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FROM THE DESK OF
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Dear Readers,

The qualitative and timely publication of Vol. VI / Issue-II(Jul–Dec 2016)of our esteemed International Journal of Engineering, Sciences and Management (ISSN: 2231-3273) has brought great joy and happiness to the entire fraternity of the journal and honorable members of the Editorial and Advisory Board. The board members rich experience and varied expertize is providing immense succour in propelling the journal to attain an envious position in areas of research and development and accentuate its visibility. The distinctive feature is indexing of the journal by Jour Informatics, Index Copernicus, Google Scholar and DOAJ. It is a matter of great pride and honor that the journal has been viewed by researchers from one hundred and thirty two countries across the globe. The aim of journal is to percolate knowledge in various research fields and elevate high end research. The objective is being pursued vigorously by providing the necessary eco-system for research and development.

Large number of research papers were received from all over the globe for publication and we thank each one of the authors personally for soliciting the journal. We also extend our heartfelt thanks to the reviewers and members of the editorial board who so carefully perused the papers and carried out justified evaluation. Based on their evaluation, we could accept fourteen research papers for this issue across the disciplines. We are certain that these papers will provide qualitative information and thoughtful ideas to our accomplished readers. We thank all the readers profusely who conveyed their appreciation on the quality and content of the journal and expressed their best wishes for future issues. We convey our deep gratitude to the Editorial Board, Advisory Board and all office bearers who have made possible the publication of this journal in the planned time frame.

We invite all the authors and their professional colleagues to submit their research papers for consideration for publication in our forthcoming issue i.e. Vol.VII| Issue I|Jan–Jun2017 as per the “Scope and Guidelines to Authors” given at the end of this issue. Any comments and observations for the improvement of the journal are most welcome.

We wish all readers meaningful and quality time while going through the journal.

Wg Cdr (Prof) TPN Singh
Executive Editor
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A bi-annual Research journal of Dronacharya Group of Institutions,
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July 2016

CONTENTS

A PROJECT-BASED APPROACH TO EMBEDDED SECURITY EDUCATION

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ABSTRACT

This paper describes a project used to educate students on encryption and embedded security. This project demonstrates a potential security vulnerability of embedded systems used for digital secure voice applications. The vulnerability is based on a method of leaking encryption keys over the audio channel. To do this, an embedded system was programmed on a Texas Instruments (TI) eZdsp development board. Malicious software (i.e., Trojan) was added to the embedded system that, when activated, would leak the secure information about the encryption keys over the audio channel. This was achieved using simple digital feedforward comb filters which were auditorily undetectable unless proper post-processing was applied.

Keywords: *Embedded security, encryption, Computer Engineering education, Digital Signal Processing (DSP), embedded systems, real-time audio effects*.

1. INTRODUCTION

The basis for trustworthy computing is trustworthy hardware. However, most applications in embedded security heavily rely on software for encryption [1]. An example of this is digital secure voice applications (e.g., [2]). A typical digital secure voice application uses an Analog-to-Digital Converter (ADC) to digitize the speech signal and a microcontroller or Digital Signal Processor (DSP) to encrypt it [3]. Crypto-protocols are built using crypto-algorithms such as symmetric-key and public-key encryption, random number generation, and hashing. These may be implemented on the microcontroller using building blocks in software or, in some cases, in dedicated hardware. Software is often preferred because of two different reasons: reducing the design cost and supporting flexibility. The main insight from this research is, because cryptographic building blocks on microcontrollers are developed using software, leakage of information about the cryptographic process can occur through the hardware either directly from the microcontroller or through attached subsystems.

The motivation for this paper is to create a complete set of materials that incorporate concepts, which are often taught as seemingly disparate concepts (i.e., encryption, embedded systems, DSP, etc.), into one complete project. The idea is to provide these materials to interested educators to incorporate into relevant undergraduate and graduate courses. This paper describes a project used to educate students on encryption and embedded security. The project demonstrates how to leak encryption keys over an audio channel. To do this, an embedded system was programmed on a TI eZdsp USB stick development tool which includes the TI C5515 digital signal processor, an AIC23 codec with CD quality sampling rate (f_s) capability (i.e., 48 kHz), and several peripherals such as an OLED display and pushbuttons (**Fig.1**). The memory transactions were encrypted which is a common practice in secure embedded applications. Malicious software (i.e., a Trojan) was added to the embedded system that, when particular combinations of the pushbuttons were entered, the system would begin to leak the secure keys over the audio channel. The keys were leaked using simple feed forward comb filters

which were auditorily undetectable unless proper post-processing was applied.

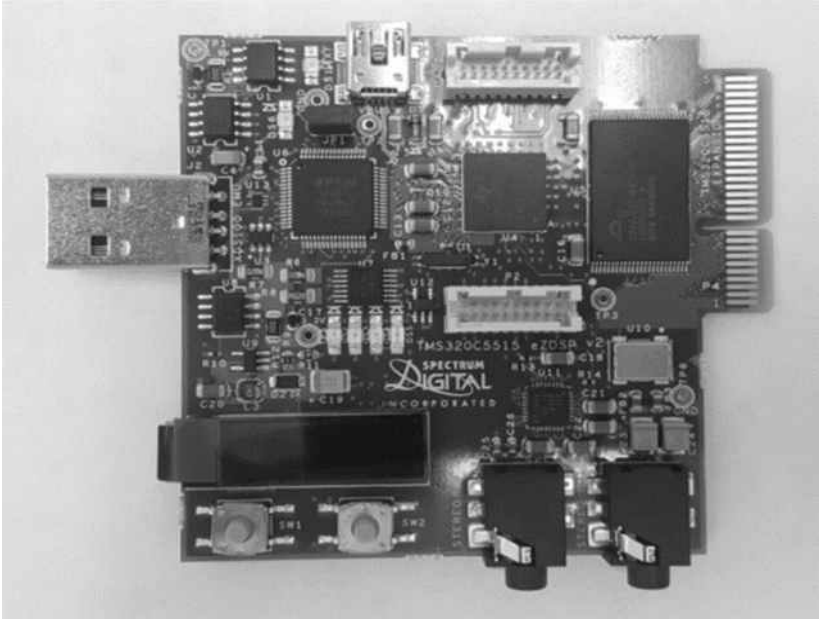

Fig. 1: TI C5515 eZdsp USB stick development tool.

2. BACKGROUND

This section will give the reader a basic understanding of the encryption algorithm and the DSP technique (feed forward comb filtering) used for leaking encryption keys over an audio channel.

2.1 Encryption Algorithm The encryption algorithm used was the Triple Data Encryption Standard (DES). However, it should be noted that the method described can be used with any symmetric-key cipher. Triple DES is a symmetric-key block cipher, which applies the cipher algorithm three times to each data block. Considering the availability of increasing computational power, the original DES algorithm has become susceptible to brute-force attacks. To protect against this, the Triple DES increases the key size which increases the required computational power to break the encryption exponentially.

Triple DES uses a set of 3 keys that are 64-bits long, with an overall length of 192-bits, which are divided into 8 sub-keys that are 8-bits long and represent an unsigned integer value (**Fig. 2**). Each encryption stage applies a unique 64-bit key (K_1, K_2, and K_3) using the standard DES algorithm. The first stage encrypts (E) the plaintext (P) and the output of this stage is then passed to the second stage. However, in the second stage, the decrypter (D) is used on the output resulting from the first stage. The final ciphertext (C) is the result of encrypting the output from the second stage (see eq. 1). The algorithm used was implemented using C language and code for this algorithm is freely available from TI [4].

$$C = E\left(K_3, D\left(K_2, E(K_1, P)\right)\right) \tag{1}$$

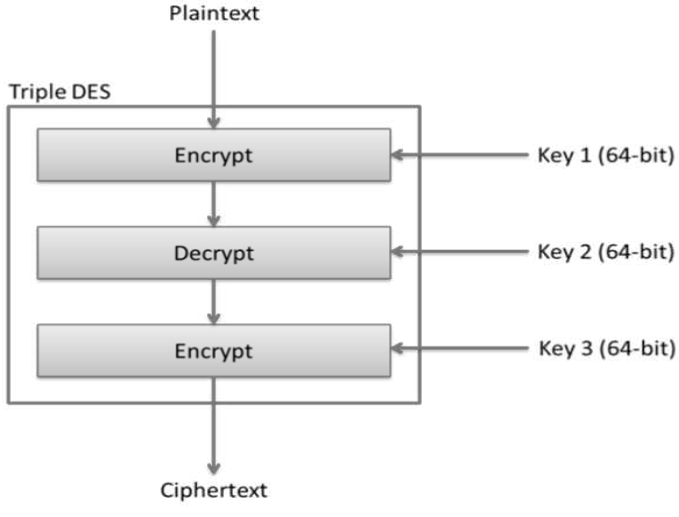

Fig. 2: Triple DES algorithm

2.2 Feedforward Comb Filter A feedforward comb filter (**Fig. 3**) was used to leak the keys over the audio channel. The filtering process is achieved by convolving the digitized input audio signal with the feedforward comb filter which are generally modelled as Finite Impulse Response (FIR) filters. As a result, the difference equation shown in eq. 2 gives the relationship between the digitized input (x) and the filtered output (y) where n is the discrete time index, "$*$" is the convolution operator, k is the delay, and b_m is the M^{th} coefficient of the feedforward comb filter (h).

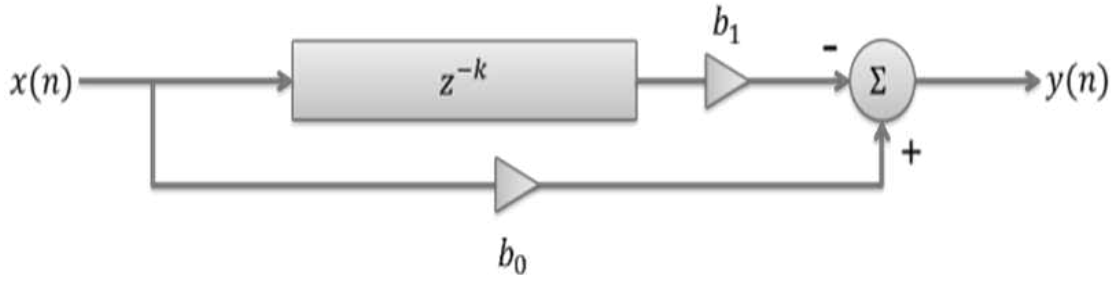

Fig. 3: Feed forward comb filter.

$$y[n] = b_0 x[n] + b_1 x[n-\mathrm{k}] = \sum_{m=0}^{1} b_m x[n-mk] = \sum_{m=-\infty}^{\infty} h[m]x[n-mk] \triangleq (h * x)[n \Big] \quad (2)$$

Alternately, the input-output description of this filtering operation in the z-transform domain is a rational transfer function (eq. 3). For a more thorough explanation of using digital filters for audio applications refer to [5].

$$H(z) = b_0 - b_1 z^{-k} \quad (3)$$

It should be noted that filtering an audio signal with a feed forward comb filter can produce a noticeable echo effect. Feedforward comb filters model the superposition of a "direct signal" plus an attenuated and delayed signal which is also, consequently, used to model an audio echo effect [6]. This superposition results in a magnitude response with periodic notches throughout the spectrum. The depth of the notches in the magnitude response are a function of b_1. For example, the notches in the magnitude response when b_1=0.1 is approximately -20 dB whereas, when b_1=0.9, it is approximately -0.92 dB (see Fig. **4**). Fortunately, if the b_1 coefficient is small enough, the notches are very shallow and, hence, the echo effect is not audible. As a result, the coefficients b_0 and b_1 were set to 1 and a small value (typically 0.1), respectively.

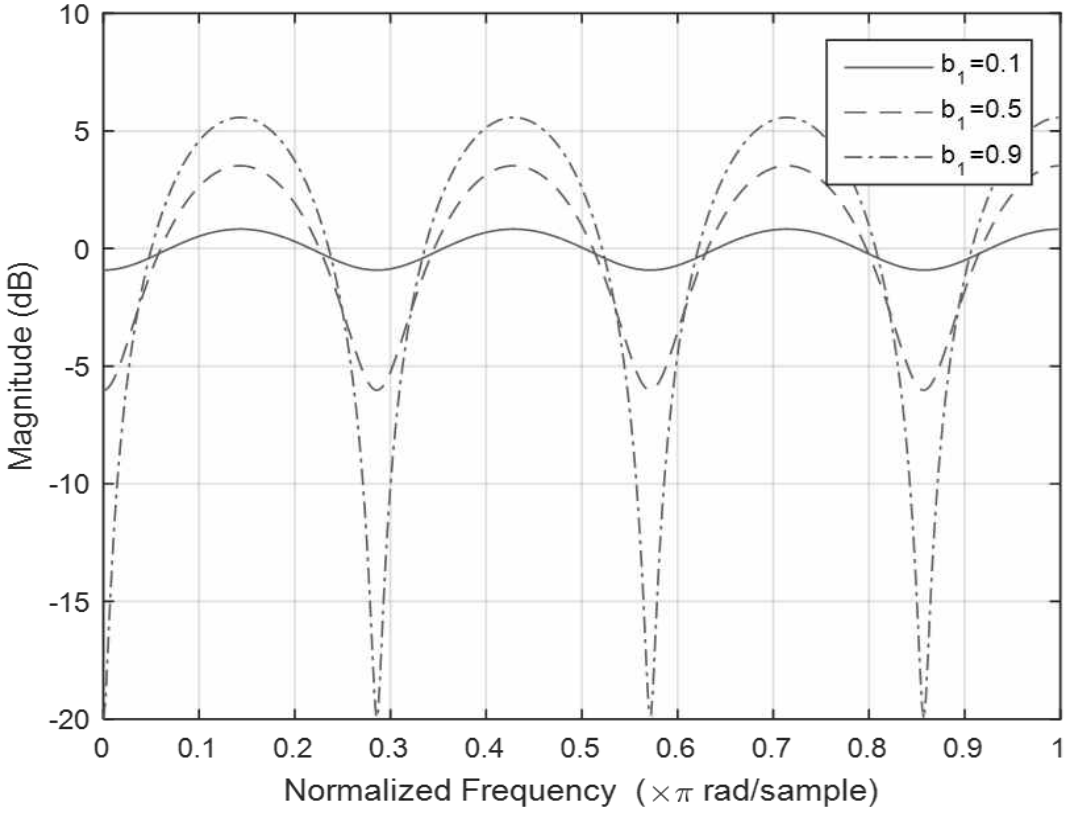

Fig. 4: Magnitude responses of a feed forward comb filter with different $\mathbf{b_1}$ values with $\mathbf{k = 7}$.

3. METHOD

This section first describes how the encryption algorithm and a feedforward comb filter were used on the TI eZdsp development board to encode and transmit the keys over the audio channel. This is followed by an explanation of how the keys were extracted from the received audio signal.

3.1 Encoding of Keys Encoding of the keys was achieved by associating each sub-key value n with a unique filter order k (i.e., $k = n$) of the feedforward comb filter transfer function (eq. 3). For example, if the sub-key value is 7, the order of the corresponding feedforward comb filter would be $k = 7$. Assuming the "Trojan" was activated, for each sub-key value, the incoming audio signal was then filtered in real-time for approximately 20 seconds with the corresponding comb filter. The filtered output was then sent out through the left channel and the unfiltered audio signal was sent through the right channel of the TI eZdsp development board. As discussed in the next sub-section, outputting both the filtered and unfiltered audio signals was necessary to extract the keys.

3.2 Estimation of the Transfer Function The output (left and right channels) of the TI eZdsp development board was recorded using a standard PC and Audacity (an open-source audio editing application). The recorded audio was then exported as a WAV file and imported into Matlab for post-processing. The transfer function was then estimated using the Matlab function "tfestimate" [7]. This is a spectral estimation method that finds a transfer function estimate given an input signal and an output signal. The magnitude response is obtained by taking the absolute values of the transfer function. As can be seen in **Fig. 5**, the estimated magnitude response is noisy. Hence, after the magnitude response is obtained, a moving average filter with a window size of 20 samples is used to smooth the response (**Fig. 6**).

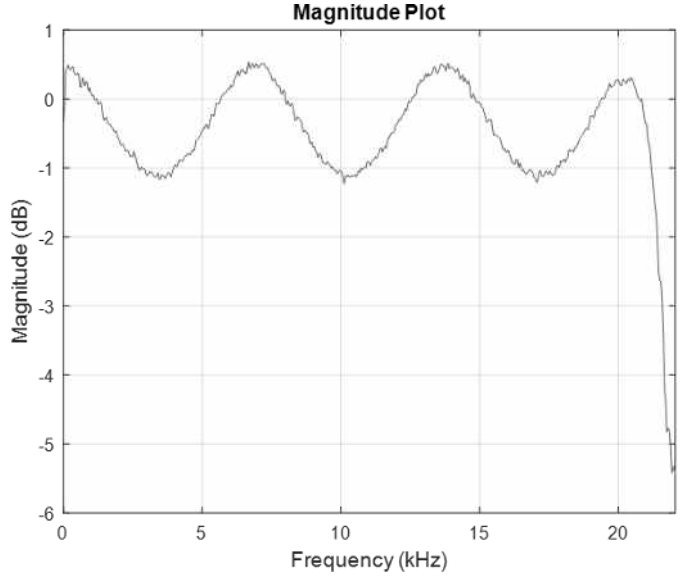

Fig. 5: Magnitude responses of comb filter when **k = 7** before smoothing.

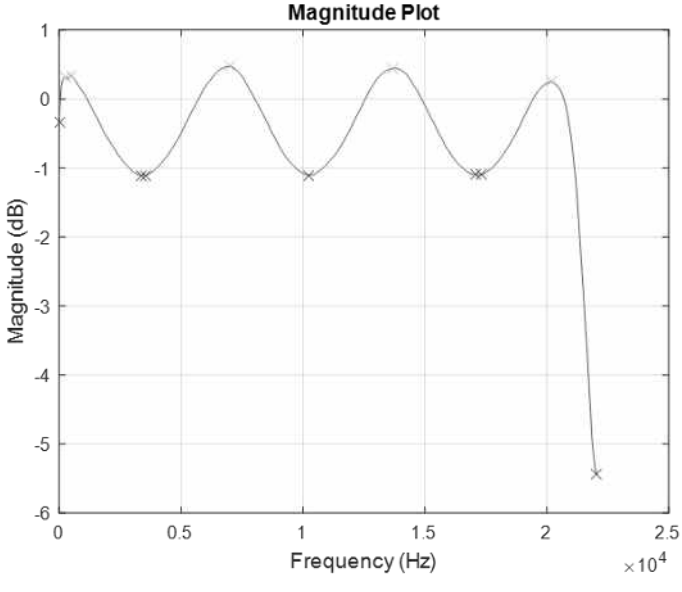

Fig. 6: Magnitude response of an audio signal from the TI C5515 when **K = 7** after moving average filter was applied

3.3 Extraction of Leaked Keys As mentioned in Section 2.2 above, the filtering process will produce a magnitude response with periodic notches and peaks throughout the spectrum. The number of notches and peaks are determined by the value of k in eq. 3 [8]. For example, consider Fig. **7** which shows the magnitude responses for the feedforward comb filters with $b_0 = 1$ and $b_1 = -0.1$ for k = 4, 7, and 10 (see Section 2.2). As can be seen, the magnitude responses will have $k + 1$ notches and peaks between normalized frequencies of 0 and 1 (i.e., frequencies between 0 Hz and $f_s/2$). The sub-key value n was determined by counting the number of notches and peaks.

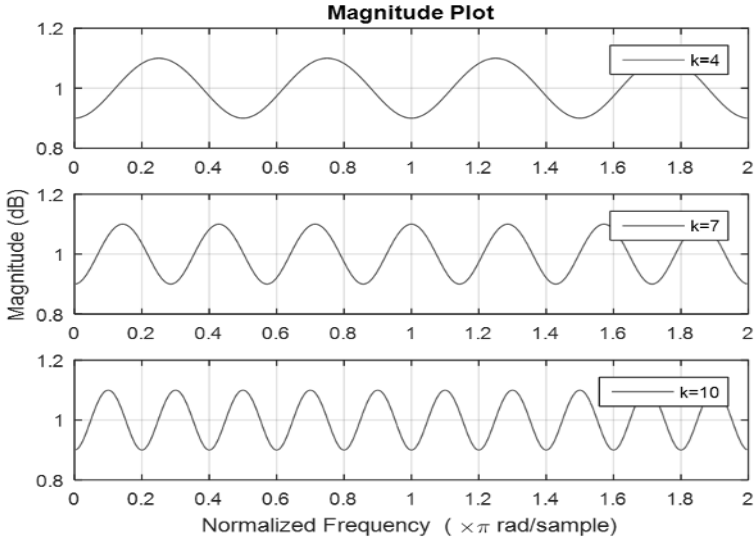

Fig. 7: Magnitude responses of feed forward comb filters for different values of **k**.

To count the number of notches and peaks in a magnitude response, first the local extrema had to be identified. The maxima and minima, also known as extrema, are points in the response at which the function takes a largest value (maximum) or smallest value (minimum) within a given neighborhood (local extrema) [9], [10]. These extrema points correspond to the peaks and notches in the magnitude response. For example, as seen in **Fig. 8**, the peaks and notches (both represented by "X") are at the local extrema of the magnitude response. The number of the extrema (which can be either the maxima or minima) in the response equals to the sub-key value plus 1 (k+1). For example, if the sub-key k = 7 then the number of extrema will be 8 (see **Fig. 8**).

In some instances, several local extrema points are found for a peak or a notch (see **Fig. 6**) which will result in an erroneous sub-key count. To remove the extra extrema points, a threshold (*thr*) is calculated using eq. (4) where d is the difference and σ is the standard deviation of all the local extrema points. All the local extrema above this threshold were eliminated.

$$thr = \max(d) - \sigma(d) \tag{4}$$

It should be noted that the magnitude responses estimated using audio signals coming from the TI eZdsp development board will also include the signal conditioning from the codec. For example, as seen in **Fig. 6**, there is a sharp roll-off at the Nyquist frequency ($f_s/2$) which is caused by the Anti-Aliasing Filter (AAF) on the codec. As a result of the AAF, when counting notches and peaks, the magnitude responses estimated using audio signals coming from the TI eZdsp development board will have one extra notch which is not a result of the key value. Hence, when counting notches and peaks on these responses, one must be subtracted from the final count to get the correct key value.

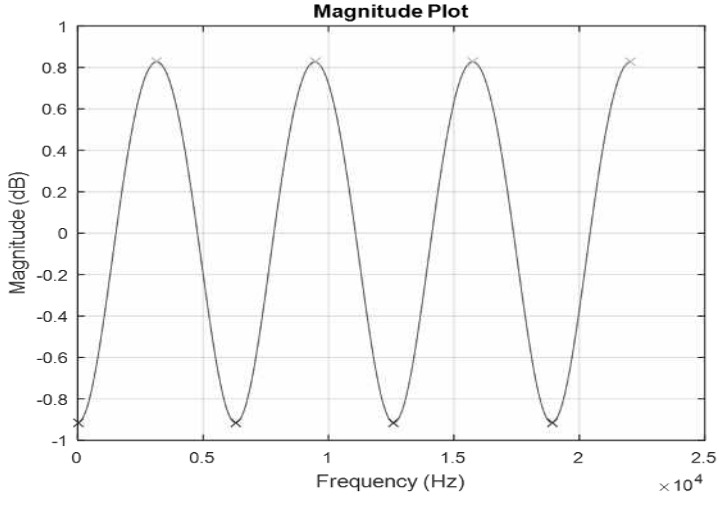

Fig. 8: Magnitude responses of comb filter when k=7.

4. SOFTWARE

The following subsections describe the supplemental materials that accompany this paper which include the Matlab code, and a real-time embedded program. Also included are brief explanations of how to setup and use the supplemental materials. All of these materials are included in a single ZIP file at: http://ecs.fullerton.edu/~jfaller/IJESM_2016_Supp_Mats.zip.

4.1 Embedded Software All of the embedded software is written in C or C-callable assembly programming languages using the Code Composer version 6.0.1 IDE. The code is based on the TI's C5515 audio filter demo [11] which contains code for initializing and configuring several of the peripherals on the kit such as the Direct Memory Access (DMA) controller, I^2C interface, the audio codec, etc. Additionally, several DSP related functions are also provided such as the FIR filter function ("fir.asm").

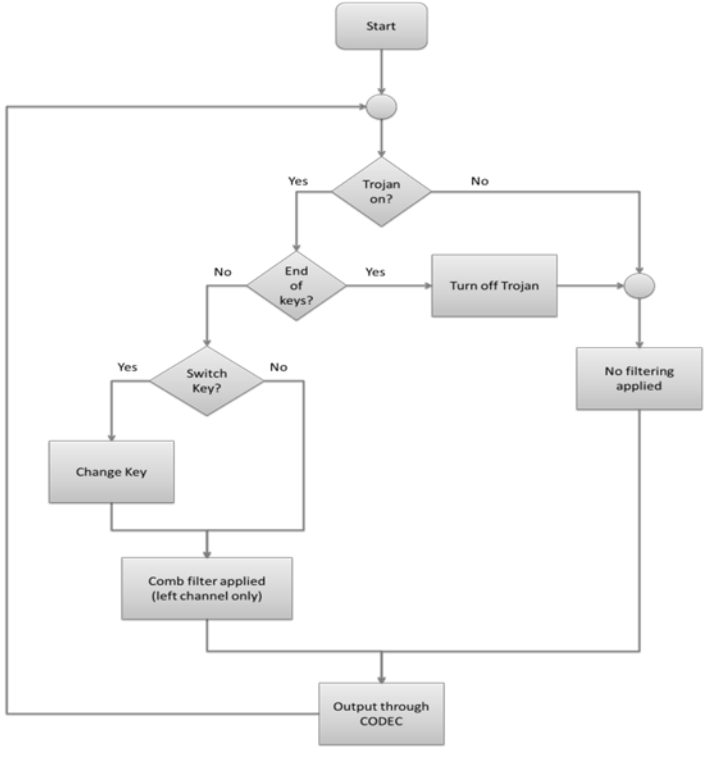

Fig. 9: Flowchart showing how an audio signal is encoded.

The user can feed a stereo signal into the input 1/8" audio connector. The audio signal was processed according to the flowchart shown in **Fig. 9**. The term "Trojan" is used to indicate that the feedforward comb filter described in Section 2.2 was used to encode the encryption keys. If a pushbutton was pressed then the Trojan was turned on. If the Trojan was on, the sub-key values were leaked one at a time for a fixed time period (approximately 20 seconds for each sub-key). During this time period, a stereo signal was created by filtering one channel with the corresponding comb filter (i.e., for that particular sub-key), and the other channel was not filtered or processed. This was repeated for the subsequent sub-key values. After all the keys were leaked, the system returned to normal operation and the Trojan was turned off. The output of the filtering process is then sent out through the output 1/8" audio connector. The stereo output signal, containing all the leaked sub-keys, was then captured and processed offline using Matlab.

4.2 Matlab Software The Matlab software provided (Figures **10** to **12**) allows the user to execute the key extraction algorithm on simulated output and output coming from the TI eZdsp development tool. The simulation worked by filtering white noise with a digital feedforward comb-filter. For the output coming from the TI eZdsp development tool, only a few sub-keys were analyzed. However, the provided embedded software can be used to obtain more output for other sub-key values. The key extraction algorithm (**Fig. 10**) was used for both the simulation and for the TI eZdsp development tool output.

```
function key = extract_key(x,y,ma_size,N,fs,do_plots)
    % TF estimate
    [Txy, f] = tfestimate(x,y,N,N/2,N,fs);

    % Magnitude
    mag = abs(Txy);
    mag = mag2db(mag);
```

```
 % Smooth using moving average
  mag = smooth(mag,ma_size);

 % Get extrema (notches/peaks)
 [xmax, imax, xmin, imin] = extrema(mag);
 ind = find(xmin > 0);

if(~isempty(ind))
   imin(ind) = [];
end
ind = find(xmax < 0);
if(~isempty(ind))
   imax(ind) = [];
end

…

% Count the number of extrema (notches/peaks)
ind = sort([imin; imax]);
d = diff(ind);
diff_d = diff(d);
if(abs(diff_d) < 10)
   num_groups = length(d);
else
   thr = max(d) - std(d);
   num_groups = find(d > thr);
   num_groups = length(num_groups);
end

…

% Estimate key
key = num_groups;

…
```

Fig. 10: Partial view of the Matlab function “extract_key”.

```
…

% Parameters
N = 2^13;           % TF estimate window size
t = 20;             % Time of input sample in secs
ma_size = 20;       % Size of moving average window
ord_range = 1:256;  % Range of filter orders to be analyzed
do_plots = 1;       % Will display plots

% Noise
fs = 44.1e3;
n_len = t*fs;
n_min = -0.25;
n_max = 0.25;
x = n_min + (n_max-n_min).*rand(n_len,1);

i = 1;
out = zeros(length(ord_range),3);
for ord=ord_range
    disp(['k = ', num2str(ord)]);

    % Comb filter
    b = zeros(1,ord+1);
    b(1) = 1;
    b(end) = -0.1;
```

```
    % Filter signal
    y = filter(b,1,x);

    % Extract key
    key = extract_key(x,y,ma_size,N,fs,do_plots);

   disp(['Extracted k = ', num2str(key)]);

   out(i,1) = ord;
   out(i,2) = key;
   out(i,3) = key-ord;
   i = i + 1;
end
…
```

Fig. 11: Partial view of the Matlab script “encode_extract_sim”.

```
…

% Parameters
% Range of filter orders to be analyzed
ord_range = [5:10 100];
do_plots = 0;       % Will display plots

i = 1;
out = zeros(length(ord_range),3);
for ord=ord_range
    disp(['k = ', num2str(ord)]);
    [in, fs] = audioread(cat(2,'./WAVs/key_', ...
        num2str(ord),'_example.wav'))

    x = in(:,1);    % Right channel (unfiltered signal)
    y = in(:,2);    % Left channel (filtered signal)

    % Parameters
    N = 2^10;       % TF estimate window size
    ma_size = 20;   % Size of moving average window

    % Extract key
    key = extract_key(x,y,ma_size,N,fs,do_plots);
    key = key + 1;      % b/c of AAF

    disp(['The key is ' num2str(key)]);

    out(i,1) = ord;
    out(i,2) = key;
    out(i,3) = key-ord;
    i = i + 1;
end

…
```

Fig. 12: Partial view of the Matlab script “extract_example”.

