EFFECT OF NANOMATERIAL IN CEMENT HYDRATION PROCESS

Geethu Dinesh¹, Jemimah Carmichael.M ², Prince Arulraj.G ³

¹Assistant Professor (S.G) in School of Civil Engineering, Karunya University, Coimbatore, Tamilnadu, (India)
²Dean of Civil Engineering, S.N.S. College of Technology, Vazhiyampalayam, Coimbatore, Tamilnadu (India)

ABSTRACT

Nano Technology is one of the areas which is gaining prominence in the field of Civil Engineering. Application of the concepts of nano technology is steadily growing. Materials at nano stage results in new materials which can change the entire property of the composites to which nano materials are added. Literature reveals that nano particles enhance the strength and durability of concrete. Studies on nano particles added cement paste indicate that stronger and durable concrete can be made by adding particles at nano scale to concrete. At present, many investigations are being carried out to understand the hydration of nano sized cement particles and the use of nano-size ingredients such as alumina, fly ash and silica particles for production of concrete. During the present study, an attempt has been made to understand the influence of nano materials on the hydration of cement by conducting consistency, setting time and strength of cement mortar. This report gives a brief introduction about nano technology and its necessity and literature reviews concerned with nano technology and nano materials in concrete. SEM, EDAX, XRD and FTIR analysis were done to study the material properties and its influence in hydration process. Cement was replaced with nano-silica(NS) and nano-silica fume (NSF). It is found that the consistency is not affected due to the presence of nano materials. The setting time and the compressive strength are influenced by the presence of nano materials to a greater extent. It is found that addition of 20% of nano-silica and 30% of nano-silica fume gave the optimum result.

I. INTRODUCTION

The world of materials is rapidly progressing with new and trendiest technologies, and obviously novel applications. Nano technology is among these modern and sophisticated technologies which is creating waves in the modern times. Actually, Nano technology includes the concept of physics and chemistry of materials. It beckons a new field coming to the limelight. So, Nano technology is an interesting but emerging field of study, which is under constant evolution offering a very wide scope of research activity. Nano-technology is an advanced technology, which deals with the synthesis of Nano-particles, processing of the Nano materials and their applications. Normally, if the particle sizes are in the 1-100 nm ranges, they are generally called Nano-particles.

Transition zone represents the region between the particles of coarse aggregate and hardened cement paste. Transition zone is a plane of weakness and has far greater influence on the mechanical behaviour of concrete. Although transition zone is composed of same bulk cement paste, the quality of paste in transition zone is of poor quality. Firstly due to internal bleeding, water accumulate below elongated, flaky and large pieces of...
aggregates. This reduces the bond between the paste and the aggregate. The size and concentration of crystalline compounds such as calcium hydroxide and ettringite are larger in the transition zone. This account for the lower strength of transition zone than bulk cement paste in concrete.

**Bhuvaneshwari.et.al (June 2013)** studied the pore filling effect and its pozzolanic activity with cement towards improvement of mechanical properties and durability aspects. The above discussions described that the influence of NS along with cement, cement mortars, concretes, supplementary cementitious materials and other cementitious materials. Considerable improvement in the properties of permeability, pore filling effects, reduction of CH leaching, rheological behaviour of cement pastes, heat of hydration, micro structure analysis, the pozzolanic activity or reactions and workability, strength and durability were reported **Sakshi Gupta.et.al (December 2013)** studied by using nanostructure and microstructure characterization tools and materials, the simultaneous and also separate optimal use of micro-silica and nano-silica will create a new concrete mixture that will result in long lasting concrete structures in future. **V.R.Rathi.et.al (February 2014)**. Nano materials paved the path to reduce the cement content in concrete than the conventional mixes while maintaining same strength characteristics, which will lead into the production of „greener” concrete. **G.Quercia.et.al (June 2010)** present the state of the art of nS application in concrete, focusing on the nS properties to render it suitable to be applicable in concrete. **Hosseni.et.al (March 2011)** reported that the cement mortars containing nano-particles had reasonably higher strength, low water absorption and denser ITZ compared to those of the OPC ferrocement mortars. Furthermore, along with increasing the W/CM, the performance of silicannano-particles has been reduced. Besides, using higher S/CM was followed by strength loss in both categories of mixtures including with and without silica nano-particles. **Ibrahim.S.Khilia.et.al (October 2013)** study was to investigate the influence of adding nano-silica particles, on the properties of fresh and hardened cement mortar through measurements of workability, compressive and flexure strengths in addition to measuring by SEM analysis. In addition, the scanning electron microscope (SEM) analysis of the microstructures showed that the nano silica filled the cement paste pores, more homogeneity for cement paste and interfacial zone, by reacting with calcium hydroxide crystals forming more calcium silicate hydration. **Hui Li.et.al (August 2004)** studied the recent developments and present state of the application of silica fume (micro-silica) and nano-silica for sustainable development of concrete industry while comparing nanostructures and microstructures nanostructures gives optimal use of micro silica and nano silica which will create a long lasting concrete in future.

**II. EXPERIMENTAL PROGRAMME**

The experimental programme consisted of making normal cement mortar by replacing cement with nano silica and nano silica fume at different proportions. Normal consistency, initial setting time, and final setting time of cement mortar was determined for each proportion. Electron Microscope (SEM), X-Ray diffraction (XRD) and Fourier transform infrared spectroscopy (FTIR) was used to study the morphology of the nano silica and nano silica fume. Mortar cubes of size 70mm x 70mm x 70mm were cast and tested using the compression testing machine. The tests were carried at a uniform rate of 14N/mm$^2$/min after the specimen had been centered in the testing machine.
III. MATERIAL

The materials used are the ordinary Portland cement, fine aggregate of specific gravity 2.67 belonging to zone II replacing different proportions of nano silica and nano silica fume were cast. For making concrete nano silica and nano silica fume was scaled down to nano level and was used for the partial replacement of cement in the production of mortar. The nano silica and nano silica fume is produced in high intensity ball milling. High impact collisions are used to reduce microcrystalline materials down to Nano crystalline structure without chemical change. (11) The Scanning Electron Microscope (SEM) was used to determine the particle size of nano-silica and nano silica fume.

![Fig: 1 particle size of nano silica](image1.png)
![Fig: 2 particle size of nano silica fume](image2.png)

From the SEM study it was proved that 80% of the particle have attained the nano size. On 60 hours of ball grinding silica is converted to nano silica and size ranges between. Similarly on 3 hours of high energy ball grinding glassy silica fume is converted to nano silica fume and the size range between

![Fig 3 Diffraction graph of nano silica](image3.png)
![Fig 4 Diffraction graph of nano silica fume](image4.png)

From the XRD analysis done for nano silica fume, silica and nano silica, it was found that nano silica fume reached the range of nano material. Comparing the graphs of silica, nano silica and nano silica fume, in the graph nano silica fume widening of peak value had attain which clearly shows property of nano material.

IV. RESULTS AND DISCUSSION

Normal consistency, initial setting time and final setting time of cement by replacing with nano silica and nano silica fume are given in table 4. From table 4 it is clear that the normal consistency is higher when the cement replaced with 30% nano silica and 20% nano siloca fume. It can be seen that the presence of nano particles alters the consistency, initial and final setting time. The compressive strength of the cement mortar when replaced with nano silica and nano silica fume given in table 5.
Table: 1 Normal Consistency And Setting Time of Nano Silica and Nano Silica Fume

<table>
<thead>
<tr>
<th>% Replacement of Nano Particles</th>
<th>Normal Consistency (mm)</th>
<th>Setting Time(mins)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Initial</td>
<td>Final</td>
</tr>
<tr>
<td>Nano silica</td>
<td>34</td>
<td>70</td>
</tr>
<tr>
<td>0</td>
<td>34</td>
<td>70</td>
</tr>
<tr>
<td>50%</td>
<td>33</td>
<td>155</td>
</tr>
<tr>
<td>10%</td>
<td>34</td>
<td>110</td>
</tr>
<tr>
<td>20%</td>
<td>34</td>
<td>85</td>
</tr>
<tr>
<td>30%</td>
<td>35</td>
<td>124</td>
</tr>
<tr>
<td>40%</td>
<td>33</td>
<td>55</td>
</tr>
<tr>
<td>50%</td>
<td>34</td>
<td>30</td>
</tr>
</tbody>
</table>

Fig: 5 Setting Time of Cement Replaced With Nano Silica and Nano Silica Fume

Fig: 6 Normal Consistency of Cement Replaced With Nano Silica and Nano Silica Fume
1. The percentage increase of normal consistency of cement for a replacement of 0% nanosilica and 50% nano-
silica fume was found to decrease by 2.94% than whereas initial and final setting time of cement was found to
increase by 121.4% and 78.5% than normal cement respectively
2. The percentage increase of normal consistency of cement for a replacement of 10% nanosilica and 40% nano-
silica fume was found to be same whereas initial and final setting time of cement was found to increase by
57.14% and 78.43% than normal cement respectively
3. The percentage increase of normal consistency of cement for a replacement of 20% nanosilica and 30% nano-
silica fume was found to be same whereas initial and final setting time of cement was found to increase by
21.42% and 25.45% than normal cement respectively
4. The percentage increase of normal consistency of cement for a replacement of 30% nanosilica and 20% nano-
silica fume was found to increase by 2.94% whereas initial and final setting time of cement was found to
increase by 77.14% and decreased by 5.88% than normal cement respectively
5. The percentage increase of normal consistency of cement for a replacement of 40% nanosilica and 10% nano-
silica fume was found to decrease by 2.94% whereas initial and final setting time of cement was found to
decreased by 21.42% and 37.83% than normal cement respectively
6. The percentage increase of normal consistency of cement for a replacement of 50% nanosilica and 0% nano-
silica fume was found to be same whereas whereas initial and final setting time of cement was found to
decreased by 57.14% and 51.96% than normal cement respectively

<table>
<thead>
<tr>
<th>% Replacement of Nano Particles</th>
<th>Compressive Strength of nano silica and nano silica fume</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nano-silica fume</td>
<td>Nano-silica</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>0</td>
<td>50%</td>
</tr>
<tr>
<td>10%</td>
<td>40%</td>
</tr>
<tr>
<td>20%</td>
<td>30%</td>
</tr>
<tr>
<td>30%</td>
<td>20%</td>
</tr>
<tr>
<td>40%</td>
<td>10%</td>
</tr>
<tr>
<td>50%</td>
<td>0</td>
</tr>
</tbody>
</table>

Table: 2 compressive strength of cement replaced with nano silica and nano silica fume
4.1 3 Days Compressive Strength
1. The percentage increase of compressive strength of cement for a replacement of 0% nano-silica and 50% nano-silica fume was found to increase by 10.93% than normal Cement respectively.
2. The percentage increase of compressive strength of cement for a replacement of 10% nano-silica and 40% nano-silica fume was found to increase by 8.55% than normal Cement respectively.
3. The percentage increase of compressive strength of cement for a replacement of 20% nano-silica and 30% nano-silica fume was found to increase by 10.43% than normal Cement respectively.
4. The percentage increase of compressive strength of cement for a replacement of 30% nano-silica and 20% nano-silica fume was found to decrease by 12.34% than normal Cement respectively.
5. The percentage increase of compressive strength of cement for a replacement of 40% nano-silica and 10% nano-silica fume was found to decrease by 14.24 % than normal Cement respectively.
6. The percentage increase of compressive strength of cement for a replacement of 50% nano-silica and 0% nano-silica fume was found to decrease by 9.52 % than normal Cement respectively.

4.2 7 Days Compressive Strength
1. The percentage increase of compressive strength of cement for a replacement of 0% nano-silica and 50% nano-silica fume was found to increase by 7.91% than normal Cement respectively.
2. The percentage increase of compressive strength of cement for a replacement of 10% nano-silica and 40% nano-silica fume was found to increase by 8.92% than normal Cement respectively.
3. The percentage increase of compressive strength of cement for a replacement of 20% nano-silica and 30% nano-silica fume was found to increase by 11.14% than normal Cement respectively.
4. The percentage increase of compressive strength of cement for a replacement of 30% nano-silica and 20% nano-silica fume was found to decreased by 13.41% than normal Cement respectively.
5. The percentage increase of compressive strength of cement for a replacement of 40% nano-silica and 10% nano-silica fume was found to decrease by 10.44 % than normal Cement respectively.
6. The percentage increase of compressive strength of cement for a replacement of 50% nano-silica and 0% nano-silica fume was found to decrease by 8.19 % than normal Cement respectively.
4.3 21Days Compressive Strength

1. The percentage increase of compressive strength of cement for a replacement of 0% nano-silica and 50% nano-silica fume was found to increase by 10.43% than normal Cement respectively.

