Bali**

## **ABSTRACT**

*The advent of Internet redefined the way business models were perceived. Internet, the WWW revolution, e-commerce and e-business phenomenon have had enormous impact on businesses. Today, it is very clear that technology and internet have changed business landscapes. Researchers like Merrifield (2000) have suggested that the impact of this technology hype would have been huge, even if traditional businesses were not abrogated. Technology has become an external environmental influence that is helping organizations work in partnership, offer joint value proposition, build up channels and distribution network and generate profit from diversified and shared revenue streams. Rentmeister and Klein (2003) call for new modeling methods in the domain of business models. Effectively, a whole range of authors propose using the relatively new concept of business models for managing companies in the Internet era (Chesbrough and Rosenbloom 2000; Afuah and Tucci 2001; Applegate 2001; Pateli and Giaglis 2003).*

*It is necessary to create a business model in response to environmental needs for the following reasons :*

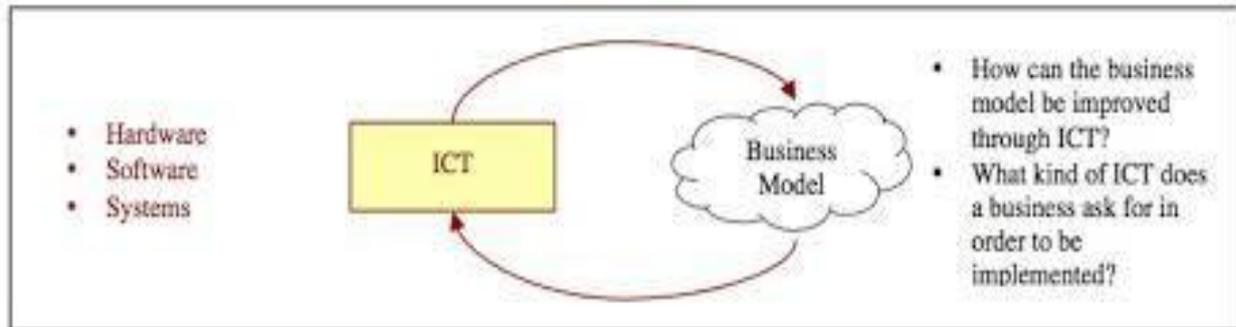
- 1) Present business environment is characterized by complexity and uncertainty. This has given rise to a possibility of large number of business models. The concepts and tools to cope up with emergency environmental needs are still missing.*
- 2) Successful business models are those which are based on coordination of large number of stakeholders, business partners, process designers and information management staff. But there are very few tools that shape business logic of today's firms.*
- 3) Business models should be capable of generating revenue and steady financial streams. This means all aspects of business models should be optimized and reinforced to meet fierce global competition.*

**Keywords : Business Environment , External Environment, Business Models**

## **I. LITERATURE REVIEW**

Due to technological change and globalization (Archibugi and Iammarino 2002), choosing business partners, reaching your customers and defining value proposition have become a complex task. However, new technologies, globalization and the abundant reservoir of choices to configure a business, make managing, a difficult task (Zahra and O'Neill 1998). Hodgson (2003) compares this phenomenon to capitalism. Competition pressure is forcing firms to pursue profit motives in two main means. Firstly, it is expanding businesses to new markets through geographical expansion or introduction of new products and services. Hodgson further

elaborates to state that innovation would be fuelled by expanding frontiers of science and technology, leading to new field of knowledge and enquiry. Second is cutting cost through smart use of technology. This will eventually help in balancing out resources.



Strategic Adaptation to Recession - A Recent example of Recession That Highlights Adaption of Business model to External Pressures

Recession and environmental shocks are likely to make business policies and strategies ineffective (Meyer et al. 1990). Adapting to business changes and environmental shocks are necessary capabilities in today's times. Strategic flexibility that refers to businesses ability to respond to changing competitive environment (Hitt, et al., 1998) influences any firm's ability to perform in crisis. Other researchers suggest that discontinuous change within an industry stimulates the formation of inter-organisational relationships, promotes experimentation with new organisational forms and precipitates affiliations spanning industry boundaries (Meyer, 1982).

Recessions present businesses with a dilemma (Chastain 1982; Deans et al. 2009). Recession asks for cutting costs and reducing production, which in turn stops firm from recovering properly.

Designing a strategic response to recession is a complex process and involves participation from various business stakeholders such as business owners and senior managers. Restructuring of business models and processes, replacement of managerial practices and functional reorganization are examples of strategic adaptation to recession (Whittington 1991; Geroski and Gregg 1994)

In simplest terms business adopts 3 kinds of response to recession : retrenchment, investment, and 'ambidextrous' strategies.

Business choose to retrench when they find it to be easier to reduce costs that generate additional revenue. Disinvestment in business, closure of establishment, reduction in labour hours, expenditure cuts and reduction in activities like R&D, marketing etc are signs of retrenchment (Rones 1981; Shama 1993; Geroski and Gregg 1997; Michael and Robbins 1998; DeDee and Vorhies 1998).

Firms may perceive recession as an opportunity and hence they are likely to go with the Investment strategy where they would like to invest, innovate and expand into new markets in order to achieve or extend a competitive advantage. Carnegie established dominant positions in the emerging oil and steel industries during the 1870s recession by taking advantage of new refining and steel production technologies and of the weakness of competitors (Bryan and Farrell 2008), and Edison established General Electric (Lynn 2009).

'Ambidextrous' combine retrenchment and investment strategies (Tushman and O'Reilly, 1996; He and Wong, 2004; Raisch and Birkinshaw 2008).

Information from academic studies of firms adapting to environmental constraints or jolts might also offer pointers to how firms adjust to recession.

## II. DEVELOPING A BUSINESS MODEL - STEPS

### 2.1 Designing a Business Model

Under this step, management defines and designs the correct business logic that responds to market circumstances

### 2.2 Finance a Business Model

Management works out a financial structure for the business model (e.g. internal funding, venture capital, stock market funding)

### 2.3 Implement a Business Model

The business model is implemented into business structure, business processes and infrastructure

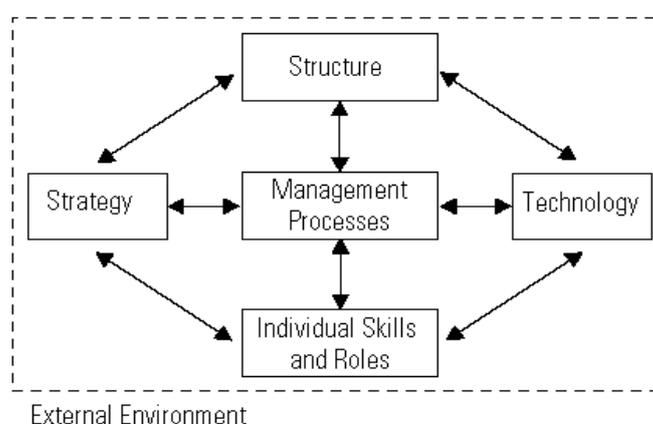
## III. EXTERNAL ENVIRONMENTS INFLUENCE ON BUSINESS MODEL

External environment looks at business organizations and firms from a different angle and different business layers. Business founders position the company in the market to define the direction and formulate objectives and goals, whereas business managers have to understand and implement these visions into concrete objectives. This is where the role of environment in influencing the business model type is seen, and conceptually defined business models come into picture.

Firms earn revenue only when creating a common and shared understanding of money and communication, and by facilitating communication between people and heterogeneous elements (Fensel 2001).

The organizational business models are subjected to continuous monitoring by external forces. As Porter defines the forces, they can be classified as competition, legal, social or technological change and changes in customer demand. It is the manager's role to design or adapt a company's business model by responding to these external forces.

**Figure 1 A Model of Strategic Change and Fit**



Source: Adapted from M.S.Scott Morton, ed., *The Corporation of the 1990s: Information Technology and Organizational Transformation* (New York: Oxford University Press, 1991), p. 20.

## Technology Evolution

The growth of technology and its impact on business application is changing rapidly. As technology is influencing every aspect of business, it becomes a manager's responsibility to oversee how technological pressures are being used by managers to improve the business logic of the firm. It will be an understatement to say that technological change is a major business influencer. In some cases, technological changes may even challenge the mere existence of the particular business model.

## IV. COMPETITIVE FORCES

A second-major influencer, on a firm's business model comes from its competitors. For traditional industry players, adapting to changes in the competitive environment is especially crucial when new dynamic competitors rapidly dispute their market position as an incumbent (cf. Christensen 1997; Christensen 2003).

## V. CUSTOMER DEMAND

Customer demand also exerts pressure on company's business model. Changes in consumer patterns, revenue streams and fashion are few of the examples of change in customer demand.

## VI. SOCIAL ENVIRONMENT

Stakeholder theory (Friedman and Miles 2002) highlights how social mood can influence the business model of a firm. A firm has to be very careful to analyze how mobilizing of public opinion can work for or against the firm. Besides social pressures, changes in social environment, ethics and technology adoption approach is crucial to interpret.

## VII. LEGAL ENVIRONMENT

Studying the legal environment and changes in regulatory regime are necessary to adapt business models. There have been examples in the past which show things as basic as anti-spamming laws may (hopefully) wipe-out business models because of sending out large trunks of unsolicited mails. It is necessary to have a good grasp over tax regime of a particular society as new taxes may make a company's value proposition too costly.

## VIII. MAKING THE BUSINESS MODEL CHOICE

Linder and Cantrell (2000) propose categorizing business models focusing on two main dimensions, which are a model's core revenue generating activity and the activity's relative position on the value continuum. Various business model categories under this are:

- 1) Price Models
- 2) Convenience models
- 3) Commodity Plus Models
- 4) Experience Models
- 5) Channel Models
- 6) Intermediary Models

7) Trust Model

8) Innovation Model

Another well-known study for classification of business models is that conducted by Rappa (2001). According to him, a business model spells-out how a company makes money by specifying where it is positioned in the value chain. His classification scheme consists of nine generic forms of e-business models, which are

1. Brokerage
2. Advertising
3. Infomediary
4. Merchant
5. Manufacturer
6. Affiliate
7. Community
8. Subscription and Utility

Afuah and Tucci (2003), in contrast, explain that a business model should include answers to a number of environmental concerns:

1. What value you offer to your customers?
2. Which category of customers to provide the value to?
3. How to monetize and charge for the value?
4. What strategies to be undertaken?
5. How do you plan to provide the value?
6. How can the competitive advantage from providing the value be sustained?

## IX. CONCLUSION

The analysis of academic research has shown that the business model concept and related influence of environment on the business models have a potential to be explored further. The ability to establish a transparent relationship between business and external environment, and relationship between various business elements seems to interest executives and consultants alike. Business models are necessary tools to understand fundamental questions of business. Choosing an effective business model is necessary to seize the business possibilities available for business practitioners. When defining business model generates a certain degree of confusion, many academic authors go deeper into defining specific environmental factors that govern what business models are composed of. It is very important to choose a business model in tandem with the environmental needs. The first step in selecting an effective business model is, viewing the business model as a tool understanding and defining the business logic of a firm.

The attempt to define business models should consist of business elements such as functions and attributes of a business model. Hence, our analysis concludes that the environment specific issues in business model frameworks are necessary for success.

## REFERENCES

- [1.] Brooks, I. and Weatherston, J. (1997), *The Business Environment: Challenges and Changes*, Prentice-Hall, London.
- [2.] Brown, S.L. and Eisenhardt, K.M. (1998), *Competing on the Edge: Strategy as Structured Chaos*, Harvard Business School Press, Boston, MA.
- [3.] Chakravarthy, B. (1997), "A new strategy framework for coping with turbulence", *Sloan Management Review*, Winter, pp. 69-82.
- [4.] Cravens, D.W. (1991), *Strategic Marketing*, 3rd ed., Irwin, Homewood, IL.
- [5.] Davis, D., Morris, M. and Allen, J. (1991), "Perceived environmental turbulence and its effect on selected entrepreneurship, marketing and organizational characteristics in industrial firms", *Journal of the Academy of Marketing Science*, Vol. 19 No. 1, Winter, pp. 43-51.
- [6.] Gordijn, J., J. M. Akkermans, et al. (2000). *Business Modelling is not Process Modelling*. ECOMO 2000, Salt Lake City, USA, Springer.
- [7.] Hooley, G. and Beracs, J. (1997), "Marketing strategies for the 21st century: lessons from the top Hungarian companies", *Journal of Strategic Marketing*, Vol. 5, pp. 143-65.
- [8.] Mavondo, F.T. (1999), "Environment and strategy as antecedents for marketing effectiveness and organizational performance", *Journal of Strategic Marketing*, Vol. 7, pp. 237-50.
- [9.] Seddon, P. B. and G. P. Lewis (2003). *Strategy and Business Models: What's the Difference*. 7th Pacific Asia Conference on Information Systems, Adelaide, Australia
- [10.] Hagel, J. and A. Armstrong (1997). *Net Gain: Expanding Markets through Virtual Communities*. Boston, Harvard Business School Press.
- [11.] Boulton, R. and B. Libert (2000). "A Business Model for the New Economy." *Journal of Business Strategy* 21(4): 29-35.
- [12.] Andriani, P. (2001). "Diversity, Knowledge and Complexity Theory: Some Introductory Issues." *International Journal of Innovation Management* 5(2): 257-274.
- [13.] Angwin, J. (2000). 'Business-Method' Patents, Key to Priceline, Draw Growing Protest. *Wall Street Journal - Eastern Edition*.
- [14.] Alt, R. and H. Zimmermann (2001). "Introduction to Special Section – Business Models." *Electronic Markets* 11(1): 3–9.
- [15.] Slater, S.F. and Narver, J.C. (1995), "Market orientation and the learning organization", *Journal of Marketing*, Vol. 59, July, pp. 63-74
- [16.] Dussauge, P. and B. Garrette (1999). *Cooperative Strategy - Competing Successfully through Strategic Alliances*. Chichester, Wiley.
- [17.] Fine, C. (1998). *Clockspeed: Winning Industry Control in the Age of Temporary Advantage*. Boulder, CO, Perseus Books.
- [18.] Courtney, H., J. Kirkland, et al. (1997). "Strategy under uncertainty." *Harvard Business Review* 75(6): 66-+.

# **A SURVEY: PRINCIPAL COMPONENT ANALYSIS (PCA)**

**Sumanta Saha<sup>1</sup>, Sharmistha Bhattacharya (Halder)<sup>2</sup>**

<sup>1</sup>*Department of IT, Tripura University, Agartala, (India)*

<sup>2</sup>*Department of Mathematics, Tripura University, Agartala, (India)*

## **ABSTRACT**

*Principal component analysis (PCA) is one of the most widely used multivariate techniques in statistics. It is commonly used to reduce the dimensionality of data in order to examine its underlying structure and the covariance/correlation structure of a set of variables. It is a statistical procedure that uses an orthogonal transformation to convert a set of observations of possibly correlated variables into a set of values of linearly uncorrelated variables called principal components. The number of principal components is less than or equal to the number of original variables. It is a way of identifying patterns in data, and expressing the data in such a way as to highlight their similarities and differences. This is the survey paper of the existing theory and techniques for PCA with example.*

***Keywords: Correlation structure, Covariance structure, Multivariate Technique, Orthogonal Transformation, Principal Component.***

## **I. INTRODUCTION OF PRINCIPAL COMPONENTS ANALYSIS (PCA)**

Principal component analysis (PCA) is a statistical procedure that uses orthogonal transformation to convert a set of observations of possibly correlated variables into a set of values of linearly uncorrelated variables are called **principal components**. The number of principal components are less than or equal to the number of original variables. This transformation is defined in such a way that the first principal component has the largest possible variance (that is, accounts for as much of the variability in the data as possible), and each succeeding component in turn has the highest variance possible under the constraint that it be orthogonal to (i.e., uncorrelated with) the preceding components [3]. Principal components are guaranteed to be independent if the data set is jointly normally distributed. PCA is sensitive to the relative scaling of the original variables.

Many papers of PCA are survey here and find that, no papers are combined with the techniques of PCA and the relevant example. That's why this type of paper is written where all these things are combined together which is easy to understand the beginner.

PCA is a widely used mathematical tool for high dimension data analysis. Just within the fields of computer graphics and visualization alone, PCA has been used for face recognition [10], motion analysis and synthesis [7], clustering [4], dimension reduction [2], etc.

## II. A BRIEF HISTORY OF PRINCIPAL COMPONENTS ANALYSIS

PCA was invented in 1901 by Karl Pearson [6], as an analogue of the principal axis theorem in mechanics; it was later independently developed (and named) by Harold Hotelling in the 1930s[1]. Depending on the field of application, it is also named the discrete Kosambi-Karhunen–Loève transform (KLT) in signal processing, the Hotelling transform in multivariate quality control, proper orthogonal decomposition (POD) in mechanical engineering, singular value decomposition (SVD) of  $X$  (Golub and Van Loan, 1983), eigenvalue decomposition (EVD) of  $X^T X$  in linear algebra, factor analysis, Eckart–Young theorem (Harman, 1960), or Schmidt–Mirsky theorem in psychometrics, empirical orthogonal functions (EOF) in meteorological science, empirical eigen function decomposition (Sirovich, 1987), empirical component analysis (Lorenz, 1956), quasiharmonic modes (Brooks et al., 1988), spectral decomposition in noise and vibration, and empirical modal analysis in structural dynamics.

## III. PCA TECHNIQUES

The techniques of PCA are collected from [5] where a 2-D facial image can be represented as 1-D vector by concatenating each row (or column) into a long thin vector. Let's suppose we have  $M$  vectors of size  $N$  (= rows of image  $\times$  columns of image) representing a set of sampled images.  $p_j$ 's represent the pixel values:

$$x_i = [p_1 \dots p_N]^T, i = 1, \dots, M \quad (1)$$

The images are mean centered by subtracting the mean image from each image vector. Let  $m$  represent the mean of that image:

$$m = \frac{1}{M} \sum_{i=1}^M x_i \quad (2)$$

And let  $w_i$  be defined as mean centered image:

$$w_i = x_i - m \quad (3)$$

The main goal is to find a set of  $e_i$ 's which have the largest possible projection onto each

$$\lambda_i = \frac{1}{M} \sum_{n=1}^M (e_i^T w_n)^2 \quad (4)$$

of the  $w_i$ 's and to find a set of  $M$  orthonormal vectors  $e_i$  for which the quantity:

$$e_i^T e_k = \delta_{ik} \quad (5)$$

is maximized with the orthonormality constraint.

It has been shown that the  $e_i$ 's and  $\lambda_i$ 's are given by the eigenvectors and eigenvalues of the covariance matrix:

$$C = W W^T \quad (6)$$

where  $W$  is a matrix composed of the column vectors  $w_i$  placed side by side. The size of  $C$  is  $N \times N$  which could be enormous. For example, images of size  $64 \times 64$  create the covariance matrix of size  $4096 \times 4096$ . It is not practical to solve for the eigenvectors of  $C$  directly. A common theorem in linear algebra states that the vectors  $e_i$  and scalars  $\lambda_i$  can be obtained by solving for the eigenvectors and eigenvalues of the  $M \times M$  matrix  $W^T W$ . Let  $d_i$  and  $\mu_i$  be the eigenvectors and eigenvalues of  $W^T W$ , respectively.

$$W^T W d_i = \mu_i d_i \quad (7)$$

By multiplying left to both sides by  $W$ :

$$W W^T (W d_i) = \mu_i (W d_i) \quad (8)$$

which means that the first  $M-1$  eigenvectors  $e_i$  and eigenvalues  $\lambda_i$  of  $W W^T$  are given by  $W d_i$  and  $\mu_i$ , respectively.  $W d_i$  needs to be normalized in order to be equal to  $e_i$ . Since we only sum up a finite number of image vectors,  $M$ , the rank of the covariance matrix cannot exceed  $M-1$  (The  $-1$  come from the subtraction of the mean vector  $m$ ).

The eigenvectors corresponding to nonzero eigenvalues of the covariance matrix produce an orthonormal basis for the subspace within which most image data can be represented with a small amount of error. The eigenvectors are sorted from high to low according to their corresponding eigenvalues. The eigenvector associated with the largest eigenvalue is one that reflects the greatest variance in the image. That is, the smallest eigenvalue is associated with the eigenvector that finds the least variance. They decrease in exponential fashion, meaning that the roughly 90% of the total variance is contained in the first 5% to 10% of the dimensions.

A facial image can be projected onto  $M' (<< M)$  dimensions by computing

$$\Omega = [v_1 v_2 \dots v_{M'}]^T \quad (9)$$

where  $v_i = e_i^T w_i$ ,  $v_i$  is the  $i^{\text{th}}$  coordinate of the facial image in the new space, which come to be the principal component. The vectors  $e_i$  are also images, so called, eigen images, or eigenfaces. They can be viewed as images and indeed look like faces. So,  $\Omega$  describes the contribution of each eigenface in representing the facial image by treating the eigen faces as a basis set for facial images. The simplest method for determining which face class provides the best description of an input facial image is to find the face class  $k$  that minimizes the Euclidean distance

$$\epsilon_k = \|(\Omega - \Omega_k)\| \quad (10)$$

Where  $\Omega_k$  is a vector describing the  $k^{\text{th}}$  face class. If  $\epsilon_k$  is less than some predefined threshold  $\theta_\epsilon$ , a face is classified as belonging to the class  $k$ .

## IV. EXAMPLE OF PCA

The example of PCA are collected from [9] and the steps are:

### Step 1: Get some data

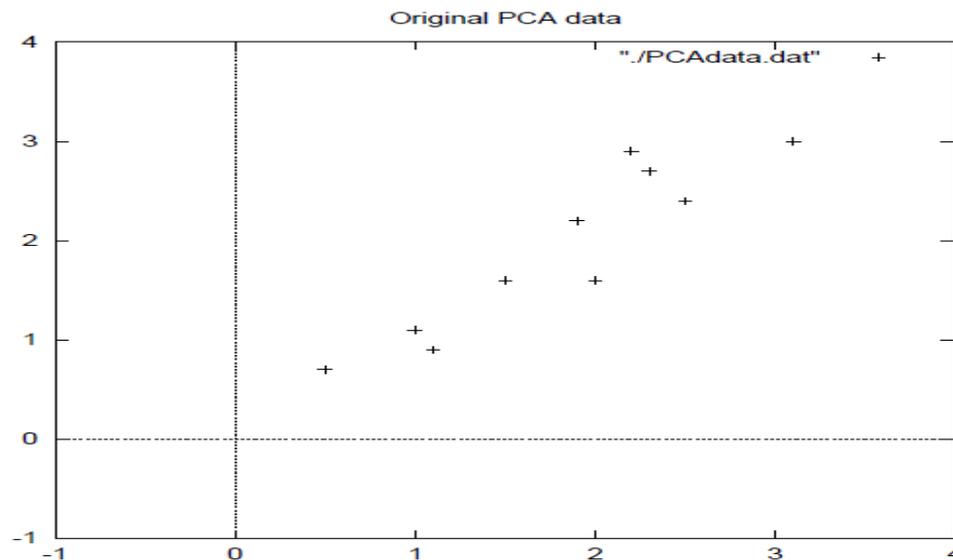
For this example self-created data set is used. It is the 2 dimension data set, which provide the plots of data to show PCA analysis at each step.

The data is given in Figure 4.1, along with a plot of that data.

### Step 2: Subtract the mean

For PCA to work properly, subtract the mean from each of the data dimensions. The mean subtracted is the average across each dimension. So, all the  $x$  values have  $\bar{x}$  (the mean of the  $x$  values of all the data points) subtracted, and all the  $y$  values have  $\bar{y}$  subtracted from them. This produces a data set whose mean is zero.

$x$	$y$		$x$	$y$
2.5	2.4	Data Adjust =	.69	.49
0.5	0.7		-1.31	-1.21
2.2	2.9		.39	.99
1.9	2.2		.09	.29
Data=3.1	3.0		1.29	1.09
2.3	2.7		.49	.79
2	1.6		.19	-.31
1	1.1		-.81	-.81
1.5	1.6		-.31	-.31
1.1	0.9		-.71	-1.01



**Figure 4.1: PCA example data, original data on the left, data with the means subtracted on the right, and a plot of the data.**

### Step 3: Calculate the covariance matrix

Covariance is always measured between 2 dimensions. If a data set having more than 2 dimensions, there is more than one covariance measurement that can be calculated. Since the data is 2 dimensional, the covariance matrix will be 2 x 2. The result is given below:

$$\text{cov} = \begin{pmatrix} .616555556 & .615444444 \\ .615444444 & .716555556 \end{pmatrix}$$

So, since the non-diagonal elements in this covariance matrix are positive, then both the  $x$  and  $y$  variable may be increased together.

### Step 4: Calculate the eigenvectors and eigenvalues of the covariance matrix

Since the covariance matrix is square, then calculate the eigenvectors and eigenvalues for this matrix. In the meantime, here the eigenvectors and eigenvalues are:

$$\text{eigenvalues} = \begin{pmatrix} .0490833989 \\ 1.210027771 \end{pmatrix}$$

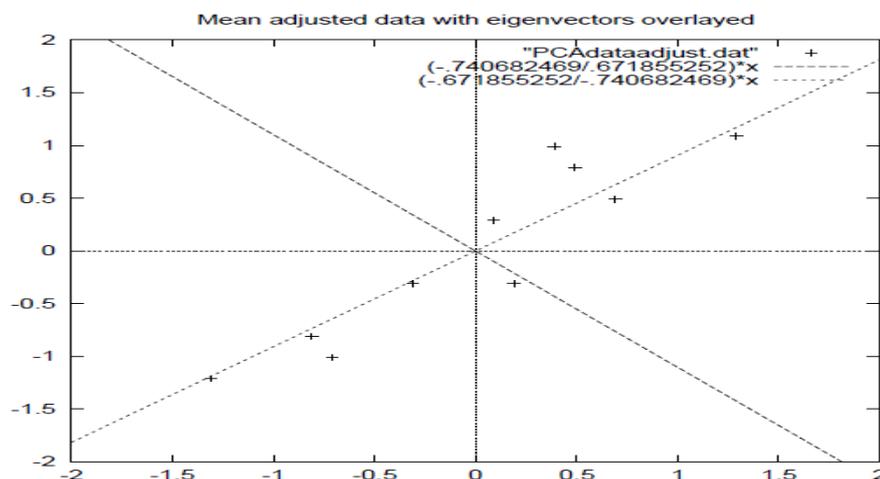
$$\text{eigenvectors} = \begin{pmatrix} -.735178656 & -.677873399 \\ .677873399 & -.735178656 \end{pmatrix}$$

It is important to notice that these eigenvectors are both *unit* eigenvectors i.e. their lengths are both 1. This is very important for PCA, but luckily, most math packages, when asked for eigenvectors, will give unit eigenvectors.

If look at the plot of the data in Figure 4.2 then see how the data has quite a strong pattern. As expected from the covariance matrix, two variables increase together. They appear as diagonal dotted lines on the plot. As stated in the eigenvector section, they are perpendicular to each other. But, more importantly, they provide us with information about the patterns in the data. So, by this process of taking the eigenvectors of the covariance matrix, now extract lines that characterize the data. The rest of the steps involve transforming the data so that it is expressed in terms of them lines.

### Step 5: Choosing components and forming a feature vector

Here is where the notion of data compression and reduced dimensionality comes into it. If look at the eigenvectors and eigenvalues from the previous section, notice that the eigenvalues are quite different values. In fact, it turns out that the eigenvector with the *highest* eigenvalue is the *principle component* of the data set.



**Figure 4.2: A plot of the normalized data (mean subtracted) with the eigenvectors of the covariance matrix overlaid on top.**

In this example, the eigenvector with the largest eigenvalue was the one that pointed down the middle of the data. It is the most significant relationship between the data dimensions.

In general, once eigenvectors are found from the covariance matrix, the next step is to order them by eigenvalue, highest to lowest. This gives the components in order of significance. Now, if user like, user can decide to *ignore* the components of lesser significance. Then user loses some information, but if the eigenvalues are small,

then don't lose much. If leave out some components, the final data set will have less dimensions than the original. To be precise, if originally have  $n$  dimensions in data set, and want calculate  $n$  eigenvectors and eigenvalues, and then choose only the first  $p$  eigenvectors, then the final data set has only  $p$  dimensions.

Now need a *feature vector*, which is just a fancy name for a matrix of vectors. This is constructed by taking the eigenvectors that are kept store in the form of eigenvectors, and forming a matrix with these eigenvectors in the columns.

$$\text{Feature Vector} = (eig_1 \ eig_2 \ eig_3 \dots \ eig_n)$$

In this example 2 eigenvectors are found and have the two choices either form a feature vector with both of the eigenvectors:

$$\begin{pmatrix} -.677873399 & -.735178656 \\ -.735178656 & .677873399 \end{pmatrix}$$

or, can choose to leave out the smaller, less significant component and only have a single column:

$$\begin{pmatrix} -.677873399 \\ -.735178656 \end{pmatrix}$$

Finally the result of each of these eigenvectors is found in the next section.

## Step 6: Deriving the new data set

This is the final and easiest step of PCA. Once the chosen components (eigenvectors) can be kept in data set and formed a feature vector, then simply take the transpose of the vector and multiply it on the left of the original data set, transposed.

$$\text{Final Data} = \text{Row Feature Vector} \times \text{Row Data Adjust},$$

where *Row Feature Vector* is the matrix with the eigenvectors in the columns *transposed* so that the eigenvectors are now in the rows, with the most significant eigenvector at the top, and *Row Data Adjust* is the mean-adjusted data *transposed*, i.e. the data items are in each column, with each row holding a separate dimension. *Final Data* is the final data set, with data items in columns, and dimensions along rows. It will give the original data *solely in terms of the vectors has been chosen*. The original data set had two axes,  $x$  and  $y$ , so the data was in terms of them. It is possible to express data in terms of any two axes. If these axes are perpendicular, then the expression is the most efficient. This was why it was important that eigenvectors are always perpendicular to each other. The data is being changed in terms of the axes  $x$  and  $y$ , and now they are in terms of 2 eigenvectors. In this case the new data set has reduced dimensionality.

To show this data and doing the final transformation with each of the possible feature vectors. Taking the transpose of the result in each case to bring the data back to the nice table like format and also plotted the final points to show how they relate to the components.

In the case of keeping both eigenvectors for the transformation, now get the data and the plot found in Figure 4.2. This plot is basically the original data, rotated so that the eigenvectors are the axes. This is understandable since we have lost no information in this decomposition.

The other transformation that can make is by taking only the eigenvector with the largest eigenvalue. The table of data resulting from that is found in Figure 4.1. As expected, it only has a single dimension. If compare this

data set with the one resulting from using both eigenvectors and notice that this data set is exactly the first column of the other. So, if plot this data, it would be 1 dimensional, and would be points on a line in exactly the  $x$  positions of the points in the plot in Figure 4.3.

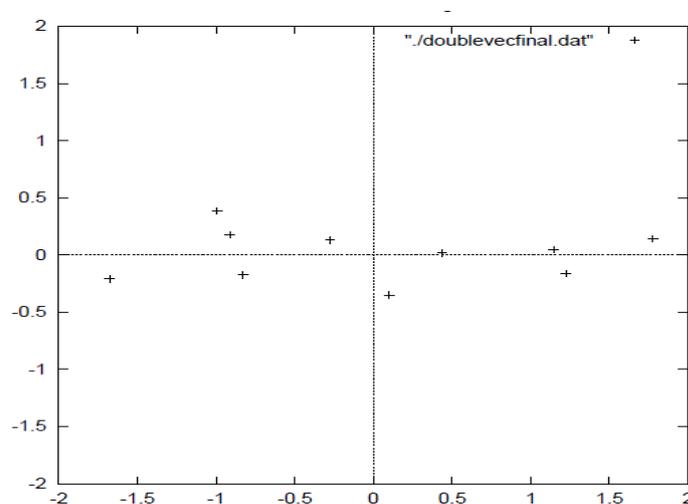
### Getting the old data back

Wanting to get the original data back is obviously of great concern, if the PCA transform for data compression is used.

Transformed Data=

X	Y
-.87970186	-.175115307
1.77758033	.142974
-.992197494	.310374989
-.274210416	.130417207
-1.67580142	-.209491061
-.912949103	.17521044
.0991094375	-.34910698
1.14457216	.046417258
.438046137	.0177646297
1.2238056	-.162675287

Data transformed with 2 eigenvectors



**Figure 4.3: The table of data by applying the PCA analysis using both eigenvectors, and a plot of the new data points.**

Transformed Data (Single eigenvector)

x
-.87970186
1.7775803
-.992197494
-.274210416
-1.67580142
-.912949103
.0991094375
1.14457216
.438046137
1.2238056

**Figure 4.4: The data after transforming using only the most significant eigenvector**

So, how do we get the original data back? Before we do that, remember that only if we take *all* the eigenvectors in our transformation will we get *exactly the* original data back. If the number of eigenvectors is reduced in the final transformation, then the retrieved data has lost some information. Recall that the final transform is this:

$$\text{Final Data} = \text{RowFeatureVector} \times \text{Row Data Adjust},$$

which can be turned around so that, to get the original data back,

$$\text{RowDataAdjust} = \text{RowFeatureVector}^{-1} \times \text{Final Data}$$

where  $\text{RowFeatureVector}^{-1}$  is the inverse of  $\text{RowFeatureVector}$ . However, when we take *all* the eigenvectors in our feature vector, it turns out that the inverse of our feature vector is actually equal to the transpose of our feature vector. This is only true because the elements of the matrix are all the unit eigenvectors of our data set. This makes the return trip to our data easier, because the equation becomes

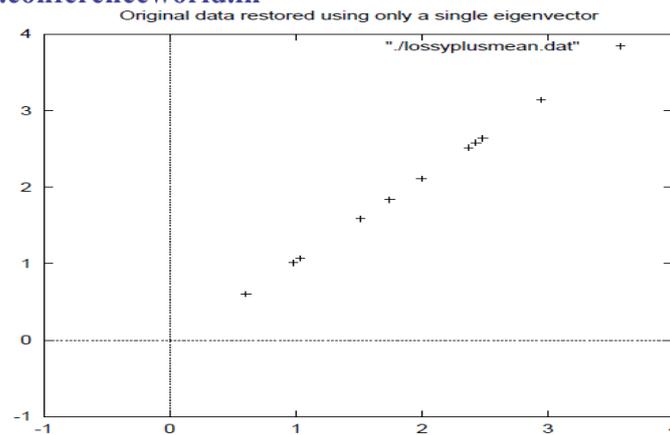
$$\text{RowDataAdjust} = \text{RowFeatureVector}^T \times \text{Final Data}$$

But, to get the actual original data back, we need to add on the mean of that original data (remember we subtracted it right at the start). So, for completeness,

$$\text{RowOriginalData} = (\text{RowFeatureVector}^T \times \text{Final Data}) + \text{Original Mean}$$

This formula also applies to when you do not have all the eigenvectors in the feature vector. So even when you leave out some eigenvectors, the above equation still makes the correct transform.

However, I will do it with the reduced feature vector to show you how information has been lost. Figure 4.5 shows this plot.



**Figure 4.5: The reconstruction from the data that was derived using only a single eigenvector**

Compare it to the original data plot in Figure 4.1 and you will notice how, while the variation along the principle eigenvector (see Figure 4.2 for the eigenvector overlaid on top of the mean-adjusted data) has been kept, the variation along the other component (the other eigenvector that we left out) has gone.

## V. CONCLUSION

Principal Component Analysis is powerful statistical techniques. PCA is used to find optimal ways combining variables into a small number of subsets. Principal Component Analysis are useful as data reduction but not for understanding the structure of the data. This paper deals with the history of PCA and the ideas of PCA. It also discusses the technique of PCA with example.

## REFERENCES

- [1] H. Hotelling, (1933). Analysis of a complex of statistical variables into principal components. *Journal of Educational Psychology*, 24, 417–441, and 498–520.
- [2] S. Huang, M. O. Ward, and E. A. Rundensteiner. Exploration of dimensionality reduction for text visualization. In *CMV '05: Proceedings of the Coordinated and Multiple Views in Exploratory Visualization*, pages 63-74, Washington, DC, USA, 2005. IEEE Computer Society.
- [3] I. T. Jollie, *Principal Component Analysis*. Springer, second edition, 2002.
- [4] Y. Koren and L. Carmel. Visualization of labeled data using linear transformations. *InfoVis*, 00:16, 2003.
- [5] Kyungnam Kim, *Face Recognition using Principle Component Analysis*.
- [6] K. Pearson, (1901). On Lines and Planes of Closest Fit to Systems of Points in Space (PDF). *Philosophical Magazine* 2 (11): 559–572. doi:10.1080/14786440109462720.
- [7] A. Safonova, J. K. Hodgins, and N. S. Pollard. Synthesizing physically realistic human motion in low-dimensional, behavior-specific spaces. *ACM Trans.Graph.*, 23(3):514-521, 2004.
- [8] Jon Shlens, A tutorial on Principal Component Analysis, 25 March,2003.
- [9] Lindsay I Smith, A tutorial on Principal Component Analysis, February 26, 2002.
- [10] M.A. Turk and A.P. Pentland, *Face Recognition Using Eigenfaces*, IEEE Conf. on Computer Vision and Pattern Recognition, pp. 586-591, 1991.

## **WIRELESS CUSTOMER PREMISES EQUIPMENT**

### **FOR LANDLINE**

**Poncy Paul<sup>1</sup>, Muhammed Riyas K<sup>2</sup>, Chithra S Pillai<sup>3</sup>, Sreeleja N Unnithan<sup>4</sup>,  
Prasad R Menon<sup>5</sup>, Likhil VD<sup>6</sup>**

<sup>1, 2, 3</sup> *Student, Electronics and Communication, NSS College of Engineering, Palakkad, (India)*

<sup>4, 5</sup> *Asst. Prof, Electronics and Communication, NSS College of Engineering, Palakkad, (India)*

<sup>6</sup> *Junior Engineer, Barat Sanchar Nigam Limited, Malapuram, (India)*

#### **ABSTRACT**

*According to current scenario the conventional telephone system is degrading day by day. This situation leads to damage of entire cable telephone system. Conventional telephone system provides good voice quality than GSM and CDMA, but its usage is diminishing due to its immobility. So the prime concern of this project is to provide user mobility at the customer premises equipment. This project is to find a wireless replacement for the conventional landline telephone receiver with providing mobility to user and satisfying the voice quality requirement with our Android phone. It provides the voice quality of conventional landline phone with full duplex data rate of 128 kbps. This project equips the above facility with any android phones and maximizes the utilization of land line call offers such as “free unlimited night calling, and Sunday unlimited calling”.*

**Keywords:** *Android minicomputer, ATmega328, Bell ring detector, MCU module, WCPE.*

#### **I. INTRODUCTION**

In current scenario, the landline calls mobility is restricted to specified or fixed locations. Right now landline customer premises equipment's are available as fixed terminals, which restricts the mobility of users which also restricts the utilization of landline features such as voice clarity (64 kbps no real time compression, crystal clarity speech), free night charge calling facilities. Our proposed system is landline customer premises equipment which enables the user mobility and users equipment reliability. Our CPE is Wi-Fi operated device which connects to the conventional PSTN network and it creates a Wi-Fi hotspot which implies a modulation scheme of conventional PSK and a WPA 2 encryption which can be accessed from any conventional Android phone. Android phone which is connected to Wi-Fi network created by the proposed system can receive as well as initiate landline call, from that mobile phone Wi-Fi zone enables the user mobility as conventional Wi-Fi zone. Our proposed WCPE is based on node MCU module (CP 2103) which has an in built Wi-Fi module and operates on 5v power supply. CP2103 has both analog and digital I/O pins. Analog pins detect the dial tone of landline. CP2103 has an in built ESP8266 based Wi-Fi module which enables the input based wireless connectivity between mobile station and CP2103 microcontroller. CP2103 samples the analog channel at 8 khz and quantized into 8 bits and send it over Wi-Fi network at 64 kbps speed to mobile station. The mobile station takes the input from microcontroller and sends the speech signals over Wi-Fi network. The main challenge of

this project is to establish a wireless speech transmission system over Wi- Fi and an Android application which is suitable for the application.

## II. OBJECTIVES

According to current scenario the conventional telephone system is degrading day to day. It provides good voice quality than GSM and CDMA, its usage diminishing day to day due to its immobility. So our prime concern is to provide user mobility at the customer premises equipment. Objectives are

1. To find a wireless replacement for the conventional landline telephone.
2. To achieve the above result with our Android phone.
3. To provide the voice quality of conventional landline phone with full duplex data rate of 128 kbps.
4. To equip the above facility with any Android phones. And maximize the utilization of land line call offers such as “free unlimited night calling , and Sunday unlimited calling”

## III. APPLICATION/SOCIOECONOMIC IMPORTANCE

Some years back, Land line industry was a monopoly in telecom sector. After the introduction of mobile phones the conventional telephony usage is degrading day by day. To reduce the dropout of landline customer, Land line telecom providers (BSNL govt of India enterprise) provides more and more free calling offers to the customer. In current scenario, even though the land line customer drops out day by day due to immobility and tapping ability of conventional telephones. So this paper thought for the solution.

1. To reduce the dropout of landline customers.
2. To provide user security and mobility for the conventional landline telephony.
3. To survive the conventional telecom landline CFA sector by giving a rebirth to the landline telephony. (Huge amount has been invested in landline CFA sector by BSNL). There by providing a new opportunity to the land phone communication.
4. To develop this product and market industrially in an economical current progress.

## IV. IMPLEMENTATION DETAILS

The proposed WCPE implementation includes some sub circuits design, study and experimentation regardless of its size or impact. We could experiment and develop some add on circuitry to automate a conventional telephony circuitry. Bell ring detector circuit, pulse dialing circuit, and electromechanical relay based off hook switch, speech amplifier, and hybrid circuit are some examples of our experimentation.

### 4.1 Block Diagram

The fig (i) shows the Block diagram of proposed WPCE (Wireless Customer Premises Equipment) system.

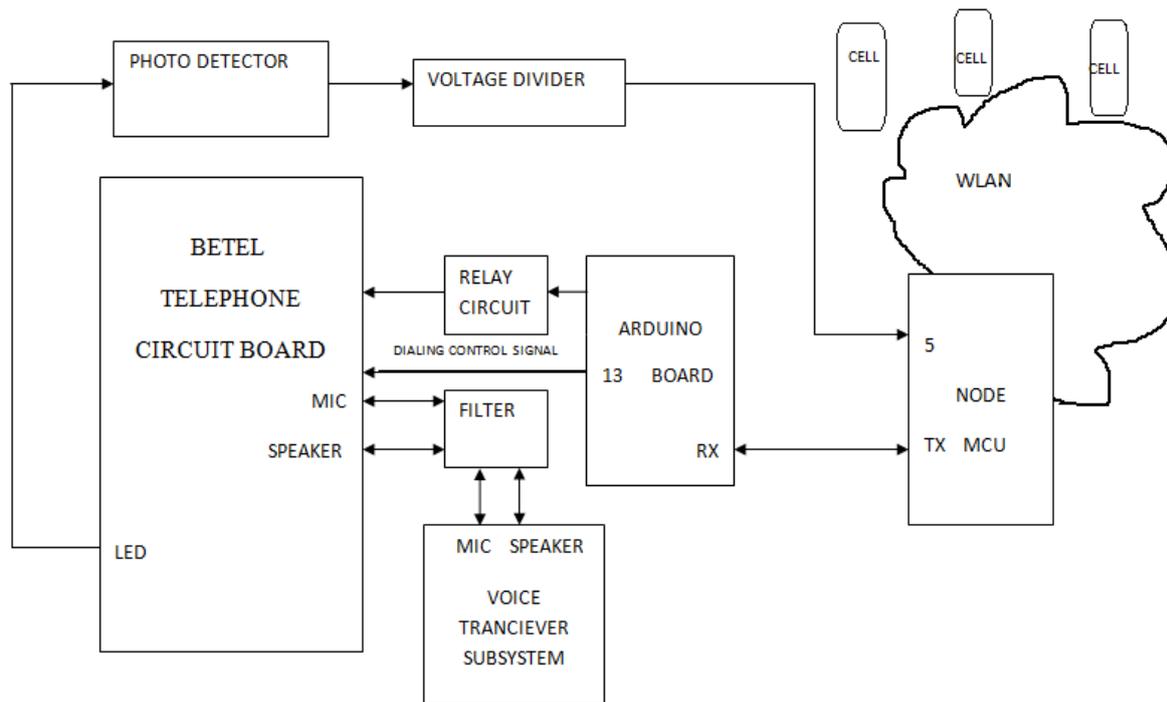


Fig (i) Block diagram of proposed WCPE

#### 4.2 Beotel's EPBT Board

This is a conventional analog EPBT circuit board, which has off/on hook switch, analog audio input/output, bell ring LED indicator, DTMF dialer, pulse dialing circuitry etc...we are utilizing this pins for automating the conventional receiver. Fig (ii) shows the Beotel's EPBT board.

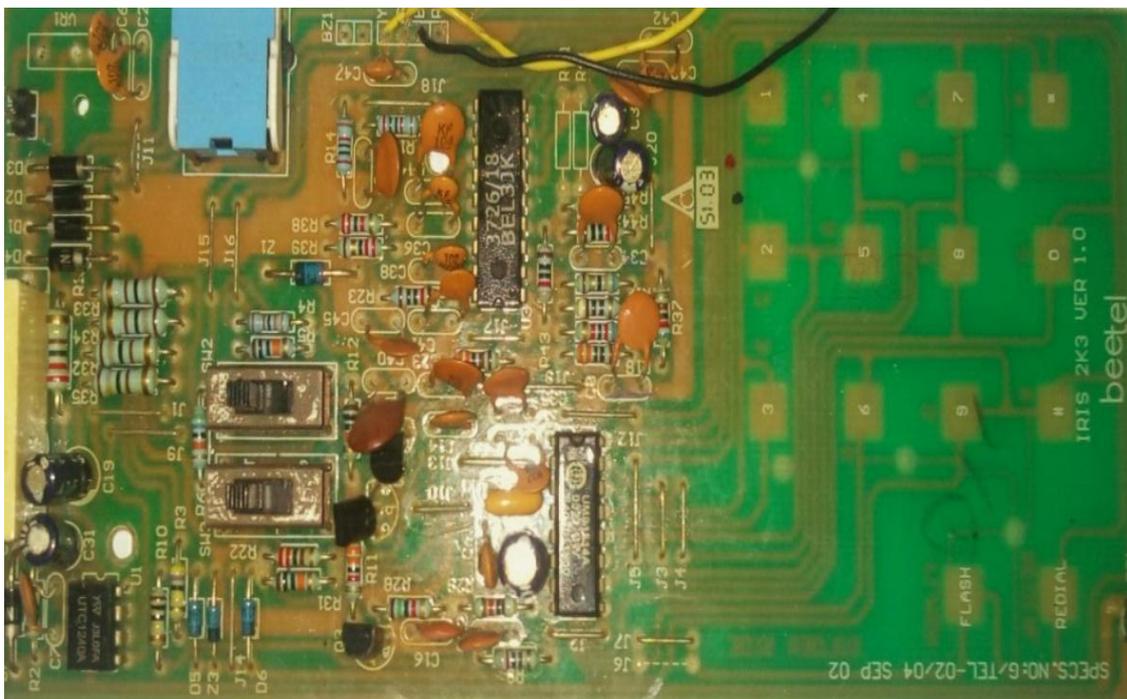


Fig (ii) Beotel's EPBT board

On Beetel's EPBT board, conventional on hook switch is replaced with a double contact relay. Then this relay is actuating from Arduino uno pins. Hence off hook and on hook can be controlled via Arduino uno board.

### 4.3 Lolin's Node MCU

Node MCU module has an in build ESP8266 based wifi transceiver, which is capable of creating a wifi hotspot region with WPA2PSK authentication. It has 16 GPIO pins which can be configured both as input or output and an analog input pin for interacting with analog input signals. Node MCU is capable of establishing IP based connectivity in one network. This is capable of handling an http server, DHCP server etc, it has USART interface for communicating with microcontrollers. This is utilized for interfacing with Arduino board. Node MCU run on a clock frequency of 80MHz and wifi module has a band of 2.4 GHz. Fig (iii) shows the node MCU module.



**Fig (iii) Node MCU module**

LoLin's node MCU module has ESP8286 based wifi module, which is wirelessly connected to android minicomputer and user android phone. An http server is created on node MCU module for interacting with control requests from android user. Node MCU module is also connected to Arduino uno via USART pins. A half-duplex connection is established between node MCU and Arduino uno to send control words from node MCU to Arduino board. Bell ring detector circuit is connected to node MCU through a potential divider level converter. (GPIO second pin is connected to the bell ring detector circuit).

### 4.4 Arduino UNO Board

This Arduino uno board is the basic platform board of Arduino board. Which is based on an ATmega 328 microcontroller, which has digital and analog pins, USART, TIMERS, COUNTERS, etc. This can be programmed using Arduino IDE. This is used here for actuating pulse dialing signal.

Arduino's digital pin 12 is connected to off/on hook relay (for actuating relay whenever is required). Arduino digital pin 13 is connected to pulse input pin of Beetel's conventional telephone board (for giving dialing pulses).

## 4.5 Lm358 Based Bell Ring Detector Module

LM358 is an opto isolator, used for detecting the bell ring. LM 358 based opto coupler board is connected to bell ring out put pin of the Beetel's EPBT board (which provides an optical isolation between high voltage EPBT board and low voltage node MCU board).

## 4.6 Voltage Level Convertor

Voltage level convertor is a potential divider based 5v to 3.3v converter. is used to couple the bell ring signal to node MCU's GPIO input pin.

## 4.7 Audio Coupling Circuits

Resistance capacitance based RC coupling is employed between audio input/output of EPBT board and audio output/input of android minicomputer which also isolates high dc bias exists on EPBT board.

Audio out of EPBT board is connected to audio in of android minicomputer. Audio out of android minicomputer is connected to audio in of EPBT board. An RC coupling is employed between audio in/out of EPBT and audio in/out of android device for getting isolation to android device from high DC bias of EPBT board.

## V. WORKING

All the boards of all the sub systems are connected in such a way as shown in connections. The working and coordination of each subsystem and circuitry is mentioned below. The circuitry as shown in Fig (iv)

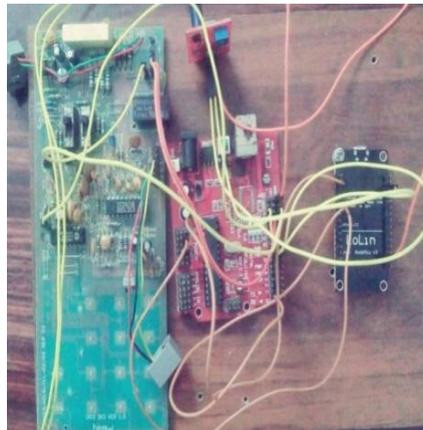


Fig (iv) Circuit board of WCPE

### 5.1 For Initializing an Outgoing Call

Our android applications have a dialer screen which provides an app interface for the user to dial a number. After dialing a number the user tap on call button. When tap on call button, the app reads the dialed number from edit text field of android application and it sends a get request to the http server created on node MCU in the below format.

<http://number?=xxxxxxxxx&status?=0&ringstatus?=0>

It also establishes full duplex voice communication between phone and minicomputer. When node MCU receives the above get request, it segregate the phone number xxxxxxxxxx from the URL request and send it to Arduino board at a board rate of 9600 bps via USART pin.

Arduino board receives the above phone number. It first actuates the on hook relay and waits for one second. Then it generates the pulse dialing signal for the input number from node MCU. The pulse signal is coupled to the pulse dialing input of EPBT board. Hence dialing occurred.

At this time audio in and out of EPBT is available at the audio input/output of EPBT board. This is coupled to the android minicomputer. It digitizes the analog voice and send over wifi to the user android phone. Hence incoming speech is received at mobile station. At the same time mobile station receives the speech via its microphone and digitizes it. Then transmit it to android minicomputer with a speed of 128kbps (8 KHz sampling and 16 bit quantization). This digital speech signals is converted to analog output on android minicomputer using DAC and reconstruction filters. Then it is coupled to analog-in of the EPBT board. Hence two way voice transmissions enabled and call is in progress. Hence two way speech is available at mobile stations. After the completion of an ongoing call, the user has to complete the call.

## 5.2 For Disconnecting a Call

While a call is ongoing the user activity screen will provide an end button to disconnect the call. When user taps on end button, the mobile application sends an http get request to the http server in the below format:

<http://number?=xx&status?=1&ring status?=0>

When server receives this request, it will intimate the arduino to turn off the on hook relay. Then Arduino will turn off the on hook relay and hence the call is disconnected.

## 5.3 For Receiving Incoming Calls

Our android application will send a get request to help server every 5 seconds to check whether a call is available or not. The format is as given below.

<http://192.168.4.1/number? = xx & status? = 0&ring status? = 1>

When receiving this URL the server checks the GPIO2 pin whether any incoming call is getting, or not. If there is any incoming call coming the server replies to the above query that it is “ringing” otherwise replies that “not ringing”. When the app receives the ringing reply from the server it will alert ringtone for user alert and an activity will start with an attend button. When user presses on attend button, the app will send another http request.

<http://192.168.4.1/number?=xxxxxxx&status?=2&ring status? = 0>

When node MCU gets this request it will alert the Arduino to turn onhook relay and thus turned on the relay. So land phone is attended and voice transmission between android transcoder and android app will be enabled. Hence voice is transferred and call is established. During an ongoing call the app will turn to call and activity with a call end option. When user presses the call end button, the app will send a request.

<http://192.168.4.1/number?=xxstatus?=1&ring status?=0>

When node MCU receives this request, the node MCU will intimate the Arduino to turn the on hook relay. Then Arduino will turn off the on hook relay. Hence call is terminated.

## VI. RESULTS

The WCPE system virtually replaced the conventional telephone system by android phone. At the installation time configured the android devices in minicomputer system using IP Address and port number through developed application. After installation of this WCPE device, initiated a call from our android phone with telephone number. The number was dialed at dial field of the application and taped the call button and generated the call. Incoming call to the telephone number was accessed by android phone. When call arrived, the incoming call was displayed on the application and a dialer tone was generated on android phone. The call was attended using the call attend button in the application.

## VII. CONCLUSION

WCPE system has replaced the receiver section of conventional landline phone with an android phone and provides mobility to the user. The proposed system is to create a communication link between smart phone and land phone using WiFi network. It is found that Real-time voice transmission is possible through WiFi without any delay. For this purpose, a new protocol is developed which could transmit voice data over WiFi network. For the dialing purpose the WCPE is used Pulse Dialing Method instead of the existing dialing techniques in land phones (DTMF). The Digital data from the Android mobile device converted to Analog, using Digital to Analog Converter Module in the hardware section. The Android application which would replace the conventional land phone receiver. This application includes dialing pad, call button, call end button, call attend button and delete button.

Future scope of this proposed WCPE for land phone, would create a complete IP based WLAN network platform for VoIP communication and also using this same network initiate calls between WLAN connected Android devices.

## REFERENCES

- [1] ESP8266 SERIAL ESP-01 WIFI WIRELESS. Manan Mehta ARK Techno Solutions, Mumbai, India, Volume 6, Issue 8, Aug 2015, Pp.07-11, Article ID: IJECET\_06\_08\_002
- [2] DUAL TONE MUTI FREQUENCY DECTECTOR IMPLEMENTATION G \_ unerArslan for EE382C Embedded Soft ware Systems May 1998
- [3] VOICE OVER INTERENT PROTOCOL. Bur Goode, Senior Member, IEEE, Vol. 90, No. 9, September 2002
- [4] WIFI calling. Lennart Norell, Anders Lundström, HÅKAN Österlund, HENRIK Johansson AND Daniel Nilsson January 30, 2015
- [5.] Voice Calls between Wireless (Android) Phones and a Cooperative Application for Sending Sms over Wi-Fi Networks. Mr. Sandip Rane  $\alpha$  , Miss. Jaya Suradkar  $\sigma$  , Miss.Akanksha Patil  $\rho$  & Miss.Ritu Gayakwad W. Global Journal of Computer Science and Technology Volume XII Issue IV Version I-2012.
- [6] Qualcomm, "A Comparison of LTE Advanced HetNetsand WiFi," white paper, WiFi.pdf,Sept. 2011.<http://www.qualcomm.com/media/>

## 4<sup>th</sup> International Conference on Innovative Trends in Science, Engineering and Management

(C-DAC, Mumbai) Centre for Development of Advanced Computing, Mumbai, Maharashtra (India)

(ICITSEM-17)

17<sup>th</sup> June 2017, [www.conferenceworld.in](http://www.conferenceworld.in)

ISBN: 978-93-86171-47-4

- [7] Bennis, M. ; Simsek, M. ; Czylwik, A. ; Saad, W. ; Valentin, S. ; Debbah, M., “When cellular meets WiFi in wireless small cell networks”, Communications Magazine, IEEE, Volume: 51 , Issue: 6, 2013, Page(s): 44 – 50.
- [8] M. Perkins, K. Evans, D. Pascal, and L. Thorpe, “Characterizing the subjective performance of the ITU-T 8 kb/s speech coding algorithm – ITU-T G.729,” IEEE Commun. Mag., vol. 35, pp. 74–81, Sept. 1997
- [9] “One-way transmission time,” ITU-T Recommendation G.114 , 1996.
- [10] A. Benyassine, E. Schlot, H. Y. Su, D. Massaloux, C. Lamblin, and J. P. Petit, “ITU-T G.729 annex B: A silence compression scheme for use with G.729 optimized for V.70 digital simultaneous voice and data applications,” IEEE Commun. Mag., vol. 35, pp. 64–73, Sep.