5. RESULT

The simulation successfully extracted all the sub-keys using only the magnitude responses of the digital feedforward comb filters. However, for the output coming from the TI eZdsp development tool, several of the sub-keys were misestimated. The worst estimate was -10 but most misestimates of the sub-keys were within ±5. One possibility for this is the signal condition of the codec will attenuate more peaks and notches of the magnitude responses for high sub-key values

causing the estimation algorithm to discard them (**Fig. 13**). Future work will include a method to compensate for the signal-condition (e.g., add a reconstruction filter prior to sub-key estimation). Although, the exact values were not discovered for some of the sub-keys, this could be used to reduce the time to crack all of the key values with a brute-force method.

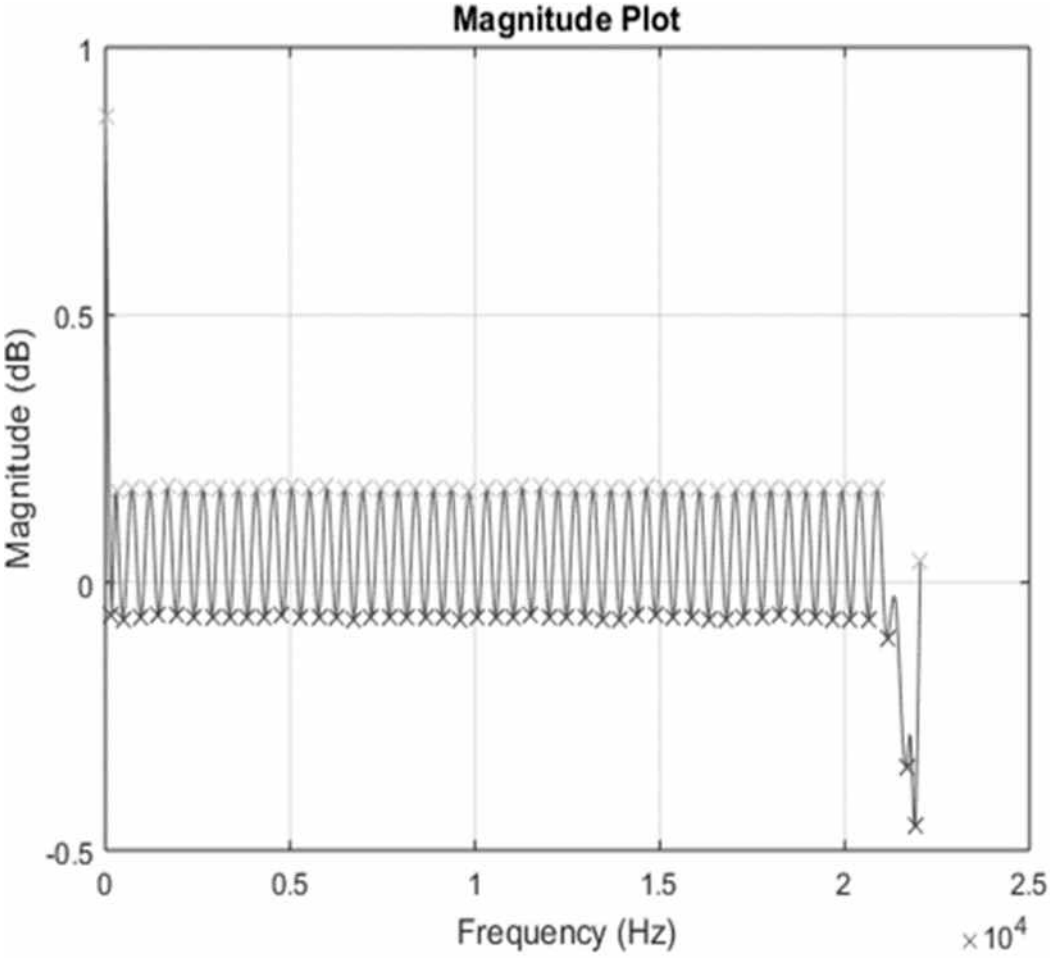

Fig. 13: Magnitude response of an audio signal from the TI C5515 when $\mathbf{k = 100}$.

6. CONCLUSION

This paper describes and demonstrates, using a simulation and a real-time system, a potential security vulnerability of embedded systems used for digital secure voice applications. This was achieved by leaking sub-key values covertly over the audio channel using a simple digital feedforward comb filter based technique. The filter was auditorily undetectable and the sub-keys could only be extracted using proper post-processing. The use of the Matlab software, the embedded program on the TI C5515 eZdsp USB Stick Development Tool, and the Matlab project were successfully integrated into some of the first author's undergraduate and graduate courses (i.e., a course on hardware security, real-time audio processing, and an independent study). Additionally, the provided supplementary materials are intended to allow interested educators to incorporate the project into their relevant courses (i.e., DSP or security related).

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X-BAND VIVALDI ANTENNA BASED LINEAR ARRAY FOR ELECTRONIC BEAM STEERING

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ABSTRACT

A Vivaldi antenna and its linear phased array has been designed and simulated for electronic steering of its main lobe. The antenna array is optimized to achieve beam scanning of $\pm 45^0$ in azimuth plane without allowing grating lobes to appear in the scan zone. The optimized interelement spacing, return loss and calculated element phase for beam steering have been presented in this paper. Also, the basic characteristics of antenna array main lobe like beam broadening and fall in gain with respect to the scan angles have been discussed in detail.

Keywords: *Vivaldi antenna, electronic steering, main lobe, beam broadening and grating lobes.*

1. INTRODUCTION

Vivaldi antenna is a compact broadband antenna and widely used as an antenna element for phased arrays. Vivaldi antenna can be fed by any of the standard transmission lines like coaxial line, microstripline and stripline. The presented Vivaldi antenna has been fed by a 50 Ω stripline and the circular cavity & radial stub geometry [1], as shown in Fig. 1, provides broadband matching for Vivaldi antenna over the entire X-Band.

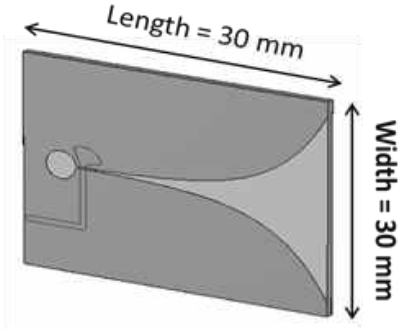

Fig. 1 Vivaldi Antenna Geometry

The stripline as shown in the Fig. 1 is sandwiched between two 20 mil thick RT Duroid 5880 substrates. The effective thickness of the Vivaldi antenna is approximately 1mm only. The length and width of the antenna element are

equal and therefore gives it a square shape with each side of 30 mm. The reflection coefficient of the optimized Vivaldi antenna for X-band has been shown in Fig. 2.

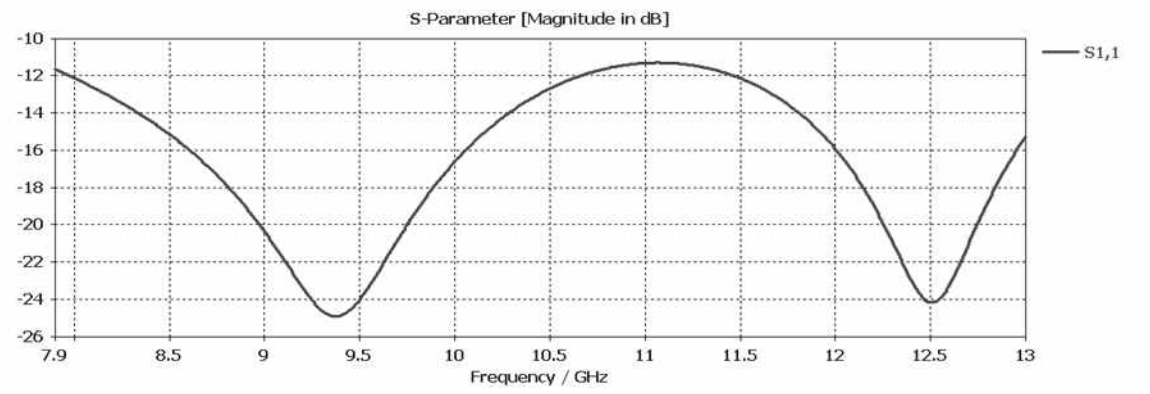

Fig. 2 Reflection Coefficient

2. INTERELEMENT SPACING AND CONFIGURATION

The number of antenna elements and the configuration of antenna elements in a phased array depend upon the following factors:

i. Available space
ii. Scan plane
iii. Scan angle
iv. Beam shape
v. Effective Radiated Power (ERP)

Grating lobe is a major challenge in designing the phased antenna arrays and the appearance of grating lobe depends upon the interelement spacing between the antenna elements. The array gain decreases if the grating lobes are present during scanning of the main beam. Therefore, to avoid the grating lobe while electronically scanning the array main lobe at an angle θ (with respect to array boresight), the optimum interelement spacing (d) should be:

$$d \leq \frac{\lambda}{1+\sin\theta} \quad (1)$$

From Eq. (1), it is clear that if the scan requirement is $\pm 45^0$ in azimuth plane then the interelement spacing comes out as 0.585*λ where the λ is free space wavelength calculated at highest frequency of operation.

The width of designed Vivaldi antenna is 30 mm which is much greater than the required interelement spacing hence the Vivaldi antenna elements are configured in H-plane [2]. In this configuration, each element is vertically polarized as shown in Fig. 3.

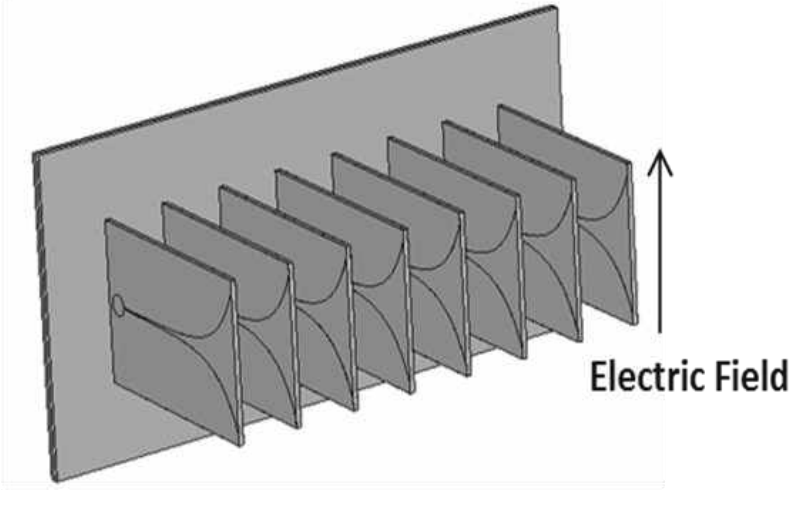

Fig. 3 1x8 Linear Vivaldi Antenna Array in H-plane

The array gain of the phased array depends upon the number of elements in the array. The array gain of N antenna elements phased array at any particular frequency [3] is defined as:

$$G_{Array} = N \times G \quad (2)$$

Where,
G = gain of individual antenna element at that particular frequency.

Based on the gain requirement, eight Vivaldi antenna elements were chosen to form a linear array and the theoretical calculation suggested that each Vivaldi antenna element would exhibit 2-5 dB gain over X-band.

3. LINEAR ARRAY SIMULATION

A model of linear Vivaldi antenna array as shown in Fig. 3 has been created and simulated using CST Microwave Studio. The reflection coefficient of the central and edge elements in the linear array has been presented in Fig.4. The reflection coefficient plot suggests that the antenna elements in array environment are matched over the entire X-band and the simulated reflection coefficient is better than -10 dB even for edge element.

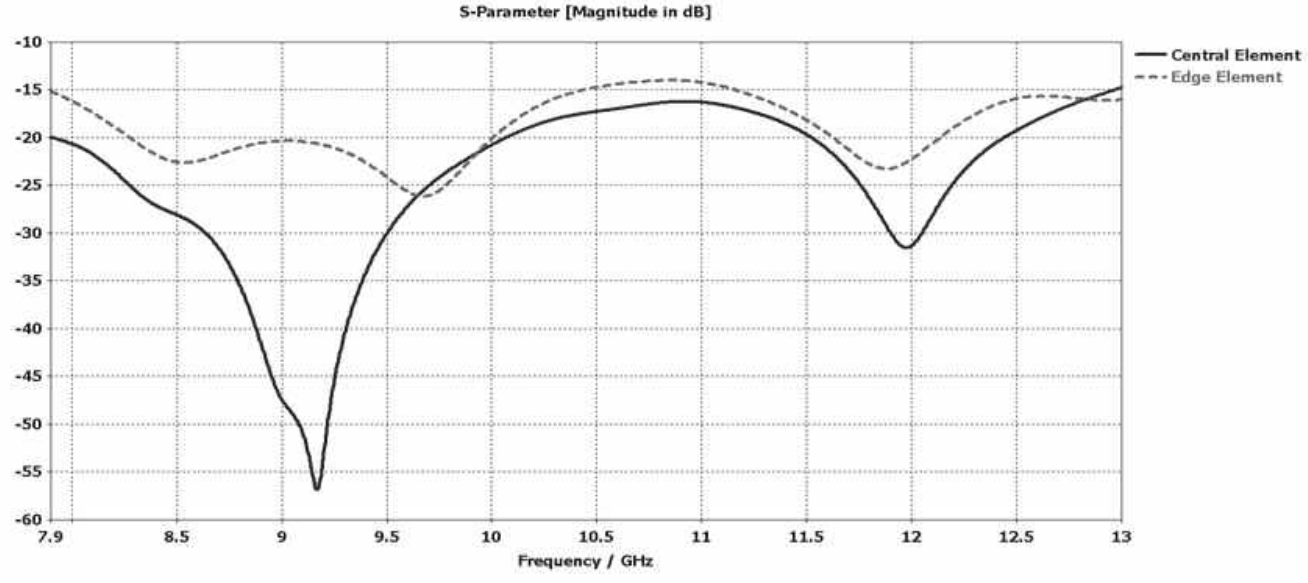

Fig. 4 S_{11} dB vs. frequency

The simulated array gain of the linear array at boresight has been tabulated in Table 1. The simulated array gain at boresight suggests that each antenna element gain ranges from 3-7 dB over the entire X-band.

Table -1: Array Gain

Frequency (GHz)	Simulated Array Gain (dB)
8	12.75
9	14.24
10	15.84
11	15.7
12	16.16

The 3 dB beamwidth in azimuth and elevation planes have been presented in Fig.5. Because the antenna elements are only in azimuth plane hence the azimuth beamwidth is narrow as compared to elevation beamwidth. Moreover with the increase in frequency of operation, the beamwidth reduces in both the planes and ranges from 11^0 to 7^0 in azimuth plane over 8-12 GHz.

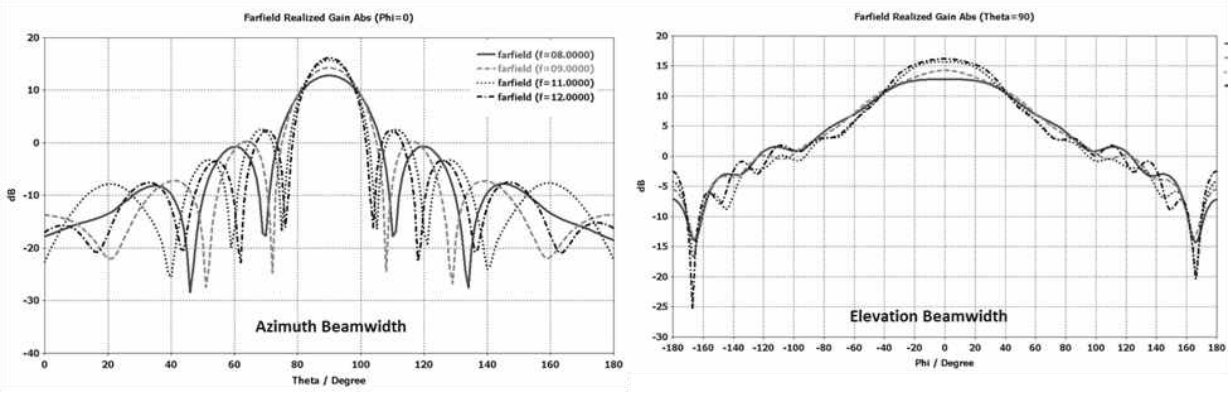

Fig. 5 Array beamwidth in principal planes

For electronic phase steering, each element in the array is fed with an incremental phase shift so that the main beam can be pointed at the required angle. Based on the scan angle, incremental phase shift in azimuth plane [4] can be calculated as:

$$\psi = \frac{2\pi}{\lambda} d \sin\theta \cos\varphi \tag{3}$$

Where,

d = inter element spacing; θ = azimuth scan angle; φ = elevation scan angle

The incremental phase has been calculated for different scan angle ranging from 0 to 45^0 in azimuth plane. The beam scanning in azimuth plane at 8 GHz has been shown in Fig. 6.

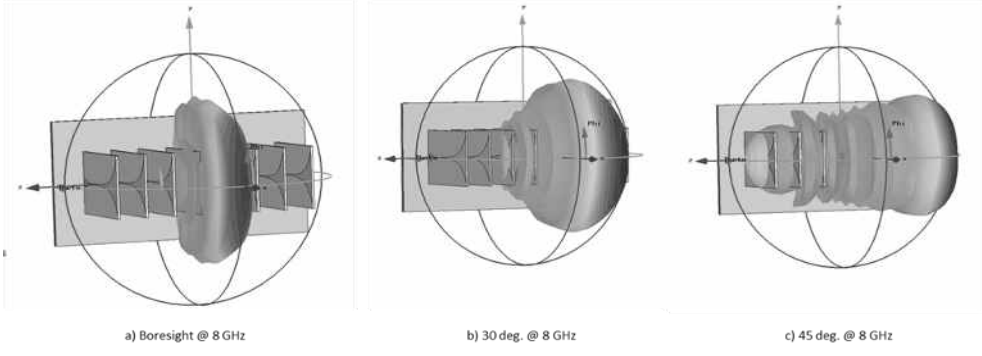

Fig. 6 Main lobe scan

The main beam broadens as it moves away from the boresight. Due to the beam broadening, the array gain comes down by the factor cosθ where θ represents the azimuth scan angle [5]. The beam broadening has been represented in Fig. 7.

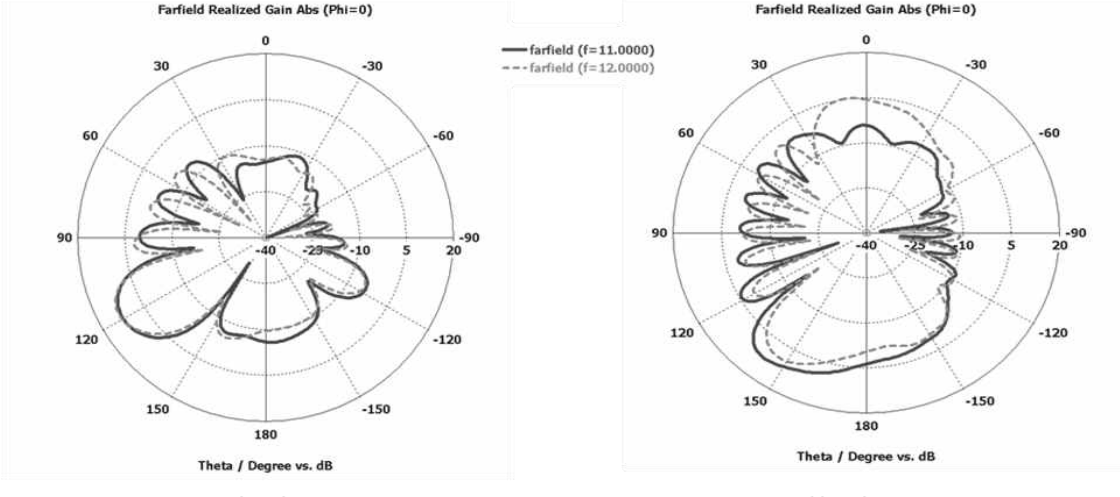

Fig. 7 Main beam vs. Scan angle

4. CONCLUSION

In this paper, the simulated performance of a Vivaldi antenna based phased array over the X-band has been discussed in detail. The simulated results suggest that the antenna array performs well within the frequency range of 8-12 GHz. The antenna array also exhibits gain ranging between 12-16 dB at boresight and electronic beam steering over $\pm 45^0$ in azimuth plane without the appearance of grating lobes. The design proves that it is possible to achieve small interelement spacing in Vivaldi antenna arrays by configuring the antenna elements in H-plane. The dimensions of the Vivaldi antenna element are optimized to make it compact and light weight. The smaller antenna dimensions and interelement spacing makes the array suitable for airborne, naval and ground platforms.

The proposed antenna array provides a fan beam in which azimuth 3 dB beamwidth varies from 11^0 to 7^0 over 8-12 GHz at boresight. The elevation beamwidth ranges between 60^0- 42^0 over the X-band at boresight. This type of antenna array is very useful for active phased array based EW jammer and in monopulse tracking radars. Such antenna can provide much better accuracy while tracking the targets in dense EW environment and amidst permanent echoes (PEs) and clutter due to thick vegetation and weather degradation.

5. ACKNOWLEDGEMENTS

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SNOWFINCH BIRD SWARM OPTIMIZATION ALGORITHM FOR SOLVING REACTIVE POWER PROBLEM

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ABSTRACT

In this paper a new-fangled Snowfinch bird Swarm Optimization (SSO) algorithm is projected to solve the reactive power dispatch problem. This algorithm is based on behaviour of social communications of snowfinch bird. Basically Snowfinch bird has three common behaviours: searching behaviour, observance behaviour and voyage behaviour. Through the shared communications Snowfinch bird will search for the food and also run away from hunters. By using the Snowfinch bird communications and behaviour, five basic rules have been created in the SSO algorithm to solve the reactive power problem. Our key aspect is to reduce the real power loss and also to keep the variables within the limits. Proposed Snowfinch bird Swarm Optimization (SSO) algorithm has been tested in standard IEEE 30, 57, 118 & practical 191 utility (Indian) bus test systems and simulations results reveal about the better performance of the proposed algorithm in reducing the real power loss and voltage profiles within the limits.

Keyword: *Snowfinch bird Swarm Optimization algorithm, swarm-intelligence, optimal reactive power, Transmission loss.*

1. INTRODUCTION

Optimal reactive power problem plays most significant role in the stability of power system operation and control. In this paper the key aspect is to reduce the real power loss and to keep the voltage variables within the limits. Formerly many mathematical methods like gradient method, Newton method, linear programming [1-7] has been employed to solve the optimal reactive power dispatch problem and those approaches have many complications in handling inequality constraints. Voltage stability and voltage collapse play an imperious role in power system planning and operation [8]. Newly Evolutionary algorithms like genetic algorithm have been already employed to solve the reactive power flow problem [9,10].In [11-20] Genetic algorithm, Hybrid differential evolution algorithm, Biogeography Based algorithm, fuzzy based methodology, improved evolutionary programming has been used to solve optimal reactive power flow problem and all the algorithm efficaciously handled the reactive power problem. This paper proposes Snowfinch bird Swarm Optimization (SSO) [21-26] algorithm for solving solve reactive power problem. This algorithm very efficiently decreases the real power loss by handing the constraints. Snowfinch bird Swarm Optimization (SSO) algorithm emulates the social behaviours and social communications of snowfinch swarms. It replicates the snowfinch searching behaviour, observance

behaviour and voyage behaviour. Thus, SSO algorithm has been modeled from the Snowfinch bird behaviour to handle the reactive power problem. The projected SSO algorithm has been valued in standard IEEE 30, 57, 118 & practical 191 utility (Indian) bus test systems. The simulation results show that our projected approach outpaces all the entitled reported algorithms in minimization of real power loss and also voltage profiles are within the limits.

2. OBJECTIVE FUNCTION

2.1. Active power loss The objective of the reactive power dispatch problem is to minimize the active power loss and can be defined in equations as follows:

$$F = PL = \sum_{k \in Nbr} g_k \left(V_i^2 + V_j^2 - 2V_iV_j\cos\theta_{ij}\right) \quad (1)$$

Where g_k : is the conductance of branch between nodes i and j, Nbr: is the total number of transmission lines in power systems.

2.2. Voltage profile improvement To minimize the voltage deviation in PQ buses, the objective function can be written as:

$$F = PL + \omega_v \times VD \quad (2)$$

Where ω_v : is a weighting factor of voltage deviation.
VD is the voltage deviation given by:

$$VD = \sum_{i=1}^{Npq} |V_i - 1| \quad (3)$$

2.3. Equality Constraint The equality constraint of the problem is indicated by the power balance equation as follows:

$$P_G = P_D + P_L \quad (4)$$

Where the total power generation PG has to cover the total power demand PD and the power losses PL.

2.4. Inequality Constraints The inequality constraint implies the limits on components in the power system in addition to the limits created to make sure system security. Upper and lower bounds on the active power of slack bus, and reactive power of generators are written as follows :

$$P_{gslack}^{min} \le P_{gslack} \le P_{gslack}^{max} \quad (5)$$

$$Q_{gi}^{min} \le Q_{gi} \le Q_{gi}^{max}, i \in N_g \quad (6)$$

Upper and lower bounds on the bus voltage magnitudes:

$$V_i^{min} \le V_i \le V_i^{max}, i \in N \quad (7)$$

Upper and lower bounds on the transformers tap ratios:

$$T_i^{min} \le T_i \le T_i^{max}, i \in N_T \quad (8)$$

Upper and lower bounds on the compensators reactive powers:

$$Q_c^{min} \le Q_c \le Q_C^{max}, i \in N_C \quad (9)$$

Where N is the total number of buses, NT is the total number of Transformers; Nc is the total number of shunt reactive compensators.

3. SNOWFINCH BIRD SWARM SUPPOSITION

The Snowfinch bird social behaviours can be written as follows:

Rule 1. Every Snowfinch bird has choice to alter between the observance behaviour and searching behaviour. Whether the Snowfinch bird searches or in observance, it is molded as a stochastic decision.

Rule 2. While searching, each Snowfinch bird can promptly record and renovate its previous most outstanding experience and the swarms' previous most outstanding experience about food area. This information has been used to discover food. Social information is shared rapidly among the whole swarm.

Rule 3. During observance, every Snowfinch will attempt to move near to the centre of the swarm. This behaviour can be embroidered by the interference tempted by the rivalry among swarm. The Snowfinch with the uppermost reserves would be more prone to lie nearer to the centre of the swarm.

Rule 4. While flying Snowfinch may often change between generating and sponging. The Snowfinch with the uppermost reserves would be a creator, while the one with the bottommost reserves would be a sponger. Snowfinch have reserves between the uppermost and bottommost reserves would randomly choose to be creator and sponger.

Rule 5. Creators with desire search for food. Spongers would randomly follow a creator to search for food.

By the above Rules the mathematical model for the problem has been developed,

All N virtual Snowfinch, portrayed by their position $Z_t^i(i \in [1,..,N])$ at time step t, search for food and fly in an organized space.

3.1. Searching behavior Every Snowfinch will search for food according to its experience. Rule 2 can be written in equation as follows,

$$Z_{i,j}^{t+1} = Z_{i,j}^{t} + \left(k_{i,j} - Z_{i,j}^{t}\right) \times M \times rand(0,1) + \left(l_j - Z_{i,j}^{t}\right) \times N \times rand(0,1) \quad (10)$$

Where $j \in [1,..,C]$, rand (0, 1) denotes independent uniformly distributed numbers in (0, 1).

M and N are two positive numbers, which can be respectively called as cognitive and social accelerated coefficients. $k_{i,j}$ is the best preceding position of the i_{th} Snowfinch and l_j is the most excellent preceding position shared by the swarm.