2. The percentage increase of compressive strength of cement for a replacement of 10% nano-silica and 40% nano-silica fume was found to increase by 9.61% than normal Cement respectively.

3. The percentage increase of compressive strength of cement for a replacement of 20% nano-silica and 30% nano-silica fume was found to increase by 13.36% than normal Cement respectively.

4. The percentage increase of compressive strength of cement for a replacement of 30% nano-silica and 20% nano-silica fume was found to decreased by 14.35% than normal Cement respectively.

5. The percentage increase of compressive strength of cement for a replacement of 40% nano-silica and 10% nano-silica fume was found to decrease by 12.98% than normal Cement respectively.

6. The percentage increase of compressive strength of cement for a replacement of 50% nano-silica and 0% nano-silica fume was found to decreased by 9.56% than normal Cement respectively.

VI. CONCLUSION

- The normal consistency, initial setting time and final setting time behavior of cement paste by replacing cement with Nano-silica and Nano silica fume were carried out.
- The compressive strength of cement mortar by replacing cement with Nano silica and Nano silica fume in 3 days, 7 days and 21 days carried out.
- From the SEM analysis result, it was found that the particles undergone grinding in ball grinding machine attained 70% to 80% nano material.
- From XRD it was found by comparing nano silica and nano silica fume, had attained wide range of nano material property.
- By replacing 50% of cement by 30% nano silica fume and 20% nano silica give higher value of normal consistency.
- It was found that replacing 50% of cement in the mix by 30% nano silica fume and 20% of nano silica shown higher initial setting value and final setting value.
- On comparing the compressive strength on 3 days, 7 days and 21 days it was found that replacing 50% cement by 40% nano silica fume and 10% of nano silica, 30% of nano silica fume and by 20% of nano silica, 30% of nano silica fume and 20% nano silica shown higher compressive strength on 3 day, 7 day and 21 day.

REFERENCES


[7]. Hui Li, Hui-gang Xiao, Jie Yuan and Jinping Ou “Micro-structure of cement mortar with nano-SiO$_2$ particles” in journal on ELSIEVER composite part B engineering, pp.no.35 (2004) 185–189 published in august 2004
IMAGE ENCRYPTION AND DECRYPTION USING
DISCRETE COSINE TRANSFORM (DCT)

Ms Anjali Shoeran\textsuperscript{1}, Taruna sikha\textsuperscript{2}

\textsuperscript{1}M.Tech Scholar, \textsuperscript{2}Assistant Professor, Department of Electronics & Communication Engineering, SPIET Rohtak (India)

ABSTRACT

Transform coding constitutes an integral component of contemporary image/video processing applications. Transform coding relies on the premise that pixels in an image exhibit a certain level of correlation with their neighboring pixels. Similarly in a video transmission system, adjacent pixels in consecutive frames show very high correlation. Consequently, these correlations can be exploited to predict the value of a pixel from its respective neighbors. A transformation is, therefore, defined to map this spatial (correlated) data into transformed (uncorrelated) coefficients. Clearly, the transformation should utilize the fact that the information content of an individual pixel is relatively small i.e., to a large extent visual contribution of a pixel can be predicted using its neighbors. A discrete cosine transform (DCT) is defined and an algorithm to compute it using the fast Fourier transform is developed. It is shown that the discrete cosine transform can be used in the area of digital processing for the purposes of pattern recognition and Wiener filtering.

JPEG image compression standard use DCT (DISCRETE COSINE TRANSFORM) and the discrete cosine transform is a fast transform. It is a widely used and robust method for image compression as encryption and decryption. It has excellent compaction for highly correlated data. DCT has fixed basis images DCT gives good compromise between information packing ability and computational complexity. Image compression is the application of Data compression on digital images. Digital images contain large amount of Digital information that need effective techniques for storing and transmitting large volume of data. Image compression techniques are used for reducing the amount of data required to represent a digital image. An Image can be compressed with use of Discrete Cosine Transformation (DCT), quantization encoding are the steps in the compression of the JPEG image format. The 2-D Discrete Cosine transform is used to convert the 8×8 blocks of image into elementary frequency components

Keywords: Discrete Cosine Transform, Fast Fourier Transform, JPEG

I. INTRODUCTION

Transform coding constitutes an integral component of contemporary image/video processing applications. Transform coding relies on the premise that pixels in an image exhibit a certain level of correlation with their neighboring pixels. Similarly in a video transmission system, adjacent pixels in consecutive frames show very high correlation. Consequently, these correlations can be exploited to predict the value of a pixel from its respective neighbors. A transformation is, therefore, defined to map this spatial (correlated) data into transformed (uncorrelated) coefficients. Clearly, the transformation should utilize the fact that the information content of an individual pixel is relatively small i.e., to a large extent visual contribution of a pixel can be
predicted using its neighbors. Image compression is very important for efficient transmission and storage of images. Demand for communication of multimedia data through the telecommunications network and accessing the multimedia data through Internet is growing explosively [14]. With the use of digital cameras, requirements for storage, manipulation, and transfer of digital images, has grown explosively. These image files can be very large and can occupy a lot of memory. A gray scale image that is 256 x 256 pixels has 65,536 elements to store, and a a typical 640 x 480 color image has nearly a million. Downloading of these files from internet can be very time consuming task. Image data comprise of a significant portion of the multimedia data and they occupy the major portion of the communication bandwidth for multimedia communication. Therefore development of efficient techniques for image compression has become quite necessary [9]. A common characteristic of most images is that the neighboring pixels are highly correlated and therefore contain highly redundant information

A Discrete Cosine Transform (DCT) expresses a sequence of finitely many data points in terms of a sum of cosine functions oscillating at different frequencies. The Fast DCT [2] process is a widely used form of lossy image compression that centers on the Discrete Cosine Transform. The DCT transformation is reversible. The DCT works by separating images into parts of differing frequencies. During a step called quantization, where par of compression actually occurs, the less important frequencies are discarded, hence the use of the term “lossy“. Then, only the most important frequencies that remain are used to retrieve the image in the decompression process. As a result, reconstructed images contain some distortion; but as we shall soon see, these levels of distortion can be adjusted during the compression stage. The JPEG method is used for both color and black-and white images. The following is a general overview of DCT Compression process. A discrete cosine transform (DCT) expresses a sequence of finitely many data points in terms of a sum of cosine functions oscillating at different frequencies. The JPEG process is a widely used form of lossy image compression that centers on the Discrete Cosine Transform. DCT and Fourier transforms convert images from time-domain to frequency-domain to decorrelate pixels. The DCT transformation is reversible. The DCT works by separating images into parts of differing frequencies. During a step called quantization, where part of compression actually occurs, the less important frequencies are discarded, hence the use of the term “lossy“. Then, only the most important frequencies that remain are used retrieve the image in the decompression process. As a result, reconstructed images contain some distortion; but as we shall soon see, these levels of distortion can be adjusted during the compression stage. The JPEG method is used for both color and black-and-white images. Used DCT function as well as RGB Content in th image for high efficiency of transmission. Telecommunication becomes one of our modern society’s characteristics, which requires more and more new techniques to meet the increasing needs of a modern society. We utilized Discrete Cosine Transform (DCT) and cut out the higher-frequency components because most of the power is concentrated in the lower frequency bands by DCT. Then the compressed DCT components are rotated, all the DCT components have energy in the lower frequencies and they are highly correlated to each other. The compressed original image is covered with random image and send to destination. It is supposed that we transmit important images to a receiver, preventing nonauthorized people from intercepting the images. In order to encrypt the images we cover the images with an insignificant image or random image. This process is called as Embedding and once after reaching the destination the random image is Extracted out and the original image is retrieved. This process is called Extraction. The basic objective of image compression is to find an image representation in which pixels are less correlated. The two fundamental
principles used in image compression are redundancy and irrelevancy. Redundancy removes redundancy from the signal source and irrelevancy omits pixel values which are not noticeable by human eye.

II. PURPOSE OF CRYPTOGRAPHY AND ITS TYPES

Cryptography, then, not only protects data from theft or alteration, but can also be used for user authentication. There are, in general, three types of cryptographic schemes typically used to accomplish these goals: secret key (or symmetric) cryptography, public key (or asymmetric) cryptography, and hash functions, each of which is described below.

Figure 1: Three Ways Of Cryptography

2.1 Secret Key Cryptography (SKC)
(Uses a single key for both encryption and decryption) :- With secret key cryptography, a single key is used for both encryption and decryption. As shown in Figure 1A, the sender uses the key (or some set of rules) to encrypt the plaintext and sends the cipher text to the receiver. The receiver applies the same key (or rule set) to decrypt the message and recover the plaintext. Because a single key is used for both functions, secret key cryptography is also called symmetric encryption.

Figure 2: Basic Symmetric Key Encryption and Decryption

2.2 Public Key Cryptography (PKC)
Uses one key for encryption and another for decryption:- Public-key cryptography has been said to be the most significant new development in cryptography in the last 300-400 years. Modern PKC was first described publicly by Stanford University professor Martin Hellman and graduate student Whitfield Diffie in 1976. Their
paper described a two-key crypto system in which two parties could engage in a secure communication over a non-secure communications channel without having to share a secret key.

Figure 3: Public Key Cryptography

2.3 Hash Functions
Uses a mathematical transformation to irreversibly "encrypt" information: Hash functions, also called message digests and one-way encryption, are algorithms that, in some sense, use no key (Figure 1C). Instead, a fixed-length hash value is computed based upon the plaintext that makes it impossible for either the contents or length of the plaintext to be recovered. Hash algorithms are typically used to provide a digital fingerprint of a file's contents often used to ensure that the file has not been altered by an intruder or virus. Hash functions are also commonly employed by many operating systems to encrypt passwords. Hash functions, then, provide a measure of the integrity of a file.

Cryptography is the science of writing in secret code and is an ancient art; the first documented use of cryptography in writing dates back to circa 1900 B.C. when an Egyptian scribe used non-standard hieroglyphs in an inscription. Some experts argue that cryptography appeared spontaneously sometime after writing was invented, with applications ranging from diplomatic missives to war-time battle plans. It is no surprise, then, that new forms of cryptography came soon after the widespread development of computer communications. In data and telecommunications, cryptography is necessary when communicating over any untrusted medium, which includes just about any network, particularly the Internet.

Figure 4: Components of A Typical Image Transmission System

Within the context of any application-to-application communication, there are some specific security requirements, including:

- Authentication: The process of proving one's identity. (The primary forms of host-to-host authentication on the Internet today are name-based or address-based, both of which are notoriously weak.)
• Privacy/confidentiality: Ensuring that no one can read the message except the intended receiver.
• Integrity: Assuring the receiver that the received message has not been altered in any way from the original.
• Non-repudiation: A mechanism to prove that the sender really sent this message.

A discrete cosine transform (DCT) expresses a sequence of finitely many data points in terms of a sum of cosine functions oscillating at different frequencies. The JPEG process is a widely used form of lossy image compression that centers on the Discrete Cosine Transform. DCT and Fourier transforms convert images from time-domain to frequency-domain to decorrelate pixels. The DCT transformation is reversible. The DCT works by separating images into parts of differing frequencies. During a step called quantization, where part of compression actually occurs, the less important frequencies are discarded, hence the use of the term “lossy”. Then, only the most important frequencies that remain are used retrieve the image in the decompression process.

As a result, reconstructed images contain some distortion; but as we shall soon see, these levels of distortion can be adjusted during the compression stage. The JPEG method is used for both color and black-and-white images. The degree of compression can be adjusted, allowing a selectable tradeoff between storage size and image quality. JPEG typically achieves 10:1 compression with little perceptible loss in image quality.

More comprehensive understanding of the process may be acquired as such given under:

a. The image is broken into 8x8 blocks of pixels.
b. Working from left to right, top to bottom, the DCT is applied to each block.
c. Each block is compressed through quantization.
d. The array of compressed blocks that constitute the image is stored in a drastically reduced amount of space.
e. When desired, the image is reconstructed through decompression, a process that uses the Inverse Discrete Cosine Transform (IDCT).