# Applications of SHEAR THINNING FLUID (STF) as NANOTECHNOLOGY on the KEVLAR Materials FOR BALLISTIC Protections

Ms. Sapna K. Kungarani<sup>1</sup>, Dr. Dharmendra C. Kothari<sup>2</sup>

Prof. Prashant V. Thorat<sup>3</sup>

Department of Chemical Engineering & Technology, Shri SHIVAJI Education Society Amravati's,  
College of Engineering & Technology, Affiliated to S.G.B.A University, Amravati, Babhulgaon (India)

## ABSTRACT

The aim of the present study is to perform a ballistic characterization of composites by means of the fundamental machine parameters have high non-linearity theoretical behavior hereafter experimental preliminary results of a prototypal device are presented and results were discussed. An intriguing issue of nano-science research for aerospace applications is to produce a new thin, flexible, lightweight and inexpensive material that have an equivalent or even better ballistic properties than the existing Kevlar fabrics. The primary objective of body armor research is to develop a low cost, lightweight, wearable garment system with improved impact resistance. Currently used body armors, particularly those for military use, are considered too heavy, limiting the agility and mobility of the wearer and eventually leading to increased casualties. Body armor standards require that an impactor should be stopped under impact, and the penetration depth into a backing material to the armor should not exceed 1.73 inches. If penetration depth exceeds this value, a wearer can acquire serious blunt trauma. Therefore, the demand for substantial improvement in the performance-to-weight ratio of body armor as well as the performance-to-thickness ratio is very high. The research results demonstrated that ballistic penetration resistance of Kevlar fabric is enhanced by impregnation of the fabric with a colloidal SHEAR THICKENING FLUID (STF). Impregnated STF/fabric composites are shown to provide superior ballistic protection as compared with simple stacks of neat fabric and STF.

**Keywords:- Kevlar, Ballistic Impact, Nano-Particles, Shear Thickening Fluid (STF), etc..**

## I. INTRODUCTION

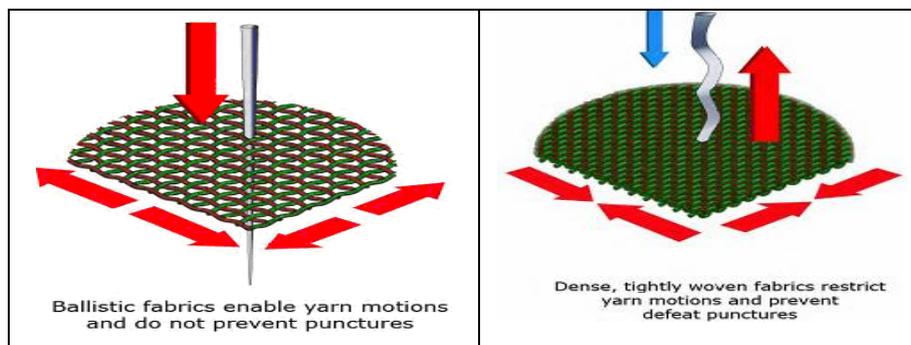
Textiles designed for stab resistance require dense weaves to prevent yarns from being pushed aside from the tip of sharp-pointed objects such as knives, needles, awls, and ice picks.<sup>[1]</sup>



Figure (1):- The body Armoured & Protective Clothing as application of KEVLAR.

Dense weaves that prevent punctures can lead to premature or punch-through failures in ballistic impacts. “Liquid Armor” (shear thickening fluid) its nano-particle based coating material allows fabric to remain flexible, but upon impact becomes hard. Used for body armor vests, helmets, and gloves as shown in Figure (1). However, techniques like supercritical fluid technology and particle repulsion in non-wetting templates (PRINT) have been also used in modern days. The principal factor that dictates the design of body armours is the type(s) of threat(s) for which protection is required (that is, ballistic, fragment, blast, stab, slash, chemical, fire, etc.). Armours optimized for protection against one threat type may not, however, be suitable for other threat types. Multithreat armours are commonly designed by integrating separate armouring solutions a process that achieves only minimal synergistic efficiencies at best. Armours that combine multiple defeat elements are often categorized as “in-conjunction” armours in which each component provides an enhanced level of protection for a given threat or multiple threat types.<sup>[2]</sup>

Design parameters for optimizing both ballistic defence and stab defence often work against each other. Traditionally, soft body armours for ballistic protection were manufactured using layers of woven fabrics stitched together; now they include laminates stacked with nonwoven, unidirectional (UD) layers and combinations of woven/nonwoven laminates. Considering the UD laminates, fibers within each UD layer are aligned in a parallel arrangement and are reinforced with a compliant polymer resin or matrix such as Kraton that binds the fibers together. The UD layers are produced in very thin sheet forms and are stacked, for example, in an alternating 0°/90° cross-ply fashion as shown in Figure (2). Polyethylene films are added to protect the layers, and the final laminated shape is attained by applying heat and pressure. Commercial UD laminates used for ballistic protection include Honeywell’s Spectra Shield (ultrahigh molecular weight polyethylene (UHMWPE) fibers) and Gold Shield (Kevlar fibers) 1 and DSM’s Dyneema (UHMWPE fibers).<sup>[3 & 4]</sup>



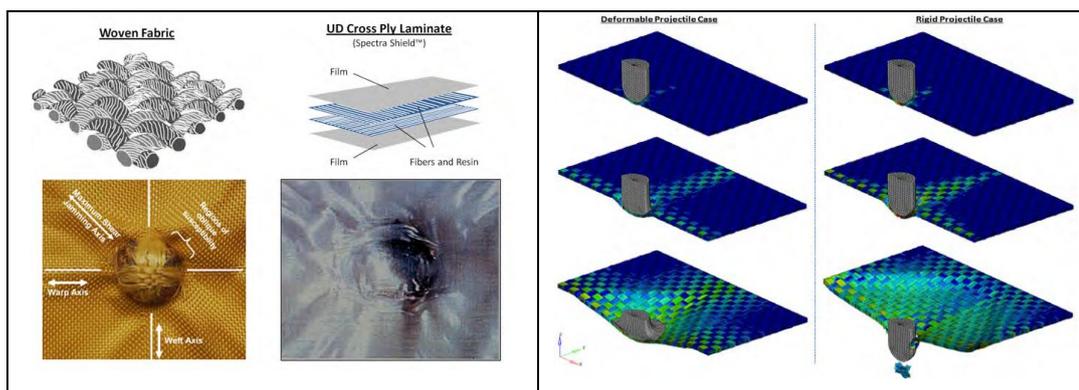
**Figure (2):- Puncture Behavior of Ballistic Versus Stab - Resistant Woven Fabrics.**

Many dynamic effects observed in ballistic impacts on soft, woven body armours parallel that which occurs when a baseball is caught in the webbing of a catcher’s mitt. Both projectiles initially contact a minimal number of yarns; these are known as the primary yarns. The primary yarns begin to compress in the “through-thickness” direction, and stress waves initiate and propagate along both yarn directions, dissipating energy away from the impact site. Body armours must be worn to be effective. Weight, mobility, and comfort therefore are vital to ensuring their use; the armours must conform to the user’s body, properly distribute their weight over the body to minimize user fatigue, provide sufficient breathability for extended use especially during high temperatures, and must not interfere with or restrict the user’s mobility. The significant challenge is to balance the level of

protection required for specific threat type(s) against weight, comfort and flexibility, cost, environmental exposure (heat, ultraviolet light, moisture, etc.), and service life.<sup>[5 & 6]</sup>

## II. LITERATURE REVIEW

The main trends and materials in protection technologies are briefly reviewed, emphasizing the properties and limitations of p-aramid fibres, widely used in amour systems, particularly in terms of their susceptibility to UV radiation, humidity and chemical attacks. Then, a novel nanotechnology capable of effectively diminishing these effects is described, as well as its application for an actual commercial ballistic vest. Protection represents an important industry, both economically and socially speaking, that includes, in the broad sense, industrial, laboratory, home and, of course, military protection, with an enormous variety of products, from simple plastic gloves to sophisticated and confidential military amour.<sup>[7]</sup> Defense personnel face multiple threats from different quarters, like terrorist groups and rogue nations, who own not only advanced lethal weapons but also chemical and biological warfare weapons. The present day protective clothing systems used by the defence sector is vulnerable to modern weapons and also have some inherent weaknesses like high cost, bulkiness and discomfort in wearing. Nanotechnology based materials offer a promising future in this area due to their extraordinary physical, chemical, mechanical, and electrical properties at nano-level.<sup>[8 & 9]</sup>



**Figure (3):- Numerical (Finite Element Analysis) Models of a 4-Ply, Plain-Woven Fabric System Subject to Ballistic Impact Showing Yarn Stress Wave Color. Contours, Projectile Blunting (Deformable Projectile Case) and Fabric Penetration Failure (Rigid Projectile Case).[10]**

Multi-axial aramid fabrics have a wide range of applications in the construction of composite structures for body armour. Nano-particles, which include nano-silica, are one of the most common nano-fillers for these structures. The particles of nano-silica possess nano-meter dimensions with high specific surface area.<sup>[11]</sup> Silane coupling agents are mostly used for modifying nano-silica surface in order to prevent silica agglomeration. Incorporation of nano-silica treated with silane adhesion promoter, in the matrix part of the hybrid composite form, leads to increased resistance to the bullet shock impact. The bullet-shooting test was applied to all the composites by two different bullet types. The structural design of the samples improved the ballistic resistance after the bullets were shot. Some ballistic image analyses for print and penetration depth of the samples were performed using Image Pro-Plus software as shown in Figure (3) right, result compared with real test on left.<sup>[12]</sup>

Use of nanotechnology allows textiles to become multifunctional. New principles will be combined into durable, multifunctional textile systems without compromising the inherent textile properties. Because it offers better built, longer lasting, cleaner safer and smarter products. Nano-science is study and Nano-technology is exploitation of the strange properties smaller than 100nm. Being so small they can be added to other materials and thus lending their properties to overall performance of composite objects.<sup>[13 & 14]</sup>

### III. MATERIALS & METHODS

The Kevlar fabric is to be taken for various tests so as to check its strength and various properties, tests are to be conducted under the application of various loads and their effects are to be noted down. Kevlar behavior under various loads and environmental conditions are to be specified. Kevlar fabric being the toughest has several effects when exposed to UV and under the application of water. The fabric is taken in the neat form firstly for the testing and then the nano-particles impregnated fabric is taken for testing. Testing of neat fabric taken in four layers, Shear Thickening Fluid (STF) preparation, Coating of STF on the neat fabric by Soaking, Sandwich pattern, Drying of the fabric, Testing of the coated fabric.



**Figure (4):- Details of Kevlar Fabric Material.**

Although Kevlar is stronger than steel, it's about 5.5 times less dense (the density of Kevlar is about 1.44 grams per cubic centimeter, compared to steel, which is round about 7.8-8 grams per cubic centimeter). That means a certain volume of Kevlar will weigh 5-6 times less than the same volume of steel. Think back to medieval knights with their cumbersome suits of armor: in theory, modern Kevlar gives just as much protection but it's light and flexible enough to wear for much longer periods. Kevlar is a polymer; this means that it is made up of a large number of the same basic unit, called a monomer, which are attached to each other to form a long chain. The monomer in this case is made up of an amide group and a phenyl group.

**Methodology:** - First, all the fabrics are prepared along with the solution. Minimum 4 fabrics are cut into size 19 X 31cm. The STF is diluted with the diluents so as that fabric will be able to completely dipped in the solution. The STF was composed of silica particles in polyethylene glycol medium. The silica sol used in this study was composed of SiO<sub>2</sub> and methanol, and the nominal average diameter of the silica particles was 15 nm. Ethylene glycol is known to be an index matching solvent of silica particles. The procedure of fabric impregnation / nano-particles coating consists in the simply methods which is either by dipping within a bowl filled with the suitable solution amount, or by sandwiching the STF between the layers then the layers are squeezed and put inside the oven for the solvent evaporation. Finally, the treated layers are enveloped with polyethylene sheets in order to minimize the loss of material not perfectly stuck on the surfaces and to avoid unwanted interaction at the interfaces between neat / treated surfaces (lubrication or degradation of fluid incompatible fabrics).

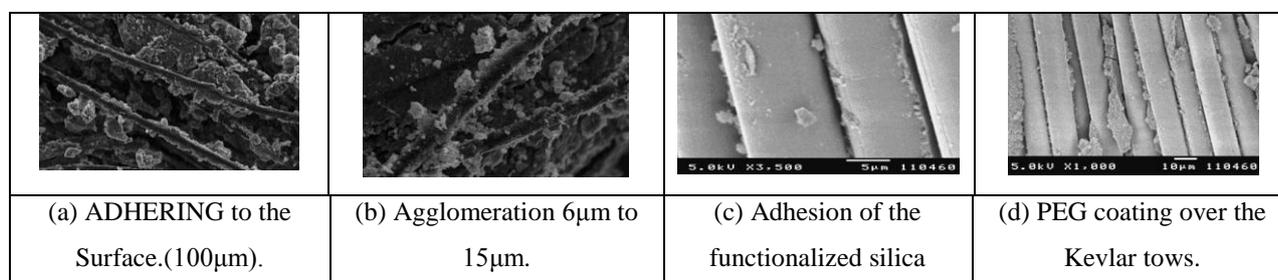


**Figure (5):- The impregnation of nano particles solution can be done in two ways; By soaking, & by sandwiching the solution into layers.**

#### IV. ANALYSIS

The strength of Kevlar comes from its unusually regular internal structure; this has implications for the Hydrogen bonding which occurs between the electron dense oxygen atom and the electron deficient hydrogen. [15 & 16] The all trans-configuration, giving long straight chains, means that the hydrogen bonding can occur very regularly to form a very strong lattice, similar to those formed in crystals. The fibres consequently have very few flaws and so are very difficult to break up. The development of strong materials still continues, both for new fibres and for ways to use them. And undoubtedly the range of uses will continue to expand as new pursuits and the need for lightweight materials increases. [17]

The modified silica particles mixed with the PEG result in agglomerations ranging from approximately 6 to 15 micrometers. Figure (6) demonstrates significant improvement corresponding to the adhesion of STF to the fabric layers. There is still consistent coating on the surface of the tows and between adjacent tows. This adhesion to the tows is credited to the silane coupling agent that was used to modify the silica particles and as a result, this adhesion feature visible even after a fibre has been impacted from spike during the test. It is projected that, the loss of impact resistance at higher impact energy in target 3 was due to the larger agglomerations, where size of majority of particles was beyond the nanoscale range in the mixture that coat the Kevlar fabric, seen in Figure (6) more details are available Kungarani, S. [10]



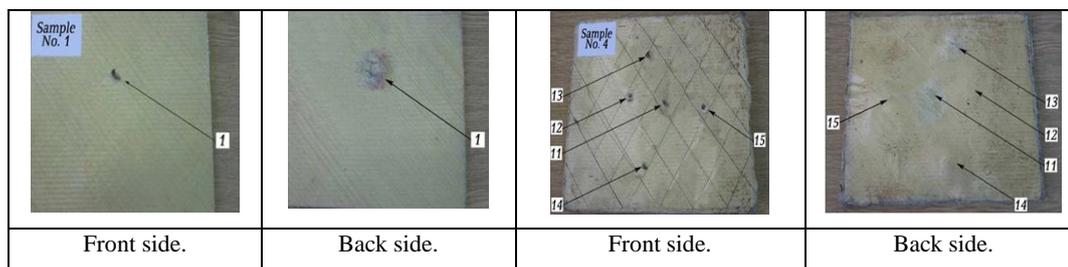
**Figure (6):- The silica-PEG mixture (a) adhering to the surface of the Kevlar tows, (b) agglomeration on the Kevlar fibre with a size range of approximately 6µm to 15µm,(c) The silica-PEG mixture adhesion to the surface of the Kevlar tows, (d) Functionalized silica particle adhesion to the tows of the Kevlar fabric. For the MSEC 15.0kV \*.0mm \* 300 SE.**

**V. RESULT & DISCUSSIONS**

Comparison of the changes occurred in coated fabric and the neat fabric. Thus different samples are made as per the methodology. Samples include Sample A, Sample B, Sample C. Sample A is taken as the neat Kevlar fabric in four layers, cut in the dimensions of 19cm x 30 cm without impregnating with any STF. Actual fabrication procedures include the mixing of silica particles, polyethylene glycol and ethanol. This ratio eventually results in a mixture of silica and polyethylene glycol after drying out ethanol. The addition of ethanol aids in the dispersion and breakup the silica agglomerations and to aid the infusion of STF mixture into the Kevlar fabric. After an hour of continuous stirring, the mixture was used to soak 4 layers of Kevlar fabric. The Tensile Strength (N) and Elongation (%) is Tabulated below in Table [1].

SAMPLE	Tensile Strength (N)	Elongation (%)
Single Layer Neat Kevlar (Sample A)	250	3.8
Nanoparticles impregnated fabric obtained by soaking (Sample B)	6305	4.5
Nanomaterials impregnated fabric obtained by sandwiched (Sample C)	7007	6.6

**Table [1]:- Results for Tensile Strength & Elongation of KEVLAR.**



**Figure (7):- Front side & Back Side of shot for sample No.1 & No.4.**

Bullet shooting showed that the composites of *p*-aramid poly (vinyl butyral) could not always act as a full protection against bullets. This is obvious from the complete penetration of bullet No.1 in sample No.1. Figure (7) show the entrance and the exit of the bullet in the target.

**VI. CONCLUSIONS**

The impregnation of Shear Thickening is a non-newtonian Fluid (STF) to a fabric increases the frictional force of a single yarn in the fabric which consequently increases the apparent modulus of the yarn. The laminating sequence was found to be a very important factor in improving the protective performance of STF impregnated fabric hybrid multilayer panels. Ropes and cables, Auto hoses and belts, Composite materials, Mooring lines, Tires, Fiber optic cables, Climbing ropes, Escape ropes for firefighters, Umbilical hoses on offshore, Oil and gas refineries, Sporting goods, such as, Tennis rackets, lacrosse, Sticks and canoes. Flame-resistant clothing, Protective clothing and helmets. Body armor, although it is being replaced by stronger polyethylene products such as Dyneema. As a composite material it is often combined with carbon fiber.

Nanostructures and nano-composites are being developed for the following defense applications. Lightweight protective clothing, flexible antiballistic textiles, chemical and biological warfare protection and self-decontaminating nano-fibre fabrics. Adaptive suits like switchable fabrics for improved thermal control, switchable camouflage. Micro-sensors for body and brain sensing, Environmental and situational awareness, integrated into a smart suit or a smart helmet. Wearable and/or flexible displays for visual feedback auxiliary supports: Flexible/rigid textiles for additional strength, exoskeletons, and robotics to assist the human tasks.

## REFERENCES

- [1.] Aleksić, R. R., (2012), “The viscoelastic properties of modified thermoplastic impregnated multi-axial aramid fabrics”, *Polymer Composites*, 33, pp. 158-180.
- [2.] Daoshun Xue, Hu, Hong., (2013), “Mechanical properties of biaxial weft-knitted flax composites”, *Materials Design*, pp. 264-269.
- [3.] Decker, M. J., Halbach C. J., Nam C. H., Wagner, N. J., Wetzel E. D., (2007), “Stab resistance of shear thickening fluid (STF)-treated fabrics”, *Composites Science and Technology*, 67, pp. 565-578.
- [4.] Grujicic, M., Bell, W.C., Arakere, G., He, T., Xie, X., Cheeseman, B. A., (2010), “Development of a Meso-Scale Material Model for Ballistic Fabric and Its Use in Flexible-Armor Protection Systems”, *Journal of Materials Engineering and Performance*, 19, pp. 22-39.
- [5.] Hassan, T.A.; Rangari, V.K. & Jeelani, S., (2010), “Sonochemical synthesis and rheological properties of shear thickening silica dispersions”, *Ultrasonics Sonochemistry*, pp. 947-952.
- [6.] Jacobs, M. J. N., Van Dingenen, J. L. J. (2001), “Ballistic protection mechanisms in personal armor”, *Journal of Materials Science*, 36, pp. 3137–3142.
- [7.] Jong Lyoul Park, Byung Il Yoon, Jong Gyu Paik, Tae Jin Kang, (2017), “Ballistic performance of p-aramid fabrics impregnated with shear thickening fluid”, *Textile Research Journal*.
- [8.] Johnson, W., Collins, C., & Kindred, F., (1968), “A Mathematical Model for Predicting Residual Velocities of Fragments after Perforating Helmets and Body Armor,” Technical Note 1705, Army Ballistic Research Laboratories.
- [9.] Karahan, M., Kus, A., Eren R., (2008), “An investigation into ballistic performance and energy absorption capabilities of woven aramid fabrics”, *International Journal of Impact Engineering*, 35, pp. 499-510.
- [10.] Kungrani, S.K., (2017), “Experimental Studies of Applications of Nanotechnology on Kevlar Fabric”, a M. Tech Thesis for Sant Gadge Baba Amravati University, Amravati, COE&T, Akola,444104, pp. 1–103.
- [11.] Lee, Y. S., Wetzel, E. D., Wagner, N. J., (2003), “The ballistic impact characteristics of Kevlar® woven fabrics impregnated with a colloidal shear thickening fluid”, *Journal of Materials Science*, 38, pp. 2825-2833.
- [12.] Mahfuz, H., Clements, F., Rangari, V., Dhanak, V., Beamson, G., (2009), “Enhanced stab resistance of armor composites with functionalized silica nanoparticles”, *Journal of Applied Physics*, 105, 064307.
- [13.] Pinto, R., Carr, D., Helliker, M., Girvan, L., Gridley, N., (2012), “Degradation of military body armor due to wear: Laboratory testing”, *Textile Research Journal*, 82, pp. 1157-1163.
- [14.] Prat, N., Miras, A., Rongieras, F., Voiglio, E., Sarron, J.-C., (2012), “Contemporary body armor: technical data, injuries, and limits”, *European Jr.l of Trauma & Emergency Surgery*, 38, 95–105.

## **4<sup>th</sup> International Conference on Innovative Trends in Science, Engineering and Management**

(C-DAC, Mumbai) Centre for Development of Advanced Computing, Mumbai, Maharashtra (India)

(ICITSEM-17)

**17<sup>th</sup> June 2017, [www.conferenceworld.in](http://www.conferenceworld.in)**

ISBN: 978-93-86171-47-4

- [15.] Szczepanski, J.M., (2011), “Modification and integration of shear thickening fluids into high performance fabrics”, Paper 761, MS Thesis.
- [16.] Thandavamoorthy, S. Gobinath, N. & Ramkumar S.S; (2006), “Self-assembled honeycomb polyurethane nanofibres”; J. Appl. Polym. Sci., 101(5), pp. 3121-124.
- [17.] Víctor M. Castaño, Rogelio Rodríguez et al., (2013); “Nanotechnology for Ballistic Materials from Concepts to Products”, Review article, Materials and Technology.

## Applications of Mimosine Derivatives from *Leucaena* or SUBABUL plants as the Natural Bio-Herbicides

Mr. Ghanshyam V. Pund<sup>1</sup>, Dr. Dharmendra C. Kothari<sup>2</sup>

Prof. Prashant V. Thorat<sup>3</sup>

*Department of Chemical Engineering & Technology, Shri SHIVAJI Education Society Amravati's,  
College of Engineering & Technology, Affiliated to S.G.B.A University, Amravati, Babhulgaon, (India)*

### ABSTRACT

*Mimosine, a non-protein amino acid, is found in several tropical and subtropical plants, which has high value for medicine and agricultural chemicals. Here, research works aimed to development of natural product-based pesticidal agents, as we present the first significant findings for insecticidal and herbicidal activities of novel mimosine derivatives. Mimosine [ $\alpha$ -amino- $\beta$ -(3-hydroxy-4-oxo-1, 4-dihydropyridin-1-yl)-propanoic acid] is a major constituent of *Leucaena* (*Leucaena leucocephala* de Wit) and which is responsible for the strong allelopathic potential of the legume tree. Mimosine showed strong herbicidal activities on various plants in a bioassay. All plant parts of *Leucaena* contain mimosine. The quantity of mimosine in the young leaves and mature seeds was the greatest, 2.66 and 2.38% of dry weight, respectively, while the quantity in root xylems and xylems was the lowest: 0.18 and 0.11% of dry weight, respectively.*

*In this study, mimosine quantification of *Leucaena leucocephala* was carried out by using extraction and distillation methods which are soxhlet extraction with either distilled water or ethyl acetate as extraction solvent and digestion method were used to compare its efficiency in extracting the mimosine from *Leucaena leucocephala* leaves. In soil to which mimosine was added, about 60% of the mimosine was adsorbed in 1–5 days, and only a minor volume of mimosine was decomposed: 5.30 and 0.16% after 1 and 5 days, respectively. Mimosine has been evaluated as a major allelochemical in *Leucaena*, which is responsible for the strong allelopathic activity, and showed a suppressive impact on some tested plants and noxious fungi.*

**Keywords:- Mimosine, *Leucaena*, Toxicity, Herbicides / Bio-pesticide & Distillation / Extraction.**

### I. INTRODUCTION

*Leucaena-leucocephala* de Wit called “Subabul” in India is a popular farm forestry tree in the coastal areas of Andhra Pradesh and Maharashtra. It is one of the fast growing hardy evergreen species in India it is shown in Figure (1). It is a vigorous coppiced and responds well to pollarding, lopping & pruning. It has deep and strong taproot and even the seedlings are deep rooted. There are four types of *Leucaena-leucocephala*.

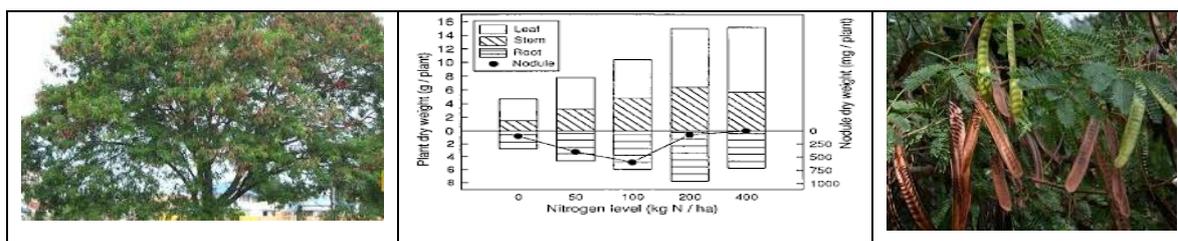


Figure (1):- *Leucaena-leucocephala de wit* (subabul).

**Hawaiian Type:** The plants are short bushy and remarkably drought tolerant. It is suited to hilly terrains in drought prone areas. It is a prolific seed producer and is good for fodder purpose.

**Salvador Type:** Tall, tree like and fast growing having maximum annual biomass production. Possesses large leaves, pods and seeds than Hawaiian types. Responds to high fertilization.

**Peru Type:** Tall and extensively branching type and is ideal for fodder purpose.

**Cunningham Type:** It is a cross between Salvador and Peru types.

*Leucaena-leucocephala* is best suited for warm regions and grows well between 22 and 30°C in regions of 500 to 2000 mm annual rainfall. Because of its strong and deep root system, the tree is highly drought resistant. It is restricted to elevations below 500 m but withstands variations in rainfall, sunlight, windstorm, slight frost and drought. *Leucaena-leucocephala* wood can be used for light construction, poles, props, pulp, furniture, flooring and fuel wood. *Leucaena-leucocephala* wood is an excellent fuel wood with a specific gravity of 0.45 - 0.55 and a high heating value of 4000 kcal/kg. *Leucaena-leucocephala* forage has a high protein and carotene content and pellets or cubes are internationally marketed as animal feed. <sup>[1]</sup>

## II. LITERATURE REVIEW

Pesticides make up one essential segment of the agro-business complex which is so vital to the future development of countries such as India. To emphasize the vital place of pesticides, it has been estimated that about 20 percent of food production in India may be lost due to destruction caused by various pests including rodents and weeds. Some of the newer organo-phosphorus compounds act as systemic insecticides which means they can be fed to plants or animals and thus effectively destroy pests at the moment of contact between the pest and the plant or animal; they need not be spread about externally, but are distributed by the inner circulatory systems of the plant or animal. <sup>[2]</sup> The classified pesticides with target pests comparison is shown Table [1].

Sr. No	Type Of Pesticide	Target Pest	Synthetic Pesticide	Natural Pesticide
1	Fungicides	Fungi	Mancozeb	Neem oil
2	Herbicides	Plants (Weed)	Glyphosate	Vinegar
3	Insecticides	Insects	Endosulphan	Salorra
4	Nematicides	Nematodes	Carbofuran	Safin



5	Avicides	Birds	Strychnine	Strychnine	
6	Rodenticides	Rodents	Zinc Phosphide	Strychnine	
7	Acaricides	Spiders, mites	Fenazaquin	<b>Carvacrol</b>	
8	Algaecides	Algae	Dichlorophen	Barley Straw	
9	Bactericides	Bacteria	Validamycin		
10	Miticides	Mites	Abamectin	Avermectin	
11	Molluscides	Snails, slugs			
12	Piscicides	Fish	Rotenone	Barringtonia	

**Table [1] - Types of pesticides and target pests.**

Allelopathy is defined by Rice (1984) as the direct or indirect harmful or beneficial effects of the donor plant on the target one through the production of chemical compounds that escape into the environment. It includes both detrimental and beneficial interactions between plants through chemicals released by the donor.<sup>[3]</sup> However, in practice, the term allelopathy is generally used to refer to detrimental plant-plant interaction (Kohili et al., 1998).<sup>[4]</sup> The importance of allelopathy in agriculture is becoming increasingly recognized, in particular in the biological control of weeds and pests (Rice, 1984).<sup>[6]</sup> Allelopathy can be successfully utilized as a biological tool in weed and pest management by (1) the transfer of the production of allelopathic genes to crops, (2) enhancement of the production of natural toxins or their products as bio-pesticides through tissue or cell culture, and (3) the use of DNA recombinant technology. To date, very few achievements in (1) and (3) have been reported. Therefore the development of bio-pesticides for eco-friendly sustainable agricultural production is the most promising and feasible.<sup>[7]</sup>

Herbicides perform a vital role in the management of weeds. As the name indicates, herbicides are chemicals that kill or control vegetation. Although the ultimate effect of most herbicides is the same (usually death of weed), the way they control weeds is vastly different as listed in Table [1], with different commercial products. One or more of the vital processes must be disrupted in order for a herbicide to kill a weed. Herbicide enters plants through shoots, roots, other below ground organs and seed. The process of herbicide entry into treated plants is called absorption, which involves contact, penetration and movement of the chemical into the plant, whereas, adsorption is the attraction of ions or molecules to the surface of a solid. Many herbicides are applied to plant surfaces as foliar spray. Leaves are the primary means of herbicide entry through shoots, although herbicide absorption can also occur through other aerial organs such as substantial amounts of some herbicides are absorbed through stems or emerging coleoptiles.<sup>[8]</sup> Foliar herbicide absorption includes the following three steps which are represented in Figure (2); Retention of spray droplets on a leaf surface, Penetration of the herbicide into plant cells & Movement into the cytoplasm of the plant cell. Maximum retention occurs when leaves are positioned at 50° to 90° to the orientation to the incidence of the spray.<sup>[9]</sup>

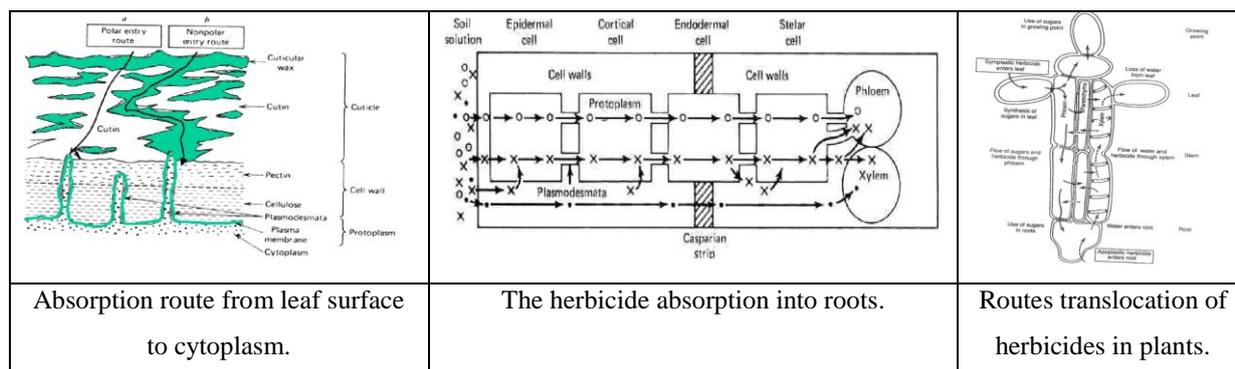


Figure (2) :- Foliar herbicide absorption in root systems of target species.

Herbicides that enter plants via the root hairs move upward in the xylem with the mass flow of water. Water and substances dissolved in water move in the xylem forward by transpirational pull and root pressure. The degree of translocation is often associated with the hydrophilic / lipophilic balance of the herbicide. In general, the movement in the xylem is faster than the phloem; therefore, when certain herbicides move readily between the symplast (phloem) and apoplast (xylem) their movement within the vascular system is in direct correlation with the transpirational stream.<sup>[10]</sup>

### III. METHODS & MATERIALS

Extraction of mimosine is conducted at lab scale by using the leaves of *Leucaena-leucocephala*. The material and methodology follows to extract the mimosine from the *Leucaena-leucocephala* de wit leaves is as follows.

**Raw Material Required:-** *Leucaena-leucocephala* de wit leaves, Distilled Water, Ethanol, Hydrochloric Acid, Ortho-phosphoric

**Equipment Required :-** Glass Kettle 3 litre Capacity, Pulveriser, Sieve 20 Mesh, 1000 ml size stoppered flask as shown in Figure (3), – Qty 01 Nos., 500 ml size stoppered flask – Qty 02 Nos. The constant temperature water bath, Buckler Filter, pH meter, Vacuum Pump and HPLC.<sup>[11 & 12]</sup>

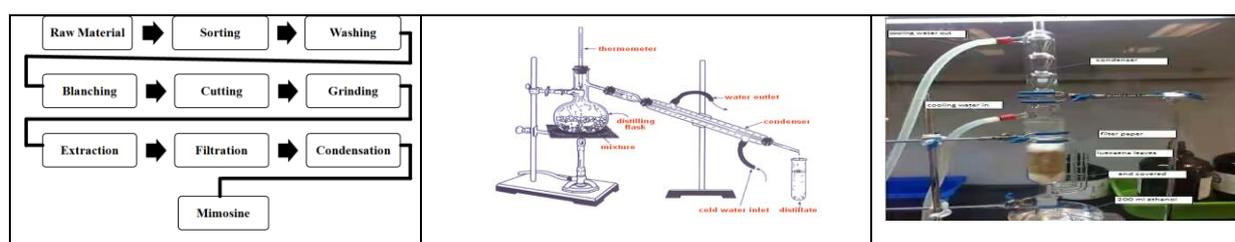
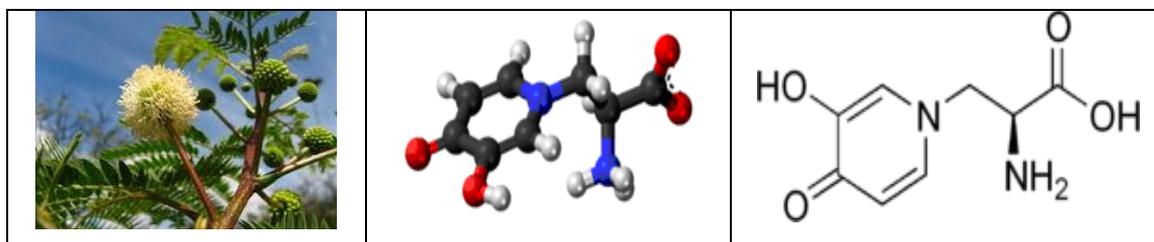


Figure (3):- Process FLOW Chart with the main diagram of Distillation & Extraction Unit.

**Methods of Extraction;** Extraction of mimosine by using distilled water and ethanol, Extraction of mimosine by using distilled water and ethanol. The extraction of mimosine from *leucaena* leaves is carried out as; Collected 1 kg of healthy leaves of *Leucaena leucocephala*, allow drying the leaves at 39 to 40 °C, grinding or pulverising dried leaves in powder form by using pulveriser and sieve it from 20 mesh sieve. Then take 500 ml distilled water in 1000 ml size stoppered flask, and then adds the 100 gram leaves powder in the distilled water. Place the flask in constant temperature water bath, and allow standing for extraction for 16-17 hrs at 59°C~60 °C. After complete extraction filter the mass through centrifuge and collect supernatant in another 1000 ml size flask. Then adjust the pH of supernatant with hydrochloric acid (2mol / L) at pH 5 with pH meter. Charge

ethanol in this solution and allow to maintain at 4°C for two days. Filter the mass through centrifuge (6000r / min), collect the supernatant. Concentrate the supernatant by using vacuum pump at 4°C so that final material remains at volume of 20 ml only and allow to stand this mixture for 3 days. Process Parameter, observation table for mimosine extract concentration temperature for batch-1 & 2, the Material Balance for Batch-1 & 2 are reported by Pund, G.V.<sup>[8]</sup>

We have examined various conditions for mimosine purification and observed that the type of ion exchange resin and adjustment of pH are crucial conditions to obtaining the maximum quantity and high purity of mimosine (5 g per 1 kg fresh *Leucaena* leaves, purity>95%). Mimosine is considered as an allelochemical and is responsible for the allelopathic activity of the *Leucaena* genus and other species belonging to *Mimosa* spp. *Leucaena* is popular in intercropping with annual crops, using as a hedgerow, and alley cropping for yield promotion and weed control.<sup>[14 & 15]</sup> The Chemical Structure of mimosine is shown in Figure (4).



**Figure (4):- Chemical Structure of mimosine.**

**Mimosine** or leucenol is an alkaloid,  $\beta$ -3-hydroxy-4 pyridone amino acid. It is a toxic non-protein free amino acid otherwise chemically similar to tyrosine, and was first isolated from *Mimosa pudica*. It occurs in a few other *Mimosa* spp. and all members of the closely related genus *Leucaena*.<sup>[16]</sup>

**Properties of Mimosine** :- Chemical formula -  $C_8H_{10}N_2O_4$ , Molecular weight / Molar mass :-  $198.18g \cdot mol^{-1}$ , Melting point :-  $291^\circ C$  ( $556^\circ F$ ;  $564 K$ ).<sup>[17]</sup> Content of Mimosine in Different Part of *Leucaena* Plant was found to be as; Xylems – 0.11%, Xylems roots – 0.18%, Mature leaves – 0.47%, Mature Stems - 0.54%, Hairy Roots – 0.66%, Cortex of roots – 0.66%, Mature seed pods – 0.67%, Bark – 0.68%, Immature seed pods – 0.88%, Immature seeds – 1%, Flowers 1.17%, Flower buds – 1.34%, Young stems – 1.5%, Mature seeds – 2.38%, Young leaves – 2.66%.<sup>[13]</sup>

## IV. ANALYSIS

Mimosine extracted at lab scale is further analyzed by using HPLC method. A useful HPLC system having 880-PU pump and column Fine peak Sil C18 of Nihonbunko company is used to determine mimosine and DHP contents by using a solvent system of 0.2% ortho-phosphoric acid at wavelength of 280 nm, the peaks of mimosine and DHP were detected at retention time of 2.5 min and 7.4 min, respectively. HPLC analysis report of mimosine extracted by using water and ethanol in batch no-1. Similarly HPLC analysis report of mimosine extracted by using ethanol in batch no-2, shown in Figure (5) below In analysis report the peak of mimosine and DHP are clearly seen at the retention time of 2.595 min and 7.308 min respectively.

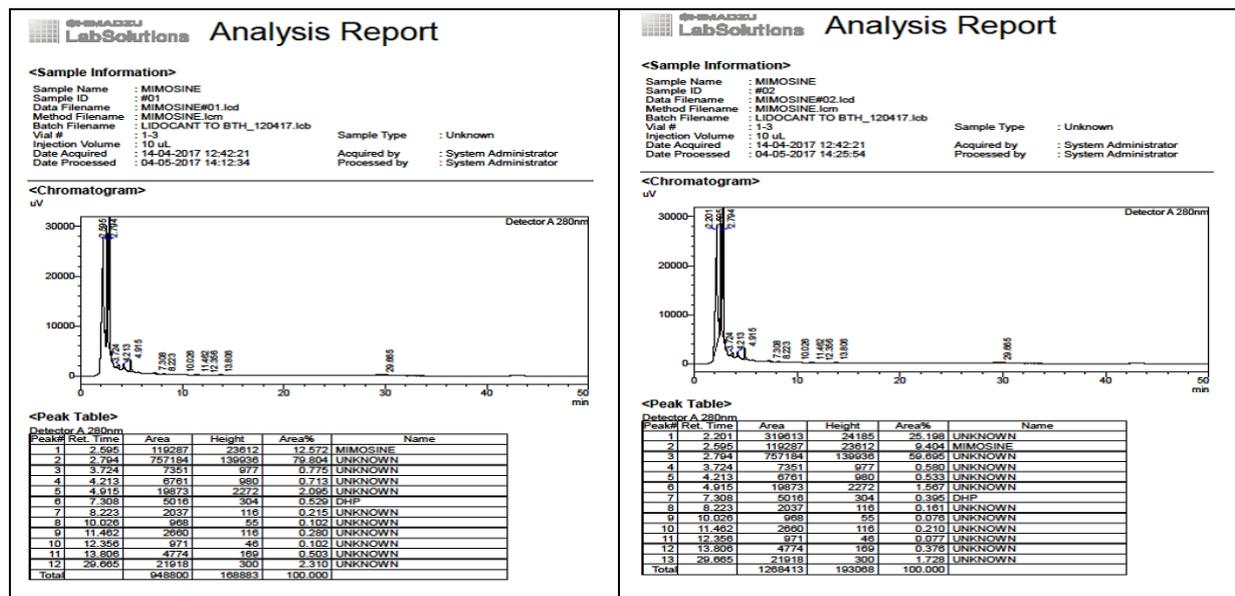
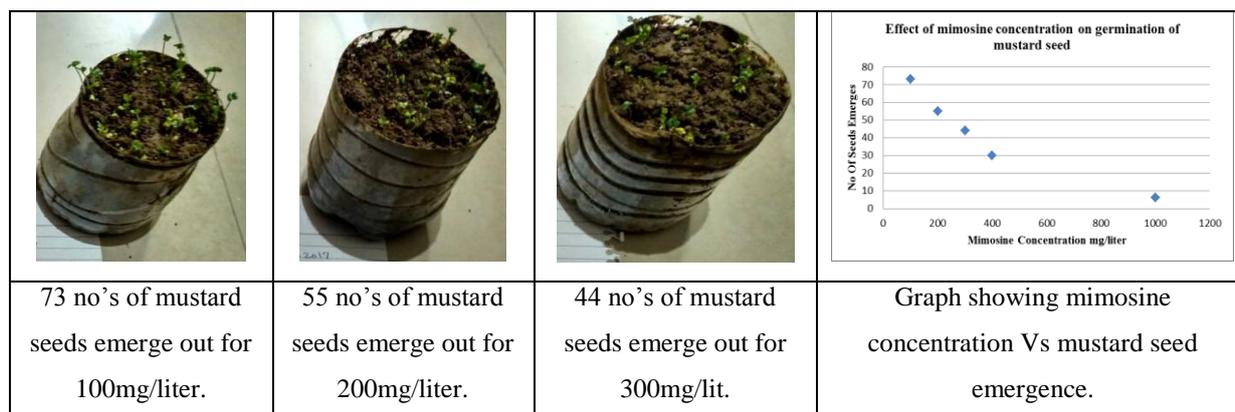


Figure (5):- HPLC analysis report for batch number 1 & 2.

In analysis report of batch no-2, the peak appears at residence time 2.201min is the peak for impurity which is not found in analysis report if batch no-1 Other impurities in both of the batches are common and unknown at retention time of 2.794 min, 3.724 min, 4.213 min, 4.213 min, 4.915 min, 8.223 min, 10.026 min, 11.462 min, 12.356 min, 13.806 min, 29.662 min. From the comparative study of both reports, it is observed that the first impurity at retention time of 2.201 min is completely washed out in batch no-1. Select 550 nm wavelength spectrometer analysis, the extracted mimosa prime purity of 99%. Each 100g Leucaena leaves can be extracted mimosa prime 2.1~2.4g, press Leucaena leaves (Mimosa) of mimosa pigment content of 3% ~ 6%, the extraction rate of the method is 40% ~ 70%. [11].

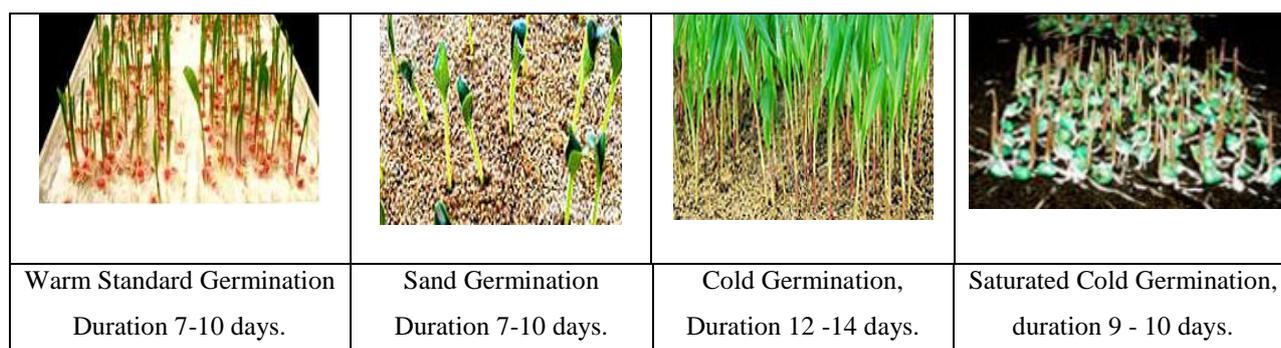
## V. RESULT & DISCUSSIONS

The mimosine extract extracted at lab scale by using leucaena leaves, are applied on the soil used for cultivation of mimosine. The study is carried out for the 7 days. At first day of cultivation approximately 100 no of mustard seeds are cultivated in five different containers. All five containers cultivated with mustard seed, are applied with mimosine (250 ml extract) with different concentration. Water is added for the cultivated mustard with gap of one day in each container. All container containing mustard seeds, i.e. container-1, container-2, container-3, are treated as a sample of testing i.e. sample-1, sample-2, sample-3 respectively. From the following Figure (6) is clear that, the concentration of mimosine extract is directly affect the emergence of mustard seed. The container-1 is applied by the 250 ml of mimosine extract with a concentration of 100 mg/liter, where 73 numbers of mustard seeds are emerge out against approximately 100 mustard seeds. Similarly at the concentration of 1000 mg/liter concentration only 6 seeds are emerge out within the 7 days of their life.



**Figure (6):- Mustard seeds emergence and concentrations of mimosine.**

Thus the mimosine is act as a pre-emergence herbicide for mustard seeds; hence it is called as Seedling Growth Inhibitors which inhibit the emergence power of seed by affecting the roots of the mustard seed. Hence mimosine can be used as selective herbicide over the wild mustard plant, which may act as a weed to the main plant. Mimosine showed strong herbicidal activities on various plants in a bioassay as shown in Figure (7).



**Figure (7):- Mimosine showed strong herbicidal activities on various plants in a bioassay.**

**Warm Standard germination** tests are used for labeling purposes and give a reasonable idea of field emergence under favorable conditions. **Sand germination tests** are done the same as Warm germination, This test is useful in suppressing some fungi. It also aids in uniform uptake of water, especially in low moisture soybean seed. For soybean samples, sand germination results are the same or slightly higher than warm germination results. **The Cold germination test** gives a reasonable idea of emergence under less than ideal conditions. **The Saturated Cold germination test** is another way of determining how well a seed lot will do under unfavorable conditions. Similar to other phytotoxins, effects of mimosine against plant germination and growth are proportional to applied doses. Mimosine also shows selective influence against certain bacteria and fungal growth. Some bacteria were inhibited, whereas growth of several bacteria was promoted by mimosine.

## VI. CONCLUSIONS

The findings in this study repeatedly demonstrated that mimosine is responsible for the allelopathic activity in Leucaena. This non-protein amino acid exhibited a strong reaction to various plants and weeds, suggesting that this compound may be utilized as a leading herbicidal compound for the development of bioactive herbicides. Mimosine is extracted by using different sources of legume tree, like mimosia pudica, leucaena-leucocephala.

Mimosine is found in different part of *Leucaena* leaves, but can be extracted through leaves easily. The analysis of Extracted mimosine is determined by using HPLC method. Mimosine is extracted in two batches at lab scale. i.e. Batch no-1 using water and methanol solvent has a relatively more pure than the batch no-2 in which only ethanol is used as a solvent. Extraction process followed in batch no-2, is quite easy than batch no-1, because supernatant obtained in batch no-2 is more clear than the batch no-1, because of separation of water is difficult through lab scale filtration process in batch no-1. One of the unknown impurity at retention time 2.201 min which is not appeared in batch no-1 may be water insoluble. Mimosine is act as herbicide for mustard seeds. Mimosine is act as seeding growth inhibitor or mustard seed. Concentration of spray of mimosine extract is directly affecting the seed germination. Approximately 1.5 to 2 grams of mimosine can be extracted from 100 grams of *Leucaena* leaves. Mimosine is a non-protein amino acid and it may be easily degraded after penetrating into soils by soil factors such as nutrients, minerals, pH and microbes. Therefore, Mimosine in *leucaena* as a potent bio-herbicide examining the fate of mimosine in different soils measured by standard kinetic parameters should be carried out in future research to estimate the potential use of mimosine as a bio-pesticide in agricultural practices.

## REFERENCES

- [1.] Brewbaker J.L., Hylin J.W. (1965) Variation in mimosine content among *Leucaena* species and related mimosaceae, *Crop Sci.* 5, 348–349.
- [2.] Chou CK, Kuo YL, (1986), “Allelopathic research of subtropical vegetation in Taiwan. III. Allelopathic exclusion of understory by *Leucaena leucocephala* (Lam.) de Wit”. *J Chem Ecol*, **12**:1431–1448.
- [3.] Chou CH, (2010), “Role of allelopathy in sustainable agriculture: Use of allelochemicals as naturally occurring bio-agrochemicals”, *Allelopath.* ,**25**: 3–16.
- [4.] Golala Rao M., Sittig Marshall, (2016),” DRYDEN’s Outlines of Chemical Technology – For the 21<sup>st</sup>. Century”, Affiliated East-West Press PVT LTD, New Delhi, 110001.
- [5.] Harith, E.A. El, Szyszka, M., K.D. Günther, K.D.,& Meulen, U. ter, (1987), “A Method for Large Scale Extraction of Mimosine<sup>1,2</sup>”, *Journal of Animal Physiology and Animal Nutrition*, 57 (1–5), pp. 105-110.
- [6.] Kanazawa J. (1989) Relationship between the soil sorption constants for pesticides and their physicochemical properties, *Environ. Toxicol. Chem.* 8, 477–484.
- [7.] Kohili R.K., Batish D., Singh H.P. (1998) Allelopathy and its implications in agroecosystems, *J. Crop Product.* 1, 169–202.
- [8.] Pund G.V., (2017), “Natural Pesticides Towards Toxic Free Future”, a M. Tech Thesis for Sant Gadge Baba Amravati University, Amravati, COE&T, Akola,444104, pp1–109.
- [9.] Rice E.L., (1984) (Ed.), “Allelopathy”, 2nd ed., Academic Press, Orlando, USA.
- [10.] Soedarjo M., Borthakur D. (1998) Mimosine, a toxin produced by the tree-legume *Leucaena* provides a nodulation competition advantage to mimosine-degrading *Rhizobium* strains, *Soil Biol. Biochem.* 30, 1605–1613.
- [11.] Silvano V., Arthur G.F., Rafael C.D., Alfredo G.F. (2001) Regulation of mimosine accumulation in *Leucaena leucocephala* seedlings, *Plant Sci.* 161, 597–604.

## 4<sup>th</sup> International Conference on Innovative Trends in Science, Engineering and Management

(C-DAC, Mumbai) Centre for Development of Advanced Computing, Mumbai, Maharashtra (India)

(ICITSEM-17)

17<sup>th</sup> June 2017, [www.conferenceworld.in](http://www.conferenceworld.in)

ISBN: 978-93-86171-47-4

- [12.] Tawata S. (1990) Effective reduction and extraction of mimosine from *Leucaena* and the potential for its use as a lead compound of herbicides, in: Casida J.E. (Ed.), *Pesticide and Alternatives*, Elsevier Science Publishers, Amsterdam, pp. 541–544.
- [13.] Soundararajan, R.P., (2012), “Pesticides – Advances in chemical and botanical pesticides”, *Plants as Potential Sources of Pesticidal Agents: A Review* Simon Koma Okwute, Pub. In Tech.
- [14.] Wankat P.C., (1994), “RATE-CONTROLLED SEPARATIONS”, Springer (India) Private Limited, Springer Science Business, Media, New Delhi 110001.
- [15.] Wee, K.L., & S. Wang, S., (1987), “Effect of post-harvest treatment on the degradation of mimosine in *Leucaena leucocephala* leaves”, *Journal of the Science of Food and Agriculture*, 39 (3), pp. 195-201.
- [16.] Wills, R.B.H., & B. Tangendjaja, B., (1981), “Effect of pH and Temperature on the Degradation of Mimosine and 3-Hydroxy-4(1H)-Pyridone”, *Phytochemistry*, 20.
- [17.] Xuan, T.D., A.A. Elzaawely, A.A., Deba, F. Fukuta, M., Tawata, S., (2006), “Mimosine in *Leucaena* as a potent bio-herbicide”, *Agron. Sustain. Dev.*, 26 (2), pp. 89-97.

## **PARAMETRIC STUDIES AND EFFECT ON**

## **PNEUMATIC JET MACHINING**

**Dr. Raju N.Panchal<sup>1</sup>, Anant D.Awasare<sup>2</sup>, Vahid M.Jamadar<sup>3</sup>**

*<sup>1</sup>Professor, Mechanical Engg. Dept, AGTI's DACOE Karad,( India)*

*<sup>2</sup>Assistant Professor, Mechanical Engg. Dept, AGTI's DACOE Karad, (India)*

### **ABSTRACT**

*In recent years some non-traditional of manufacturing have been invented .In order to supplement affectivity the machining problems of hard to machine and brittle materials. Once of these non- traditional techniques is Pneumatic Jet machining. The pneumatic jet machining can be suitable employed for machining super alloys and refractory type material. The process is also very much suitable for cutting, grooving, cleaning, finishing and deburring operations of hard and brittle materials like germanium, glass, ceramics and mica.*

**Keywords—Non-traditional, Brittle material, Super alloys**

### **I. INTRODUCTION**

As the world is advancing forth technically in the field of space research, missile and nuclear industry, very complicated and precise components having some special requirements are demanded by these industries. This challenge is taken by new development taking place in the manufacturing field. The most basic requirements of future manufacturing technology are:

1. Sustained productivity in the face of rising strength barrier.
2. Higher accuracy consistent with increasing demand for higher tolerance.

The Abrasive Jet Machining (AJM) is considered as an attractive and effective machining method for hard and brittle materials. Abrasive jet machining is similar to sand blasting process but in abrasive jet machining finer abrasive powders and smaller nozzles are used. Focusing on the abrasive jet stream from the nozzle onto the work piece, smaller holes or slots can be machined on hard and brittle materials. Machining mechanism and characteristics of abrasive jet machining are major topics of many research works in the recent years .The parameters associated with abrasive jet machining are summarized .

The nozzle pressure effect has been reported in many proved that after threshold pressure, the Material Removal Rate (MRR) and the penetration rates have increased with increasing the nozzle flow pressure. Similarly, the effect of impingement angle has been reported and concluded that the maximum MRR for brittle material is obtained when normal impingement was applied. The stand-off-distance which is the distance between the work piece and the nozzle has also great effect on the material removal rate as well as the generated surface quality

Part list-

Sr. No.	Part Name	Quantity
1.	Hose Pipe 3m long & 12mm	01
2.	Connectors ½ inch.	03
3	Coupler ½ inch.	05
4.	Cock ½ inch.	01
5.	Pneumatic Powder 120 grit	0.250 kg.
6.	Tungsten Nozzle	01
7.	Reducer & Nut	01
8.	Teflon Tape	01
9.	Clamps 15 mm.	02
10.	Base plate	1
11	M.S. Pipe chamber	01
12	M.S. Pipe flange	01
13	'T' couplor ½ inch.	2
14	Brass nipple	2
15	Glass	1
16	Dead nut	1
17	Air filter	1

## II.CONSTUCTION

The process criteria are greatly influenced by various process parameters as enumerated below:

- A) Pneumatics: composition, Shapes, Size and flow rate of pneumatic.
- B) Carrier Gas: Pressure, Viscosity, Molecular, Weight, flow rate of carrier gas etc.
- C) Nozzle: Geometrical features, material for construction, orientation with horizontal and stand-off distance.

Pneumatic jet machining is the process in which a material is removed from the work piece due to the impingement of fine grained pneumatic by high velocity gas stream. The stream of pneumatic mixed gas is directed to the work piece by suitably designed nozzles. The process differs from conventional sand blasting. In that pneumatic particles used are finer and the process parameters and cutting actions is carefully controlled. Pneumatic jet machining is applied to cut hard and brittle material such as mica, germanium, glass, ceramics etc. The process is free from vibrations and chatter problems. As no current passes from the tool and the work piece. There is no restriction to material to be machined. Thus it cuts conductive as well as non-conductive materials. The process however is no conductive to machine soft due to pneumatic particles getting embedded in the work material.

## III. PRINCIPLE OF OPERATION OF PJM

The operating principle of the process is very simple. High pressure air from the compressor passes through filters and control valves into a mixing chamber. The pneumatic particles and carrier gas are thoroughly mixed in the mixing chamber and a stream of pneumatic mixed gas passes through a nozzle on the work piece. It

causes indentation on the work piece. The indentation ultimately results in rupture of particles from the work surface.

The nozzle geometry and its inclination, size of grit, the pneumatic used for cutting and the carrier gas pressure and the velocity are used as a criteria for evaluating PJM process.

A high velocity jet containing pneumatic particles is directed on to the work surface through the nozzle. Due to this the nozzle has to sustain maximum wear due to abrasion. Secondly, the accuracy of working and the metal removal rate depends upon the nozzle wear. The material used for nozzle should be therefore have high wear resistance. In practice the nozzle are made of tungsten carbide or sapphire having regular round or square hole. Nozzle made from tungsten carbide last for 12 to 30 hrs. When used with 27 micron pneumatic in the present study the tungsten carbide nozzle 1mm and 2 mm diameters are used.