The Rule 1 can be defined as a stochastic decision. If a uniform arbitrary number in (0, 1) is smaller than, $K\left(K \in (0,1)\right)$ a constant value, the Snowfinch would search for food. Otherwise, the Snowfinch would carry on observance.

3.2.Observance behavior Rule 3 indicates that Snowfinch would try to move near the Centre of the swarm, and they would inevitably contend with each other. Thus, each snowfinch cannot directly move towards the Centre of the swarm.
This drive can be written as follows:

$$Z_{i,j}^{t+1} = Z + F1\left(mean_v - Z_{i,j}^{t}\right) \times rand(0,1) + F2\left(K_{k,j} - Z_{i,j}^{t}\right) \times rand(-1,1) \quad (11)$$

$$F1 = f1 \times exp\left(-\frac{kfit_i}{sumFit+\varepsilon} \times N\right) \quad (12)$$

$$F2 = f2 \times exp\left(\left(\frac{kFit_i - kFit_r}{|kFit_r - kFit_i| + \varepsilon}\right)\frac{N \times kFit_r}{sumFit + \varepsilon}\right) \quad (13)$$

Where $k(k \neq 1)$ is a positive integer, which is illogically chosen between 1 and N. f1 and f2 are two positive constants in [0, 2], $kFit_i$ denotes the ith Snowfinch's best fitness value and sumFit represents the sum of the swarms' best fitness value. 1,

which is used to keep away from zero-division error, $mean_v$ denotes the jth element of the average position of the whole swarm. When a Snowfinch moves near the Centre of the swarm, it will unavoidably compete with each other. The average fitness value of the swarm is measured by the surrounding swarm when a Snowfinch moves to the Centre of the swarm. Each Snowfinch always wants to position at the Centre of swarm, the product of F1 and rand (0,1) should not be more than 1. Here, F2 is used to create the direct effect persuaded by interference when a Snowfinch moves to the Centre of the swarm. If the most outstanding fitness value of a random k_{th} Snowfinch (k – i) is greater than that of the ith Snowfinch, then F2,f2 which means that the i_{th} Snowfinch may bear a greater interference than the k_{th} Snowfinch. The k_{th} Snowfinch would be move near the centre of the swarm than the ith Snowfinch.

3.3.Voyage behavior Snowfinch may fly to other areas due to countless reasons. When the Snowfinch arrived at an innovative site, they would again search for food .Some Snowfinch as creators would search for food patches, while other Snowfinch try to feed from the food patch found by the creators. By the Rule 4 the creators and spongers can be detached from the swarm. The behaviours of the creators and spongers can be written as follows:

$$Z_{i,j}^{t+1} = Z_{i,j}^{t} + randn(0,1) \times Z_{i,j}^{t} \quad (14)$$

$$Z_{i,j}^{t+1} = Z_{i,j}^{t} + \left(Z_{k,j}^{t} - Z_{i,j}^{t}\right) \times GH \times rand(0,1) \quad (15)$$

Where randn (0,1) denotes Gaussian distributed arbitrary number with mean zero and standard deviation 1, $k \in [1,2,3,..,N]$, $k \neq i. GH(GH \in [0,2])$ means that the sponger would follow the creator to search for food. We assume that each Snowfinch flies to alternative place every GH (positive integer) unit interval.

Snowfinch bird Swarm optimization Algorithm for reactive power problem

Enter: P: the number of individuals (snowfinch) bounded in the population
Q: the utmost number of iteration
GH: the rate of repetition of Snowfinch voyage behaviours
K: the probability of searching for food
M, N, f1, f2, GH: are five constant parameters
t=0;
Initialize the population
Assessment of the N individuals' fitness value, and find the most outstanding solution
While (t<Q)
If (t% GH≠0)
For i=1:N)
If rand (0,1)<K
At that juncture Snowfinch searches for food (Equation 10)
Else
The Snowfinch keep surveillance (Equation 11)
End if
End for
Else
Classifying swarms as creators and spongers.
For i= 1:N
If i is a creator
Then Create (Equation 14)
Else
It will be Sponger (Equation 15)
End if
End for
End if
Calculate innovative solutions
If the innovative solutions are greater to their previous ones, renovate them
Find the current most outstanding solution
t=t+1;
End while
Output:
The individual with the finest objective function value in the population

4. SIMULATION RESULTS

At first Validity of the proposed Snowfinch bird Swarm Optimization (SSO) algorithm has been verified by applying it in IEEE 30-bus, 41 branch system. And the system has 6 generator-bus voltage magnitudes, 4 transformer-tap settings, and 2 bus shunt reactive compensators. Bus 1 is taken as slack bus and 2, 5, 8, 11 and 13 are taken as PV generator

buses and the rest are taken as PQ load buses. Control variables limits are given in Table 1.

Table 1.Variable Limits (Pu)

List of Variables	Min.	Max.	Type
Generator Bus	0.95	1.1	Continuous
Load Bus	0.95	1.05	Continuous
Transformer-Tap	0.95	1.1	Discrete
Shunt Reactive Compensator	-0.10	0.30	Discrete

In Table 2 the limits of generators has been given as follows:

Table 2.Generators Power Limits

Bus	Pg.	Pgmin	Pgmax	Qgmin
1	98.00	50	201	-20
2	81.00	21	80	-20
5	53.00	15	52	-15
8	21.00	10	33	-15
11	21.00	10	28	-10
13	21.00	12	40	-15

Table 3.Values of Control Variables after Optimization

List of Control Variables	SSO
V1	1.0612
V2	1.0520
V5	1.0307
V8	1.0410
V11	1.0813
V13	1.0614
T4,12	0.00
T6,9	0.01
T6,10	0.90
T28,27	0.90
Q10	0.12
Q24	0.12
Real power loss	4.2865
Voltage deviation	0.9092

Table 3 shows the control variables are within limits.

And Table 4 summarizes the comparison results of the optimal solution obtained by various methods

Table 4.Comparison Results

Techniques	Real power loss (MW)
SGA [27]	4.98
PSO [28]	4.9262
LP [29]	5.988
EP [29]	4.963
CGA [29]	4.980
AGA [29]	4.926
CLPSO [29]	4.7208
HSA [30]	4.7624
BB-BC [31]	4.690
SSO	4.2865

Secondly proposed Snowfinch bird Swarm Optimization (SSO) is tested in standard IEEE-57 bus power system. The reactive power compensation buses are 18, 25 and 53. Bus 2, 3, 6, 8, 9 and 12 are PV buses and bus 1 is selected as slack-bus. The system variable limits are given in Table 5.

The preliminary conditions for the IEEE-57 bus power system are given as follows:

P_{load} = 12.424 p.u. Q_{load} = 3.335 p.u.

The total initial generations and power losses are obtained as follows:

$\sum P_G$ = 12.7726 p.u. $\sum Q_G$ = 3.4556 p.u.

P_{loss} = 0.27457 p.u. Q_{loss} = -1.2247 p.u.

Table 6 shows the various system control variables i.e. generator bus voltages, shunt capacitances and transformer tap settings obtained after SSO based optimization which are within the acceptable limits. In Table 7, shows the comparison of optimum results obtained from proposed SSO with other optimization techniques. These results indicate the robustness of proposed SSO approach for providing better optimal solution in case of IEEE-57 bus system.

Table 5. Variable limits

Reactive Power Generation Limits							
Bus no	1	2	3	6	8	9	12
Qgmin	-1.4	-.015	-.02	-0.04	-1.3	-0.03	-0.4
Qgmax	1	0.3	0.4	0.21	1	0.04	1.50
Voltage And Tap Setting Limits							
vgmin	Vgmax		vpqmax	tkmin		tkmax	
0.9	1.0		1.05	0.9		1.0	
Shunt Capacitor Limits							
Bus no	18			25		53	
Qcmin	0			0		0	
Qcmax	10			5.2		6.1	

Table 6. Control variables obtained after optimization

Control Variables	SSO
V1	1.1
V2	1.052
V3	1.044
V6	1.023
V8	1.041
V9	1.025
V12	1.022
Qc18	0.0764
Qc25	0.232
Qc53	0.0573
T4-18	1.010
T21-20	1.064
T24-25	0.972
T24-26	0.931
T7-29	1.088
T34-32	0.943
T11-41	1.014
T15-45	1.041
T14-46	0.918
T10-51	1.027
T13-49	1.062
T11-43	0.911
T40-56	0.903
T39-57	0.952
T9-55	0.955

Table 7. Comparison results

S.No.	Optimization Algorithm	Finest Solution	Poorest Solution	Normal Solution
1	NLP [32]	0.25902	0.30854	0.27858
2	CGA [32]	0.25244	0.27507	0.26293
3	AGA [32]	0.24564	0.26671	0.25127
4	PSO-w [32]	0.24270	0.26152	0.24725
5	PSO-cf [32]	0.24280	0.26032	0.24698
6	CLPSO [32]	0.24515	0.24780	0.24673
7	SPSO-07 [32]	0.24430	0.25457	0.24752
8	L-DE [32]	0.27812	0.41909	0.33177
9	L-SACP-DE [32]	0.27915	0.36978	0.31032
10	L-SaDE [32]	0.24267	0.24391	0.24311

S.No.	Optimization Algorithm	Finest Solution	Poorest Solution	Normal Solution
11	SOA [32]	0.24265	0.24280	0.24270
12	LM [33]	0.2484	0.2922	0.2641
13	MBEP1 [33]	0.2474	0.2848	0.2643
14	MBEP2 [33]	0.2482	0.283	0.2592
15	BES100 [33]	0.2438	0.263	0.2541
16	BES200 [33]	0.3417	0.2486	0.2443
17	Proposed SSO	0.22246	0.23112	0.23092

Then Snowfinch bird Swarm Optimization (SSO) has been tested in standard IEEE 118-bus test system [34] .The system has 54 generator buses, 64 load buses, 186 branches and 9 of them are with the tap setting transformers. The limits of voltage on generator buses are 0.95 -1.1 per-unit., and on load buses are 0.95 -1.05 per-unit. The limit of transformer rate is 0.9 -1.1, with the changes step of 0.025. The limitations of reactive power source are listed in Table 8, with the change in step of 0.01.

Table 8. Limitation of reactive power sources

BUS	5	34	37	44	45	46	48
QCMAX	0	14	0	10	10	10	15
QCMIN	-40	0	-25	0	0	0	0
BUS	74	79	82	83	105	107	110
QCMAX	12	20	20	10	20	6	6
QCMIN	0	0	0	0	0	0	0

The statistical comparison results of 50 trial runs have been list in Table 9 and the results clearly show the better performance of proposed SSO algorithm.

Table 9. Comparison results

Active power loss (p.u)	BBO [35]	ILSBBO/ strategy1[35]	ILSBBO strategy [35]	Proposed SSO
Min	128.77	126.98	124.78	118.91
Max	132.64	137.34	132.39	122.89
Average	130.21	130.37	129.22	119.96

Finally Snowfinch bird Swarm Optimization (SSO) has been tested in practical 191 test system and the following results has been obtained.

In Practical 191 test bus system – Number of Generators = 20, Number of lines = 200, Number of buses = 191 Number of transmission lines = 55.

Table 10 shows the optimal control values of practical 191 test system obtained by SSO method. And table 11 shows the results about the value of the real power loss by obtained by both proposed SSO algorithm.

Table-10. Optimal Control values of Practical 191 utility (Indian) system by SSO method

VG1	1.15		VG 11	0.90
VG 2	0.84		VG 12	1.01
VG 3	1.03		VG 13	1.03
VG 4	1.02		VG 14	0.93
VG 5	1.10		VG 15	1.01
VG 6	1.13		VG 16	1.04
VG 7	1.11		VG 17	0.90
VG 8	1.02		VG 18	1.01
VG 9	1.10		VG 19	1.12
VG 10	1.03		VG 20	1.10

T1	1.01		T21	0.90		T41	0.90
T2	1.05		T22	0.95		T42	0.91
T3	1.03		T23	0.94		T43	0.94
T4	1.10		T24	0.90		T44	0.92
T5	1.01		T25	0.91		T45	0.93
T6	1.02		T26	1.00		T46	0.91
T7	1.01		T27	0.92		T47	0.94
T8	1.03		T28	0.91		T48	1.01
T9	1.01		T29	1.04		T49	0.91
T10	1.01		T30	0.91		T50	0.92
T11	0.90		T31	0.93		T51	0.91
T12	1.04		T32	0.92		T52	0.90
T13	1.03		T33	1.03		T53	1.01
T14	1.02		T34	0.91		T54	0.90
T15	1.01		T35	0.90		T55	0.90
T19	1.05		T39	0.95			
T20	1.04		T40	0.90			

Table-11. Optimum real power loss values obtained for practical 191 utility (Indian) system by SSO method.

Real power Loss (MW)	SSO
Min	147.998
Max	150.848
Average	148.123

5. CONCLUSION

In this paper, Snowfinch bird Swarm Optimization (SSO) algorithm has been productively implemented to solve reactive power problem. Proposed Snowfinch bird Swarm Optimization (SSO) algorithm successfully handles the equality and inequality constraints. The validity of the Snowfinch bird Swarm Optimization (SSO) Algorithm has been proved by testing it in standard IEEE 30,57,118&191 practical utility (Indian) bus systems. The results are compared with the other heuristic methods and the Snowfinch bird Swarm Optimization (SSO) algorithm established its efficiency and strength in minimization of real power loss. And control variables are well within specified limits.

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MODELING AND CONTROL OF VARIABLE SPEED DFIG BASED WIND ENERGY CONVERSION SYSTEM

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ABSTRACT

This paper presents the modeling of doubly fed induction generator based wind energy conversion system and control methods for rotor side and grid side converters. Doubly fed induction generators are commonly employed in wind energy conversion systems compared to permanent magnet synchronous generators and squirrel cage induction generator due to their ability to perform in super and sub synchronous modes of operation. The modeling of doubly fed induction generator is implemented such that it enhances the dual mode of operation, thus enabling control of active and reactive power flow in the system. This is achieved by employing stator voltage orientation control and grid voltage orientation control for rotor side and grid side converters respectively.

Keywords: *wind energy conversion system, doubly fed induction generator, rotor side converter, grid side converter*

NOMENCLATURE

V_{ds}, V_{dr} Grid voltage and rotor voltage vectors in d-axis

V_{qs}, V_{qr} Grid voltage and rotor voltage vectors in q-axis

I_{ds}, I_{dr} Grid current and rotor current vectors in d-axis

I_{qs}, I_{qr} Grid current and rotor current vectors in q-axis

P_s, Q_s	Active and reactive power of grid side
θ_s	Grid angular frequency
θ_r	Rotor angular speed
P_m	Mechan ical power
T_m	Mechanical torque
T_e	Electro-magnetic torque
L_s	Self-inductance
W_i	Machine speed in synchronous reference frame
W_r	Rotor speed
Lm	Mutual inductance
φ	Generator flux
f	Grid frequency
T_m	Mechanical torque
T_e	Electrical swing torque
β_s ,β_r	Grid voltage and rotor voltage angle
d, q	Synchronous d- and q- axis

1. INTRODUCTION

Global energy consumption is rising sharply posing a huge demand for electricity. Most of the power is generated from conventional power stations utilizing fossil fuels which not only lead to depletion of these fuels but also aid in global warming. From the past two decades, power generation using renewable energy sources gained a lot of awareness and most of the developed countries have successfully integrated a significant portion of renewable power generation to the conventional power grid. Major renewable energy sources are solar, wind, small hydro, biogas, geothermal etc. out of which solar and wind are only two renewable sources which became more popular than others due to their versatile nature [1]. Wind energy is an indirect form of solar energy because the sun's differential heating of the earth's surface causes wind. Wind energy is the kinetic energy associated with the movement of atmospheric air. The kinetic energy present in the wind is converted into mechanical energy through a wind turbine, which in turn is converted into electrical energy through an electrical generator. This process of conversion of wind energy into electrical energy is known as Wind Energy Conversion System (WECS). WECS can be classified as fixed speed WECS and variable Speed WECS. In variable speed WECS, Doubly Fed Induction Generator (DFIG) has many advantages over Permanent Magnet Synchronous Generator (PMSG) and Squirrel Cage Induction Generator (SCIG) in terms of system efficiency and cost effectiveness. With increased penetration of wind energy into grid, wind turbine should be capable of handling faults for small period of time and remain connected to the grid during and after the fault to maintain the reliability of the system. DFIG exhibits enhanced controllability and extended speed range. Using vector control, DFIG enables decoupling of active and reactive power in addition to torque and flux. This feature helps in independent control of active and reactive power flow. Also, a cost effective power converter can be employed with a power requirement of (20-30) % of stator power [2-3].

DFIG is wound rotor induction generator whose stator output is directly connected to the grid and the rotor output is also connected to grid via back to back converters namely, Rotor Side Converter (RSC) and Grid Side Converter (GSC) with a DC-link capacitor in between these converters as shown in Fig. 1. Both RSC and GSC have their own specialized functions. RSC controls the active power flow from stator and reactive power flow in rotor, whereas GSC controls the DC link voltage and reactive power flow into the grid. Different control techniques are employed in these converters via. direct torque control, indirect torque control and decoupled P-Q control. Under grid faults conditions or over loaded conditions, reactive power control at generator end is important so that the wind turbine is still under steady state without causing any disturbance to the existing network. In this paper, modeling of DFIG based variable speed WECS has been implemented using MATLAB. Control of RSC and GSC has been implemented using stator and grid voltage orientation control schemes respectively. Simulation results indicated that with change in mechanical torque, the control schemes have maintained the

electrical torque at a constant value ensuring the generated voltage to have a constant value. Also, constant speed of the generator ensures constant frequency for the generator.

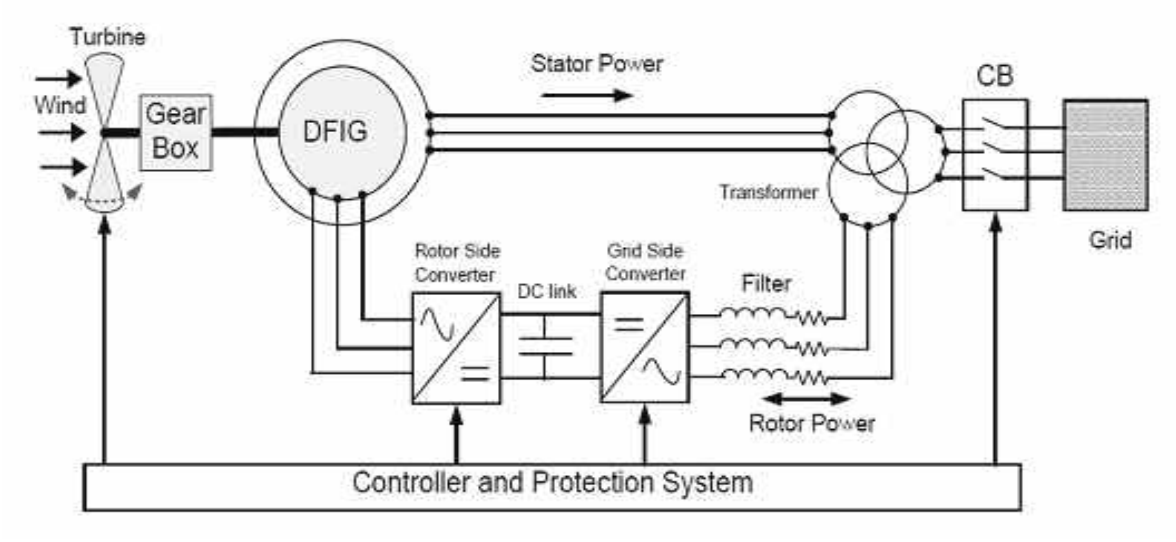

Fig. 1. Layout of DFIG based WECS.

2. MODELLING OF DFIG BASED WECS

In this section, modelling of wind turbine and DFIG is presented along with their respective simulation results and analysis.

2.1 Wind Turbine In WECS, energy conversion occurs in three stages. Initially kinetic energy of wind is converted to mechanical energy with the help of wind turbine, low shaft power is converted to high shaft power through gearbox in the next stage and finally high shaft power is converted into electrical energy [3]. Wind power available in the wind is given by Eq. (1).

$$P_m = \frac{1}{2}\rho A v^3 \tag{1}$$

where ρ = air density (kg/m^3)
A = area swept by the blade (m^2)
v = velocity of the wind (m/s^2)

Mechanical wind power is converted into mechanical torque and is given by Eq. (2)

$$T_m = \frac{P}{W_w} \tag{2}$$

Where W_w = speed of wind turbine (m/s^2)

The electrical torque is given by Eq. (3)

$$Te = \frac{3}{2} * \frac{4}{2} * L_m * \left(I_{dr} * I_{qs} - I_{qr} * I_{ds}\right) \tag{3}$$

From Eq. (2) and Eq. (3) generator rotor speed can be obtained as shown in Eq. (4)

$$W_r = \int \frac{T_e - T_m}{J} \tag{4}$$

Where J = moment of inertia (Kg.m^2)

The MATLAB/Simulink model of the wind turbine is presented in Fig. 2.

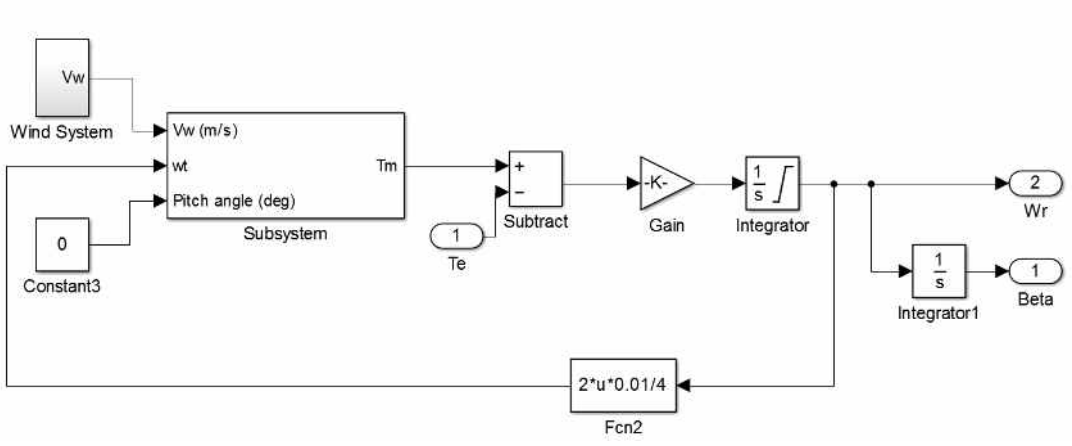

Fig. 2. Wind Turbine MATLAB/Simulink model.

2.2 Doubly Fed Induction Generator DFIG is modeled using the dynamic equations which are equivalent to any fixed speed induction generator [4]-[6]. The voltage equations of stator and rotor are represented by Eq. (5) and Eq. (6) respectively.

$$V_s = R_s I_S + \frac{d\varphi s}{dx} + jw_i \varphi_s \tag{5}$$

$$V_r = R_r I_r + \frac{d\varphi_r}{dx} + j(w_i - w_r)\varphi_r \tag{6}$$

The voltage equations in d-q axis for stator and rotor are represented by Eq. (7) to Eq. (10).

$$V_{sd} = R_s I_{sd} + \frac{d\varphi}{dt} - w_i \varphi_{sq} \tag{7}$$

$$V_{sq} = R_s I_{sq} + \frac{d\varphi}{dt} + w_i \varphi_{sd} \tag{8}$$

$$V_{rd} = R_r I_{rd} + \frac{d\varphi}{dt} - (w_i - W_{r)}\varphi_{rq} \tag{9}$$

$$V_{rq} = R_r I_{rq} + \frac{d\varphi}{dt} + (w_i - W_{r)}\varphi_{rd} \tag{10}$$

The flux linkages of stator and rotor are represented by Eq. (11) and Eq. (12).

$$\varphi_s = L_s I_S + L_m I_r \tag{11}$$

$$\varphi_r = L_r I_r + L_m I_s \tag{12}$$

The flux linking with stator and rotor in d-q axis are represented by Eq. (13) to Eq. (16).

$$\varphi_{sd} = L_s I_{sd} - L_m I_{rq} \tag{13}$$

$$\varphi_{sq} = L_s I_{sq} - L_m I_{rd} \tag{14}$$

$$\varphi_{rd} = L_r I_{rd} + L_m I_{sq} \tag{15}$$

$$\varphi_{rq} = L_r I_{rq} + L_m I_{sd} \tag{16}$$

The park transformation matrix is given by Eq. (17)

$$\begin{bmatrix} V_a \\ V_b \\ V_c \end{bmatrix} = \begin{bmatrix} \cos\emptyset & \sin\emptyset & 1 \\ \cos(120-\emptyset) & \sin(120-\emptyset) & 1 \\ \cos(120+\emptyset) & \sin(120+\emptyset) & 1 \end{bmatrix} \begin{bmatrix} V_q \\ V_d \\ V_0 \end{bmatrix} \tag{17}$$

The MATLAB implementation of DFIG is represented in Fig. 3.

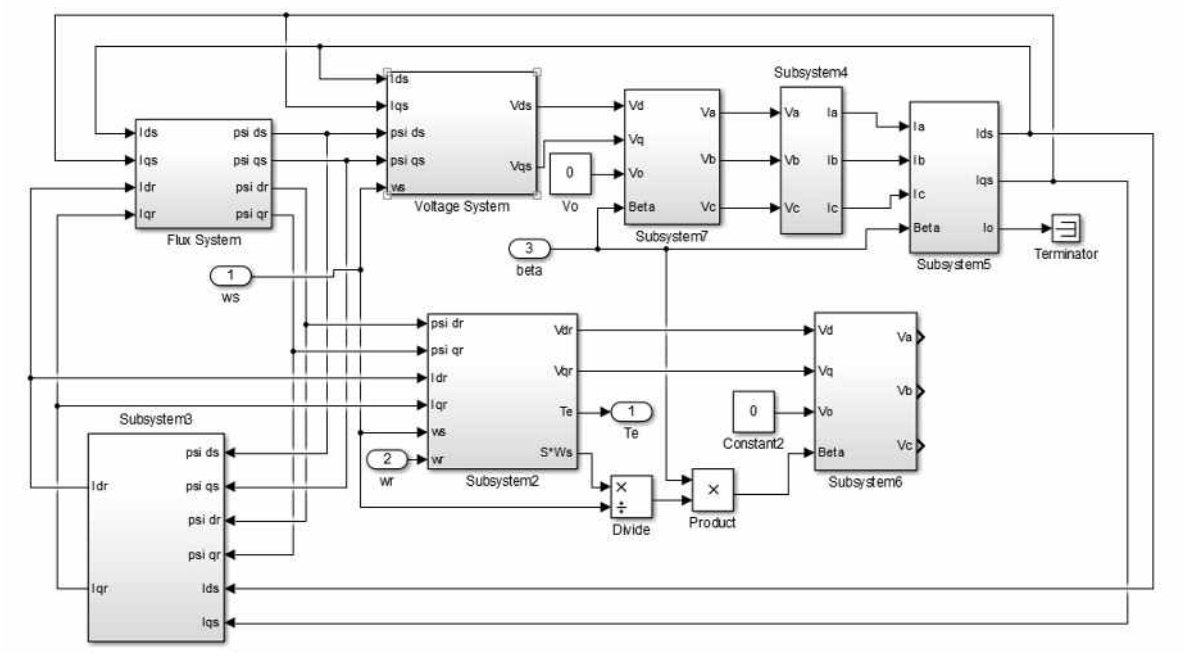

Fig. 3. MATLAB implementation of DFIG.

3. CONTROL SCHEMES

DFIG has two control objectives to be accomplished. The first objective is to maintain constant rotor speed at high wind speeds and the second objective is to control the magnitude and frequency of rotor currents and voltages for Rotor Side Converter (RSC) and Grid Side Converter (GSC). Two control schemes, namely pitch control and speed control are employed to achieve these two objectives in accordance with wind speed variation. The power extracted from wind can be regulated using pitch control which will normalize the turbine speed and ensure that the machine is following a predefined power curve. Speed control is implemented using vector control for RSC and GSC to maintain the power flow on either side of the grid.

3.1 Pitch Control Pitch control is implemented to regulate the power coefficient. The power coefficient has to be maintained constant using tip speed ratio for low or medium wind speeds. During low or medium wind speeds, pitch control is rarely activated and is set to an optimum value. During high wind speed, pitch angle control regulates the extracted wind speed to a predefined or a designed value of the power. The rotor speed has to be maintained constant operating the machine at rated power. To operate the machine at rated power during high wind speed, power coefficient has to be decreased to maintain constant power output. The MATLAB/Simulink implementation of pitch angle control is represented in Fig. 4.