The One-Dimensional DCT Equation:

\[
N-1 \sum_{n=0}^{N-1} x_n \cos\left(\frac{2\pi n}{N}k\right) = \frac{1}{N} \sum_{k=0}^{N-1} X_k \cos\left(\frac{2\pi n}{N}k\right),
\]

where:
- \( X_n \) is the DCT result
- \( k = 0, 1, 2, \ldots, N-1 \)
- \( n = 0, 1, 2, \ldots, N-1 \)

The One-Dimensional IDCT Equation:

\[
X_k = \sum_{n=0}^{N-1} c[u] x_n \cos\left(\frac{2\pi n}{N}k\right),
\]

where:
- \( c[u] = 1 \) for \( u=0 \)
- \( c[u] = 2 \) for \( u=1, 2, 3, \ldots, N-1 \)

The Two-Dimensional IDCT Equation:

\[
f[m, n] = \sum_{u=0}^{N-1} \sum_{v=0}^{N-1} c[u] c[v] \cos\left(\frac{(2m + 1)u\pi}{2N}\right) \cos\left(\frac{(2n + 1)v\pi}{2N}\right),
\]

where:
- \( m, n \) = image result pixel indices (0, 1, 2, ..., \( N - 1 \)),
- \( F[u, v] = N \) by \( N \) DCT result,
- \( c[\lambda] = 1 \) for \( \lambda = 0 \) and \( c[\lambda] = 2 \) for \( \lambda = 1, 2, 3, \ldots, N-1 \)
- \( f[m, n] = N \) by \( N \) IDCT result
Where: \( m, n \) = image result pixel indices (0, 1, 2, ..., \( N - 1 \)),
\[
F[u, v] = N \text{ by } N \text{ DCT result},
\]
\[
C[\lambda] = 1 \text{ for } \lambda=0 \text{ and } c[\lambda]=2 \text{ for } \lambda=1,2,3,...N-1
\]
\[
F[m, n] = N \text{ by } N \text{ IDCT result}
\]

III. METHODOLOGY

3.1 Transmitter Side Process

Discrete Cosine Transform

At first we divide original images to be transmitted into small square blocks and apply two-dimensional discrete cosine transform to each block and we obtain DCT components of each block.

For a fast communication, we would like to reduce the amount of transmitting data. Consequently, compression of the DCT components is required. In each block, most of DCT components have high energies in low frequency bands, we only use low frequency components through a simple low pass filter that is, left-up corners of each block with size of \( NC \times NC \) are selected and higher frequency components are dropped. As a result of this process we can compress the transmitting images.

3.2 Receiver Side Process

- Extracting

Authorized people receive the mixtures and extract it. Turning back the rotated DCT components and using inverse discrete cosine transform (IDCT), original images are decrypted.

- Inverse Rotation And Inverse Discrete Cosine Transform:

After separation of the original image and random image original images are reconstructed. the rotated dct components have to be restored. the receiver is beforehand given the rotation “key” by the transmitter. based on the rotation “key”, the receiver can reconstruct the original images, rotating the dct components contrary to the encryption stage. Without rotation key, it is difficult to reconstruct the original dct components. finally he can apply inverse discrete cosine transform (idct) to them. in this way the receiver can obtain the estimated original images from the observed mixtures.

![Figure 5: Our Approach For Encryption And Compression](image-url)
Algorithm (Transmitting)
1. First divide the original or target image into blocks and apply DCT (Discrete Cosine Transformation) on each blocks
2. Then rotate the DCT blocks keep the direction of rotation as key for reconstructing the image
3. Then cover the original image with another random image
4. The random image is also divided into blocks and applies DCT on each block and the original image is covered by random image and it is send to the destination. This process is called embedding

Algorithm (Receiver)
6. The random image is taken out. This process is called extraction
7. Using the rotation key the DCT blocks are reconstructed for the source image
8. Then to each block we apply inverse DCT
9. The image is reconstructed
IV. RESULT AND FUTURE SCOPE

In order to validate our approach several simulations are conducted. “Lena” and “random” images are encrypted and decrypted by the proposed method. 256×256 grayscale bitmap files are used as the original images. An example of the simulations is given above. After execution of extract function and applying IDCT to the separated DCT components with the rotation key, we can get the source images. The quality of the reconstructed images, however, is not as same as the original ones, because compression cut off higher frequency components. In future we can use RGB content as a key and use to encrypt and decrypt the image using RGB content of the image.

V. ACKNOWLEDGMENT

This research was supported by the SPIET Rohtak under their strategic award program. I am thankful to Ms. Taruna Sikka for their support and proper giddiness.

REFERENCES


Ms Anjali Sheoran is presently pursuing M. Tech. final year in Electronics & Communication Engineering Department (from SPIET Rohtak, India.

Mr. Ajay Khokhar is working as an Assistant Professor in Electronics & Communication Engineering Department (from SPIET Rohtak, India).
DESIGN OF WELDING ROTATOR

S. B. Ambekar¹, Shantanu Bihani², Sumit Dhangar³, S. U. Gunjal⁴

¹Assistant Professor, Department of Mechanical Engineering,
²UG Student, Department of Computer Engineering,
³UG Student, Department of Mechanical Engineering,
⁴Assistant Professor, Department of Mechanical Engineering,

Sandip Foundation's- Sandip Institute of Technology and Research Centre, Nashik, (India)

ABSTRACT
There are many manufacturing processes. There are several machining operations like casting, forging, surface finishing, welding, milling, drilling etc. plays an important role in any industry.
Welding is a fabrication or sculptural process that joins materials, usually metals or thermoplastics, by causing coalescence. This is often done by melting the work pieces and adding a filler material to form a pool of molten material (the weld pool) that cools to become a strong joint, with pressure sometimes used in conjunction with heat, or by itself, to produce the weld.
There are various such joints in the machines or the components made in industry which are difficult to weld. Welding them requires a work of high stability and work is to be carried out in proper specific angles. An attempt has been made in our project work to design such a stable welding machine or a rotator of the welding machine.

Keywords: Difficult Components, Fabrication, Specific Angles, Welding, Welding Rotator

I. INTRODUCTION
There are many manufacturing processes. There are several machining operations like casting, forging, surface finishing, welding, milling, drilling etc. plays an important role in any industry.
Welding is a fabrication or sculptural process that joins materials, usually metals or thermoplastics, by causing coalescence. This is often done by melting the work pieces and adding a filler material to form a pool of molten material (the weld pool) that cools to become a strong joint, with pressure sometimes used in conjunction with heat, or by itself, to produce the weld. This is in contrast with soldering and brazing, which involve melting a lower-melting-point material between the work pieces to form a bond between them, without melting the work pieces.
Many different energiesources can be used for welding, including a gas flame, an electricarc, a laser, an electronbeam, friction, and ultrasound. While often an industrial process, welding can be done in many different environments, including open air, underwater and in outerspace. Regardless of location, welding remains dangerous, and precautions are taken to avoid burns, electricshock, eye damage, poisonous fumes, and overexposure to ultravioletlight.
There are many new technologies are to be introduce in last 10 years. Like friction stir welding, inertia friction welding, by using welding fixtures or rotators. These are advanced automated technologies. It helps to give high quality of weld. Which improves the performance of part welded and the look also.
II. DESIGN OF WELDING ROTATOR

The attempt is made to design a special purpose machine and have to adopt a very careful approach; the total design work has been divided into two parts mainly:

- System design
- Mechanical design

In system design the focus mainly concentrate on the following parameter[1]

2.1 System Selection Based on Physical Constraints
The selection of machine is based on the availability of the floor area. This project is specially made for small scale industry, where small work pieces are welded together. As it is design for small scale industry, the space is the major constrain. So, the system should be very compact.[2]

2.2 Components of System
As already stated, system should be compact enough so that it can be easily accommodated at anywhere of a shop floor. All the moving parts should be well closed & compact. A compact system gives a better look & structure. Following are some example;

- Height of machine.
- Energy expenditure in hand operation, lighting condition of machine.

2.3 Chances of Failure
The losses incurred by owner in case of failure of a component are important criteria of design. Factor of safety, while doing the mechanical design, is kept high so that there are less chances of failure. Periodic maintenance is required to keep the machine trouble free.

2.4 Servicing Facility
The layout of components should be such that easy servicing is possible especially those components which required frequent servicing can be easily dismantled.

2.5 Height of Machine from Ground
For ease and comfort of operator the height of machine should be properly decided so that operator may not get tired during operation. The machine should be slightly higher than that the level also enough clearance be provided from ground for cleaning purpose.

2.6 Weight of Machine
The total weight of machine depends upon the selection of material components as well as dimension of components. A higher weighted machine is difficult for transportation & in case of major break down it becomes difficult to repay.

III. SELECTION OF MOTOR

The motor is an electric drive which is use to transmit power. Motor converts an electric energy to twisting of the shaft or axle. The selection of the motor is depending upon the following factors:-

1. Required Torque (T)
2. Nature and Magnitude of load (W)
3. Gravitational force (G)
4. External Force (F)
5. Coefficient of friction (µ).

Torque is the force that produces rotation. It causes an object to rotate. Torque consists of force acting on a

distance. Torque, like work, is measured in N.mm. however, torque, unlike work, may exist even though no

movement occurs.

Consider, the load acting on motor is 20 N acting at a distance of 100 mm.

\[ T = W \times D \]
\[ T = 20 \times 100 \]
\[ T = 2000 \text{ NM i.e. } 2 \times 10^6 \text{ N.mm} \]

An external force is a force exerted by welding gun on a work piece. It is nearly 130N.

\[ T = P \times (F + \mu W G) \]
\[ 20 \times 10^6 = P \times (130 + 0.2 \times 20 \times 9.81) \]
\[ P = 118.17 \text{ WATT} \]

III. DESIGN OF WORM WHEEL SHAFT

3.1 Asme Code For Design of Shaft

Since, the loads on most shafts in connected machinery are not constant, it is necessary to make proper

allowance for the constant load. According to ASME code permissible values of shear stress may be,

Calculated by considering various equations [3]

\[ fs = 0.18 \times 800 \]
\[ = 144 \text{ N/mm}^2 \]

Shaft is provided with key way; this will reduce its strength. Hence reducing above value of allowable stress by

25%

\[ fs_{max} = 108 \text{ N/mm}^2 \]

This is the allowable value of shear stress that can be induced in the shaft material for safe operation.

To Calculate Worm Wheel shaft Torque

POWER = 2 ΠNT

\[ T = \frac{60 \times P}{2 \times \sigma_c \times N} \]
\[ = \frac{60 \times 120}{2 \times 10} \]
\[ T = 57.29 \text{ N-m} \]

T design = 57.29N-m

Shaft in torsional shear failure

\[ Td = x f_{act} \times d^3 \]
\[ 57.29 \times 10^3 = \frac{2}{16} \times 108 \times d^3 \]
\[ d = 13.92 \text{ mm} \]

Shaft in bending failure

As vertical maximum load of 1200N may be acting on shaft, bending stress \( f_c \) act on shaft.

\[ \sigma_c = \frac{M_{\text{max}}}{I} \]

from standared table shaft sizes 15 mm is selected for the project.
Cross Sectional Area of shaft

\[ \sigma_c = \frac{P}{\pi \times d^2} \]

\[ \sigma_c = \frac{1200}{0.785 \times 15^2} \]

\[ \sigma_c = 7.79 \text{ N/mm}^2 \]

Check For Torsional Shear Failure Of Shaft.

\[ \tau_{max} = \frac{1}{2} \sigma_c^2 + 4(\tau)^2 \]

\[ \tau_{max} = \frac{1}{2} 7.79^2 + 4 \times (5.40)^2 \]

\[ \tau_{max} = \frac{1}{2} 117.46 \]

\[ \tau_{max} = 6.6607 \text{ N/mm}^2 \]

but \[ \tau_{max} = 108 \text{ N/mm}^2 \]

Therefore design of shaft is Safe for torsional shear failure.