Material and application of various unconventional methods are summarized in Table 1.

Process	Aluminum	Steel	Super- Alloy	Ceramics	Plastics	Glass
USM	P	F	P	G	F	G
PJM	F	F	G	G	F	G
ECM	F	G	G	N	N	N
CHM	G	G	F	P	P	F
EDM	F	G	G	N	N	N
EBM	F	F	F	G	F	F
LBM	F	F	F	G	F	F
PAM	G	G	G	N	P	N

**TABLE 1**

G= Good

F = Fair

P= Poor,

N= Not Applicable

PJM Shows fairly constant performance for all material process capabilities of different unconventional machines are discussed in Table 2.

Process	M.R.R. MM3/ Min	Tolerance ( Micron)	Surface finish Micron CLA	Depth of surface damage (micron )	Power (Watt)
USM	300	7.5	0.2-0.5	25	2400
PJM	0.8	50	0.5-1.2	5	250
ECM	15000	50	0.5-2.5	5	100000
CHM	15	50	0.5-2.5	5	--
EDM	800	15	0.2-1.2	125	2700
EBM	1.6	25	0.2-2.5	250	150(Average) 200 (Peak)
LBM	0.1	25	0.5-1.2	125	2(Average ) 200(peak)
PAM	75000	125	Rough	500	50000
Conven-tional Machining	50000	50	0.5-5	25	3000

**TABLE 1**

## IV. PJM AS UNCONVENTIONAL MACHINE

The word unconventional is used in the sense that the metals are such that they cannot be machined by conventional methods, and require some special techniques.

PJM is included in these methods carried by high pressure as at high velocity, which is made to impinge on the work interface.

This eliminates tool to metal contact, which are the main criteria of unconventional machining method used in PJM. Following are the parameters, which affect the material removal are of the work piece.

1. Stand- off distance.
2. Pneumatic particle size and type.
3. Pneumatic jet velocity.
4. Carrier gas pressure.
5. Mass flows rate of pneumatic.
6. Nozzle diameter.

## V.MERITS OF PJM

- 1) It is the ability to cut intricate holes in material of any hardness and brittleness.
- 2) It is possible to machine fragile, brittle and heat sensitive materials without damage.
- 3) Mechanical contact between the tool and work piece is avoided. This absence of tool work contact and metal removal at microscopic scale leads to very little or no heat generation, resulting, insignificant surface damage.
- 4) This sections if hard and brittle material like germanium, silicon, glass and ceramics can be machined without mechanical, thermal distortion.
- 5) The process can be utilized conventionally in drilling, cutting, deburring, etching, polishing and cleaning operations.
- 6) High surface finish can be achieved.
- 7) Depth of surface damage is low.
- 8) The process is characterized by low capital investment and low power consumption.
- 9) The initial cost of PJM is low.

## VI. DEMERITS OF PJM

1. Limited capability owing to low material rate.
2. Embedding of the pneumatic in the work piece surface may occur while machining softer material.
3. Tapering effect may be found because of the unavoidable flaring of the pneumatic jet.
4. Nozzle wear is high.
5. There must be suitable dust collection system as the process tends to pollute the environment.

## VII. RESULTS AND DISCUSSION

The results indicate that time decreased with increasing the cut-off distance up to 5 mm. This is due to the abrasive stream has covered a wide area which decrease its effect on the spot. Moreover, the dimension of the

required hole becomes not accurate from these results, it can be concluded that the optimum cut-off distance is 5 mm under these conditions. The effect of nozzle diameter on the material removal rate was studied at a pressure of 0.5 MPa and an abrasive sized of 0.05 mm. The increase of the nozzle diameter increases the material removal rate due to the increase of the flow rate of the abrasive particles. Moreover, the increase of the abrasive size increases the material removal rate. The results indicate that the mass of the abrasive particles is an important factor in this machining.

## VIII.CONCLUSION

Experimental and theoretical analyses are introduced. The experimental and theoretical results obtained for material removal rates are close to each other within an error of not more than 20 percent which can be accepted for a mathematical model based on an erosion model. More experimental work and also more refinement for the theoretical model are needed to reduce the difference between the results as well as to introduce the neglected controlling parameters of the cutting process such as the cutoff distance.

## REFERENCES

- [1] Evans AG, Gulden ME, Rosenblatt ME., "Impact damage in brittle materials in the elastic-plastic response regime", Proc R Soc London, Ser A 1978; 361:343-65
- [2] Ruff AW, Wiederhorn SM., "Erosion by solid particle impact"; Treat Mater Sci. Tech, 1979.
- [3] Marshall DB, Lawn BR, Evans AG., "Elastic/plastic indentation damage in ceramics: the lateral crack system", J Am Ceramic Soc, 1982;65(11).
- [4] Wiederhorn SM, Hockey BJ., "Effect of material parameters on the erosion resistance of brittle materials", J Mater Sci 1983; 18:766-80.
- [5] Neelesh K. Jain, V.K. Jain, K. Deb, "Optimization of process parameters of mechanical type advanced machining processes using genetic algorithms", International Journal of Machine Tools & Manufacture (2006).
- [6] Slikkerveer, P.J., Bouten, P.C.P., de Haas, F.C.M., "High quality mechanical etching of brittle materials by powder blasting", Sensors and Actuators, A: Physical 85 (1-3) (2000) 296-303.
- [7] Wensink, H., Elwenspoek, M.C. , "Reduction of sidewall inclination andblast lag of powder blasted channels", Sensors and Actuators A: Physical 102 (1-2) (2002) 157-164.
- [8] Park, D.S. , Cho, M.-W., Lee, H., Cho, W.-S. , "Micro-grooving of glass using micro-abrasive jet machining", Journal of Materials Processing Technology 146 (2) (2004) 234-240.

# Study of Dielectric and Photocatalytic activity of Composite of Polythiophene with Photosubstituted Complex of Potassium Hexacyanoferrate(III)

Syed Kazim Moosvi<sup>1</sup>, Kowsar Majid<sup>2</sup>

*Department of Chemistry, National Institute of Technology Srinagar, Hazratbal Srinagar(India)*

## ABSTRACT

*The synthesis of composite of Polythiophene with [Fe(TEMED)(H<sub>2</sub>O)(CN)<sub>3</sub>].H<sub>2</sub>O photoadduct was achieved via in-situ oxidative chemical polymerisation method using FeCl<sub>3</sub> as oxidant. The as synthesised composite and photoadduct was investigated by UV-Vis, FTIR, XRD and SEM characterization techniques, which indicate successful synthesis of composite. From dielectric study, the magnitude of dielectric constant was found to be  $4.4 \times 10^6$  at 100 Hz and ac-conductivity of the synthesized composite was found to be  $4.5 \times 10^9$  S/m at  $10^4$  Hz. The photocatalytic activity of the synthesised composite was also investigated against Rhodamine B (RhB) dye and was found to degrade 60% of the dye in two hours. Thus the nanocomposite synthesised can be used as a photocatalytic material for water purification.*

**Keywords:** *Dielectric study, Dye degradation, photocatalytic activity, Rhodamine B*

## Synthesis, Characterisation and Study of Dielectric Behaviour of PANI/[Co(NH<sub>3</sub>)<sub>3</sub>(C<sub>4</sub>H<sub>4</sub>N<sub>2</sub>)<sub>3</sub>]Cl<sub>3</sub> Composite

Waseem Naqash<sup>1</sup>, Kowsar Majid<sup>2</sup>

<sup>1,2</sup>Department of Chemistry, National Institute of Technology Srinagar, J&K, India-190 006

### ABSTRACT

*In this study we have synthesised polyaniline/[Co(NH<sub>3</sub>)<sub>3</sub>(C<sub>4</sub>H<sub>4</sub>N<sub>2</sub>)<sub>3</sub>]Cl<sub>3</sub> composite by in-situ chemical polymerisation method in non-aqueous dimethyl sulphoxide medium. The filler photoadduct was synthesised by irradiating aqueous solution mixture of hexaminecobalt(III) chloride metal complex and pyrazine, which was subsequently reduced in size by high energy ball milling prior to incorporation into the polyaniline matrix. FTIR and XRD results show presence of photoadduct nanoparticles in the polyaniline matrix and successful interactions between them, with photoadduct retaining its structure in the composite. Presence of modified agglomerate regions in composite have been confirmed from FESEM which facilitates better charge separation in the material as observed from dielectric measurements. The dielectric measurements ( $\epsilon'$ ,  $\epsilon''$ ,  $\tan\delta$  and  $\sigma_{ac}$ ) were studied as a function of frequency and their variation with frequency is explained by "Maxwell-Wagner" model. The composite shows higher value of dielectric constant ( $10^6$ ) and higher value of ac-conductivity ( $10^9$ ) as compared to pure PANI. The high value of dielectric constant and ac-conductivity of the nanocomposite makes the material suitable for energy storage applications and an effective electromagnetic interference shielding material both at low and high frequency.*

**Keywords:** polyaniline (PANI), photoadduct (PA), nanocomposite, dielectric measurement, irradiation

# Synthesis and Characterization of AgX/Ag<sub>2</sub>MoO<sub>4</sub> Heterostructures with Enhanced Visible Light Activity and Improved Stability

Owais Mehraj<sup>1</sup>, Kowsar Majid<sup>2</sup>

<sup>1,2</sup>Department of Chemistry, National Institute of Technology Srinagar, J&K, ( India)

## ABSTRACT

AgX/Ag<sub>2</sub>MoO<sub>4</sub> were synthesized by a solvothermal approach and were implemented as visible light driven photocatalysts for the degradation of di-azo dyes under visible light irradiation. The as synthesized samples were characterized by X-ray diffraction (XRD), scanning electron microscopy (SEM), Transmission electron microscopy (TEM), UV-vis diffuse reflectance spectroscopy (DRS), FTIR, N<sub>2</sub> adsorption-desorption isotherms (BET) and Florescence technique. The synthesized samples showed enhanced visible light absorption and displayed exceptionally high photocatalytic activity towards the degradation of di-azo dyes. The superior photocatalytic activity of heterostructures was attributed to the migration of electron-hole pairs across the heterojunction interface.. In order to find the mechanistic pathway involved in the degradation of dyes, different quenchers were used to trap the radicals produced during photocatalytic oxidation process of dyes. The cyclic runs were also carried out to determine the stability of as prepared heterostructures. The as-synthesized samples showed great stability and did not show any significant loss of activity even after 5 cyclic runs.

**Keywords:** composites, Congo red, heterostructure, photocatalytic Oxidation, Ponceau BS (PBS), solvothermal

# Multi-Band Patch Antenna for THz Applications

Varindra Kumar

<sup>1</sup>Department of Engineering, University of Cambridge, UK

## ABSTRACT

*With the advent of miniaturisation in electronic components, the terahertz applications are expanding rapidly. A miniature and high gain antenna has been proposed for terahertz applications and its effect on bending has been investigated. The model has been designed using copper and graphene as conducting media for its resonance in multi-band frequencies of 1.465 THz, 2.859 THz and 3.266 THz. Various parameters such as return loss, gain, directivity, bandwidth and efficiency has been compared for two different conducting media and the bending effect has been analysed for these parameters.*

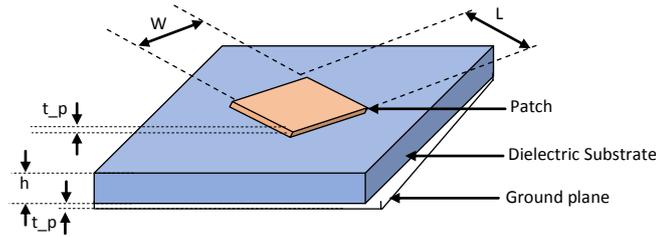
**Keywords:** Antenna, Flexible, Miniature, Patch, Terahertz

## I. INTRODUCTION

Medical and wearable electronics has provided an opportunity to integrate and design various small, compact and flexible components including conducting patches. A key feature of the electronics communication is over terahertz (THz) range due to the overcrowding of the bandwidth in GHz range and untapped spectrum of electromagnetic waves in THz range [1 – 4]. At the same time due to miniaturization of electronics devices and rapid prototyping within a PCB environment, the antenna needs to be compact and small with high gain. Hence a patch antenna in the size of micrometer ( $\mu\text{m}$ ) for its good directivity, gain and radiation efficiency has been designed [5 – 8] and these parameters have been compared to its bend shape. The paper talks about these patch antennas working at multiband frequency with 1.465 THz, 2.859 THz and 3.266 THz for its application using copper and graphene as conducting media with Fr4 as substrate and PEC as ground. Various past papers have presented the bending effect due to its upcoming applications such as antenna printed on a textile and wearable electronics [8]. The paper has been set into various sections such as design methodology, modeling and simulation results, comparison of parameters, conclusion and acknowledgement.

## II. DESIGN METHODOLOGY

A patch antenna can be defined by a conducting patch with substrate over a ground plane. Although the patch can form various shapes but an efficient radiating element can be defined with its proper size and characteristic of the conducting patch, substrate and ground plane. The dimension and characteristic of the material can also provide the flexibility of antenna for its wearable and medical electronics application. The material of the radiating patch presented in this paper is very thin sized copper/graphene while a thin Fr4 has been selected as a substrate and a thin PEC material has been selected for its ground plane.



**Fig. 1 Patch planar antenna**

So far little research has been done on miniature flexible antenna for copper and graphene with planar and bend surface. The present work provides a comparison of these structures. Performance of a patch antenna can be defined by its reflection co-efficient, directivity, gain and efficiency and these parameters can be calculated using various factors such as conductivity and dimension of the patch, substrate media, matching impedance and feeding mechanism. The patch can be defined using its length 'L', width 'W' and thickness 'tp'. The thickness 'tp' is considerably small in comparison of the wavelength of the propagation,  $\lambda_0$  and has been defined using a very thin layer of copper, 10 nm thickness. Equations (1) - (7) [9] can be used to calculate various design parameters of its patch. The effective dielectric constant of effective permittivity is dependent on surrounding media (it can be homogenous or inhomogeneous) and its effective dielectric constant. Assuming 'W' being the width of the metal plate and 'h' being the height of dielectric slab, a wide microstrip trace (electric field can be considered to be located at the center of the strip)  $\epsilon_{eff}$  can be defined by (1) for the condition  $W \gg h$ . Similarly  $W_{eff}$ ,  $\Delta L$  and L can be obtained using (2), (3), (4) and (5) [9].

$$\epsilon_{reff} = \frac{\epsilon_r + 1}{2} + \frac{\epsilon_r - 1}{2} \frac{1}{\sqrt{1 + \frac{12h}{W}}} \quad \text{for } \frac{W}{h} \geq 1 \quad (1)$$

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

$$L_{eff} = \frac{c}{2f_r \sqrt{\epsilon_{reff}}} \quad (3)$$

$$\Delta L = 0.412 * h * \frac{(\epsilon_{reff} + 0.3) \left(\frac{W}{h} + 0.264\right)}{(\epsilon_{reff} - 0.258) \left(\frac{W}{h} + 0.8\right)} \quad (4)$$

$$L = L_{eff} - 2\Delta L \quad (5)$$

$$L_g = 6h + L \quad (6)$$

$$W_g = 6h + W \quad (7)$$

Using above equations, we can obtain geometric shape of the radiating plate L, W,  $\epsilon_{reff}$ ,  $L_{eff}$ ,  $\Delta L$  and size of its substrate and ground plane ( $L_g$  and  $W_g$ ). For its application at various resonating frequencies in THz, the dimension of the patch configuration has been obtained as 50  $\mu\text{m}$  arm length and width with a copper/graphene thickness of 0.01  $\mu\text{m}$  over a thin layer (3  $\mu\text{m}$ ) of Fr4 substrate with the dimension of 100  $\mu\text{m}$  x 127.6  $\mu\text{m}$  and permittivity of 4. The ground layer is made of PEC and is the same size as of substrate with its thickness of 0.01  $\mu\text{m}$  while the feed of the patch antenna has been designed for 50 ohm characteristic impedance with patch width of 6.2  $\mu\text{m}$ , length of 23.8  $\mu\text{m}$  and thickness of 0.01  $\mu\text{m}$ . The impedance matching circuit also known as

transformer circuit has the dimension of 0.8 μm width and 15 μm length, while its thickness is 0.01 μm and has been defined to match the antenna impedance to a characteristic impedance of 50 Ω. These patch configurations has also been bent with a radius obtained from its substrate/ground width size as its perimeter that is a radius of (50/π) μm to create corresponding bend structures. The feed of the antenna has been designed for 50 Ω impedance considering the matching impedance across the PCB however the impedance of the patch antenna does not match to 50 Ω and this requires an impedance matching circuit between the feed and patch element. One mechanism is with the use of quarter wave transformer circuit. The matching circuit is formed by a transmission line with its characteristic impedance  $Z_1$  and the length, a quarter of the impinging wavelength.

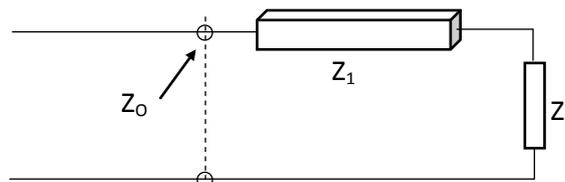


Fig. 2 Quarter wave transformer

Fig. 2 shows the Load impedance  $Z_L$ , transformer impedance  $Z_1$  and transmission line characteristic impedance  $Z_0$ , the transformer impedance can be obtained using (8) [10].

$$Z_1 = \sqrt{Z_0 Z_L} \tag{8}$$

**A. Copper and Graphene media**

Copper with its conductivity 5.8e7 S/m and graphene with its average surface conductivity 1e5 S/m has been used in the antenna design [9]. The thin layer of the surface with 10 nm thickness makes the design an excellent choice for its analysis of bending behaviour.

**III. MODELLING AND SIMULATION RESULTS**

The parametric effect of the antenna has been investigated using the CST software. While section ‘A’ talks about the planar shape antenna for two different conducting media (copper and graphene), section ‘B’ presents the corresponding result of a bend shape for its two different conducting media.

**A. Planar configuration**

Fig. 3 shows the planar shape antenna for two different conducting media with copper and graphene. The PEC has been used as ground plane here.

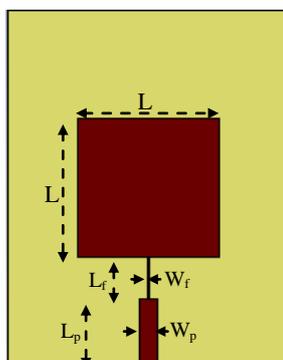


Fig. 3 Planar shape antenna

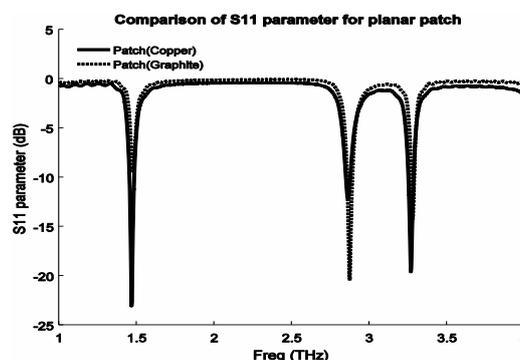


Fig. 4 S11 parameter

The reflection coefficient of the patch antenna has been shown and compared in Fig. 4. As shown in Fig. 4, copper and graphene patch shows the resonating behaviour at 1.465 THz, 2.859 THz and 3.266 THz. The copper patch shows the reflection coefficient of -23.03 dB at 1.465 THz, -12.14 dB at 2.859 THz and -19.45 dB at 3.266 THz while the graphene patch shows its resonating behaviour with reflection coefficient -8.92 dB at 1.473 THz, -22.10 dB at 2.859 THz and -12.56 dB at 3.266 THz.

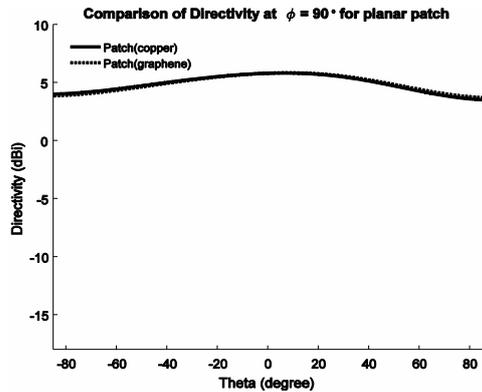


Fig. 5 Directivity at 1.465 THz

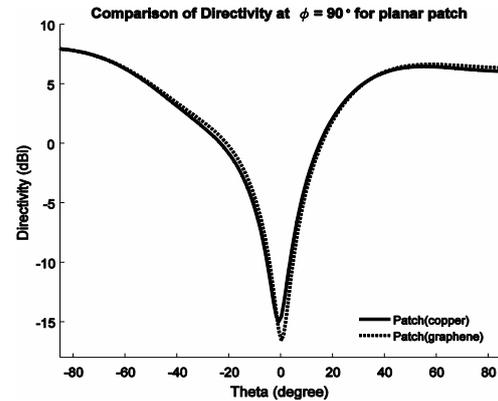


Fig. 6 Directivity at 2.859 THz

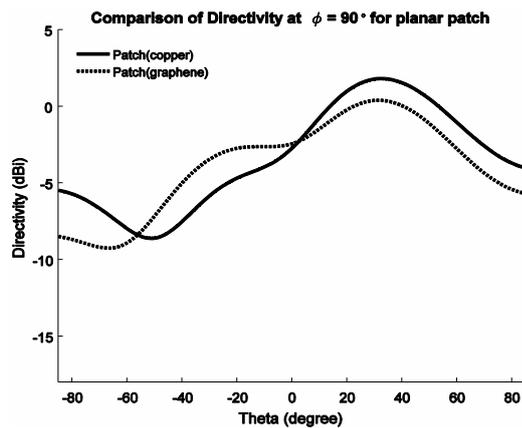


Fig. 7 Directivity at 3.266 THz

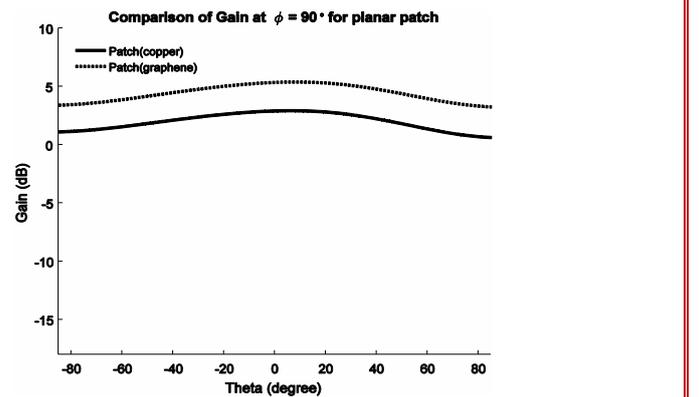


Fig. 8 Gain at 1.465 THz

Figs. 5 and 6 show the similar directivity for copper and graphene planar patch antenna with 5.86 dBi at 1.465 THz and 5.89 dBi at 1.473 THz and 8.02 dBi and 7.94 dBi at 2.859 THz for  $\phi = 90^\circ$  while the directivity at its resonating frequency 3.266 THz of Fig. 7 shows a difference in directivity of about 0.17 dBi for copper and graphene media.

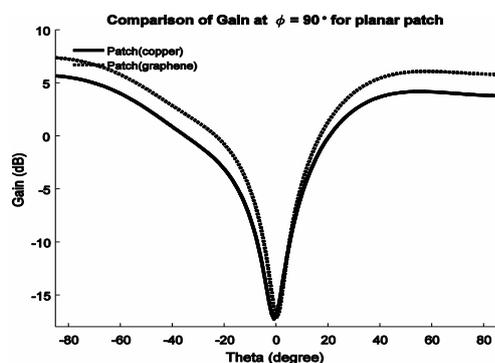


Fig. 9 Gain at 2.859 THz

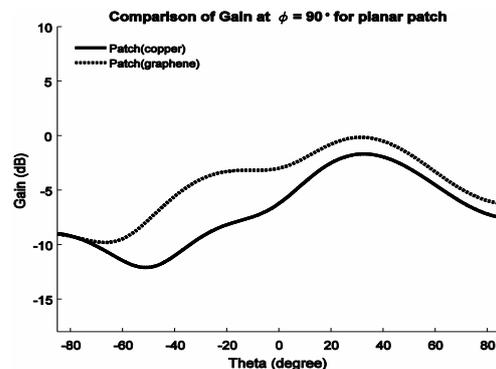


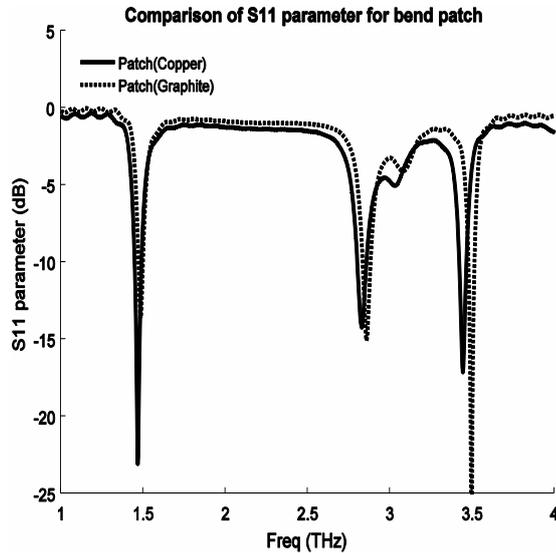
Fig. 10 Gain at 3.266 THz

Figs. 8 – 10 show the comparison of gain for these patch antennas with copper and graphene conducting media at its resonating frequencies, 1.465 THz, 2.859 THz and 3.266 THz. As shown here, Graphene patch show higher gain in these instances with 2.49 dB, 1.69 dB and 3.17 dB difference at  $\phi = 90^\circ$ .

*B. Bend configuration*

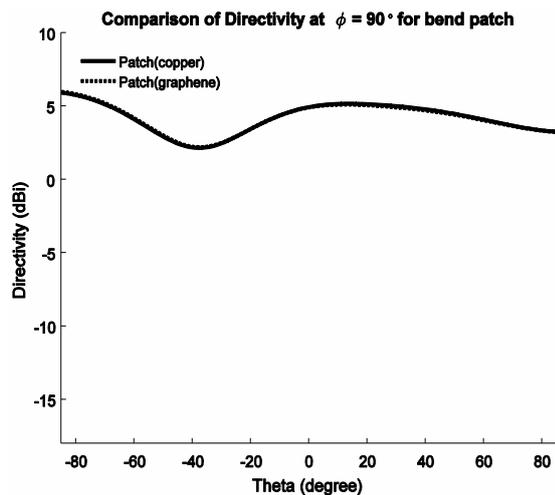


**Fig. 11 Bend shape antenna**

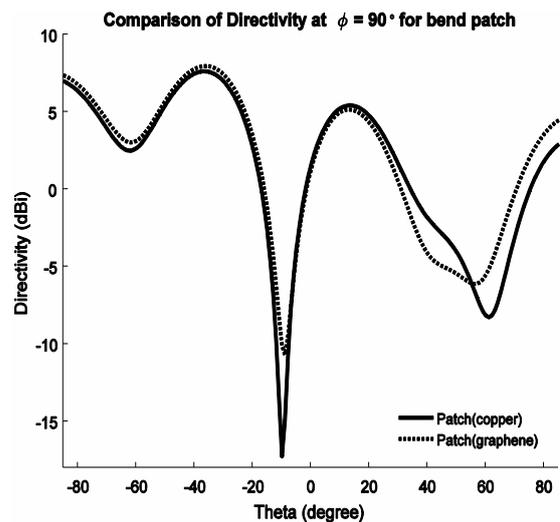


**Fig. 12 S11 parameter for bend patch**

The bend configuration of the antenna for copper and graphene as conducting media has been shown in Fig. 11 and its reflection coefficient has been compared in Fig. 12. As seen from Fig. 12, the copper patch shows the reflection coefficient of -23.05 dB at 1.465 THz, -14.10 dB at 2.829 THz and -16.85 dB at 3.444 THz while the graphene patch shows its resonating behaviour with reflection coefficient -13.40 dB at 1.485 THz, -14.83 dB at 2.859 THz and -30.19 dB at 3.493 THz.



**Fig. 13 Directivity at 1.465 THz**



**Fig. 14 Directivity at 2.829 THz**

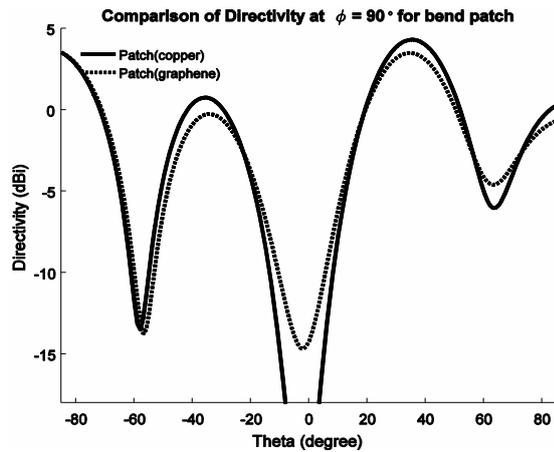


Fig. 15 Directivity at 3.444 THz

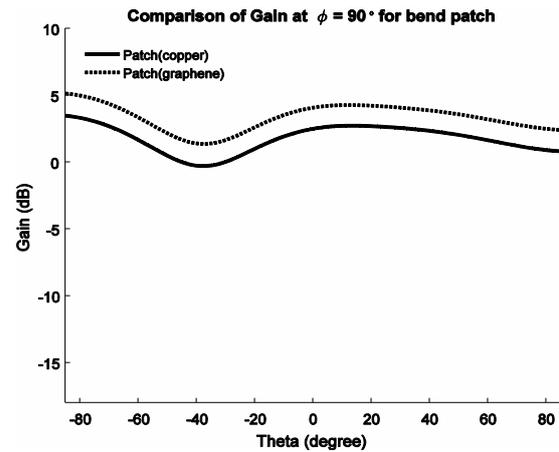


Fig. 16 Gain at 1.465 THz

Figs. 13, 14 and 15 show the comparison of its directivity for various bend structures at  $\phi = 90^\circ$ . As seen here the bend structure provides a higher gain and radiation efficiency for copper patch and lesser gain and radiation efficiency for graphene patch with other parameters being similar though there is a slight shift in the resonating frequency for the copper and graphene patch.

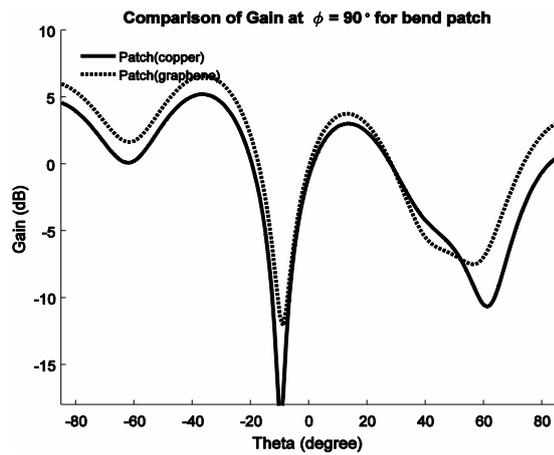


Fig. 17 Gain at 2.829 THz

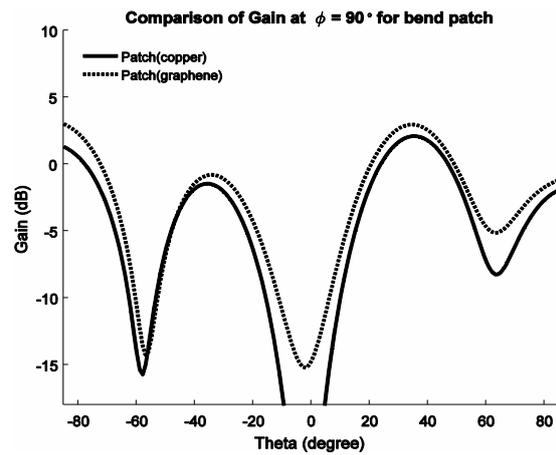


Fig. 18 Gain at 3.444 THz

Similarly Figs. 16, 17 and 18 show the comparison of gain for these patch configurations at  $\phi = 90^\circ$  where obtained gain has difference of about 1.67 dB, 1.38 dB and 1.86 dB at their resonating frequencies. These results show that after bending these patch configurations provide similar behaviour and there is an increase in gain and efficiency of the radiating element.

#### IV. COMPARISON OF PARAMETRS

TABLE I COMPARISON OF PLANAR ANTENNA PARAMETERS

Patch (planar)	Freq ( $f_0$ ) in THz	S11 (dB)	VSWR	Gain (dB)	Directivity (dBi)	Main Lobe direction ( $^\circ$ )	3 dB Angular width ( $^\circ$ )	Total efficiency (%)
Copper	1.465	-23.03	1.15	2.95	5.86	6.0	180	71.28
	2.859	-12.14	1.65	5.75	8.02	-90	38.9	74.64
	3.266	-19.45	1.24	5.03	8.51	32	53.0	66.68

Graphene	1.473	-8.92	2.11	5.44	5.89	8	180	88.71
	2.859	-22.10	1.17	7.44	7.94	-90	39.7	93.64
	3.266	-12.56	1.61	8.2	8.68	31	78.6	91.8

**TABLE II. COMPARISON OF BEND ANTENNA PARAMETERS**

Patch (Bend)	Freq ( $f_0$ ) in THz	S11 (dB)	VSWR	Gain (dB)	Directivity (dBi)	Main Lobe direction (°)	3 dB Angular width (°)	Total efficiency (%)
Copper	1.465	-23.05	1.15	3.56	6.01	-90.0	39.4	75.34
	2.829	-14.10	1.49	5.22	7.65	-37.0	29.4	74.47
	3.444	-16.85	1.33	5.62	7.83	35.0	27.5	76.64
Graphene	1.485	-13.40	1.54	5.23	6.06	-90.0	39.6	88.71
	2.859	-14.83	1.44	6.6	7.99	-36.0	29.9	84.04
	3.493	-30.19	1.06	7.48	8.01	-90.0	17.0	93.97

Table I shows the comparison of reflection coefficient, VSWR, and Gain at  $\theta = 90^\circ$  for planar antenna with copper and graphene as its conducting media in its tri-band frequency (1.485 THz, 2.829 THz and 3.444 THz). As seen from Table I and II, the gain, directivity and total efficiency of the graphene radiating element is higher than the copper conducting media. This can be an important factor in the selection of the conducting material for its patch configuration. Similarly the comparison of Table I to Table II shows that the bending of the patch provides an increased parametric result for its gain and radiation efficiency, although the bend structure in comparison of planar structure provides a lesser bandwidth.

## V. CONCLUSION

Here the modelling and simulation results of a small patch antenna operating over THz range have been investigated for two different conducting media, copper and graphene. As seen from their various simulation results, these small patch antennas provide multi-band frequency range of operation while providing good gain, directivity and radiation efficiency. The antenna parametric effect has been also investigated for its bend structure. Looking from Table I and II, the bending of the structure provides an improvement in the parametric results such as reflection coefficient, gain, directivity, and radiation efficiency of the planar antenna. The designed antenna being in the  $\mu\text{m}$  range, its gain and other parameters can be enhanced considerably with an array. The thin layers of these designed antennas can make it an excellent choice for wearable electronics applications apart from many other automotive and medical applications.

## VI. ACKNOWLEDGMENT

The author would like to acknowledge the CSIC at Department of Engineering, University of Cambridge for providing the necessary support and funding for the project. This project was completed as part of the supervision to UROP projects.

## REFERENCES

- [1] K. R. Jha, G. Singh, Analysis and design of rectangular microstrip antenna on two-layer substrate materials at terahertz frequency, *J. Comput. Electron.*, 2010, 68-78.
- [2] J. Perruisseau-Carrier, Graphene for antenna applications: Opportunities and challenges from microwaves to THz. In Antennas and Propagation Conference (LAPC), Loughborough, 2012, 1-4.
- [3] P. H. Siegel, Terahertz technology in biology and medicine, *IEEE Trans. Microwave Theory Tech.*, 52(10), 2004, 2438-2447.
- [4] R. Appleby and R. N. Anderton, Millimeter-wave and submillimeterwave imaging for security and surveillance, *Proc. of IEEE*, 95(8), 2007, 1683-1690.
- [5] J. Q. Howel, Microstrip Antennas, Proc. IEEE Int. Symp. Antennas Propag. Soc., Williamsburg, VA, 1972, 177-180.
- [6] K. R. Carver and J. W. Mink, Microstrip Antenna Technology, *IEEE Trans. Antennas Propag.*, 29(1), 1981, 2-24.
- [7] K.-L. Wong, Compact and roadband Microstrip Antennas (John Wiley & Sons, New York, USA, 2002).
- [8] P. S. Hall and Y. Hao, *Antennas and Propagation for Body-Centric Wireless Communications* (Artech House, Inc., Norwood, MA, USA, 2012).
- [9] C. A. Balanis, *Antenna theory: analysis and design* (John Wiley & Sons, New Jersey, USA, 2005).
- [10] D. M. Pozar, *Microwave Engineering* (John Wiley & Sons, MA, USA, 2005).
- [11] H.-J. Song and T. Nagatsuma, Present and future of terahertz communications, *IEEE Trans. THz Sci. Technol.*, 1(1), 2011, 256-263.

# Effect of Ce ion Doping on the Microwave Shielding Properties of Ni-Zn Ferrite/Polythiophene Nano-Composites

M. Abdullah Dar

Department of Chemistry, National Institute of Technology Srinagar, Hazaratbal, Srinagar, (India)

## ABSTRACT

Successful synthesis of polycrystalline Ni-Zn ferrite doped by Ce was achieved using sol gel auto-combustion method. Single phase spinel cubic structure has been obtained for all the samples, except for the sample with  $x = 0.08$ . It denotes that doping an appropriate amount of  $Ce^{3+}$  ions into ferrite can replace the  $Fe^{3+}$  ions on the octahedral sites. The increase of Ce content led to the increase of average grain size up to  $x = 0.04$ . The average grain size for the sample with  $x = 0.08$  was found to decrease. This has been attributed to the formation of  $Ce_2O_3$  phase along the grain boundaries that inhibit the grain growth. Synthesis of PTH/Ni-Zn ferrite composites has been achieved by surfactant assisted in situ emulsion polymerization of thiophene monomer for the investigation of microwave shielding in X-band frequency range. The higher values of  $\epsilon'$  and  $\epsilon''$  have been obtained on composite formation and can be due to the heterogeneity developed in the material. An enhancement in the value of saturation magnetization (123 emu/g for  $x = 0.04$ ) and Curie temperature was obtained with Ce concentration, which is useful for high density recording purposes. A low value of saturation magnetization has been obtained for PTH/Ni-Zn ferrite composite. The overall shielding effectiveness ( $SE_T = SE_A + SE_R$ ) up to 34 dB (~99.9 % attenuation) has been recorded for PTH/ $Ni_{0.5}Zn_{0.5}Fe_{2-x}Ce_xO_4$  composites ( $x = 0.04$ ) in the frequency range of 8.2-12.4 GHz (X-band). Hence, surpasses the shielding criteria of  $SE_T > 30$  dB for commercial purposes. Such a material with high SE identifies their potential for making future electromagnetic shields.

**Keywords:** Composites, Ferrites, Magnetic properties, Microwave shielding, Polythiophene (PTH).

## **5G Wireless Communication Technology**

**Rajesh Yadav**

*Computer Science Department, BML Munjal University (India)*

### **ABSTRACT**

*5G Technology is a fifth generation of cellular network, before the 5th generation there is an some evolutions of cellular network that are 1G, 2G, 3G, 4G and now 5G. After the each evolution there are some issues and challenges. 5G systems are built upon the evolution of existed technologies contribute extra features by new radio Frequency band such as 6 GHz. In modern world, use of mobile devices and smart phone increasing very vastly and they need to communicate each other (Digital World). It needs huge size frequency band and adaptive network. The 5G has many advanced features that help to solve many problems in human life, like audio/video streaming, slow network connection, buffering and loading, mobility and switching network. This paper tries to clarify emerging technologies comparative study, revolution and evolution of the wireless network and existing research work in mobile communication is related to 5G technology.*

**Keywords:** 1G, 2G, 3G, 4G, 5G, 6G, LTE.

### **I. INTRODUCTION**

As the developing and growing technology new inventions and research are continuously done and it also need. After the 1G to 4G and 5G many improvements are done. 5G fifth generation cellular network very clear that as compare to 4G, 5G will give better response in various factors like bandwidth, spectral efficiency, energy efficiency, etc. 1G-analog FM cellular systems in 1981. 2G-digital technology in 1992, 3G in 2001, and 4G LTE-A Basically 5G is improvement over the 4G and 4G LTE as shown in Fig.1. 5G enable a perceived fully ubiquitous connected world [1]. The cellular network system based on radio frequency. Radio spectrum having specific band i.e., limited and costly. To improve the communication system, it need huge frequency band to handle heavy network traffic.

The 4G Technology is deployed in between 2000-2010. it provides high speed as 2Mbps to 100Mbps. It is completely IP based system, with the main aim to provide high speed, QoS and low cost services. 4G uses LTE (Long Term Evolution) and Wi MAX standards. It uses CDMA multiplexing technique with packet switching. 5G Technology will be deploy by 2020. It provides great feature to users, having higher data rate 1Gbps or higher. 5G support 4G+WWW (4th Generation + World Wide Wireless Web). It operates on IPv6 protocol. 5G aim to provides unlimited access and information at anywhere anytime with high speed.

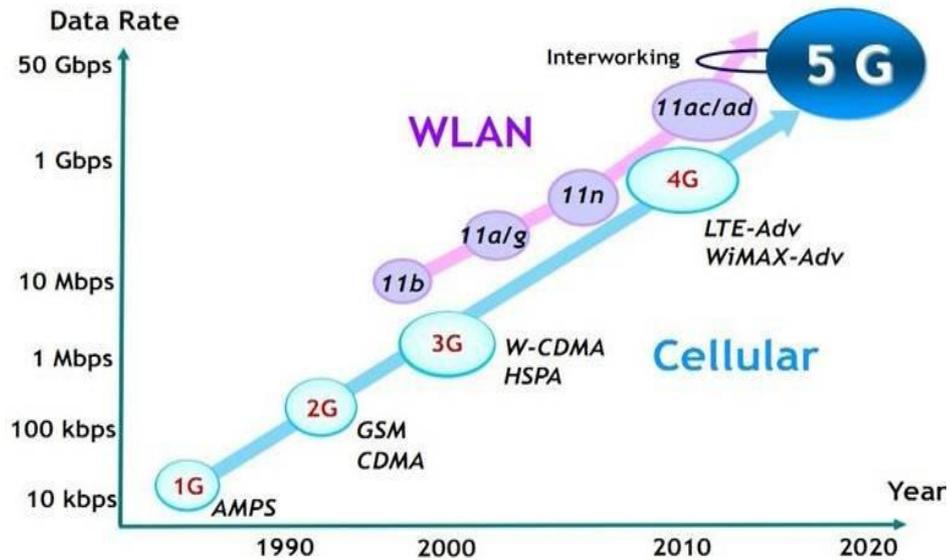


Fig.1. Evolution of Wireless Communication Technologies [1].

II. LITERATURE SURVEY

TABLE 1. Literature Survey On 5G wireless communication Technology.

Sr. No.	PAPER NAME	AUTHORS	WORK DONE
1.	Emerging Technologies and Research Challenges for 5G Wireless Networks.(IEEE)	Woon Hau Chin, Zhong Fan, and Russell Haines	In this paper Research challenges and other Merging technologies are Explained along with their new research problems[2]
2.	A Survey of 5G Network: Architecture and Emerging Technologies.	Akhil Gupta, Student Member, IEEE, Rakesh Kumar Jha, Senior Member, IEEE	This Paper introduced 5G technology with 5G cellular network architecture in detail. Author's done comparatively study with various parameters and also pose different issues & challenges in 5G technology[1].
3.	An Overview on Resource Allocation Techniques for Multi-User MIMO Systems	Eduardo Castaneda, Member, IEEE, Adao Silva, Member, IEEE, Atilio Gameiro, and Marios Kountouris, Senior Member, IEEE	This paper provide an overview of the various methodologies used to approach the aforementioned joint optimization task in the downlink of MUMIMO communication systems [3].
4.	Next Generation 5G Wireless Networks: A Comprehensive	Mamta Agiwal, Abhishek Roy and	In this survey paper 5G architecture, mm-wave, beamforming, channel model,

	Survey	Navrati Saxena	CRAN, SDN, HetNets, massive MIMO, SDMA, IDMA, D2D, M2M, IoT, QoE, SON, sustainability, field trials -terms are describe in detail and gives emerging application of 5G communication [4].
--	--------	----------------	---

### III. ARCHITECTURE & WORKING OF 5G

It is necessary to look thoughtfully for 5G network in the market now, it is clear that the multiple access techniques in the network are still available and requires some improvement. The current technologies like OFDMA will be work at least for next 50 years. By taking this into consideration, it is not necessary to have a change in the wireless setup which had come about from 1G to 4G. Correspondingly, it only needs the improvement to be done at the fundamental network to fulfill user requirements. To fulfill user requirements and to reduce the challenges that has

been introduced in the 5G system, an effective change in the technique of designing the 5G wireless cellular architecture is needed. According to observation of the researchers, most of the wireless users stay inside for up to 80 % of time and outside for up to 20 % of the time. In these wireless cellular network architecture, for a mobile users wish to communicate either inside or outside, an outside base station located at the middle of a cell helps in communication. When the inside users wants to communicate with the outside base station, the signals has to travel through the walls of the indoors, and it will result in very high penetration loss, which alternatively reduced the spectral efficiency, data rate, and energy efficiency of wireless communications. To overcome these challenges, a new designing technique that has come in to market for implementing the 5G cellular architecture is to distinct outside and inside setups. With the help of this designing technique, the penetration loss through the walls of the building will be slightly reduced. This technique will be implemented with the help of some standard technologies like massive MIMO technology, which deployed geographically distributed array of antenna's which include tens or hundreds of antenna units. Not only MIMO systems are using either two or four antennas, but also the idea of massive MIMO systems has come up with utilization of the advantages of large array antenna elements in terms of huge capacity gains. To implement a large massive MIMO network, basically it having two stages- First, the outside base stations will be attached with large antenna arrays and they are distributed around the some hexagonal cell and connected to the base station via optical fiber cables, which are aided with massive MIMO technologies. The mobile users present at outside are basically attached with few number of antenna units but a large virtual antenna array can be built with cooperation, which antenna arrays of base station will together form virtual massive MIMO links.

Second, for every building their will be large antenna arrays from outside, to communicate with outdoor base stations using line of sight components. To communicate with indoor users the wireless access points being installed inside the building which will be connected with the large antenna arrays via cables. This will improves the energy efficiency, cell average throughput, data rate, and spectral efficiency of the cellular system but at the high rate of increased infrastructure cost. As larger antenna arrays remained installed outside the

buildings, the inside users will only have to communicate with inside wireless access points. For small range communications (Indoor communication) having large data rates there are some of technologies like Wi-Fi, Small cell, ultra-wideband, millimeter wave communications, and visible light communications[6,7] are very useful. But there are some of the technologies like millimeter wave and visible light communication they requires higher frequencies which are not useful for cellular communications. But these high frequency waves are not efficient for outside and long distance applications because these waves will not infiltrate from dense materials efficiently and can easily be dispersed by rain droplets, gases, and flora. As millimeter waves and visible light communications technologies come up with large bandwidth can improve the transmission data rate for indoor setups [6, 7]. As we see with the introduction of new spectrum, which is not being efficiently used for wireless communication, there is one more method to solve the spectrum shortage problem by improving the spectrum utilization of current radio spectra through cognitive radio (CR) networks.

The 5G cellular network architecture explained [8] above, having equal importance in terms of front end and backhaul network. In this paper, I introduced general 5G cellular network architecture as shown in Fig. 2. It shows the interconnectivity between different emerging technologies will be like Massive MIMO network, Cognitive Radio network, mobile and static small-cell networks. It also explains the role of network function virtualization (NFV) cloud in the 5G cellular network architecture. Similarly this 5G cellular network architecture has also included the concept of D2D communication, small cell access points and IoT. In short, this 5G cellular network architecture may provide a very good platform for future 5G standardization network [1].

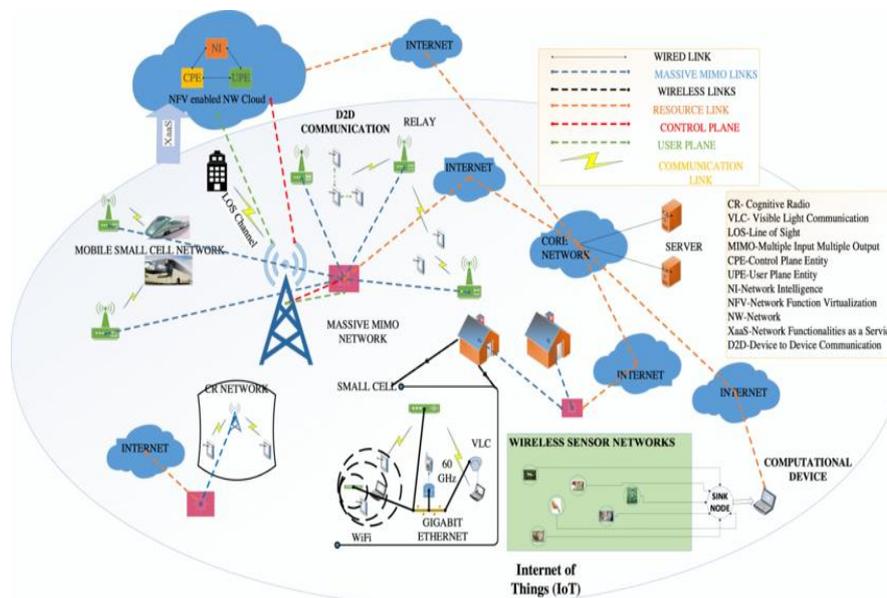


Fig. 2. 5G cellular network Architecture [1].

## IV. COMPARATIVELY STUDY OF 4G AND 5G

TABLE II. TECHNICAL COMPARISON BETWEEN 4G AND 5G [2, 3, 4, 5]

Sr. No.	Specification	4G (Fourth Generation)	5G (Fifth Generation)
1.	Data Bandwidth	Up to 100Mbps	Greater than 1Gbps
2.	Frequency Band	2GHz to 8GHz	3GHz to 300GHz
3.	Standards	OFDMA, MC-CDMA, N/W-LMPS	CDMA and BDMA
4.	Technologies	unified IP, seamless integration of broadband LAN/WAN/PAN and WLAN	4G and advanced technologies based on OFDM modulation used in 5G
5.	Service	Dynamic information access, wearable devices, HD streaming, global roaming	Dynamic information access, wearable devices, HD streaming, any demand of users with all Capabilities.
6.	Multiple Access	CDMA	CDMA, BDMA
7.	Core Network	All IP network	Flatter IP network, 5G network Interfacing(5G-NI)
8.	Deployment	2000-2010	By 2020

## V. FEATURES OF 5G TECHNOLOGY

- Increase in Capacity -1000x higher data volumes and 10-100x higher data rates to end user [2].
- Low Latency –Latency decrease by a factor of 5 in order to enable remote presence, tactile internet, etc. services.
- Increase in number of connected device- up to 300,000 will be served per access point [1].
- Increase in Efficiency- Energy, Spectrum like resource utilization higher.
- Increase in reliability- 5G will be deliver extremely reliable connections (Typically 99.999% Availability).
- 5G support to Internet of Thing, Smart Home Appliances, Autonomous Car and it also applicable in following area- Health, Transport, Agriculture and Education [1].
- 5G provide uniform, uninterrupted, and consistent connectivity across the world [5].

## VI. CHALLENGES IN 5G CELLULAR WIRELESS NETWORK

### A. HETEROGENEOUS NETWORK

The 5G network have heterogeneous network with including Pico cells, microcells, small cells to reduce the energy consumption and increasing the cost efficiency. Heterogeneous network offer numerous access point with their efficiency and various spectrum that may use different transmission power level to deliver higher data

rate [2]. It also consist of following sub-challenges are Inter cell interface, efficient medium access control, Distributed Interface coordination, Device discovery and link setup, etc.

## **B. DEVICE-TO-DEVICE COMMUNICATION**

Device-to-Device communication high end user mobility will be considered, while communicating with directly terminal to terminal or sharing radio frequency connection to exchange data with reduce interference in communication. 5G is a full duplex system [1], at the same time devices can transmit and receive signals and reduce the time complexity. It uses simplest two-tier architecture and base station traffic free [2].

## **C. MASSIVE MIMO**

Massive MIMO include very large antenna array at each base station connected with multiple tens of users. Massive MIMO offer large number of users are served simultaneously without consuming more radio spectrum and also decreases the dead radio spectrum and decrease the dead zones and gives high quality data [4].

## **D. RADIO WAVES**

Radio waves enables to cellular network communication, But Capacity, Efficiency, Availability and Security are major issues in radio waves. Radio waves having limited spectrum and expensive band. 5G use new spectrum above 6GHz to achieved very high data rates, low latency, energy efficiency, and ultra- high reliability [7].

## **VII. EMERGING APPLICATIONS**

A. D2D Communication – Peer to Peer [2] or direct device to device communication [2], eliminate IP based or Base

Station oriented connectivity.

B. M2M Communication- Intelligent machines automatically done all data operations, like data generation, processing and Transfer [2].

C. Internet Of Things- Supports IoT concept which is large scale development smart homes as well as smart objects

connected together via Internet. Internet of Things Connecting “Anytime, Anyplace, Anyone, Anything” [1].

D. Internet Of Vehicles- Supports vehicle to vehicle communication through Internet and traffic, collision reduces [1, 4]. It provides low latency and high mobility connectivity.

E. Health Care-Advance sensor and communication technology enables health monitoring, real time communication, data storage [1]. Wearable technology provides health care solution.

F. Smart Home and Smart City- applicable for smart homes and cities in Automation, Appliances, Embedded system and security.

## **VIII. CONCLUSION**

In this survey paper, I explained fifth generation (5G) technology in shortly which mainly includes architecture, challenges, emerging application and comparatively study of 4G and 5G.This will helps to understand easily and

motivate to researchers to improvement outcome for next generations issues and challenges. This technology is in research field so, there is lot of issues and challenges. 5G will be completely developed in 2020 or before. It will improve the communication as well as digital life with higher performance.

## REFERENCES

- [1] Akhil Gupta and Rakesh Kumar Jha “A Survey of 5G Network: Architecture and Emerging Technologies” 2169-3536 (c) 2015 IEEE.
- [2] Woon Hau Chin, Zhong Fan, and Russell Haines, “Emerging Technologies and Research Challenges for 5G Wireless Networks” Toshiba Research Europe Limited, Bristol, BS1 4ND, United Kingdom.
- [3] Eduardo Castañeda, Adão Silva, Atílio Gameiro, and Marios Kountouris, “An Overview on Resource Allocation Techniques for Multi-User MIMO Systems”, 1553-877X (c) 2016 IEEE
- [4] Mamta Agiwal<sup>1</sup>, Abhishek Roy<sup>2</sup> and Navrati Saxena, “Next Generation 5G Wireless Networks: A Comprehensive Survey” 1553-877X (c) 2015 IEEE.
- [5] Jing WANG & Chih-Lin , “Recent advances and future challenges for massive MIMO channel measurements and models”, from science china February 2016, Vol. 59 021301:1–021301:16
- [6] H. Haas, “Wireless Data from Every Light Bulb”, TED website, Aug 2011; <http://bit.ly/tedvlc>
- [7] Gaikwad Vaibhav Vitthal and Bhor Pooja Vijay, “Review of Light fidelity”, International Journal for Scientific Research & Development| Vol. 4, Issue 02, 2016 | ISSN (online): 2321-0613
- [8] Kwadwo, P., Agyapong, et al, “Design considerations for a 5G network architecture”. IEEE Commun. Mag. 52(11), 65 (2014).
- [9] G. Wunder et al., “5GNOW: Non-orthogonal, asynchronous waveforms for future mobile applications”, IEEE Communications Magazine, vol. 52, pp. 97–105, February 2014
- [10] K. Davaslioglu and E. Ayanoglu, “Quantifying potential energy efficiency gain in green cellular wireless networks” IEEE Communications Surveys and Tutorials, vol. 16, pp. 2065–2091, Fourth Quarter 2014.
- [11] Engr. Muhammad Farooq, Engr. Muhammad Ishtiaq Ahmed, Engr. Usman M Al, “5G WIRELESS TECHNOLOGIES-Still 4G auctions not over, but time to start talking 5G Future Generations of Mobile Communication Networks.
- [12] Bikos, Sklavos. *LTE/SAE Security Issues on 4G Wireless Networks*, Published in IEEE Security & Privacy, March/April 2013.