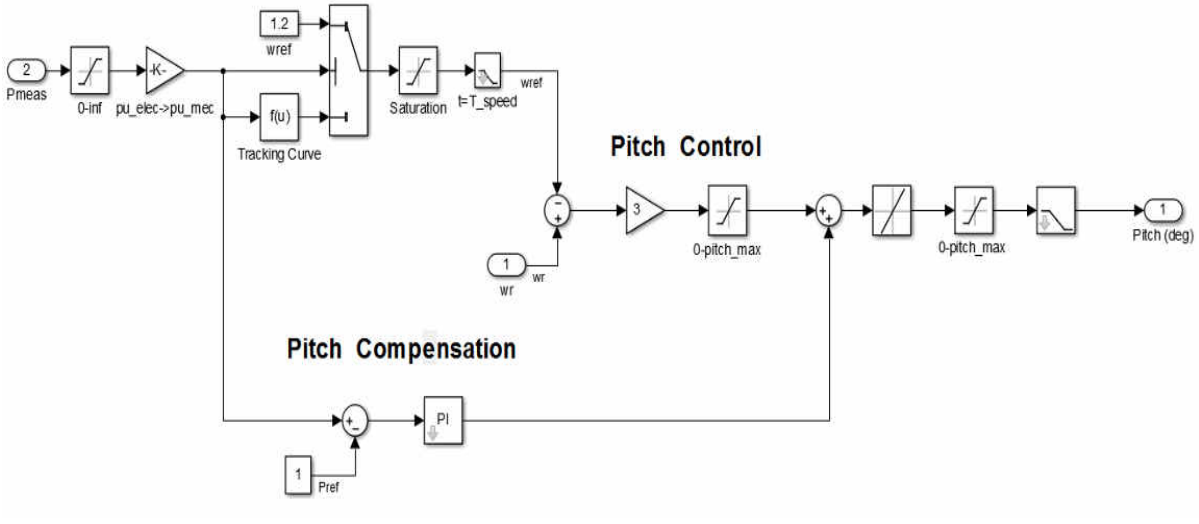

Fig. 4. MATLAB/Simulink implementation of Pitch angle control

3.2 Speed Control The controllability of a DFIG can be enhanced with Rotor Side Converter (RSC) and Grid Side Converter (GSC) which controls the magnitude and frequency of rotor currents and voltages [7-10]. In this section, implementation of vector control for RSC and GSC is presented.

3.2.1 RSC Control The control of wound rotor induction machine is done in synchronously rotating frame of reference i.e. by aligning V_{ds} to supply voltage V_s and V_{qs} to 0 .i.e. $V_{ds}=V_s$ and $V_{qs}=0$ linked with stator voltage space vector. Vector control not only decouples the torque and flux, but also active and reactive powers which enables independent control of active power flow from the stator and the reactive power flow into/from the rotor to/from the load. RSC is modelled as Voltage Source Converter (VSC). Rotor voltage d-q components at slip frequency of rotor speed can be obtained using Proportional Integral (PI) controllers. V_{qr} component is obtained from stator reactive power, whereas from stator active power in cascade with mechanical speed, V_{dr} component is obtained [7-10]. The MATLAB/Simulink implementation of RSC vector control scheme is represented in Fig. 5, where Q_s is the reactive power, T_m is the mechanical torque and T_e is the electromechanical torque generated by the machine. Q_{s*} is considered as a reference value obtained from a predefined power curve of the machine and T_m is also considered as the reference value here.

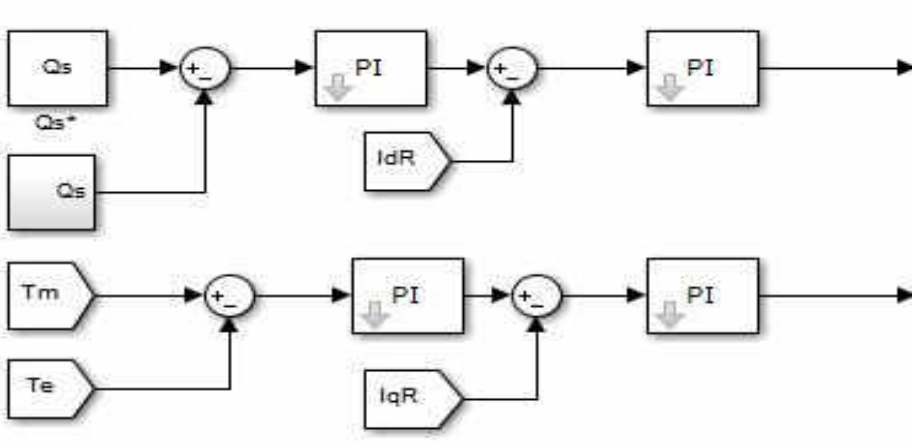

Fig. 5. Vector control scheme for RSC

3.2.2 GSC Control In this control scheme, the GSC is aligned w.r.t synchronously rotating reference frame, which enables independent control of active and reactive power exchange between respective converters and grid. GSC is modeled as Current Controlled Converter (CSC). The main function of GSC control is to maintain DC link voltage at a constant value and monitor the reactive power flow into the grid. This can be achieved by controlling the d-axis and q-axis currents to regulate DC link voltage and reactive power respectively [7-10]. The MATLAB/Simulink implementation of GSC vector control scheme is represented in Fig. 6.

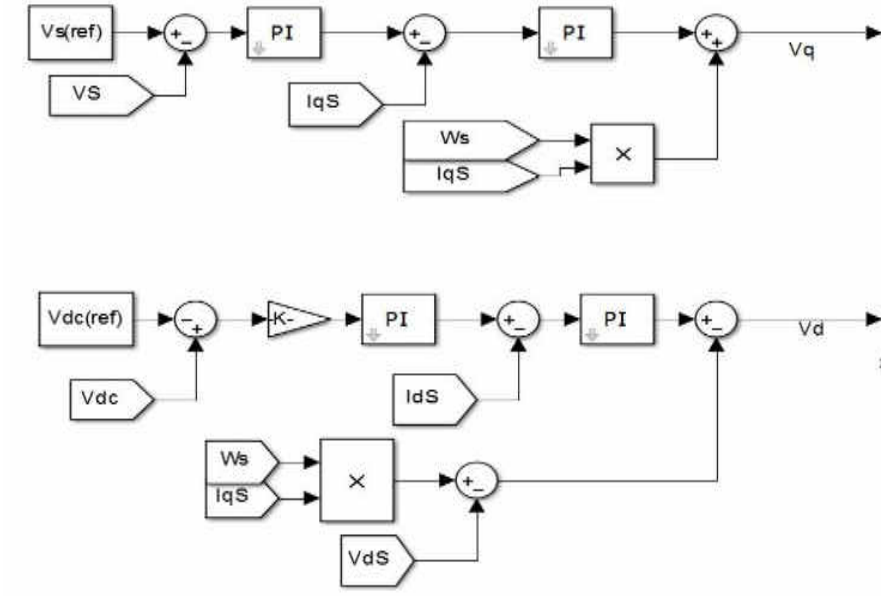

Fig. 6. Vector control scheme for GSC.

4. RESULTS AND DISCUSSION

In the present study, modeling of wind turbine and DFIG based WECS has been done and implemented in MATLAB/Simulink. Simulation results of wind turbine indicate that with the change in the wind speed, there will be some effect on the coefficient of power, C_p. From Fig. 7 it is clear that, C_p will increase with the increase in the wind speed till the cut-off speed and after the cut-off speed, C_p value starts decreasing and finally reaches zero. To protect the wind turbine from getting damaged from high wind speeds, pitch control is implemented. In Fig. 8, the variations of wind with respect to time are shown. With the change in the wind speed the mechanical power also changes accordingly, due to which the power curve will follow this mechanical torque curve which is as shown in Fig. 9 and Fig. 10.

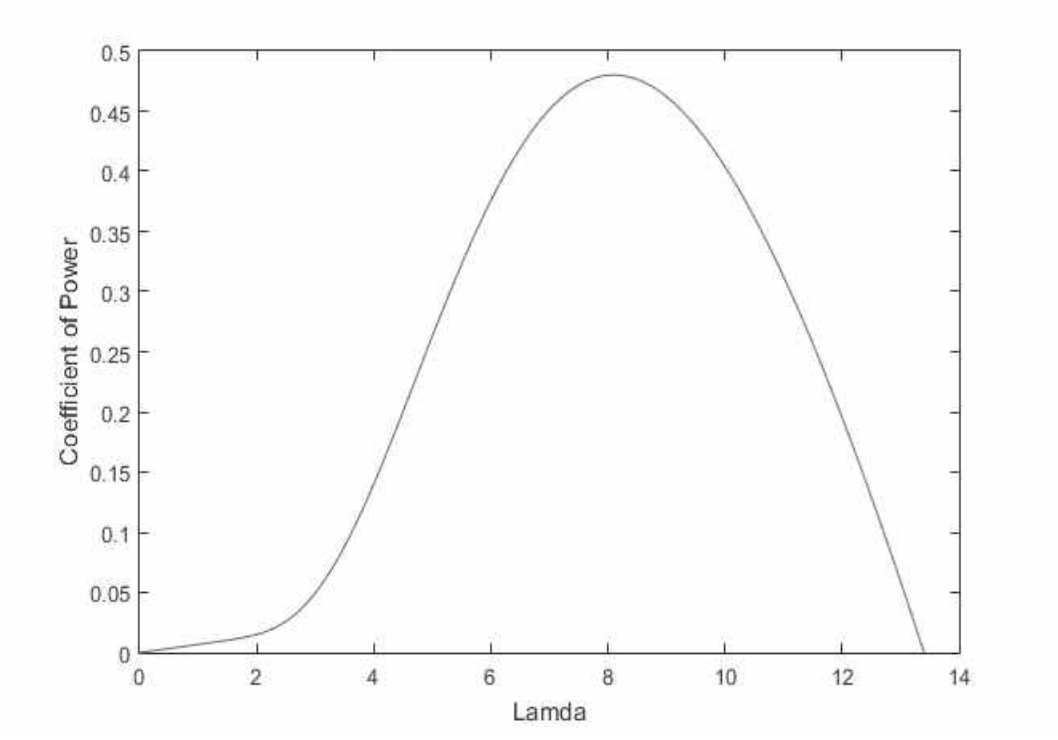

Fig 7. C_p vs Lambda.

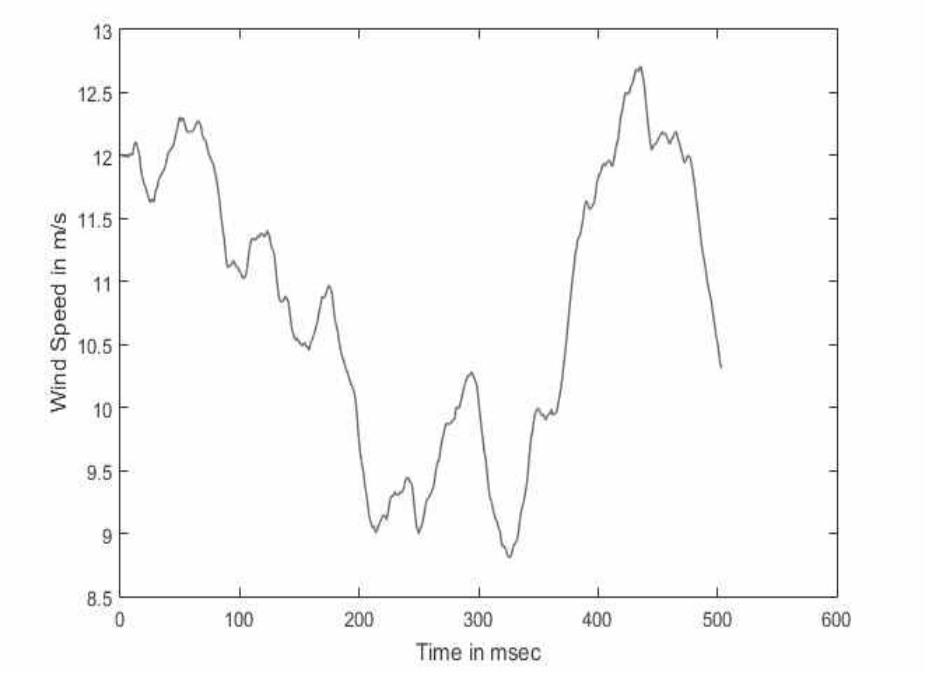

Fig. 8. Wind velocity (m/s) vs Time (s)

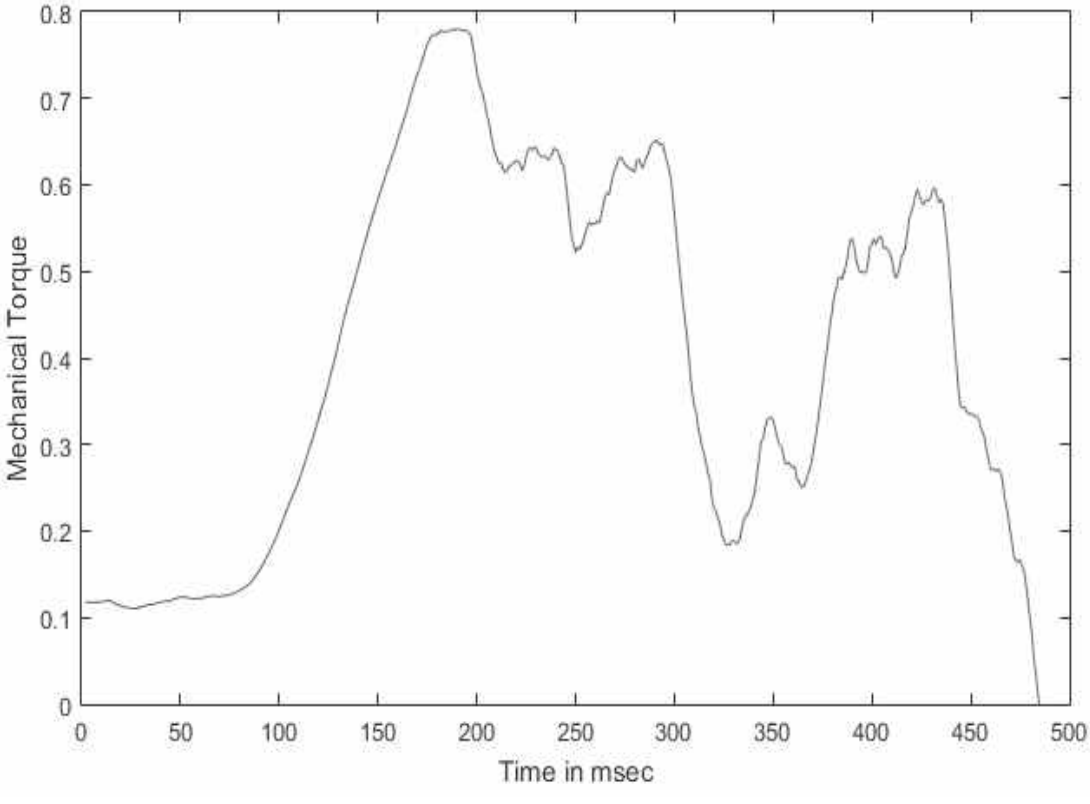

Fig. 9. Mechanical torque vs time

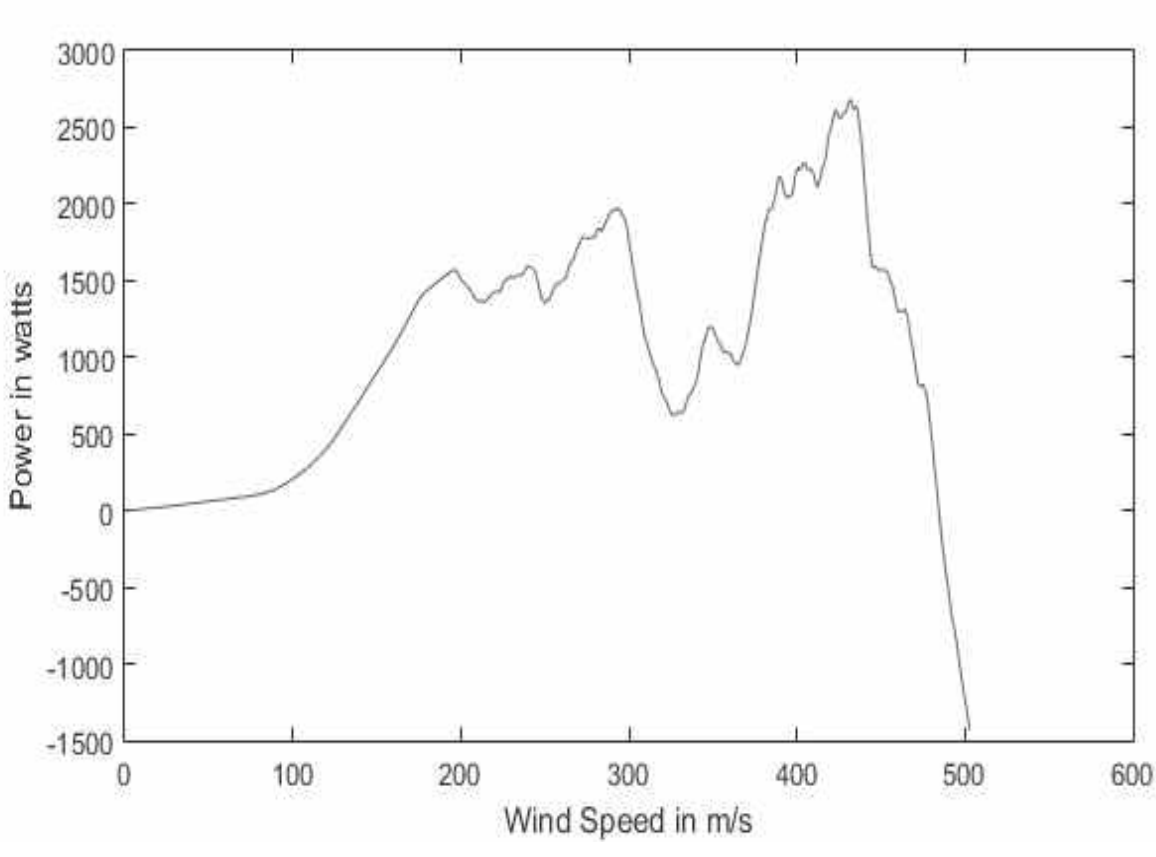

Fig. 10. Power curve.

The MATLAB model of DFIG based WECS is shown in Fig. 11. The generator and wind turbine parameters are considered as presented in Table I. Simulated MATLAB/SIMULINK result of DFIG system and the wind turbine specifications are given in this section.

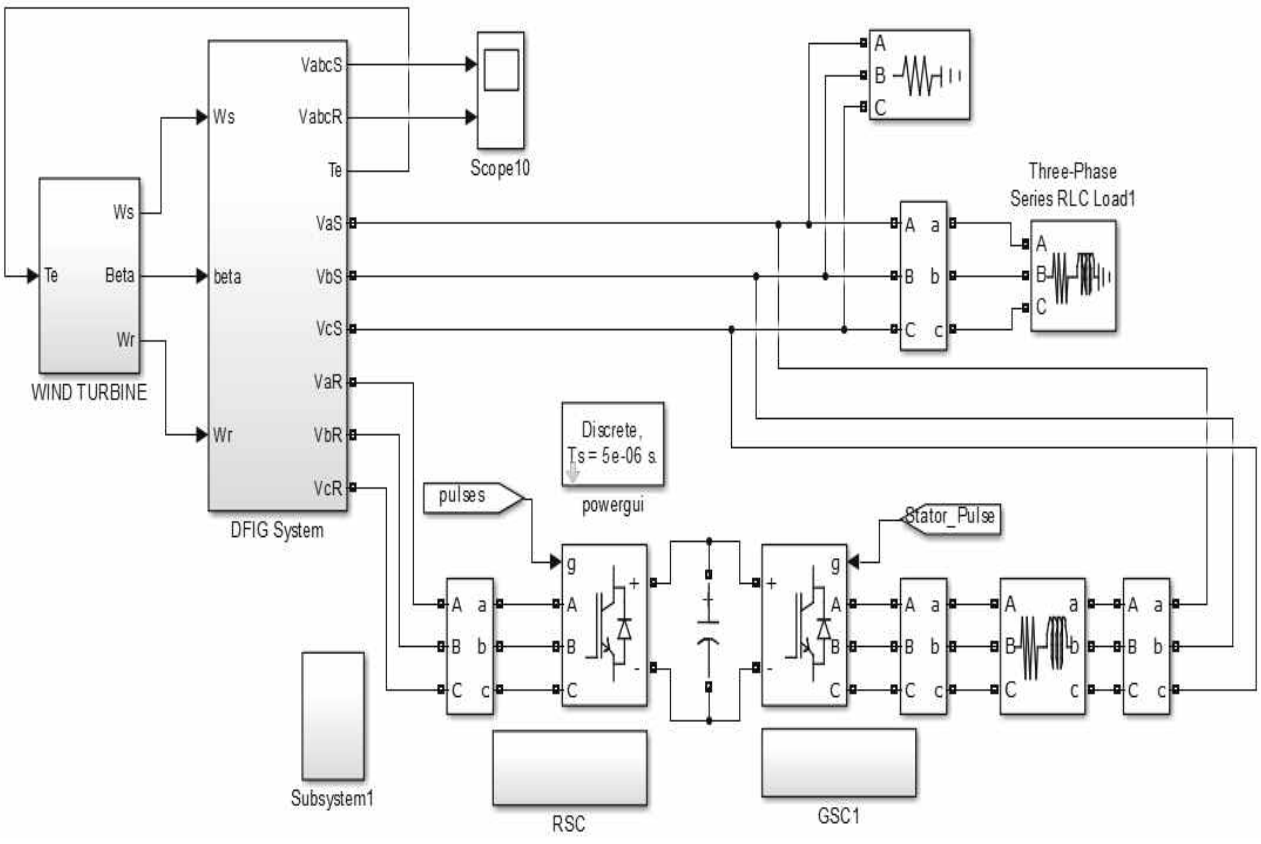

Fig. 11. DFIG based variable speed WECS.

Table 1. System Parameters

Wind Turbine		**DFIG**	
Rated capacity	3 kW	P_{rated}	2 kW
Cut-in wind speed	4 m/s	V_{rated}	440 V
Cut-off wind speed	22 m/s	Stator resistance($R_{s)}$	0.0067 Ω
Number of blades	3	Rotor resistance($R_{r)}$	0.0399 Ω
Rotor diameter	82.5 m	Stator inductance(L_s)	7.468 mH
Swept area	5346 m^2	Rotor inductance(L_r)	52.006 mH
		Mutual Inductance($L_{m)}$	19.37 mH

Stator and rotor outputs for the system under consideration are presented in Fig. 12 and Fig. 13 respectively. The rotor output is the input for RSC and the DC link voltage is the input for GSC converter. The outputs for RSC-GSC are as shown in Fig. 13 and Fig. 14. The electro-mechanical torque, DC link voltage and rotor speed developed by the system, are validating the regulation of the active and reactive power from the converters. The outputs of these are shown in Fig. 15.

The results of RSC and GSC illustrates that the RSC is controlling the slip power in terms of rotor current and voltages by decoupling active and reactive powers. This represents the independent control of active power being fed to the load/grid via stator and reactive power flow into the rotor. GSC is maintaining the DC link voltage at constant value along with the current flowing through the converter is too maintained constant. The reactive power flow from/into the grid and stator supplying the constant active power to the load/grid is made possible with GSC control with constant change in the wind speed. Wind speed reflection in the stator output is been negligibly noticed due the presence of the control schemes namely pitch control and speed control of the machine. This makes the generator to follow the predefined set values of the

power curve for a given set of wind speed values. Therefore we can obtain the steady power flow even in periods of wind speed nearing cut-in speed and cut-off speed without any power interruption to the supply network.

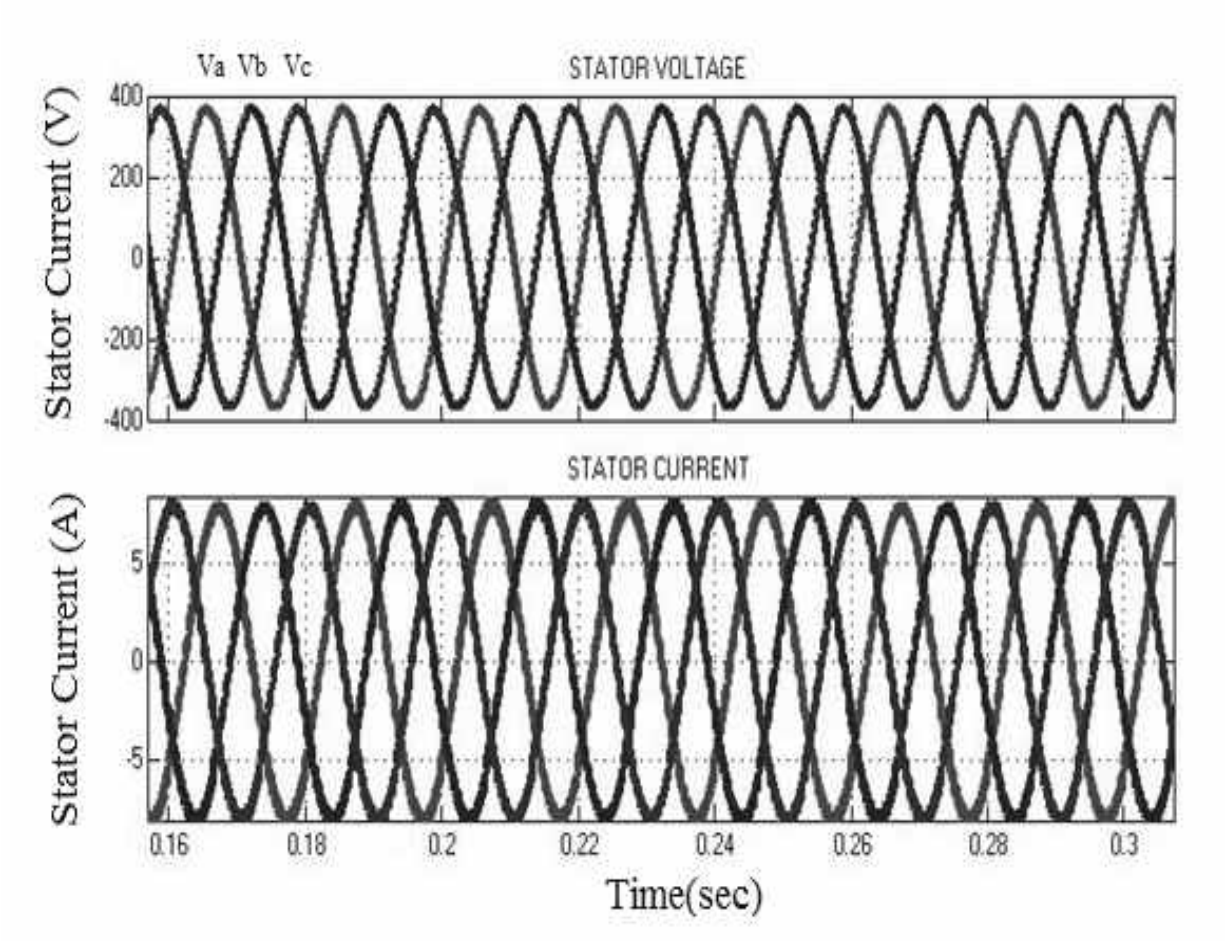

Fig 12. Stator voltage and current outputs of DFIG.

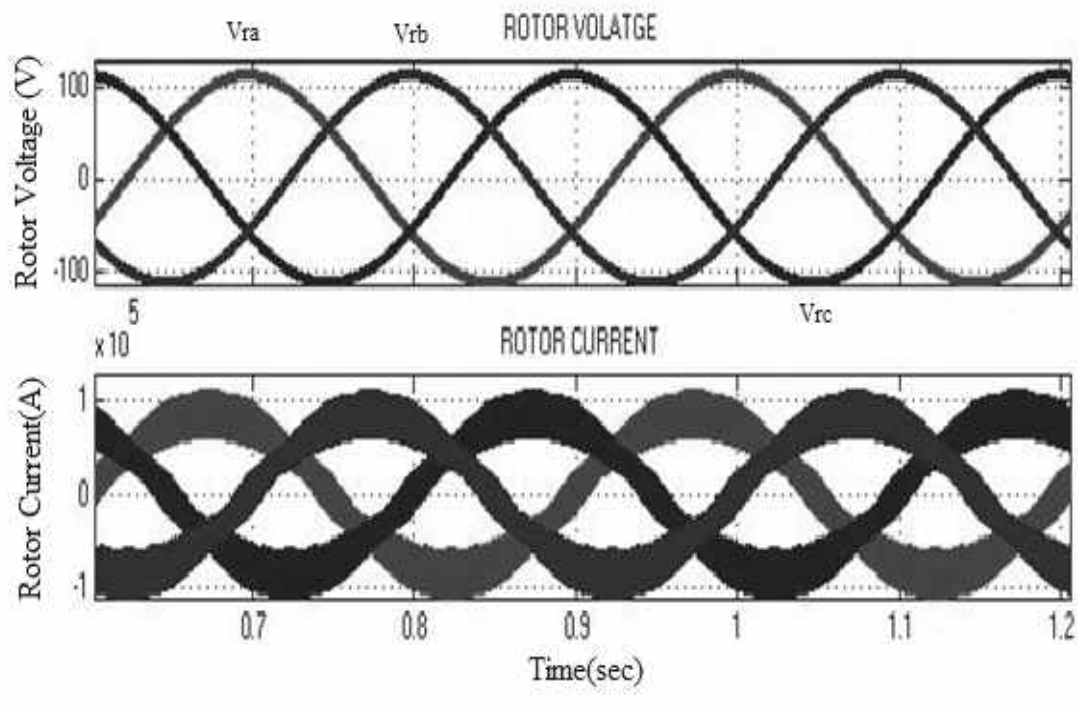

Fig 13. Rotor voltage and current outputs from DFIG.