IV. DESIGN (SELECTION OF INPUT SHAFT BALL BEARING)

In selection of ball bearing the main factor is the system design of the drive i.e.; the size of the ball bearing is of major importance; first select an appropriate ball bearing first select an appropriate ball bearing first taking into consideration convenience of mounting the planetary pins and then we shall check for the actual life of ball bearing. \[4\]

\[ P = X \times Fr + Y \times Fa. \]

Where;

\( P \) = Equivalent dynamic load, (N)

\( X \) = Radial load constant

\( Fr \) = Radial load (H)

\( Y \) = Axial load contact

In our case; \( \frac{t}{r} = 57.29 \times 103 / 60 = 954.8 \)

Radial load \( Fr = 954.8 \text{N} \)

Axial load \( F_a \) = Maximum table load = 60 kg =600 N

\[ P = 1 \times 954.8 + 1 \times 600 = 1554 \text{N} \]

\[ L = (C/p)^p \]

Considering 4000 working hours

\[ L = 60 \times L \times h = 4.5 \text{ mre} \]

\[ 10^6 \]

\[ \Rightarrow 4.5 = C^3 \]

\[ 1350 \]

\[ C = 2565 \text{N} \]

AS: required dynamic of bearing is less than the rated dynamic capacity of bearing
# TABLE 1

**MATERIAL SPECIFICATION:** EN 9  
**RAW MATERIAL SIZE:** 170X150X16

<table>
<thead>
<tr>
<th>Time in minutes</th>
<th>Total time</th>
<th>15</th>
<th>19</th>
<th>25</th>
<th>25</th>
<th>25</th>
<th>25</th>
</tr>
</thead>
<tbody>
<tr>
<td>M/C time</td>
<td>-</td>
<td>14</td>
<td>-</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Setting time</td>
<td>15</td>
<td>5</td>
<td>25</td>
<td>15</td>
<td>15</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Tools</td>
<td>Measuring Instrument</td>
<td>-</td>
<td>Venire</td>
<td>-</td>
<td>Venire</td>
<td>Venire</td>
<td>Venire</td>
</tr>
<tr>
<td>Cutting Tools</td>
<td>-</td>
<td>Facing cutter</td>
<td>-</td>
<td>Twist drill</td>
<td>Boring tool</td>
<td>Boring tool</td>
<td></td>
</tr>
<tr>
<td>M/c Tools</td>
<td>Milling</td>
<td>Milling</td>
<td>Lathe</td>
<td>Lathe</td>
<td>Lathe</td>
<td>Lathe</td>
<td></td>
</tr>
<tr>
<td>Jigs &amp; Fixture</td>
<td>M/C Vice</td>
<td>M/C Vice</td>
<td>4 jaw chuck</td>
<td>4 jaw chuck</td>
<td>4 jaw chuck</td>
<td>4 jaw chuck</td>
<td></td>
</tr>
<tr>
<td>Clamp stock</td>
<td>Facing All Sides Sq. to total length 165x144x12 mm</td>
<td>Clamp stock on lathe</td>
<td>Drilling Ø 25 through thickness</td>
<td>Boring Ø 28 through thickness</td>
<td>Counter Boring Ø 35 through 10 thickness</td>
<td>-</td>
<td></td>
</tr>
</tbody>
</table>

**QUANTITY:** - 01 NO’S[5]
TABLE 2. STANDARD TABLE

<table>
<thead>
<tr>
<th>Sr No.</th>
<th>Description</th>
<th>Qty</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Motor</td>
<td>01</td>
<td>450</td>
</tr>
<tr>
<td>2.</td>
<td>Belt</td>
<td>01</td>
<td>110</td>
</tr>
<tr>
<td>3.</td>
<td>Grub Screw</td>
<td>09</td>
<td>36</td>
</tr>
<tr>
<td>4.</td>
<td>Bearings</td>
<td>05</td>
<td>680</td>
</tr>
</tbody>
</table>

V. COST ESTIMATION

5.1 Bill of Materials

TABLE 3

<table>
<thead>
<tr>
<th>Sr No.</th>
<th>Description</th>
<th>Qty</th>
<th>Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Motor</td>
<td>01</td>
<td>S</td>
</tr>
<tr>
<td>2.</td>
<td>Belt</td>
<td>01</td>
<td>Rubber</td>
</tr>
<tr>
<td>3.</td>
<td>Reduction Pulley</td>
<td>01</td>
<td>Ms</td>
</tr>
<tr>
<td>4.</td>
<td>Worm Shaft</td>
<td>01</td>
<td>20MnCr5</td>
</tr>
<tr>
<td>5.</td>
<td>Worm Gear</td>
<td>01</td>
<td>Cast Iron</td>
</tr>
</tbody>
</table>

5.2 Machining Cost

TABLE 4

<table>
<thead>
<tr>
<th>Operation</th>
<th>Rate Rs/Hr</th>
<th>Total Time Hrs</th>
<th>Total Cost Rs/-</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lathe</td>
<td>80</td>
<td>18</td>
<td>1440</td>
</tr>
<tr>
<td>Milling</td>
<td>90</td>
<td>10</td>
<td>900</td>
</tr>
<tr>
<td>Drilling</td>
<td>60</td>
<td>4</td>
<td>240</td>
</tr>
<tr>
<td>Hobbing</td>
<td>-</td>
<td>-</td>
<td>980</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td>3560</td>
</tr>
</tbody>
</table>

Figure 1: Welding Rotator with Proximity Sensor [6]

VI. MISCELLANEOUS COSTS

TABLE 5

<table>
<thead>
<tr>
<th>Operation</th>
<th>Cost (Rs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gas Cutter</td>
<td>300</td>
</tr>
<tr>
<td>Sawing</td>
<td>120</td>
</tr>
<tr>
<td>Total</td>
<td>420</td>
</tr>
</tbody>
</table>

The cost of purchase parts = Rs 3566/-
6.1 Total Cost

TOTAL COST = Raw Material Cost + Machine Cost + Miscellaneous Cost + cost of Purchased Parts + Overheads

Hence the total cost of machine = Rs 10036/-

VII. CONCLUSIONS

From the above report, it is concluded that, welding rotator is very essential equipment for heavy and light fabrication shop. It is mainly used to rotate or position the cylindrical jobs for circumferential welding. A substantial opportunity exists in the technology of using welding rotator to relieve people from boring, repetitive, hazardous and unpleasant work in all forms of human labour.

On the shop floor level, an organization pays Rs.6000 per month for a skilled operator. While the initial investment in the welding rotator is nearly Rs.11000/- . The production rate for manual welding is 150 jobs per day; hence the manual welding is very time consuming. While using welding rotator the production rate is increased up to 225 jobs per day (By considering 8 Hr). An investment of welding rotator is covered within 3 months. Simultaneously, the man-hours and human effort require is reduced. The wastage of weld material decreased compare to the manual welding.

VIII. ACKNOWLEDGEMENT

Research on a specific topic as well as its project work takes a lot of efforts. The various components of the project requires help from various people. In the making of the machine components an intense amount of energy and guidance is required.

For this guidance and help we would like to thank many people. We would like to thank Mr. Ishwar Koli sir & Entire workshop staff for helping us and guiding us in making of various machine components. We would like to thank college authorities for believing in us and permitting us to do this project work. At last but not the least we would like to thank all our friends and colleagues for helping us out in some or other way.

REFERENCES

[1] http://www.twi.co.uk/content/weldingintro.html
A SURVEY ON ZIGBEE TECHNOLOGY

Neha Roy

M.Tech Scholar, Computer Science Engineering,
Galgotias College of Engineering & Technology, Greater Noida, (India)

ABSTRACT

The IEEE 802.15.4 is a new standard defined for LR-WPAN which provides a low cost and very less complicated solution. ZigBee is the name of a specification for a suite of high level communication protocols using small, low power digital radios based on the IEEE 802.15.4 standard. It is designed for low power consumption enabling batteries to last forever. The ZigBee standard provides network, security, and application support services operating on top of the IEEE 802.15.4 Medium Access Control (MAC) and Physical Layer wireless standard. It employs a group of technologies to enable scalable, self-organizing, self-healing networks that can manage various data traffic patterns. ZigBee is a low-cost, low-power, wireless mesh networking standard. The low cost allows the technology to be widely deployed in wireless control and monitoring applications, the low power-usage allows longer life with smaller batteries, and the mesh networking which promises high reliability and larger range. ZigBee has been developed to meet the growing demand for capable wireless networking between numerous low power devices. In industry. This paper focuses on ZigBee as a technology innovation which would bring about low cost connectivity. This paper also contains the comparative study on different energy efficient routing protocols for ZigBee network, where authors have compared different routing protocols considering different performance metrics to find the most energy efficient routing protocol.

Keywords: IEEE802.15.4, LR-WPAN, Mesh, Protocol, Zigbee Protocol

I. INTRODUCTION

An LR-WPAN is a simple, low-cost communication network that allows wireless connectivity in applications with limited power and relaxed throughput requirements. The main objectives of an LR-WPAN are ease of installation, reliable data transfer, short-range operation, extremely low cost, and a reasonable battery life, while maintaining a simple and flexible protocol. ZigBee is a specification for a suite of high level communication protocols using tiny, low-power digital radios based on an IEEE 802 standard for personal area networks. ZigBee has a defined rate of 250 Kbit/s best suited for periodic or irregular data or a single signal transmission from a sensor or input device. ZigBee based traffic management system have also been implemented[1]. The name refers to the waggle dance of honey bees after their return to the beehive. ZigBee is a low-cost, low-power, wireless mesh network standard. The low cost
allows the technology to be widely deployed in wireless control and monitoring applications. Low power-usage allows longer life with smaller batteries. Mesh networking provides high reliability and more extensive range. ZigBee chip vendors typically sell integrated radios and microcontrollers with between 60 KB and 256 KB flash memory. The ZigBee network layer natively supports both star and tree typical networks, and generic mesh networks. As shown in figure 1. Every network must have one coordinator device, tasked with its creation, the control of its parameters and basic maintenance. In star networks, the coordinator must be the central node. Both trees and meshes allow the use of ZigBee routers to extend communication at the network level.

Need for ZigBee

1) There are a multitude of standards that address mid to high data rates for voice, PC LANs, video, etc. However, up till now there hasn’t been a wireless network standard that meets the unique needs of sensors and control devices. Sensors and controls don’t need high bandwidth but they do need low latency and very low energy consumption for long battery lives and for large device arrays [2].

2) There are a multitude of proprietary wireless systems manufactured today to solve a multitude of problems that also don’t require high data rates but do require low cost and very low current drain.

3) These proprietary systems were designed because there were no standards that met their requirements. These legacy systems are creating significant interoperability problems with each other and with newer technologies.
II. OVERVIEW OF IEEE802.15.4 STANDARD BASED ZIGBEE

2.1 Network topology
An IEEE 802.15.4 LR-WPAN [3], mainly three types of network topologies is supported. In the star topology network, all communications, even those between the devices themselves, must go through the PAN coordinator. In the peer-to-peer topology, the devices can communicate with one another directly, but the PAN coordinator must be present. Cluster tree is the combination of both star and the mesh networks, so it has the properties of both topologies. Network topologies are shown in figure 2.

III. ZIGBEE DEVICE TYPES, PROTOCOLS AND ADVANTAGES

3.1 Device Types

Zigbee devices are of three types:

1) **ZigBee coordinator (ZC):** The most capable device, the coordinator forms the root of the network tree and might bridge to other networks. There is exactly one ZigBee coordinator in each network since it is the device that started the network originally. It stores information about the network, including acting as the Trust Center & repository for security keys.

2) **ZigBee Router (ZR):** As well as running an application function, a router can act as an intermediate router, passing on data from other devices.

3) **ZigBee End Device (ZED):** Contains just enough functionality to talk to the parent node (either the coordinator or a router); it cannot relay data from other devices. This relationship allows the node to be asleep a significant amount of the time thereby giving long battery life. A ZED requires the least amount of memory, and therefore can be less expensive to manufacture than ZR or ZC.

3.2 Protocols

The protocols build on recent algorithm (Ad-hoc On-demand and Distance vector, nueRFon) to automatically construct a low-speed ad-hoc network of nodes[4]. In most large network instances, the network will be a cluster of clusters. It can also form a mesh or a single cluster. The current ZigBee protocols support beacon and non-beacon...
enabled networks. In non-beacon-enabled networks, an unslotted CSMA/CA channel access mechanism is used. In this type of network, ZigBee Routers typically have their receivers continuously active, requiring a more robust power supply. However, this allows for heterogeneous networks in which some devices receive continuously, while others only transmit when an external stimulus is detected. The typical example of a heterogeneous network is a WIRELESS SWITCH: The ZigBee node at the lamp may receive constantly, since it is connected to the mains supply, while a battery-powered light switch would remain asleep until the switch is thrown. The switch then wakes up, sends a command to the lamp, receives an acknowledgment, and returns to sleep. In such a network the lamp node will be at least a ZigBee Router, if not the ZigBee Coordinator; the switch node is typically a ZigBee End Device. In beacon-enabled networks, the special network nodes called ZigBee Routers transmit periodic beacons to confirm their presence to other network nodes. Nodes may sleep between beacons, thus lowering their duty cycle and extending their battery life. Beacon intervals depend on data rate; they may range from 15.36 milliseconds to 251.65824 seconds at 250 Kbit/s, from 24 milliseconds to 393.216 seconds at 40 Kbit/s and from 48 milliseconds to 786.432 seconds at 20 Kbit/s.