**AN EXPERIMENTAL EVALUATION AND TESTING  
OF CEMENTITIOUS BASED COMPOSITES WITH  
CONDUCTIVE ADDITIVES OF CARBONYL-IRON  
AND SILICA-FUME FOR THE EFFICIENT USE OF  
MINERAL WASTE FOR DEVELOPMENT OF COST-  
EFFECTIVE BROADBAND RADAR WAVE  
ABSORBER.**

**Rupali Rai**

*PG Research Scholar, Electronics and Communication Engineering, DAV University (India)*

**ABSTRACT**

*The electromagnetic absorbing effectiveness of proposed radar absorbing based specimen with different contents involve: Carbonyl Iron as ferrite, conductive filler as carbon fibres/carbon black and admixture of silica fume with Portland cement studied in this paper. Double-layer Cementitious composites filled with Carbonyl Iron ferrite as microwave absorbers. The addition of silica fume, use to improve the impedance matching between the cementitious composites and free space. To design the Cementitious-based radar absorber, Carbon contents will be added to Carbonyl-iron and Silica-fume, since the study shows that these have high percentages of absorption values. This innovation material combination will be investigated to determine the best reflectivity performance of microwave absorbers. Carbon is the most important element that must be in the absorber to absorb unwanted microwave based material that has been used in Cementitious-based microwave absorber fabrication. Instead of using chemical and agriculture waste based material, this study shows that mineral waste is more effective and has much lower cost. The main objective is to achieve good absorption with wide bandwidth corresponds to reflection loss,  $RL \leq -10$  dB for absorber layer thickness about 10mm for cost-effective production of radar wave absorber. An experimental evaluation of this cement based composite is tested using dielectric probe method and radar cross-section method and therefore, reflection loss is tested under frequency range of 8 to 12GHz. A double layer approach is applied for obtaining good absorption. Carbonyl-iron and Silica-fume is an innovation in enhancing the microwave absorption properties of Cementitious-based radar absorber, to be used in radio frequency anechoic chambers. An anechoic chamber consists of radar absorbing material (RAM) along at its wall; floor and ceiling to eliminate unwanted reflections to create electromagnetically quite environment. With more and more severity of electromagnetic environment pollution, the study on building materials that can prevent electromagnetic interference(EMI) has caused great attention. So, The cement-based radar absorbing material used for EMI shielding and wave absorbing building materials.*

**Keywords:** *Carbonyl iron, Silica fume, Carbon fibres, Carbon black, ferrites, Impedance matching, Layered cementitious composites, Microwave absorption, Reflectivity.*

## I. INTRODUCTION

Now people are living in a more and more complicated electromagnetic environment. Actually, electrical devices have greatly improved the quality of our lives. However, everything has its bad effects. For example, sometimes we have to shield the electromagnetic radiations from such devices as computers, mobiles, and military devices to avoid leaking out of important information or avoid radar tracing. In other cases, the reflection of electromagnetic waves from the enclosure of high buildings can lead to the disorder of TV signals around the buildings. Now people are aware that radiation of electromagnetic waves may do harm to the health of human beings. Thus, development of building composite materials containing low cost components such as carbon black (CB) which are able to absorb or shield electromagnetic radiations becomes more and more necessary in the modern society.

The shielding effectiveness (SE) is the sum of three terms such as reflection loss, absorption loss and multi-reflections. So, SE is defined in decibels (dB) and its magnitude can be written as follows:

$$SE_T(\text{dB})=10 \log (P_I/P_T) \quad \text{eq. (1)}$$

where  $P_I$  and  $P_T$  are the electric fields that are incident on and transmitted through the shield. The reflectivity of -10 to -20 dB means that the incident electromagnetic waves have been reduced by about 70–90%. As the reflectivity of absorbing wave materials is less than -10 dB, they can be used in practice. Cement is slightly conductive, but its SE is very low. To increase the cement materials SE by adding a small amount of a conductive additive such as graphite powder, carbon black, carbon fibers, carbon filaments/steel fibers.

For the purpose of preparing a low-reflecting absorber in the desired wide frequency range, two fundamental conditions must be satisfied [7,8]: the first is that the incident wave can enter the absorber to the greatest extent (impedance matching characteristic), and the second is that the electromagnetic wave entering into the materials can be almost entirely attenuated and absorbed within the finite thickness of the material (attenuation characteristic). The impedance matching is the principle that the electromagnetic wave is absorbed in the materials. There are several methods to improve impedance matching between material and free space. One of them is to use low dielectric constant materials to adjust the characteristic impedance of the absorber. Silica fume [9] is a kind of fine non-crystalline silica produced in electric arc furnaces as a by-product used for this purpose. Carbonyl Iron has excellent absorptive abilities at lower frequencies and can widen frequency band when combined with other absorbents and having quality of good reflectors as it is used in the production of some ferrites. Typically applicable in radar absorbing material, EMI/RFI shielding product and metal injection molded parts [9,10]. It's well known that carbonyl-iron particles (CIP), which possesses excellent magnetic-loss property, in the frequency range of 2-18 GHz, is widely blended in polymer matrix as microwave absorbing materials [23-26].

So, Double-layered Cement based composite with involvement of such additives studied in this paper in which Silica-Fume present in Surface-layer and Carbonyl-Iron act as Loss-layer with carbon contents in order to increase its conductive value.

## II. LITERATURE REVIEW

Guang HT, Liu SH, et al. [2007] and Wang C, Li KZ, Li HJ, et al. has presented cementitious composites are one of the most common building materials used in engineering construction. Cement-based composites are complex systems that include hydration products, unhydrated cement particles and aggregates of different sizes. Generally, as a whole system cement-based material is slightly conducting, but its EMI shielding effectiveness and wave absorbing property are very low, so admixtures are needed to improve the ability to resist the electromagnetic wave interference. There have been many studies on the reflection loss of cement matrix composites by introducing fillings, such as expanded Polystyrene (EPS) and carbon fibers [3,4].

Yamane T, Numata S, Mizumoto T, Naito Y. and Morimoto M, Kanda K, Hada H, et al. [2002] has studied ferrite is one of the most commonly used materials as a kind of electromagnetic wave absorber. Many studies have been carried out in Japan in Radio frequency (RF) area to investigate the electromagnetic absorption properties of buildings employing ferrite[5].

Cao MS, Zhu J, Yuan J, et al. [2002] shows the application has been restricted by the narrow band characteristics of single-absorbers. It is known from many research studies that the microwave absorber with double-layer structure has wider absorption bandwidth and lower reflection loss (RL) than the single-layer absorber in GHz frequency [6].

Zhang BS, Feng Y, Xiong J, et al. [2006] and Oikonomou A [2007] studied for the purpose of preparing a low-reflecting absorber in the desired wide frequency range, two fundamental conditions must be satisfied [7,8]: the first is that the incident wave can enter the absorber to the greatest extent (impedance matching characteristic), and the second is that the electromagnetic wave entering into the materials can be almost entirely attenuated and absorbed within the finite thickness of the material (attenuation characteristic). The impedance matching is the principle that the electromagnetic wave is absorbed in the materials. There are several methods to improve impedance matching between material and free space. One of them is to use low dielectric constant materials to adjust the characteristic impedance of the absorber.

Toutanji Houssam A, et al. studied silica fume [9] is a kind of fine non-crystalline silica produced in electric arc furnaces as a by-product during the production of metallic silicon or ferrosilicon alloys, the SiO<sub>2</sub> content of which ranges from 85% to 98%.

Duan Yuping, et al. [2012] shows the microwave absorbing coatings with PVC (polyvinyl chloride) sheet as base plate are fabricated composed of CIP (carbonyl-iron particle) as absorbent and PU (polyurethane varnish) as matrix. The absorption properties of PVC-based coatings with different CIP content are investigated and compared with the corresponding Al (aluminium)-based coatings [10].

Luo X and Chung DDL. [2001] studied in order for a conductive filler to be highly effective for shielding, it preferably should have a small unit size, a high conductivity and a high aspect ratio. As to improving the conductive ability and shielding effectiveness of cement matrix composites, carbon fibres are more effective

than particles such as carbon black and coke due to their large aspect ratio, which can help to make more conductive networks through intercalating [11–13].

Chung DDL. [2002] studied with the decrease in carbon fibre cost and the increase of demand for cement based composites with high structure and multi-function, carbon fibre cement matrix composites are gaining in importance quite rapidly. In the carbon fibre reinforced cement based composites, the carbon fibre with a diameter of more than 0.1  $\mu\text{m}$  is often called fibre, whereas that with the diameter less than 0.1  $\mu\text{m}$  is often called carbon filament. Due to its higher aspect ratio, carbon filament is superior to carbon fibre in shielding [14,15].

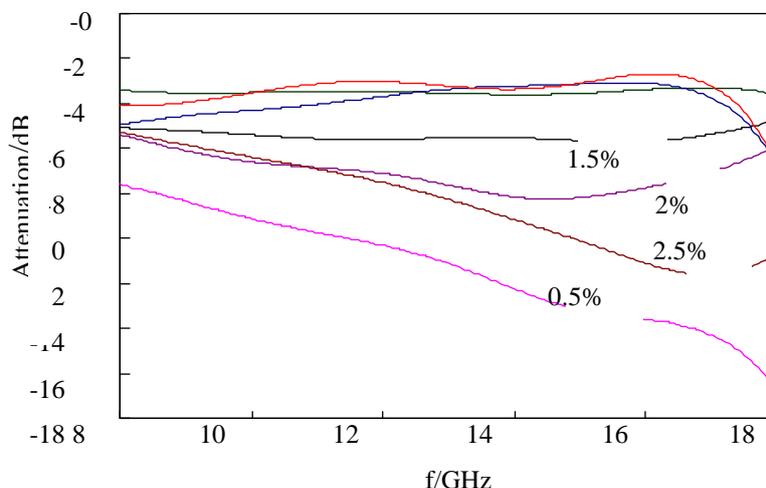
Fu X, Lu W, Chung DDL. [1996] explains when the carbon materials are used as the conductive fillers, it is necessary that the fillers be well dispersed, so it often needs to introduce some dispersants. Dispersants are not conductive themselves, but their introduction can obviously improve the dispersion degree of conductive fillers so as to help make more efficient conductive networks. Among the various types of dispersants, styrene butadiene latex and silica fume are the most common for use in cement based composites. Moreover due to the weak strength between the carbon fibre and cement matrix, the introduction of latex, silica fume or methylcellulose can improve the bond between the fibre and matrix, thereby improving the mechanical properties of the cement composites [16,17].

Chen PW, et al. [1995] studied the surface pretreatment of carbon fibre or treating silica fume with silane can improve the bond strength between carbon fibre and the cement matrix and the dispersion degree of conductive fillers, thereby increase the shielding effectiveness of the composites [18–20].

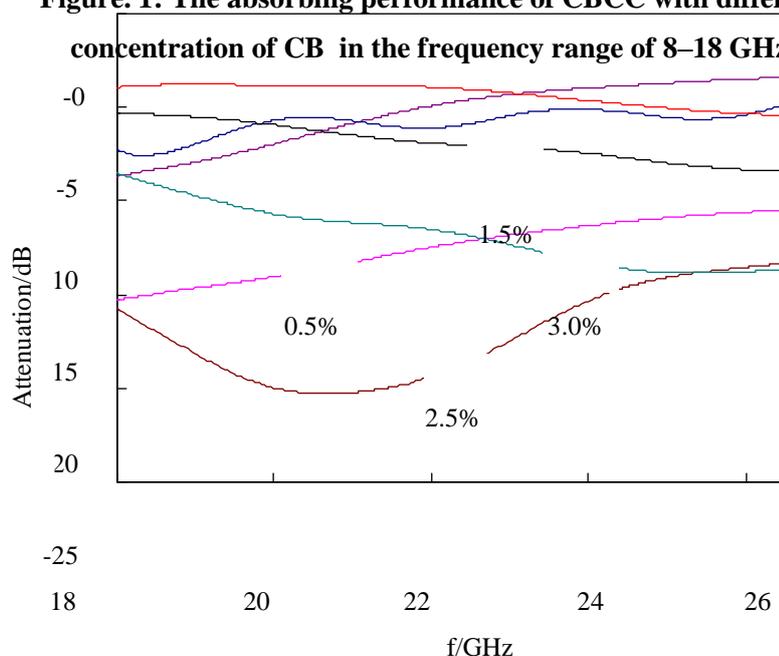
X. Zhang, et al. [2010] has studied the mortar with silica fume can be used as an impedance matching layer to adjust the permittivity of the surface materials of the cement-based absorbing material in order to attain the impedance matching. The microwave reflectivity of the single-layer mortar filled with ferrite is higher than that of the plain mortar due to the mismatching of the impedance and the design of double-layer structure has excellent absorption property because of the impedance match of materials. The impedance match layer is made of silica fume mortar and the loss layer is added with 30 wt.% ferrite based composite [21].

Dai Yawen, et al. [2010] has presented the filling of CB improves the loss factor of the cement material remarkably, which makes CBCC absorb electromagnetic waves by polarization. The loss factor of CBCC increases with the CB content increasing and the Compressive strength of CBCC decreases with CB content increasing. Compressive strength decreased substantially when CB content is more than 3 wt.% [22].

Main data drawn from Figure 1 and 2 is listed in Table 1. It can be found that the bandwidth in which the reflectivity is less than -10 dB decreased in the order: CBCC containing 0.5 wt.% of CB, CBCC containing 2.5 wt.% of CB, and 3.0 wt.% of CB. The absolute value of maximum reflectivity decreases in the order: CBCC containing 2.5 wt.% of CB, CBCC containing 0.5 wt.% of CB, and 3.0 wt.% of CB.



**Figure. 1: The absorbing performance of CBCC with different concentration of CB in the frequency range of 8–18 GHz.**



**Figure. 2: The absorbing performance of CBCC with different concentration of CB in the frequency range of 8–26.5 GHz.**

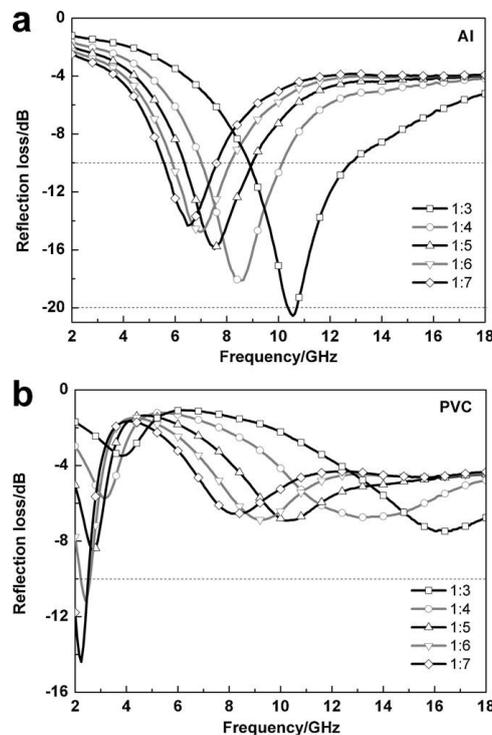
D. Yuping et al. [2012] studied that in order to characterize the microwave absorbing properties of the composite coatings based on Al or PVC sheet, the reflection loss (RL) curves versus frequency for different CIP content are simulated, and shown in Fig. 3. The content of CIP varies from 1:3 to 1:7 (PU:CIP mass ratio). The thicknesses of coating and base plate are 2 mm and 3 mm, respectively. The sweeping frequency ranges from 2 to 18 GHz. From Fig. 3(a), it can be found that the allowable reflection loss ( $RL \leq -10$  dB, for over 90% microwave absorption) can get in the frequency range of 5.5–13 GHz through varying the component content of the coating. It is worth noting that, in Fig. 3(b), the PVC-based coatings display good absorption properties in the lower frequency region (2–4 GHz, S-band), though the overall performance is poor compared with the Al-

based coatings. Therefore, the microwave absorbing properties of composite coating based on Al and PVC studied in frequency range of 2-18 GHz.

**Table. 1: Minimum reflectivity and bandwidth of CBCC in the range of 8–26.5 GHz.**

Content of CB (wt%)	0.5	2.5	3.0
Minimum reflectivity (dB), at frequency (GHz)	-17.04 (18)	20.30 (20.6)	13.86 (25.3)
Bandwidth (reflectivity $\leq$ 10 dB, GHz)	11-26.5	14.9-26.5	19.2-26.5
Bandwidth (reflectivity $\leq$ 15 dB, GHz)	17.4-18.4	18-24.2	-

The results show that the RL peaks of coatings shift towards the lower frequency region by increasing the CIP content or coating thickness. PVC-based coatings with a fixed component content of 1:7 (PU:CIP mass ratio) in CIP/PU layer, exhibit a minimum RL value of -29 dB at 4 GHz and a permissible RL ( $RL \leq -10$  dB) band of 2–6 GHz through varying the thicknesses of PVC sheet and PU/CIP layer, which is much better than the performance of the common metal-based coatings in the lower frequency.



**Figure. 3: Measured reflection loss curves versus frequency of the CIP/PU coatings with varied CIP content (PU:CIP mass ratio) based on Al (a) or PVC (b) sheet.**

### III. MATERIAL AND METHOD

#### 3.1 Material

In this work, low cost mineral waste materials like Carbonyl-Iron powder is used as the microwave absorber in lower layer, as loss layer. The silica fume used as impedance matching and transmission line absorber in upper layer called as surface layer. The bonding agent used is cement and hardening agent used is sand. Carbon black/carbon fibers used in order to accelerate the rate of absorption. Naphthelene powder used as water reducing agent. The specification and chemical composition of used materials are as follows:

**Table. 2: Specification of Carbonyl-Iron**

Atomic Number	Molecular Weight (g/mol.)	Density	Specific Heat	Boiling Point (°F)	Melting Point (°C)	Thermal Conductivity	Soluble in Water
26	195.9	7.87	12	217	1536	12	Insoluble

**Table. 3: Chemical composition of Silica-Fume**

SiO <sub>2</sub>	Al <sub>2</sub> O <sub>3</sub>	Fe <sub>2</sub> O <sub>3</sub>	CaO	MgO	SO <sub>3</sub>	Loss	Specific surface (m <sup>2</sup> /Kg)
95.48	0.27	0.83	0.54	0.97	0.80	1.11	22,000

**Table. 4: Chemical composition of Portland cement, Grade-53**

SiO <sub>2</sub>	Al <sub>2</sub> O <sub>3</sub>	Fe <sub>2</sub> O <sub>3</sub>	CaO	MgO	SO <sub>3</sub>	Loss	Specific surface (m <sup>2</sup> /Kg)
21.50	5.12	3.42	65.3	1.05	2.03	0.46	380

**Table. 5: Specification of (a)Carbon-black & (b) Carbon-Fibres**

Surface area (m <sup>2</sup> /g)	pH scale value	Particle Size
1056	8.0	33 nm

**(a)Carbon-black**

Tensile strength (Gpa)	Density (g/cm <sup>3</sup> )	Carbon Content (%)
≤3500	1.65-1.75	≤98

**(b) Carbon-Fibres**

#### 3.2 Method

The exact ratio and four different Cementitious-based composites having dimensions of 20x20 cm<sup>2</sup> are prepared with different thickness discussed as below in Table 6 and 7.

**Table. 6: Ratio of used material**

S.No	Material	Description
1	Portland Cement	-
2	Carbon Black	5 wt% as that of cement
3	Silica Fume	15 wt% as that of cement
4	Carbonyl-Iron Powder	60 wt% as that of cement
5	Sand	1.5 : 1 (sand to binder)
6	Carbon fibers	5 wt% as that of cement
7	Napthalene Powder	0.5 wt% of cement
8	Al sheet (Grade- 6061)	5mm (thick)

**Table. 7: Thickness and Materials used in each sample**

S.No	Mixture (Layer)	Thickness
1	C+S+CB+SF+N (Single)	10 mm
2	C+S+CF+CI+N (Single)	10 mm
3	C+S+CB+SF+N C+S+CF+CI+N (Double)	1 <sup>st</sup> layer- 2 mm 2 <sup>nd</sup> layer- 2 mm
4	C+S+CB+SF+N C+S+CF+CI+N (Double)	1 <sup>st</sup> layer- 2 mm 2 <sup>nd</sup> layer- 4 mm

Where, C=Cement, S=Sand, CI=Carbonyl-Iron, SF=Silica-Fume, N=Napthalene, CB=Carbon-black, CF=Carbon-Fibres.

The preparation of samples in detail as follows:

**Single-layer:**

**1<sup>st</sup> Sample-** Mix all the materials properly given in Table 8. Add water in proportional to the cement in order to make a thick paste, then pour the paste into the 10mm thick plywood mould and place the mould on the vibrator for 30 seconds, to remove the air bubbles and to get settle down the mixture in all corners with the help of vibrator. Then Place the mould at room temperature for 24 hours to get solidified. After that demoulded it and put the sample in curing process for 28 days. The water level under curing process must be little above from the sample. After curing, In order to reduce the influence of free water in composite material, sample dried at 60<sup>0</sup> C prior to test with the help of Thermostatic Oven, so that its weight do not change with time. Place the fabricated

single cementitious-based layer on the Aluminum sheet.



Figure. 4: Vibrator



Figure. 5: Curing



Figure. 6: Oven

2<sup>nd</sup> Sample- The preparation of second sample same as that of first.

**Double layer:**

3<sup>rd</sup> sample- Firstly make loss layer, Then pour the paste of surface layer onto loss layer, rest all procedure is same as previous one.

4<sup>TH</sup> sample- All the procedure is same as that of 3<sup>rd</sup> sample.



Figure. 7: Fabricated cement based samples



Figure. 8: double layer view



Figure. 9: CI



Figure. 10: CB



Figure. 11: CF



Figure. 12: SF

## IV. TEST METHOD WITH RESULTS AND DISCUSSION:

**4.1 Vector Network Analyser (VNA)-** The Vector Network Analyser is the most important instrument in microwave measurement. Its primary function is measurement of S-parameters. It calculates both magnitude and phase thus this is called Vector Network Analyser. Both Reflection and Transmission characteristics are measured by Network Analyser. Network Analysis is concerned with the accurate measurement of the ratios of the reflected signal to the incident signal, and the transmitted signal to the incident signal. The used VNA operating in the range of 10MHz-67GHz and far field taken as 21 cm. The frequency range chosen for the measurement is 8 to 12 GHz for. Horn Antenna and a co-axial cable is used for the testing process. Horn Antenna is connected with the co-axial cable and the co-axial cable is connected with the port 1 of VNA. Calibrate the VNA using aluminium sheet. Calibration is done in order to make aluminium sheet showing maximum reflection that is no absorption. Place the MUT (Material under Test) exactly in front of the Horn

Antenna one by one at the distance of 30cm, so that maximum reflections must be observed by Horn Antenna.

The obtained S-parameters graphs are shown in below figures:



(a)



(b)



(c)



(d)

Figure. 13: (a) S-parameter graph of 1<sup>st</sup> sample (b) S-parameter graph of 2<sup>nd</sup> sample (c) S-parameter graph of 3<sup>rd</sup> sample (d) S-parameter graph of 4<sup>th</sup> sample



Figure. 14: Sample in front of Horn Antenna

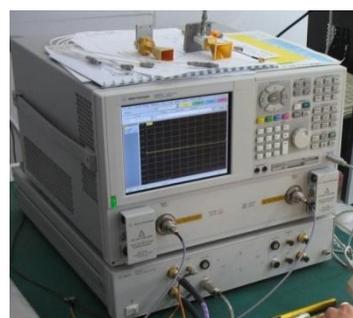
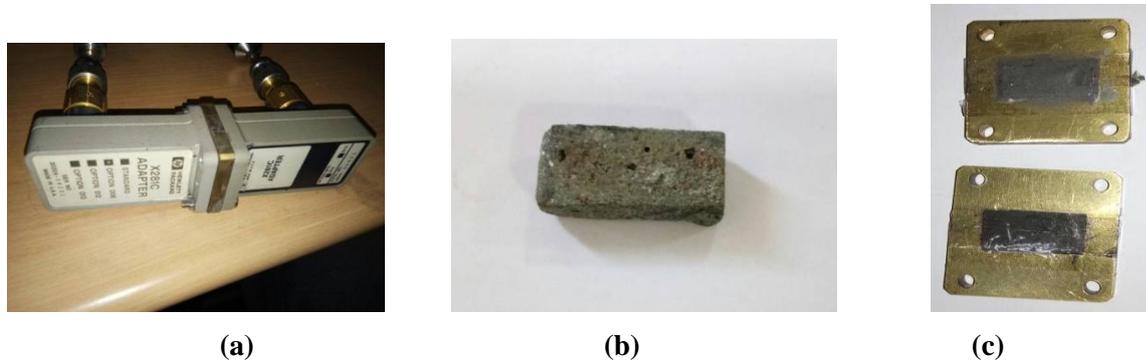


Figure. 15: VNA

**4.2 Dielectric Probe Method-** Another common use of VNA is measurement of permittivity and permeability of the materials. The method used for the calculation of dielectric constant is called Dielectric Probe Method. In this method, two co-axial cables are used to calculate the dielectric constant of MUT. These are designed to calculate dielectric constant in the range of 8 to 12 GHz. The method works best for the sample loaded in waveguide, although transverse electromagnetic guide such as co-axial line can also be used. The sample has to

be in the shape that fit exactly inside the waveguide. Before measurement, calibration of VNA is required. The results obtained from this method by using 85071 Material Measurement Software E07.01.08 through Agilent Technologies N5247A.



**Figure. 16: (a) X281C Adapter (b) WR-90 Waveguide size sample (c) MUT inside waveguide**

## V. CONCLUSION

Microwave absorption, reflectivity and dielectric constant properties of single-layer and double-layer cementitious based radar absorbent containing different contents of silica fume and carbonyl iron as absorbers with involvement of carbon particles have been studied in this paper. The conclusions can be summarized as follows:

- (1) The mortar with silica fume can be used as an impedance matching layer to adjust the permittivity of the surface materials of cement-based absorbing material in order to attain the impedance matching.
- (2) The microwave absorption of single layer is more than that of double layer cement based composite attaining close to -38 dB as shown in Figure. 13 (a) and (b), which put limitation to double layer cement based radar absorbent, investigated in this work.
- (3) The filling of carbon contents to the basic material improves the loss factor of cement material remarkably, which makes cement based composites absorb electromagnetic waves by polarization. The loss factor of cement based radar absorbent increases with carbon content increasing.
- (4) The reflection loss of double-layer plate reaches -29 dB at 8.1 to 8.12 GHz and -25 dB at 9.42 to 9.48 GHz. For single-layer reaches -36 dB at 8.08 to 8.1 GHz and -35 dB at 8.14 to 8.16 GHz with thickness of specimens about 10 mm and absorption bandwidth below -10 dB for both single and double-layer cement based radar absorbent composites.

## REFERENCES

- [1] Chung DDL. Electromagnetic interference shielding effectiveness of carbon materials. Carbon 2001;39(2):279–85.
- [2] Cao JY, Chung DDL. Coke powder as an admixture in cement for electromagnetic interference shielding. Carbon 2003;41(12):2433–6.
- [3] Guang HT, Liu SH, Duan YP, et al. Investigation of the electromagnetic characteristics of cement based composites filled with EPS. Cem Concr Compos 2007;29(1):49–54.

- [4] Wang C, Li KZ, Li HJ, et al. Influence of CVI treatment of carbon fibers on the electromagnetic interference of CFRC composites. *Cem Concr Compos* 2008;30(6):478–85.
- [5] Yamane T, Numata S, Mizumoto T, Naito Y. Development of wide-band ferrite fin electromagnetic wave absorber panel for building wall. In: *Electromagnetic compatibility, 2002. EMC 2002 international symposium, vol. 2; 2002. p. 799–804.*
- [6] Cao MS, Zhu J, Yuan J, et al. Computation design and performance prediction towards a multi-layer microwave absorber. *Mater Des* 2002;23(6):557–64.
- [7] Zhang BS, Feng Y, Xiong J, et al. Microwave-absorbing properties of deaggregated flake-shaped carbonyl-iron particle composites at 2–18 GHz. *Magn IEEE Trans* 2006;42(7):1778–81.
- [8] Oikonomou A, Giannakopoulou T, Litsardakis G. Design, fabrication and characterization of hexagonal ferrite multi-layer microwave absorber. *J Magn Mater* 2007;316:827–30.
- [9] Toutanji Houssam A, Tahar El-Korchi. The influence of silica fume on the compressive strength of cement paste and mortar. *Cem Concr Res* 1995;25(7):1591–602.
- [10] Study on microwave absorbing properties of carbonyl-iron composite coating based on PVC and Al sheet  
Duan Yupinga, Wu Guanglia, Gu Shuchao, Li Shuqing, Ma Guojia. <http://dx.doi.org/10.1016/j.apsusc.2012.02.082>.
- [11] Luo X, Chung DDL. Electromagnetic interference shielding using continuous carbon–fiber carbon–matrix and polymer–matrix composites. *Compos Part B: Eng* 1999;30(3):227–31.
- [12] Chung DDL. Cement reinforced with short carbon fibers: a multifunctional material. *Compos Part B: Eng* 2000;31(6–7):511–26.
- [13] Chung DDL. Cement-based electronics. *J Electroceram* 2001;6(1):75–88.
- [14] Chung DDL. Comparison of submicron-diameter carbon filaments and conventional carbon fibers as fillers in composite materials. *Carbon* 2001;39(8):1119–25.
- [15] Chung DDL. Composites get smart. *Mater Today* 2002(1):30–5.

# **CRITICALITY OF HEAT TREATMENT ON THE PROPERTIES ENHANCEMENT OF MILD STEEL**

**Shubham Sharma<sup>1</sup>, Shalab Sharma<sup>2</sup>**

<sup>1</sup>*Research Scholar, Mechanical Engineering, DAV University (India)*

<sup>2</sup>*Research Scholar, Mechanical Engineering, CT Institute of Technology (India)*

## **ABSTRACT**

*In this current work undertaking, the author examined the heat treatment effect on the tensile properties of Annealed Mild steel. The distinct heat treatments like annealing, normalizing and tested the mechanical properties terminate Torsion Testing Machine. Although heating the material the ductility of material, hardness, toughness should be changed. When we are going to heating the material, then we take superior result for bettering the material parameters of steel.*

**Keywords: Annealing, Heat Treatment, Hardness, Toughness, Tensile strength**

## **I. INTRODUCTION**

The long period of decades, mechanical parameters can be easily refined by heat treatment processes. The main considerable factor for enhancing the microstructure of material is normalizing and annealing. The normalizing process to the heated material up to austenitic temperature parameters. Then after air cooling is done. But hardening process, steel is heated at that temperature which can assist the composition of austenite and grip in temperature up to carbon has diffuse in water or oil steel is an alloy of iron in which carbon parameter varies from 0.15 -1.5 % and the plain carbon steel hold in 0.1 – 0.25%. In this current paper, we explain the heat treatment parameter used in the industry for hot work tool steels and conclusion of material for their hardness and toughness.

## **II. PROPOSED METHODOLOGY**

The research analogous to the heat treatment effect on the Mechanical assets into the divergent fields of research [2].

1. Analytical study of the material associated to the parameter values of heat treatment evolution used to the specimen.
2. The Experimental studies of the material characteristics of the specimen and those samples were adjusted to discrete heat treatment processes.
3. Analyzing of microstructure on each type of heat treatment.

## **III. LITERATURE REVIEW**

1. Gabriela Nicoletta[3] analyzed about the CA-15(ferrite steel) in synchronism of opinion with the ASTM 217

is one of the martensitic steel that meets the needs of the standard. And the results choosing the selection of superior heat treatment parameter's which can proposition the good composite between the yield, tensile strength, impact strength at low-temperature hardness and in order to obtain a superior behavior of the material covered by corrosive environment way things shape up.

2. S.K. AKAY, M. YAZICI, [4] check over the effect of heat treatment evolution on mechanical characteristics of low-grade steel. At that work the author deliberates the new aggregation of HSLA (high strength low alloy steels) which is also known as DPS (dual phase steel). These two classes have to look up the safety standards of fuel economy, with the help of annealing the steel and equilibrium phase diagram and the dual phase of steel microstructures can be composed. The steel microstructures have a ferrite matrix forward with particle of martensite. The physical characteristics are depending upon the morphology of two phases. It can be regarded by changing the annealing temperature with time the annealing proceeding quenching medium and alloying element. This paper investigator deliberate about the heat treatment run by quenching depends upon the physical characteristics of Fe 0.055% C steel. The experimental procedure was the specimen used in this is 2.5mm thick and the chemical composition is fixed and then normalized at 910° C and hold for 45 minutes and then, air cooling is done.

3. B.S. Motagi[5], examined this paper about the heat treatment effect on the mechanical parameter of medium carbon steel. The author accepts various heat treatment processes distribution such as annealing, oil quenching and tempering. All these processes are as used at the different temperature such 200°C , 400° C and 600° C near around 1 hour. After complete this process, the specimen is proved mechanically such as tensile strength, ductility, hardness. The test was completed at room temperature. After this testing, the temperature of tempering is increasing but the steel hardness is decreasing. Therefore steel with copper has high superior strength in comparison to without copper.

4. Devnath Khunte[6] experimentally studied the material parameters like Tensile strength, yield stress at variance types of steels such as low carbon steel and the stainless steel on distinct heat treatment processes to check out the effect of annealing, quenching and normalizing on the mechanical properties at the time testing on Universal Testing Machine UTM. The different types of heat treatment process on the fracture, toughness and hardness are being analyzed. the technique of most favorable heat treatment on the commercial steel that drop in to tempering in the 900°C temperature range and rise superior toughness and high hardness. Then the heated samples used for testing of distinct types of material properties. It means the heat treatment will be superior for bettering the mechanical characteristics of mild steel and stainless steel specimen.

## IV. EXPERIMENTAL SET-UP

The whole test was applied on a torsional testing machine. The Torsional testing machine has been achieve for twisting the distinct types of wires and the tubes sheet materials and then torque would be measured by a pendulum dynamometer system. The Torque can be adjusted to the material with the help of geared motor is concluded a gearbox. The autographic recorder gives the relation enclosed by the torque and angle of twist.



Figure 1. Torsion testing machine

## V. RESULTS & DISCUSSIONS

The Torsional Strength of a specimen without Heat Treatment as shown in table1.

<i>Torsion (KNm)</i>	<i>Angle ( In Degrees)</i>
0	0
0.0411	180
0.0524	360
0.0589	540
0.0630	720
0.0644	800

Table 1. Torsion Strength of mild steel without heat treatment

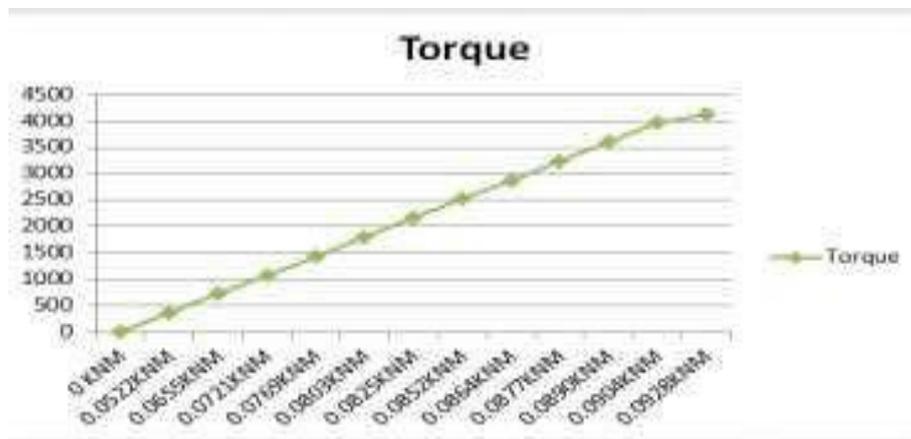
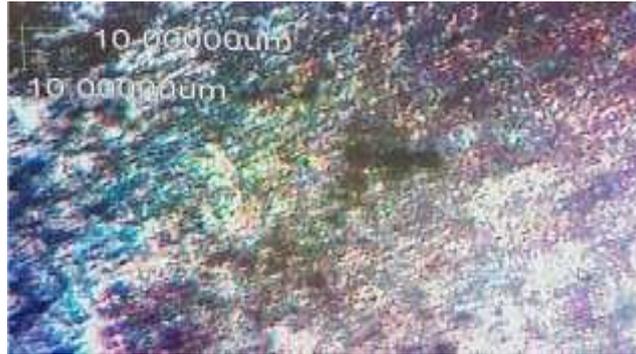


Figure 2. Graph between degrees and torsion for mild steel (without heat treatment)

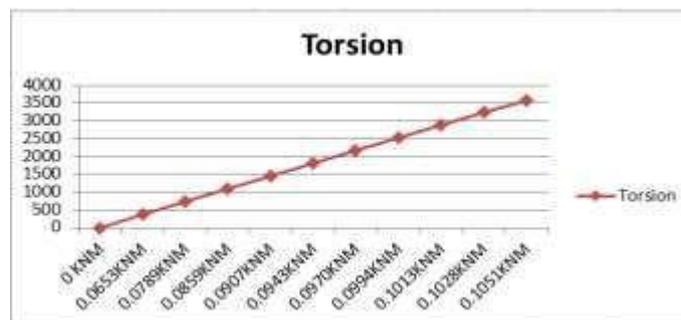


**Figure 3. Mild steel microstructure (without heat treatment)**

The Mechanical characteristics like Tensile Strength, Toughness & Hardness on the heat treatment affect due to Normalizing the specimen. After this Process we performed on the Torsional testing machine has designed for convey Torsion & Twisting moment.

Torsion	Degrees
0 KNM	0
0.0653KNM	360
0.0789KNM	720
0.0859KNM	1080
0.0907KNM	1440
0.0943KNM	1800
0.0970KNM	2160
0.0994KNM	2520
0.1013KNM	2880
0.1028KNM	3240
0.1051KNM	3560

**Table 2. Torsion strength of mild steel with heat treatment (Normalizing)**



**Figure 4. Graph between degrees and torsion for mild steel with heat treatment (Normalizing)**

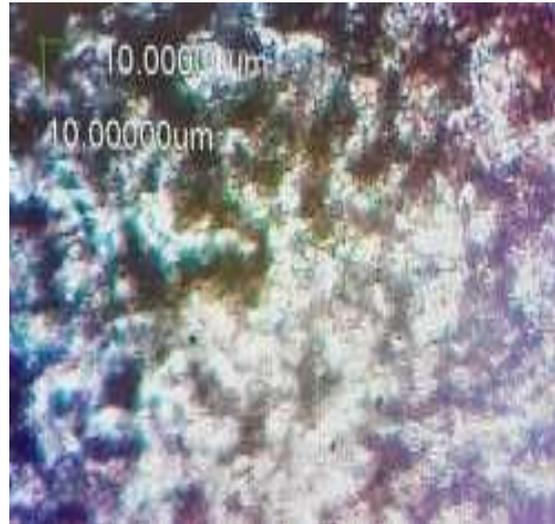


Figure 5. Mild Steel microstructure with heat treatment (Normalizing)

Torsion (K	Angle (In Degrees)
0 KNM	0
0.0522KNM	360
0.0655KNM	720
0.0721KNM	1080
0.0769KNM	1440
0.0803KNM	1800
0.0825KNM	2160
0.0852KNM	2520
0.0864KNM	2880
0.0877KNM	3240
0.0890KNM	3600
0.0904KNM	3960
0.0928KNM	4130

Table 3. Torsion Strength of mild steel wit heat treatment (Annealing)



**Figure 6. Graph between degrees and torsion for mild steel with heat treatment (Annealing).**

The material microstructure shows the nucleation and recrystallization which is due to cold deformation. grain growth is held at the higher degree of dislocation which can lead the reduction of mechanical parameters of material. Therefore its conclusion the mechanical parameters of nails and microstructure analysis, aspired to property of nails has achieved and composed the microstructure evolution of the mild steel at the same time as annealing [7].



**Figure 7. Mild Steel microstructure with Heat Treatment (Annealing)**

## VI. CONCLUSIONS

The time between performing this test, the heat treatment consequence on the annealed tensile properties was review. The material is heated at 700° C temperature during the full anneals that causes a large effect of the material parameter. It's effect on both the microstructure and the room temperature of tensile properties. The ductility of steel grade is increasing on increasing the tempering temperature. That shows mild steel has dual phase which can be incomparably enlarge by heat treatment processes. The conclusion shows that we can amend the strength at high temperature.

## REFERENCES

- [1] John V.B (1980), an introduction to material science, 1st edition, page no.(321-324).
- [2] ASTM Ohio book, volume 4, heat testing for metals, ohio 1991.
- [3] Gabriela Nicoleta,(2000), CA-15(Ferrite material) martensitic stainless steel properties effected by heat treatment processes.
- [4] S. K. Akay(2009). The heat treating on the mild steel to find the desired properties of the specimen.
- [5] B.S. Motegi (July 2012), the microstructure of mild carbon steel is changing during heat treatment process.
- [6] Devnath hunter(2010), the mechanical properties of medium carbon steels materials characterization during heat treatment.
- [7] Vinod Joshi(2015), A review on the effect of microstructure of steel.

# **A REVIEW ON EXPERIMENTAL EVALUATION AND TESTING OF CEMENTITIOUS BASED COMPOSITES WITH CONDUCTIVE ADDITIVES AS RADAR ABSORBING MATERIAL**

**Rupali Rai**

*PG Research Scholar, Electronics and Communication Engineering, DAV University (India)*

## **ABSTRACT**

*The electromagnetic absorbing effectiveness of proposed radar absorbing based specimen with different contents involve: Carbonyl Iron as ferrite, conductive filler as carbon fibres/carbon black and admixture of silica fume with Portland cement studied in this review paper. Double-layer cementitious composites filled with Carbonyl Iron ferrite as microwave absorbers. The addition of silica fume, use to improve the impedance matching between the cementitious composites and free space. The main objective of this paper to achieve good absorption with wide bandwidth corresponds to reflection loss,  $RL \leq -10$  dB for absorber layer thickness about 10mm for cost-effective production of radar wave absorber. An experimental evaluation of this cement based composite is tested under frequency range of 8 to 12GHz. A double layer approach is applied for obtaining good absorption. With more and more severity of electromagnetic environment pollution, the study on building materials that can prevent electromagnetic interference(EMI) has caused great attention. This paper mainly reviews the cement-based EMI shielding and wave absorbing building materials.*

**Keywords:** *Carbonyl iron, Silica fume, Carbon fibres, Carbon black, ferrites, Impedance matching, Layered cementitious composites, Microwave absorption, Reflectivity.*

## **I. INTRODUCTION**

Now people are living in a more and more complicated electromagnetic environment. Actually, electrical devices have greatly improved the quality of our lives. However, everything has its bad effects. For example, sometimes we have to shield the electromagnetic radiations from such devices as computers, mobiles, and military devices to avoid leaking out of important information or avoid radar tracing. In other cases, the reflection of electromagnetic waves from the enclosure of high buildings can lead to the disorder of TV signals around the buildings. Now people are aware that radiation of electromagnetic waves may do harm to the health of human beings. Thus, development of building composite materials containing low cost components such as carbon black (CB) which are able to absorb or shield electromagnetic radiations becomes more and more necessary in the modern society. The shielding effectiveness (SE) is the sum of three terms such as reflection loss, absorption loss and multi-reflections.

So, SE is defined in decibels (dB) and its magnitude can be written as follows:

$$SE_T(\text{dB})=10 \log (P_I/P_T) \quad \text{eq. (1)}$$

where  $P_I$  and  $P_T$  are the electric fields that are incident on and transmitted through the shield. The reflectivity of -10 to -20 dB means that the incident electromagnetic waves have been reduced by about 70–90%. As the reflectivity of absorbing wave materials is less than -10 dB, they can be used in practice. Cement is slightly conductive, but its SE is very low. To increase the cement materials SE by adding a small amount of a conductive additive such as graphite powder, carbon black, carbon fibers, carbon filaments or steel fibers. The need of preventing electromagnetic interference (EMI) has been increasing with the development and application of electronic science and communication technology [1] EMI prevention is particularly needed for underground vaults containing transformers and other electronics that are related to electric power and telecommunication [2]. Cementitious composites are one of the most common building materials used in engineering construction. Cement-based composites are complex systems that include hydration products, unhydrated cement particles and aggregates of different sizes. Generally, as a whole system cement-based material is slightly conducting, but its EMI shielding effectiveness and wave absorbing property are very low, so admixtures are needed to improve the ability to resist the electromagnetic wave interference. There have been many studies on the reflection loss of cement matrix composites by introducing fillings, such as expanded Polystyrene (EPS) and carbon fibers [3,4].

Ferrite is one of the most commonly used materials as a kind of electromagnetic wave absorber. Many studies have been carried out in Japan in Radio frequency (RF) area to investigate the electromagnetic absorption properties of buildings employing ferrite[5]. However, the application has been restricted by the narrow band characteristics of single-absorbers. It is known from many research studies that the microwave absorber with double-layer structure has wider absorption bandwidth and lower reflection loss (RL) than the single-layer absorber in GHz frequency [6].

For the purpose of preparing a low-reflecting absorber in the desired wide frequency range, two fundamental conditions must be satisfied [7,8]: the first is that the incident wave can enter the absorber to the greatest extent (impedance matching characteristic), and the second is that the electromagnetic wave entering into the materials can be almost entirely attenuated and absorbed within the finite thickness of the material (attenuation characteristic). The impedance matching is the principle that the electromagnetic wave is absorbed in the materials. There are several methods to improve impedance matching between material and free space. One of them is to use low dielectric constant materials to adjust the characteristic impedance of the absorber. Silica fume [9] is a kind of fine non-crystalline silica produced in electric arc furnaces as a by-product during the production of metallic silicon or ferrosilicon alloys, the  $\text{SiO}_2$  content of which ranges from 85% to 98%. The microwave absorbing coatings with PVC (polyvinyl chloride) sheet as base plate are fabricated composed of CIP (carbonyl-iron particle) as absorbent and PU (polyurethane varnish) as matrix. The absorption properties of PVC-based coatings with different CIP content are investigated and compared with the corresponding Al (aluminium)-based coatings [10].

In order for a conductive filler to be highly effective for shielding, it preferably should have a small unit size, a high conductivity and a high aspect ratio. As to improving the conductive ability and shielding

effectiveness of cement matrix composites, carbon fibres are more effective than particles such as carbon black and coke due to their large aspect ratio, which can help to make more conductive networks through intercalating [11–13]. With the decrease in carbon fibre cost and the increase of demand for cement based composites with high structure and multi-function, carbon fibre cement matrix composites are gaining in importance quite rapidly. In the carbon fibre reinforced cement based composites, the carbon fibre with a diameter of more than 0.1  $\mu\text{m}$  is often called fibre, whereas that with the diameter less than 0.1  $\mu\text{m}$  is often called carbon filament. Due to its higher aspect ratio, carbon filament is superior to carbon fibre in shielding [14,15].

When the carbon materials are used as the conductive fillers, it is necessary that the fillers be well dispersed, so it often needs to introduce some dispersants.

Dispersants are not conductive themselves, but their introduction can obviously improve the dispersion degree of conductive fillers so as to help make more efficient conductive networks. Among the various types of dispersants, styrene butadiene latex and silica fume are the most common for use in cement based composites. Moreover due to the weak strength between the carbon fibre and cement matrix, the introduction of latex, silica fume or methylcellulose can improve the bond between the fibre and matrix, thereby improving the mechanical properties of the cement composites [16,17]. A surface pretreatment of carbon fibre or treating silica fume with silane can improve the bond strength between carbon fibre and the cement matrix and the dispersion degree of conductive fillers, thereby increase the shielding effectiveness of the composites [18–20].

The mortar with silica fume can be used as an impedance matching layer to adjust the permittivity of the surface materials of the cement-based absorbing material in order to attain the impedance matching. The microwave reflectivity of the single-layer mortar filled with ferrite is higher than that of the plain mortar due to the mismatching of the impedance and the design of double-layer structure has excellent absorption property because of the impedance match of materials. The impedance match layer is made of silica fume mortar and the loss layer is added with 30 wt.% ferrite based composite [21].

The filling of CB improves the loss factor of the cement material remarkably, which makes CBCC absorb electromagnetic waves by polarization. The loss factor of CBCC increases with the CB content increasing and the Compressive strength of CBCC decreases with CB content increasing. Compressive strength decreased substantially when CB content is more than 3 wt.% [22]. Fig. 1 shows the influence of filling CB volume concentration on the reflectivity of CBCC in the range of 8–18 GHz. In Fig. 2, plain cement mortar has a low reflectivity of about -5 dB. All CBCC specimens except CBCC containing 1.0 wt.% and 3.0 wt.% of CB have lower reflectivity than plain paste.

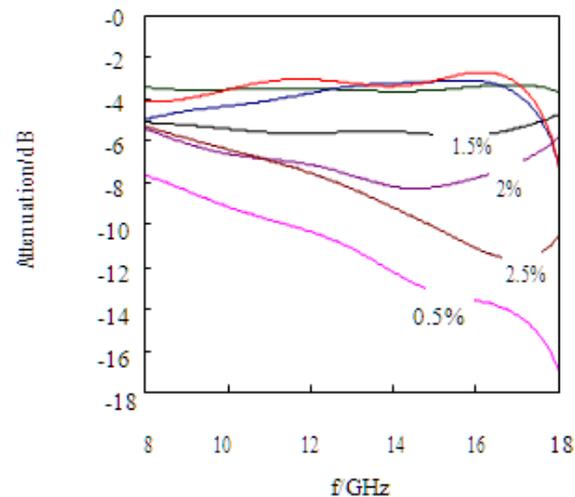
It can be observed that CBCC containing 0.5 wt% of CB has the minimum reflectivity in 8–18 GHz. Its reflectivity decreases with the increasing frequency. At 18 GHz, its minimum reflectivity is -17.04 dB. The bandwidth in which the reflectivity is less than -10 dB is from 11 GHz to 18 GHz. Another worthwhile material is CBCC containing 2.5 wt.% of CB. At 17 GHz, its minimum reflectivity is -11.64 dB. The bandwidth in which the reflectivity is less than -10 dB was from 14.9 GHz to 18 GHz. Fig. 2 shows the influence of filling CB volume concentration on the reflectivity of CBCC in the range of 18–26.5 GHz. All CBCC specimens except CBCC containing 1.0 wt.% and 2.0 wt.% of CB have lower

reflectivity than plain paste.

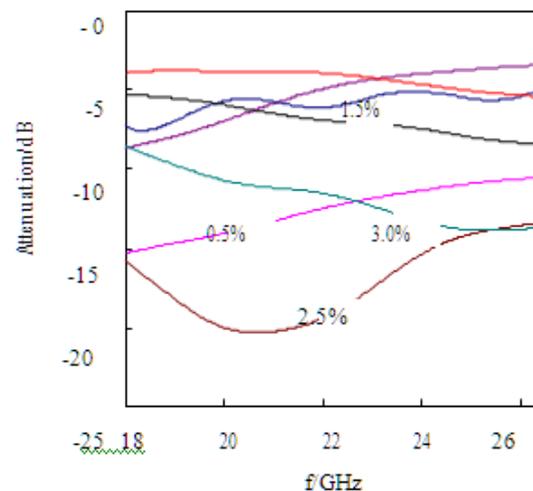
It can be observed that CBCC containing 2.5 wt.% of CB has the minimum reflectivity in 18–26.5 GHz. At 20.6 GHz, its minimum reflectivity is -20.30 dB. In the whole frequency range of 18–26.5 GHz, the reflectivity is less than -10 dB.

The bandwidth in which the reflectivity is less than -15 dB is from 18 GHz to 24.2 GHz. Other worthwhile materials are CBCC containing 0.5 wt.% of CB and 3.0 wt.% of CB. In the whole range of 18–26.5 GHz, the reflectivity is less than -10 dB in CBCC containing 0.5 wt.% of CB. In CBCC containing 3.0 wt.% of CB, its minimum reflectivity is -13.86 dB at 25.3 GHz.

The bandwidth in which the reflectivity is less than -10 dB is from 19.2 GHz to 26.5 GHz. Main data drawn from Figs. 1 and 2 is listed in Table 1. It can be found that the bandwidth in which the reflectivity is less than -10 dB decreased in the order: CBCC containing 0.5 wt.% of CB, CBCC containing 2.5 wt.% of CB, and 3.0 wt.% of CB. The absolute value of maximum reflectivity decreases in the order: CBCC containing 2.5 wt.% of CB, CBCC containing 0.5 wt.% of CB, and 3.0 wt.% of CB.



**Figure. 1: The absorbing performance of CBCC with different concentration of CB in the frequency range of 8–18 GHz.**



**Figure. 2: The absorbing performance of CBCC with different concentration of CB in the**

## frequency range of 18-26.5 GHz.

**Table. 1: Minimum reflectivity and bandwidth of CBCC in the frequency range of 8– 26.5 GHz.**

Content of CB (wt%)	0.5	2.5	3.0
Minimum reflectivity (dB), at frequency (GHz)	-17.04 (18)	20.30 (20.6)	13.86 (25.3)
Bandwidth (reflectivity ≤ 10 dB, GHz)	11-26.5	14.9-26.5	19.2-26.5
Bandwidth (reflectivity ≤ 15 dB, GHz)	17.4-18.4	18-24.2	-

The microwave absorption property of material is typically characterized in terms of the power reflection of the plane wave reflected from an infinite slab of material which is backed by metallic surface [27]. The power reflectivity of the coating, is generally produced for normal incidence, is commonly expressed as R:

$$R = 20 \lg \left| \frac{Z_{in} - Z_0}{Z_{in} + Z_0} \right| \quad (2)$$

Where  $Z_{in}$  and  $Z_0$  present the input impedance of coating and intrinsic impedance of free space with a value of  $377 \Omega$ , respectively. According to transmission theory, for a single-layer absorber backed by a perfect conductor, the input impedance of the absorber  $Z_{in}$  of a metal-backed microwave absorbing coating is given by:

$$Z_{in} = \eta \tanh(\gamma d) \quad (3)$$

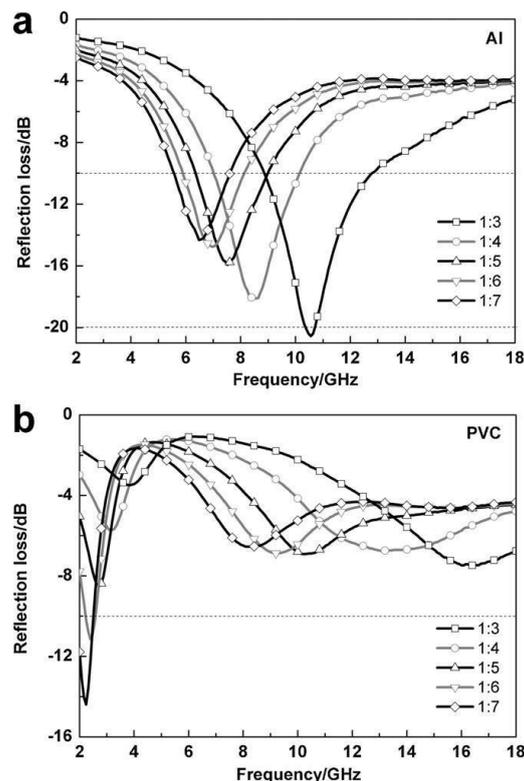
$$\eta = Z_0 \sqrt{\mu/\epsilon} \quad (4)$$

$$\gamma = j 2\pi f \quad (5)$$

In order to characterize the microwave absorbing properties of the composite coatings based on Al or PVC sheet, the reflection loss (RL) curves versus frequency for different CIP content are simulated based on eq. (2)–(3), and shown in Fig. 3. The content of CIP varies from 1:3 to 1:7 (PU:CIP mass ratio). The thicknesses of coating and base plate are 2 mm and 3 mm, respectively. The sweeping frequency ranges from 2 to 18 GHz.

From Fig. 3(a), it can be found that the allowable reflection loss ( $RL \leq -10$  dB, for over 90% microwave absorption) can get in the frequency range of 5.5–13 GHz through varying the component content of the coating.

It is worth noting that, in Fig. 3(b), the PVC-based coatings display good absorption properties in the lower frequency region (2–4 GHz, S-band), though the overall performance is poor compared with the Al-based coatings.



**Figure. 3: Measured reflection loss curves versus frequency of the CIP/PU coatings with varied CIP content (PU:CIP mass ratio) based on Al (a) or PVC (b) sheet.**

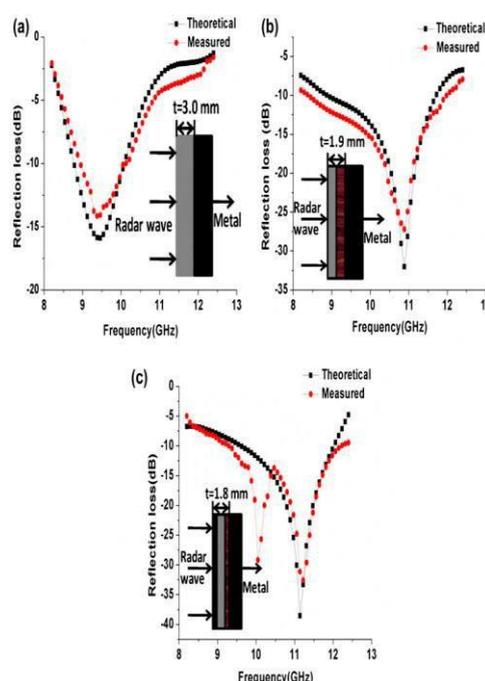
The mineral dust (M) and beach sand-based waste composite (C) material as broadband radar wave absorber in the frequency range of 8.2–12.4 GHz. A multilayer approach is applied for obtaining the good absorption, where thickness of different layers is optimized by genetic algorithm [29].

The result indicates that a thin broadband absorber, having coating thickness less than 2.0 mm and bandwidth ( $RL \leq -10$  dB) can be obtained by adopting multilayer absorber. The optimal coating thickness for single-layer absorber (M1) for which the maximum absorption takes place is 3.0 mm.

The measured RL value for single-layer absorber is  $-14.15$  dB at 9.3 GHz. In two-layer absorber, the peak RL of  $-27.20$  dB at 10.8 GHz can be obtained with a thickness of each upper and lower layer less than 1.0 mm.

The total coating thickness for two-layer absorber is less than 2.0 mm. Similarly, three-layer absorber possesses a RL of  $-32.58$  dB at 11.2 GHz with 1.8 mm coating thickness.

The total coating thickness for both the multilayer absorbers is less than that of 2.0 mm, i.e. 1.9 mm for two layer and 1.8 mm for three layer, respectively and shown in Figure 4.



**Figure 4. Measured RL of (a) single layer of M1 with thickness 3.0 mm (b) two layer consists of M1 (1.0 mm) and M2C (0.9 mm), and (c) three-layer absorber consists of M2 (0.5 mm), M1 (0.7 mm), and M2C (0.6 mm).**

Comparison of different papers on the basis of its type, thickness, frequency and reflection loss shown in Table 2.

**Table. 2: Comparison of different papers.**

S.No.	Paper	Material used	Information includes RL/BW/Frequency Range/Thickness/Base Material.
1.	Microwave absorbing properties of double-layer cement Composites containing ferrites.	Silica fume and Ferrites	Minimum reflectivity reaches -15 dB at 12 GHz when layer thickness is 10 mm. Absorption bandwidth below -10 dB is 6.6 GHz ranging from 11.4 to 18 GHz when layer thickness is 5 mm.