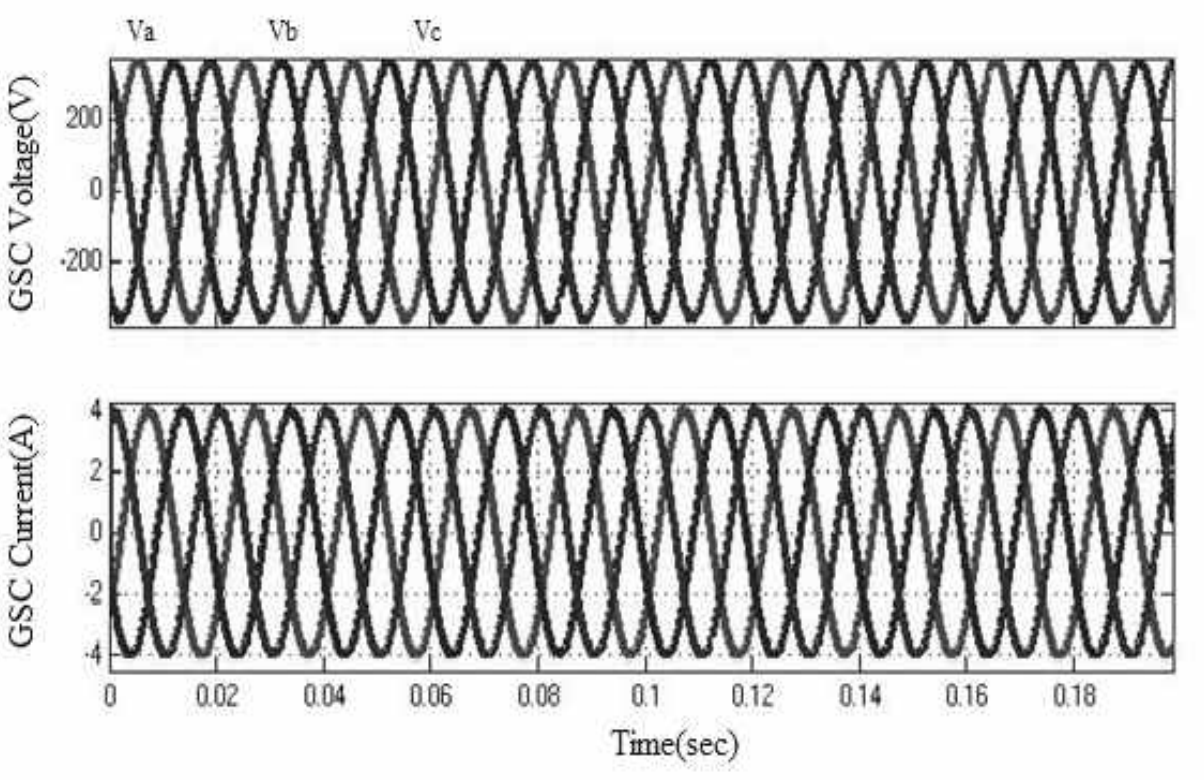

Fig 14. Grid Side Converter controller output.

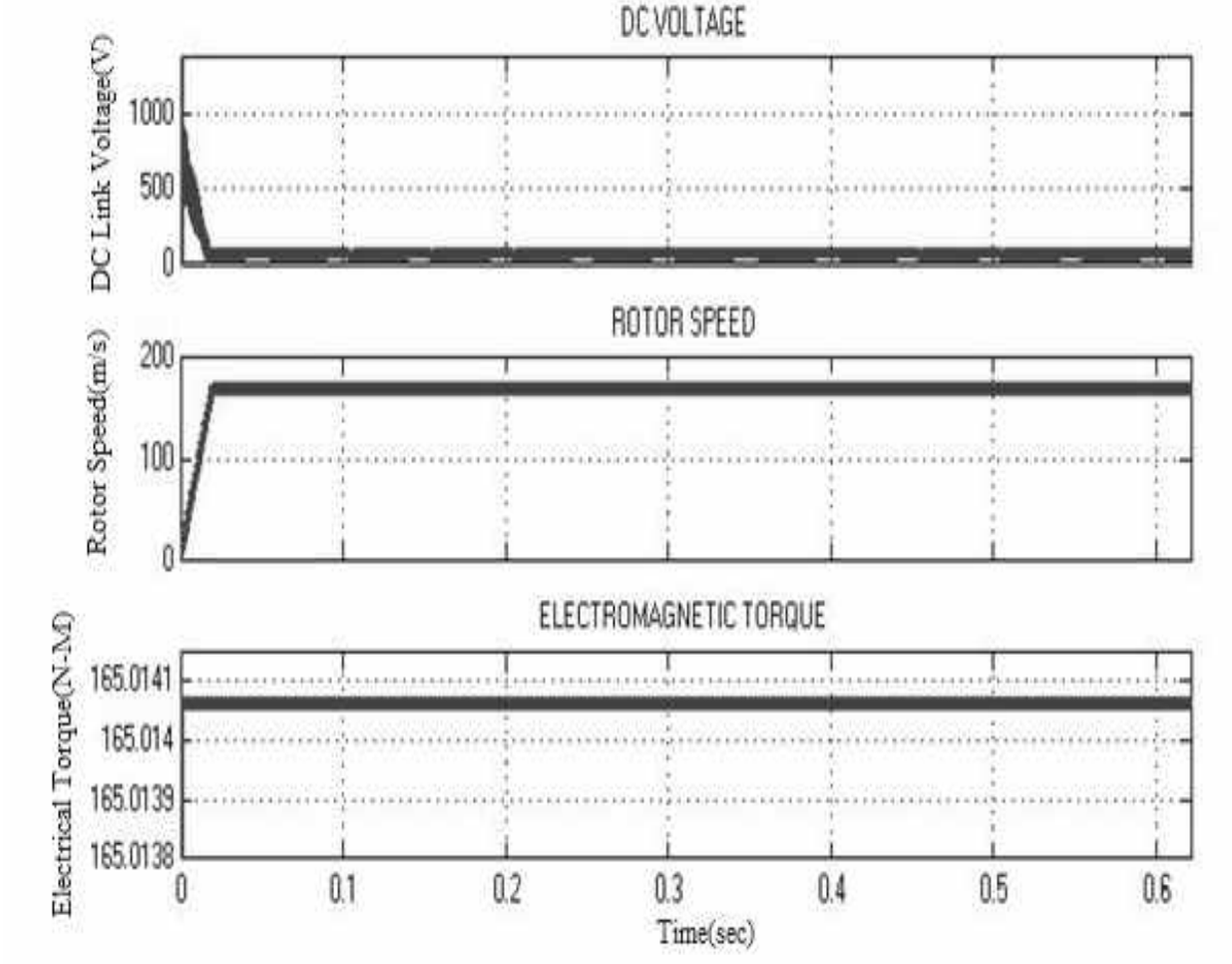

Fig 15. Electro-mechanical torque, rotor speed and dc link voltage of the DFIG based WECS.

5. CONCLUSION

The paper presents the modelling of standalone wind-turbine connected to DFIG. The wind turbine is modelled according to the mechanical power equation of the wind turbine and the DFIG is modelled using the dynamic equations for stator and rotor. Control of RSC and GSC was implemented using vector control technique. The control of RSC is realized by aligning the reference frame to stator voltage vector so as to obtain the control over rotor speed and active and reactive power flow. For GSC, the reference frame is aligned to grid voltage vector to obtain the control over dc-link voltage and reactive power flow into grid. The wind speed control is realized using the pitch control. Modelling of the total DFIG based WECS was implemented in MATLAB/Simulink and the results were illustrated.

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LOAD FLOW ANALYSIS ON IEEE 14 BUS SYSTEM WITH WIND POWER PLANTS (WPP) WITH MATLAB-PSAT

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ABSTRACT

Wind power plants (WPP) are typically large generation facilities connected to the transmission system, although many smaller WPPs are connected to distribution networks. Power flow analyses with Wind Power Plants are important in power system analysis and design. They are necessary for planning, operation, economic scheduling and exchange of power between utilities. The principal information of power flow analysis is to find the magnitude and phase angle of voltage at each bus and the real and reactive power flowing in each transmission lines.

In this paper the application of the wind power plant generic dynamic models is studied. In this analysis, iterative techniques are used due to there no known analytical method to solve the problem. The objective of this paper is to study and analysis power flow in 14 bus system with Wind Power Plant that will help the analysis become easier. Power flow analysis software package like MATLAB and Power System Analysis Toolbox (PSAT) is used.

Keywords: *Load flow, wind turbine-generator, bus, SVC/STATCOM*

1. INTRODUCTION

Wind power plants are different than conventional power plants. The majority of commercially available wind power plants use one of the wind turbine-generator (WTG) technologies listed below. The WTG rating is in the range of 1 to 5 MVA. Figure 1 shows the topology of the generators for each type of WTG.

- Type-1– Fixed-speed, induction generator
- Type-2–Variable slip, induction generators with variable rotor resistance
- Type-3–Variable speed, doubly-fed asynchronous generators with rotor-side converter
- Type-4–Variable speed generators with full converter interface

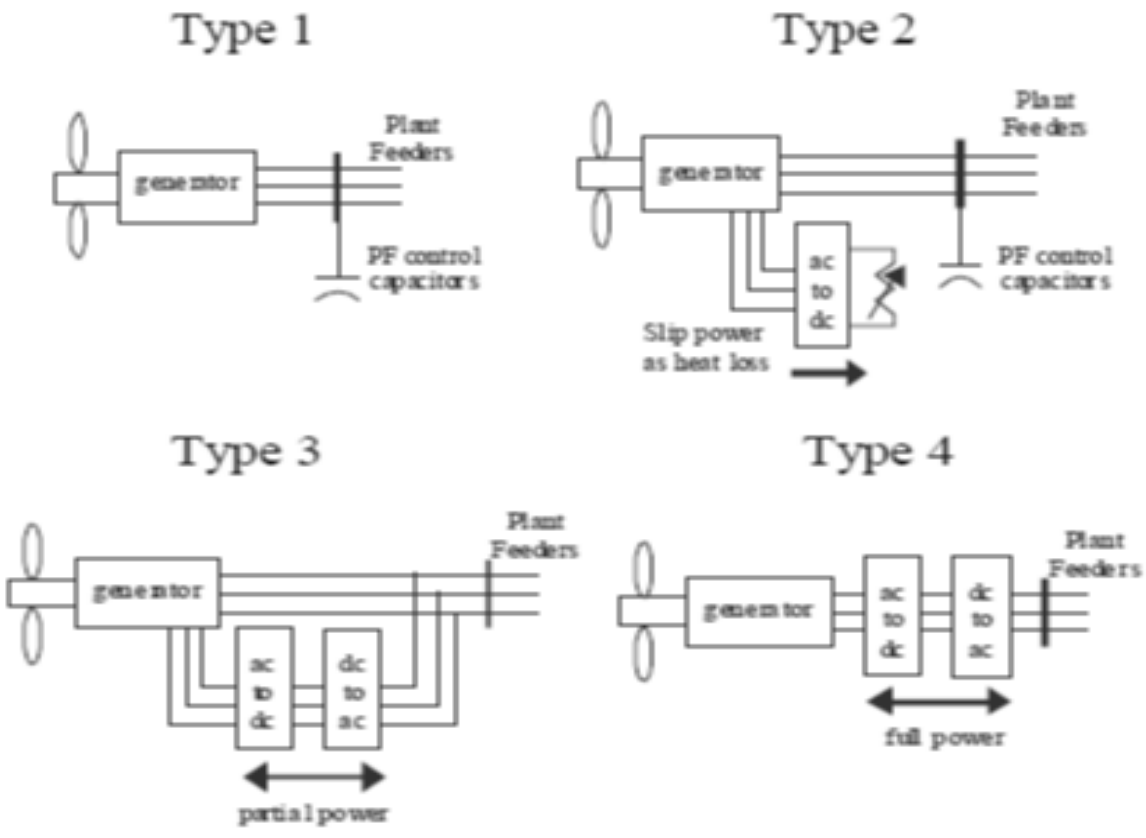

Fig. (1) Classification of WTGs Based on Generator Topology and Grid Interface

2. POWER FLOW ANALYSIS

The Load flow (Power Flow) analysis is an importance tool involving numerical analysis applied to a power system. The advantage in studying power flow analysis is in planning the future expansion of power systems as well as in determining the best operation of existing systems [3]. This sub-chapter will discuss all two methods generally on formula or mathematical step in order to solve power flow problem.

Definition: *"A bus is a node at which one or many lines, one or many loads and generators are connected."*
In a power system each node or bus is associated with 4 quantities in load flow problem, such as

- *Magnitude of voltage,*
- *Phase angle of voltage,*
- *Active or true power and*
- *Reactive power.*

Two out of these 4 quantities are specified and remaining 2 are required to be determined through the solution of equation.

2.1 Bus Classification Depending on the quantities that have been specified, the buses are classified into 3 categories. For load flow studies it is assumed that the loads are constant and they are defined by their real and reactive power consumption. The main objective of the load flow is to find the voltage magnitude of each bus and its angle when the powers generated and loads are pre-specified. To facilitate this we classify the different buses of the power system shown in the chart below.

2.1.1 Slack or Swing Bus Usually this bus is numbered 1 for the load flow studies. This bus sets the angular reference for all the other buses. Since it is the angle difference between two voltage sources that dictates the real and reactive power flow between them, the particular angle of the slack bus is not important. However it sets the reference against which angles of all the other bus voltages are measured. For this reason the angle of this bus is usually chosen as 0°. Furthermore it is assumed that the magnitude of the voltage of this bus is known. In this paper the Wind Generator is connected to the slack bus.

2.1.2 Voltage Controlled Buses: These are the buses where generators are connected. Therefore the power generation in such buses is controlled through a prime mover while the terminal voltage is controlled through the generator excitation [4]. Keeping the input power constant through turbine-governor control and keeping the bus voltage constant using automatic voltage regulator, we can specify constant P_{Gi} and $|V_i|$ for these buses.

2.1.3 Load Buses: In these buses no generators are connected and hence the generated real power P_{Gi} and reactive power Q_{Gi} are taken as zero. The load drawn by these buses are defined by real power $-P_{Li}$ and reactive power $-Q_{Li}$ in which the negative sign accommodates for the power flowing out of the bus. This is why these buses are sometimes referred to as P-Q bus. The objective of the load flow is to find the bus voltage magnitude $|V_i|$ and its angle δ_i.

3. INTRODUCTION LOAD FLOW SOLUTION

In this paper Power flow analysis is being used for solving power flow problem in power system with Wind Power Plant (WPP) by Newton-Raphson method.

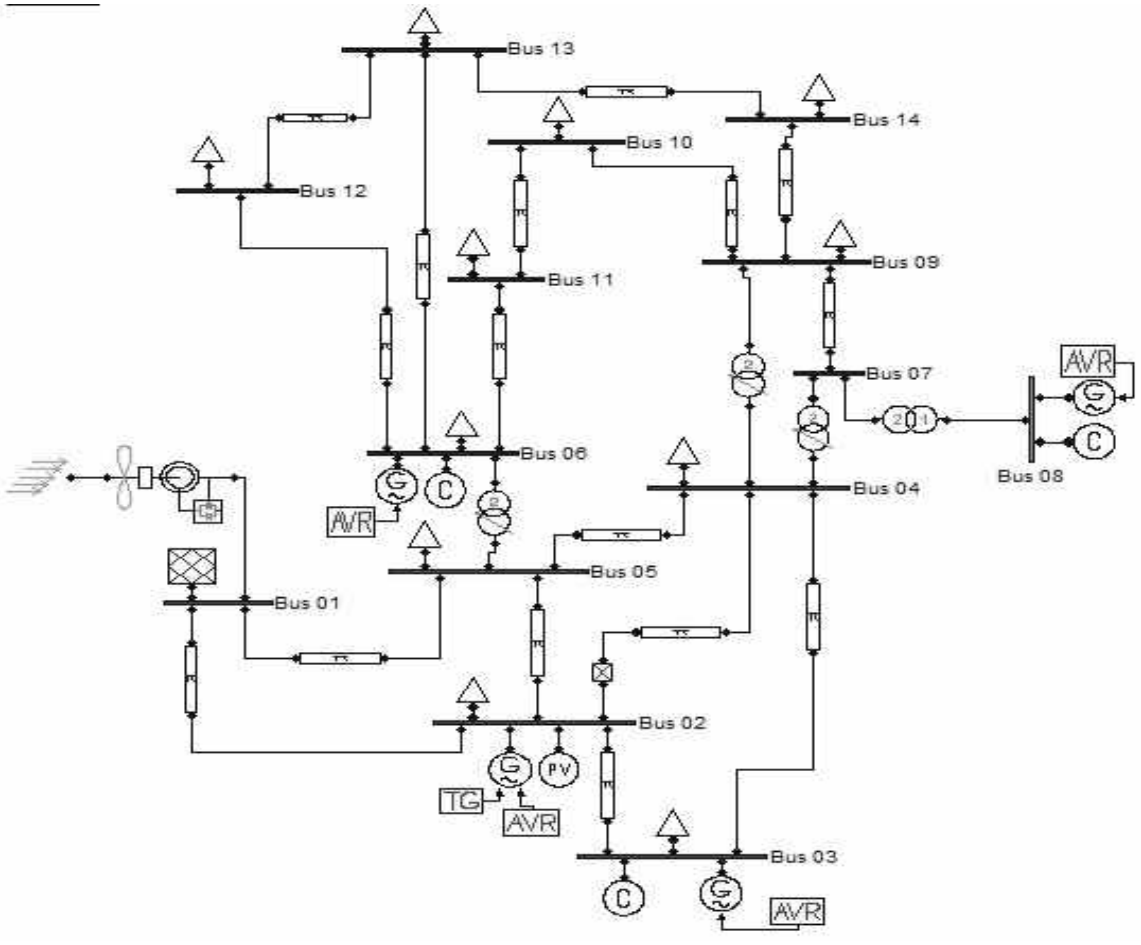

Fig. (3.1) Single line diagram of IEEE 14 bus system

The Load flow (Power Flow) analysis is an importance tool relating numerical analysis applied to a power system. Unlike conventional circuit analysis, a power flow study usually uses simplified notation such as a one-line diagram and per -unit system, and focuses on Reactive, Real and Apparent Power rather than voltage and current. It analyses the power systems in normal steady state operation. There exist a number of software implementations of power flow studies. In this paper MATLAB/PSAT is used for power flow studies.

Newton-Raphson Method The Newton-Raphson method is widely used for solving non-linear equations. It transforms the original non-linear problem into a sequence of linear problems whose solutions approach the solutions of the original problem. Let G=F(x,y) be an equation where the variables x and y are the function of arguments of F. G is a specified quantity. If F is non-linear in nature there may not be a direct solution to get the values of x and y for a particular value of G. in such cases, we take an initial estimate of x and y and iteratively solve for the real values of x and y until the difference is the specified value of G and the calculated value of F(using the estimates of x and y) i.e. ΔF is less than a

tolerance value. The procedure is as follows let the initial estimate of x and y be x^0 and y^0 respectively.

By using Taylor Series

$$G = f(X^o, Y^o) + \left|\frac{\partial F}{\partial X}\right| X^o Y^o . \Delta X + \frac{\partial F}{\partial Y} X^o Y^o . \Delta Y \quad (1)$$

Where $\frac{\partial F}{\partial X}$ *and* $\frac{\partial F}{\partial Y}$ are calculated at X^o *and* Y^o

$$G = f(X^o, Y^o) + \Delta F = \frac{\partial F}{\partial X} . \Delta X + \frac{\partial F}{\partial Y} . \Delta Y \quad (2)$$

In matrix form

$$(\Delta F) = \left(\frac{\partial F}{\partial X} \; \frac{\partial F}{\partial Y}\right)\begin{pmatrix}\Delta X \\ \Delta Y\end{pmatrix} - - -(9) \quad (3)$$

Or

$$\begin{pmatrix}\Delta X \\ \Delta Y\end{pmatrix} = inv\left\{\left(\frac{\partial F}{\partial X} \; \frac{\partial F}{\partial Y}\right)\right\} . (\Delta F) \quad (4)$$

After the first iteration x is updated to x1= x0 + Δx and y to y1 = y0 + Δy. The procedure is continued till after some iteration both ΔF is less than some tolerance value ε. The values of x and y after the final update at the last iteration is considered as the solution of the function F. For the load flow solution, the non-linear equations are given by equation (4). There will be 2n – 2 – p such equations, with n being the total number of buses and p the number of PV and generator buses.

$$\begin{pmatrix}\Delta P \\ \Delta Q\end{pmatrix} = \begin{pmatrix}\frac{\partial P}{\partial \delta} & \frac{\partial P}{\partial |V|} \\ \frac{\partial Q}{\partial \delta} & \frac{\partial F}{\partial |V|}\end{pmatrix} . \begin{pmatrix}\Delta \delta \\ \Delta |V|\end{pmatrix} \quad (5)$$

Or

$$\begin{pmatrix}\Delta \delta \\ \Delta |V|\end{pmatrix} = inv\left\{\begin{pmatrix}\frac{\partial P}{\partial \delta} & \frac{\partial P}{\partial |V|} \\ \frac{\partial Q}{\partial \delta} & \frac{\partial F}{\partial |V|}\end{pmatrix}\right\} . \begin{pmatrix}\Delta P \\ \Delta Q\end{pmatrix} \quad (6)$$

The matrix of equation (6) consisting of the partial differentials, is known as the Jacobian matrix and is very often denoted as J.ΔP is the difference between the specified value of P (P^{sp}) and the calculated value of P using the estimates of δ and |V| in a previous iteration. We calculate ΔQ similarly. The Newton power flow is the most robust power flow algorithm used in practice. However, one drawback to its use is the fact that the terms in the Jacobian matrix must be recalculated each iteration, and then the entire set of linear equations in equation (6) must also be resolved each iteration. Since thousands of complete power flow are often run for planning or operations study, ways to speed up this process were devised.

4. RESULTS AND DISCUSSION

In this paper an IEEE 14 bus system is implemented with Wind Power Plant and its Power flow is analyzed. The generated is represented using R, L and E series. Line is represented by series impedance model. Figure 3.1 shows the topology of a 14 bus system with large wind power plant. The WTGs connect to medium voltage radial feeders, each of which can be several miles long. Each WTG has a dedicated step-up transformer. Most plants have a plant controller that coordinates the operation of passive (capacitors) and active (SVC/STATCOM or the WTG converters) in order to meet requirements at the point of connection.

Load flow analysis is carried out in IEEE 14 bus test system. Output Voltage magnitude and Voltage Angle values from Newton-Raphson method for IEEE 14 bus system are anayasied with and without the compensators. All data's are in per unit and Angle is given in radian.

NETWORK STATISTICS	
Buses	**14**
Lines	**16**
Transformers	**04**
Generators	**04**
Loads	**11**

SOLUTION STATISTICS	
Number of Iterations	**3**
Maximum P mismatch [p.u.]	**3.4925**
Maximum Q mismatch [p.u.]	**0.75077**
Power rate [MVA]	**100**

4.1 LOAD FLOW ANALYSIS WITHOUT COMPENSATORS The following tables show the Power Flow Results of IEEE 14 Bus Test System without any compensators. The Table 4.1 shows Voltages, load angle, Active and Reactive powers at different bus.

Table 4.1: Bus Voltages, Load angle, Active and Reactive Power

Bus	**V**	**phase**	**P gen**	**Q gen**	**P load**	**Q load**
	[p.u.]	**[rad]**	**[p.u.]**	**[p.u.]**	**[p.u.]**	**[p.u.]**
Bus 01	1.0479	0.67577	3.5837	0.02171	0	0
Bus 02	1.045	0.57631	0.4	2.3661	0.3038	0.1778
Bus 03	0.87313	0.34775	0	0	1.3188	0.266
Bus 04	0.85086	0.38272	0	0	0.6692	0.056
Bus 05	0.88357	0.44455	0	0	0.1064	0.0224
Bus 06	0.83817	0.26073	0	0	0.1568	0.105
Bus 07	0.81996	0.28727	0	0	0	0
Bus 08	0.81996	0.28727	0	0	0	0
Bus 09	0.79691	0.2325	0	0	0.413	0.2324
Bus 10	0.79209	0.22725	0	0	0.126	0.0812
Bus 11	0.80908	0.23971	0	0	0.049	0.0252
Bus 12	0.81265	0.22963	0	0	0.0854	0.0224
Bus 13	0.8033	0.2269	0	0	0.189	0.0812
Bus 14	0.76979	0.19228	0	0	0.2086	0.07

The Table 4.2 and Table 4.3 shows the line flows of Active and Reactive powers from one bus to the other bus and vises versa.

Table 4.2: Line Flows Form One Bus to Other Bus

From Bus	To Bus	Line	P Flow	Q Flow	P Loss	Q Loss
			[p.u.]	[p.u.]	[p.u.]	[p.u.]
Bus 02	Bus 05	1	0.93067	0.69285	0.07156	0.18666
Bus 06	Bus 12	2	0.10042	0.03665	0. 002	0.00416
Bus 12	Bus 13	3	0.02294	0.01269	0.00023	0.00021

From Bus	To Bus	Line	P Flow	Q Flow	P Loss	Q Loss
			[p.u.]	[p.u.]	[p.u.]	[p.u.]
Bus 06	Bus 13	4	0.23078	0.11013	0.00616	0.01212
Bus 06	Bus 11	5	0.10633	0.07255	0.00224	0.00469
Bus 11	Bus 10	6	0.06111	0.04576	0.00073	0.00171
Bus 09	Bus 10	7	0.04935	0.02699	0.00016	0.00042
Bus 09	Bus 14	8	0.10619	0.03184	0.00246	0.00523
Bus 14	Bus 13	9	-0.07845	-0.03453	0.00212	0.00432
Bus 07	Bus 09	10	0.32514	0.18071	0	0.02264
Bus 01	Bus 02	11	1.7018	-0.44401	0.05415	0.10752
Bus 03	Bus 02	12	-1.132	-0.38616	0.0874	0.32759
Bus 03	Bus 04	13	-0.09218	0.13925	0.00279	-0.01859
Bus 01	Bus 05	14	1.1005	0.58882	0.07825	0.27683
Bus 05	Bus 04	15	1.2098	0.33174	0.02697	0.07543
Bus 02	Bus 04	16	0	0	0	0
Bus 05	Bus 06	17	0.5763	0.46638	0	0.15412
Bus 04	Bus 09	18	0.18829	0.14233	0	
Bus 04	Bus 07	19	0.32514	0.22375	0	0.04304
Bus 08	Bus 07	20	0	0	0	0

Table 4.3: Line Flows Form One Bus to Other Bus

From Bus	To Bus	Line	P Flow	Q Flow	P Loss	Q Loss
			[p.u.]	[p.u.]	[p.u.]	[p.u.]
Bus 05	Bus 02	1	-0.85911	-0.50618	0.07156	0.18666
Bus 12	Bus 06	2	-0.09842	-0.03249	0.002	0.00416
Bus 13	Bus 12	3	-0.02271	-0.01248	0.00023	0.00021
Bus 13	Bus 06	4	-0.22462	-0.09801	0.00616	0.01212
Bus 11	Bus 06	5	-0.10409	-0.06786	0.00224	0.00469
Bus 10	Bus 11	6	-0.06038	-0.04405	0.00073	0.00171
Bus 10	Bus 09	7	-0.0492	-0.02657	0.00016	0.00042
Bus 14	Bus 09	8	-0.10373	-0.02661	0.00246	0.00523
Bus 13	Bus 14	9	0.08057	0.03884	0.00212	0.00432
Bus 09	Bus 07	10	-0.32514	-0.15807	0	0.02264
Bus 02	Bus 01	11	-1.6476	0.55152	0.05415	0.10752
Bus 02	Bus 03	12	1.2194	0.71375	0.0874	0.32759
Bus 04	Bus 03	13	0.09497	-0.15784	0.00279	-0.01859
Bus 05	Bus 01	14	-1.0223	-0.31199	0.07825	0.27683
Bus 04	Bus 05	15	-1.1828	-0.2563	0.02697	0.07543
Bus 04	Bus 02	16	0	0	0	0
Bus 06	Bus 05	17	-0.5763	-0.31226	0	0.15412
Bus 09	Bus 04	18	-0.18829	-0.10214	0	0.04019

From Bus	To Bus	Line	P Flow	Q Flow	P Loss	Q Loss
			[p.u.]	[p.u.]	[p.u.]	[p.u.]
Bus 07	Bus 04	19	-0.32514	-0.18071	0	0.04304
Bus 07	Bus 08	20	0	0	0	0

4.2 LOAD FLOW ANALYSIS WITH COMPENSATORS The following tables show the Power Flow Results of IEEE 14 Bus Test System with compensators like. The Table 4.4 shows Voltages, load angle, Active and Reactive powers at different bus.