ZigBee/IEEE 802.15.4 - General Characteristics
1) Dual PHY (2.4GHz and 868/915 MHz) , Data rates of 250 kbps (@2.4 GHz), 40 kbps (@ 915 MHz), and 20 kbps (@868 MHz) , Optimized for low duty-cycle applications (<0.1%) ,CSMA-CA channel access.
2) Yields high throughput and low latency for low duty cycle devices like sensors and controls
3) Low power (battery life multi-month to years)
4) Multiple topologies: star, peer-to-peer, mesh
5)Addressing space of up to:18,450,000,000,000,000,000 devices (64 bit IEEE address) and 65,535 networks
6)Optional guaranteed time slot for applications requiring low latency
7)Fully hand-shaked protocol for transfer reliability
8) Range: 50m typical (5-500m based on environment)

3.3 Advantages of Zigbee
Zigbee is poised to become the global control/sensor network standard. It has been designed to provide the following features:
1)Bluetooth has many different modes and states depending upon your latency and power requirements such as sniff, park, hold, active, etc.; ZigBee/IEEE 802.15.4 has active(transmit/receive) or sleep. Application software needs to focus on the application, not on which power mode is optimum for each aspect of operation
2)Low cost (device, installation, maintenance)
Low cost to the users means low device cost, low installation cost and low maintenance. ZigBee devices allow batteries to last up to years using primary cells (low cost) without any chargers (low cost and easy installation). ZigBee’s simplicity allows for inherent configuration and redundancy of network devices provides low maintenance [5].
3) High density of nodes per network
ZigBee’s use of the IEEE 802.15.4 PHY and MAC allows networks to handle any number of devices. This attribute is critical for massive sensor arrays and control networks.

4) Simple protocol, global implementation
ZigBee’s protocol code stack is estimated to be about 1/4th of Bluetooth’s or 802.11’s. Simplicity is essential to cost, interoperability, and maintenance. The IEEE 802.15.4 PHY adopted by ZigBee has been designed for the 868 MHz band in Europe, the 915 MHz band in N America, Australia, etc; and the 2.4 GHz band is now recognized to be a global band accepted in almost all countries.

IV. FORMING ZIGBEE NETWORK AND ARCHITECTURE
The Co-ordinator is responsible for starting a ZigBee network. Network initialization involves the following steps:

1. Search for a Radio Channel- The Co-ordinator first searches for a suitable radio channel (usually the one which has least activity). This search can be limited to those channels that are known to be usable - for example, by avoiding frequencies in which it is known that a wireless LAN is operating[6], [7].

2. Assign PAN ID- The Co-ordinator starts the network, assigning a PAN ID (Personal Area Network identifier) to the network. The PAN ID can be pre-determined, or can be obtained dynamically by detecting other networks operating in the same frequency channel and choosing a PAN ID that does not conflict with theirs. At this stage, the Co-ordinator also assigns a network (short) address to itself. Usually, this is the address 0x0000

3. Start the Network- The Co-ordinator then finishes configuring itself and starts itself in Co-ordinator mode. It is then ready to respond to queries from other devices that wish to join the network

4.1 ZigBee Stack Architecture
The ZigBee standard defines a stack shown in figure 3 which has a layered structure with four distinct layers, the physical layer, the MAC layer, the network layer and the application layer. The two lowest layers are defined by the IEEE 802.15.4 standard [3]. This standard defines a protocol for wireless device to be low-power consuming. The IEEE 802.15.4 standard defines how to associate to a coordinator, disassociate from a coordinator and how to send messages between an end device and a coordinator. The network layer is the lowest layer defined by the ZigBee standard which provides network configuration, manipulation, and message routing. An application layer provides the intended function of the device.

The PHY [3] provides two services: the PHY data service and the PHY management service interfacing to the physical layer management entity (PLME) service access point (SAP) (known as the PLME-SAP). The PHY data service enables the transmission and reception of PHY protocol data units (PPDUs) across the physical radio channel. The features of the PHY are activation and deactivation of the radio transceiver, ED, LQI, channel selection, clear channel assessment (CCA), and transmitting as well as receiving packets across the physical medium. The radio operates at one or more of the unlicensed frequency bands of 868–868.6 MHz (e.g., Europe), 902–928 MHz (e.g., North America), 2400–2483.5 MHz (worldwide).
The MAC sub layer [3] provides two services: the MAC data service and the MAC management service interfacing to the MAC sublayer management entity (MLME) service access point (SAP) (known as MLME-SAP). The MAC data service enables the transmission and reception of MAC protocol data units (MPDUs) across the PHY data service. The features of the MAC sublayer are beacon management, channel access, GTS management, frame validation, acknowledged frame delivery, association, and disassociation.

V. COMPARATIVE STUDY ON DIFFERENT ENERGY EFFICIENT ROUTING PROTOCOLS

YiGong Peng et al. [8] have proposed an energy-aware routing mechanism EA-AODV which was the improvement and perfection of ZigBee-AODVjr, maximizes the use of the limited energy and prolong the lifetime of ZigBee network. In order to analyze the efficiency of the proposed mechanism, YiGong Peng et al. [9] have compared the EA-AODV results with original AODV-jr using the same scenarios. The simulation results shows that the method
about EA-AODV is feasible for saving energy and could improve the performance of ZigBee network as compared to AODVjr.

Jun Xiao et al. [10] have introduced an improved E-AOMDVjr algorithm over the traditional AODVjr algorithm based on the on-demand distance vector routing (AODV) algorithm. The proposed E-AOMDVjr algorithm is based on the AOMDV algorithm applicable for Ad hoc network. Jun Xiao et al. [10], adopting the energy balance algorithm shows that the improved algorithm can improve the reliability of the network transmission, reduce the energy consumption of the network and can also extend the lifetime of the network.

Zhao Hong-tu et al. [11] have combined the traditional AODVjr and the Cluster-Tree algorithm to get an optimal improved algorithm which deals with the problems like RREQ packets flooding in AODVjr and the non-optimal routing in Cluster-Tree as some nodes may use up all the energy because of heavy transmissions. They have presented an improved algorithm based on the traditional AODVjr algorithm combined with Cluster-Tree algorithm. The simulation results show that the algorithm has saved the network's overall energy consumption by controlling the PREQ packet, residual energy of the node during data transfer and also considering the neighbor table.

Juan-Carlos Cano et al. [12] have offered a performance comparison of the Ad-hoc on demand Distance Vector (AODV) [13], Direct Source Routing (DSR) [14], Temporally-Ordered Routing Algorithm (TORA) [15] and Destination-Sequenced Distance-Vector Routing (DSDV) [16]. In their work, they have evaluated and compared the behavior of these four routing protocols in terms of energy consumption. After comparing the four routing protocols, they concluded that with respect to energy consumption, DSR and AODV perform better as compared to DSDV and TORA.

Liu Dan et al. [16] have proposed an improved tree routing algorithm (NTR) over the traditional tree routing by using the neighbor table. Authors have made the comparison between NTR and traditional TR performance by doing the simulation in NS-2 and shown that by using the neighbor table, the packet reaches the destination with the less hops without the coordinator. So the end to end delay is reduced and the energy of the coordinator is saved at the same time.

M.Al-Harbawi et al. [17] introduces an enhanced TR protocol called Improved Tree Routing (ImpTR) protocol. In TR protocol, the packets follow the tree topology for forwarding the data to the descend node only. The new ImpTR protocol determines the shortest path to the descend node on the basis of neighbor table instead of using the tree topology. The packets are forwarded to the neighbor node if the path to the destination through neighbor node is shorter than the path through PAN coordinator. Simulation Results of NS-2 shows that the proposed ImpTR algorithm provides lesser average end-to-end delay, increased throughput, decreased energy consumption from the network and end to end delay as compared to traditional TR routing protocol.
5.1 Comparative analysis of different technologies providing similar services and their trade-offs

<table>
<thead>
<tr>
<th>Category</th>
<th>ZigBee</th>
<th>Bluetooth</th>
<th>Wi-Fi</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distance</td>
<td>50-1600m</td>
<td>10m</td>
<td>50m</td>
</tr>
<tr>
<td>Extension</td>
<td>Automatic</td>
<td>None</td>
<td>Depend on the existing network</td>
</tr>
<tr>
<td>Power supply</td>
<td>Years</td>
<td>Days</td>
<td>Hours</td>
</tr>
<tr>
<td>Complicity</td>
<td>Simple</td>
<td>Complicated</td>
<td>Very complicated</td>
</tr>
<tr>
<td>Transmission speed</td>
<td>250Kbps</td>
<td>1Mbps</td>
<td>1.54Mbps</td>
</tr>
<tr>
<td>Frequency range</td>
<td>868MHz, 916Mhz, 2.4GHz</td>
<td>2.4GHz</td>
<td>2.4GHz</td>
</tr>
<tr>
<td>Network nodes</td>
<td>65535</td>
<td>8</td>
<td>50</td>
</tr>
<tr>
<td>Linking time</td>
<td>30ms</td>
<td>Up to 10s</td>
<td>Up to 3s</td>
</tr>
<tr>
<td>Cost of terminal unit</td>
<td>Low</td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>Cost of use</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Security</td>
<td>128bit AES</td>
<td>64bit, 128bit</td>
<td>SSID</td>
</tr>
<tr>
<td>Integration level &amp; reliability</td>
<td>High</td>
<td>High</td>
<td>Normal</td>
</tr>
<tr>
<td>Prime cost</td>
<td>Low</td>
<td>Low</td>
<td>Normal</td>
</tr>
<tr>
<td>Ease of use</td>
<td>Easy</td>
<td>Normal</td>
<td>Hard</td>
</tr>
</tbody>
</table>


VI. CONCLUSION

It is likely that ZigBee will increasingly play a vital role in the future of computer and communication technology. In terms of protocol stack size, ZigBee's 32 KB is about one third of the stack size necessary in other wireless technologies. The IEEE 802.15.4–based ZigBee is designed for remote controls and sensors, which are very many in number, but need only small data packets and, extremely low power consumption for longer life. Therefore they are naturally different in their approach to their respective application arenas. ZigBee and the underlying 802.15.4 communications technology could form the basis of future wireless sensors, offering data reliability, long battery life, lower system costs, and good range through flexible networking. This paper presents the overview of ZigBee protocol in terms of its network topologies, architecture, and the functional overview. This paper also contains the comparative study on different energy efficient routing protocols for ZigBee network, where authors have compared different routing protocols considering different performance metrics to find the most energy efficient routing protocol.

REFERENCES


[4] 802.15.4, Part 15.4: Wireless Medium Access Control (MAC) and Physical Layer (PHY) Specifications for Low-Rate Wireless Personal Area Networks (LRWPANs).


[16] Liu Dan, Qian Zhihong, Zhang Xu and Li Yue , “Research on Tree Routing Improvement Algorithm in ZigBee Network”, published in 2010 Second International Conference on Multi Media and Information Technology.

AUDIO STEGANOGRAPHY-MODIFIED LSB USING REDUCED DISTORTION

Pooja Sharma

M.tech(C.S.E) Research Scholar, Galgotias College of Engineering & Technology
Greater Noida, (India)

ABSTRACT

In this study, we will have a survey on audio steganography recent researches. In present day to day life, effective data hiding methods are needed due to attack made on data communication. This paper presents the technique for the above requirement. In this proposed method, secret message in form of audio file is embedded within another carrier audio file (.wav). In the transmitter end the output will be similar to the carrier with secret message embedded inside. The hacker will be blinded by the transmitted signal. At the receiver end the original message can be retrieved without any loss. The entire proposed system is simulated and their corresponding waveforms prove the effectiveness of this method. The basic idea behind this paper is to provide a good, efficient method for hiding the data from hackers and sent to the destination in a safer manner. The paper follows the least distortion method applied in improving the LSB and data is hid in the bits whose frequency ranges are least audible. Though it is well modulated software it has been limited to certain restrictions. The quality of sound depends on the size of the audio which the user selects and length of the message. Though it shows bit level deviations in the frequency chart, as a whole the change in the audio cannot be determined.