# 4<sup>th</sup> International Conference on Innovative Trends in Science, Engineering and Management

(C-DAC, Mumbai) Centre for Development of Advanced Computing, Mumbai, Maharashtra (India)

(ICITSEM-17)

17<sup>th</sup> June 2017, [www.conferenceworld.in](http://www.conferenceworld.in)

ISBN: 978-93-86171-47-4

2.	Study on microwave absorbing properties of carbonyl-iron composite based on PVC and Al sheet	Carbonyl iron Particle	Frequency range is 2-18 GHz, RL of -29 dB at 4 GHz and $RL \leq -10$ dB band of 2-6 GHz through varying thickness of sheet and particles.
3.	Electromagnetic wave absorbing characteristics of carbon Black cement-based composite.	Carbon black	Frequency range is 8-26.5 GHz, minimum reflectivity of -20.30 dB, bandwidth in which the reflectivity is less than -10 dB is from 14.9 to 26.5 GHz.
4.	Microwave properties of high-aspect ratio carbonyl iron/epoxy absorbers	Carbonyl iron (spherical and flaked shape)	Frequency range is 2-18 GHz, thickness of 3 mm, the reflection loss at 5.5 GHz reaches -23.0 dB.
5.	Absorption properties of carbon black/silicon carbide microwave absorbers	Carbon fibres	Frequency range of 8.0–18.0 GHz, reflectivity of -19.3 dB (without) and -8.1 dB (with treatment)
6.	Complex permeability and permittivity variation of carbonyl iron rubber in the frequency range of 2 to 18 GHz	CB/SiC	2 mm thickness, maximum reflection loss becomes -41 dB at 9 GHz, and the -10 dB bandwidth reaches 6 GHz. frequency range is 2-18 GHz.
7.	Electromagnetic Radiation Absorbing Paints Based on Carbonyl Iron (CI) and Polyaniline	Carbonyl iron	Frequency range of 2 to 18 GHz
8.	Electromagnetic Radiation Absorbing Paints Based on Carbonyl Iron (CI) and Polyaniline	Carbonyl and Polyaniline.	Attenuation is 4 dB, about 60% of absorption. Frequency range is 8-12 GHz.

II. CONCLUSION

The single and double layer absorbers composed of cost-effective composites like CB,CF, silica fume and carbonyl iron with a different coating thickness and tested under the 8–12 GHz frequency range. Evidently enhanced absorption with good bandwidth ( $RL \leq -10$  dB) and less coating thickness is provided for double layer absorbers, probably caused by the matching of the impedance of the respective absorption layers. A double-layer cementitious composites filled with carbonyl iron and silica fume as microwave absorbers is design on the basis of impedance matching theory and electromagnetic wave propagation laws as study shows that silica fume can improve the impedance matching between cementitious composites and free space. The silica fume used to improve the impedance matching for cementitious composites. Two types of microwave absorbers used: single-layer microwave absorber composed of Carbonyl Iron and double-layer microwave absorber composed of mortar with silica fume mortar as the surface layer and Carbonyl Iron mortar as the loss layer.

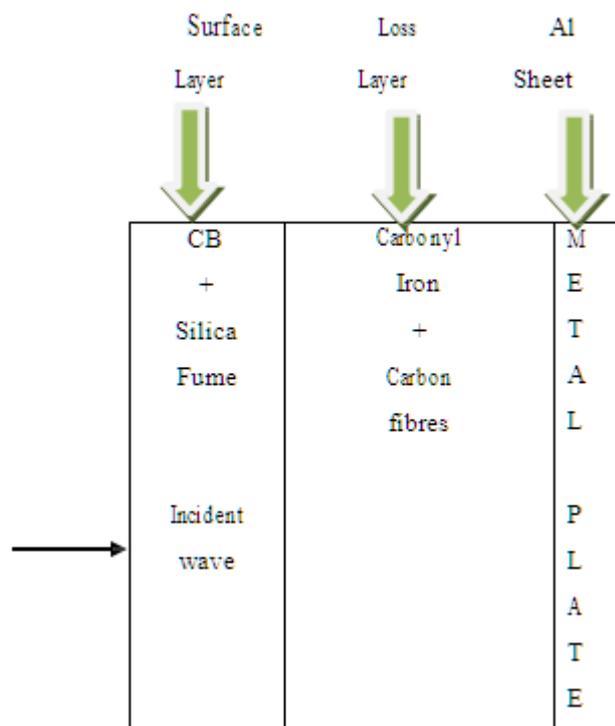


Figure. 5: Structure of Proposed Cement-based Radar Absorbent

The significance of materials as follows:

- a) Silica fume used to improve the impedance matching and having quality of best transmission line absorber [21]. The view and properties of silica as follow:

b)

**Table. 3: Specification of Silica-Fume**

SiO <sub>2</sub>	Al <sub>2</sub> O <sub>3</sub>	Fe <sub>2</sub> O <sub>3</sub>	CaO	MgO	SO <sub>3</sub>	Loss
95.48	0.27	0.83	0.54	0.97	0.80	1.11



**Figure. 6: Silica-Fume**

c) Carbonyl Iron has excellent absorptive abilities at lower frequencies and can widen frequency band when combined with other absorbents and having quality of good reflectors as it is used in the production of some ferrites. Typically applicable in radar absorbing material, EMI/RFI shielding products and metal injection molded parts [9,10]. It's well known that carbonyl-iron particles (CIP), which possesses excellent magnetic-loss property, in the frequency range of 2-18 GHz, is widely blended in polymer matrix as microwave absorbing materials [23-26].

**Table. 4: Specification of Carbonyl-Iron**

Atomic Number	Molecular Weight (g/mol.)	Density	Specific Heat	Boiling Point (°F)	Melting Point (°C)	Thermal Conductivity
26	195.9	7.87	12	217	1536	12



**Figure. 7: Carbonyl-Iron**

c) Carbon fibres are more efficient than particles like Carbon black and coke due to their large Aspect ratio, which can help to make more conductive networks [11-15]. Cement is slightly conductive, but its SE is very low. It is a simple and practical method to increase the cement materials SE by adding a small amount of a conductive additive such as graphite powder, carbon black, carbon fibers, carbon filaments or steel fibers.

**Table. 5: Specification of Carbon-Fibres**

Tensile strength (Gpa)	Density (g/cm <sup>3</sup> )	Carbon Content (%)
≤3500	1.65-1.75	≤98

**Table. 6: Specification of Carbon-Black**

Surface area (m <sup>2</sup> /g)	pH scale value	Particle Size
1056	8.0	33 nm



**Figure. 8: Carbon-Black**



**Figure. 9: Carbon-Fibres**

Therefore, the concept of waste composite-based Double layer coatings expected to be a good concept and results in the eventual formation to an efficient absorber. All these fascinating properties of developed coatings are quite encouraging and show their enormous potential for various practical EM applications.

## REFERENCES

- [1] Chung DDL. Electromagnetic interference shielding effectiveness of carbon materials. Carbon 2001;39(2):279–85.
- [2] Cao JY, Chung DDL. Coke powder as an admixture in cement for electromagnetic interference shielding. Carbon 2003;41(12):2433–6.
- [3] Guang HT, Liu SH, Duan YP, et al. Investigation of the electromagnetic characteristics of cement based composites filled with EPS. Cem Concr Compos 2007;29(1):49–54.

- [4] Wang C, Li KZ, Li HJ, et al. Influence of CVI treatment of carbon fibers on the electromagnetic interference of CFRC composites. *Cem Concr Compos* 2008;30(6):478–85.
- [5] Yamane T, Numata S, Mizumoto T, Naito Y. Development of wide-band ferrite fin electromagnetic wave absorber panel for building wall. In: *Electromagnetic compatibility, 2002. EMC 2002 international symposium*, vol. 2; 2002. p. 799–804.
- [6] Cao MS, Zhu J, Yuan J, et al. Computation design and performance prediction towards a multi-layer microwave absorber. *Mater Des* 2002;23(6):557–64.
- [7] Zhang BS, Feng Y, Xiong J, et al. Microwave-absorbing properties of deaggregated flake-shaped carbonyl-iron particle composites at 2–18 GHz. *Magn IEEE Trans* 2006;42(7):1778–81.
- [8] Oikonomou A, Giannakopoulou T, Litsardakis G. Design, fabrication and characterization of hexagonal ferrite multi-layer microwave absorber. *J Magn Mater* 2007;316:827–30.
- [9] Toutanji Houssam A, Tahar El-Korchi. The influence of silica fume on the compressive strength of cement paste and mortar. *Cem Concr Res* 1995;25(7):1591–602.
- [10] Study on microwave absorbing properties of carbonyl-iron composite coating based on PVC and Al sheet Duan Yupinga, Wu Guanglia, Gu Shuchao, Li Shuqing, Ma Guojia. <http://dx.doi.org/10.1016/j.apsusc.2012.02.082>.
- [11] Luo X, Chung DDL. Electromagnetic interference shielding using continuous carbon-fiber carbon-matrix and polymer-matrix composites. *Compos Part B: Eng* 1999;30(3):227–31.
- [12] Chung DDL. Cement reinforced with short carbon fibers: a multifunctional material. *Compos Part B: Eng* 2000;31(6–7):511–26.
- [13] Chung DDL. Cement-based electronics. *J Electroceram* 2001;6(1):75–88.
- [14] Chung DDL. Comparison of submicron-diameter carbon filaments and conventional carbon fibers as fillers in composite materials. *Carbon* 2001;39(8):1119–25.
- [15] Chung DDL. Composites get smart. *Mater Today* 2002(1):30–5.
- [16] Fu X, Lu W, Chung DDL. Improving the bond strength between carbon fiber and cement by fiber surface treatment and polymer addition to cement mix. *Cem Concr Res* 1996;26(7):1007–12.
- [17] Fu X, Chung DDL. Degree of dispersion of latex particles in cement paste, as assessed by electrical resistivity measurement. *Cem Concr Res* 1996;26(7):985–91.
- [18] Chen PW, Chung DDL. Improving electrical conductivity of composites comprised of short conducting fibers in a nonconducting matrix: the addition of a nonconducting particulate filler. *J Electron Mater* 1995;24(1):47–51.
- [19] Xu Y, Chung DDL. Improving silica fume cement by using silane. *Cem Concr Res* 2000;30(8):1305–11.
- [20] Cao J, Chung DDL. Improving the dispersion of steel fibers in cement mortar by the addition of silane. *Cem Concr Res* 2001;31(2):309–11.
- [21] Microwave absorbing properties of double-layer cementitious composites containing Mn–Zn ferrite Xiuzhi Zhang a,b,\* , Wei Sun a,b.
- [22] Electromagnetic wave absorbing characteristics of carbon black cement-based composites Dai Yawen a, Sun Mingqing b,\* , Liu Chenguo a, Li Zhuoqi.

# 4<sup>th</sup> International Conference on Innovative Trends in Science, Engineering and Management

(C-DAC, Mumbai) Centre for Development of Advanced Computing, Mumbai, Maharashtra (India)

(ICITSEM-17)

17<sup>th</sup> June 2017, [www.conferenceworld.in](http://www.conferenceworld.in)

ISBN: 978-93-86171-47-4

- [23] M.S. Pinho, M.L. Gregori, R.C.R. Nunes, B.G. Soares, Performance of radar absorbing materials by waveguide measurements for X- and Ku-band frequencies, *Eur. Polym. J.* 38 (2002) 2321–2327.
- [24] L.D. Liu, Y.P. Duan, S.H. Liu, L.Y. Chen, J.B. Guo, Microwave absorption properties of one thin sheet employing carbonyl–iron powder and chlorinated polyethylene, *J. Magn. Magn. Mater.* 322 (2010) 1736–1740.
- [25] Y.B. Feng, T. Qiu, C.Y. Shen, Absorbing properties and structural design of microwave absorbers based on carbonyl iron and barium ferrite, *J. Magn. Magn. Mater.* 318 (2007) 8–13.
- [26] Y.C. Qing, W.C. Zhou, S. Jia, F. Luo, D.M. Zhu, Electromagnetic and microwave absorption properties of carbonyl iron and carbon fiber filled epoxy/silicone resin coatings, *Appl. Phys. A* 100 (2010) 1177–1181.
- [27] E.F. Knott, The thickness criterion for single-layer radar absorbents, *IEEE Trans. Antennas Propag.* 27 (1979) 698–701.
- [28] Khurram AA, Ali N, Rakha SA, Zhou P, Munir A. Optimization of the carbon coating of honeycomb cores for broadband microwave absorption. *IEEE Trans. Electromagn. Compat.* 2014;56:1061–1066.

# CO JOINING OF COMPRESSOR ADDER WITH 8x8 BIT VEDIC MULTIPLIER FOR HIGH SPEED

Neha Trehan<sup>1</sup>, Er. Inderjit Singh<sup>2</sup>

<sup>1</sup>PG Research Scholar, <sup>2</sup>Assistant Professor, Department of Electronics and Communication Engineering, DAV University Jalandhar, Punjab (India)

## ABSTRACT

*In this paper we present technique of 'Co joining of compressor adder with 8x8 bit Vedic multiplier for high speed'. Vedic mathematics is an ancient technique for solving the complex problems. Equations of each 16 bit resultant are calculated using Urdhava-triyakbhyam sutra in English named as 'Vertically and Crosswise' technique. The best feature of this method is that the partial product needed for the multiplication are already generated in advance and this lead to decrease in delay and thus saves time. Compressor adders are used to implement these equations. In comparison to traditional architectures of compressor using half and full adders the modified compressor adder that make use of MUX gave better delay performance. Designs are coded in VHDL and synthesis in Xilinx ISE 14.5 with Spartan 3e series of FPGA, fg320 and speed grade -4.*

**Keywords:** Vedic Mathematics, Urdhava-Triyakbhyam Method, Compressor Adder.

## I. INTRODUCTION

These days we have concern about three main issues in VLSI domain i.e. Speed, Area, Power and these all are related with microprocessor and the speed is utmost need everywhere, the speed of the processor merely depends on how it is performing multiplications as all data processing needs multiplication so multiplication is the building block that describes the speed. The equations of 16 bit resultant are calculated using Urdhava-Triyakbhyam method which is an ancient sutra derived from Vedas. Compressor adder are used to implement them Basically we have two types of compressor adder in the purposed methodology one are traditional that make use of compressor adder made up of half adders and full adders only and other are modified compressor adder that make use of compressor adder that are made of half adder and full adder from multiplexers. Compressor adders used with Mux perform better delay performance as compares to traditional ones. Urdhava-Triyakbhyam method for two eight bit numbers is given below:

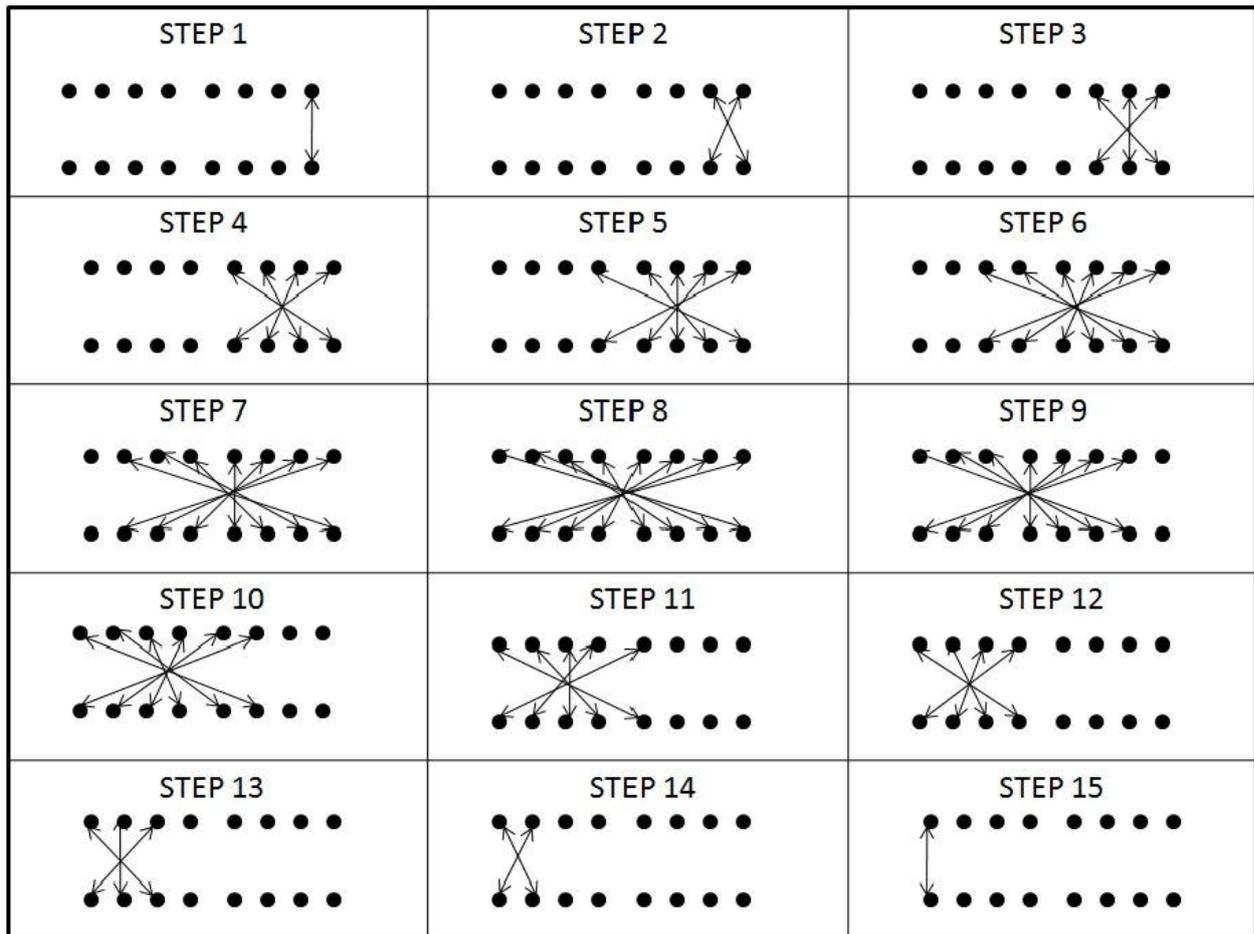


FIGURE 1: Pictorial representation of Urdhva-Tiryakbhyam Sutra for multiplication of two eight bit numbers

This paper comprises of four sections. Section I describes Introduction. Section II compressor adders. Section III is implementation and equations. Section IV Tables and simulation results. Section V Conclusion and future scope.

## II. COMPRESSOR ADDER

Compressor adders are basic circuits which add bits more than four at a time to give better delay. The symbolic representation of compressor architecture is  $N-r$  where 'N' represents the number of the bits that are fed and 'r' represents the total count of the 1s present in N bits.

**2.1. 2-2 compressor adder:** A 2-2 compressor adder is a logical circuit in which maximum two bits can be added at same time and two bit resultant can be obtained. The circuit is simply a half adder. Fig2. represent modified 2-2 compressor adder that uses half and full adder made up from 2:1 MUX.

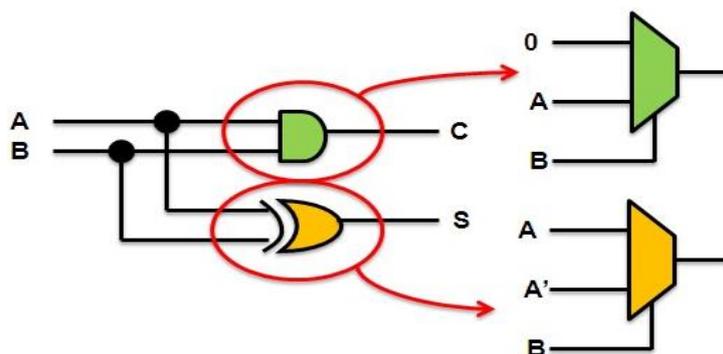


FIGURE2. Modified Design of Half Adder

**2.2. 3-2 compressor adder:** A 3-2 compressor adder is a logical circuit in which maximum three bits can be added at same time and two bit resultant can be obtained. The circuit is simply a full adder. Fig3. represent modified 3-2 compressor adder that uses half and full adder made up from 2:1 MUX.

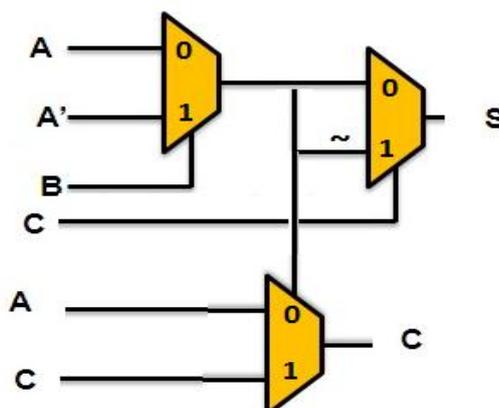


FIGURE3. Modified Design of Full Adder

**2.3. 4-3 compressor adder:** A 4-3 compressor adder is a logical circuit in which maximum four bits can be added at same time and three bit resultant can be obtained. The half adder and full adder designs with the use of multiplexers mentioned before are being used in a modified designed.

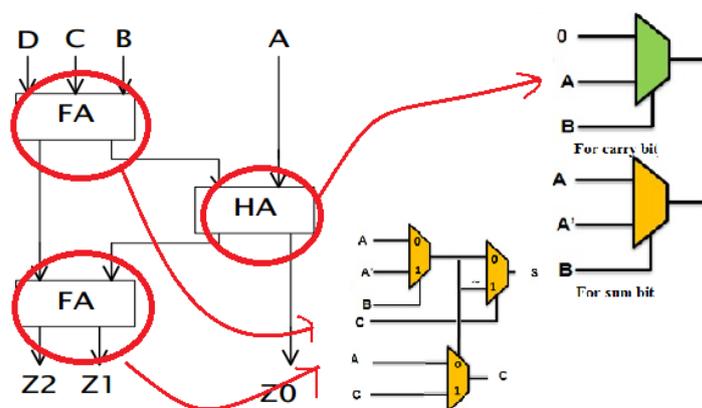


FIGURE4. Modified Design of 4-3 compressor Adder

**2.4. 5-3 compressor adder:** A 5-3 compressor adder is a logical circuit in which maximum five bits can be added at same time and three bit resultant can be obtained. The half adder and full adder

designs with the use of multiplexers mentioned before are being used in a modified designed. If we are considering all the inputs to be 1 then the maximum output can be 101.

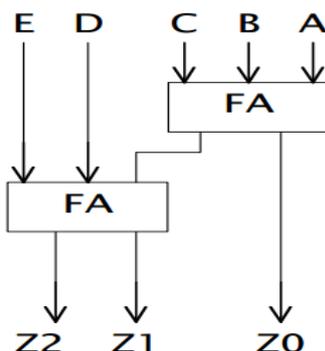


FIGURE5. Modified Design of 5-3 compressor Adder

**2.5. 6-3 compressor adder:** A 6-3 compressor adder is a logical circuit in which maximum six bits can be added at same time and three bit resultant can be obtained. The half adder and full adder designs with the use of multiplexers mentioned before are being used in a modified designed.

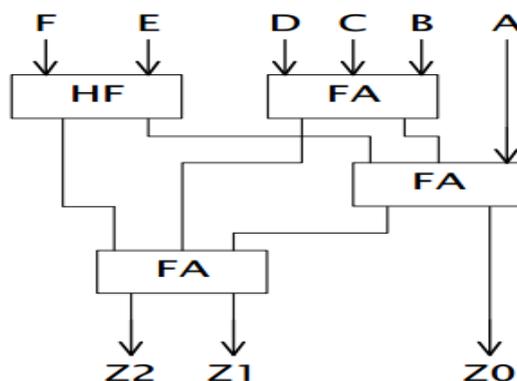


FIGURE6. Modified Design of 6-3 compressor Adder

**2.6. 7-3 compressor adder:** A 7-3 compressor adder is a logical circuit in which maximum seven bits can be added at same time and three bit resultant can be obtained. The half adder and full adder designs with the use of multiplexers mentioned before are being used in a modified designed.

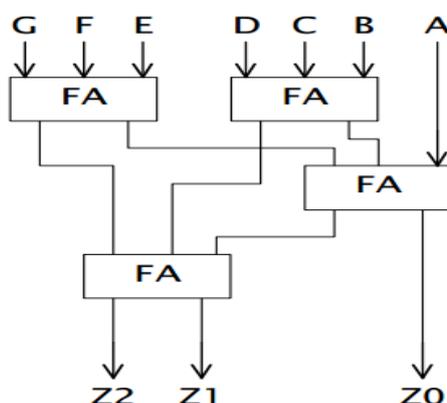
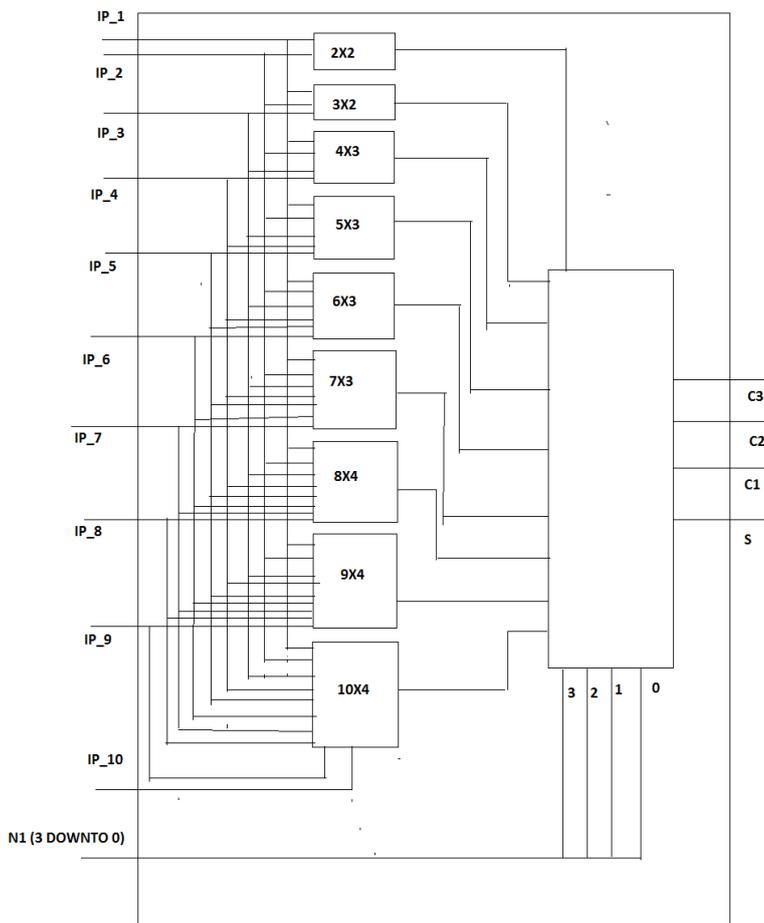


FIGURE7. Modified Design of 7-3 compressor Adder

**2.7. Purposed compressor adder for N=10**

The model which is purposed i.e. given above as here N=10 therefore it can take any value till N=10 and give us output as according to it. If we talk about 1<sup>st</sup> equation it is simply and gate operation and initially as there is no carry so carry bit will remain zero then next in 2<sup>nd</sup> equation 2-2 compressor adder will be used i.e. simply a half adder it will have two inputs i.e. A<sub>1</sub>B<sub>0</sub> and B<sub>0</sub>A<sub>1</sub> and will give one sum bit i.e. S<sub>0</sub> and one carry bit C<sub>1</sub>. In next equation 4-3 compressor adder will be used it will have four inputs A<sub>0</sub>B<sub>2</sub>, A<sub>1</sub>B<sub>1</sub>, A<sub>2</sub>B<sub>0</sub> & previous carry C<sub>1</sub> and give output as one sum bit S<sub>2</sub> and two carries bit C<sub>2</sub> & C<sub>3</sub> For next equation 5-3 compressor adder will be used and so on the compressor adders will be used as per the input and give result according to it.



**FIGURE8. Purposed compressor adder for N=10**

**III. EQUATIONS TO BE IMPLEMENTED**

Let two 8 bit numbers be

$$A = A_0A_1A_2A_3A_4A_5A_6A_7$$

$$B = B_0B_1B_2B_3B_4B_5B_6B_7$$

Now the Resultant bits R = (0-15)

Carry bits C = (C<sub>1</sub>- C<sub>32</sub>)

$$S_0 : A_0B_0$$

- C1 S1 :  $A1B0 + B0A1$
- C3 C2 S2 :  $C1 + A0B2 + A1B1 + A2B0$
- C5 C4 S3 :  $C2 + A0B3 + A1B2 + A2B1 + A3B0$
- C7 C6 S4 :  $C3 + C4 + A0B4 + A1B3 + A2B2 + A3B1 + A4B0$
- C10 C9 C8 S5 :  $C5 + C6 + A0B5 + A1B4 + A2B3 + A3B2 + A4B1 + A5B0$
- C13 C12 C11 S6 :  $C7 + C8 + A0B6 + A1B5 + A2B4 + A3B3 + A4B2 + A5B1 + A6B0$
- C16 C15 C14 S7 :  $C9 + C11 + A0B7 + A1B6 + A2B5 + A3B4 + A4B3 + A5B2 + A6B1 + A7B0$
- C19 C18 C17 S8 :  $C10 + C12 + C14 + A1B7 + A2B6 + A3B5 + A4B4 + A5B3 + A6B2 + A7B1$
- C22 C21 C20 S9 :  $C13 + C15 + C17 + A2B7 + A3B6 + A4B5 + A5B4 + A6B3 + A7B2$
- C25 C24 C23 S10 :  $C16 + C18 + C20 + A3B7 + A4B6 + A5B5 + A6B4 + A7B3$
- C27 C26 S11 :  $C19 + C21 + C23 + A4B7 + A5B6 + A6B5 + A7B4$
- C29 C28 S12 :  $C22 + C24 + C26 + A5B7 + A6B6 + A7B5$
- C31 C30 S13 :  $C25 + C27 + C28 + A6B7 + A7B6$
- C32 S14 :  $C29 + C30 + A7B7$
- C33 S15 :  $C31 + C32$

## IV. RESULTS

The designs are coded in VHDL and synthesized using Xilinx ISE 14.6 simulator and family used is XILINX: SPARTAN 3E:XC3S500E FG3200, speed grade -4. Results are clearly indicating better speed performance. Table 1 is tabulated with the comparison results of combinational delay of 8 bit multiplier on basis of with use of multiplexers or not using multiplexers Table 2 is tabulated with the comparison results of combinational delay of modified compressor adder with traditional ones. Table 3 is tabulated with results of Combinational delay of Dedicated and General 8 bit Multiplier for N=10.

Multiplier	Combinational delay(ns)	
	Without use Of Multiplexers	With use of Multiplexers
8	16.630	14.317

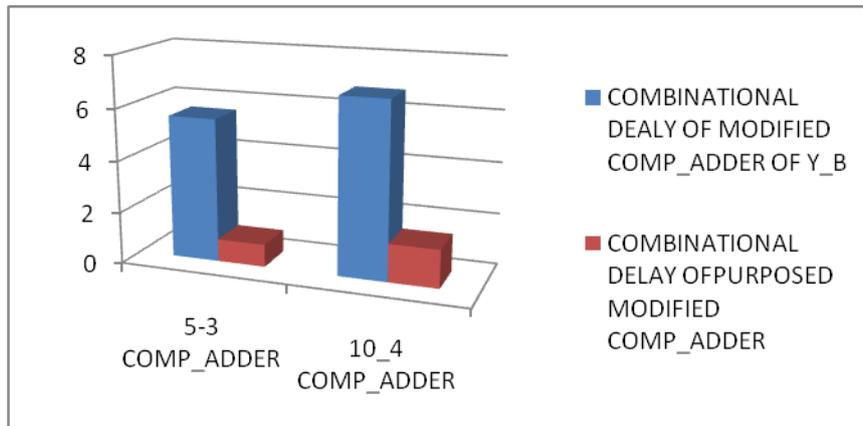
FIGURE 9. Comparison table of 8 bit multiplier with use of MUX or without use of MUX

Input bits	Combinational delay(ns)		Percentage improvement (%)
	Modified Comp Results of Yogita_b	Modified comp result of purpsd adders	
2		0.670	
3		0.755	
4		0.788	
5	5.570	0.874	84.308
6		0.882	
7		1.352	
8		1.363	
9		2.545	
10	6.787	1.476	78.252

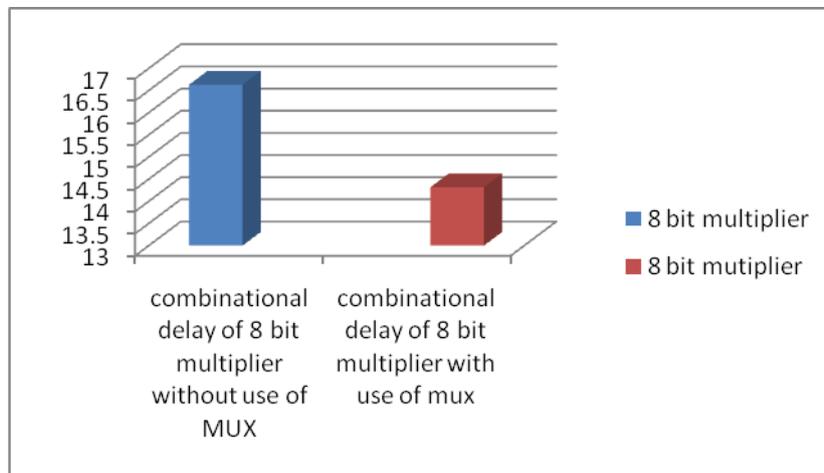
FIGURE 10. Comparison table of combinational delay for modified compressor adder of base paper and purposed compressor adders

Multiplier	Combinational delay(ns)	
	Dedicated 8 bit Multiplier For N=10	General 8 bit Multiplier For N=10
8	12.270	14.317

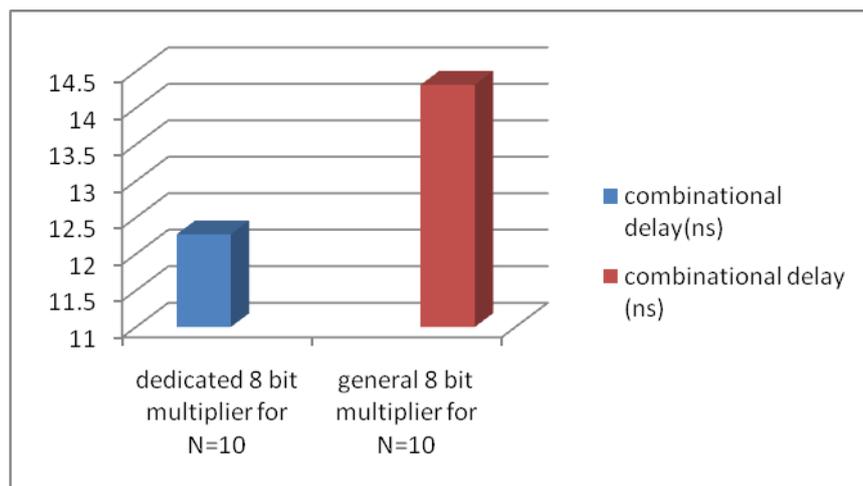
FIGURE 11. Comparison table of 8 bit multiplier as a dedicated 8 bit multiplier and as a general 8 bit multiplier for N=10



Comparison of modified compressor adder of base paper and purposed one.



Comparison of 8 bit multiplier on basis of with use of multiplexers or not using multiplexers



Comparison of Combinational delay of Dedicated and General 8 bit Multiplier for N=10

## V. CONCLUSION AND FUTURE SCOPE

The proposed architecture is based upon 'Urdhava-tiryakbhyam' sutra of Vedic mathematics which is a general multiplication technique for multiplication. This sutra makes the parallel generation of partial products and

removes unwanted multiplication steps. Results shows clearly better improvement of 8 bit multiplier with the use of multiplexers. This proposed optimized Vedic multiplier design may prove to be of great use in future digital signal processing applications, ALU, MAC etc. with stringent demands of speed, area and power. As a future work, the multiplier can be expanded for 16 bits and 32 bits and can be tested for its performance after implementing in an ALU.

## REFERENCES

- [1.] [Shanthala S, Cyril Prasanna Raj and Dr. S Y Kulkarni. “ Design and VLSI implementation of pipelined Multiply Accumulate Unit”, Second International Conference On Emerging Trends in Engineering Technology, ICETET. 2009.
- [2.] Yogita bansal, charu madhu , A novel high-speed approach for 16×16 Vedic multiplication with compressor adders, computers and electrical engineering journal elsevier publication 10.1109/RAECS.2014.6799502
- [3.] Hanumantharaju MC, Jayalaxmi H, Renuka RK, Ravishankar M. A high-speed block convolution using ancient indian Vedic mathematics. In: Proceedings of IEEE conference on computational intelligence and multimedia applications (ICCIMA); 2007. p. 169–73. doi:10.1109/ICCIMA.2007.332.
- [4.] Prakash AR, Kirubaveni S. Performance evaluation of FFT processor using conventional and Vedic algorithm. In: Proceedings of IEEE conference on emerging trends in computing, communication and nanotechnology (ICE-CCN); 2013. p. 89–94. doi:10.1109/ICE-CCN.2013.6528470.
- [5.] Saha P, Banerjee A, Dandapat A, Bhattacharyya P. ASIC design of a high-speed low power circuit for factorial calculation using ancient Vedic mathematics. *Microelectron J* 2011;42:1343–52.
- [6.] Ramalatha M, Thanushkodi K, Deena Dayalan K, Dharani P. A novel time and energy efficient cubing circuit using Vedic mathematics for finite field arith-metic. In: Proceedings of advances in recent technologies in communication and computing; 2009. p. 873–5. doi:10.1109/ARTCom.2009.227.
- [7.] Aliparast P, Koozehkanani ZD, Khianvi AM, Karimian G, Bahar HB. A new very high-speed MOS 4-2 compressor for fast digital arithmetic circuits. In: Proceedings of mixed design of integrated circuits and systems (MIXDES); 2010. p. 191–4.
- [8.] Jaina D, Sethi K, Panda R. Vedic mathematics Based Multiply Accumulate Unit. In: Proceedings ocomputational intelligence and communication systems (CICN); 2011. p. 754–7. doi:10.1109/CICN.2011.167.
- [9.] Saokar SS, Banakar RM, Siddamal S. High-speed signed multiplier for digital signal processing applications. In: Proceedings of signal processing, computing and control (ISPCC);, 2012. p. 1–6. doi:10.1109/ISPCC.2012.6224373.
- [10.] Kumar A, Raman A. Low power ALU design by ancient mathematics. In: Proceedings of IEEE international conference on aerospace and aviation engineering (ICAAE); 2010. p. 862–5.

## **BiOI @MOF-235 heterostructures as an efficient visible light driven photocatalyst**

**Feroz Ahmad Sofi<sup>1</sup>, Kowsar Majid<sup>2</sup>**

### **ABSTRACT**

In this work, MOF-235, an Iron based metal organic framework (MOF) was incorporated with different molar ratios (0.1, 0.3, 0.5 and 0.7) of Bismuth Oxy Iodide to develop visible light active BiOI/MOF-235 photocatalyst. The MOF-235 was synthesized via facile microwave assisted route. The materials were characterized by XRD, FT-IR, FESEM, HRTEM, UV-vis DRS, BET and PL analysis. The photocatalytic activity of as prepared systems was investigated by degrading an azo dye, acid orange under visible-light irradiation. Among the as synthesized samples, the 0.7 BiOI/MOF-235 heterostructure system exhibited highest photocatalytic activity and improved stability compared to others for the degradation of acid orange under visible light. The superior activity and improved stability of this heterostructured photocatalyst was attributed to the synergistic effects from two components of a heterostructure, for effective separation of electron-hole pairs. Radical-trapping experiments demonstrate that holes ( $h^+$ ) and  $\cdot O_2$  are primary reactive species involved in photocatalytic oxidation process. Moreover, the BiOI/MOF-235 photocatalyst did not show any obvious loss of photocatalytic activity during five cycle tests, which indicate that the heterostructured photocatalyst is highly stable and can be used repeatedly. Therefore, the work provides new insights into the design and fabrication of Metal-organic frameworks (MOFs) for use as a visible light photocatalyst for degrading organic contaminants.

**Keywords:** *Acid orange, azo dye, BiOI/MOF-235, Heterostructures, MOF-235, radical trapping.*

**SYNTHESIS OF GRAPHENE OXIDE/NIO  
NANOCOMPOSITES: ROLE OF 2D GRAPHENE  
OXIDE IN THE ENHANCEMENT OF  
PHOTOCATALYTIC ACTIVITY FOR THE  
DEGREDDATION OF ORGANIC POLLUTANTS**

**Jahangir Ahmad<sup>1</sup>, Kowsar Majid<sup>2</sup>**

<sup>1,2</sup>*Department of Chemistry, National Institute of Technology, Srinagar (J&K) (India)*

**ABSTRACT**

*The NiO/GO nanocomposites as efficient photocatalysts, were successfully synthesized by an in-situ method without the use of any stabiliser or surfactant using GO and nickel nitrate as the starting material in a controlled atmosphere. Graphene Oxide is synthesised via eco-friendly method and the NiO nanoparticles displaying spherical morphology, are randomly distributed on the surface of GO sheets. The as-synthesised nanocomposites were characterised by different characterisation techniques like X-ray diffraction (XRD), scanning electron microscopy (SEM), and FTIR spectroscopy. The average crystallite size of the nanocomposites was calculated using Scherrer's formula and was found to be around 9.0 nm. The results suggested that the concentration of graphene oxide in starting solution has an important role in the enhancement of photocatalytic activity of the nanocomposites. These semiconductor heterojunctions have been demonstrated as highly efficient photocatalysts with enhanced performance for the degradation of a organic pollutant, Methylene blue (MB). Moreover, the photocatalytic activity of the NiO/GO nanocomposites was much higher than that of pure NiO nanoparticles, which can be attributed to the formation of p-n heterojunction in the nanocomposites. The photocatalytic activities of the composite were higher than that of P25 (a commercial TiO<sub>2</sub> as a benchmark photocatalyst). The characterisation results exhibited significantly improved photocatalytic activity of the nanocomposites which could be attributed to the high charge separation and suppressed recombination of photogenerated electron-hole pairs due to GO.*

**Keywords:** *photodegradation; photocatalyst; nanocomposites; heterojunction; Graphene oxide*

# **OPTIMIZING CLOUD STORAGE WITH THE UTILIZATION OF DYNAMIC DEDUPLICATION TECHNIQUES**

**Madhu Ramteke<sup>1</sup>, K.L. Sinha<sup>2</sup>**

*<sup>1,2</sup>Computer Science & Engineering, CSVTU (India)*

## **ABSTRACT**

*Cloud computing performs a maximum essential job within the industry area in nowadays as computing resources are introduced as a utility on demand to customers over the internet. Cloud storage is probable one of the offerings supplied in cloud computing which has been increasing in reputation. The important advantage of utilizing cloud storage from the clients' factor of view is that customers can decrease their expenditure in shopping and preserving storage infrastructure on the equal time as paying the quantity of storage asked, which may be scaled-up and down upon demand. With the growing records length of cloud computing, a discount in data volumes ought to assist vendors to reduce the expenses of walking big storage system and saving strength intake. So information deduplication systems had been added to beautify storage performance in cloud storages. With the dynamic nature of facts in cloud storage, statistics usage in cloud alterations time beyond regulation, some information chunks could also be read in all likelihood in time frame, but will now not be used in but yet again length. Some datasets can be usually retrieved or up to date thru various customers whilst, at the same time others may also want the excessive degree of redundancy for reliability requirement. For that reason, it is essential to aid this dynamic function in cloud storage. However modern techniques are usually targeted on dynamic scheme with much less parameter. To better ensure information optimization, the proposed system makes the number one try and officially copes with the problem of storage space by adding more parameter inside the present device; we take into account the converting of consumer's demand of documents. An element in redundancy manager will monitor file access activities.*

***Index Terms: Deduplication, Cloud Computing, Cloud Storage, Availability.***

## **I. INTRODUCTION**

Cloud computing, where application and files are hosted on a "cloud" consisting of thousands of computers and servers, all linked together and accessible via the internet. The idea of cloud computing is quite similar to grid computing, which pursuits to reap useful resource virtualization [1]. In grid computing, the companies sharing their computing resources, inclusive of processors, in an effort to achieve the most computing potential, while cloud computing pursuits to offer computing assets as a utility on demand, that can scale up or down at any time, to more than one customers. This makes cloud computing play a chief role in the enterprise domain, while grid is famous in instructional, scientific and engineering studies [2].

# 4<sup>th</sup> International Conference on Innovative Trends in Science, Engineering and Management

(C-DAC, Mumbai) Centre for Development of Advanced Computing, Mumbai, Maharashtra (India)

(ICITSEM-17)

17<sup>th</sup> June 2017, [www.conferenceworld.in](http://www.conferenceworld.in)

ISBN: 978-93-86171-47-4

Many definitions of cloud computing have been described, depended on the man or woman factor of view or generation used for system improvement. In widespread, we are able to outline cloud computing as a enterprise version that offer computing sources as a service on demand to customers over the Internet [3].

The important characteristics of cloud computing have been defined in [3]. Cloud vendors pool computing assets collectively to serve clients via a multi-tenant version. Computing resources are introduced over the Internet in which clients can access them through numerous customer structures. Customers can get entry to the sources on-demand at any time without human interplay with the cloud provider. From a customers' point of view, computing sources are countless, and client demands can hastily trade to meet business targets. This is facilitated by way of the potential for cloud offerings to scale resources up and down on call for leveraging the strength of virtualization. Moreover, cloud companies are able to screen and manipulate the use of sources for each customer for billing functions, optimization resources, capability planning and other tasks. Cloud storage is one of the offerings in cloud computing which affords virtualized storage on demand to customers.

Cloud storage may be used in lots of one of a kind ways [4]. For example, customers can use cloud storage as a backup carrier, rather than keeping their very own storage disks. Organizations can pass their archival storage to the cloud which they can obtain greater capacity at the low-price, in place of shopping for additional bodily storage. Applications walking within the cloud also require transient or everlasting records storage in an effort to guide the programs.

As the amount of information inside the cloud is unexpectedly increasing, clients assume to reach the on-demand cloud offerings at any time, whilst carriers are required to hold system availability and method a massive amount of data. Providers want a manner to dramatically reduce data volumes, so we can reduce prices whilst saving energy intake for going for walks huge storage structures. Similar to different storages, storage in cloud environments also can use records deduplication technique.

Data deduplication is a technique whose objective is to enhance storage efficiency. With the goal to lessen storage space, in traditional deduplication structures, duplicated facts chunks discover and shop handiest one reproduction of the statistics in storage. Logical pointers are created for different copies in place of storing redundant data. Deduplication can reduce both storage area and community bandwidth [7]. However such techniques can end result with a poor impact on machine fault tolerance.

Because there are numerous files that consult with the equal facts chunk, if it turns into unavailable due to failure can result in reduced reliability. Due to this problem, many processes and strategies were proposed that no longer handiest provide solutions to achieve storage efficiency, however additionally to improve its fault tolerance. These strategies offer redundancy of data chunks after performing deduplication. However, modern data deduplication mechanisms in cloud storage are static schemes implemented agnostically to all facts situations. This is a trouble as records situations exhibit extraordinary statistics traits that require exceptional levels of fault tolerance necessities.

For instance, records utilization in cloud changes additional time; some facts chunks may be study frequently in a time period, however won't be utilized in some other period. Due to the downside of static schemes, which cannot address converting person behavior, deduplication in cloud storages calls for a dynamic scheme which has the ability to conform to diverse get right of entry to styles and changing person behavior in cloud storages.

The contribution of this paper is a dynamic records deduplication scheme for cloud storage, as a way to fulfil a stability among storage performance and fault tolerance requirements, and also to enhance performance in cloud storage systems that experience modifications in records situations and person patterns. The relaxation of this paper is organized as follows: segment II provides heritage principles and associated work. Section III demonstrates a proposed device version. Section IV illustrates the simulation of the proposed system version. Section V describes the experimental end result. Section VI discusses the future work. Finally phase VII concludes this paper.

## II. BACKGROUND AND RELATED WORK

### A. Deduplication in Cloud Storages

Data deduplication is a technique to reduce storage area. By figuring out redundant statistics the use of hash values to compare records chunks, storing handiest one replica, and creating logical hints to other copies as opposed to storing different actual copies of the redundant statistics [5], [6]. Deduplication reduces records quantity so disk space and network bandwidth may be reduced which reduce prices and power consumption for walking storage systems [7]. Data deduplication may be implemented at nearly every factor which records is saved or transmitted in cloud storage [7]. Many cloud carriers offer catastrophe recuperation [8] and deduplication can be used to make disaster recovery extra effective by using replicating information after deduplication for speeding up replication time and bandwidth value financial savings. Backup and archival storage in clouds can also follow data deduplication to be able to lessen physical ability and network visitors [9], [10]. Moreover, in stay migration method, we need to transfer a large quantity of duplicated reminiscence photograph facts [11]. There are 3 major performance metrics of migration to recall: overall statistics transferred, overall migration time and carrier downtime. Longer migration time and downtime could be lead to provider failure. Thus, deduplication can help in migration [12]. Deduplication may be used to reduce storage of lively records such as digital system snap shots. Factors to recall when the usage of deduplication in primary storage is a way to stability the alternate-offs between storage area saving and overall performance effect [13].

Additionally, Mandagere, et al., [13] nation that deduplication algorithms reflect the performance of deduplicated storage in terms of fold thing, reconstruction bandwidth, metadata overhead, and useful resource usage.

B. Dependability Issues When acting deduplication, a part of facts chunks are a lot greater essential than others (For example, information chunks that are referenced through many documents). Traditional deduplication tactics do no longer put into effect redundancy of facts chunks. Thus, deduplication may additionally reduce the reliability of the storage device due to the loss of a few vital chunks that can cause the loss of many documents. As a result, the essential chunks should be replicated more than the much less vital information chunks with a purpose to improve reliability of the system. The authors in [14], remember the outcomes of deduplication at the reliability of the archival device. They proposed an method to improve reliability by using growing a method to weigh and degree the significance of each chew through inspecting the variety of information files that percentage the chew, and use this weight to pick out the level of redundancy required for the bite to guarantee QoS.

## C. Related Work

Looking at system architectures of current works of deduplication for cloud backup offerings including SAM [10], AA-Dedupe [15], CABdedupe [16], and SHHC [17].

SAM [10] device structure consists of 3 subsystems: File Agent, Master Server and Storage Server. Clients join backup offerings, then File Agents are distributed and set up on their machines, even as provider provider gives Master Server and Storage Server in datacentre to serve the backup requests from clients. Most of present solutions that use deduplication technology in most cases cognizance on the reduction of backup time while ignoring the healing time. The authors proposed CABdedupe [16], a performance booster for both cloud backup and cloud restore operations, which is a middleware that is orthogonal and can be incorporated into any present backup system. CABdedupe includes CAB-Client and CAB-Server, that's positioned on the authentic consumer and server modules in present backup systems. The primary aim of these related works are the subsequent: SAM aims to acquire an foremost change-off among deduplication performance and deduplication overhead, CABdedupe reduces both backup time and recovery time.

AA-Dedupe [15] goals to lessen the computational overhead, growth throughput and switch performance, at the same time as SHHC [17] tries to improve fingerprint storage and research mechanism, however has a issue of scalability. SHHC is a novel Scalable Hybrid Hash Cluster designed for enhancing response times to fingerprint research system. Because of a massive quantity of simultaneous requests are expected in cloud backup services.

In order to resolve this trouble, the hash cluster is designed for high load-balancing, scalability and minimizing the value for every fingerprint research question. The hash cluster is designed as middleware between the customers and the cloud storage. It offers the fingerprint storage and lookup carrier. There are other works on deduplication storages which their architectures are designed for scalability issue, for example; Extreme Binning [18], and Droplet [19].

Extreme Binning is used to construct a allotted record backup system. The architecture of such machine is composed of several backup nodes. Each backup node consists of a compute center and RAM in conjunction with a dedicated attached disk. The first undertaking while a record arrives to the system for backup is, it must be chunked. The system can delegate this mission to someone of the backup nodes via choosing one consistent with the system load at that point. After chunking, stateless routing set of rules is used to course the chunked report with the aid of the usage of its bite ID. The chunked document can be routed to a backup node where it is going to be deduplicated and stored.

Droplet, a distributed deduplication storage machine designed for excessive throughput and scalability. It includes 3 additives: a single meta server that monitors the entire machine reputation, a couple of fingerprinting servers that run deduplication on enter facts flow, and more than one storage nodes that keep fingerprint index and deduplicated facts blocks.

Meta server maintains statistics of fingerprinting and storage servers in the machine. When new nodes are added into the system, they want to be registered on the meta server first. The meta server provides a routing provider with this data. The consumer first connects to the meta server and queries for listing of fingerprinting servers, after which connects to one of them. After this, a uncooked statistics circulate containing backup content

material can be sent to this fingerprinting server, which calculates facts block fingerprints and replies consequences to the patron. Fingerprint servers check duplicated fingerprint through querying storage servers.

The nature of facts in cloud storage dynamic [20], [21]. For instance, facts usage in cloud changes time beyond regulation, a few records chunks may be study often in time period, however won't be used in all over again period. Some datasets may be frequently accessed or updated with the aid of multiple users on the identical time, at the same time as others may additionally want the high level of redundancy for reliability requirement. Therefore, it is essential to assist this dynamic characteristic in cloud storage. However, modern-day approaches are ordinarily targeted on static scheme, which limits their full applicability in dynamic characteristic of records in cloud storage.

### III. PROPOSED SYSTEM MODEL

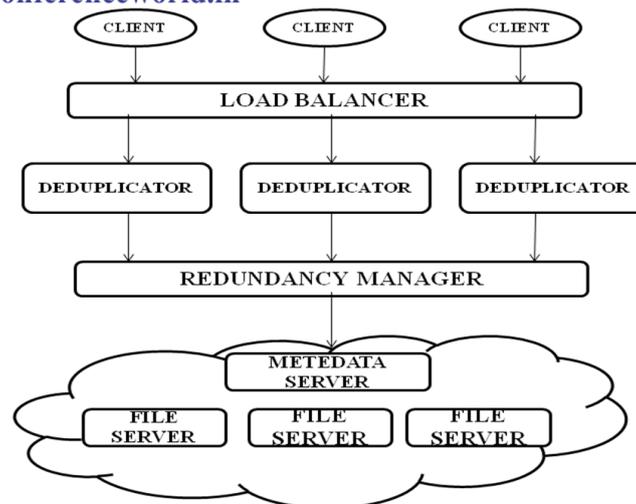
#### A. Overall Architecture

Our machine is presently primarily based on client-side deduplication using entire record hashing. Hashing method is carried out on the consumer, and connects to any individual of Deduplicators in line with their hundreds at that time. The deduplicator then identifies the duplication by evaluating with the prevailing hash values in Metadata Server. In traditional deduplication structures, if it is a new hash price, it is going to be recorded in metadata server, and the record will be uploaded to File Servers, its logical path may even recorded in metadata server. If it does exist, the number of references for the report will be accelerated. Some structures may also preserve a number of copies of each record with a static range. However, the documents with a huge wide variety of references can also require more replicas for you to enhance availability. To resolve this trouble, a few existing works introduced level of redundancy into deduplication structures.

However, figuring out stage of redundancy with the aid of quantity of references is a negative measurement because files with fewer references may be crucial documents. In order to improve availability at the same time as maintaining storage performance, we suggest a deduplication system which considers each the dynamicity and taking Quality of Service (QoS) of the Cloud surroundings into attention. In our machine model, after identifying the duplication, the Redundancy Manager then calculates an choicest variety of copies for the file based totally on range of references and stage of QoS vital. The numbers of copies are dynamically changed based at the changing range of references, stage of QoS and call for for the files. The adjustments are monitored, for instance, while a document is deleted by means of a consumer, or the level of QoS of the file has been up to date, this will cause the redundancy manager to re-calculate most advantageous range of copies.

Our proposed device model is shown in figure 1. The device is composed of the subsequent components:

- Load Balancer: after hashing method with SHA-1, customers send a fingerprint (hash value) to a deduplicator through the burden balancer.



**Figure : System model**

The load balancer responds to requests from clients sending to anybody of deduplicators in step with their masses at that point.

- Deduplicators: a element designed for figuring out the duplication by means of evaluating with the existing hash values saved in metadata server.
- Cloud Storage: a Metadata Server to shop metadata, and some of File Servers to store actual files and their copies.
- Redundancy Manager: a factor to pick out the preliminary quantity of copies, and reveal the changing degree of QoS.

## IV. SIMULATION ENVIRONMENT

HDFS Simulator is more relevant to our work, as HDFS Simulator already provides replication mechanisms, despite the fact that the replication degree is a predefined and static cost. However, it's far feasible to adjust the supply code if you want to introduce replication dynamicity. Moreover, we are able to perform experiments via simulating activities just like the converting degree of QoS. The mechanism of this painting is evaluated through the usage of simulation, because it enables researchers an opportunity to simulate huge-scale cloud environments, particularly failure occasions in the cloud as well as assist in evaluation QoS metrics which includes availability and overall performance.

The ideas of HDFS Simulation have been adapted to simulate our proposed device model. We create one Name node as Metadata server, and five Data nodes as File servers. Metadata in XML layout is saved in metadata server. File servers store the copies of documents. There are three occasions which we simulated: upload, replace, and delete. The upload event is while the report is first uploaded to the device. If documents already exist in the machine, and had been uploaded again, the quantity of copies of the files could be recalculated according to the best level of QoS, that is for an update occasion. For a delete record event, users can delete their documents, however the files will not completely deleted from the device if there are every other users confer with the identical documents.

## A. Upload

Deduplicator calls a hash price of the uploaded document from client, after which exams for any duplicates with the same present hash price in metadata server. If it is a brand new document, the new metadata of the file might be introduced to the machine and the file might be uploaded to file server. The replicas of the file will be created in line with the level of QoS of the add report.

## B. Update

In the case of current record, the metadata of the report might be updated and the device may also want to create or delete the replicas of the document consistent with the maximum fee of QoS of the record.