Table 4.4: Bus Voltages, Load angle, Active and Reactive Power

Bus	**V**	**phase**	**P gen**	**Q gen**	**P load**	**Q load**
	[p.u.]	**[rad]**	**[p.u.]**	**[p.u.]**	**[p.u.]**	**[p.u.]**
Bus 01	1.0564	0.03595	3.5203	-0.28197	0	0
Bus 02	1.0456	-0.08824	0.4	0.9486	0.3038	0.1778
Bus 03	1.0063	-0.32902	0	0.59736	1.3188	0.266
Bus 04	0.97721	-0.29692	0	0	0.6692	0.056
Bus 05	0.98586	-0.23688	0	0	0.1064	0.0224
Bus 06	1.0629	-0.38848	0	0.44433	0.1568	0.105
Bus 07	1.0235	-0.36847	0	0	0	0
Bus 08	1.0847	-0.36858	0	0.33402	0	0
Bus 09	1.0001	-0.40598	0	0	0.413	0.2324
Bus 10	1.0004	-0.40985	0	0	0.126	0.0812
Bus 11	1.0261	-0.40191	0	0	0.049	0.0252
Bus 12	1.0388	-0.41008	0	0	0.0854	0.0224
Bus 13	1.0288	-0.4114	0	0	0.189	0.0812
Bus 14	0.98656	-0.43437	0	0	0.2086	0.07

The Table 4.5 and Fig 4.6 shows the line flows of Active and Reactive powers from one bus to the other bus and vises versa

Table 4.5: Line Flows Form One Bus to Other Bus

From Bus	To Bus	Line	P Flow	Q Flow	P Loss	Q Loss
			[p.u.]	[p.u.]	[p.u.]	[p.u.]
Bus 02	Bus 05	1	0.91857	0.10528	0.04475	0.10152
Bus 06	Bus12	2	0.11512	0.0456	0.00167	0.00347
Bus 12	Bus 13	3	0.02924	0.02004	0.00026	0.00023
Bus 06	Bus 13	4	0.2662	0.14541	0.00539	0.01061
Bus 06	Bus 11	5	0.13665	0.13198	0.00303	0.00635
Bus 11	Bus 10	6	0.08552	0.10089	0.00136	0.00319
Bus 09	Bus 10	7	0.03898	-0.01822	6e-005	0.00016
Bus 09	Bus 14	8	0.10466	0.00224	0.00139	0.00296
Bus 14	Bus 13	9	-0.10101	-0.06927	0.00263	0.00536

From Bus	To Bus	Line	P Flow	Q Flow	P Loss	Q Loss
			[p.u.]	[p.u.]	[p.u.]	[p.u.]
Bus 07	Bus 09	10	0.34888	0.22431	0	0.01807
Bus 01	Bus 02	11	2.188	-0.4091	0.08563	0.20313
Bus 03	Bus 02	12	-1.2103	0.21831	0.07066	0.25157
Bus 03	Bus 04	13	-0.10089	0.19585	0.00369	-0.02463
Bus 01	Bus 05	14	1.3045	0.16356	0.08415	0.29602
Bus 05	Bus 04	15	1.3176	-0.18012	0.02426	0.0642
Bus 02	Bus 04	16	0	0	0	0
Bus 05	Bus 06	17	0.67373	0.02977	0	0.10244
Bus 04	Bus 09	18	0.19736	0.026	0	0.02167
Bus 04	Bus 07	19	0.3496	-0.10355	0	0.02785
Bus 08	Bus 07	20	-0.00071	0.37699	0	0.02128

Table 4.6: Line Flows Form One Bus to Other Bus

From Bus	To Bus	Line	P Flow	Q Flow	P Loss	Q Loss
			[p.u.]	[p.u.]	[p.u.]	[p.u.]
Bus 05	Bus 02	1	-0.87382	-0.00376	0.04475	0.10152
Bus 12	Bus 06	2	-0.11345	-0.04213	0.00167	0.00347
Bus 13	Bus 12	3	-0.02898	-0.01981	0.00026	0.00023
Bus 13	Bus 06	4	-0.26082	-0.1348	0.00539	0.01061
Bus 11	Bus 06	5	-0.13362	-0.12562	0.00303	0.00635
Bus 10	Bus 11	6	-0.08416	-0.09769	0.00136	0.00319
Bus 10	Bus 09	7	-0.03892	0.01838	6e-005	0.00016
Bus 14	Bus 09	8	-0.10327	0.00072	0.00139	0.00296
Bus 13	Bus 14	9	0.10364	0.07463	0.00263	0.00536
Bus 09	Bus 07	10	-0.34888	-0.20624	0	0.01807
Bus 02	Bus 01	11	-2.1024	0.61223	0.08563	0.20313
Bus 02	Bus 03	12	1.2809	0.03326	0.07066	0.25157
Bus 04	Bus 03	13	0.10458	-0.22048	0.00369	-0.02463
Bus 05	Bus 01	14	-1.2204	0.13246	0.08415	0.29602
Bus 04	Bus 05	15	-1.2934	0.24432	0.02426	0.0642
Bus 04	Bus 02	16	0	0	0	0
Bus 06	Bus 05	17	-0.67373	0.07266	0	0.10244
Bus 09	Bus 04	18	-0.19736	-0.00433	0	0.02167
Bus 07	Bus 04	19	-0.3496	0.1314	0	0.02785
Bus 07	Bus 08	20	0.00071	-0.35571	0	0.02128

The following table 4.7 shows the comparison between the compensated and un-compensated results of the IEEE 14 Bus system. Its shows clearly that by using the Compensators the voltage regulation and Reactive power is compensated.

Table 4.7: Line Flows Form One Bus to Other Bus

Total	Without Compensators		With Compensators	
	P {p.u.]	Q [p.u.]	P [p.u.]	Q [p.u.]
Generation	3.9837	2.3878	3.626	1.1396
Load	3.626	1.1396	3.626	1.1396
Losses	0.3577	1.2482	0.2943	0.90275

5. SIMULATION WAVEFORMS

The following results fig (5.1), (5.2) & (5.3) shows the reference voltage reference speed of wind turbine and generated wind output in p.u values

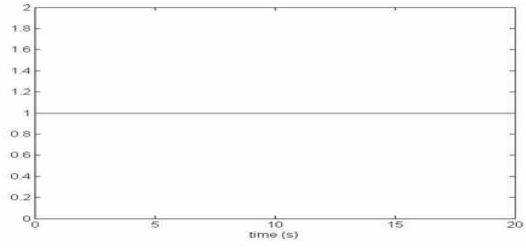

Fig (5.1) Ref Voltage at Bus-01

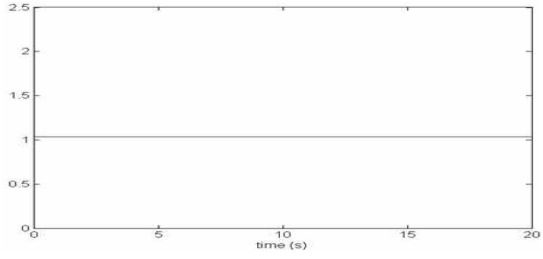

Fig (5.2) Ref speed of Wind Turbine at Bus-01

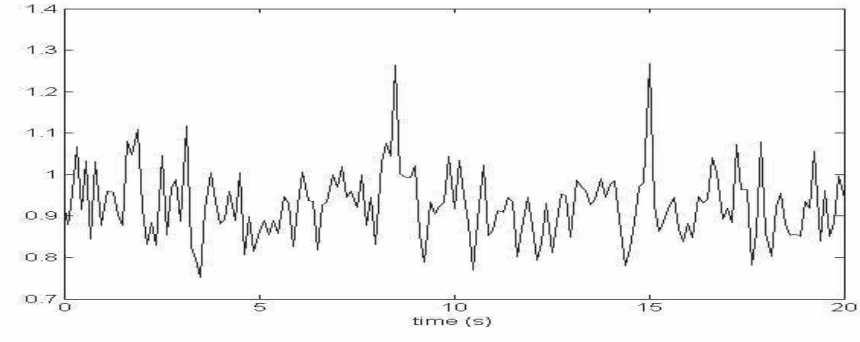

Fig (5.3) Generated speed of Wind Turbine at Bus-01

5.3.1 Bus Voltages: The following Figs from Fig (5.4) to Fig (5.8) shows voltage at different buses like Bus-01, Bus-2, Bus-3, Bus-6 and Bus-8

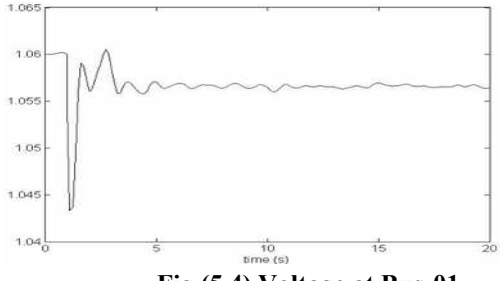

Fig (5.4) Voltage at Bus-01

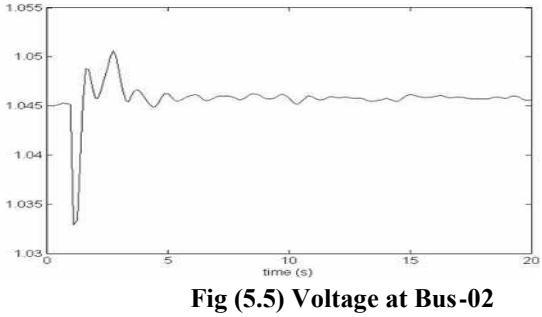

Fig (5.5) Voltage at Bus-02

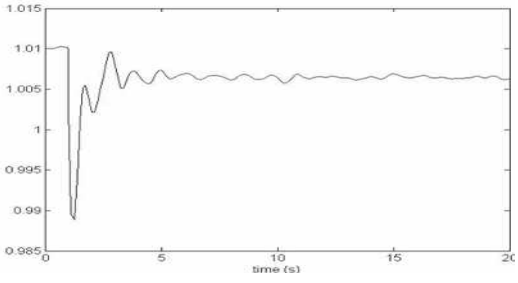

Fig (5.6) Voltage at Bus-03

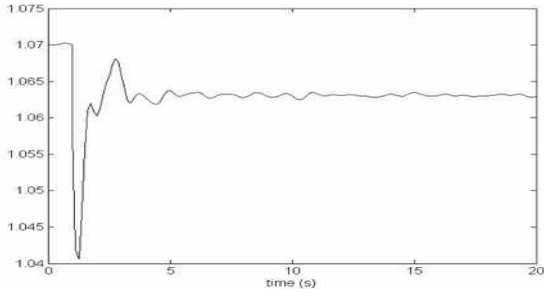

Fig (5.7) Voltage at Bus-06

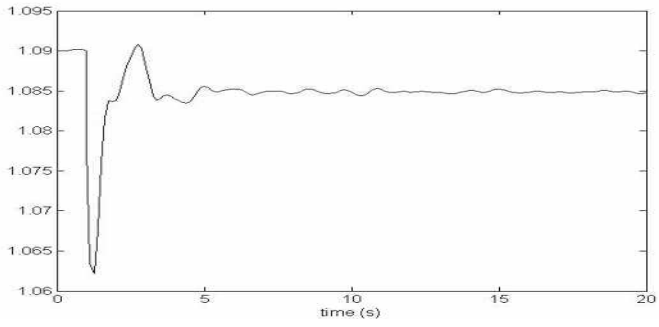

Fig (5.8) Voltage at Bus-08

5.3.2 Line Active Power and Reactive Power The following Figs from Fig (5.9) - Fig (5.11) and Fig (5.12) - Fig (5.14) shows active and reactive powers flows through different Lines

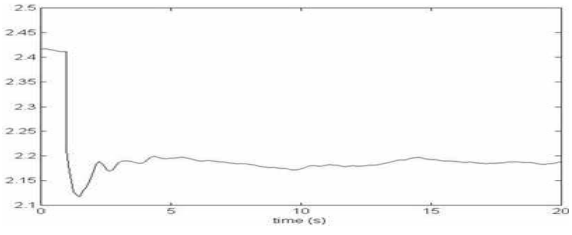

Fig (5.9) Line Active Power from Bus-1 to Bus-2

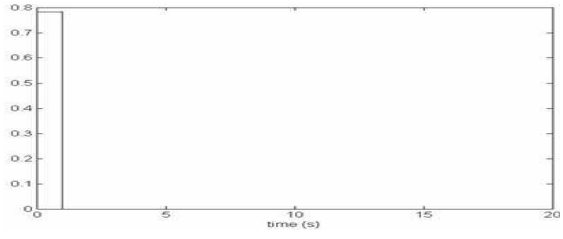

Fig (5.10) Line Active Power from Bus-2 to Bus-5

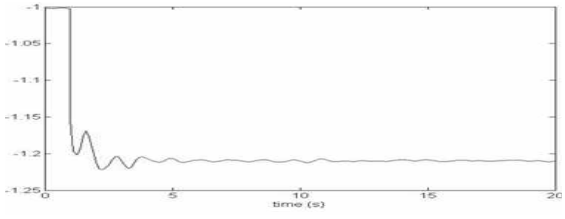

Fig (5.11) Line Active Power from Bus-3to Bus-2

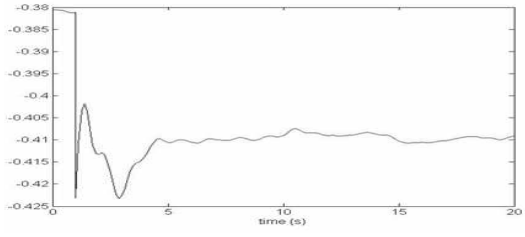

Fig (5.12) Line Reactive Power from Bus-1 to Bus 2

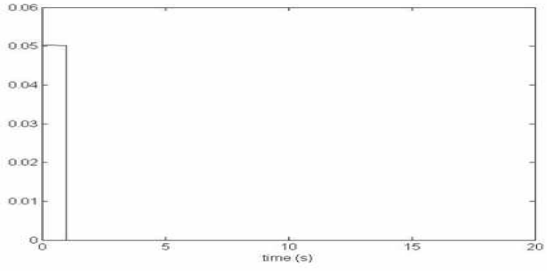

Fig (5.13) Line Reactive Power from Bus-2 to Bus-5

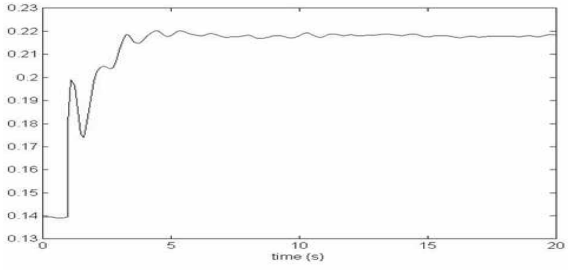

Fig (5.14) Line Reactive Power from Bus-3 to Bus-2

5.3.3 Active Powers: The following figures from fig-5.15 to Fig-5.18 shows voltage at different buses like Bus-01, Bus-2, Bus-3, Bus-6 and Bus-8

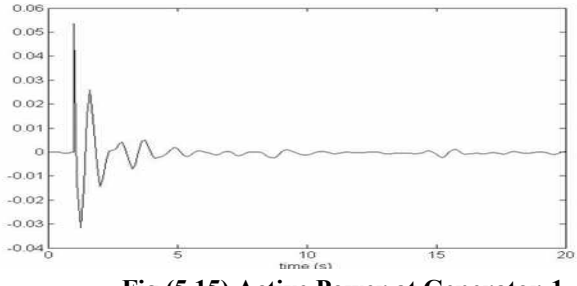

Fig (5.15) Active Power at Generator-1

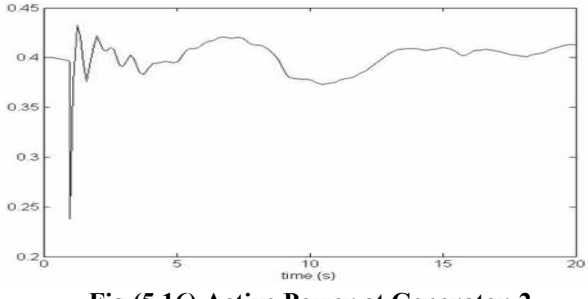

Fig (5.16) Active Power at Generator-2

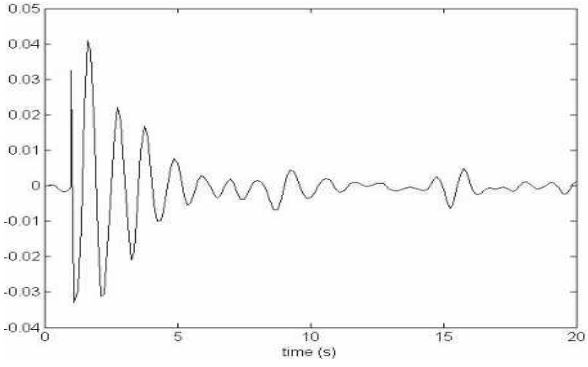

Fig (5.17) Active Power at Generator-3

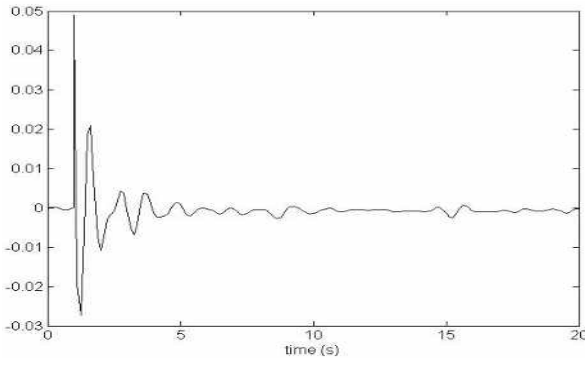

Fig (5.18) Active Power at Generator-4

5.3.4 Reactive Powers: The following figures from fig-5.19 to Fig-5.22 shows voltage at different buses like Bus-01, Bus-2, Bus-3, Bus-6 and Bus-8

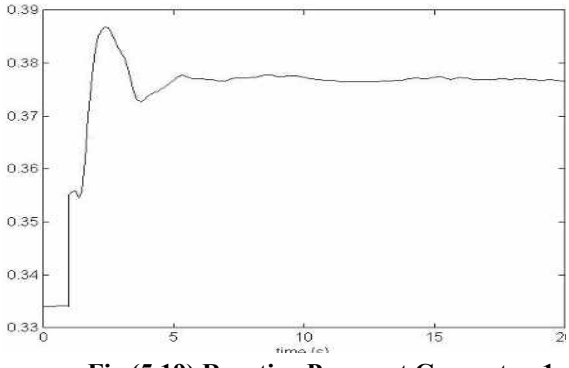

Fig (5.19) Reactive Power at Generator-1

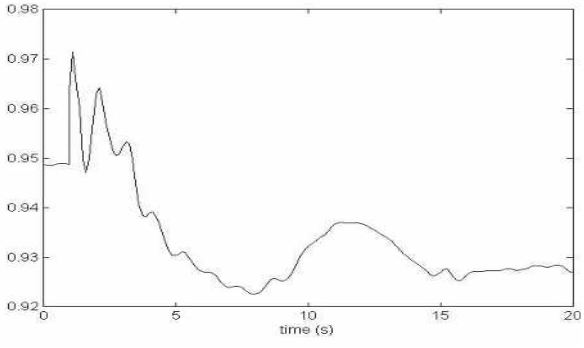

Fig (5.20) Reactive Power at Generator-2

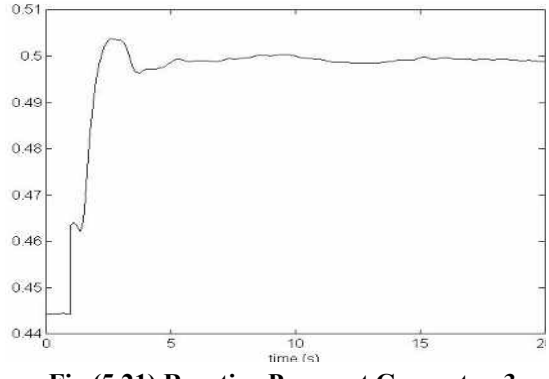

Fig (5.21) Reactive Power at Generator-3

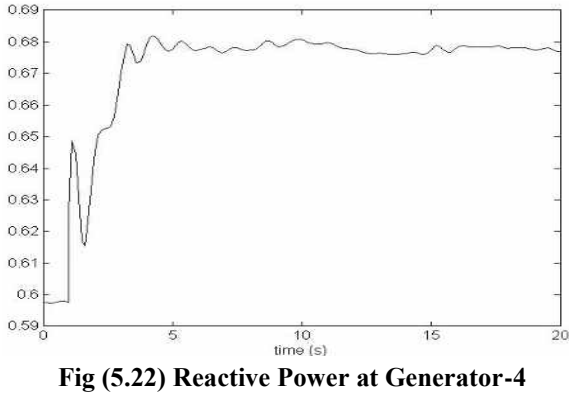

Fig (5.22) Reactive Power at Generator-4

6. CONCLUSION

Power flow or load-flow studies are important for planning future expansion of power systems as well as in determining the best operation of existing systems. The principal information obtained from the power flow study is the magnitude and phase angle of the voltage at each bus, and the real and reactive power flowing in each line.

We have formulated the algorithm and designed the MATLAB-PSAT programs for bus admittance matrix, converting polar form to rectangular form and Newton Raphson method for analyzing the load flow of the IEEE-14 bus systems which consists of Wind Power Plant (WPP). The Voltage magnitude and angles of a 14 bus system were observed for different values of Reactance loading and the findings have been presented with and without Compensators. From the findings, it is concluded that using the compensators there is increased voltage regulation and reactive power compensated. Along with this by using the compensators the losses in the system has been reduced drastically. On the other hand, in Newton-Raphson method, the calculations are complex, but the number of iterations is low even when the number of buses is high.

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PEOPLE'S PERCEPTION ON GEOMETRIC DESIGN CONSISTENCY AND ITS IMPACTS ON ROAD SAFETY: A CASE FROM CHAINPUR-KHANDABARI SECTION OF NORTH-SOUTH KOSHI ROAD IN NEPAL

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ABSTRACT

The study "**People's Perception on Geometric Design Consistency and its Impacts on Road Safety: A Case from Chainpur-Khandabari Section of North-South Koshi Road in Nepal"** was conducted in the year 2015. The main objective of this study was to find out the inconsistent geometric design of road and its consequences along with people's perceptions about the concerned design. The road accident data of previous five years were collected from district police headquarter of Khandbari, Sankhuwasabha. The traffic flow data were collected primarily by field observation. A semi-structured set of questionnaire survey and focus group discussions were conducted with selected engineers, supervisors, and local contractors. The respondents during questionnaire survey have complained against the improper design of road geometry. Many of them answered that the cause of accident in this road section is due to insufficient road width, sight distance, transition curve, shoulder, gradient, chamber and super-elevation. The study concludes that the inconsistent road geometry is correlated to road accidents in Chainpur-Khandbari Section of North-South Koshi Road.

Keywords: *Road geometry, safety, accidents, chamber, and sight distance*

1. INTRODUCTION

Human beings have been using roads since the very early stage of evolution. Highway transportation is the means of detail distribution between homes, shops, factories, and so on. It is only the roads, which can carry goods from and to aerodromes, harbors, and railway stations. Considering the utility of roads anywhere in different parts of a country, those can be compared to arteries in a human body, which maintains human health by functioning blood circulation [1].

Nepal is a developing landlocked country and there are huge development activities yet to be undertaken. One of the key factors to ensure a desired level of economic growth in a developing country like ours is development of road networks. Nepal's transport sector accounts for a large part of domestic passengers and freight movements. Nepal being a

landlocked country and due to high current and inadequate water depth in Nepalese river, the water transport has very limited potential [2].

The North-South Koshi Road is still under-construction by a project named North-South Koshi Road Project under Department of Roads (DOR). This is an ambitious project, financed by Nepal Government to join Indian boarder at Jogabani with Chinese boarder at Kimanthangka. The study region i.e. Chainpur-Khandbari Road section is one of the sections of North-South Koshi Road. The section is 42 Kilometers in length from starting point Chainpur to the end of Khandbari (Fig. 1).

The written records related to the initial function of this road were not found. According to local people's belief, this road was initially started with collaboration of local people and Government. The North-South Koshi Road, which is also known as Koshi corridor, is still under-construction but the stretch Chainpur- Khandbari is already blacktopped. A comprehensive accident and geometric design database of Chainpur-Khandabari section was used to investigate the effect of several design inconsistency measures on road safety.

There are some initiatives taken by the Government of Nepal, which shall give immediate visible impacts on Road Traffic Safety. Government of Nepal has increased the budget for traffic safety awareness, and also improving engineering features of the roads. Bilateral and multilateral donor agencies are also coming forward focusing on reducing traffic accidents in Nepal. Asian Development Bank (ADB), World Bank (WB), DFID of UK, Japan International Cooperation Agency (JICA), Government of India, etc. are providing technical as well as physical assistances to improve the road safety status of the country. In addition, Nepal Roads Board has allocated some budget for traffic safety [3]. In the involvement of design and construction of roads, several problems related to design consistency were faced. This study focuses on the effects on safety and environment due to inconsistent geometric design of the roads.

The modern technique of road construction was supposed to be developed by a Scottish engineer John McAdam in the early 19th century [4]. McAdam proposed multilayer road construction technology with beds of soil and crushed stone aggregate. It was then packed down with heavy rollers to lock it all together. Therefore, this technology has been adopted till now throughout the world [4].

Ancient history of India reveals that long ago Indians knew the science of road construction. The excavations at Mohenjodaro and Harappa (Pakistan) have established even 3500 years BC [5]. There had been a well-designed network of roads, and streets were paved at that time as well [5]. During the Aryan period, there are references in Rig Veda (Part 1, Para 5) about 'Mahapaths' as a means of communication. About 600 years B.C., a Pucca Road (6.1 m to 7.3 m wide) was built in Rajgir (ancient Rajagriha) of Patna District by king Bimbisara. This road was made of stones and some part of it is still in existence [5, 6].

Highway design ensures that successive elements are coordinated in such a way as to produce harmonious and homogeneous driver performances along the road. It is considered consistent and safe as well. On the other hand, an alignment, this requires drivers to handle high-speed that need proper geometric design [6]. The alignment of a modern highway is generally designed representing a key issue of safety and consistent geometric design. A consistent alignment must allow all drivers to operate at their desired speed along the entire alignment. The highways, which have design speeds less than desired are based on existing design. Speed-based alignment policies, which permit the selection of speed limit to a specified design speed although desired speed being more of a majority of the drivers [7].

From standpoint view of road safety, a proper design has a crucial significance in preventing road user's errors. When the numbers of these errors are decreased, much number of deaths, injuries, and material losses also decrease [8]. Researchers found that rate of accidents on horizontal curves are 2 to 5 times bigger than the accident rates on tangent sections of rural two lane highways [9]. The safe and efficient movement of vehicles can be influenced by the geometric features of the highway.

The review of accident spot maps, which normally shows accidents, tends to take place on curves, particularly on very sharp curves. The highway design engineers acquire detailed information, which are derived from driving dynamic formulas and standard values on driving through a curve. While obtaining such basic information, it is found that accident frequency and severity often do not appear to coincide with the actual driving behaviors of the human beings [7].

2. MATERIALS AND METHODS

Study Area: This study area is a section of North-South Koshi Road. The road track of Chainpur-Khandbari section was constructed initially by a project named Rural Access Program (RAP) in the year 2001[3]. The project was under the aid of British Government. After that, Asian Development Bank (ADB) granted through a project named Road Network Development Project (RNDP) in the year 2007 [3, 10]. The RNDP upgraded this road section by major works like widening, gravelling, retaining structures cross drain structures, and side drains. The road was again upgraded by ADB loan through project named Sectoral Transportation Enhancement Project (STEP) in the year 2014 [3, 10]. The main upgrading works done by STEP was surface works including DBST (Double Bituminous Surface Treatment) [3, 10].

The overall length of blacktopped road portion of North-South Koshi Road in Sankhusabha District is 92 km. The study area Chainpur-Khandbari section is 42 Kilometers long[3,10]. The Chainpur-Khandbari road starts from Chainpur zero point at Chainpur Municipality. Chainpur is also the former headquarter of Sankhuwasabha District. The road ends at Khandbari, which is the current headquarter of the Sankhuwasabha District. The Chainpur-Khandbari road crosses Sabha River at 25 kilometers and passes Tumlingtar airport at 31 kilometers (Fig. 1) [10].