Keywords: Audio Steganography, LSB Method, Cryptography, Data Hiding, Frequency Range, Logical Operators

I. INTRODUCTION

The word steganography comes from the Greek Steganos, which means covered or secret and - graphy means writing or drawing. Therefore, steganography means, literally, covered writing. Steganography is the art and science of hiding secret information in a cover file such that only sender and receiver can detect the existence of the secret information. A secret information is encoded in a manner such that the very existence of the information is concealed. The main goal of steganography is to communicate securely in a completely undetectable manner and to avoid drawing suspicion to the transmission of a hidden data. It is not only prevents others from knowing the hidden information, but it also prevents others from thinking that the information even exists. If a steganography method causes someone to suspect there is a secret information in a carrier medium, then the method has failed. The basic model of Audio steganography consists of Carrier (Audio file), Message and Password. Carrier is also known as a cover-file, which conceals the secret information. Basically, the model for steganography is shown in Fig below. Message is the data that the sender wishes to remain it confidential. Message can be plain text, image, audio or any type of file. Password is known as a stego-key, which ensures that only the recipient who knows the corresponding decoding key will be able to extract the message from a cover-file. The cover-file with the secret information is known as a stego-file.
This paper proposes a technique of audio steganographic that gives a unique stage to hide the secret information in audio file. Least Significant Bit (LSB) data modification technique is the most easy and popular technique used for audio steganography. This proposed technique has been tested successfully on a .wav using MATLAB. The information hiding process consists of following two steps:

1) Identification of redundant bits in a cover-file. Redundant bits are those bits that can he modified without corrupting the quality or destroying the integrity of the cover-file.

2) To embed the secret information in the cover file, the redundant bits in the cover file is replaced by the bits of the secret information.

Audio Steganography is the technique of hiding information inside an audio signal. The secret message is embedded by slightly altering the binary sequence of a sound file. Existing audio steganography software can embed messages in WAV, AU, and even MP3 sound files. Embedding secret messages in digital sound is usually a more difficult process than embedding messages in other media, such as digital images. As data is embedded in the signal, it gets modified. This modification should be made imperceptible to the human ear. Image can also be taken as a medium but audio steganography is more challenging because of the characteristics of Human Auditory System (HAS) like large power, dynamic range of hearing and large range of audible frequency. All paragraphs must be indented. All paragraphs must be justified, i.e. both left justified and right justified.

II. LITERATURE SURVEY

2.1 Hiding is done Using Pattern

Wav files make use of either 8 or 16 bits to store sound information. 8 bit files allow values of sound in the range between 0 and 255 and the 16 bit files will have values from 0 to 65535. By changing the values of bytes slightly, we can store our secret data.

If for example, we have 8 byte sample ofwav audio:

200 234 157 141 128 178 62 39

These values would be represented in binary as:

11001000 11101010 10011101 10001101
10000000 10110010 0111110 00100111

Suppose we want to hide the binary file 11101010 (234) inside this sequence. We replace the least significant bit in each byte of wav sample (the least significant bit because it will cause the least amount of change in the value) by bits of the binary form that makes up 234. The sequence of binary after modifying wav by stuffing 234 is shown below:

11001001 11101011 10011101 10001100
10000001 10110010 0111111 00100110

The new binary values deviates from the values of original audio only a little.. These discrepancies are negligible since human auditory system cannot differentiate between the two at such small levels.

This system has replaced the LSB of every byte whatever its value may be. There won’t be much variation from original audio file if the byte value whose LSB being replaced is large. But if the value is very less say 1 or 2, the change in LSB causes change in the value of the byte by around 100% . This large deviation may make one think of LSB being used and one may try to crack it. This could be overcome by modifying least significant bit
only when its value is large or by using some pattern to stuff bits in various positions of the byte in all channels of WAV file which is our proposed system.

Wav file consists of number of channels. In the modified LSB algorithm proposed here, instead of stuffing bit of the message only in the least significant bit in the consecutive bytes of wav file, a pattern is used to stuff bits. The same pattern can be made use to decode the file to get back the hidden message. Since it is quite easy to encode and decode if we make use of the same pattern to stuff message bits in different positions of byte in all channels, we stuff the bits in same pattern in all the channels. For example if we use the pattern 3142, then the 1st bit of message is stored at 3rd bit position, 2nd bit of message is stuffed in 1st position, 3rd bit in 4th position, 4th bit in 2nd position, 5th bit in 3rd position and so on.

In this scheme we stuff the entire byte in 1 channel, next byte in next channel and so on using the same pattern. Instead of stuffing bits in consecutive sequential bytes as in conventional LSB, we stuff entire byte in one channel, next byte in next channel and so on. This gives the shield against possible attack by trying to read the wav file sequentially.

For example if we want to stuff the message “abcdef” in a wav file consisting of 3 channels using the pattern 3142, character “a” will be stuffed in 1st channel, “b” in 2nd channel, “c” in 3rd channel, “d” in 1st channel and so on. While storing a character in a channel, pattern 3142 is used to stuff bits. ASCII value of “a” is 97 i.e 01100001. It requires 8 bytes of channel 1 to stuff „a”, 1st bit 1 is stored in 1st byte of channel 1 at position 3, 2nd bit 0 is stored in 2nd byte of channel 1 at position 1 and so on according to the pattern chosen. This gives additional security and robustness for encoding scheme.

2.2 Hiding is done Using Key

In the proposed method the carrier file is taken as audio format and the secret message may be a text or audio format files. Here a key is taken at the transmitter with that a pseudo sequence is generated and this sequence is performed a logical operation with the secret message. Then the embedding process is carried out with the carrier audio file and is transmitted at the transmitter side as

In the receiver side with the audio stego file the LSB are recovered first and with the known key generated at the transmitter the decryption process is carried out and the secret message is recovered from the stego file

The steps are as follows:
1. Get the carrier audio signal and calculate the length it is noted as A1.
2. Get the secret audio or text file and calculate the length, it is noted as A2.
3. As per the assumption check whether the L1 is eight times greater than A2.
3.1 If it is greater than proceed with the proposed algorithm.
3.2 Else display the message as secret message is too large and initializes the process from starting.
4. Get the secret key and with that a pseudorandom sequence is generated and is performed logical operation with the secret message and is then embedded using LSB method in the carrier audio file.
5. The stego file is created and is transmitted from the transmitter side.
The reverse operation is performed at the receiver side for retrieving the secret message embedded in the transmitted stego audio file.

III. PROPOSED WORK

Enhanced Audio Steganography is a method of hiding the message in the audio file of any formats. EAS provides an easy way of implementation of mechanisms when compared with audio steganography.
To improve the outcome and quality of received audio file with the image and data hidden in it is done in such a way that it would lead to less distortion and more robustness.
This can be done by applying the LSB technique separately in audible and non-audible voices. The data hidden in less audible and non-audible voice will lead the audio file to be less or not at all distorted. The misuser or intruder would find no difference in cover file and original audio file.
Apart from the encoding and decoding in Audio steganography, EAS contain extra layers of encryption and decryption.
The four layers in EAS are:

- Encoding
- Decoding
- Encryption
- Decryption

**Encoding** is a process of hiding the message in the audio.

**Decoding** is a process of retrieving the message from the audio.

Accepted audible range of frequency is 20 to 20000 Hz.
Range of frequency individual hear is greatly influenced by environmental factor.
Frequency below 20Hz → generally felt rather than heard.
Frequency above 20000Hz → sensed by young people.
1) Audible frequency is between 32.70 Hz to 16744 Hz.
2) Non-Audible Frequency → Frequency below 32.70 Hz → lowest organ note, Lowest note for tuba, Large pipe organs etc.
   • Frequency below 32.70 Hz are not audible.
   • 32.70 Hz → Lowest C on a standard 88-key piano.
   • Frequency above 16744 Hz are also not audible.
   • 16744 Hz → the tone that a typical CRT TV emits while running.

3.1 Algorithm for Stagnography Using Logical Operator

3.1.1 For Encoding Process
   1. First hide the identity.
   2. Hide the size of image.
   3. Apply logical operator in LSB Coding.

3.1.2 For Decoding Process
   1. Match the identity hidden in encoding process.
   2. Fetch the size of the image.
   3. Apply logical operator in LSB coding to retrieve the image.
   4. Make the frame with the help of image size recovered and set all value of image at proper pixel position.

3.2 Logical Operator During Encoding
   1. Take the last wave sample LSB (648) where last size bit is stored
      Set as bit1
   2. Take the next wave sample LSB (649)
      Set as bit2
   3. Fetch the all bit sample of image from column vector starting from first to last
Set as bit3 (FROM 1: LENTH)

4. Now apply the XOR Operation to bit1 and bit2 and obtain the bit4.
5. Now apply the XOR Operation to bit3 and bit4 to obtain new bit named bit5
6. At last we will hide bit5 to wave sample (650)
7. This will be happened until all the bits are imbedded.

3.3 Logical Operator During Decoding
1. Take the last wave sample LSB (648) where last size bit is stored
   Set as bit1
2. Take the next wave sample LSB (649)
   Set as bit2
3. Fetch bit sample from next wave sample LSB (650) where the image data is saved
   Set as bit3
4. Now apply the XOR Operation to bit1 and bit2 and obtain the bit4
5. Now apply the XOR Operation to bit3 and bit4 to obtain new bit named bit5
6. We will hide bit5 to wave sample (648) TO LENGTH
7. Fetch the LSB OF wave sample starting (648) all this LSB bit is the image data
8. All data is kept in the frame of the image using the size of image obtained.

IV. EVALUATION OF AUDIO STEGANOGRAPHY

4.1 Advantages
Audio based Steganography has the potential to conceal more information
- Audio files are generally larger than image
- Our hearing can be easily fooled
- Slight changes in amplitude can store vast amounts of information

The flexibility of audio Steganography makes it very potentially powerful:
- The methods discussed provide users with a large amount of choice and makes the technology more accessible to everyone. A party that wishes to communicate can rank the importance of factors such as data transmission rate, bandwidth, robustness, and noise audibility and then select the method that best fits their specifications.
- For example, two individuals who just want to send the occasional secret message back and forth might use the LSB coding method that is easily implemented. On the other hand, a large corporation wishing to protect its intellectual property from "digital pirates" may consider a more sophisticated method such as phase coding, SS, or echo hiding.

Another aspect of audio Steganography that makes it so attractive is its ability to combine with existing cryptography technologies.
- Users no longer have to rely on one method alone. Not only can information be encrypted, it can be hidden altogether.

Many sources and types makes statistical analysis more difficult:
- Greater amounts of information can be embedded without audible degradation
4.2 Security

- Many attacks that are malicious against image Steganography algorithms (e.g. geometrical distortions, spatial scaling, etc.) cannot be implemented against audio Steganography schemes. Consequently, embedding information into audio seems more secure due to less steganalysis techniques for attacking to audio.
- As emphasis placed on the areas of copyright protection, privacy protection, and surveillance increases, Steganography will continue to grow in importance as a protection mechanism.
- Audio Steganography in particular addresses key issues brought about by the MP3 format, P2P software, and the need for a secure broadcasting scheme that can maintain the secrecy of the transmitted information, even when passing through insecure channels.

4.3 Disadvantages

- Embedding additional information into audio sequences is a more tedious task than that of images, due to dynamic supremacy of the HAS over human visual system.
- Robustness: Copyright marks hidden in audio samples using substitution could be easily manipulated or destroyed if a miscreant comes to know that information is hidden this way.
- Commercialized audio Steganography have disadvantages that the existence of hidden messages can be easily recognized visually and only certain sized data can be hidden.
- Compressing an audio file with lossy compression will result in loss of the hidden message as it will change the whole structure of a file. Also, several lossy compression schemes use the limits of the human ear to their advantage by removing all frequencies that cannot be heard. This will also remove any frequencies that are used by a Steganography system which hides information in that part of the spectrum.

V. FUTURE SCOPE

In today’s world, we often listen a popular term HACKING. Hacking is nothing but an unauthorised access of data which can be collected at the time of data transmission. With respect to steganography, this problem is often taken as steganalysis. Steganalysis is a process in which a steganalyser cracks the cover object to get the hidden data. So whatever be the technique will be developed in future, degree of security related to that has to be kept in mind. It is hoped that dual steganography, steganography along with cryptography may be some of the future solution for this below mentioned technique. Work on this techniques is in progress. The better and improved version of steganography can be done as follows:

To improve the outcome and quality of received audio file with the image and data hidden in it is done in such a way that it would lead to less distortion and more robustness.