## C. Delete

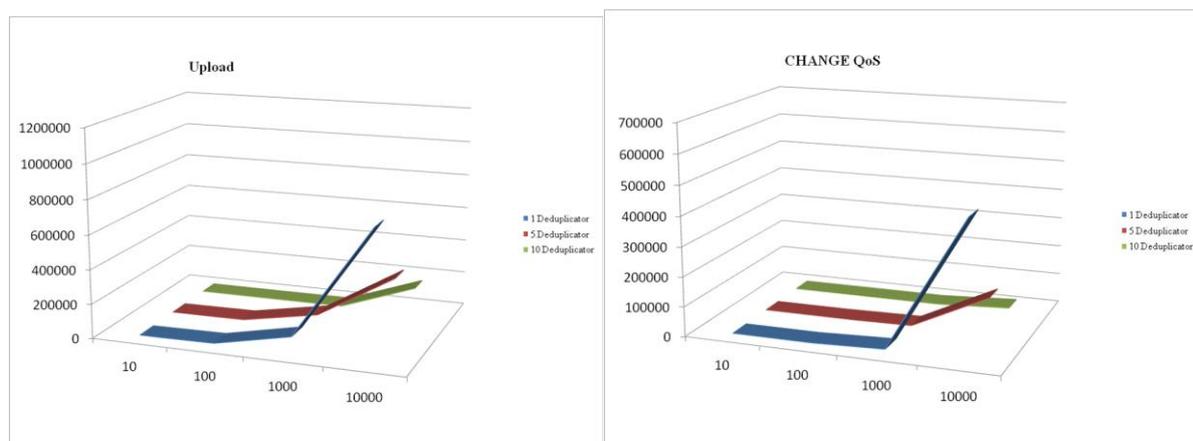
The deduplicator checks the quantity of documents which talk over with the same hash value person desires to delete. If there may be handiest one reference to the hash, all replicas of the report may be deleted. On the other hand if there are every other files that talk to the hash, handiest the metadata may be updated, and the quantity of replicas of the record might also need to lower consistent with the most fee of QoS.

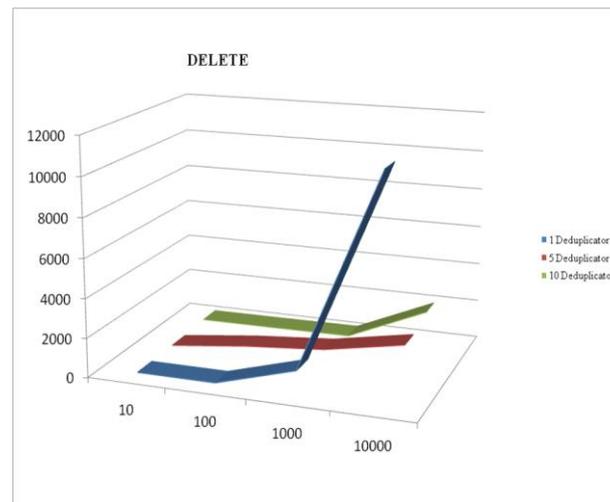
## V. EXPERIMENTAL RESULTS

We perform experiments at the simulation of our proposed version. The experiments are completed for one, five, and ten deduplicators. all the documents used within the experiments have been created with stochastic contents and properties. For trying out the converting level of QoS, each file has been randomly assigned its degree of QoS (1-5). A single QoS value of 1-5 indicates the level of redundancy of every report. documents with higher stage of QoS will be replicated greater than the decrease ones. when a single deduplicator is used, the system faced scalability troubles taking an extended time when the range of documents extended as proven in figure 2.

This is due to the fact underneath the heavy load with greater requests and extra customers, a single deduplicator cannot maintain the overall performance of the machine. while the quantity of deduplicators is elevated to 5 and ten, the results show that it helps to reduce the processing time.

For uploads, when all the documents have been uploaded to the device for the primary time, comparing the time taken by using one deduplicator to five and ten deduplicators. including extra deduplicators when the number of upload documents increase, could help to lessen the processing time.





**Figure 2: Experimental Results**

whilst files have already got been uploaded to the system, we carry out experiments for the case when there may be a changing level of QoS, because of this the number of copies of files in the device could be modified consistent with the most cost of QoS. The effects of replace documents display that once the number of documents growth, including more deduplicators can assist to lessen the processing time. We found that, whilst the numbers of files are ten, one hundred and one thousand, time saving via including more deduplicators are less than time saving for the add cases. but, whilst the numbers of files are extended to at least one thousand and ten thousands files, the time saving through 5 and ten deduplicators still boom, in comparison to the upload instances. We perform experiments to delete files. Including extra deduplicators can also to lessen the processing time, however the consequences of delete files are slightly different from the upload and replace cases. We are able to see that, for the delete case, times saving by using including extra deduplicators are decreased when the numbers of documents are expanded from ten to one hundred and one thousand files. but, while the numbers of documents are multiplied to 10 lots, extra deduplicators assist to increase time saving.

## VI. CONCLUSION

Cloud storage offerings furnished in cloud computing has been increasing in reputation. It gives on call for virtualized storage property and clients simplest pay for the gap they sincerely consumed. As the growing call for and records keep inside the cloud, records deduplication is in all likelihood one of the techniques used to decorate storage efficiency. Nevertheless, modern information deduplication mechanisms in cloud storage are dynamic scheme, which video display units the QoS (nice of service) and NoF (number of failure). The proposed system uses a dynamic statistics deduplication scheme for cloud storage, in order to fulfill stability among converting storage efficiency and fault tolerance specifications, and also to enhance performance in cloud storage applications. We dynamically trade the wide variety of copies of files according to the changing stage of QoS, number of failure (NoF) and changing of clients' call for of files. The experimental effects show that, our proposed machine is performing well and can manipulate with scalability hassle.

## REFERENCES

- [1] I. Foster, Z. Yong, I. Raicu, and S. Lu, "Cloud Computing and Grid Computing 360-Degree Compared," in Grid Computing Environments Workshop, 2008. GCE '08, 2008, pp. 1-10.
- [2] T. Dillon, W. Chen, and E. Chang, "Cloud Computing: Issues and Challenges," in Advanced Information Networking and Applications (AINA), 2010 24th IEEE International Conference on, 2010, pp. 27-33.
- [3] T. G. Peter Mell, "The NIST Definition of Cloud Computing," National Institute of Standards and Technology NIST Special Publication 800-145, September 2011.
- [4] SNIA Cloud Storage Initiative, "Implementing, Serving, and Using Cloud Storage," Whitepaper 2010.
- [5] D. Harnik, B. Pinkas, and A. Shulman-Peleg, "Side Channels in Cloud Services: Deduplication in Cloud Storage," Security & Privacy, IEEE, vol. 8, pp. 40-47, 2010.
- [6] S. Guo-Zi, D. Yu, C. Dan-Wei, and W. Jie, "Data Backup and Recovery Based on Data De-Duplication," in Artificial Intelligence and Computational Intelligence (AICI), 2010 International Conference on, 2010, pp. 379-382.
- [7] SNIA, "Advanced Deduplication Concepts," 2011.
- [8] V. Javaraiah, "Backup for cloud and disaster recovery for consumers and SMBs," in Advanced Networks and Telecommunication Systems (ANTS), 2011 IEEE 5th International Conference on, 2011, pp. 1-3.
- [9] L. L. You, K. T. Pollack, and D. D. E. Long, "Deep Store: An Archival Storage System Architecture," presented at the Proceedings of the 21<sup>st</sup> International Conference on Data Engineering, 2005.
- [10] T. Yujuan, J. Hong, F. Dan, T. Lei, Y. Zhichao, and Z. Guohui, "SAM:A Semantic-Aware Multi-tiered Source De-duplication Framework for Cloud Backup," in Parallel Processing (ICPP), 2010 39th International Conference on, 2010, pp. 614-623.
- [11] S. Kumar Bose, S. Brock, R. Skeoch, N. Shaikh, and S. Rao, "Optimizing live migration of virtual machines across wide area networks using integrated replication and scheduling," in Systems Conference (SysCon), 2011 IEEE International, 2011, pp. 97-102.
- [12] S. K. Bose, S. Brock, R. Skeoch, and S. Rao, "CloudSpider: Combining Replication with Scheduling for Optimizing Live Migration of Virtual Machines across Wide Area Networks," in Cluster, Cloud and Grid Computing (CCGrid), 2011 11th IEEE/ACM International Symposium on, 2011, pp. 13-22.
- [13] N. Mandagere, P. Zhou, M. A. Smith, and S. Uttamchandani, "Demystifying data deduplication," presented at the Proceedings of the ACM/IFIP/USENIX Middleware '08 Conference Companion, Leuven, Belgium, 2008.
- [14] D. Bhagwat, K. Pollack, D. D. E. Long, T. Schwarz, E. L. Miller, and J. F. Paris, "Providing High Reliability in a Minimum Redundancy Archival Storage System," in Modeling, Analysis, and Simulation of Computer and Telecommunication Systems, 2006. MASCOTS 2006. 14th IEEE International Symposium on, 2006, pp. 413-421.
- [15] F. Yinjin, J. Hong, X. Nong, T. Lei, and L. Fang, "AA-Dedupe: An Application-Aware Source Deduplication Approach for Cloud Backup Services in the Personal Computing Environment," in Cluster Computing (CLUSTER), 2011 IEEE International Conference on, 2011, pp. 112-120.

# 4<sup>th</sup> International Conference on Innovative Trends in Science, Engineering and Management

(C-DAC, Mumbai) Centre for Development of Advanced Computing, Mumbai, Maharashtra (India)

(ICITSEM-17)

17<sup>th</sup> June 2017, [www.conferenceworld.in](http://www.conferenceworld.in)

ISBN: 978-93-86171-47-4

- [16] T. Yajuan, J. Hong, F. Dan, T. Lei, and Y. Zhichao, "CABdedupe: A Causality-Based Deduplication Performance Booster for Cloud Backup Services," in Parallel & Distributed Processing Symposium (IPDPS), 2011 IEEE International, 2011, pp. 1266-1277.
- [17] X. Lei, H. Jian, S. Mkandawire, and J. Hong, "SHHC: A Scalable Hybrid Hash Cluster for Cloud Backup Services in Data Centers," in Distributed Computing Systems Workshops (ICDCSW), 2011 31<sup>st</sup> International Conference on, 2011, pp. 61-65.
- [18] D. Bhagwat, K. Eshghi, D. D. E. Long, and M. Lillibridge, "Extreme Binning: Scalable, parallel deduplication for chunk-based file backup," in Modeling, Analysis & Simulation of Computer and Telecommunication Systems, 2009. MASCOTS '09. IEEE International Symposium on, 2009, pp. 1-9.
- [19] Z. Yang, W. Yongwei, and Y. Guangwen, "Droplet: A Distributed Solution of Data Deduplication," in Grid Computing (GRID), 2012 ACM/IEEE 13th International Conference on, 2012, pp. 114-121.
- [20] W. Cong, W. Qian, R. Kui, C. Ning, and L. Wenjing, "Toward Secure and Dependable Storage Services in Cloud Computing," *Services Computing, IEEE Transactions on*, vol. 5, pp. 220-232, 2012.
- [21] K. Yang and X. Jia, "An Efficient and Secure Dynamic Auditing Protocol for Data Storage in Cloud Computing," *Parallel and Distributed Systems, IEEE Transactions on*, vol. PP, pp. 1-1, 2012.
- [22] R. N. Calheiros, R. Ranjan, A. Beloglazov, C. A. F. De Rose, and R. Buyya, "CloudSim: a toolkit for modeling and simulation of cloud computing environments and evaluation of resource provisioning algorithms," *Software: Practice and Experience*, vol. 41, pp. 23-50, 2011.
- [23] C. Debains, P. A.-T. Togores, and F. Karakusoglu, "Reliability of Data- Intensive Distributed File System: A Simulation Approach," 2010.
- [24] X. Jin, H. Yiming, L. Guojie, T. Rongfeng, and F. Zihua, "Metadata Distribution and Consistency Techniques for Large-Scale Cluster File Systems," *Parallel and Distributed Systems, IEEE Transactions on*, vol. 22, pp. 803-816, 2011.
- [25] O. Parisot, A. Schlechter, P. Bauler, and F. Feltz, "Flexible Integration of Eventually Consistent Distributed Storage with Strongly Consistent Databases," in Network Cloud Computing and Applications (NCCA), 2012 Second Symposium on, 2012, pp. 65-7

# Task Scheduling Using Hybrid PSO in Cloud Based Environment

Anjaneer Mourya<sup>1</sup>, Bhupesh Kumar Dewangan<sup>2</sup>

*Computer Science & Engineering, Chhatrapati Shivaji Institute of Technology Durg, (India)*

## ABSTRACT

Cloud computing ensures access to shared resources and ordinary infrastructure, providing services on concern over a community for operations to fulfil changing industrial enterprise requirements. Scheduling may be a prominent activity that's finished during a cloud computing surroundings. To increase cloud computing work load performance, responsibilities programming is accomplished to induce most financial profit. In cloud, excessive communication cost prevents assignment schedulers from being distributed in immense scale assigned environments. This study proposes a hybrid improvement primarily based entirely on Particle Swarm improvement (PSO) and Genetic algorithmic program (GA) for programming in cloud environments.

**Keywords:** cloud computing, scheduling, particle swarm optimization (PSO), genetic algorithm (GA).

## I. INTRODUCTION

Cloud computing is a new computing generation to enhance the virtualized sources designed for quit clients in a dynamic environment so as to provide reliable and relied on service [1]. The provided services includes however not restrained to the opportunity of building application & special sever a offerings through net virtualization which is the essential approach which improve physical belongings utilization in cloud computing [2]. It lets in abstraction and isolation of underlying bodily assets and reduce required hardware device. establish an green load balanced algorithm should be proposed to make sure cloud computing have to be used correctly & powerfully which is a important reason of the delivery carrier. There is an actual want to make bigger new project scheduling algorithm to fulfil the virtualization ideas & demand. The intention of the assignment scheduling algorithm is international journal of Grid Distribution Computing to reap immoderate tool throughput, enhance the load balance and lessen the final touch period at the equal time as ensuing in the identical time meeting the task requirement with available virtualized sources. Constant with the undertaking scheduling, a set of the perfect wide variety of duties is to be scheduled to the virtual machines. Task scheduling over the Cloud Computing belongings are the most essential undertaking due to the fact the consumer will have to pay for aid use on the premise the time Evolutionary algorithms are based on species origin. Examples are Particle Swarm Optimization (PSO) and Genetic algorithm (GA). PSO is a parallel evolutionary computation method and a heuristic seek method stimulated by way of biological populations swarming behaviour [4]. The usage of PSO ensures an excellent performance. GA is a search heuristic that mimics natural evolution. It is mechanically used to generate useful answers for optimization and search problems. GAs belongs to a larger class of evolutionary algorithms,

producing answers to optimization issues with techniques from herbal evolution like inheritance, selection, mutation, and crossover [5]. PSO algorithm has many blessings like easy realization, excessive flexibility, strong robustness, and scalability because of which it solves many combinational issues. But, its negative aspects are low convergence charge when fixing big scale optimization troubles and easily sinking into nearby optima due its randomness [6]. PSO is ideal in a preliminary section however while going via iterations convergence charge turns into low and particles lose variety. There is want for an algorithm to offset these troubles and so this study proposed a hybrid algorithm in which PSO combines with GA i.e. GAPSO algorithm ensuring higher effects because of the houses of each. The final sections of this paper are prepared as follows: section 2 opinions related works, section 3 explains the methodology. Section 4 discusses experimental consequences and section 5 concludes the work.

## II. RELATED WORK

(Zhifeng Zhong.et al. 2016) [7] This paper introduces a greedy Particle Swarm Optimization (G&PSO) primarily based algorithm to remedy the assignment scheduling hassle. It makes use of a grasping algorithm to quickly remedy the initial particle cost of a particle swarm optimization algorithm derived from a virtual machine-based cloud platform. The archived experimental consequences show that the algorithm exhibits higher overall performance including a quicker convergence fee, more potent nearby and international search capabilities, and an extra balanced workload on each virtual device. Consequently, the G&PSO algorithm demonstrates stepped forward virtual system performance and useful resource utilization compared with the traditional particle swarm optimization algorithm.

(Xu. Panpan et al. 2015) [17] Genetic algorithm is widely utilized in optimization troubles for its outstanding global seek approach and fairly parallel processing approach; Simulated annealing algorithm can keep away from the quest process falling into local most useful. A hybrid genetic algorithm based on simulated annealing is designed via combining the benefits of genetic algorithm and simulated annealing algorithm. The numerical experiment represents the hybrid genetic algorithm may be applied to solve the characteristic optimization troubles effectively.

(I. C. Trelea 2003) [15] the particle swarm optimization algorithm is analyzed the use of preferred results from the dynamic machine principle. Graphical parameter selection pointers are derived. The exploration–exploitation tradeoffs is mentioned and illustrated. Examples of overall performance on benchmark capabilities superior to formerly posted effects are given.

Keng Mao Cho[9]This paper combines ant colony optimization and particle swarm optimization to resolve the VM scheduling trouble, with the result being called ant colony optimization with particle swarm (ACOPS). ACOPS uses ancient information is expecting the workload of latest enter requests to adapt to dynamic environments without extra task facts. ACOPS also rejects requests that cannot be satisfied before scheduling to reduce the computing time of the scheduling technique.

Al-maamari, F. Omara.[20] have proposed a venture scheduling algorithm for cloud computing based totally on a merge PSO algorithm with the Cuckoo seek (CS) algorithm, called (PSOCS), the task assigned to the virtual device, that goals to minimizes make span and the most useful resource usage. In

keeping with the work in a paper, the Particle Swarm Optimization has been involved to optimize the assignment scheduling hassle with focusing on minimizing the overall executing time.

### III. METHODOLOGY

#### 3.1 PSO Algorithm

The PSO algorithm first proposed by using the use of Eberhart and Kennedy in 1995, and its easy concept is based totally on a look at of birds foraging behaviour [8]. Therefore, PSO algorithm turns out to be inspired by the use of the behavioural trends of natural organization and in the end has been used to clear up and optimize problem. The critical purpose is to reduce the entire completion time and to reduce the load balance within the cloud computing machine

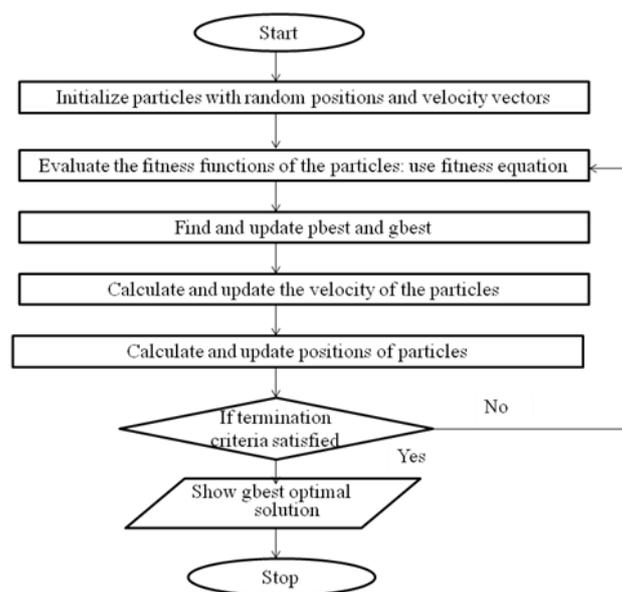


Fig 1 Proposed PSO algorithm

**3.2 PSO algorithm flow chart-** Figure contains the flow of the PSO algorithm from starting to end. It is starting from the initialization of particle

- S= size of swarm particle
- T= it is a number of tasks
- M= it represents number of virtual machine

And then it evaluates fitness value by using the fitness formula:

$$\text{fitness}(i) = \frac{1}{SFT}, 1 \leq i \leq S \quad (1)$$

Where,

$$SFT = \max_{1 \leq m \leq M} \left( \sum_{n=1}^k VM(m, n) \right) \quad (2)$$

- Fitness Function: The inverse of the total task completion time is used to represent the fitness function, which is a key parameter in cloud computing
- SFT represents the time needed to complete all the tasks;

- $VM(m; n)$  represents the time for the  $n$ -th task to run on the  $m$ -th virtual machine, and
- $K$  is the number of tasks distributed to this virtual machine.

Then find out the value of  $pbest$  and  $gbest$  that is local/particle best and global best, by using the equation (3), (4) and (5)

$$pbest_i(t+1) = \begin{cases} pbest_i(t), & \text{if } f(p_i(t+1)) \leq f(pbest_i(t)); \\ p_i(t+1), & \text{if } f(p_i(t+1)) < f(pbest_i(t)) \end{cases}$$

(3)

$$if(max(pbest(t)) = \text{getMax}(f(pbest_1(t)), f(pbest_2(t)) \dots \dots f(pbest_s(t)))$$

(4)

$$gbest(t) = \begin{cases} \max(pbest(t)), & \text{if } f(\max(pbest(t))) > f(gbest); \\ gbest, & \text{else} \end{cases}$$

(5)

After finding the 2 high-quality values, the particle updates its speed and positions with following equation (6) and (7).

$$v_i(t+1) = \omega \times v_i(t) + c_1 \times \text{Rand}() \times (pbest_i(t) - p_i(t)) + c_2 \times \text{Rand}() \times (pbest_i(t+1) - p_i(t))$$

(6)

$$p_i(t+1) = p_i(t) + v_i(t) \quad (7)$$

- In the above formulas,  $t$  represents the number of iterations;
- $\omega = 0.8$  is the inertia weight;
- $C1$  and  $c2$  are learning factors, and generally  $c1 = c2 = 2$ .
- $\text{Rand}()$  is a random value within  $[0, 1]$ .
- $f(p_i(t))$  = denotes particles fitness function
- $f(p_i(t+1))$  = denotes as fitness function during next iteration.

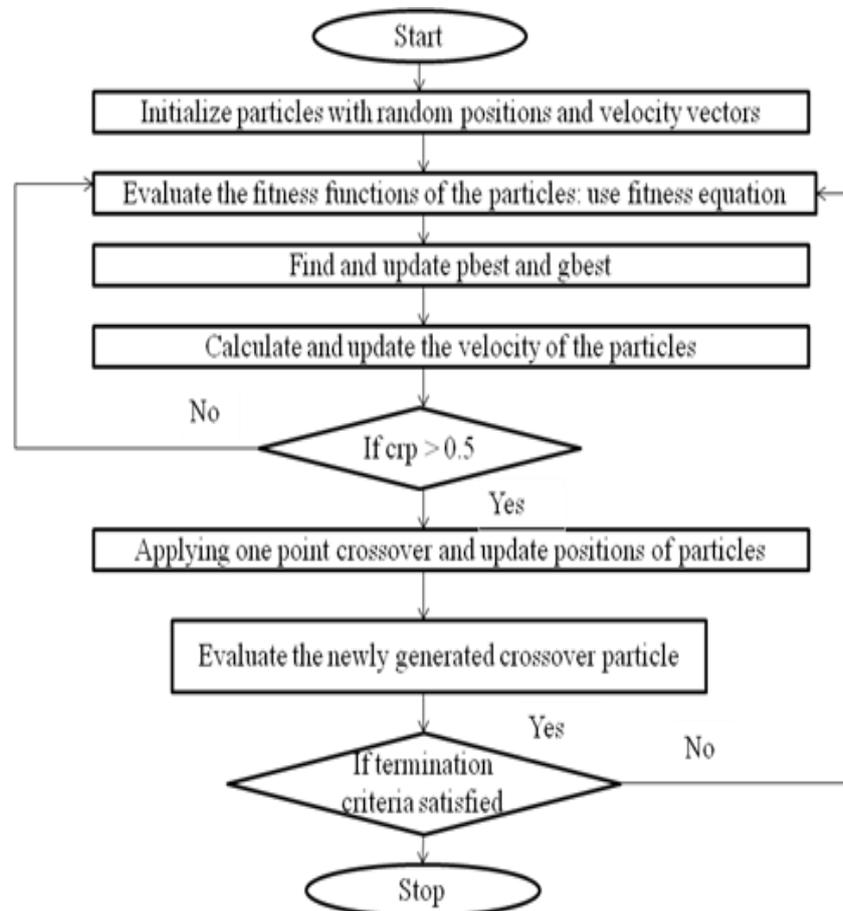
During the process of iteration, the position of the particle is limited to a specific range ( $1 \leq p_i(t) \leq M$ ) then calculate its velocity then calculate and update position of particles, then terminate if criteria is satisfy and show the  $gbest$  optimal value. If criteria is not satisfies then again go back to second process and calculate the fitness value and execute the whole loop and repeat the process till optimise solution achieve

### 3.3 Genetic Algorithm

Genetic algorithms (GA) are search based totally at the ideas of natural desire and genetics. GAs is a subset of a much larger branch of computation referred to as evolutionary computation.

It does some distance make bigger through John Holland. In GAs, we have a pool or a population of feasible answer to the given problem. Those answers then go through crossover and mutation (like in natural genetics), producing new child, and the system is repeated over numerous generations. Each individual is assigned a

fitness value (based mostly on its intention characteristic cost), and the extra match people are given a higher danger to mate and yield more “greater fitness” particle.



**Fig 2 Proposed hybrid PSO&GA algorithm**

### 3.4 Process of Hybrid PSO and Genetic Algorithm

The steps of Hybrid PSO and GA algorithm are as follows: [6]

**Step 1** Initialization of the particle swarm. The position and velocity of the particles are first initialized.

**Step 2** Calculate each particle's fitness function value using Formulas (1) and (2).

**Step 3** Update the optimal. Update the individual and group optimal based on Formulas (3)–(5):

(1) Compare the value of the particle's fitness function to its individual optimal pbest, if the value of the particle's fitness function is better than pbest, and then replace the value of pbest with the current position of the particle.

(2) Compare the particle's fitness function value to its group optimal gbest, if the fitness function value of the particle is better than that of the initial solution calculated by the greedy algorithm, then reset the value of gbest with the particle's current position.

**Step 4** Update the velocity and position of the particle using Formulas (6) and (7) respectively.

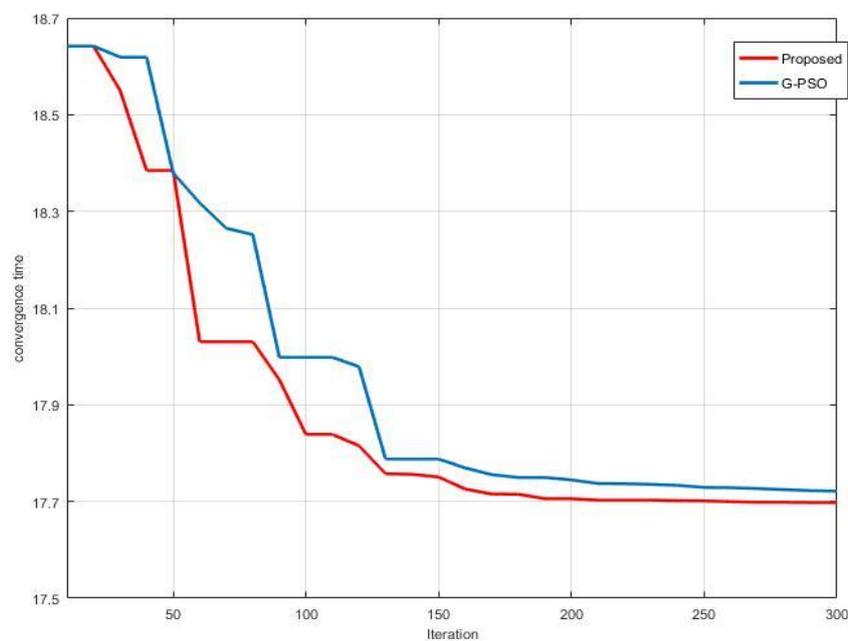
**Step 5** Then use the genetic algorithm crossover function  $cr / random > 0.5$ , it will perform a crossover operation till the random value is greater than 0.5.

**Step 6** Evaluate the newly generated crossover particle to find out the best solution

**Step 7** Stop conditions. The loop will return to Step2 until the stop conditions are met.

## VI. SIMULATION AND ANALYSIS

To validate the feasibility and performance of the Hybrid PSO and Genetic algorithm in terms of scheduling potential in a cloud, we used the cloud computing simulation platform cloudsim [11], NetBeans 8.2 javase windows is used for the implementation. The computer architecture and operating system of the cloud data centre were x86 and windows7, respectively, where each virtual machine had a 1.2 GHz CPU, 4GB RAM, and 100GB hard drive



**Fig 3 Completion time Vs iteration with 50 tasks**

Figures 3 show the entire completing times for 5 virtual machines with 50 iterations. It is able to be seen from Fig 3. whilst the use of the proposed PSO&GA algorithm, the full finishing touch time for the assigned task became 10 s a whole lot less than using the G&PSO algorithm. similarly, the proposed PSO&GA algorithm had less new release, a faster convergence velocity, and much less randomness inside the strategies of optimization for small-or-massive scale venture scheduling. Fig 3 suggests that regardless of the truth that the entire task completion time of the proposed PSO&GA algorithm while scheduling a small-scale challenge is longer than the PSO algorithm on the preliminary stage of generation, the proposed algorithm has a shorter overall undertaking of entirety time. It additionally has a more potent potential for close by seek, because of this that it has, to some extent, conquered the lack of ability of the G&PSO algorithm with its inadequate close by seek capability. Compared with the G&PSO algorithm, while scheduling a large-scale task, the proposed algorithm suggests a stronger functionality in the optimization procedure and has a higher scheduling effect.

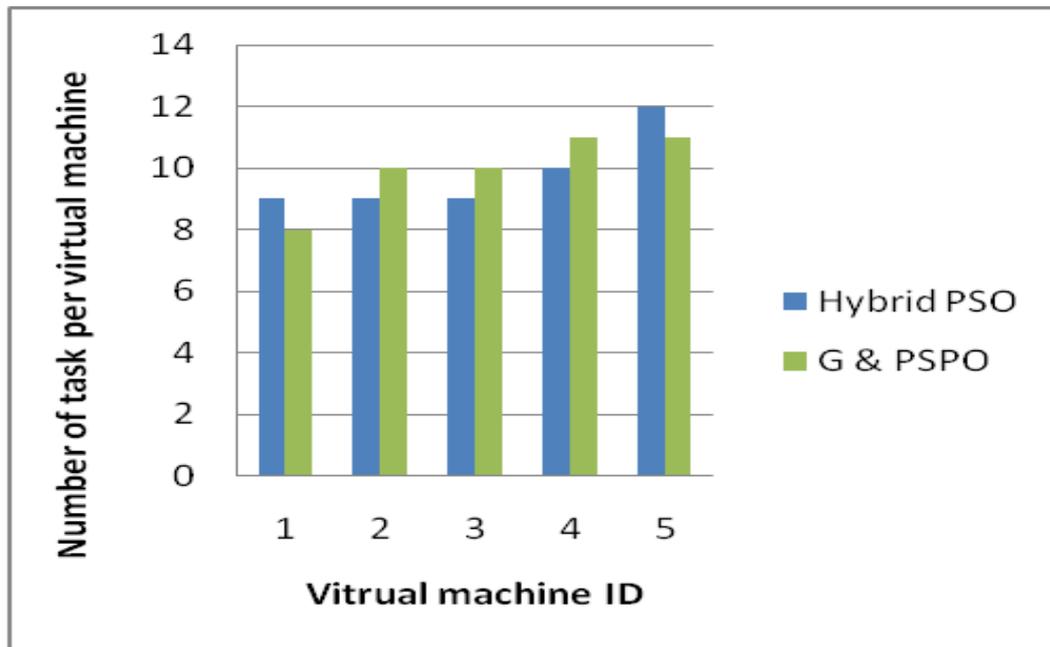


Fig 4 5 Virtual machine with 50 tasks

The wide variety of obligations assigned to each virtual system is proven in Fig.4 (50 tasks). In phrases of usage of the virtual machine aid, as shown in Fig. 4, whilst performing huge-or-small scale task scheduling, the number of obligations assigned to each virtual device is closer to the suggest cost when using the PSO&GA algorithm. This consequences in stepped forward usage of device assets and avoids a workload overload on the virtual machines.

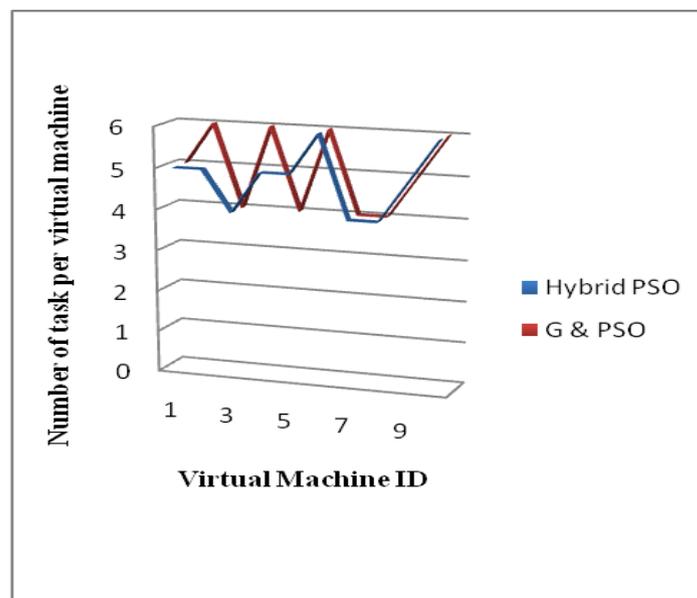


Fig 5, 10 virtual machine with 50 tasks

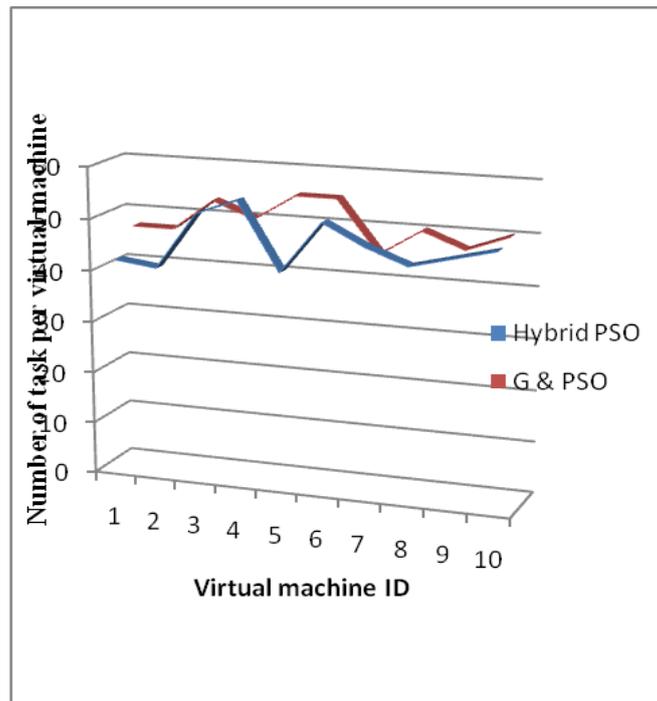


Fig 6, 10 virtual machine with 500 tasks

Figure 5 indicates that PSO&GA algorithm has better load balancing overall performance as compared with the G&PSO algorithm. usually, using more virtual machines does no longer imply acquiring a better result, as configuring every virtual device often consumes extra machine sources and eventually results in a increase in the basic system overall performance. because of the predicament of the physical hardware within the widespread host and community bandwidth, the number of virtual machines assigned to a single host ought to be set to no greater than 10 to obtain the first-class system overall performance. To similarly verify the performance of the proposed G&PSO algorithm of load balancing in virtual machines, the variety of virtual machines turned into improved from 5 to 10 and their processing competencies updated to 500, 600, 700, 800, 900, 1000, 550, 650, 750, and 850. The variety of duties remained unchanged, and those responsibilities are assigned to each virtual device proven in Figs. 5 and 6. In Figs.5 and 6, the simulation effects for each large-scale and small-scale mission scheduling are proven. When the usage of the proposed algorithm the number of tasks assigned to each virtual machine remains toward the mean cost and the device load remains balanced. In conclusion, the proposed G&PSO algorithm achieves the desires of shorter mission of completion time and a greater balanced virtual machine load; the comprehensive efficiency of the cloud computing platform has therefore been advanced.

## VII. CONCLUSION

This paper aimed to clear up the task scheduling problems of virtual machines on a cloud platform, and the PSO&GA algorithm was proposed to decrease the same old final time and balance the workload in each virtual system. compared with the G&PSO algorithm, the hybrid PSO&GA algorithm has a faster convergence charge inside the early level of latest release, a stronger local seek functionality all through the later duration of era, better global optimization average overall performance, and overcomes the incapacity of the traditional

algorithm with an awful lot less randomness. On a cloud platform simulated with the aid of Cloudsim (facts centre disposes one server), the proposed algorithm now not only satisfactory reduces the overall task completion time, however additionally balances the system load and improves the complete performance of the whole cloud platform

## REFERENCES

- [1.] T. Dillon, C. Wu, and E. Chang, "Cloud computing: issues and challenges", in Advanced Information Networking and Applications (AINA), 2010 24th IEEE International Conference on, (2010), pp. 27-33.
- [2.] F. Baroncelli, B. Martini and P. Castoldi, "Network virtualization for cloud computing", *annals of telecommunications-Annales des telecommunications*, vol. 65, (2010), pp. 713-721.
- [3.] X. Wang, C. S. Yeo, R. Buyya And J. Su, "Optimizing The Makespan And Reliability For Workflow Applications With Reputation And A Look-Ahead Genetic Algorithm", *Future Generation Computer Systems*, Vol. 27, (2011), Pp. 1124-113.
- [4.] Saeed Javanmardi, Mohammad Shojafar, Danilo Amendola, Nicola Cordeschi, Hongbo Liu, And Ajith Abraham, "Hybrid Job Scheduling Algorithm For Cloud Computing Environment", Springer verlag Berlin Heidelberg 2014
- [5.] Chun-Yan Liu Cheng-Ming ZOU, Pei WU, "A Task Scheduling Algorithm Based On Genetic Algorithm And Ant Colony Optimization In Cloud Computing" In 978-1-4799-4169-8/14 2014 IEEE
- [6.] Zhifeng Zhong, Kun Chen, Xiaojun Zhai, And Shuang Zhou, "Virtual Machine-Based Task Scheduling Algorithm In A Cloud Computing Environment" In *Issn11007-0214/07/091pp660-667* Volume 21, Number 6, December 2016 Ieee
- [7.] Panpan Xu, Shulin Sui, Zongjie Du Application Of Hybrid Genetic Algorithm Based On Simulated Annealing In Function Optimization World Academy Of Science, Engineering And Technology International Journal Of Mathematical, Computational, Physical, Electrical And Computer Engineering Vol:9, No:11, 2015
- [8.] I. C. Trelea, The Particle Swarm Optimization Algorithm: Convergence Analysis And Parameter Selection, *Information Processing Letters*, Vol. 85, No. 6, Pp.317-325, 2003.
- [9.] Keng-Mao Cho Pang-Wei Tsai Chun-Wei Tsai Chu-Sing Yang A hybrid meta-heuristic algorithm for VM scheduling with load balancing in cloud computing *Neural Comput & Applic* DOI 10.1007/s00521-014-1804-9 Springer 2014
- [10.] A. Al-Maamari And F. Omara, "Task Scheduling Using Hybrid Algorithm In Cloud Computing Environments", *Iosr Journal Of Computer Engineering (Iosr-Jce)*, Vol. 17, (2015), Pp. 96-106.
- [11.] R. N. Calheiros, R. Ranjan, A. Beloglazov, C. A. F. De Rose, and R. Buyya, CloudSim: A toolkit for modelling and simulation of cloud computing environments and evaluation of resource provisioning algorithms, *Software Practice & Experience*, vol. 41, no. 1, pp. 23-50, 2011.
- [12.] Xu Gaug An adaptive parameter tuning of particle swarm optimization algorithm Elsevier Vol:219 Issue: 9 2013

## **4<sup>th</sup> International Conference on Innovative Trends in Science, Engineering and Management**

(C-DAC, Mumbai) Centre for Development of Advanced Computing, Mumbai, Maharashtra (India)

(ICITSEM-17)

**17<sup>th</sup> June 2017, [www.conferenceworld.in](http://www.conferenceworld.in)**

ISBN: 978-93-86171-47-4

- [13.] S. Kaur And A. Verma, An Efficient Approach To Genetic Algorithm For Task Scheduling In Cloud Computing Environment, International Journal Of Information Technology & Computer Science, Vol. 4, No. 10, Pp. 74–79, 2012.
- [14.] H. Liu, A Measurement Study of Server Utilization In Public Clouds, In IEEE Ninth International Conference On Dependable, Autonomic And Secure Computing, 2011, Pp.435–442.

# **AN APPLICATION OF MULTIRELATIONAL CLUSTERING WITH DOMAIN EXPERT GUIDENCE FOR VERIFYING SESSION FIXING IN CRICKET**

**K.Ananthapadmanabha<sup>1</sup>, Dr.K.Udayakumar<sup>2</sup>**

<sup>1</sup>*Research Scholar, PP COMP.SCI.ENG.0251, Computer Science & Engineering*

*Rayalaseema University, Kurnool,( India)*

<sup>2</sup>*Principal and Professor, Department of Computer Science and Engineering*

*Adarsha Institute of Technology, Bangalore, (India)*

## **ABSTRACT**

*According to Kevin Peterson a well known international reputé sport's advocate and editor of lawinsport.com, the greatest threat for sport world wide is match fixing. Different types of match fixing are spot fixing, session fixing and bracket fixing. Session fixing is a type of match fixing in which the match is divided into different sessions and in each session, betting opportunities are made available for general public. To verify session fixing in cricket latest technology like sports data mining can be used. Sports Data Mining deals with sports data in all domains of sports like football, cricket, volleyball, hockey and expertise available in related sports domain helps in analyzing sports data. Session fixing is done by dividing each inning of the cricket match into different sessions like a T20 cricket match inning can be divided into four sessions each of five over's and number of session in a match of two inning will be eight sessions. To check session fixing in this paper we are applying Multi relational clustering with Domain expert guidance.*

**Keywords :** *Cricket, Domain expert guidance, Multi relational clustering, Session fixing, Sports Data Mining.*

## **I. INTRODUCTION**

The association that exists between different players, umpires and officials participating in a cricket match can be represented in different relations. Multi relational clustering is applied on these relations to partition these relations into different clusters. Domain experts like former captain or senior commentators have good knowledge about problems like session fixing, what inside information is needed for performing session fixing etc. This knowledge can help in analyzing whether any match is session fixed or not.

## **II. SPORTS DATA MINING**

In today's world, sports is not only played for entertainment, It has moved beyond entertainment and it is a multi trillion dollar industry. With many sports based enterprises investing multiple billions of dollars for their operations. This industry today has huge volumes of sports data across all domains of sports. This data can be with respect to individual player performance, team performance, tournament details and game details. All these sports data can be used for professional purposes like team selection, captain decision making process, for coaching or managerial decision making process. It can also be used for trend analysis, sports management,

talent recognition, Sports sponsorship, prediction of match result outcomes, analyzing controversies in sports like doping scandals, match fixing scandals to name a few problems. It also helps in fine tuning fitness level of players and enhances teams performance. In any team decision making process this sports data can be utilized for competitive advantages to be ten steps ahead of their opponents. It assists them in designing match strategies, team selection, analysis of opponent teams strength and weakness. With each sport there is huge amount of expertise available. This helps in analyzing sports data and contribute for development of research and development in this area. This sports data have hidden relationship which when mined provides competitive advantages.

Sports data may be in the form of comments and reviews stored in social media like Twitter, Face book to name a few which can be analyzed using data mining techniques like Opinion mining or Sentiment analysis, to understand background knowledge using Ontology based mining techniques. Its application includes Ontology mapping, expertise matching, Opinion spam detection etc. Review mining can be conducted for verifying reviews stored in sports reviews on the social media by both viewers and domain experts on a particular sports based on event, topic or game.

Sports Data Mining consists of different tools and techniques to measure individual player performance and team performance. It has given an opportunity to automate sports data from human level to automated Information retrieval and storage system for extracting knowledge from sports data. Sports data analysis requires new and novel techniques which are completely different from classical data mining procedures and techniques.

### III. LITERATURE SURVEY

Not much work is done on session fixing in cricket. In a paper titled “ Match fixing network analysis for verifying nearness among internal participants of a cricket match” authored by the same authors in IEEE proceeding they have highlighted the role of internal participants of a cricket match and significance of match fixing network for conducting match fixing. Here they have proposed three algorithms for defining nearness based on geographic proximity. These algorithms are ApartmentNN() Algorithm, OfficeNN() and TransportationbasedNN(). In another paper authored by the same authors they have focused on role of Iceberg diagrams in verifying match fixing in cricket.

### IV. METHODOLOGY

In a game of cricket there will be N number of players and umpires participating out of which K number of clusters can be created. But not all K number of clusters are match fixers or outliers. Between players, umpires, officials, bookies and gamblers there will be some form of association .This association can be represented in multiple relations. Also multi relational clustering process is used to partition these different data objects into a set of clusters. Here user guidance in clustering and tuple ID propagation is used to avoid physical joins.

### V. N DIMENSIONAL SPACE

N Dimensional Space is a space in clustering and nearest neighbor used to define what is near and what is far away based on distance calculated. This distance is Euclidean distance given by the formula

$$D(x,y)= \sum (( x_i - y_j )^2)^{1/2} \dots (1)$$

Real world problems like match fixing in cricket consists of N dimensions where each predictor that is used can be considered to be a new dimension .

## VI. MULTI RELATIONAL CLUSTERING WITH DOMAIN EXPERT GUIDANCE

One major problem in multi relational clustering is there are too many predictors or attributes in different multiple relations. Also a specific set of these attributes are relevant to a specific clustering task. End users with their application experience have a specific event or pattern in mind using which they would like to find a pattern. Also they have a good idea about application requirements and data semantics. They know which attributes are relevant and which attributes are irrelevant. To empower end users to conduct their own prediction there is a need to include multi relational clustering with domain expert guidance . Here domain expert guidance will be in the form of simple queries which is used to improve the efficiency and quality of high dimensional multi relational clustering.

## VII. N DIMENSIONAL SPACE REPRESENTATION.

A multidimensional representation of the data together with all aggregates is known as Data Cube. A Data Cube may have either more or fewer than three dimensions. It is a generalization of Cross Tabulation. Multidimensional data analysis consist of viewing the data as a multidimensional array and aggregating data for better analysis of structure of data. Multidimensional data analysis supporting relational databases are ROLAP Systems. There are other types of multidimensional data analysis like MOLAP Systems.

## VIII. SIMPSON’S PARADOX

In multidimensional clustering there are too many attributes in different relations. It is important to exercise caution when interpreting the association between attributes because the observed relationship may be influenced by the presence of other confounding factors like hidden variables that are not included in the analysis. These hidden variables may cause the observed relationship between a pair of variables to disappear or reverse its direction. This phenomenon is called Simpson’s paradox. It leads to generation of spurious tuples. To avoid the generation of such spurious patterns proper stratification is required.

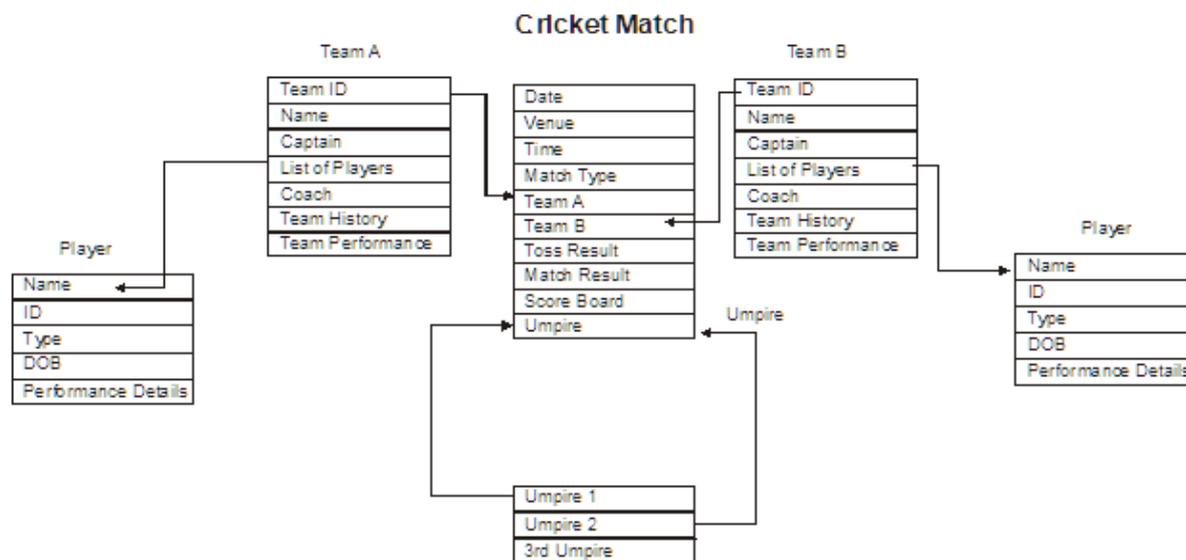


Fig 1: Multi Relational Schema of a Cricket Match

With respect to Match Fixing in cricket consider team A. In order to cluster team A players, attributes like Matchtype(Test, ODI and T20) participated by players, performance of players, coach details are considered.

A user is interested in clustering players based on certain aspect of information like clustering based on T20. Here users have a clear picture about their application requirement and data semantics. The user who provides guidance may be a experienced player or an expert commentator. His guidance in the form of simple query is used. Now consider user queries with a target relation with one or more pertinent attributes to specify goal of the user. A multi relational attribute A is defined by a join path An attribute R.A of R and an optional aggregate operator like Max, Min, Count, Average. Multi relational attribute A is represented by A.joinpath.A.attr.Aggregater in which A.attr.Aggregater is optional A multi relational clustering can be a categorical feature or a numerical one. If A is a categorical feature then for target tuple t, t.A represents the distribution of values among the tuples in R that are joinable with t. If As a numerical, then it has a certain aggregation operator like max, min, count, average and t.A is the aggregated value of tuples in R that are joinable with t. In Multi relational clustering process, search for pertinent attribute across multiple relations.

### Major challenges in the search process are

1. The target relation R can join with non target relation R via many different join paths and each attribute in R can be used as a Multi Relation Attribute. But it is not feasible to conduct exhaustive search.
2. Among the huge number of attributes, some are pertinent to the user query where as many other attributes are irrelevant. So there is a need to identify pertinent attributes while avoiding aimless search in irrelevant regions in the attribute space.

### Steps taken to overcome challenges of multi relational clustering are

1. To confine the search process. Consider the relational schema as a graph with relations as nodes and joins as edges of the graph. Apply heuristic approach of search which starts search from the user specified attribute and the repeatedly search for useful attribute in the neighborhood of existing attribute.
2. To identify neighboring attributes as pertinent attribute check how attribute cluster target tuples. The Pertinent attribute are selected based on their relationship to the user specified attribute. If two attributes cluster tuples vary differently, then the similarity is low and they are not related. But if two attributes cluster tuples very similarly their similarity is high and they are considered related. If two attributes cluster tuples in almost the same way their similarity is very high and they may represent redundant information.
3. From the set of pertinent features found select a set of non redundant feature so that similarity between any two features is not greater than a specified Maximum.
4. For evaluating the similarity between attributes the data structure used is Similarity vector which is defined as follows

Suppose there are N target tuples  $t_1, t_2, \dots, t_n$   $V_a$  be the similarity vector of attribute A. It is an N dimension vector that indicates the similarity between each pair of target tuple  $t_i$  and  $t_j$  based on A.

## IX. SESSION FIXING

In an ODI cricket match, a team's inning can be divided into three sessions. The first two sessions are of fifteen over's while the third session will be of twenty over's. In a two inning ODI match there will be six sessions. For each of these sessions, bets are accepted by the bookies based on permutation and combination of few important critical information . This information corresponds to teams game plan, team composition, pitch report, weather

report etc. Such information is called Inside Information. Bookies offer odds on session betting. So there are more betting options for bookies when compared to match fixing where they can provide betting option only on the end result of the match. Inside information is extracted from teams dressing room and this information helps bookies in understanding its impact on a particular session of the match or the final end result of the match.

## X. ALGORITHM SESSIONFIXING()

//Purpose : To identify occurrence of session fixing in a cricket match

//Input : Inside information from dressing room and score board details

//Output : To verify any session fixing is done or not

Step 1 : Decide in advance players from which team who are part of dressing room who will pass information to the bookies.

Step 2 : Divide the T20 cricket match into sessions. Check the inside information to decide its impact on every session of the match

Step 3: For each session in the match

Step 4: Decide signal of underperformance by player of a specific team like displaying a towel on the trouser of the player.

Step 5 : Decide betting rates based on inside information.

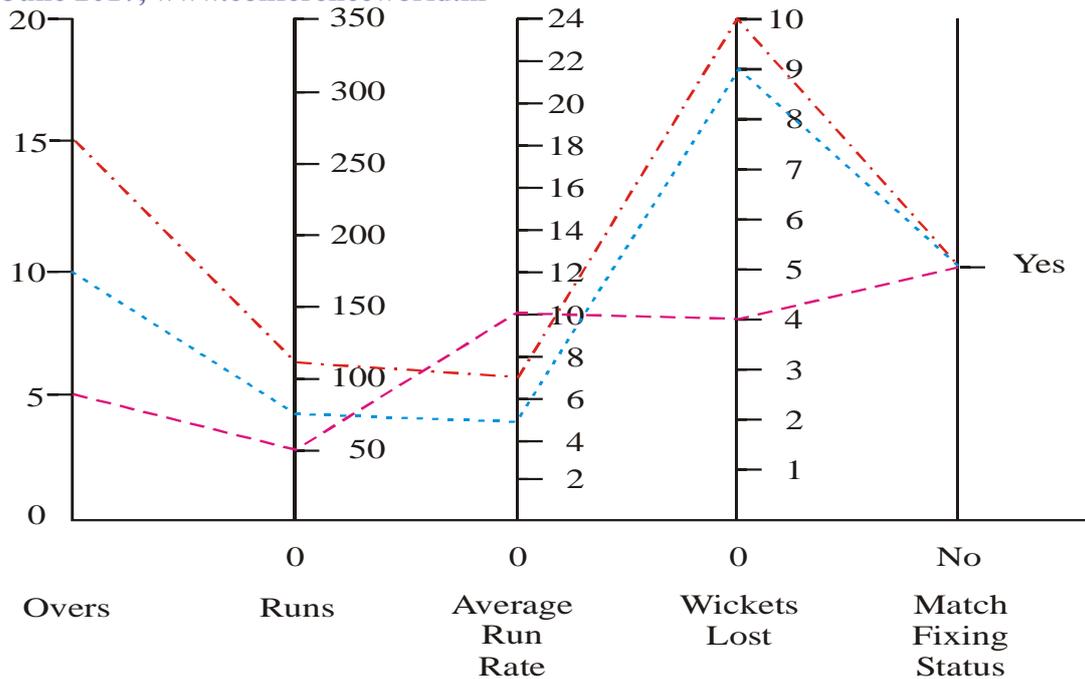
Step 6 : If the specified number of runs in the session and number of wickets to be lost is decided between the bookies and players and if the players are ready for underperformance players have to give signals to the bookies as decided earlier.

Step 7 : Players to underperform their role as decided earlier.

Step 8 : If players do not give signals to bookies even though they are ready to underperform the bookies may not involve in betting for that session.

## XI. RESULTS

In a cricket match there will be two teams namely team A and team B. If team A wins the toss and elects to bat first then team A is called target setter and team B is called target chaser. For each team there is a need to draw Iceberg diagram which is based on parallel coordinate system and can include any number of dimensions. Here dimensions included for target setter team are overs, runs scored, average run rate, wickets lost and status of match fixing. For target chaser team all the above dimensions are included along with an additional dimension called target run rate.



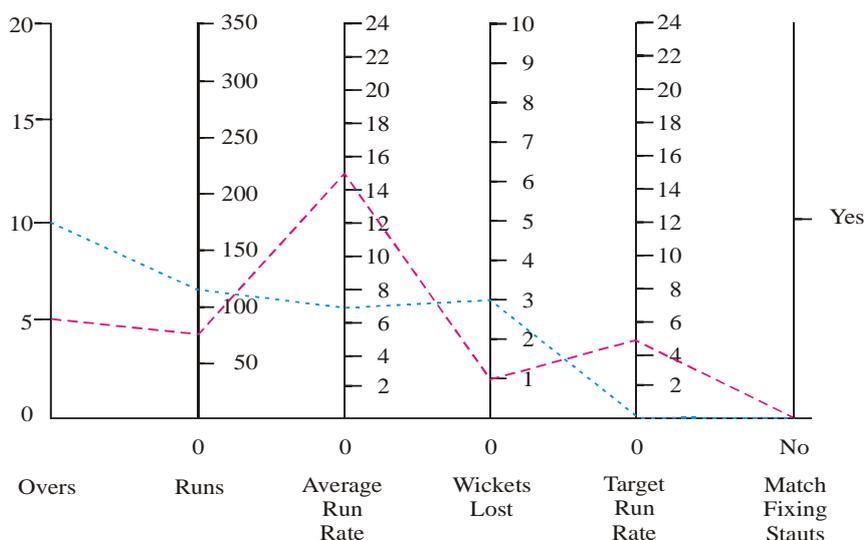
**Graph 1: Iceberg Diagram for Team A (Target Setter) in Match 1**

Graph 1 represents Iceberg diagram for team A as target setter in match 1 between team A and team B. Team A in its first 5 overs (overs 1-5) of its batting innings scores 50 runs by loosing 4 wickets at an average run rate of 10 runs per over.

In the next five overs(overs 6-10), team A scores 25 runs by loosing 5 wicket at an average run rate of 5 runs per over.

In the next five overs (overs 11-15), team A scores 35 runs by loosing 1 wicket at an average run rate of 7 runs per over.

Team A is unable to complete their 20 overs quota. Team A sets a target score of 110 runs in 20 overs for team B.