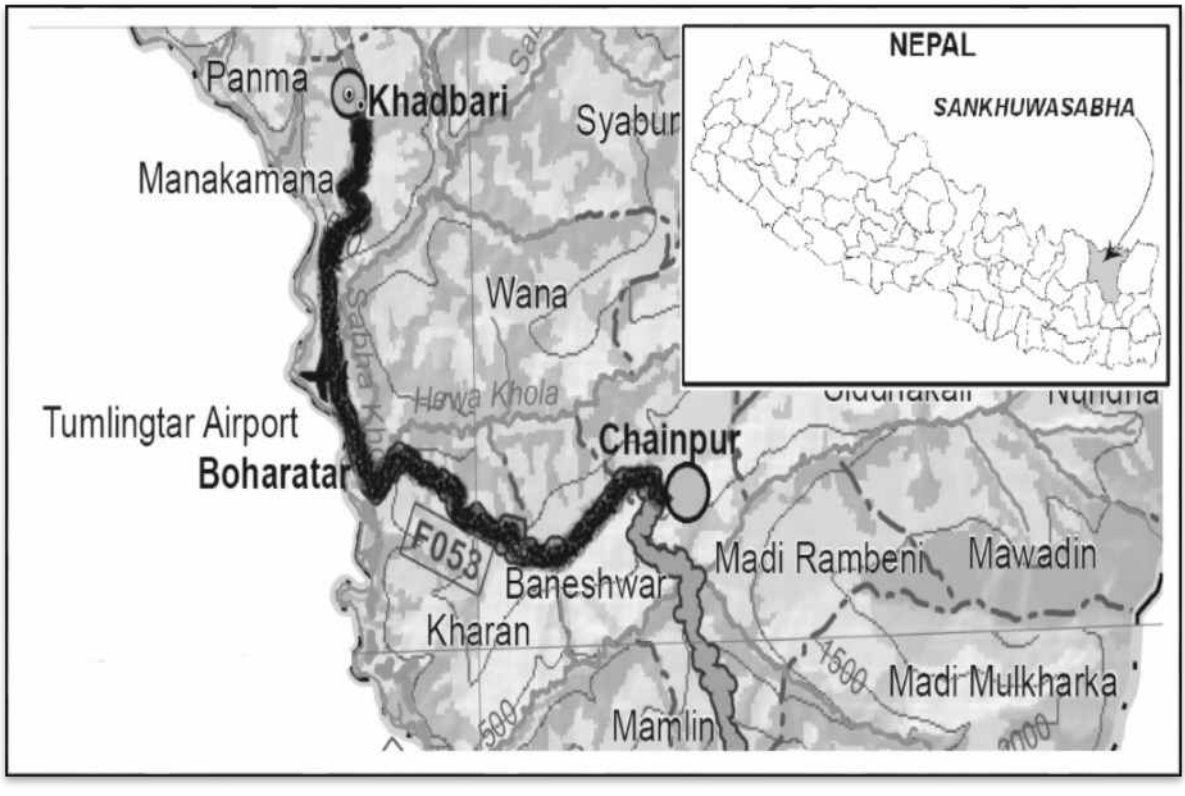

Fig. 1: Map of Study Area

The data collected in this research were from two sources: primary and secondary sources. The primary data were collected by means of interview. The interviews were taken with different engineers, consultants, contractors, and road users including local people of Chainpur-Khandbari section of the road. Focus Group Discussions [FGDs] were also held during field survey of this study. For the purpose of FGD about 7-10 people were collected in four different places. FGDs with were held in different locations like Ratomate, Tumlingtar, Kharang and Khandbari.

3. RESULTS AND DISCUSSION

3.1: Traffic Accident and Road Safety Issues in Chainpur-Khandbari Road Most accidents occur, which do not simply happen. Road was found narrow in most of the sections. Similarly, adequate sight distance required to stop and overtake was not found especially in sharp bends. Overall, geometric design of the road section was not found satisfactory. The design speed of the road was found 25 km/hr throughout the section but in straight portions, it was not adequate. This type of inconsistencies was the major causes of accidents. The safety precautions and safety measures were not found adequate. Driving a vehicle is a high-risk occupation. The driver's motto is to reach wanted destination as soon as possible

and relax. This could have led to high speed that cause accidents, but the combination of this type of manual mistakes or carelessness and inconsistent road geometry have increased numbers of accidents.

3.2 Road Accident Analysis of Chainpur-Khandbari Section The history of road accident data in Chainpur-Khandbari section was obtained from district traffic police. This data were analyzed and tabulated (Table 1).

Table 1: Past Five Year's Record of Accidents of Chainpur –Khandbari Road

Year (BS)		2011	2012	2013	2014	2015	Total	Remarks
Accidents		11	26	14	22	12*	85	*Till September 2015
Fatalities		3	5	4	5	3	20	
Injuries	Minor	17	14	12	11	13	67	
	Major	5	57	11	9	2	84	

The table 1 displays the facts that can be discussed. The average number of accidents per annum of the study region was found to be 17. The annual average fatality was found 4 persons per annum. The people, who were seriously injured per year on average, were found to be 13.4 per annum and slight injury was found 16.8 people per year. However, from the discussion and interview with police authorities, it was found that several minor accidents were not even reported.

According to the Highway Safety Manual (HSM) of the American Association of State Highway and Transportation (AASHTO), three percent (3%) of road accidents are occurred only due to roadway factors, but thirty four percent (34%) of road crashes are a result of road design factors and other factors like human errors and vehicle factors [11]. Now according to the HSM of the AASHTO the loss of life and property due to the road geometry in Chainpur-Khandbari section can be tabulated as in Table 2.

Table 2: Accident Analysis in Chainpur–Khandbari Section of North-South Koshi Road

	Total	@3% Due to road geometry alone	@ 34% Due to road geometry and others factors combined	Remarks
Accidents	85	2.55	28.9	
Fatalities	20	0.6	6.8	
Serious Injuries	67	2.01	22.78	
Minor Injuries	84	2.52	28.56	

Average Daily Traffic Flow of Chainpur-Khandbari Section: During site visit, the average daily traffic flow of Chainpur-Khandbari Road was recorded in two points to obtain primary sample data. The number of incoming as well as outgoing vehicles was counted from 7 am to 7 am to obtain data of 24 hours. The vehicles were categorized into three groups and counted separately. The three groups were heavy, light and two wheelers. Bus, Truck, Tractors etc. were categorized as heavy, whereas Jeep, Car, Van etc. were counted as light vehicles and Motorcycles were termed as two wheelers. The primary data obtained from the site is presented in the table (Table 3).

Table 3 : Average Daily Traffic of Chainpur-Khandbari Section

Type of Vehicle	Collection Point at Chainpur Zero Point		Collection Point at Khandabari Bus Stand	
	From Chainpur to Khandabari	From Khandbari to Chainpur	From Khandbari to Chainpur	From Chainpur to Khandabari
Heavy	5	15	11	13
Light	10	5	31	27
Motorcycle	38	34	115	135
Total	53	54	157	175

Total ADT at Chainpur in Passenger Car Unit (PCU)
= (15+5) x 3 + (10+5) + (38+34) x 0.5
= 93
Total ADT at Khandbari in Passenger Car Unit (PCU)
= (11+13) x 3 + (27+31) + (115+135) x 0.5
=192.5

During field visit the primary data of ADT was collected by direct survey method at two stations of the study areas. The first point was at Chainpur Zero Point and other was Khandbari Bus Park. The main purpose of our survey was to find out the real field data, to represent the real average traffic volume. The count of traffic recorded and its calculation is presented in table 3. In Passenger Car Unit (PCU) the value of heavy vehicle such as bus, truck, tractors etc, were taken as 3 units whereas light vehicles like car, jeep, van, etc., were taken as 1 unit and two wheelers bicycles were taken as 0.5 units. The other factors affecting in ADT are not considered during calculation.

From the ADT, which we have collected, it can be said that the traffic volume in this road is very low and the number of accidents compared to this volume of traffic is high. This fact supports our assumptions that road accident was high in this region before the start of this study. The spot for counting the vehicle were both market areas, where the number of two wheelers counted was high because of continuous and repeated flow of local moving vehicles.

3.3 Questionnaire Survey There were 21 numbers of different questions for the people to understand their perceptions. The total number of respondents was 60. Most of the questions were asked to the designers and the implementers. Among the respondents 22 people were civil engineers who frequently visited the study area. Local civil contractors related to road works were 21 in numbers. Road supervisors and surveyors who were in continuous touch to Chainpur-Khandbari section were 17 in numbers. Even though the respondents were not supposed to have the same level of knowledge about road geometric design, their involvement in road construction and regular maintenance have taught them enough to understand and answer the engineering terms of road geometric parameters incorporated in the questionnaire. The respondents and their category are presented in the Fig. 2.

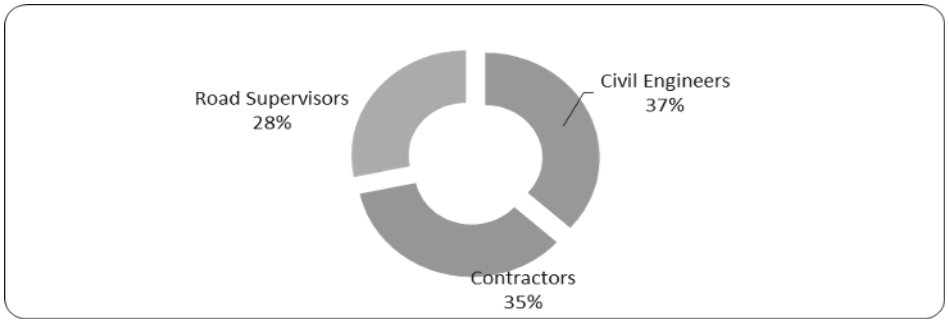

Fig. 2: Category of Respondents

The questions incorporated in the questionnaire were related with the design parameters, safety, and road accident of Chainpur-Khandbari section and the people answered differently to most questions. The answers of questions have been presented serially and graphically .

The first question was, "The inconsistent road geometry has created" in which the respondents answered differently and the result is presented in Fig. 3. Three percent (3%) of the people realized uneasy driving, 12% people said it created road accidents and remaining majority of people (85%) said inconsistent geometry has created both uneasy driving and road accidents. According to the people's perception the conclusion was that the inconsistent road geometry has created both uneasy driving and road accidents. Some group discussions were also held with the respondents, where most of the complaints were about inconsistent road geometry of the study area

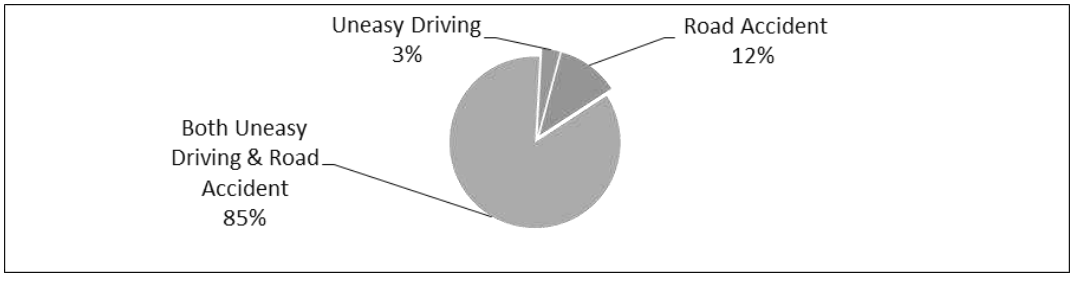

Fig. 3: People's Perception on the Inconsistent Road Geometry

The other question was, "The causes of landslide in Chainpur-Khandbari Road is inconsistent slope cutting" in which the respondents answered differently and the result is presented in Fig. 4. The majority of the people (63%) realized inconsistent slope cutting, 10% people said it was weak geology and the remaining 27% said both inconsistent slope cutting and weak geology. The main purpose of this question was to find out the consistency in road slope cutting during construction. The expected result was weak geology and inconsistent slope cutting. But the respondent answered surprisingly that there exists inconsistent slope cutting in the study area.

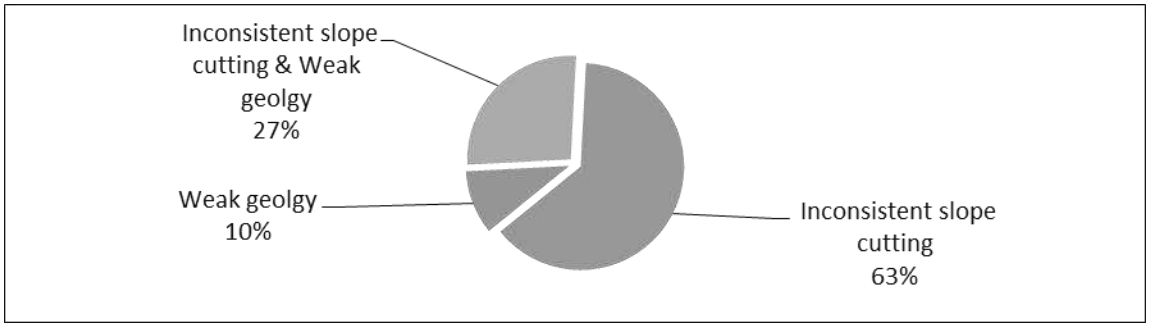

Fig. 4: People's Perception on the Causes of Landslide

The next question was, "The inconsistent road geometry has invited accident" in which majority respondents (97%) answered 'Yes'. The remaining of the people, only 3 %, said 'No' [Fig. 5]. The question was aimed to find out the people's perception about the relationship between the road geometry and the road accident.

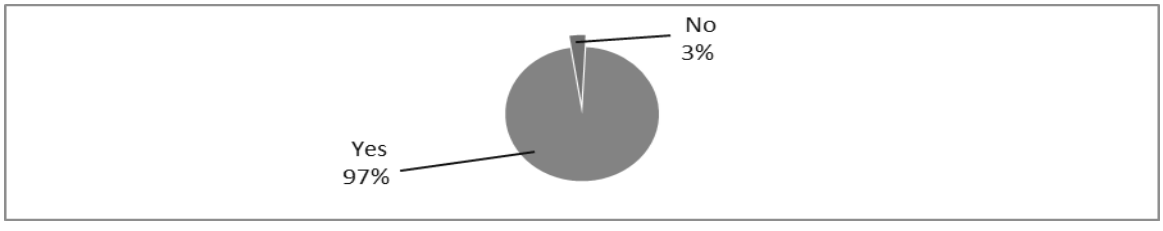

Fig. 5: People's Perception on Road Geometry has Invited Accidents

The other question was, "The accidents are responsible for loss of life and property" in which the respondents answered differently and the result is presented in Fig. 6. The majority of people (92%) said 'Yes'. The answer of the respondents to this question was the proof that most of the respondents were conscious about the road accidents and its impact to the society. Their answers supported the facts of our data of accident collected during site visit. In such a low volume of traffic flow, the accident number was found high resulting in high loss of life and property.

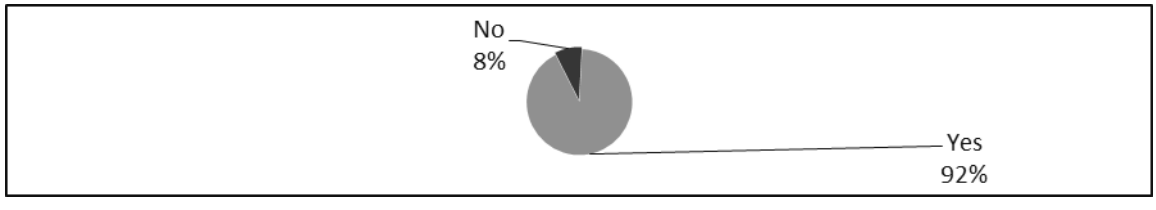

Fig. 6: People's Perception on Accidents for Loss of Life and Property

The fifth question was, "Have you found the road geometry as per your perception?" in which the respondents answered differently, which is presented in Fig.7. The majority of people (83%) responded as 'No'. The same answer was expected. And the geometric design of the road section was found to be inconsistent during the field observation of seven different locations for the purpose of statistical analysis.

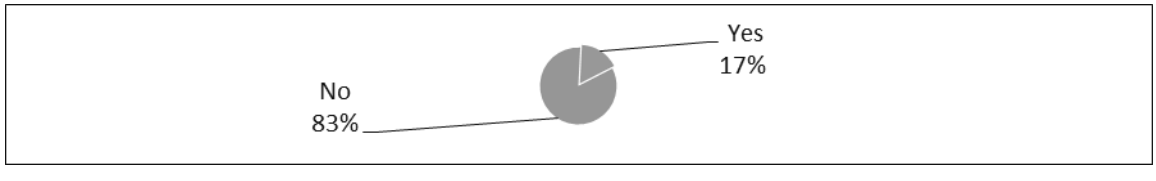

Fig. 7: People's Perception about Road Geometry

The next question was, "Are the geometric features comfort for driving on road?" in which respondents answered differently and the result is presented in Fig.8. The 15% of people said 'Yes' and the majority of people (67%) said 'No', and the remaining 18% said they 'Do not know'. This question was prepared for the respondents' view and feelings of comfort driving. The accident and the comfort driving is a co-related issue. The comfortable roads obviously create less accidents and the road with good geometric features creates more comfort to the drivers and road users as well.

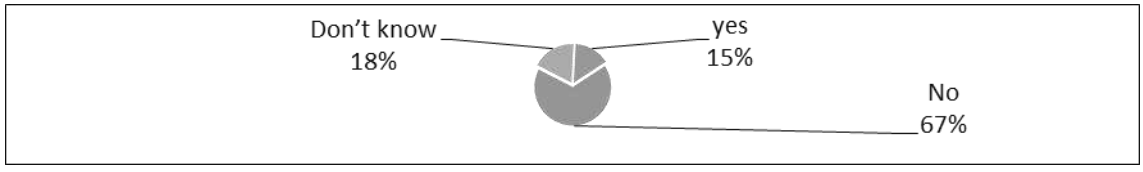

Fig. 8: People's Perception on Comfortless of Geometric Features

The seventh question was, "Is the sight distance adequate in the Road?" in which the respondents answered differently and the result is presented in Fig.9. The 8% said 'Yes', majority of people (87%) said 'No' and the remaining (8%) said 'Do not know'. Since most of the respondents said that the sight distance was inadequate, even the existence of inconsistent road geometry was found according to the people's perception.

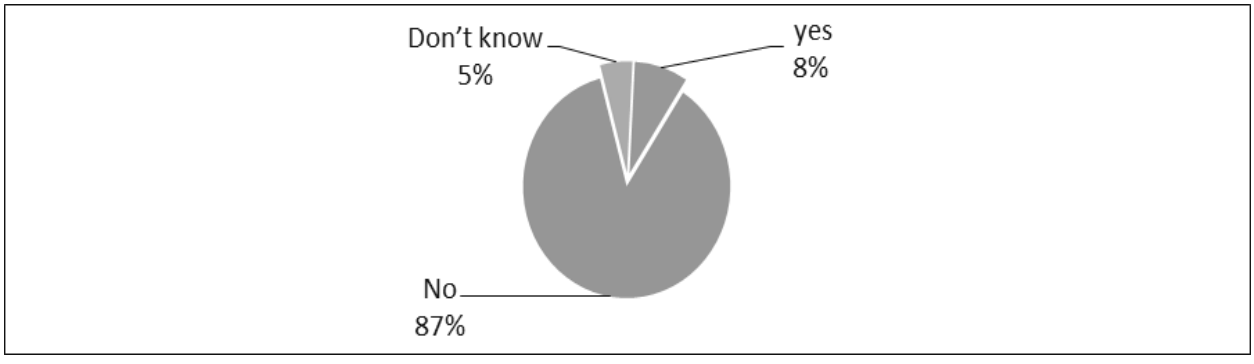

Fig. 9: People's Perception about Adequate Sight Distance

The next question was about "The combination of horizontal and vertical elements of road is appropriate" in which the respondents answered differently and the result is presented in Fig.10. The 15% people said 'appropriate', the majority of the people (80%) said 'inappropriate' and the remaining (5%) of the people said 'Do not know'. In this question, most of the respondents were confused about the theme that the question was arisen for, but the answer was expected. At first, most of the respondents showed unknowingness to the subject matter but soon after the discussion, they agreed that they have not noticed the subject matter even though it was important.

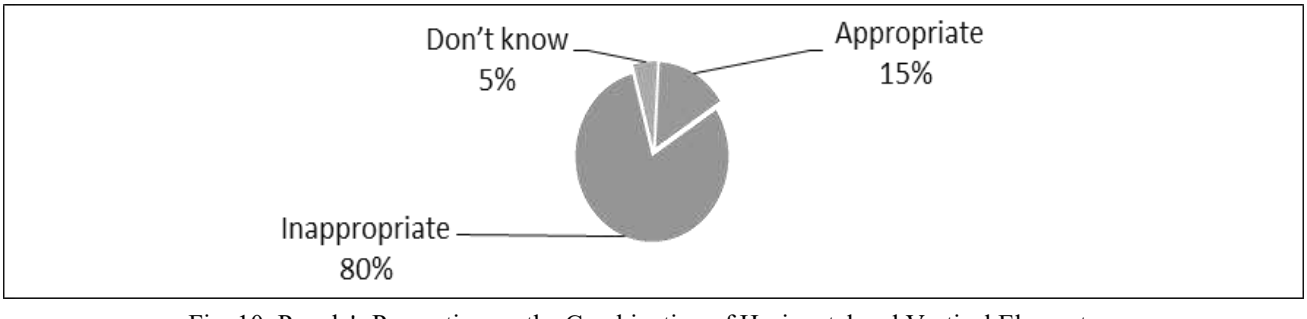

Fig. 10: People's Perception on the Combination of Horizontal and Vertical Elements

The other question was, "The road width (Carriageway) is not sufficient" in which the respondents answered differently (Fig.11). The 8% said sufficient, majority of the people (87%) said insufficient and the remaining 8% said 'Do not know'. This response of people was supported by the design standard of the road, which was found single lane and normal width of the road was designed (width=3.75 m). The traffic count of the road showed that there was a countable number of flow of heavy traffic and the encounter of two heavy vehicles were also found common. In a single lane road like this, the overtaking seemed also risky.

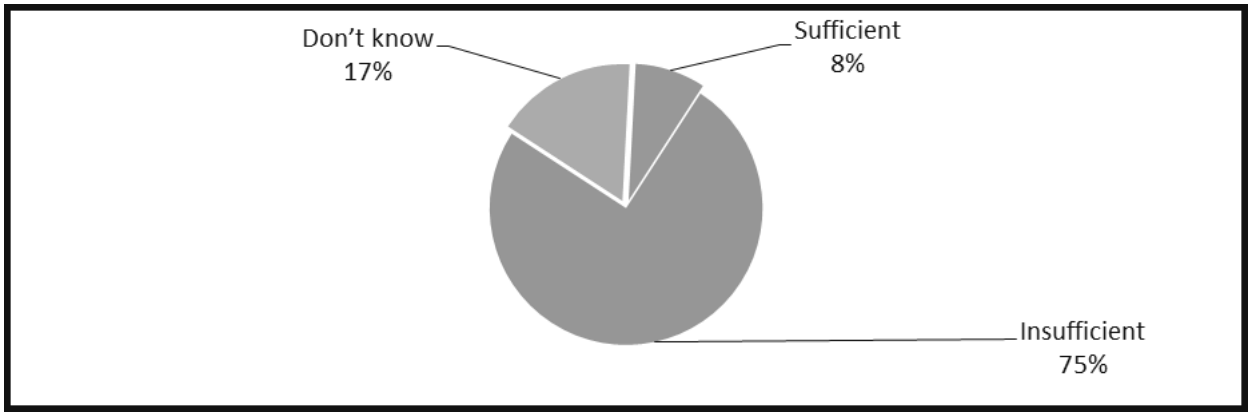

Fig. 11: People's Perception on the Road Width (Carriageway)

The question was, "Do you feel the necessity of extra-widening on curves" in which the respondents answered differently and the result is presented in Fig. 12. The majority of people (85%) said 'Yes', the 8% said 'No' and the remaining (7%) of people said 'don't know'. In such an alignment in hilly area the sharp curves are also common. In sharp curves the extra-widening plays a vital role to the comfort and road safety. Therefore, the same answers of the respondents were also expected.

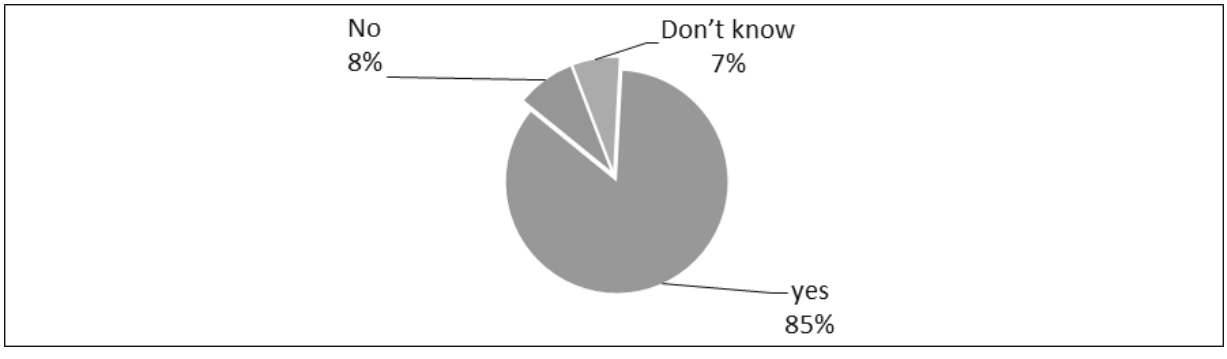

Fig.12: People's Perception on Necessity of Extra Widening

The eleventh question was, "Are chambers provided on the roads adequate?" in which the respondents answered differently and the result is presented in the Fig. 13. 27% of the people said 'Yes', the majority people (58%) said 'No' and the remaining (15%) of people said 'do not know'. The necessity of chamber or its adequateness can easily be observed in rainy season if the rainwater is drained out or not.

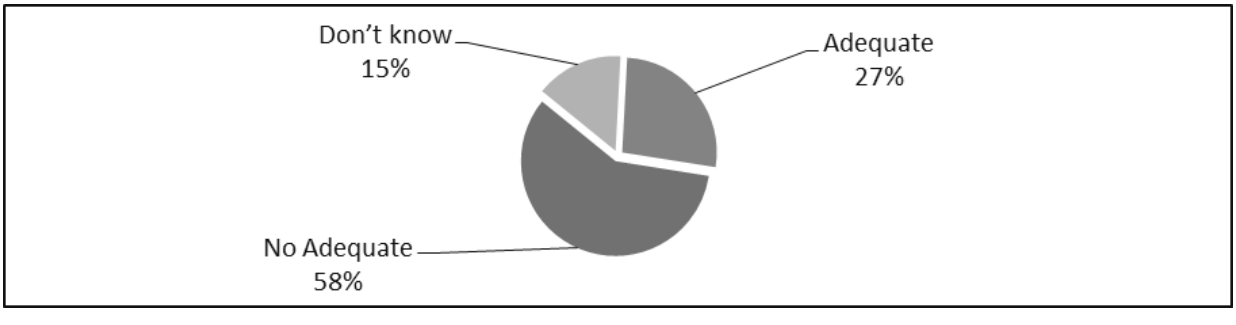

Fig.13: People's Perception on the Chamber

The twelfth question was, "Are transition curves necessary?" in which the respondents answered differently and the result is presented in Fig. 14. The majority of people (70%) said 'Yes', the 8% said 'No' and the remaining (22%) of people said 'do not know'. Most engineers and technical persons involved in construction and design answered that they were not aware about the transition curves. The use of complicated software in design and the use of advanced technology like total station in layout have reduced the actual implementation of these curves.

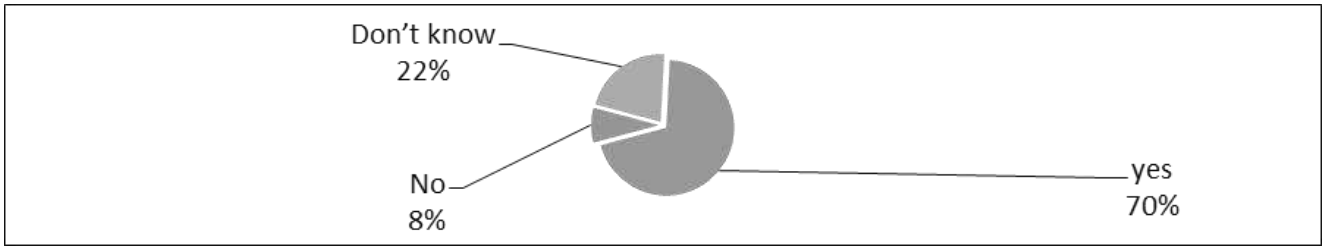

Fig.14: People's Perception on the Necessity of Transition Curves

The next question was, "What do you think about gradient of the road?" in which the respondents answered differently and the result is presented in Fig. 15. 9% said too high, the 41% said normal and the remaining (50%) of the people said it varies in different locations. In general the gradient compared to other hill roads of Nepal, was found normal.