This can be done by applying the LSB technique separately in audible and non-audible voices. The data hidden in less audible and non-audible voice will lead the audio file to be less or not at all distorted. The misuser or intruder would find no difference in cover file and original audio file.
VI. AUDIO STEGANOGRAPHIC APPLICATIONS

Audio data hiding can be used anytime you want to hide data. There are many reasons to hide data but most important is to prevent unauthorized persons from becoming aware of the existence of a message. In the business world Audio data hiding can be used to hide a secret chemical formula or plans for a new invention. Audio data hiding can also be used in the non commercial sector to hide information that someone wants to keep private. Terrorists can also use Audio data hiding to keep their communications secret and to coordinate attacks. In the project ARTUS1 which aims to embed animation parameters into audio and video contents. Data hiding in video and audio, is of interest for the protection of copyrighted digital media, and to the government for information systems security and for covert communications. It can also be used in forensic applications for inserting hidden data into audio files for the authentication of spoken words and other sounds, and in the music business for the monitoring of the songs over broadcast radio.

REFERENCES

UTILIZATION OF WTP SLUDGE & TEA WASTE IN BRICK MANUFACTURING

Prashast Gupta¹, Rounak Attri², Rakesh Kumar³

¹,²,³ 8th Semester, B.Tech, Department of Civil and Environmental Engineering,
ITM University Gurgaon, (India)

ABSTRACT

The objective of this study is to investigate the effect of processed waste tea (PWT) and water treatment plant (WTP) sludge addition on the physical, mechanical and thermal properties of the burnt clay bricks. PWT and WTP sludge has been added to raw brick clay in the ratio of 5% by mass. Bricks have been manufactured through hand molding and burnt in kilns at a temperature of 990°C. The samples were tested as per standard methods given in Indian standard codes. The compressive strength of the brick sample consisting of WTP sludge increased significantly while the compressive strength of brick samples consisting PWT decreased slightly. However, thermal insulation of PWT bricks depicted an increment when compared to the controlled bricks. As a result, WTP sludge and PWT both can be utilized for substituting clay brick by taking advantage of increased strength, increased thermal insulation, low cost and environmental benefit.

Keywords: Clay Bricks, Processed Tea Waste, Sludge, Thermal Conductivity

1. INTRODUCTION

The construction industry is a backbone to any nation. In India it is witnessing a strong growth due to huge infrastructure development. As the construction progresses rapidly, the demand of good quality construction and building materials also increases. Brick is a popular building material all over the world because of its highly economical cost, superior finish as well as high compressive strength and durability. With the onset of the industrial revolution and infrastructure development, bricks gained importance due to its fire and weather resistance as well as its property of sound insulation. Demand for bricks is ever increasing which is resulting in an escalation of cost, particularly across the Indian subcontinent. Along with an increase in the cost, brick manufacturing is also causing depletion of the top fertile clay layer in and around the kiln (a tall exhaust chimney) which is used to manufacture bricks. These problems of cost escalation and depletion of the fertile top soil layer can be tackled by substituting the primary components of common bricks with ordinarily available waste material. It will result in resource saving and also solves the disposal problem of the waste materials. Two such potential waste materials facing disposal problem...
and are present in bulk quantity are processed tea waste (PWT) and water treatment plant (WTP) sludge. The disposal of these materials is a matter of concern and is a burden to the growing economy.

Water treatment plants all over the world treat raw water by implementing varied techniques prevalent in that region. The plants help treat raw water to potable water with the help of various treatment chemicals. Water treatment plants produce large quantities of by-products commonly known as sludge as a result of treatment processes of raw water such as coagulation, flocculation and filtration. The problem of sludge disposal is a grave problem owing to environmental concerns, limited resources and few landfills. By replacing primary components of mud bricks with WTP sludge, we can not only solve the problem of disposal of sludge, but can also take advantage of favorable properties while minimizing the manufacturing cost at the same time.

Few studies have been performed on utilizing WTP sludge in brick making. The excavated soil, mainly clay is mixed with sludge to improve the brick properties. Five different mixing ratios of sludge at 0, 5, 10, 15 and 20 percent of the total weight of sludge-clay mixtures were studied. The result also showed that increasing the sludge content improved workability and physical appearance (color) of sludge –clay burnt bricks (Victoria, 2013). Hence, we can use up to 15% of the WTP sludge in manufacturing of bricks. The amount of sludge can be increased above 15% but the energy consumption in firing of bricks will increases due to presence of high amount of alumina and low silica in WTP sludge (Huang et al, 2005).

Tea is a beverage, known for its medicinal properties, which is being consumed worldwide for centuries. Tea consists of alkaloids, tannins, catechin and polyphenols which are revealed on phyto-chemical screening of tea (Archana et al., 2011). In India, yearly production of tea is approximately 857,000 tones which is 27.4% of total world production (Wasewar, 2010). The waste which is produced after the preparation of tea is termed as processed tea waste (PTW) or tea dust which is organic in nature. In order to enhance the properties of bricks PTW can be added to raw material. Addition of PTW will increase the porosity of bricks which ultimately enhances the thermal insulation property of the burnt bricks (Demir, 2006).

Hence the purpose of the present work is to replace the depleting clay with household tea waste and WTP sludge in brick manufacturing. Experiments have been performed to study the effect of 5% clay replacement with PWT and WTP respectively.

II MATERIALS

2.1 WTP Sludge

Raw water to be treated is initially passed through screens, which are kept inclined at about 45°-60°, in order to remove the big visible objects such as trees, dead animals etc. Then this water is allowed to pass through coagulation and flocculation tanks where colloidal matter and suspended solids are removed. In order to remove the colloidal matter and very fine suspended mud particles, coagulants (alum in this case) has been added and thoroughly mixed
to form a gelatinous precipitate termed as floc which are large enough to get settled under the effect of gravity. This process is known as coagulation and flocculation. The flocculated water is then passed through sedimentation tank where these flocs are allowed to settle and the resulted by-product which is obtained from the base of tank is termed as sludge. The water from outlet of sedimentation tank is allowed to pass through rapid sand filter and chlorine is added to the water obtained from filtration and then this water is distributed in the city through distribution system. The clay utilized in the bricks has been replaced with tea waste by up to 5% of total clay weight i.e. 150 grams (WTPS5)

2.2 Tea Waste

The tea dust which is obtained after preparation of household tea is organic in nature and is termed as tea waste. The tea dust was collected from the cafeteria situated at ITM University Gurgaon, Haryana. The clay utilized in the bricks has been replaced with tea waste by up to 5% of total clay weight i.e. 150 grams (PTW5)

III METHODS

3.1 Compatibility Test

A good material (earth) for making bricks should have a liquid limit between 25 to 38%, plastic limit between 7 to 13% and a shrinkage limit between 15 to 25%. In order to ensure the suitability of brick earth two field tests are performed. In the first field test, the soil to be tested is transformed into the plastic mass by adding sufficient amount of water to it. Then balls of about 80mm diameter are formed from this plastic mass through hand moulding which are then left for sun drying. The dried balls are then pressed between fingers and if they crumble easily then it shows excessive sand content in the earth. Any surface cracks on drying indicate deficiency of sand content. In case of the second field test, the plastic mass prepared in first field test is transformed into threads of 3mm diameter through
rolling and then allowed to dry under the sun for four days. Any surface cracks on the dried threads will indicate excessive shrinkage limit (Gurucharan, 2005).

3.2 Manufacturing of bricks

First of all the raw material (soil) was collected and spread on a levelled surface after sprinkling sand on it. The waste material (WTP sludge or PTW) was then mixed with the raw material (5% of total weight). Water was then added to the mixture in an appropriate amount so that the mixture would be workable and bricks after burning process would gain sufficient strength. Moulding of this mixture was then done with the help of wooden moulds (22.4*11.6*7.5 cm in dimension). Sand was sprinkled on every face of the mould and the mixture was then pressed and put into the mould through the hands. The mixture was then pressed by frog attached to a wooden plate, from open face of the mould. These moulded bricks were allowed to get sun dried in drying sheds for 3 to 5 days, so that bricks could get some strength and these dried bricks could easily undergo the burning process. In the burning process, dried bricks were burnt in the kilns at a temperature of 990°C for 2 to 4 days. Kilns are rectangular burning chambers were the temperature was raised up to 990°C with the help of thermal energy. Burnt bricks were then allowed to get cooled for 3 to 4 days. After a cooling period, burnt bricks could be tested and checked against Indian standards and according to the results obtained these bricks would be used for various construction purposes.

3.3 Testing of bricks

The compressive strength of the bricks were determined(IS 3495:1992, Part I) with the help of universal testing machine (UTM). The sample of brick to be tested was prepared by filling the frog and the voids with cement mortar and placing these bricks in a wet jute bag for 24 hours. After 24 hours, sample bricks were kept immersed in water for 3 days. These bricks were then tested using UTM keeping the face having mortar filled frog in the upward direction. Burnt bricks were also tested for water absorption capacity (IS 3495:1992, Part-II). In this test, burnt bricks were first weighed on a balance and then kept immersed in water for 24 hours. After 24 hours, bricks were weighed again on the same balance and by using the formula (IS 3495:1992, Part II) the percentage water absorption was calculated. Burnt bricks were also tested for efflorescence and warpage (IS 3495:1992, Part III-IV). Field tests were also conducted on the burnt bricks in which the first test was done by striking two burnt bricks with each other and examining the sound created by their strike. Second field test was conducted to determine hardness of bricks by scratching bricks by finger nail. The third field test was to drop the burnt brick from 1 meter height on a leveled ground surface. Thermal insulation of the burnt bricks was also tested with the help of simulated Lee’s- Disk apparatus. Three samples of burnt bricks were tested in each case and the mean result of three bricks was reported (IS SP: 41, 1987 Part I-IV)
IV RESULTS AND DISCUSSIONS

4.1 Compatibility tests of WTP Sludge and Processed Tea Waste

Table 1 shows the characteristics of physical compatibility tests of WTP Sludge mixture and Processed Tea Waste (PTW) mixture respectively. The field tests performed exhibited satisfactory results which lead us to manufacture bricks of a fixed proportion (5% waste, 95% Clay).

<table>
<thead>
<tr>
<th>S.No</th>
<th>Property</th>
<th>WTP Sludge</th>
<th>PTW</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Homogeneity</td>
<td>Satisfactory</td>
<td>Satisfactory</td>
</tr>
<tr>
<td>2</td>
<td>Field Test Procedure</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.1</td>
<td>• Balls of 80 mm diameter</td>
<td>Satisfactory</td>
<td>Satisfactory</td>
</tr>
<tr>
<td>2.2</td>
<td>• Threads of 3 mm diameter</td>
<td>Satisfactory</td>
<td>Satisfactory</td>
</tr>
</tbody>
</table>

Table I- Physical Compatibility Tests

Plate I and II show wet WTP Sludge and PTW and plate III and IV show dry & crushed WTP Sludge and PTW.

4.2 Physical attributes of manufactured bricks

Table II shows the mean physical characteristics of WS5 and TW5 bricks. The mean weight of brick samples ranged from 2743 grams to 2945 grams with the TW5 brick being the lightest.
Plate III- Crushed WTP Sludge

Plate IV- Crushed PTW

<table>
<thead>
<tr>
<th>S.No</th>
<th>Character</th>
<th>WS5</th>
<th>PTW5</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Length (mm)</td>
<td>217.00</td>
<td>218.50</td>
</tr>
<tr>
<td>2.</td>
<td>Width (mm)</td>
<td>108.00</td>
<td>107.50</td>
</tr>
<tr>
<td>3.</td>
<td>Height (mm)</td>
<td>76.00</td>
<td>76.60</td>
</tr>
<tr>
<td>4.</td>
<td>Weight (g)</td>
<td>2945.00</td>
<td>2743.00</td>
</tr>
</tbody>
</table>

Table II- Physical Attributes

4.3 Mechanical attributes of bricks

Table III shows the mean compressive strength of WS5, TW5 and controlled bricks. Compressive strength determines the applicability potentials of the bricks, which is affected by the composition, moisture content and type of crystallization. Table III also depicts mean water absorption of brick samples. Water absorption is a key factor that affects the durability of bricks, thus lesser the water infiltrating into the brick, the more durable is the brick. The results of water absorption test ranged between 13.84 and 19.25 percent. The efflorescence test was performed in accordance with (IS 3495 Part III). The efflorescence test results mentioned in Table III showed that efflorescence was of “Nil” class for all of the clay brick types, which comply with the requirements of the (IS 3495 Part III). This result could be considered as an indicator for the very low values of soluble salts content of the brick. All the three categories of brick further satisfied the warpage (IS 3495 Part IV). The bricks also exhibited satisfactory results for the field tests of soundness, hardness and drop. Plates V and VI depict the compressive strength test and drop test being performed.
Table III- Mechanical Attributes

<table>
<thead>
<tr>
<th>S.No</th>
<th>Property</th>
<th>WTPS5</th>
<th>PTW5</th>
<th>Controlled Bricks</th>
<th>Permissible Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Compressive Strength (N/mm²)</td>
<td>14.47</td>
<td>04.68</td>
<td>10.28</td>
<td>10-15 (Class AA)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3-7 (Class B)</td>
</tr>
<tr>
<td>2.</td>
<td>Water Absorption</td>
<td>13.84%</td>
<td>19.52%</td>
<td>17.21%</td>
<td>&lt;20%</td>
</tr>
<tr>
<td>3.</td>
<td>Efflorescence</td>
<td>Nil</td>
<td>Nil</td>
<td>Nil</td>
<td>Slight</td>
</tr>
<tr>
<td>4.</td>
<td>Warpage</td>
<td>Negligible</td>
<td>Negligible</td>
<td>Negligible</td>
<td>-</td>
</tr>
<tr>
<td>5.</td>
<td>Soundness</td>
<td>Satisfactory</td>
<td>Satisfactory</td>
<td>Satisfactory</td>
<td>-</td>
</tr>
<tr>
<td>6.</td>
<td>Hardness</td>
<td>Satisfactory</td>
<td>Satisfactory</td>
<td>Satisfactory</td>
<td>-</td>
</tr>
<tr>
<td>7.</td>
<td>Drop Test</td>
<td>Satisfactory</td>
<td>Satisfactory</td>
<td>Satisfactory</td>
<td>-</td>
</tr>
</tbody>
</table>

Plate V- Compressive Strength Test

Plate VI- Drop Test

4.4 Thermal conductivity of bricks

Table IV depicts the mean results for the thermal conductivity test performed on the brick samples. The results of thermal conductivity test ranged from 0.11 for PTW to 0.15 W/mK for controlled bricks. The thermal conductivity for PTW5 came out to be the lowest among the lot.