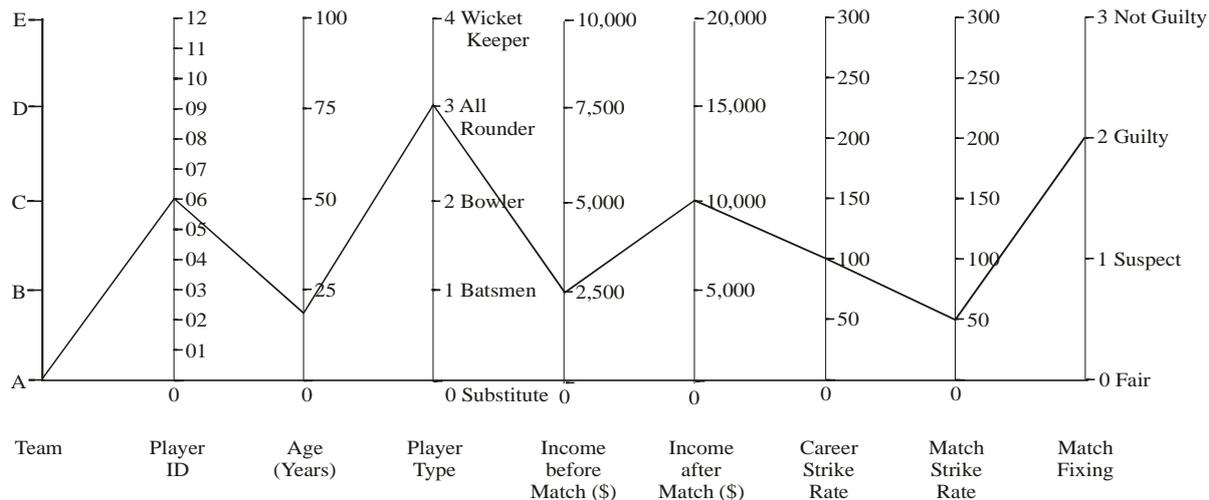


**Graph 2: Iceberg Diagram for Team B (Target Chaser) in Match 1**

Graph 2 represents Iceberg diagram for team B as target chaser. In its first five overs(overs 1-5) team B scores 75 runs by loosing 1 wicket at an average of 15 runs per over.

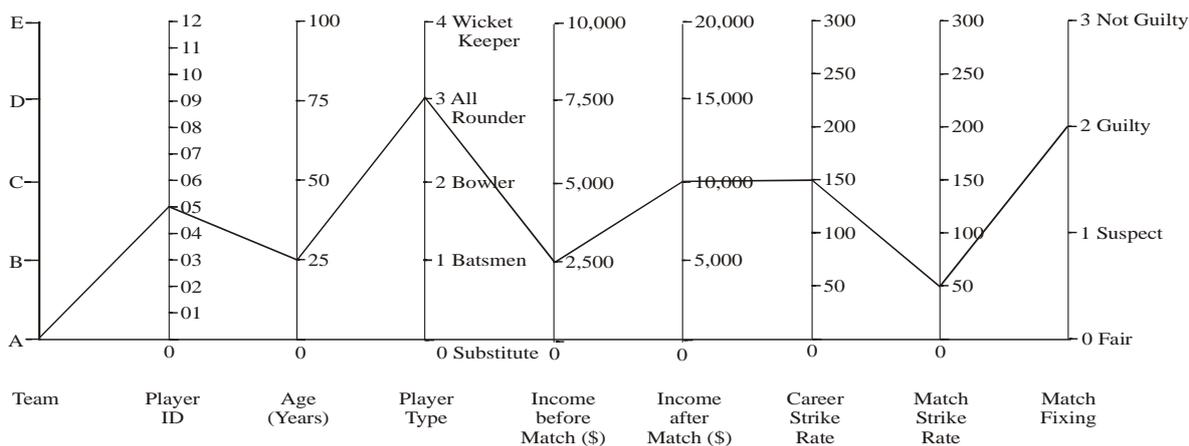
In its next five overs(overs 6-10) team B scores 35 runs at an average run rate of 7 runs per over by losing 2 wickets. They are above the required target run rate. Team B in their first ten overs are able to score the target set by team A and wins the match.

Match 1 between Team A and Team B in Graph 4 and graph 5 represents Iceberg diagrams for players involved in match fixing. Here Iceberg diagram is used to represent favors received by players . These Iceberg diagrams include important dimensions like team, player id, age, player type(batsmen, bowler, all rounder, wicket keeper), income before match and income after match, player’s career strike rate and match strike rate and match fixing status of player(fair, suspect, guilty, not guilty).



**Graph 3: Iceberg Diagram for Match 1 Representing Player ID 06 involved in Match Fixing**

In graph 3 Iceberg diagram shows how player with player id 06 belonging to team A, aged 20 years, who is an all rounder whose income before match is \$ 2500 and income after match is \$ 10000. His career strike rate is 100 but his current match run rate is 50 and he is found to be guilty of match fixing.



**Match 1**

**Graph 4: Iceberg Diagram for Match 1 Representing Player ID 05 involved in Match Fixing**

Graph 1 represents Iceberg diagram for team A as target setter in match 1 between team A and team B. Team A in its first 5 overs (overs 1-5) of its batting innings scores 50 runs by losing 4 wickets at an average run rate of 10 runs per over.

In the next five overs(overs 6-10), team A scores 25 runs by loosing 5 wicket at an average run rate of 5 runs per over.

In the next five overs (overs 11-15), team A scores 35 runs by loosing 1 wicket at an average run rate of 7 runs per over.

Team A is unable to complete their 20 overs quota. Team A sets a target score of 110 runs in 20 overs for team B.

In a T20 tournament involving 3 teams A, B and C and in match 1 between team A and team B, team A wins the toss and elects to bat. According to pitch report and weather report, the minimum expected target to be set is 225. Also in the tournament team A is the highest ranked team (Rank 1) followed by team C (Rank 2) and team B (Rank 3). In match 1 team A as a target setter sets team B a target of 110 runs. In scoring 110 runs it utilizes 15 overs. Team B achieves this target in 10 overs. According to CIS finding this match is fixed by team A for the following reasons

1. Even though team A is a higher ranked team it has under-performed.
2. It has not utilized all the 20 overs allotted to it.
3. It has lost wickets regularly and could not utilize last 5 overs.
4. The target score set is a very mere target when compared to expected minimum target.
5. Team A did not want to face Team C in the tournament final. For this reason it has lost to team B so that now it can face team B in the tournament final.

All these information can be inferred from Iceberg diagram shown in the result for match 1. To know the culprits involved in match fixing dimensions like income of player before match and income of player after match, players career strike rate and match strike rate are included.

Strike rate comparison helps in identifying players under performance. Income before match and income after match indicates illegal financial transactions done by the player for match fixing.

Both these dimensions clearly help to identify match fixing.

## **XII. CONCLUSION**

Today Match fixing in cricket is a ground reality. Session fixing is a new form of match fixing where betting and match fixing is done in different sessions of the match and it provides bookies more opportunity for betting and detection of session fixing is much more complicated than match fixing. Multi relational clustering helps in analyzing multi dimensional data that deals with match fixing. Key challenges in application of multi relational clustering are highlighted in this paper along with Simpson's Paradox.

## **XIII. FUTURE ENHANCEMENTS**

For multi dimensional data analysis new techniques like relevance analysis, dimensionality reduction techniques can be incorporated. Nowadays new types of match fixing like spot fixing and bracket fixing are used by bookies. So there is a need for developing solutions for these type of fixing problems. If the captain himself is involved in match fixing then it leads to bracket fixing. Bracket fixing is more complicated than session fixing.

## XIV. ACKNOWLEDGEMENT

Authors wish to thank the Management of Adarsha Institute of Technology, Bangalore and special thanks to Dr.P.V.Krupakara for their constant support.

## REFERENCES

- [1] Any Levitin, "Introduction to the Design and Analysis of Algorithms", Pearson Publications
- [2] G.K.Gupta, "Introduction to Data Mining with case studies", PHI Learning Private Limited.
- [3] R.V.Hauck et.al, "Using coplink to analyze criminal justice data", Computer, March, 2002, 30-37.
- [4] Alex Berson, Stephan J Smith " Data Warehousing, Data Mining and OLAP", Tata McGraw Hill Edition publication.
- [5] Pang-Ning Tan, Michael Steinbach and Vipin kumar "Introduction to Data Mining", Pearson Education publication
- [6] Jiawei Han and Micheline Kambe "Data Mining Concepts and Techniques", 2<sup>ND</sup> Edition, Morgan Kaufmann publishers An imprint of Elsevier.
- [7] K.Udayakumar and K.Ananthapadmanabha, KL Cluster Nearest Neighbor Outlier Prediction Algorithm for Match Fixing in Cricket, International Journal of Advances in Electronics and Computer Science, Special Issue, Sep.-2016, pp. 79-81, ISSN: 2393-2835.
- [8] K.Udayakumar and K.Ananthapadmanabha, Algorithmic Design Notation for Match Fixing in Cricket Using Outlier Analysis, Higher Education Conclave 2016, p. 31, 2016, ISBN No. 978-81-8281-575-9.
- [9] K.Udayakumar and K.Ananthapadmanabha, Forest Fire Model Proposal for Match Fixing in Cricket Based on Criminal Network Analysis, International Journal of Engineering Research, Volume No.5 Issue: Special 4, pp: 790-991, May 2016, doi: 10.17950/ijer/v5i4/016, ISSN: 2319-6890 (online), 2347-5013(print).
- [10] G. Wang, H. Chen and H. Atabakhsh "Automatically detecting deceptive criminal identities ", Comm. ACM, March 2004, pp 70-76.
- [11] T. Senator et al, " The FinCEN Artificial Intelligence system Identifying potential money laundering from reports of large cash transactions ", AI magazine vol. 16, no. 4, 1995, pp 23-39.
- [12] K.Ananthapadmanabha and Dr.K.Udayakumar, Match Fixing Network Analysis to Verify Nearness among Internal Participants of a Cricket Match, 2017 2nd IEEE International Conference on Recent Trends in Electronics, Information & Communication Technology, at SEVC, Bangalore, IEEE xplore ISBN: 978-1-5090-3704-9.
- [13] K.Ananthapadmanabha and Dr.K.Udayakumar, Role of Iceberg Diagram as a Data Visualization Tool for Verifying Match Fixing in Cricket, 2017, 3rd National Conference on Recent Trends in Computer Science and Engineering (NCRTCS), at SJCIT, Bangalore on 3rd and 4th May, 2017, ISBN 978-81-931545-0-2.
- [14] K.Ananthapadmanabha and Dr.K.Udayakumar, "Trustworthy Collaborative Investigation System for Match Fixing in Cricket Using Spectator Voting Scheme" at International Conference on Signal Processing Communication and Automation (ICSIPCA), 2017 in Tata McGraw Hill Journal, Grenze Digital Library and Grenze International Journal of Engineering and Technology (GIJET) ISSN: 2395-5295 (Online) 2395-5287 (Print) Indexed in Scopus (Cross Ref. or other indexing services).

***B. monnieri* - MICROPROPAGATION USING  
VERMICOMPOST, ELUANT AND EXTRACTS OF  
VERMICOMPOST IN PLANT TISSUE CULTURE  
MEDIA**

**Suman Kashyap<sup>1</sup>, Neera Kapoor<sup>2</sup>, Radha D Kale<sup>3</sup>**

<sup>1</sup>*Department of Biotechnology and Centre for Scientific Research and Advanced Learning,  
Mount Carmel College, Bengaluru, (India)*

<sup>2</sup>*School of Sciences, Indira Gandhi National Open University (IGNOU),  
Maidan Garhi, New Delhi, (India)*

<sup>3</sup>*Centre for Scientific Research and Advanced Learning, Mount Carmel College, Bengaluru, (India)*

**ABSTRACT**

*Vermicompost produced by the activity of earthworms is rich in macro and micronutrients, vitamins and growth hormones. Vermicompost was evaluated with different methods of extractions like vermicompost only, eluant and vermicompost extract to use in the tissue culture media for micropropagation of *B. monnieri*. ANOVA, Student's t-test and Tukey's Honestly Significant Difference (HSD) Test were considered for analyses of significance of various parameters. The values for number of roots ranged from 4 in only vermicompost medium to 7 in vermicompost extract medium. This had F value of 92.67 and Pr > F of < 0.0001. The mean number of shoots formed in medium having vermicompost was 3.0 whereas in vermicompost extract it was 1.2. The level of significance has given the F value of 91.00 and Pr > F of < 0.0001. Vermicompost extract has significantly supported higher nodes and leaves compared to eluant and only vermicompost. The significance level was Pr > F of 0.0011 and 0.0012 respectively. Significant increase in the weight of the plantlets (in milligrams) was observed in vermicompost extract as compared to other two treatments. The value for significance was at < 0.0001. Test for percentage response of survival of plantlets has shown that in all the three treatments there was 100 per cent survival of the explants. The results have shown that the response in vermicompost extract medium was significantly higher.*

**Keywords:** *B. monnieri, Eluant, Economical Plant Media, Vermicompost, Vermicompost Extract.*

**I. INTRODUCTION**

*Bacopa monnieri* (L.), commonly known as "Brahmi" is a glabrous, sprawling succulent herb with ayurvedic medicinal importance in Indian subcontinent. The perennial creeper is a member of the family Scrophulariaceae and grows in damp and marshy places and on the banks of slow flowing rivers and lakes, ascending up to an altitude of 1,320 meters<sup>1</sup>. The herb is known to improve memory cells and thus known as "memory booster" or "thinking person's herb". The rejuvenating herb with reputed drug value is used in folk and traditional system of medicine as a nerve, cardio and brain tonic to enhance concentration<sup>2</sup>. The principal active factors in *Bacopa* are

two steroidal saponins, bacosides A and B (“memory chemicals”), that help repair damaged neurons by enhancing proteins involved in the regeneration of neural-cell synapses<sup>3</sup>. Two new dammarane-type jujubogenin bisdesmosides, bacosaponins E and F of biological interest have also been isolated from this herb<sup>4</sup>. In India, brahmi is used to prepare important ayurvedic preparations like “Brahmighritam” and “Brahmirasayanam”<sup>5</sup>. On the basis of medicinal importance and potential for future research and development, *B. monnieri* is placed second in a priority species list of the most important medicinal plants<sup>6</sup>. This is one among 32 medicinal plants identified for cultivation and conservation by the NMPB<sup>7</sup>. In recent years, the release of brahmi-based Memory Plus product-containing bacoside extracts increased the demand in the Indian market, which led to over-collection of the plant from the natural habitat. Multiple numbers of brahmi-based commercial ayurvedic preparations are already available in the market due to its therapeutic values<sup>8</sup>. *In vitro* regeneration and micropropagation of brahmi was reported by many researchers<sup>9-15</sup> and synthetic seed mediated plant conversion<sup>16</sup>.

Vermicompost produced by the activity of earthworms is rich in macro and micronutrients, vitamins, growth hormones, enzymes such as proteases, amylases, lipase, cellulase and chitinase and immobilized microflora. The enzymes continue to disintegrate organic matter even after they have been ejected by the earthworms<sup>17-21</sup>. Vermiwash, a liquid nutrient obtained during vermicomposting has significant influence on plant growth and yield attributes<sup>22-24</sup>. Due to this, these vermiproducts have become key components of crop nourishment in organic and sustainable farming systems. Of the many species of earthworms evaluated for vermicomposting, *Eudrilus eugeniae* (Kinberg.), *Eisenia fetida* (Savigny) and *Perionyx excavatus* (Perrier) have been considered as the key species for organic matter recycling, throughout the world<sup>25-30</sup>.

The present investigation was planned to report a simple and rapid but novel method for *in vitro* multiplication of *B. monnieri* by using highly economical nutrient tissue culture media. All available medical literature<sup>31</sup> confirms that there has been no toxicity report associated with the use of *Bacopa* as a dietary supplement in children or adults<sup>32</sup>. Brahmi is especially suitable for students as it enhances the mind’s ability to learn and to focus<sup>33</sup>.

## II. MATERIALS AND METHODS

### 2.1 Collection of Medicinal Plant Sample (Explants)

Explants from certified disease-free medicinal plants were obtained from Botanical Garden of University of Agricultural Sciences (UAS), Gandhi Krishi Vigyan Kendra, Bangalore. Plants were planted in potted soil at the institution.

### 2.2 Preparation of the MS Medium

Murashige and Skoog’s<sup>34</sup> medium was used for the cultivation of *B. monnieri*, under *in vitro* conditions as reference standard medium.

The MS medium was purchased from the Sigma and final volume was made up with distilled water. The pH of the medium was adjusted to 6.0 using 1 N NaOH / HCl. About 20 ml of the medium was poured into sterile culture bottles. The culture bottles were autoclaved.

## 2.3 Use of aqueous extract of vermicompost as nutrient plant tissue culture medium

Three grams of vermicompost was mixed with 10 ml of distilled water, homogenized and the volume was made up to 10 ml with distilled water. Tubes were centrifuged at 3000 rpm for 10 minutes. The pH of the supernatant (extract) was made upto 10 ml with distilled water and agar was added.

## 2.4 Modified method

Fresh vermicompost (30 per cent) was suspended in sterile distilled water and was placed on a stirrer for continuous agitation for 8 hours. After 24 hours, aqueous extract was collected containing humic and fulvic acids and was used to prepare the medium. This was supplemented with 9 grams / Litre of agar. Explants of *B. monnieri* were inoculated into this sterile medium under aseptic conditions.

## 2.4 Use of eluant as nutrient in plant tissue culture medium

Vermicompost (30 per cent) was suspended in known volume of distilled water and left undisturbed for 24 hours. Filtrate (eluant) was collected and used for media preparation.

## 2.5 Use of vermicompost as nutrient plant tissue culture medium

Vermicompost produced by the activity of epigeic earthworms on organic waste mix of plant litter, vegetable waste and cow dung slurry at the college campus was used for the present study. Vermicompost was sieved for collecting only the castings. Vermicompost (30 per cent) containing humic and fulvic acids were used to prepare the medium. Known volume of distilled water was added to vermicompost (30 percent).

All the above media samples were prepared and pH was maintained at 6.0 and was supplemented with 9 grams /Litre of agar and autoclaved. The medium was poured into washed and dried jars (approximately 50 ml) or test tubes (approximately 20 ml). They were then autoclaved at 121°C for 20 minutes at 15 psi pressure and transferred to the media storage room where they were kept under aseptic conditions till their further use.

## 2.6 Explant sterilization

*B. monnieri* chosen for *in vitro* micropropagation were washed under running tap water for 30 minutes in order to wash off the externally adhered soil, dust and other contaminants.

The nodal segments were cut into 1.5 cm to 2.0 cm length with single node and internode intact. These nodal and internodal cuttings were washed with 5 per cent (v/v) detergent solution (Teepol) for 10 minutes followed by a rinse with running tap water for several times.

In the laminar chamber the nodal segments of *B. monnieri* were further treated with 70 per cent alcohol for one minute followed by 0.1 per cent (w/v) Mercuric chloride treatment for 5 minutes. Aseptically explants were washed with sterile distilled water for three to four times and leaves were removed using sterile blade.

Sterile explants of *B. monnieri* were inoculated into the MS, vermicompost, vermicompost extract and eluant media jars. The experiments were carried out in culture rooms under 16 hours cycled cool white fluorescent light of average 2500 lux (cool white fluorescent tube light 40 W) and at  $25 \pm 2$  °C, with a photoperiod of 16 hours day light and 8 hours night breaks.

After 10 – 14 days of culture on rooting media, the rooted plantlets were transplanted to pots or trays for hardening prior to their final transfer to soil. After this the plants were carefully planted in the polybags containing vermicompost and soil mixtures in 1:1 ratio.

## 2.7 Experimental Data Analysis

ANOVA, Student's t-test and Tukey's Studentized Range or Tukey's Honestly Significant Difference (HSD) Test were considered for analyses of significance of various parameters and were carried out to compare the mean number of nodes, leaves, roots and shoots formed in the vermicompost extract, eluant and vermicompost media with respect to *B. monnieri*. The 'P' values less than 0.05 were considered as indicative of significance. The analysis was performed using SAS statistical software.

## III. RESULTS AND DISCUSSION

Adventitious shoot buds were induced from nodal and stem explants of *B. monnieri* on MS basal medium supplemented with 3.0 mg/L BAP alone which showed highest rate of shoot regeneration with this treatment (Fig 1A, 1B). Low concentration of NAA combined with high concentrations of BAP resulted in shoot initiation, whereas root induction required low concentration of BAP and high amount of IAA (Table 1). It was found that the response of the explants to BAP or IAA individually or in combination with MS media was more or less the same and the final weight of the plantlets ranges 131.4 milligram to 154.0 milligram. The results have shown that the growth response in vermicompost medium was significantly higher than those from MS medium (Table 2).

Vermicompost was evaluated with different methods of extractions like use of vermicompost only, eluant and extract of vermicompost to use in the tissue culture media for micropropagation of *B. monnieri* (Fig 1D, 1E, 1F). Vermicompost extract has supported significantly higher growth of roots, shoots, nodes and leaves over the eluant and vermicompost media. The values for number of roots ranged from 4 in only vermicompost medium to 7 in vermicompost extract medium. This had F value of 92.67 and  $Pr > F < 0.0001$  (Table 3). Use of vermicompost as such in medium was significantly higher in the formation of shoots (Table 4). This indicates that some biomolecules that are in vermicompost to help in shoot initiation has not been extracted into vermicompost extract medium. This mean number of shoots formed in medium having vermicompost was 3.0 whereas in vermicompost extract it was 1.2. The level of significance has given the F value of 91.00 and  $Pr > F < 0.0001$ . In case of the development of nodes and leaves from the nodal explants of *B. monnieri*, vermicompost extract has significantly supported higher growth compared to eluant and only vermicompost (Table 5). The significance level was  $Pr > F$  of 0.0011 and 0.0012 respectively. Plantlets have shown significant variation among the treatments. Significant increase in the weight of the plantlets (in milligrams) was observed in vermicompost extract as compared to other two treatments (Table 6). The value for significance was at  $< 0.0001$ . Tukey's Studentized Range (HSD) Test for percentage response of survival of plantlets has shown that in all the three treatments there was 100 per cent survival of the explants (Table 7).

Some studies speculated that the growth responses of plants from vermicompost appeared more like hormone-induced activity associated with the high levels of nutrients, humic acids and humates in vermicompost<sup>35-36</sup>.

Some studies have also reported that vermicompost contained growth promoting 'auxins', 'cytokinins' and flowering hormone gibberellins<sup>37-39</sup>. Growth regulators were analysed in worm castings<sup>40</sup>. It contained gibberellins (GA3) 2.75 microgram/gram, cytokinins (IBA) 1.05 microgram/gram and auxins (IAA) 3.80 microgram/gram. Bano *et al.* (1987) studied the nutrient status of the vermicompost (Vee Comp E 83 UAS). It was found to be rich in all mineral nutrients. It contained N (0.75 per cent), P (0.37 per cent), K (0.4 per cent),

Mg (0.38 per cent), Zn (0.16 per cent), Cu (0.02 per cent), Fe (1.38 per cent) and organic carbon (4.0 to 5.04 per cent). Vermicompost is rich in vitamins, enzymes, antibiotics and growth hormones, which provides balanced nutrients to the plant making them resistant against pests<sup>41</sup>.

Growth promoting activity of vermicompost was tested using a plant bioassay method. The plumule length of maize (*Zea mays*) seedling was measured 48 hours after soaking in vermicompost extract and in normal water. The marked difference in plumule length of maize seedlings indicated that plant growth promoting hormones are present in vermicompost<sup>42-43</sup>.

The addition of vermicompost, including that produced from agrowastes, medicinal, and aromatic plants<sup>44</sup> to soil can increase the population of beneficial microbes<sup>45</sup>. The earthworm castings contain higher percentage (nearly two fold) of both macro and micronutrients than the garden compost.

A two-stage culture procedure has been developed<sup>46</sup> for highly efficient shoot regeneration from leaf and internode explants of *B. monnieri*. Adventitious shoot buds were obtained on the shoot induction medium containing Murashige and Skoog's (MS) basal salt supplemented with 1.5 mg/L thidiazuron and 0.5 mg/L naphthalene acetic acid (NAA). Further subcultured on multiplication medium containing 0.5 mg/L BAP produced more shoots (13.5) and longer shoots (7.8 cm) with more nodes (6). Best response of root induction with more number of roots (16.5) and longer roots (8.7 cm) was observed in half strength MS basal medium supplemented with 1.0 mg/L IBA (indole-3-butyric acid) and 0.5 mg/L phloroglucinol. *In vitro* obtained plants were transferred to the field after hardening with a 100 per cent survival rate<sup>46</sup>.

Bud initiation was seen immediately after two days of inoculation on vermicompost extract, humin and vermicompost media by showing a small newly sprouted bud, which proliferates into shoot buds with leaves during 21-25 days which were placed in the culture room under the standard conditions of temperature ( $25 \pm 2^\circ\text{C}$ ). Shoot bud initiation was observed visually on the ninth day of incubation in all replicates in the MS media having different concentrations of BAP and KIN<sup>47</sup>. The response of the explant to the new test media is much easier than that is observed in the regular MS media used in tissue culture studies.

## IV. CONCLUSION

The growth responses were most probably due to hormone-like activity of humic acids from the vermicompost. The study has indicated that by standardizing the technique, it is possible to develop the plants through micropropagation in an economical way. Cost analysis carried out during this study confirms that vermicompost is more economical (Rs. 10.227/- per litre) compared to conventional MS medium (Rs. 66.576/- per litre) used in plant tissue culture<sup>48</sup>. It can reach farmers as affordable plantlets, to develop in agricultural fields for mass production.

## V. ACKNOWLEDGEMENTS

The authors thank Prof Rajanna (Botanical garden, Gandhi Krishi Vigyan Kendra, Bengaluru) for supplying the plant samples to conduct research work. Authors thank Mount Carmel College, Bengaluru for providing lab and other chemical supplements for successful completion of the research work.

## REFERENCES

- [1.] National Medicinal Plants Board. Agrotechniques of selected medicinal plants. National Medicinal Plants Board, Department of Ayush, Ministry of Health and Family Welfare, Govt of India. TERI Press, New Delhi, 2008, 33–38.
- [2.] Singh, R. H. and Singh, L. Studies on the anti anxiety effects of the medhya rasayana drug *Bacopa monniera* Wettst. *J Res Ayurveda and Siddha*. 1980, 1, 33–148.
- [3.] Sivaramakrishna, C., Rao, C.V., Trimurtulu, G., Vanisree, M., Subbaraju, G.V. 2005. Triterpenoid glycosides from *Bacopa monnieri*. *Phytochemistry*. 2005, 66, 2719–2728.
- [4.] Chakravarty, A. K., Garai, S. and Masuda, K. Bacopasides III - V : three new triterpenoid glycosides from *Bacopa monnieri*. *Chemistry and Pharmaceutical Bulletin, Tokyo*. 2003, 51, 215-217.
- [5.] Prasad, R., Bagde, U. S., Puspangadan, P., Varma, A. *Bacopa monniera* L. pharmacological aspects and case studies involving *Piriformospora indica*. *Int J Integr Biol*. 2008, 3, 100–110.
- [6.] Rajani, M. *Bacopa monnieri*, a nootropic drug. In: Ramawat KG, Merillon JM (eds) *Bioactive molecules and medicinal plants*. Springer, Berlin. 2008, 175–195.
- [7.] National Medicinal Plants Board. 32 Prioritized Medicinal Plants, National Informatics Centre, Ministry of Health and Family Welfare, Department of Ayush, Government of India. 2004.
- [8.] Pravina, K., Ravindra, K.R., Goudar, K.S., Vinod, D.R., Joshua, A.J., Wasim, P., Venkateswarlu, K., Saxena, V.S. and Amit, A. Safety evaluation of BacoMind™ in healthy volunteers: a phase 1 study. *Phytomedicine*. 2007, 12, 301–308
- [9.] Tiwari, V., Singh, B. D. and Tewari, K. N. Shoot regeneration and somatic embryogenesis from different explants of Brahmi (*Bacopa monniera* (L.) Wettst). *Plant Cell Rep*. 1998, 17, 538–543.
- [10.] Tiwari, V., Tewari, K. N. and Singh, B. D. Suitability of liquid cultures or in vitro multiplication of *Bacopa monniera* (L.) Wettst. *Phytomorphology*. 2000, 50, 337–342.
- [11.] Tiwari, V., Tewari, K. N. and Singh, B. D. Comparative studies of cytokinins on in vitro propagation of *Bacopa monniera*. *Plant Cell Tissue Organ Cult*. 2001, 66, 9–16.
- [12.] Tiwari, V., Tewari, K. N. and Singh, B. D. Shoot bud regeneration from different explants of *Bacopa monniera* (L.) Wettst. by trimethoprim and bavistin. *Plant Cell Rep*. 2006, 25, 629–635.
- [13.] Mohapatra, H. P and Rath, S.P. In vitro studies of *Bacopa monnieri*—an important medicinal plant with reference to its biochemical variations. *Indian J Exp Biol*. 2005, 43, 373-376.
- [14.] Ramesh, M., Saravanakumar, R. M. and Pandian, K. S. Benzyl amino purine and adenine sulphate induced multiple shoot and root induction from nodal explants of Brahmi, *Bacopa monnieri* (Linn.) Penn. *Nat Prod Radiance*. 2006, 5, 44–51.
- [15.] Praveen, N., Naik, P. M., Manohar, S. H., Nayeem, A. and Murthy, H. N. In vitro regeneration of brahmi shoots using semisolid and liquid cultures and quantitative analysis of bacoside A. *Acta Physiol plant*. 2009, 31, 723–728.
- [16.] Ramesh, M., Marx, R., Mathan, G. and Pandian, K.S. Effect of bavistin on In vitro plant conversion from encapsulated uninodal microcuttings of micropropagated *Bacopa monnieri* (L.)—an ayurvedic herb. *J Environ Biol*. 2009, 30: 441–444.

## 4<sup>th</sup> International Conference on Innovative Trends in Science, Engineering and Management

(C-DAC, Mumbai) Centre for Development of Advanced Computing, Mumbai, Maharashtra (India)

(ICITSEM-17)

17<sup>th</sup> June 2017, [www.conferenceworld.in](http://www.conferenceworld.in)

ISBN: 978-93-86171-47-4

- [17.] Kale, R. D., Bano, K. and Krishnamoorthy, R. V. Potential of *Perionyx excavatus* for utilizing organic wastes. *Pedobiologia*. 1982, 23, 419-425.
- [18.] Barik, T., Gulati., Garnayak, J. M. L. and Bastia, D. K. Production of Vermicompost from Agricultural Wastes- A Review. *Agric.* 2011, 31, 172 -183.
- [19.] Bano, K., Kale, R. D. and Gajanan, G. N. Culturing of earthworms *Eudrilus eugeniae* for cast production and assessment of worm cast as biofertilizer. *J. Sol. Biol. Ecol.* 1987, 7, 98-104.
- [20.] Kale, R. D. Earthworm Cindrella of organic farming. Prism Books, Pvt. Ltd. Bangalore, India, 1998.
- [21.] Ghosh, M., Chatopadhyay, G. N. and Baral, K. Transformation of phosphorous during vermicomposting. *Bioresource Technol.* 1999, 69, 149-154.
- [22.] Lozek, O. and Gracova, A. The influence of vermisol on the yield and quality of tomatoes. *Acta-Hort. et . Regirctecture.* 1999, 12, 17-19.
- [23.] Ranijasmin, Ushakumari, M. and Sailaja, K. Soil application of vermiwash on growth, yield and quality of tomato. *J. agric. Res..mgt.* 2003, 2, 80-82.
- [24.] Thangavel, P., Balagurunathan, R., Divakaran, J. and Prabhakaran, I. Effect of vermiwash and vermicast extract on soil nutrient status, growth and yield of paddy. *Adv. Pl. Sci.* 2003, 16, 187-190.
- [25.] Lee, K.E. 1985. Earthworms, their Ecology and Relationship with Soils and Land Use. Academic Press, London, United Kingdom
- [26.] Reinecke, A.J., Viljoen, S. A. and Saayman, R. J. The suitability of *Eudrilus eugeniae*, *Perionyx excavatus* and *Eisenia fetida* (Oligochaeta) for vermicomposting in southern Africa in terms of their temperature requirements. *Soil Biol. Biochem.* 1992, 24, 1295-1307.
- [27.] Edwards C A. The use of earthworms in processing organic wastes into plant growth media and animal feed protein. In: *Earthworm Ecology*, ed C A Edwards, 1998, 327-354. CRC Press: Boca Raton, Florida.
- [28.] Kale, R. D. and Bano, K. Earthworm cultivation and culturing techniques for production of vermicompost, 83E USA, Vee Meel. 83 p UAS. *Mysore J. Agric. Sci.* 1988, 22: 339-344.
- [29.] Chaudhuri, P. S., Pal, T. K., Bhattacharjee, G. and Dey, S. K. Suitability of rubber leaf litter (*Hevea brasiliensis* var. PRIM 600) as substrate for epigeic earthworms, *Perionyx excavatus*, *Eudrilus eugeniae* and *Eisenia fetida*. *Proceedings of VII Nation. Soil.Biol.Ecol.* 2001, 7-9: 18-26.
- [30.] Reddy M. V. and Ohkura K. 2004. Vermicomposting of rice-straw and its effects on sorghum yield. *Trop. Ecol.* 2004, 45, 327-331.
- [31.] Shukla, S.P. Preliminary chemical and pharmacological screening of an indigenous drug Brahmi (*B. monniera*). *Nagarjun.* 1983, 267, 154-56.
- [32.] Chopra, R., Chopra, I., Handa, K. and Kapur, L. In *Indigenous Drugs of India*, Academic Publishers, Calcutta, India, 1994.
- [33.] Singh, H.K. and Dhawan, B.N. Effect of *Bacopa monniera* Linn.(brahmi) extract on avoidance responses in rat. *J Ethnopharmacol.* 1982, 5, 205-214.
- [34.] Murashige, T. and Skoog, F. 1962. A revised medium for rapid growth and bioassay with tobacco tissue cultures. *Physiology and plants.* 1962, 15, 472-497.
- [35.] Atiyeh, R. M., Subler, S., Edwards, C. A., Bachman, G., Metzger, J. D. and Shuster, W. Effects of Vermicomposts and Composts on Plant Growth in Horticultural Container Media and Soil. *Pedobiologia.* 2000c, 44, 579-590.

# 4<sup>th</sup> International Conference on Innovative Trends in Science, Engineering and Management

(C-DAC, Mumbai) Centre for Development of Advanced Computing, Mumbai, Maharashtra (India)

(ICITSEM-17)

17<sup>th</sup> June 2017, [www.conferenceworld.in](http://www.conferenceworld.in)

ISBN: 978-93-86171-47-4

- [36.] Edwards, C. A. and Burrows, I. The potential of earthworms composts as plant growth media. In: Edward C A and Neuhauser E F. Eds., 'Earthworms in Waste and Environmental Management', SPB Academic Publishing, The Hague. 1988, 21-32.
- [37.] Suhane, R. K. Vermicompost. Publication of Rajendra Agriculture University, Pusa, Bihar, India. 2007, 88.
- [38.] Tomati, U., Grappelli, A. and Galli, E. The Presence of Growth Regulators in Earthworm-Worked Wastes. Proceeding of International Symposium on 'Earthworms', Bologna-Carpi. 1987, pp.423-436.
- [39.] Tomati, V., Grappelli, A. and Galli, E. The Hormone like Effect of Earthworm Casts on Plant Growth. Biology and Fertility of Soils. 1995: 5, 288-294.
- [40.] Grapelli, A., Tomati, V. and Galli, E. Earthworm castings in plant propagation. Hort. Sci. 1985, 20, 874-876.
- [41.] Atlavinyte, O. and Vanagas, J. The effect of earthworms on the quality of barley and rye grain. Pedobiologia, 1982, 23, 256-262
- [42.] Nagavallema, K. P., Wani, S. P., Lacroix, S., Padmaja, V. V., Vineela, C., Rao, B. M. and Sahrawat, K. L. 2006. Vermicomposting: Recycling wastes into valuable organic fertilizer; An Open Access Journal published by ICRISAT. 2006, 2, 20.
- [43.] Mahale, V.G., Ashok, T.H. and Kale, R.D. Vermicompost as rooting medium for Carnation (*Dianthus caryophyllus* L.). Journal of Plant Biology. 2002, 29, 175-178.
- [44.] Chandra, M., Kumar, A., Wasnik, K., Kalra, A., Ahmed, S. and Ram, G. Microbial inoculants hastening the vermicomposting process and improving population of *Eisenia fetida*. 18th All India Congress of Zoology and National Seminar on 'SCIAZE', 2007.
- [45.] Kumari, M. S. S. and Ushakumari, K. Effect of vermicompost enriched with rock phosphate on the yield and uptake of nutrients in Cowpea (*Vigna unguiculata* L. Walp). J Trop Agricul. 40, 2002, 27-30.
- [46.] Ceasar, A. S., Maxwell, L. S., Prasad, B. K., Karthigan, M. and Ignacimuthu, S. Highly efficient shoot regeneration of *Bacopa monnieri* (L.) using a two-stage culture procedure and assessment of genetic integrity of micropropagated plants by RAPD. Acta Physiologiae Plantarum. 2009, 32, 443-452.
- [47.] Shrivastava, N. and Rajani, M. 1999. Multiple shoot regeneration and tissue culture studies on *Bacopa monnieri* (L.) Pennell. Plant Cell Rep. 18: 919-923.
- [48.] Kashyap S, Kapoor N, Kale RD. Callus Induction and Tissue Differentiation of *Tinospora cordifolia* on Using Vermicompost and its Extracts along with Coelomic Fluid as Tissue Culture Media Horizon Journal of Micro. Biotech. Res. 2015, 1(1):01007. <http://www.horizonjournals.org/hjmbr/content/2015/august/augustcontent.php>

## ABBREVIATIONS

**Abb1:** MS—Murashige and Skoog

**Abb2:** KIN—kinetin

**Abb3:** 2,4-D-2,4—Dichlorophenoxy acetic acid

**Abb4:** GAEs—gallic acid equivalent

**Abb5:** QE—Quercetin equivalents

**Abb6:** BA—butyric acid

**Abb7:** NAA—Naphthalene acetic acid

**Abb8:** IAA—Indole acetic acid.

**Abb9:** IBA- Indole-3-butyric acid

**Abb10:** BAP- 6-Benzyl amino purine

**Table 1: Growth parameters of *B. monnieri* analysed after third week of incubation on MS Basal medium containing growth regulators**

Growth Parameters	MEDIA		
	MS+IAA+BAP $\bar{X} \pm SE$	VC extract only	t-statistical value
Number of roots	3.8±0.2	6.8±0.2	0.00008**
Number of shoots	1.2±0.2	1.2±0.2	1.0000
Number of nodes	1.6±0.24	6.4±0.6	0.0007**
Number of leaves	3.2±0.48	12.8±1.2	0.0007**
Weight of plantlets	15.4±1.51	437±6.6	0.00007**
Percentage response	78.6±0.97	99.6±0.2	0.0000009**

Note: MS - Murashige and Skoog medium

IAA - Indole3-acetic acid

BAP - 6-Benzyl amino purine

**Table 2: Student's t-test to compare the means of growth parameters of *B.monnieri* micropropagated on MS medium with hormones and vermicompost extract medium without chemical supplements**

VC=Vermicompost

Note: P≤0.05: \* Significance at 5per cent level

\*\* Significance at 1per cent level

**Table 3: Tukey's Studentized Range (HSD) Test for development of roots from nodal explants *B.monniери* grown on vermicompost extract, eluant and vermicompost media.**

Source	DF	Anova SS	Mean Square	F Value	Pr > F
Types of Media	2	18.53	9.26	92.67	<.0001
	<b>Mean</b>	<b>N</b>	<b>Tukey Grouping</b>		
VC extract	7.0000	5	A		
			A		
Eluant	5.0000	5	B		
			A		
VC only ( 30 per cent)	4.4000	5	C		

**Note: VC=Vermicompost.**

**Table 4: Tukey's Studentized Range (HSD) Test for development of shoots from nodal explants *B.monniери* grown on vermicompost extract, eluant and vermicompost media**

Source	DF	Anova SS	Mean Square	F Value	Pr > F
Types of Media	2	12.13	6.06	91.00	<.0001
	<b>Mean</b>	<b>N</b>	<b>Tukey Grouping</b>		
VC only (30 per cent)	3.0000	5	A		
VC extract	1.2000	5	B		

			B
Eluant	1.0000	5	B

Note: VC=Vermicompost.

**Table 5: Tukey's Studentized Range (HSD) Test for development of nodes and leaves from nodal explants of *B.monniери* grown on vermicompost extract, eluant and vermicompost media.**

Source	DF	Anova SS	Mean Square	F Value	Pr > F
Nodes	2	18.53	9.26	12.64	0.0011
Leaves	2	72.40	36.20	12.34	0.0012
	<b>Mean number of nodes</b>	<b>Mean number of leaves</b>	<b>N</b>	<b>Tukey Grouping</b>	
VCextract	6.4000	12.800	5	A	
				A	
Eluant	5.8000	11.400	5	A	
VC only	3.8000	7.600	5	B	

Note: VC=Vermicompost.

**Table 6: Tukey's Studentized Range (HSD) Test for development weight of *B.monniери* plantlets grown on vermicompost extract, eluant and vermicompost media.**

Source	DF	Anova SS	Mean Square	F Value	Pr > F
Types of Media	2	134314.53	67157.26	39.29	<.0001
	<b>Mean</b>	<b>N</b>	<b>Tukey Grouping</b>		
VC extract	371.20	5	A		

Eluant	276.20	5	B
VC only	140.60	5	C

Note: VC=Vermicompost.

Table 7: Tukey's Studentized Range (HSD) Test for percentage survival of hardened plantlets of *B. monnieri* micropropagated on vermicompost extract, eluant and vermicompost media.

Source	DF	Anova SS	Mean Square	F Value	Pr > F
Types of Media	2	0	0	.	.
	<b>Mean</b>	<b>N</b>	<b>Tukey Grouping</b>		
Eluant	100.0	5	A		
			A		
VC only	100.0	5	A		
			A		
VC extract	100.0	5	A		

Note: VC=Vermicompost.

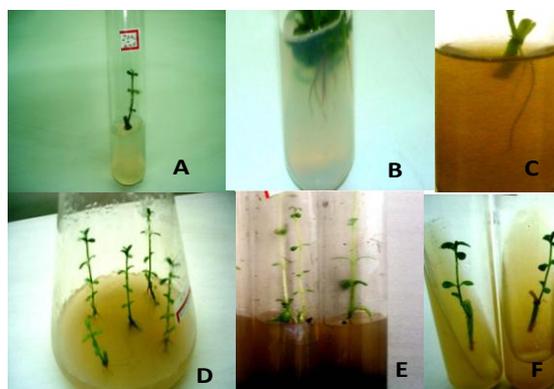


Fig 1 A: *B.monnieri* shoots developed on MS medium supplemented with 3mg/L BAP+0.5mg/L NAA  
 B: Rooting of *B.monnieri* on MS medium supplemented with 1mg/L BAP+3mg/L IAA  
 C: Rooting of *B.monnieri* on vermicompost extract medium.  
 D: *B.monnieri* shoots developed on vermicompost extract medium.  
 E: Micropropagation of *B.monnieri* on only vermicompost medium.  
 F: Micropropagation of *B.monnieri* on eluant.

## **Security in WSN using Polynomial And SAMA**

### **Techniques**

**Deepika<sup>1</sup>, Ms. Kusum Dalal<sup>2</sup>**

*<sup>1</sup>M.Tech. Scholar, <sup>2</sup>Assistant Professor,*

*Department of Electronics and Communication Engineering, DCRUST, Murthal (India)*

#### **ABSTRACT**

*In wireless sensor networks (WSNs), security has become a topic of vital importance these days. Message authentication is one of the most effective ways to prevent unauthorized and corrupted traffic from being forwarded in WSNs. To provide this service, various authentication schemes have been proposed earlier for protecting communication authenticity and integrity in WSNs. After analyzing some of the message authentication protocols for WSNs it was found that most of them suffer threshold limitation problem or could only provide end-to-end authentication. In this paper, these problems are being addressed through ECC technology. This scheme not only provides hop-by-hop authentication, but also allows any node in WSNs to transmit an unlimited number of messages without suffering the threshold problem. In addition, this scheme can also provide message source privacy. This scheme has also been compared with the bi-variate polynomial scheme through simulations using MATLAB.*

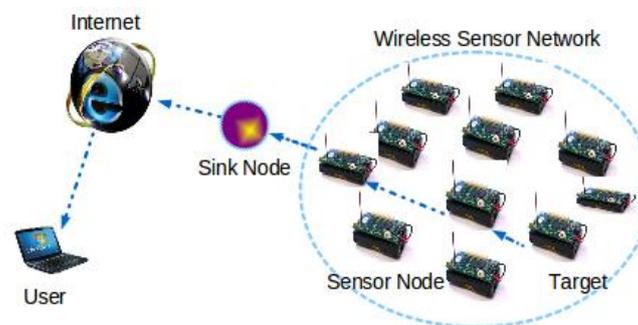
**Keywords-** *Elliptic curve cryptography (ECC), Source anonymous message authentication (SAMA) scheme, source privacy, symmetric-key cryptosystem, public-key cryptosystem, Wireless sensor networks (WSNs),*

#### **I. INTRODUCTION**

Wireless sensor network (WSN) comprises of a large number of static or mobile sensor nodes which form the wireless network using self-organization and multi-hop method. Its basic purpose is to collaborate detection, processing and transmitting the object monitoring information in those areas where the network converges [1]. The sensor node, sink node and the user node are the three elements of sensor networks. Sensor node is the foundation of the whole network which is responsible for the perception of data, data processing, storage of data and its transmission. The sensor node can sense many environmental conditions, including temperature and humidity, pressure, light condition, vehicle movement, mechanical pressure strength, the speed of the airflow direction and other characteristics. The main features of WSNs are self-organization, multi-hop route, dynamic network topology, data-centric and security problem. The nodes of the WSN have the automatic networking function and the nodes can communicate with each other. In the application of wireless sensor network, typically the sensor nodes are placed somewhere with no base network facility, such as a vast area of virgin forest, or the danger area where people cannot reach. When a node cannot directly communicate with the gateway, it requires other nodes to transmit data, so the network data transmission is a multi-hop routing. There are a large number of sensor nodes in WSN and often need to be arranged in a specific monitoring area. The

hardware resources of sensor node are limited because of the size and cost constraints. So its computing power, storage capacity is relatively weak. Mobile communication network or Ad-hoc network mainly considers how to improve the network transmission capacity under current conditions, which is to provide users with a sufficient bandwidth, safe and reliable transmission channel. As wireless sensor networks uses wireless transmission, so the monitoring data is easy to be intercepted, or even confuse users after tampering. After a large number of sensor nodes are captured, the enemy may use them to destroy the existing network. Therefore, in the design of WSNs, security problem is the main focus of the study.

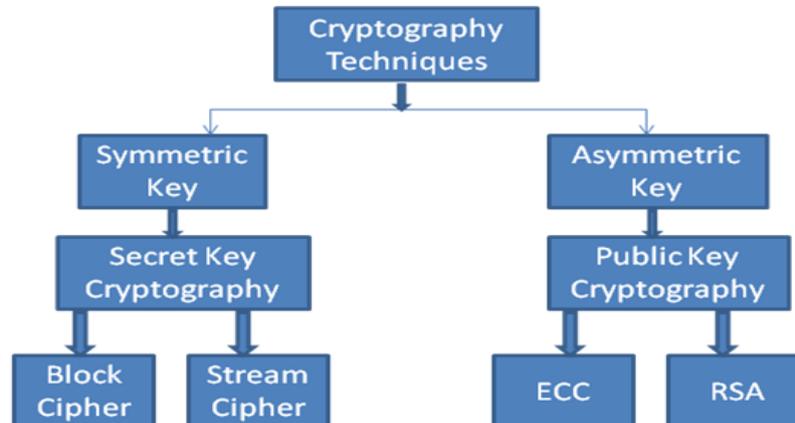
WSNs are designed to operate unattended for long periods of time, so recharging or replacement of battery seems to be infeasible or impossible. Hence, computationally intensive cryptographic algorithms such as public-key cryptosystems and large scale broadcasting-based protocols may not be quite suitable for WSNs. In the wireless sensor domain, anybody with an appropriate wireless receiver can monitor and intercept the sensor communication [2]. In addition, the adversaries may use expensive radio transceivers and powerful workstations to interact with WSNs to get traffic information from a distance because they are not restricted to use sensor network hardware. In the worst case, adversaries may be able to take control of some sensor nodes, compromise the cryptographic keys and reprogram some sensor nodes. This makes privacy preserving communication in WSNs a very challenging research task. Unfortunately, to optimize the sensor nodes for the limited capabilities and application specific nature of WSNs, traditionally, security requirements were largely ignored. This leaves WSNs vulnerable to security attacks [3].



**Fig.1: Wireless Sensor Network**

Source-location privacy is an important security issue for WSNs. Lack of location privacy can cause exposure of significant information about traffic carried on the network and the physical world entities. While confidentiality of a message can be ensured through content encryption, it is much more difficult to adequately address pattern and source-location information. Using certain equipments to monitor the transmission direction of any detected message, adversaries can easily trace back to the source node hop by hop or deduce the location of the source node through traffic analysis [4]. Besides source-location privacy, non-repudiation is another property that cannot be ignored for source privacy in wireless communication. Without the non-repudiation, not only attackers, but also network administrators cannot get any information about the source. This makes managing operations almost impossible for network administrators. Lack of non-repudiation also prevents administrators from distinguishing valid messages from fake and unauthorized messages set by attackers. Therefore, attackers could carry out flooding attack to disable the wireless communications in WSNs. To summarize, there are two

aspects that need to be considered for source privacy: source-location privacy and anonymous source authentication. To make secure data transmission over networks cryptography is used. Cryptography is a method used to encrypt, or scramble, the contents of a file in such a way that only those with the knowledge of how to decrypt, or unscramble, the contents can read them. The algorithm being selected for cryptography must fulfill the conditions of integrity protection, conventional message authentication and digital signatures.



**Fig.2: Types of Cryptography Techniques**

The paper is organized as follows: Routing protocols for WSNs are discussed in section II. In section III, various attacks in WSNs are being explained. Source Anonymous Message Authentication (SAMA) scheme on elliptic curve is discussed in section IV. Section V explains the simulation results. Conclusion is given in section VI.

## II. ROUTING PROTOCOLS FOR WSNs

Important applications of sensor networks are data gathering and processing. All the data collected by the individual sensor nodes need to be sent to the sink node, from where it is accessible by the end user. The distributed nature and dynamic topology of WSNs introduces some special requirements of routing protocols that should be met. Hence, various routing techniques are introduced for WSNs based on certain characteristics like, in-network processing, data aggregation and processing, position of node, clustering nodes, energy consumption, etc. The routing protocols for WSNs can be categorized into data-centric or flat-based, hierarchical or cluster-based and location-based, depending on the network structure. They can also be divided into multipath based, QoS-based depending on how the protocol operates. By having a review of various routing protocols, a comparison can be made between various routing protocols which show that the hierarchical protocols are proved to be the energy efficient routing protocols. So, data communication is sustained by using LEACH protocol in the network [17].

### A. Hierarchical Protocols

Hierarchical clustering is an energy efficient communication protocol that can be used by the sensors to report their sensed data to the sink. Some of the layered protocols in which a network is composed of several clumps (or clusters) of sensors are described below.

1) *LEACH*: Low-Energy Adaptive Clustering Hierarchy, i.e. LEACH is the hierarchical clustering algorithm for WSNs which was proposed for reducing power consumption. Here, various clusters of the sensor nodes are being formed on basis of the received signal strength and use the local cluster heads as routers to the sink. This

leads to saving of energy since the transmissions will only be done by cluster heads rather than all sensor nodes. Optimal number of cluster heads is estimated to be approximately 5% of the total number of nodes. All the data processing functions such as data fusion and aggregation are local to the cluster. The cluster heads change randomly over time in order to balance the energy dissipation of the nodes. This decision that which node will become a cluster head is made by the node choosing a random number between 0 and 1. The node becomes the cluster head for the current round if number is less than the threshold. The nodes start to die randomly and the dynamic clustering thus further increases the lifetime of the system. LEACH is distributed completely and requires no global knowledge of the network. However, LEACH uses single-hop routing in which each node can transmit directly to the sink and the cluster-head. Thus limiting its use for large regions. Also, the idea of dynamic clustering brings extra burden, like, head changes, advertisements etc., which may nullify the gain in energy consumption [19].

2) **PEGASIS**: Power-Efficient Gathering in Sensor Information Systems, i.e. PEGASIS is an extension of the LEACH protocol. In PEGASIS, various sensor nodes form chains so that each node can transmit and receive from a neighboring node and only one node is selected from that chain to transmit data to the base station (sink). The data is aggregated while it moves from node to node, and eventually sent to the base station. The chain construction is performed in a greedy way. Unlike LEACH, there is no cluster formation in PEGASIS but it uses only one node in a chain to transmit to the base station instead of using multiple nodes. The sensor also transmits to its local neighbors in the data fusion phase instead of sending directly to its cluster head, as in the case of LEACH. Here, the construction phase considers that the sensors already have global knowledge about the network especially, the positions of the sensors, and use a greedy approach. The same approach is being used when a sensor fails due to low battery power; the chain is constructed by bypassing the failed sensor. In each round, a randomly chosen sensor node transmits aggregated data to the sink, thus reducing the per round energy consumption as compared to LEACH [20].

### III. ATTACKS IN WSNs

WSN consists of a large number of small and low cost sensor nodes which are randomly deployed in an area. The sensor nodes have computational capability to carry out simple computations and transmit the required information [21]. These nodes transmit information to the sink node that aggregates the entire information received from other nodes and generates a summary data to be transmitted to another network. These sensor nodes can collectively monitor physical and environmental conditions like pressure, temperature, humidity and sound vibrations. Such features ensure a wide range of applications for wireless sensor network such as military, medical, industrial, disaster relief operations, environmental monitoring, traffic surveillance, agriculture, infrastructure monitoring [21][22]. Since the majority of sensor nodes are deployed in hostile environment, they are susceptible to various attacks that are caused by malicious or compromised nodes in the network. The malicious nodes can alter the normal behavior of the network, tamper with the node's hardware and software, transmit false information, or drop the required information. Hence, security of WSN becomes a critical issue.

#### A. Types of attacks

The attacks on wireless sensor networks can be categorized into several forms but there are basically two main types of attacks that an intruder may adopt.

1) **Passive Attack:** A passive attack involves monitoring and listening of the data stream but doesn't involve modification of the data stream. Passive attacks do not cause direct harm to the network as they cannot modify the data. Attack against privacy is a passive attack [22]. The goals and effects of this kind of attacker include –

- Eavesdropping, gathering and stealing information;
- Compromised privacy and confidentiality requirements;
- Storing energy by selfish node and to avoid from cooperation;
- The WSN functionality degradation;
- Network partition by non-cooperate in operations [23].

2) **Active Attack:** An active attack involves monitoring, listening and modification of the data stream by the malicious nodes/adversaries prevailing inside or outside the network. Active attacks cause direct harm to the network because they can manipulate the data stream [22]. Some of the goals and effects of these attacks are:

- The WSN functionality disruption;
- The WSN performance degradation;
- Sensor nodes destruction;
- Data alteration;
- Inability in use the WSN's services;
- Obstructing the operations or to cut off certain nodes from their neighbours.

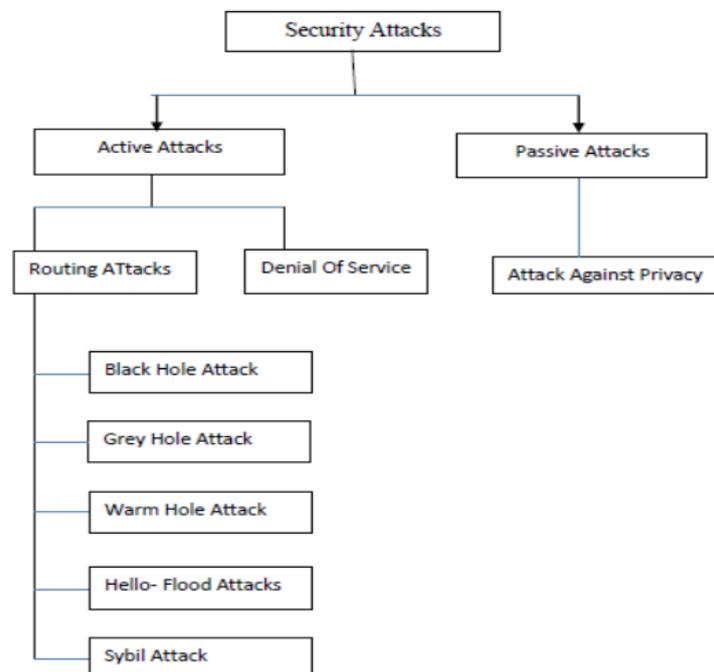


Fig. 3: Types of attacks

## IV. SOURCE ANONYMOUS MESSAGE AUTHENTICATION (SAMA) SCHEME ON ELLIPTIC CURVE

The main idea is that for each message  $m$  to be released, the message sender, or the sending node, generates a source anonymous message authentication for the message  $m$ . The generation is based on the MES scheme on elliptic curve. For a ring signature, each ring member is required to compute a forgery signature for all other

members in the AS individually. In this scheme, the entire SAMA generation requires only three steps, which link all non-senders and the message sender to the SAMA alike. In addition, the design enables the SAMA to be verified through a single equation without individually verifying the signatures.

## A. MES Scheme on Elliptic Curve

Let  $p > 3$  be an odd prime. An elliptic curve  $E$  is defined by an equation of the form:

$$E : y^2 = x^3 + ax + b \pmod{p}$$

where  $a, b \in F_p$ , and  $4a^3 + 27b^2 \not\equiv 0 \pmod{p}$ . The set  $E(F_p)$  consist of all points  $(x, y) \in F_p$  on the curve, together with a special point  $O$  called the point at infinity.

Let  $G = (x_G, y_G)$  be a base point on  $E(F_p)$  whose order is a very large value  $N$ . User  $A$  selects a random integer  $d_A \in [1, N - 1]$  as his private key. At that point, he can process his public key  $Q_A$  from  $Q_A = d_A \times G$ .

1) *Signature Generation Algorithm*: For Alice to sign a message  $m$ , she follows these steps –

- Select a random integer  $k_A$ ,  $1 \leq k_A \leq N - 1$ .
- Calculate  $r = x_A \pmod{N}$ , where  $(x_A, A) = k_A G$ . If  $r = 0$ , backtrack to step 1.
- Calculate  $h_A \leftarrow h(m, r)$ , where  $h$  is a cryptographic hash function, such as SHA-1, and  $\leftarrow$  means the  $l$  leftmost bit of the hash.
- Calculate  $s = rd_A h_A + k_A \pmod{N}$ . If  $s = 0$ , go back to step 2.
- The signature is the pair  $(r, s)$ . When computing  $s$ , the string  $h_A$  resulting from  $h(m, r)$  shall be converted into an integer.

2) *Signature Verification Algorithm*: For Bob to authenticate Alice's signature, he must have a copy of her public key  $Q_A$  –

- Check that  $Q_A \neq O$ , otherwise invalid
- Check that  $Q_A$  lies on the curve
- Check that  $nQ_A = O$

After that, Bob follows these steps to verify the signature –

- Verify that  $r$  and  $s$  are integers in  $[1, N - 1]$ . If not, the signature is invalid.
- Calculate  $h_A \leftarrow h(m, r)$ , where  $h$  is the same function used in the signature generation.
- Calculate  $(x_{1,2}) = sG - rh_A Q_A \pmod{N}$ .
- The signature is valid if  $r = x_1 \pmod{N}$ , invalid otherwise.

In fact, if the signature is correctly generated, then

$$\begin{aligned} (x_{1,2}) &= sG - rh_A Q_A \\ &= (rd_A h_A + k_A)G - rh_A Q_A \\ &= k_A G + rh_A Q_A - rh_A Q_A \\ &= k_A G. \end{aligned}$$

Therefore, we have  $x_1 = r$  and the verifier should accept the signature.

## B. SAMA scheme on Elliptic Curve

Assume that the message sender (say Alice) wishes to transmit a message  $m$  secretly from her network node to any other nodes. The AS includes  $n$  members,  $A_{1,2}, \dots, A_n$ , e.g.,  $S = \{A_1, A_2, \dots, A_n\}$ , where the actual message

sender Alice is  $A_t$ , for some value  $t$ ,  $1 \leq t \leq n$ . In this dissertation, we will not distinguish between the node  $A_t$  and its public key  $Q_t$ . Consequently, we also have  $S = \{Q_1, Q_2, \dots, Q_n\}$ .

1) *Authentication generation algorithm*: Suppose  $m$  is a message to be transmitted.

The private key of the message sender Alice is  $d_t$ ,  $1 < t < N$ . To generate an efficient SAMA for message  $m$ ,

Alice performs the following three steps:

- Select a random and pairwise distinctive  $k_i$  for each  $1 \leq i \leq n - 1$ ,  $i \neq t$ , and compute  $r_i$  from  $(r_{i,i}) = k_i G$ .
- Choose a random  $k_t \in Z_p$  and compute  $r_t$  from

$$(r_t, y_t) = k_t G - r_t \sum_{i \neq t} r_i h_i Q_i \text{ such that } r_t \neq 0 \text{ and } r_t \neq r_i \text{ for any } i \neq t; \text{ where } h_i \stackrel{i}{\leftarrow} h(m, r_i).$$

- Compute  $s = k_t + \sum_{i \neq t} k_i + r_t d_t h_t \text{ mod } N$ .

The SAMA of the message  $m$  is characterized as:

$$S(m) = (m, S, r_1, y_1, \dots, r_n, y_n, s).$$

2) *Verification Algorithm*: Verification algorithm for Bob to verify an alleged SAMA  $(m, S, r_1, y_1, \dots, r_n, y_n, s)$ , he must have a copy of the public keys  $Q_1, \dots, Q_n$ . Then he checks:

- Check that  $Q_i \neq O$ ;  $i = 1, \dots, n$ , otherwise invalid
- Check that  $Q_i$ ,  $i = 1, \dots, n$  lies on the curve
- Checks that  $nQ_i = O$ ,  $i = 1, \dots, n$

After that, Bob follows these steps:

- Verify that  $r_{i,i}$ ,  $i = 1, \dots, n$ , and  $s$  are integers in  $[1, N - 1]$ . If not, the signature is invalid.
- Calculate  $h_i \stackrel{i}{\leftarrow} h(m, r_i)$ , where  $h$  is the same function used in the signature generation.
- Calculate  $(x_0, y_0) = sG - \sum_{i=1}^n r_i h_i Q_i$
- The signature is valid if the first coordinate of  $\sum_i (r_i y_i)$  equals  $x_0$ , invalid otherwise.

In fact, if the SAMA has been correctly generated without being modified, then we compute

$$\begin{aligned} (x_0, y_0) &= sG - \sum_{i=1}^n r_i h_i Q_i \\ &= (k_t + \sum_{i \neq t} k_i + r_t d_t h_t)G - \sum_i r_i h_i Q_i \\ &= \sum_{i \neq t} k_i G + (k_t G - \sum_{i \neq t} r_i h_i Q_i) \\ &= \sum_{i \neq t} (r_i y_i) + (r_t y_t) \\ &= \sum_i (r_i y_i) \end{aligned}$$

Therefore, the verifier should always accept the SAMA

## V. RESULTS AND DISCUSSIONS

### A. Tool Used

The tool being used for the simulation is MATLAB (R2014a), developed by Math Works. It is an interactive software package which is mainly used for numerical computing.

### B. Parameters Used

1) *Energy Consumption*: It is measure of energy consumed at nodes of the network. This shows the energy consumed by the nodes in total rounds.

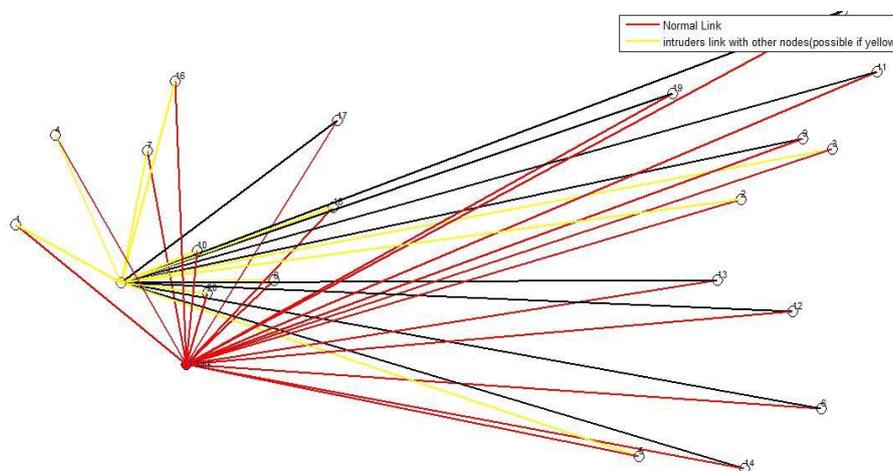
2) *Throughput*: Throughput is the rate of production or the rate at which something can be processed. Throughput is the measure of comparative effectiveness of a process or an operation.

3) *Delivery ratio*: Ratio of number of packets delivered against the number of packets sent.

4) *Memory Consumption*: It is the amount of memory consumed by the nodes to store and processing the network information.

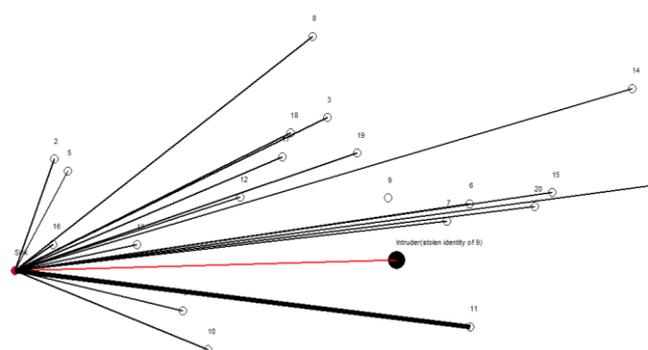
## C. Simulation Results of Polynomial Technique

1) *Network and Possibility of Intruders Attack*: Here, link between intruder node and other nodes is shown by black color and connection between sink node and other nodes is shown by red color. Maximum network range is 15m and maximum distance between two nodes is 10m. The distance of the nodes from intruder node is less than 10 m, is shown by yellow color. So the nodes close to the intruder node have more probability of being hacked by the intruder node than other nodes. The energy of all the nodes is  $E=0.5$  and the probability of the node being dead is  $P=0.2$ .



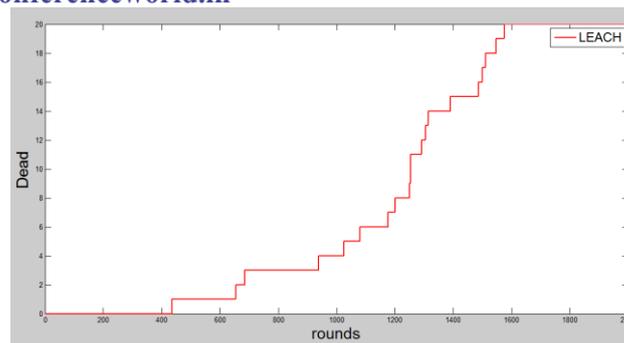
**Fig.4: Network and possibility of intruders attack**

2) *Relation between intruder node, sink node and other nodes*: The red color is for the intruder node and link between the sink node and nodes is shown with black color. Here, node no.9 is hacked and its identity is stolen by the intruder node, known as Sybil attack.



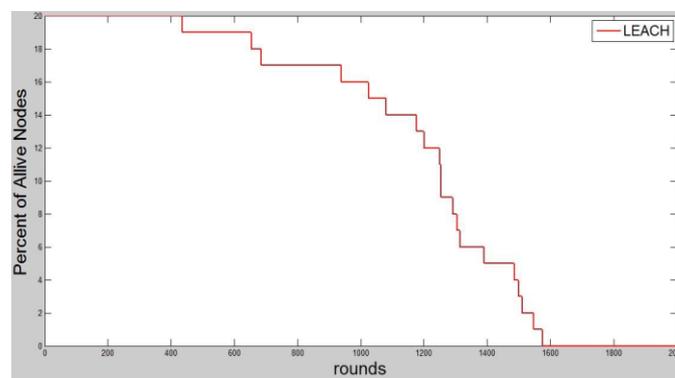
**Fig.5: Relation between intruder, sink node and other nodes**

3) *Dead Nodes vs. Rounds*: Here, we have taken 2000 round and after approx. 400 rounds the energy of nodes starts decreasing and upto approx. 1580 rounds all nodes are dead. So after this, communication will be stopped.



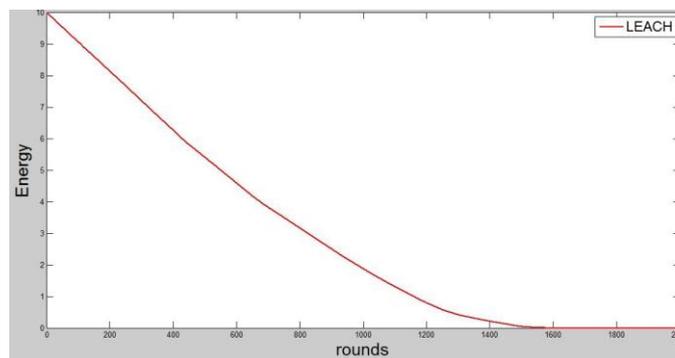
**Fig.6: Dead nodes vs. rounds**

4) *Percentage of alive nodes vs. rounds:* After approx. 1580 rounds all nodes are dead thus network is left with 0% alive nodes.



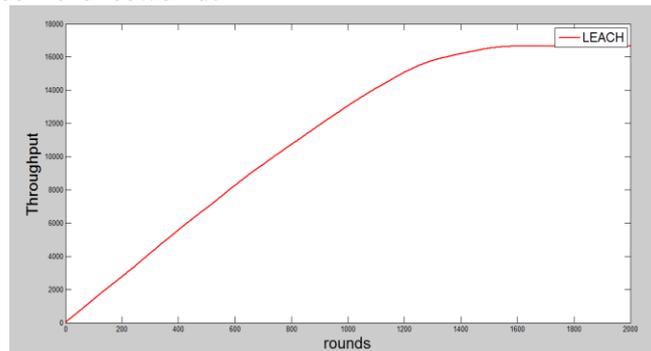
**Fig.7: Percentage of alive nodes vs. rounds**

5) *Energy vs. rounds:* After approx. 1580 rounds all the energy is consumed by the nodes thus leaving the whole network dead.



**Fig.8: Energy vs. Rounds**

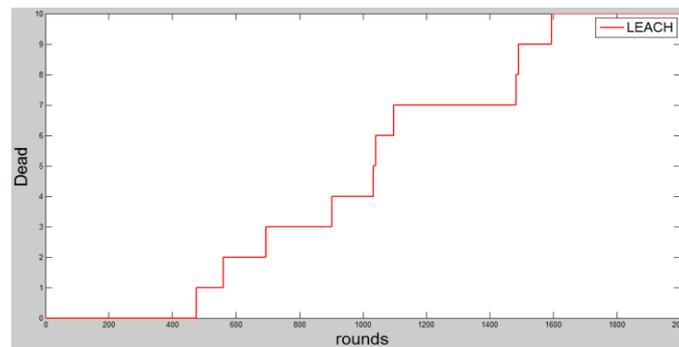
6) *Throughput vs. Rounds:* This graph shows that the data is processed or communicated efficiently upto how much rounds.



**Fig.9: Throughput vs. rounds**

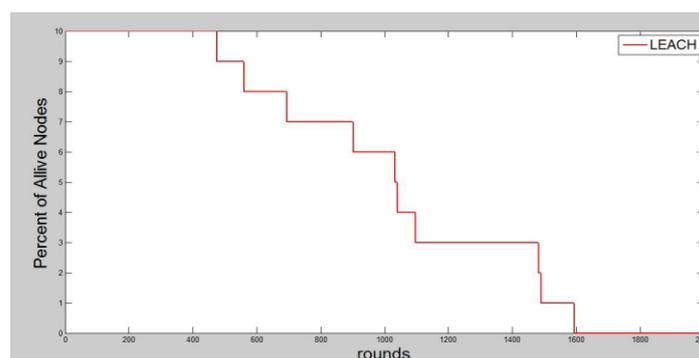
## D. Simulation results of SAMA technique

1) *Dead vs. Rounds*: We have taken 2000 rounds and after approx. 440 rounds, the energy of nodes starts decreasing and upto approx. 1600 rounds all nodes are dead. So after this, communication will be stopped as all nodes are dead in the network. So, network using SAMA technique conserves more energy than using polynomial technique.



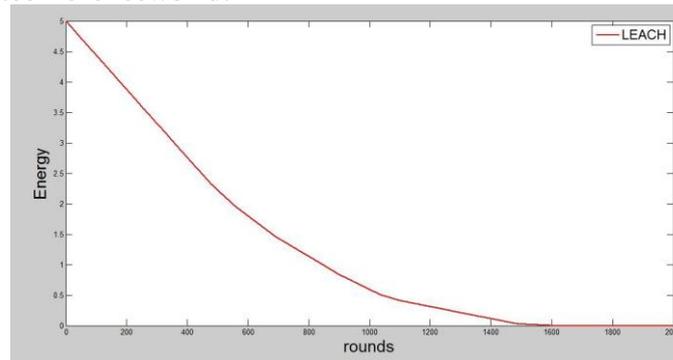
**Fig.10: Dead vs. Rounds**

2) *Percentage of alive nodes vs. rounds*: After approx. 1600 rounds all nodes are dead thus network is left with 0% alive nodes.



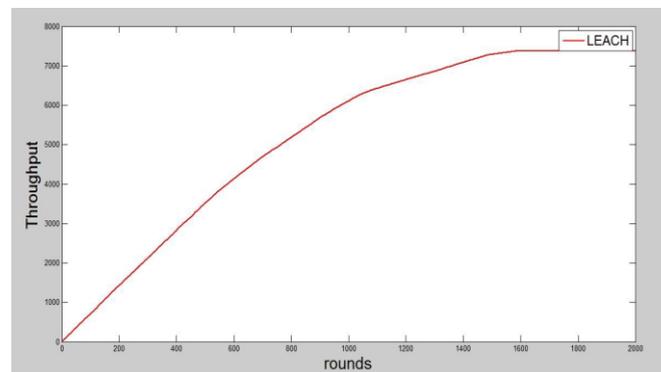
**Fig.11: Percentage of alive nodes vs. Rounds**

3) *Energy vs. rounds*: After approx. 1600 rounds all the energy is consumed by the nodes while communicating and thus leaving the whole network dead.



**Fig.12: Energy vs. Rounds**

4) *Throughput vs. Rounds*: Throughput is the measure of comparative effectiveness of a process or an operation.



**Fig.13: Throughput vs. Rounds**

The simulation results demonstrate that our proposed scheme has a much lower energy consumption and the delivery ratio of our scheme is slightly better than the bivariate polynomial-based scheme. Moreover, the overall memory consumption for the bivariate polynomial-based scheme is at least 5 times larger than our proposed scheme.

## VI. CONCLUSION

In this paper, source anonymous message authentication scheme (SAMA) based on elliptic curve cryptography (ECC) is implemented using MATLAB software for the purpose of security of WSN. While ensuring message privacy, SAMA can be applied to any messages to provide hop-by-hop message content authenticity without the weakness of the built-in threshold of the polynomial-based scheme. Both theoretical and simulation results, conducted using MATLAB, show that, in comparable scenarios this proposed scheme is more efficient than the bivariate polynomial-based scheme in terms of energy consumption, and overall throughput. The results also demonstrate that the proposed scheme is secure with light overhead. In future, energy and security are both important design issues for WSNs. An interesting research topic that can be investigated is to develop a novel secure and energy aware routing protocol that can address these two issues concurrently through balanced energy consumption and probabilistic random walking. Based on the tradeoff relationship between security and energy, this protocol should provide tunable security level and energy consumption pattern. More detailed further researches in these supportive topics can be carried out.

## REFERENCES

- [1] Ming Liu, Jiannong Cao, et. al., "An Energy-aware Routing Protocol in Wireless Sensor Networks", *Sensors*, vol. 9, pp. 445-462, 2009.
- [2] Shiwei Zhang and Haitao Zhang, "A Review of Wireless Sensor Networks and its Applications", "Automation and Logistics(ICAL), 2012 IEEE International Conference on ", pp. 386, August 2012
- [3] J.P. Walters, Z. Liang, W. Shi, V. Chaudhary, "Wireless Sensor Network Security: A Survey", "Security in Distributed", *Grid and Pervasive Computing*, pp.3-5, 10-15, 2006.
- [4] S. Zhu, S. Setia, S. Jajodia, and P. Ning, "An interleaved hop-by-hop authentication scheme for filtering false data in sensor networks," in *IEEE Symposium on Security and Privacy*, 2004.
- [5] S. William, *Cryptography and Network Security: Principles and Practice*, 2nd edition, Prentice-Hall, 1999.
- [6] Ayushi, "A Symmetric Key Cryptographic Algorithm", "International Journal of Computer Applications", Vol 1 – No. 15, pp. 2, 2010
- [7] B.Schneier. *Applied Cryptography*, John Wiley and Sons, second edition, 2012.
- [8] V. Miller, "Uses of elliptic curves in cryptography", "Advances in Cryptology -CRYPTO'85", LNCS 218, pp.417-426, 2011.
- [9] C. Blundo, A. De Santis, A. Herzberg, S. Kutten, U. Vaccaro, and M. Yung, "Perfectly-secure key distribution for dynamic conferences," in *Advances in Cryptology - Crypto'92*, *Lecture Notes in Computer Science Volume 740*, pp. 471–486, 1992.
- [10] W. Zhang, N. Subramanian, and G. Wang, "Light-weight and compromise resilient message authentication in sensor networks," in *IEEE INFOCOM*, (Phoenix, AZ.), April 15-17 2008.
- [11] D. Pointcheval and J. Stern, "Security proofs for signature schemes," in *Advances in Cryptology – EUROCRYPT*, *Lecture Notes in Computer Science Volume 1070*, pp. 387–398, 1996.
- [12] K. Nyberg and R. A. Rueppel, "Message recovery for signature schemes based on the discrete logarithm problem," in *Advances in Cryptology - EUROCRYPT*, *Lecture Notes in Computer Science Volume 950*, pp. 182– 193, 1995.
- [13] H. Wang, S. Sheng, C. Tan, and Q. Li, "Comparing symmetric-key and public-key based security schemes in sensor networks: A case study of user access control," in *IEEE ICDCS*, (Beijing, China), pp. 11–18, 2008.
- [14] S. Zhu, S. Setia, S. Jajodia, and P. Ning, "An interleaved hop-by-hop authentication scheme for filtering false data in sensor networks," in *IEEE Symposium on Security and Privacy*, 2004.
- [15] A. Perrig, R. Canetti, J. Tygar, and D. Song, "Efficient authentication and signing of multicast streams over lossy channels," in *IEEE Symposium on Security and Privacy*, May 2000.
- [16] C. K. Wong and S. S. Lam, "Digital signatures for flows and multicasts," *IEEE/ACM Trans. Netw.*, vol. 7, no. 4, pp. 502-513, 1999.
- [17] Kemal Akkaya and Mohamed Younis, "A Survey on Routing Protocols for Wireless Sensor Networks", *Ad hoc Networks*, vol. 3, no. 3, pp. 325-349, May 2015.
- [18] Rajashree.V.Biradar, V.C. Patil, et. al., "Classification And Comparison Of Routing Protocols In Wireless Sensor Networks", "UbiCC Journal", Vol-4, pp. 708-709.

## 4<sup>th</sup> International Conference on Innovative Trends in Science, Engineering and Management

(C-DAC, Mumbai) Centre for Development of Advanced Computing, Mumbai, Maharashtra (India)

(ICITSEM-17)

17<sup>th</sup> June 2017, [www.conferenceworld.in](http://www.conferenceworld.in)

ISBN: 978-93-86171-47-4

- [19] W.R. Heinzelman, A. Chandrakasan, and H. Balakrishnan, "Energy-efficient Communication Protocol for Wireless Microsensor Networks", in IEEE Computer Society Proceedings of the Thirty Third Hawaii International Conference on System Sciences (HICSS '00), Washington, DC, USA, vol. 8, pp. 8020, Jan. 2011.
- [20] S. Lindsey and C.S. Raghavendra, "PEGASIS: Power-efficient Gathering in Sensor Information System", Proceedings IEEE Aerospace Conference, vol. 3, Big Sky, MT, pp. 1125-1130, Mar. 2012.
- [21] Mohamed-Lamine Messai, "Classification of Attacks in Wireless Sensor Networks", International Congress on Telecommunication and Application'14 University of A.MIRA Bejaia, Algeria", 23-24 APRIL 2014
- [22] Deepali Virmani, et. al., "Routing Attacks in Wireless Sensor Networks: A Survey", International Journal of Computer Science and Information Technologies (IJCSIT), Vol.5(2), pp.2666-26667, 2014.
- [23] Dr. Shahriar Mohammadi, et.al, "A Comparison of Physical Attacks on Wireless Sensor Networks", International Journal of Peer to Peer Networks (IJP2P)", vol. 2, No. 2, pp.29-30, April 2011.
- [24] Wensheng Zhang and Nalin Subramanian, "Lightweight and Compromise-Resilient Message Authentication in Sensor Networks", IEEE INFOCOM, 2008.
- [25] A. S. Wander, N. Gura, H. Eberle, V. Gupta, and S. C. Shantz, "Energy analysis of public-key cryptography for wireless sensor networks," in PERCOM '05: Proceedings of the Third IEEE International Conference on Pervasive Computing and Communications, (Washington, DC, USA), pp. 324-328, IEEE Computer Society, 2005
- [26] G. Gaubatz, J.-P. Kaps, E. Ozturk, and B. Sunar, "State of the art in ultra-low power public key cryptography for wireless sensor networks," in PERCOMW 05: Proceedings of the Third IEEE International Conference on Pervasive Computing and Communications Workshops, (Washington, DC, USA), pp. 146-150, IEEE Computer Society, 2005.
- [27] H. Chan and A. Perrig, "Security and privacy in sensor networks," IEEE Computer Magazine, pp. 103-105, Oct. 2003.
- [28] N. Gura, A. Patel, A. W, H. Eberle, and S. C. Shantz, "Comparing elliptic curve cryptography and rsa on 8-bit cpus," pp. 119-132, 2004.
- [29] W. Zhang, N. Subramanian, and G. Wang, — Lightweight and compromise resilient message authentication in sensor networks,|| in IEEE INFOCOM, Phoenix, AZ., April 15-17 2008.
- [30] H. Wang, S. Sheng, C. Tan, and Q. Li— Comparing symmetric key and public-key based security schemes in sensor networks: A case study of user access control,|| in IEEE ICDCS, Beijing, China, 2008, pp. 11–18.
- [31] Wenliang Du, Jing Deng, Yunghsiang S. Han, "A Key Management Scheme for Wireless Sensor Networks Using Deployment Knowledge" in 2004.
- [32] T. A. ElGamal, "A public-key cryptosystem and a signature scheme based on discrete logarithms," IEEE Transactions on Information Theory, vol. 31, no. 4, pp. 469-472, 1985.

## **Comparison of Various Solar Tracking Technique:**

### **Review Paper**

**Sarika<sup>1</sup>, Prachi chaudhary<sup>2</sup>**

<sup>1</sup> *M.Tech Scholar, Deenbandhu Chhotu Ram University of Science And Technology,  
Murthal, Sonapat-131001*

<sup>2</sup> *Professor, Deenbandhu chhotu Ram University of Science And Technology,  
Murthal, Sonapat-131001*

#### **ABSTRACT**

*This paper describes different solar tracking method for tracking sun position and getting maximum solar power point. In recent time power generation is one of the biggest problem in sustainable growth. The sun tracking solar system allows step up of solar panel power ratio. So, to illustrate this concept, this paper presents a basic and didactical small scale system for educational application and sensitizing deed. Different sun tracking solar tracking described in this paper are MPPT, dual axis solar tracking system, Automatic solar tracking system , High precision solar tracking system, Finite element method of solar collector's tracking system.*

**Keywords:** *MPPT(Maximum power point tracking).*

#### **i. INTRODUCTION**

Recently, much attention has been given towards the study of Photovoltaic (PV) cells and their conversion efficiencies. It is necessary to provide PV systems with Maximum Power Point Tracking (MPPT) controllers in order to draw maximum electrical power from the PV modules under varying loads and atmospheric conditions[1]. The tracking systems of the solar collectors are used to orient the solar collector normal to the solar radiation, in the way to catch the maximum amount of light from the sun[2]. solar energy is rapidly getting popularity as an important means of expanding renewable energy resources. But most of the solar panels in are positioned on a fixed surface such as roof. As sun is a moving object, this approach is not the best method. One of the solutions is to use a solar tracker that will actively follow the Sun. A solar tracker is a sensory device built with the solar panel which tracks the motion of the sun across the sky and moves the solar panel according to that motion of the sun, ensuring that the maximum amount of sunlight strikes the panels throughout the day[3].

#### **II. LITERATURE SURVEY**

More than 170 years ago, in France, the development of the solar cell started from the work of the French experimental physicist Antoine-Cesar Becquerel back in the 19<sup>th</sup> century[1]. In 1839, Becquerel observed that shining light on an electrode submerged in a conductive solution would create an electric current[2]. In the same year, another French physicist, Edmond Becquerel found that a certain material would produce a small amount

of an electric current when it was exposed to light[3]. This was described as the photovoltaic (PV) effect[1]. It was an interesting part of science for the next three quarters of a century[2].

In 1877, Charles Fritts constructed the first true solar cell (made from solid materials) by using junctions formed by coating the semiconducting selenium with an ultrathin, nearly transparent, layer of gold[4]. Fritts's devices were very inefficient, transforming less than 1 percent of the absorbed light into electrical energy[3]. Sera et al (2008) have proposed optimized change in power Perturbation & Observation (dp P&O) algorithm for PV system under fast changing environmental conditions[6]. This method overcomes the drawbacks of conventional P & O methods such as oscillations and slow response time and gives the guidelines for proper tracking direction[7]. But the proposed method consumes more time to reach maximum power point (MPP) than the conventional algorithms[2]. Here constant step size is used for perturbation under lower change in irradiation condition. Abu-Rub et al (2013) have proposed Adaptive Neuro-Fuzzy Inference System (ANFIS) based maximum power point tracking for quasi-Zsource inverter based PV system[4]. This algorithm controls the shoot through duty ratio and modulation index, to maintain the required voltage, current, and frequency as required and harness maximum power from PV plant[5]. Nevertheless, these algorithms require previous knowledge of PV plant characteristics to train the algorithms and result in increased memory space and complex computation[8]. De Brito et al (2013) have presented detailed comparisons of maximum power point tracking (MPPT) techniques for PV applications[9]. This analysis is performed with dc-dc converter based on the amount of energy extracted from PV plant, PV voltage ripple, dynamic response, and use of sensors[2]. Ellabban et al (2009) have presented the design of voltage mode and current mode controller for Z source inverter[10]. The proposed controller controls the peak dc link voltage by measuring the input and capacitor voltages. The authors have used a small signal modeling for controller design[11]. However, the authors did not give attention to shoot through ratio control[2]. Gajanayake et al (2007) demonstrated a multi loop controller for Z-source inverter based distributed generation system[1]. The authors have employed indirect DC link controller for DC side and synchronous reference frame controller in the AC side, which maintains the power quality of the power supply to the grid during disturbances[4]. The controller is designed using state space averaging technique[5]. The proposed system has good voltage regulation and disturbance rejection capability[9]. However, the authors have not given the attention to the resonant problem in the inverter[2].

### III. MPPT

Maximum power point tracking (MPPT) is a method that grid connected inverters, solar battery chargers and similar devices use to get the maximum potential power from one or more photovoltaic devices, normally solar panels[11].

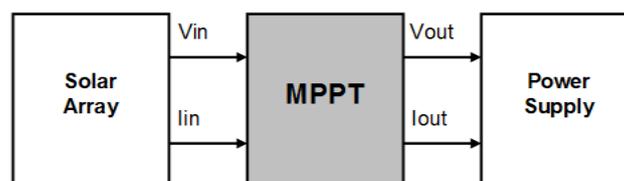


Fig5 Basic Block Diagram of MPPT

the purpose of the MPPT system to model the output of the cells and apply the appropriate load resistance to obtain maximum power for any given ecological conditions[11]. solar radiation energy is most Viable & eco

friendly source of energy[11]. It shows ways to Integrate solar design into multi-units of small household PV plant, and provides calculations and examples to show how better design optimization decisions can increase the useable solar energy. The improvement in overall system efficiency of integrated PV modules embedded in power plant increased power generation is achieved by minimizing and capturing energy losses[11].

#### IV. DUAL AXIS SOLAR TRACKING SYSTEM

Earth has two types of motion, the daily motion and the annual motion. The daily motion causes the sun to appear in east to west direction over the earth where as the annual motion causes the sun to tilt at 23 degree while moving along east-west direction [4]. So the maximum efficiency of the solar panel is not being used by single axis tracking system[12]. To track the sun movement accurately dual axis tracking system is necessary[13]. With the sun always facing the panel, the maximum energy can be absorbed as the panel operates at its greatest efficiency[14]. The main objective of this paper is to improve the power gain by accurate tracking of the sun[15]. To develop this dual axis tracking system light dependent resistor (LDR) is used as sensor. The resistance of LDR decreases with increasing light intensity [5]. Two dual Op-amps are used as comparator for comparing the light intensity in two different axes[12]. Again diodes are used for neglecting the negative voltages coming from the comparators. Microcontroller generates the suitable control signals to move the motors in the proper direction[12]. But the microcontroller output ranges from 0 to 5 volt [6]. So to increase the voltage and current level motor driver is used. Two 12 volt full geared stepper motors are used here for rotating the solar panel in two different axes[12].

#### V. METHODOLOGY

In order to simplify the design process the whole system is divided into four different units. These are: light sensing unit, light comparison unit, control unit and movement adjustment unit. Fig. 1 shows the overall block diagram of the whole system.

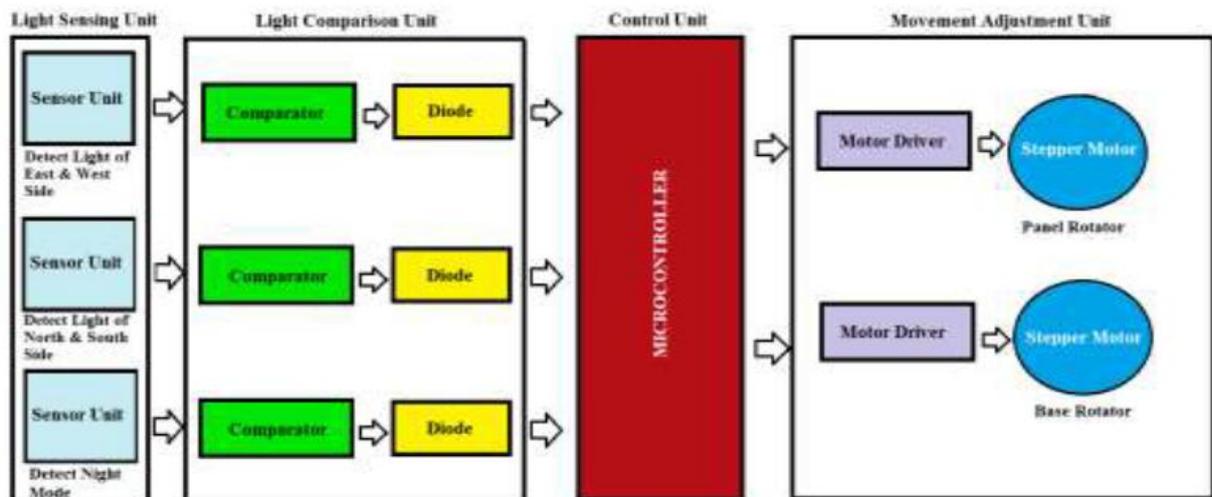


Fig. 1 shows the overall block diagram of the whole system.



## **VI. FINITE ELEMENT METHOD OF SOLAR COLLECTOR'S TRACKING SYSTEM**

The tracking systems of the solar collectors are used to orient the solar collector normal to the solar radiation, in the way to catch the maximum amount of light from the sun. The finite elements analysis of three main solar collector tracking systems: for plate, for dish and for trough solar collectors; the aim is to find out the critical position of the tracking systems, when the equivalent stresses and the displacements have a maximum value. The solar collectors are used to transform the energy from the sun in heat used for domestic heat water or for buildings heating [3, 7]. The maximum amount of energy is collected from the sun when the solar collector's surface has a position normal to the solar radiation. During the day-light time, as inverse relative motion, the sun has a diurnal motion from east to west. During one year the sun has a smaller seasonal motion from north to south. Due to these considerations, it is necessary to find solution on the way to orient the solar collectors surface normal to the solar radiation during a day light period and during one year, also. The solution is given by the tracking systems [3, 7].

## **V. CONCLUSIONS**

In this paper a dual axis sun tracking system has been successfully discussed[4]. It allows the sun's path from morning to evening and then it's back to the initial position facing towards east side[2]. So the system saves lot of energy by keeping the motors off during night period. This tracking technology is very simple in design, low in cost and accurate in tracking. Several solar technologies are available on the market[27][28]. But this dual axis tracking technology has higher energy gain comparing with both fixed solar panel and single axis solar tracking technologies[23][24]. Considering all above aspects of this dual axis tracking system it can be concluded that, it is an efficient tracking system with low cost electromechanical set up and low maintenance requirements[21][25]. In finite elements analysis of the presented solar collectors tracking systems, important conclusions can be issued the maximum values of the equivalent stresses are obtained in the rotational joints of the structures[18][19]. The maximum values of the equivalent stresses and displacements are obtained for big orientation angles (in this case the actuator stroke has a minimum stroke and it means that the structure is a stabile one)[8].

## **REFERENCES**

- [1.] Hcoman Dehbonei, Chem Nayar. Lawrence Borle. "A Combined Voltage Controlled and Current Controlled 'Dual Converter for a Weak Grid Connected Photovoltaic System with Battery Energy Storage". IEEE Conference 011 Power Electronics Specialists. Vol. 3. pp: 1495-1500. 2002.
- [2.] J. S. Siva Prasad and B. G. Femandes\_. "Active Commutated Thyristors CS1 for Grid Connected Photovoltaic Applications". The 4m International Conference on Power Electronics and Motion Control. Vol. 3, pp: 1767-1771. 2004.
- [3.] Anastasios Ch. Kyritsis. Nikolaos P. Papanikolaou. "Design and control of a current source fly-back inverter for decentralized grid connected photovoltaic systems." European Conference on Power Electronics and Applications. pp: p.1-p.10, 2005.



- [4.] Qingrong Zeng. Liuchen Chang. "Novel SVPWM Based Predictive Current Controller' for Single-phase Grid Connected Inverters". Canadian Conference on Electrical and Computer Engineering. pp: 1262-1265. 2005.
- [5.] Juan Jose Negroni. Carlos Meza. Domingo Biel. "Control of a Buck Inverter for Grid- Connected PV Systems: a Digital and Sliding Mode Control Approach ".IEEE International Symposium on Industrial Electronic. Vol. 2. pp: 739-744. 2005.
- [6.] Yi Huang, Miaosen Slien and Iin Wang. "Z-Source Inverter for Residential Photovoltaic Systems". IEEE Transaction on Power Electronics. Vol.21. No. 6, pp: 1176-1782,2006
- [7.] Yang Chen, Keyue Smedley, "A Cost-effective Single-phase Grid-connected Inverter with Maximum Power Point Tracking". IEEE Conference on Industrial Applications (41st IAS annual meeting). Vol.2. pp: 995-1000. 2006.
- [8.] Hoorman Dehhonei and C.V. Nayar, "A Grid-Connected Photovoltaic System with Direct Coupled Power Quality Control". 32nd IEEE Annual Conference on Industrial Electronics. pp: 5203-5208, 2006.
- [9.] Bahak Parhang. Shahnokh Farhangi, "Comparison of Z-Source and Boost-Buck Inverter Topologies as a Single Phase Transformer-less Photovoltaic Grid-Connected Power Conditioner". 37th IEEE Conference on Power Electronics Specialists. pp: 1-6. 2006
- [10.] Pedro Gonies Barbosa, Henrique Antonio Carvallio Braga, "Boost Current Multilevel Inverter and Its Application on Single-Phase Grid-Connected Photovoltaic Systems". IEEE Transactions on Power Electronics. vol. 21, Issue no.: 4, pp: 1116-1124, 2006.
- [11.] Hirotaka Koizumi, Norio Goshima, and Kosuke Kurokava. "A Novel Microcontroller for Grid-Connected Photovoltaic Systems". IEEE Transactions on Industrial Electronics. Vol. S3, Issue no.: 6, pp: ISS9-1897. 2006.
- [12.] Mi Dong, An Luo, Lisha Bai. Jian Yang, "An Integrative Control Scheme for Boost-buck Inverter in Grid Connected Photovoltaic Systems." IEEE Conference on Applied Power Electronics. pp: 524-528. 2007
- [13.] J. B. Wang, Joe Chen, Ronald Li, "A Grid Connected Photovoltaic System with Irradiation Injected Current Control". IEEE The 7th International Conference on Power Electronics. pp: 43-435, 2007.
- [14.] G. Brando, A. Dannier. "A Sensor-less Control of H-bridge Multilevel Convener for Maximum Power Point Tracking in Grid Connected Photovoltaic Systems". International Conference on Clean Electrical Power. pp: 789-794. 2007.
- [15.] Gabriele Grandi, Daiko Ostojic. Claudio Rossi, "Dual Inverter Configuration for Grid-Connected Photovoltaic Generation Systems". 29th International Conference on Telecommunications Energy. pp: 880-885, 2007.
- [16.] T. Shamhi and N. Ammasai Gormden, "Power Electronic Interface for Grid Connected PV array using Boost Converter and Line-Commutated Inverter with MPPT". International Conference on Intelligent and Advanced Systems. pp: 882-886, 2007.
- [17.] Ulrich Boeke and Heinz van der Broeck. "Transformer-less Converter Concept for a Grid Connection of Thin-film Photovoltaic Modules". IEEE Industry Applications Society Annual Meeting. pp: 1-8, 2008.



- [18.] Mateus F. Scionardie and Denizar C. Martins, "Single-Phase Grid-Connected Photovoltaic System with Active and Reactive Power Control Using dq0 Transformation". IEEE Conference on Power Electronics Specialists. pp: 1202-1203. 2008.
- [19] P. K. Barnerjee, The Boundary Element Methods in Engineering, Mc Graw-Hill Publishing House, Maidenhead, England, 1993.
- [20] G. Bee, J. O. Watson, Introduction to Finite and Boundary Element Methods for Engineers, John Wiley & Sons Publishing House, Chichester, England, 1992.
- [21] J. A. Duffie a. o., Solar Engineering of Thermal Processes, John Wiley & Sons Inc., USA, 1991.
- [22] M. J. Fagan, Finite Element Analysis. Theory and Practice, Longman Group, England, 1992.
- [23] M. Gerardin, A. Cardona, A. Flexible Multibody Dynamics: A Finite Element Approach, John Wiley & Sons Publishing House, Chichester, England, 2001.
- [24] M. T. Lates, Metoda Elementelor Finite în Inginerie. Aplicatii, Editura Universitatii Transilvania din Brasov, Romania, 2008.
- [25] R. Lates, I. ViMa, Solar Collectors – An Overview, Proceedings of Conference of Sustainable Energy, Brasov, Romania, 7-9 July 2005.
- [26] G. L. Mogan, Metoda Elementelor Finite in Inginerie. Bazele Teoretice, Editura Lux Libris, Brasov, Romania, 1997.
- [27] O. C. Zienkiewicz, R. L. Taylor, The Finite Elements Method, Vol. I. Mc Graw-Hill Publishing House, Maidenhead, England, 1988.
- [28] O. C. Zienkiewicz, R. L. Taylor, The Finite Elements Method, Vol. II. Mc Graw-Hill Publishing House, Maidenhead, England, 1989.

# **STRUCTURAL EQUATION MODELLING**

**Bhavika Bali**

## **ABSTRACT**

*The authors try to provide a basic set of guidelines for any research that has confirmatory factor analysis or Structural Equation Modeling as a primary statistical analysis technique. Structural Equation Modeling has evolved as a valued statistical technique for insiders. This paper is an overview of underlying ideas and application of SEM, as well as an exploration of best practices for using this technique.*

**Keywords:** *SEM, Structural Equation Modeling, Observed Variables, Latent Variable , SEM Models*

## **I. INTRODUCTION**

Structural Equation Modeling is a statistical approach to testing hypotheses about the relationships amongst observed and latent variables ( Hoyle 1995) Structural Equation Modeling is generally perceived as a rather large toolbox that can be applied to serve different data analysis situations. In other words it is tool for verifying theory. SEM is used widely , to hypothesize how set of variables desire construct and how the constructs are related to each other.

We can understand the definition with the following examples

- 1) Education professionals might hypothesise the possible influence of students friend circle on his/her achievement in school.
- 2) An advertising professional might be interested in mapping the possible connect between digital advertising and digital sales.

In the above example , we are not sure that a connection is valid , but we are interested in following whether it exists and thereafter measure the strength of connection in numerical form.

## **II. LITERATURE REVIEW**

The use of Structural Equation Modeling in research has increased in psychology, sociology , education and economics since it was first conceived by Wright (1918 , a biometrician who was credited with the development of path analysis to genetic theory in biology . Over the years , the combination of methodological advances and improved interfaces in various SEM software's have contributed to diverse usage of SEM ( Teo & Khine, 2009) Structural Equation Modeling ( SEM) is the youngest member of statistical modeling techniques, mainly used for cross -sectional Factor Analysis , Path Analysis and Regression Analysis ( Byrne , 1998)

Time and again literature has compared SEM against other multivariate techniques and listed four unique features of SEM :

- 1) SEM takes a confirmatory approach to data analysis by specifying the relationship among variable *a priori*.

2) SEM provides explicit estimates of error variance parameters. Other multivariate techniques are not capable of either assessing or correcting the measurement error.

3) SEM procedures incorporate both unobserved ( I.e latent) and observed variables.

4) SEM is capable of modeling multivariate relations, and estimating direct and indirect effects of the study.

According to Judea Pearl ( 2000) , modern SEM is a far cry from the original causality modeling theme, mainly for the following two reasons

1) Researchers have tried to build scientific ‘credibility’ of SEM by isolating ( or removing) references to causality.

2) Causal relationships do not have commonly accepted mathematical notations

According to Raykov and Marcoudlis ( 2006) there are 4 common SEM models relevant in literature -

1) Path Analytic Models ( PA) : PA models are conceived in terms of observed variables

2) Confirmatory Factor Analysis Models ( CFA) : CFA models are commonly used to structure patterns of relationships among various constructs

3) Structural Regression Models ( SR): SR models are built on CFA models, by postulating latent regressions amongst the construct.

4) Latent Change Model ( LC) : LC models are used to study change over a period of time.

### III. MODEL AND ASSUMPTIONS OF SEM

Structural equation models comprise both a measurement model and a structural model ( TEO ET AL)

The two step approach proposed by James, Mulaik and Brett( 1982) emphasizes the analysis of measurement and structural models as two conceptually distinct models. This approach expanded the idea of assessing the fit of the structural equation among the latent variables ( structural model) independently of assessing the fit of observed variables to latent variables ( measurement model)

A measurement model is a part of a SEM model which specifies the relations between observed variables and latent variables. Confirmatory Factor Analysis is commonly used to test the measurement model..

### IV. INTRODUCTION TO SEM TECHNIQUE

1. SEM helps in establishing connection between various concepts in order to solve a statistical problem.

2. SEM is confirmatory rather than exploratory technique.

3. SEM is not a single model, but an amalgamation of models originating in different disciplines at different times and findings merged together.

#### Analysing Non Experimental Data

Non experimental research generally involves using statistical models that have numerous statistical assumptions and equations. The underlying concept of causation , helps us understand that we can never prove a causal relationship , we can only render it probable ( Niels J. Blunch)

SEM is often called as the analysis of covariance structures. The basis of estimation of parameters for a SEM model is built on the above foundation. Every model involves minimisation of a function of a residual matrix.

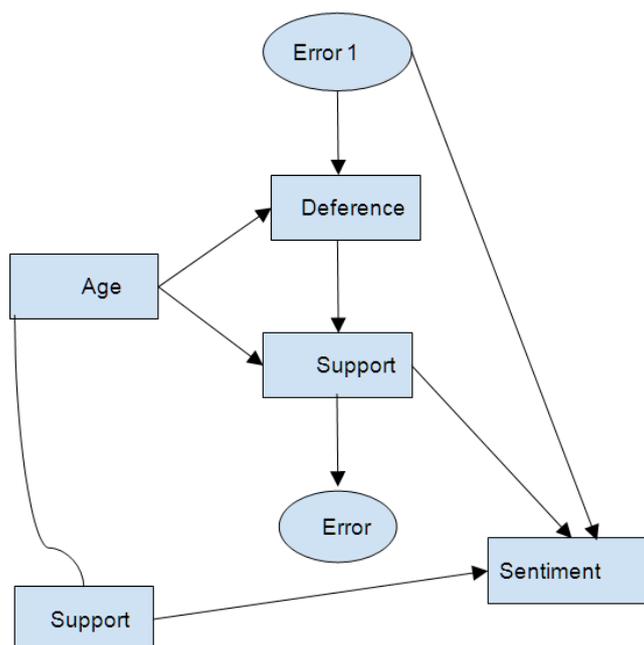
As SEM is a correlation research method, SEM analysis is impacted by measurement scale, restriction of range in data values, missing data, outliers, non linearity and non normality of data. Thus any researcher using SEM softwares should have a good understanding of the data characteristics.

SUGGESTION	ISSUE
Need to take into account measurement scale of all variables in mind	Measurement Scale
Need to consider range of values obtained for variables, as restricted range of on one or more variable can reduce the magnitude for correlation	Restriction of Range
Modern imputation methods are recommended	Missing Data
Can detect outliers with methods such as box plots, scatter plots, histograms or frequency distribution	Outliers
Can be detected by scatter plots and can be dealt with by transformation or deleting outliers	Linearity
Test the distribution of variables with univariate tests, multivariate tests and skewness and Kurtosis statistics	Non-Normality

### PATH ANALYSIS MODELS

The development of path analysis as a method for understanding the direct and indirect relationship of variables can be credited to Sewall Wright. Path model has evolved from being causal modelling technique to a method to test theoretical models that depicts relationship amongst the variables

#### A Path Model Example - Union Sentiment Model



On studying the path model it is observed that the age and years are correlated and age has a direct effect on on deference and support. Deference has a direct relationship on support and years, deference and support have a direct effect on sentiment. As we are predicting deference, support and sentiment, each have an error term. Path model permit specification of theoretically meaningful relation amongst the variable that cannot be specified in a single additive regression model. Path model provides for testing the additional ability to test indirect effects. Indirect effects provide for a test of moderating variables. The issue of measurement error in observed variable, however is not treated either in regression or path models ( Wolfe, 1979)

deference = (1) age + error1

support = (2)age + (3) deference + error2

sentiment = (4) years + (5) support+ (6)deference + error3

Satisfying the Order Condition

There would be 6 different relations that will be included in the path model and other possible paths .

6 path coefficients

3 equation error variances (for 3 dependent variables)

1 correlation among the independent variables

2 independent variable variances

There are 12 free parameters in the path model. The number of distinct values in the sample variance-covariance matrix would be

$[p(p+1)]/2 = 15$

where p is the number of observed variables in the matrix.

Hence the order condition is satisfied here .

The degrees of freedom is 3 for this path model. The degree of freedom should be greater than 1 for model identification. In SEM, preference is given to over identified models.

The model estimation is all about choosing the estimation method to estimate the parameters in the path models.

In this example the union sentiment path model was used. The model fit was assessed using chi square testing.

For the Union sentiment path model, three regression equation computed and thus three R<sup>2</sup> values are reported.

The three R<sup>2</sup> values are use to compute the overall R<sup>2</sup>m for the path model. Based on the accomplishment, a generalised squared multiple correlation will be FACTOR ANALYSIS

### Factor Analysis

Factor analysis is a procedure used to determine the extend to which measurement overlap ( Williams, 1992) - that is, shared variance - exists among a set of variables.

Principal component analysis is one of the most commonly used method of extraction as this method evaluates all possible variability for each variable ( Craig A. Mertler and Rachel Vannatta Reinhart)

As the principal component analysis is typically exploratory, the researcher must determine the appropriate number of components to retain. The key criteria used in the decision making process are

1. Eigenvalue - Components with Eigenvalue greater than 1 should be retained
2. Variance - Retain components that account for 70% of the variability
3. Scree Plot - Retain all components with sharp descent, before eigenvalue level off.
4. Residuals - Retain the components generated in model if only a few residual.

## 4<sup>th</sup> International Conference on Innovative Trends in Science, Engineering and Management

(C-DAC, Mumbai) Centre for Development of Advanced Computing, Mumbai, Maharashtra (India)

(ICITSEM-17)

17<sup>th</sup> June 2017, [www.conferenceworld.in](http://www.conferenceworld.in)

ISBN: 978-93-86171-47-4

Suppose we try to develop a model for life expectancy. The underlying structure is assumed to contain 10 variables namely,

- 1) male life expectancy
- 2) female life expectancy
- 3) birth rate
- 4) infant mortality rate
- 5) fertility rate per woman
- 6) natural log of doctors per 10,000 individuals
- 7) natural log of radios per 100 individuals
- 8) natural log of telephones per 100 individuals
- 9) natural log of gross domestic product
- 10) natural log of hospital beds per 10,000 individuals

Through the usage of any of the conveniently available SEM software we seek to analyse that what, if any underlying structure exists for the measures on the above 10 variables. Univariate linearity and normality were analysed by creating scatter plot matrix. A factor analysis was then conducted using Dimension Reduction and all 4 key decision making criteria were assessed. Principal components analysis was conducted utilising a varimax rotation. the initial analysis retained only one component, Four criteria were then utilised to indicate that retaining the components should be investigated.

After Varimax rotation the first component accounted for 53.35% and second accounted for 33.97%.

Loading	Component Loadings
-0.879	Fertility Rate
-0.858	Birth Rate per 1000 individuals
0.846	Male Life Expectancy
-0.839	Infant Mortality
0.829	Female Life Expectancy
0.763	Number of Doctors per 10,000 individuals
	Component 2 : Economic Stature
0.879	Number of Radios over 100 individuals
0.719	Number of hospital beds per 10,000 individuals
0.688	Gross Domestic Product
0.679	Number of phones per 100 individual

## **V. THE MEASUREMENT MODELS IN SEM**

Usually under the common heading of factor analysis , we have 3 different models

Principal component analysis

Exploratory factor analysis

Confirmatory Factor Analysis

Confirmatory Factor Analysis is considered to be the measurement model of SEM with the following characteristics

1. Ideally every manifest variable is an indicator of one and only one factor
2. Some error terms may be allowed to correlate
3. Some of the parameters may be restricted to certain values or have the same values as parameter , or they may b restricted to fulfil other conditions.

## **VI. IDENTIFICATION AND ESTIMATION**

For correct identification in the confirmatory factor models it is necessary that we follow two rules , which are both sufficient but not necessary

The Three indicator Rule : Identification of confirmatory factor model depends on

1. every factor has at least three indicator
2. No manifest variable is an indicator of more than one factor
3. The error terms are not correlated

The two-indicator rule : A confirmatory factor model with at least two factors is identified if

1. every factor has at least two indicators
2. no manifest variable is an indicator for more than one factor
3. the error terms are not correlated
4. the covariance matrix for latent variables does not contain zero

Example : A few Financial Institutions want to determine the quality of investment for their financial instruments. The financial statement is analyzed to derive a number of indicators . Factor analysis was used to group together the variation in data matrix into distinct dimensions and results was as follows

### **Confirmatory Factor Analysis - The Measurement Models in SEM**

Usually under the common heading of factor analysis, we have 3 different models

Principal component analysis Exploratory factor analysis Confirmatory Factor Analysis

Confirmatory Factor Analysis is considered to be the measurement model of SEM with the following characteristics

1. Ideally every manifest variable is an indicator of one and only one factor
2. Some error terms may be allowed to correlate
3. Some of the parameters may be restricted to certain values or have the same values as parameter, or they may b restricted to fulfill other conditions. Identification and Estimation

For correct identification in the confirmatory factor models it is necessary that we follow two rules, which are both sufficient but not necessary

The Three Indicators Rule: Identification of confirmatory factor model depends on

1. every factor has at least three indicator
2. No manifest variable is an indicator of more than one factor
3. The error terms are not correlated

The two-indicator rule: A confirmatory factor model with at least two factors is identified if

1. every factor has at least two indicators
2. no manifest variable is an indicator for more than one factor
3. the error terms are not correlated
4. the covariance matrix for latent variables does not contain zero

Example: A few Financial Institutions want to determine the quality of investment for their financial instruments. The financial statement is analyzed to derive a number of indicators. Factor analysis was used to group together the variation in data matrix into distinct dimensions and in the result, only variables with factor loading greater than .55 are included. The factor analysis was done by collecting data on 35 variables for about 130 companies. From the intercorrelations of 135 variables seven groups were identified. The name of the seven dimensions

- 1) Size
- 2) Financial Leverage
- 3) Long-term capital intensiveness
- 4) Return on investment
- 5) Short term capital intensiveness
- 6) Earning stability
- 7) Debt and debt coverage stability

The advantage of reducing the 35 variables into seven independent groups is

- 1) For subsequent analysis, only seven representative variables need to be considered for decision making.
- 2) Factors analysis is a method of partitioning the variance present in the data into subset and it helps in using the values of those composite variables for decision making

## VII. GUIDELINES FOR APPROPRIATE MODEL FIT

### 7.1 Absolute Fit Indices

McDonald and Ho defined Absolute Fit in 2002 as indices that determine how well a priori model fits a sample data and demonstrated which proposed model has the most superior fit.

Included in this category are

- 1) Chi Square Tests: The Chi-Square valuation methods are traditionally used to assess the magnitude of discrepancy between sample and fitted covariance matrices.
- 2) Root mean square error of approximation (RMSEA): A second fit statistics, RMSEA tells us how well the model with unknown but optimally chosen parameter estimates would fit the population co variation matrix.
- 3) Goodness-of-fit statistics (GFI) and the adjusted goodness-of-fit statistics (AGFI): Created by Joreskog and Sorbom, this method calculates the proportion of variance that is accounted for by the estimated population covariance. Related to GFI is AGFI, which adjusts GFI, based on degrees of freedom.

- 4) Root mean square residual (RMR) and standardized root mean square residual (SRMR)- The RMR and the SRMR are the square root of the difference between residual of the sample covariance matrix and the hypothesized covariance model.
- 5) Incremental Fit Indices- Incremental Fit Indices are a group of indices that compare the chi-square value to the baseline model. For these models the null hypothesis are uncorrelated.

Included in this category are

- 1) Normed-fit index (NFI): NFI statistics assesses the SEM model by comparing chi-square value of the model with the chi-square value of the null model.
- 2) Comparative Fit Index (CFI): CFI model which takes into account sample sizes that perform well even when sample size is small. This is one of the most popular indexes used in SEM program due to being one of the measures least affected by sample size (fan et al, 1999)

### 7.2 Parsimony Fit Indices

Parsimony Fit Indices is a less rigorous theoretical model that paradoxically produces better fit indices (Maulaik et al, 1989, Crowley and Fan, 1997)

The Parsimony Goodness-of-Fit Index (PGFI) is based upon the GFI by adjusting the loss of degrees of freedom. The Parsimony Normed Fit Index also adjusts for the degree of freedom but is based on NFI.

## VIII. CONCLUSION, LIMITATION AND OPPORTUNITIES FOR FUTURE RESEARCH

This paper illustrates the common contributions to the field of SEM studies. However it is commonly observed that in SEM, there are substantial theoretical background differences. While the Covariance based SEM approach is based on a priori knowledge about the model, the Variance based SEM is more robust and less sensitive to smaller sample size. Further there are several practical and methodological differences in measurement model used.

There are several competent software's available in the market such as LISREL, AMOS, SmartPLS, G\*Power.

In our view it is important that future management studies focus on practical enhancement of correct usage of SEM techniques. Management literature is scarce on empirical simulations to support evolution of new age practices.