<table>
<thead>
<tr>
<th>S.No</th>
<th>Property</th>
<th>WS5</th>
<th>PTW5</th>
<th>Controlled Bricks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Thermal Conductivity (W/mK)</td>
<td>0.132</td>
<td>0.11</td>
<td>0.15</td>
</tr>
</tbody>
</table>

Table I- Thermal Conductivity
V CONCLUSIONS

The present study reveals that both the wastes (WTP sludge and PTW) can be used as a substitute of raw material used for brick manufacturing. Based on the result analysis following conclusions can be made:

1) The addition of WTP sludge (5 % by weight) will increase the compressive strength of bricks.

2) The addition of PTW (5% by weight) will increase the thermal insulation property of the bricks, but will increase the water absorption capacity of the bricks.

VI ACKNOWLEDGEMENTS

The authors are grateful to Ms. Vaishali Sahu, Assistant Professor (Senior Scale), Department of Civil & Environmental Engineering, ITM University for guiding us for this study.

REFERENCES


A COMPACT WIDEBAND FILLED OMEGA UWB ANTENNA

Aruna Rana\(^1\), Nitin Kathuria\(^2\), V.K. Pandey\(^3\)

\(^1\) MTech Student, Noida Institute of Technology and Engineering, G Noida, (India)
\(^2\) Assistant Professor, Accurate Institute of Management and Technology, G Noida, (India)
\(^3\) Professor, Noida Institute of Technology and Engineering, G Noida, (India)

ABSTRACT

This paper presents antenna design and analysis for UWB applications. A novel planar ultrawideband (UWB) antenna consists of an omega-shaped radiating patch and a partially ground plane is proposed. With this design, the return loss achieved i.e lower than -10 dB in 3.1–10.6 GHz frequency range and the radiation pattern is highly similar to the monopole antenna. This antenna has been designed and simulated on HFSS 12.0 and has given wide impedance bandwidth from 2.4 to 11.7 GHz, which covers both UWB and Bluetooth antenna with a stable radiation pattern and constant gain from 3 to 6dBi.

Index Terms: Microstrip Antenna, CPW, UWB, Monopole, Radiation Bandwidth

I. INTRODUCTION

Wireless multimedia systems are receiving increasing research and application interests, but the improvements are still required to provide higher data-rate links, for instance, the transmission of video signals. For the transmission of higher data rate signal we need to have higher bandwidth in the system. In order to achieve higher data rate, Ultra-Wideband (UWB) communication systems, which according to FCC ranges from 3.1-10.6 GHz is currently being investigated. For this high frequency communication there is need of a compact wideband antenna. Earlier microstrip patch antennas were basically low profile and narrow bandwidth antenna. In order to overcome the inherently narrow bandwidth of microstrip antennas, various techniques have been developed to cover the entire UWB bandwidth, such as L-/F-shaped probe to feed the patch, triangular patch, U-/V-slot monopoles, among others.

Here the focus is on UWB antenna design and analysis. Studies have been undertaken covering the areas of UWB fundamentals and antenna theory. Extensive investigations were also carried out on different types of UWB antennas.

The type of antenna proposed in this paper is an Omega shape monopole antenna. The vertical disc monopole originates from conventional straight wire monopole by replacing the wire element with a disc plate to enhance the operating bandwidth substantially. This vertical monopole is fed by a micro-strip line. The proposed antenna has been successfully designed and simulated and showing broadband matched impedance, stable radiation patterns and constant gain. The following design has been proposed after extensive study of different types of monopoles in UWB was considered. Among these antenna configurations, omega-shape monopole features simple structure, easy fabrication, wide frequency bandwidth and satisfactory radiation patterns [1, 2].

The UWB antennas studied in the open literature were mainly slot and monopole antennas. Printed wide slot antennas have an attractive property of providing a wide operating bandwidth, especially for those having a...
modified tuning stub, such as the fork-like stub [4]–[7], the rectangular stub [8], [9], and the circular stub [10] inside the wide slot. Broadband planar monopole antennas have received considerable attention owing to their attractive merits, such as ultra wide frequency band, good radiation properties, simple structure and the ease of fabrication.

The typical shapes of these antennas are half-disc [11], circle, ellipse [12], [13], and rectangle [14]. Despite the approval of the FCC for UWB to operate over 3.1 to 10.6 GHz, the antenna structure is simple and the aperture size is compact. Broad impedance bandwidth and stable radiation patterns are obtained, whereas the ground plane dimension is a bit large. In practice, when integrated with the system board of different ground plane size, the antenna might need a retuning for the optimized dimensions.

In [14] the authors propose a new ultra wide band antenna for UWB applications. The proposed antenna consists of a rectangular patch with two steps, a single slot on the patch, and a partial ground plane. Compact size but the gain is not constant

This antenna yields an impedance bandwidth of 3.1–10.6 GHz with VSWR ≤ 2, The stable radiation patterns and constant gain are also obtained.

II. PROPOSED ANTENNA DESIGN

The antenna is simulated on an h=1.5mm FR4 epoxy substrate with dielectric constant εr=4.4 and loss tangent \( \tan \delta=0.02 \). As shown in the Fig. 1, a rectangle radiator is fed by a 50 \( \Omega \) CPW transmission line which is terminated with a subminiature A (SMA) connector for measurement purpose. Since both the antenna and the feeding are implemented on the same plane, only one layer of substrate with single-sided metallization is used, and the manufacturing of the antenna is very easy and extremely low cost. Both the radiating patch and the ground plane are bevelled, which results in a smooth transition from one resonant mode to another and ensures good impedance match over a broad frequency range.

The optimize dimensions of the antenna are:

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>( L )</td>
<td>35mm</td>
</tr>
<tr>
<td>( W )</td>
<td>24mm</td>
</tr>
<tr>
<td>( L_1 )</td>
<td>13.4mm</td>
</tr>
<tr>
<td>( g )</td>
<td>1.5mm</td>
</tr>
<tr>
<td>( L_2 )</td>
<td>2mm</td>
</tr>
<tr>
<td>( R )</td>
<td>18mm</td>
</tr>
<tr>
<td>( W_1 )</td>
<td>18mm</td>
</tr>
</tbody>
</table>

These parameters were found out mathematically. First of all Design of a 50\( \Omega \) CPW line on a substrate with permittivity \( \varepsilon_r \). Therefore the effective permittivity \( \varepsilon_{\text{eff}} \) using

\[
\varepsilon_{\text{eff}} = \frac{\varepsilon_r+1}{2} \tag{1}
\]

Ground plane plays a major role in determining the first and second resonances. The dimensions of the ground plane are calculated as follows:

\[
L = \left( 0.8 \times \frac{\lambda_c}{2} \right) \tag{2}
\]
\[ W = (0.55 \times \lambda_c) \]  
\[ L1 = (0.3 \times \lambda_c) \]

Where \( \lambda_c \) is the wavelength corresponding to centre frequency of the operating band. Sides of the Rectangle \( L2 \) and \( W1 \) are calculated using

\[ L2 \leq \frac{120 \times h \times \pi}{Z_0 \times \varepsilon_r^{1/2}} \]

\[ 2R = W1 = (0.41 \times \lambda_c) \]

Fig. 1 Geometry and configuration of purpose antenna.

(a) Top view (b) Back view.

As shown in Fig. 1, a omega -shape radiating patch with radius of \( R \) is selected as the radiator and mounted vertically above a rectangular copper ground plane. \( W \) and \( L1 \) denote the width and the length of the ground plane, respectively. A 50\( \Omega \) coaxial probe connects to the bottom of the patch through the ground plane via an SMA connector. \( h \) is the height of the feed gap between the feed point and the ground. Fig 2 shows the fabricated antenna.

Fig. 2- Fabricated Antenna

III. RESULTS

The first parameter that we take in to account for our design is the VSWR of the antenna. The VSWR is a way of calculating how well two transmission lines are matched. The number for the VSWR ranges from one to infinity, with one meaning that the two transmission lines are perfectly matched. In regards to antenna design, a VSWR that is as low as possible is desired because any reflections between the load and the antenna will reduce the effectiveness of the antenna.
Fig 3 shows the stimulated response of the return loss with frequency range 2.45-11.7 GHz as the UWB applications.

![Fig. 3- Stimulated Return loss of antenna](image)

Fig. 3 presents the simulated gain for the proposed antenna. The antenna gain in the UWB band is about 3–6 dBi.

![Fig. 4- Simulated Gain of Antenna](image)

It is assumed that the antenna is receiving a signal in the direction of maximum gain. It is also common for the gain to be expressed in decibels and referenced to an isotropic source (G = 1), as shown.

The simulated radiation patterns of the antenna in E-plane (xz-plane) and H-plane (yz-plane) for three different frequencies 3, 8 and 10 GHz are shown in Figs. 5 (a-c). The patterns in the H-plane are quite omnidirectional as expected. In the E-plane, the radiation patterns remain roughly a dumbbell shape like a small dipole leading to bidirectional patterns.

(a) at 3GHz  
(b) at 8 GHz  
(c) at 10 GHz

![Fig. 5- Simulated Radiation Patterns of Antenna for E-Field and H-Field](image)

It has been seen that this antenna has the nearly Omni-directional radiation pattern like normal monopole antennas. However, the Omni-directional radiation properties have a little deterioration as frequency increases. Over the entire bandwidth, it’s similar to a conventional wideband monopole antenna.
Vector network analyzer or VNA is a device which is used to measure both magnitude and phase of the response, from which all of the important other data formats can be mathematically calculated. VNA is used to measure the S –Parameters as S-parameters work by characterizing a network, in this case an antenna or RF system, through the use of matched loads instead of open and/or short circuit conditions. It is much simpler to characterize a resistive load across a wide range of frequencies than it is to accurately represent a true open or short circuit condition.

The comparison between measured and simulated result of $S_{11}$ is done In entire BW of UWB (3.1–10.6GHz) the measured result of $S_{11}$ shows the perfect impedance matching except notch frequency band.

![Fig. 6- Setup of Measurement on VNA](image)

![Fig. 7- Simulated and Measured Return Loss of Antenna with Optimal Dimensions](image)

**IV. CONCLUSION**

In wireless communications, ultra wideband has many advantages. This paper introduces the design of UWB antenna to minimize the potential interferences between the UWB system and the narrowband systems, a compact microstrip line-fed planar UWB antenna with omega – shape. It has been designed and analysed. And the results like VSWR, Return Loss, Stable radiation patterns and constant gain in the UWB band are obtained and discussed. The simulation results of the proposed antenna show a good agreement in term of the VSWR, antenna gain and radiation patterns. Accordingly, this antenna is expected to be a good candidate in various UWB systems.
REFERENCES