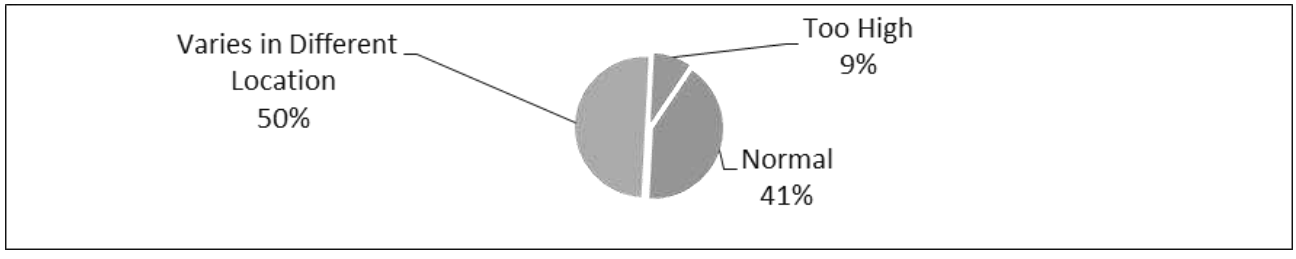

Fig.15: People's Perception on Gradient

The next question was, "Is the technical skill of the designer sufficient?" In which the respondents answered differently and the result is presented in Fig. 16. The 27% said yes, the majority of the people (63%) said 'No' and the remaining (10%) of people said 'Do not know'. Since there are lot of inconsistencies and defects in design, the skill of designer was not found sufficient.

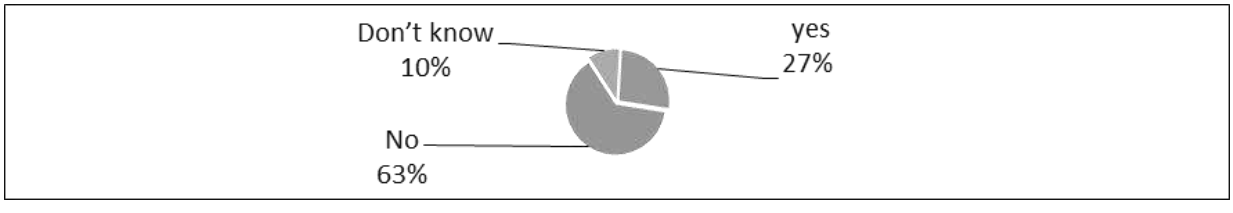

Fig.16: People's Perception on the Technical Skill of Designer

The other question was, "Do you feel any relationship between road geometry and safety" in which the respondents answered differently and the result is presented below. The majority of the people (67%) said 'yes', 28% said 'no' and the remaining 5% of people said don't know. The positive answer indicated towards another question.

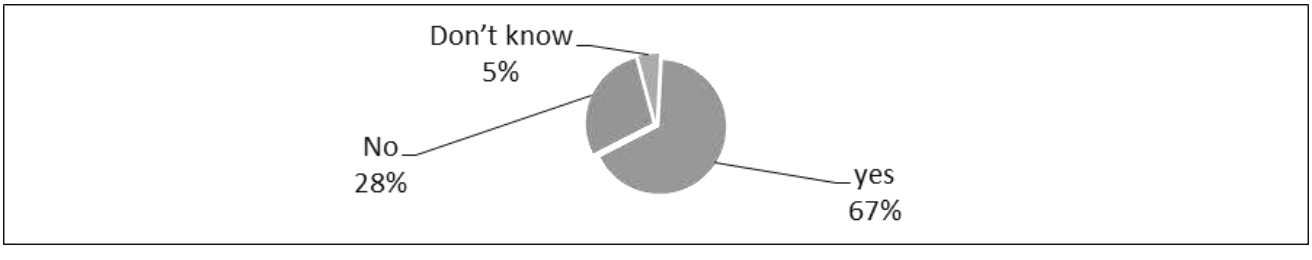

Fig.17: People's Perception on Relationship of Road Geometry with Safety

The related question was added to the same number. The question was, "If 'Yes' tick the following," in which the respondents answered differently and the result are presented in Fig. 18. The 9% said increase in accident rates, the 12% said increase in discomfort, 2% of people said decrease in aesthetic beauty and the majority of the people (77%) ticked 'all of the above'. From the people's perception it was concluded that inconsistent road geometry has increased accident rate and discomfort. The aesthetic beauty was also found decreased by inconsistent road geometry.

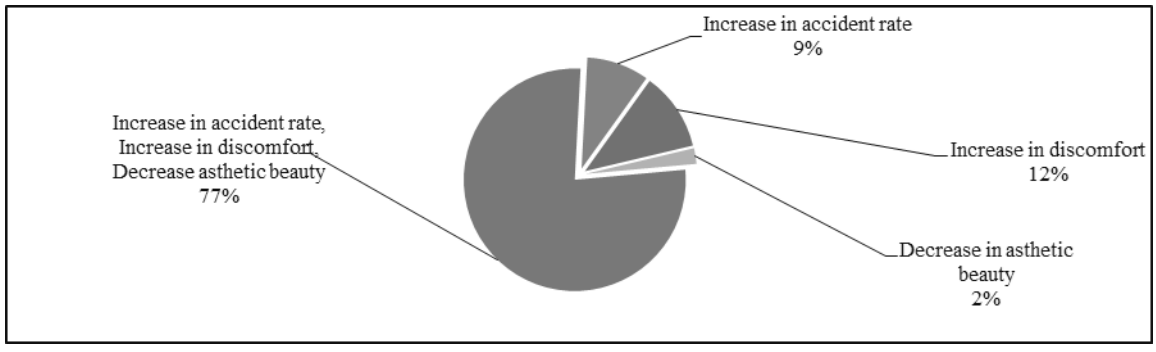

Fig. 18: People's Perception on the Relation of Inconsistent Road Geometry and Safety

The next question was, "The major cause of accident in Chainpur-Khandbari road is…" in which the respondents answered differently and the result is presented in Fig.19. The 11% said road geometry, the 7% said careless of driver, 2% said bad vehicle condition and the majority of the people (80%) said all of the above (i.e. road geometry, careless driving, bad vehicle condition). The conclusion of the people's perception was that cause of road accident is mostly dependent on combination of road geometry, carelessness of the driver and poor vehicle condition.

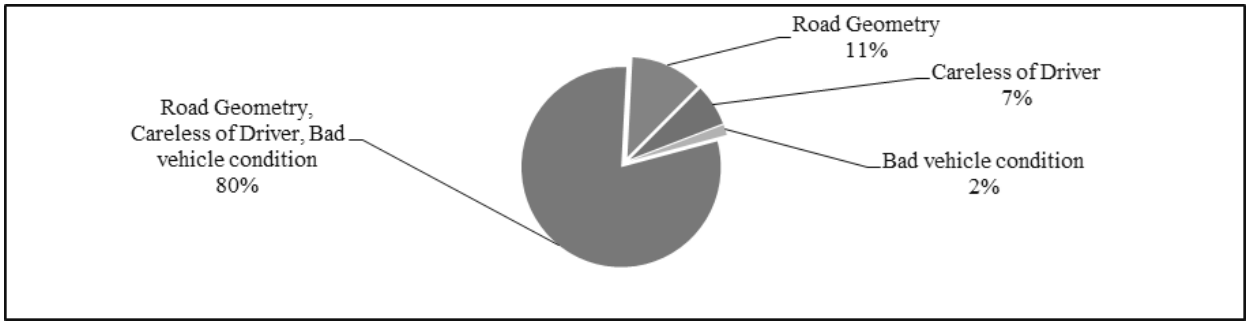

Fig.19: People's Perception on the Causes of Accident

The other question was, "Defective design of road are due to….low bidding, unskilled designers, and inadequate technology" in which the respondents answered differently and the result is presented in Fig. 20. The 10% people said low Bidding, the 22% said Unskilled Designers, 1% said inadequate technology, and the remaining majority of the people (67%) said all of the above. The result of the respondents' answers was that all of the components put as options has role on defective design, however the combination of all components like low bidding, unskilled designers and inadequate technology plays vital role in defective design.

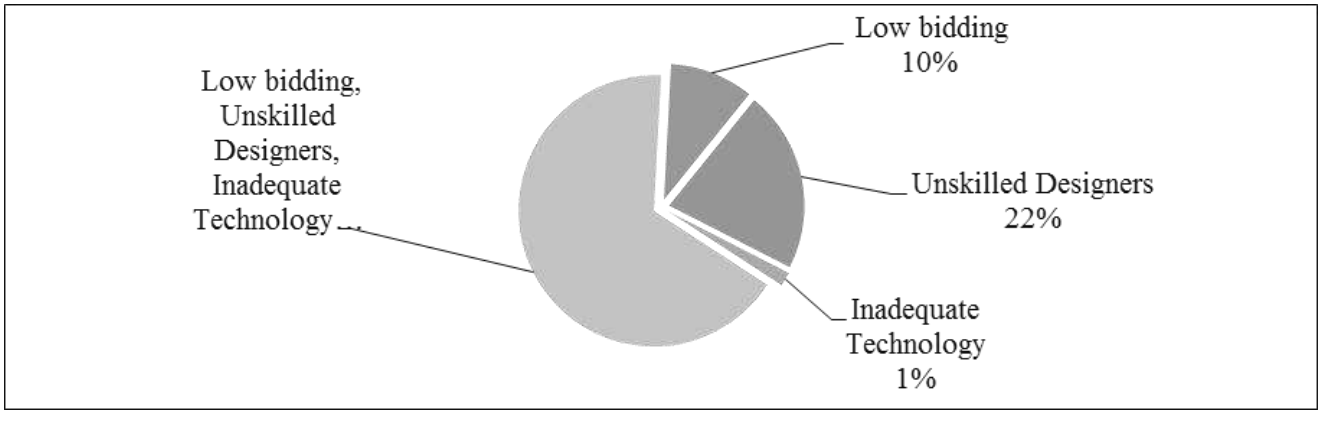

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Fig. 20: People's Perception on the Causes of Defective Design of Road

The eighteenth question was, "Is there any awareness program during construction of road?" in which the respondents answered differently and the result is presented in Fig. 21. The 42% said 'Yes' and the majority of the people (58%) said 'No'. Most of the development projects have its negative as well as positive effects on the society and on the environment. Road accident is a major disadvantage of a road project and the lack of awareness increases the accident rate. The awareness programs are needed frequently in this matter.

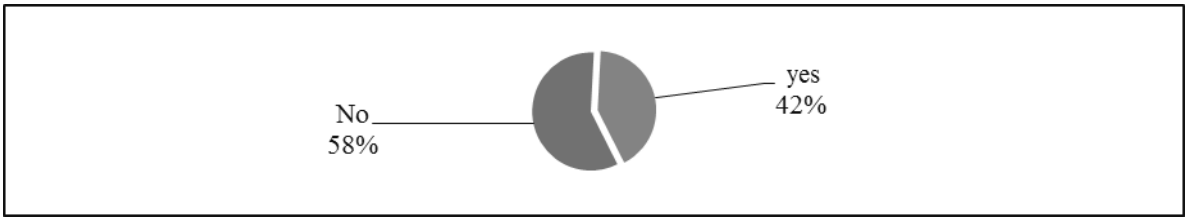

Fig.21: People's Perception on Awareness Program Conducted During Construction

Another question was, "Was Chainpur-Khandbari road constructed through participatory approach?" in which the respondents answered differently (Fig.22). The 20% said 'Yes', the majority of the people (58%) said 'No' and 22% of people said they ‘do not know’. People's participation in the development projects increases the knowledge, which helps in safe run of the projects in long term.

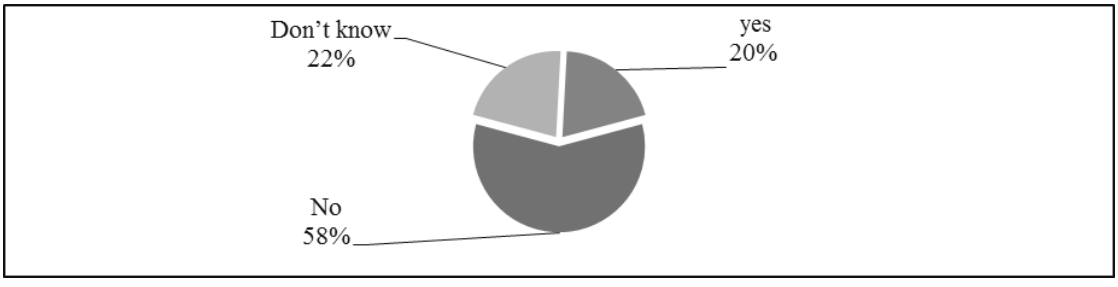

Fig.22: People's Perception if the Road was constructed through Participatory-Approach

Besides these 19 subjective questions, there were two open questions for the respondents. The 20th question was "What can be the other causes of accidents of Chainpur-Khandbari road?" in which the people openly suggested their views about the causes of road accidents in Chainpur-Khandbari road. In the analysis of this question every single people may have suggested several causes of accidents and each suggestion is counted as one number. The suggestions less than three numbers in total are cumulated as "others." 20 numbers ‘overload’ mostly suggested causes of accidents. Drinking, driving, and narrow road was secondly suggested causes of accidents by 16 people. 13 people suggested causes of accidents as carelessness of driver. Twelve people suggested that cause of accident was poor vehicle condition. Other suggestions were high speed (by 8 people), inconsistent road geometry, non-obeying of traffic rules and inadequate sight distance was suggested by equal six numbers. Similarly, lack of awareness unskilled drivers and low quality road were suggested by equal 5 numbers of people. Four people suggested the cause of accident as climatic or geographical condition. The remaining suggestions were animals on roads, encroaching right of way, etc., which are presented in Fig 23. The following chart shows the perception of people towards the causes of road accidents in Chainpur-Khandbari stretch.

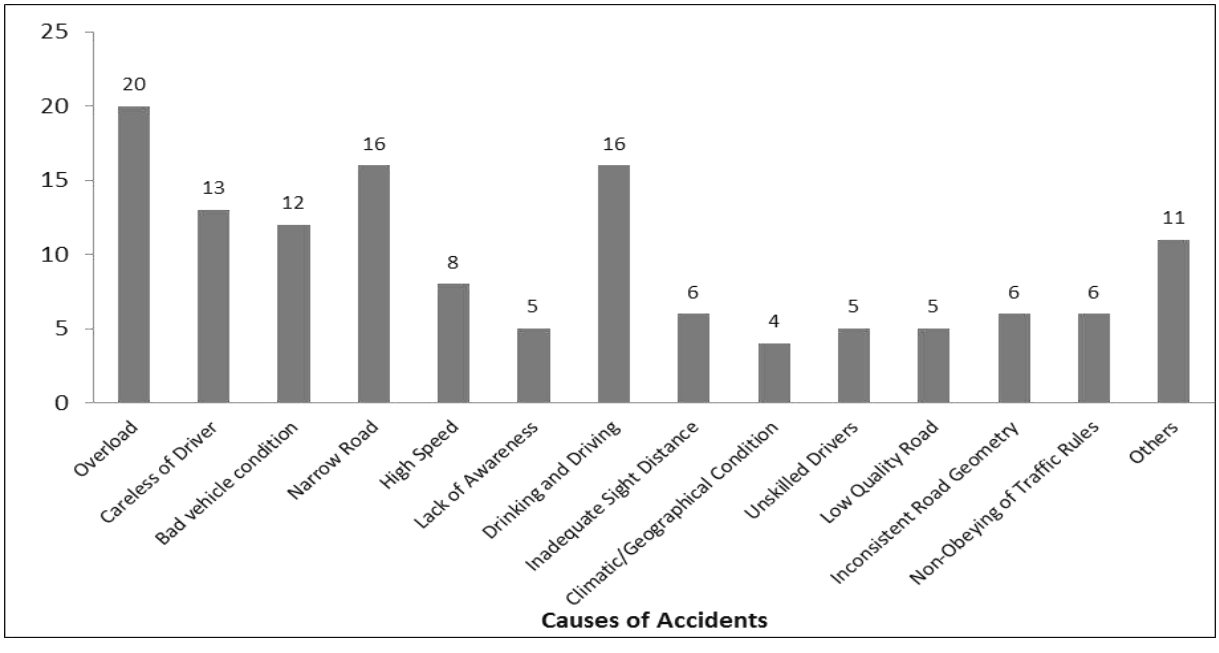

Fig. 23: People's Perception on Causes of Road Accident

The next question was "Please elaborate what can be the remedial measures to decrease road accidents ?" in which the people openly suggested their thinking about the remedial measures of road accident in Chainpur-Khandbari road. In the analysis of this question one people may have suggested several remedial measures to decrease road accidents and each suggestion is counted as one number. The suggestions less than three numbers in total are cumulated as "others". Mostly suggested remedial measures to decrease road accidents by increasing of awareness programs to the road users, which likely suggested by 20 numbers of people. Implementation of traffic rules and widening of roads were secondly suggested through remedial measures to decrease road accidents by the equal number of 18 people. The 16 numbers of people suggested remedial measures to decrease road accidents by improving inconsistent road geometry. Increasing of road safety measures was suggested by 11 people as remedial measures to decrease road accidents. Eight people suggested remedial measures to decrease road accidents from proper and regular maintenance of the road. Five people thought that accidents can be decreased by controlling overload vehicles. Three people said that proper traffic management may reduce the number of accidents. The following chart shows people's perception about the remedial measures to decrease road accidents.

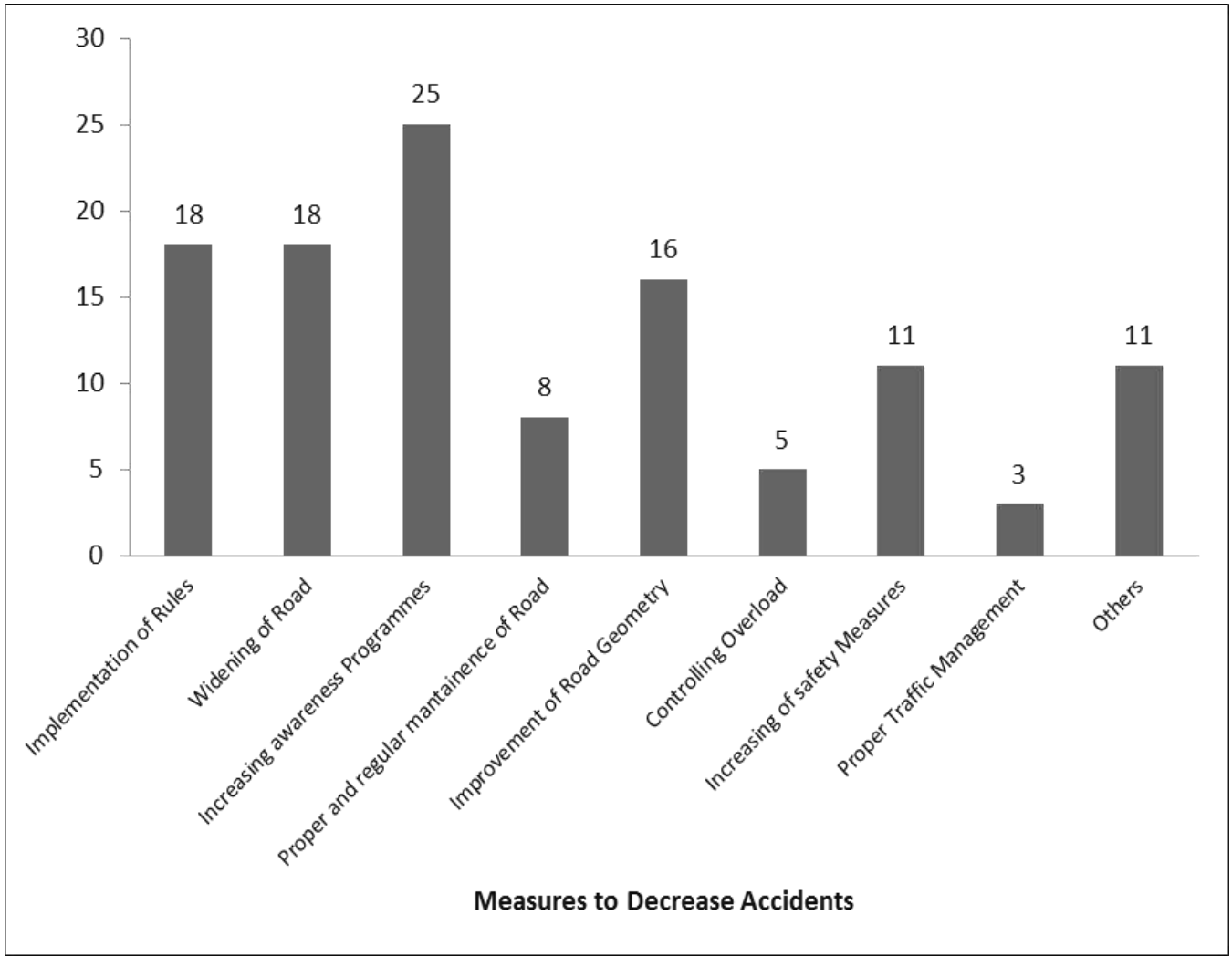

Fig.24: People's Perception on Remedial Measures to Decrease Road Accidents

3.5 Measurement of Inconsistency by Analytical Method The respondents in questionnaire survey pointed that there exists inconsistencies in road geometric elements. The actual degree of correlation between design parameters and the actual field layouts were to be established. Seven different locations in field were selected randomly where possibility of inconsistency was assumed. All the field parameters were measured. The correlation was established using ANOVA table.

Selection of site Seven spots were chosen, where possibility of inconsistency was higher and the accident was occurred. The spots were marked and their chainages according to survey were found out with the help of road supervisors of DOR. The seven random sites are shown in table 4.

Table 4: Field Survey Data of Road Geometric Elements

Chainage	50+230	53+960	61+615	72+430	73+910	80+100	86+860	Design Standards
Local Name of the Place	Chainpur	Baneshor Temple	Kingring	Saal Ghari	Sabha Khola	Tumling-Taxistand	Dhunge Dhara	
Site No.	1	2	3	4	5	6	7	
No of accident recorded	3	2	5	6	3	6	1	
Carriageway (m)	3.50	3.50	3.20	2.80	3.70	3.50	3.50	3.50
Shoulder (m)	0.50	1.00	0.00	0.00	0.00	0.00	1.00	0.5x2
Formation Width (m)	4.00	6.70	3.20	2.80	3.70	3.50	7.30	4.50
Grade (%)	4.20	1.20	4.10	3.50	1.50	5.90	2.80	12.00
Radious of HC (m)	50.00	48.00	20.00	10.00	30.00	12.00	30.00	12.50
SSD (m)	55.00	50.00	38.00	12.00	40.00	18.00	65.00	20.00
Superelevation (%)	8.00	0.00	10.00	10.00	0.00	8.00	2.00	10.00
Camber (%)	0.00	0.00	3.00	0.00	2.50	1.00	0.00	3.00
Extrawidening (m)	0.00	2.20	0.00	0.00	0.00	0.00	2.80	3.00

Now, for the convenience in calculation of the data are tabulated as in the following form of table (Table 5). Some road parameters are put combined for easiness of calculation. Road width consists of carriageway width, shoulder and extra-widening.

Table 5 : Geometric parameters for calculation of values

Number of Accident	Road Width (m)	Gradient (%)	Radius (m)	Super Elevation (%)	Sight Distance (m)
3	4	4.2	50	8	55
2	6.7	1.2	48	0	50
5	3.2	4.1	20	10	38
6	2.8	3.5	10	10	12
3	3.7	1.5	30	0	40
6	3.5	5.9	12	8	18
1	7.3	2.8	30	2	65

Table 6: Correlation Table

	Number of Accidents	Road Width (m)	Gradient (%)	Radius (m)	Super Elevation (%)	Sight Distance (m)
Number of Accident	1					
Road Width (m)	0.863575825	1				
Gradient (%)	0.66981804	0.512286086	1			
Radius (m)	0.764178438	0.549678028	0.498532187	1		
Super Elevation (%)	0.789692466	0.708910924	0.809139233	0.52314666	1	
Sight Distance (m)	0.931785205	0.759585469	0.445463548	0.78726311	0.558500781	1

From the correlation table 6, the relationship is established with each parameters of the road width with the road accidents. The high co-relationship between road parameters and the road accidents was found. The sight distance (visibility) was found to be the highest road geometric parameters responsible for accidents, which is 93.18%. Similarly, road width was found to be 86.36% co-related with road accidents. The super-elevation was also found to be highly correlated with road accidents, which contributed 78.97%. In the same manner radius of curvature was 76.42% correlated with accidents and gradients plays least role to the road accidents, which were found to be 66.98%. Speed is also an important factor for road accidents. Many speed errors are related to inconsistencies that cause the driver to be surprised by sudden changes in the road characteristic, to exceed the critical speed of alignment and to lose the control of the vehicle. These inconsistencies can be controlled by design as well as field engineers, whenever a highway section is being designed or improved [12].

4. CONCLUSION

Many geometric design inconsistencies were found in the Chainpur-Khandbari section of North-South-Koshi Road. The design standards of the road were not met in most of the road sections. Majority of the respondents during questionnaire survey have complained against the improper design of road geometry. Most of the respondents answered that the cause of accident in this road is due to insufficient road width. Sight distance is found to be another major problem of the study area. The provision of transition curve was not found sufficient. Shoulder was not found adequate. The gradient of the road was found to be normal. The radius of the curvature was not sufficient in most of the sharp curves. Chamber and super-elevation was not according to the standards. The study has concluded that the inconsistent road geometry is correlated to road accidents in Chainpur-Khandbari road section of North-South Koshi Road. The major remedial measures suggested by the people for the enhancement of road safety are increasing awareness programs, widening of road, enforcement of rules and regulations, improvement of road geometry, proper and regular maintenance of roads, controlling overload and proper traffic management.

5. ACKNOWLEDGEMENTS

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AN EMPIRICAL ANALYSIS OF EMPLOYEE PERCEPTION TOWARDS 360 DEGREE PERFORMANCE APPRAISAL

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ABSTRACT

Now-a-days performance appraisal is important functions of organizations. It is assists to measuring and evaluating the performance of the employees in an organization. 360-Degree feedback is an appraisal that incorporates feedback from all who observe and are affected by the performance of a candidate. Organizations are created in order to achieve certain goals in the most effective and efficient manner. 360-degree feedback will include direct feedback from an employee's subordinates, peers, and supervisors, as well as a self evaluation. 'It can also include, in some cases, feedback from external sources, such as customers and suppliers or other interested stakeholders. This paper explains that how the employee perceived towards 360 degree performance appraisal. The primary purpose of performance appraisal is to provide feedback on an employee's performance, to create a development plan for areas of improvement and to provide the basis for promotion. Finally the paper is contribute the various suggestions with the support of analyzing various statistical tools.

Keywords: *employees, organization, performance appraisal, 360 degree.*

1. INTRODUCTION

A 360 degree appraisal is a type of employee performance appraisal in which subordinates, co-workers, and managers all anonymously rate the employee. This information is then incorporated into that person's performance review. 360 degree respondents for an employee can be his/her peers, managers (i.e. Superior), subordinates, team members, customers, suppliers/vendors - anyone who comes into contact with the employee and can provide valuable insights and information or feedback regarding the "on-the-job" performance of the employee.

360 degree appraisal is also a powerful development tool because when conducted at regular intervals (say yearly) it helps to keep a track of the change others' perceptions about the employees. A 360 degree appraisal is generally found most suitable for the managers as it helps to assess their leadership and managing styles. The performance appraisal is the process of assessing an employee's performance based on a set of standards. Performance appraisal may be defined as a structured formal interaction between a subordinate and supervisor, that usually takes the form of a periodic interview (annual or semi-annual), in which the work performance of the subordinate is examined and discussed, with a view to identifying weaknesses and strengths as well as opportunities for improvement and skills development. The performance of the employees should assess continuously to make their contribution to higher extend. The process of measurement of the performance of employees at work is termed as performance appraisal. Performance appraisal has long been regarded as one of the most critical areas of human resource management. 360-degree feedback**,** also known as multi-rater feedback, multi source feedback**,** or multi source assessment**,** is the feedback that comes from members of an employee's immediate work circle.

2. REVIEW OF LITERATURE

The following quote by John F. Welch, Jr., CEO, GE was taken from the book 360 degree feedback [6]. “Any company that’s going to make it in the 1990’s and beyond has got to find a way to engage the mind of every single employee. If you’re not thinking all the time about making every person more valuable, you don’t have a chance. 360-Degree feedback is aimed at improving performance by providing a better awareness of strengths and weaknesses. The employee receives feedback, in anonymous form, on performance ratings from peers, superiors and subordinates [12]. Employees view performance information from multiple sources as fair, accurate, credible and motivating. They are more likely to be motivated to change their work habits to obtain the esteem of their co-workers than the respect of their supervisors [6].

360 Degree Feedback improves the quality of performance measures by using multiraters providing a more balanced and comprehensive view. The information is more reliable, valid and credible because the providers interact regularly with the employee at work [6]. [16], a well known Management Consultant and a Post Graduate in the subject from the University of Michigan, USA, has specialized in HR Systems and Industrial Relations, and she defines 360 degrees feedback‟ as: “360 degree feedback is a method and a tool that provides each employee the opportunity to receive performance feedback from his or her supervisor and four to eight peers, reporting staff members, co-workers and customers. Each individual in self-assessment also responds to most 360 degree feedback tools. 360-degree feedback allows each individual to understand how his effectiveness as an employee, Co-worker or staff member is viewed by others.

It has been found that "input from subordinates was effective in eliciting modest changes in managerial behavior" [1, 14] London and Beatty (1993), while agreeing that mixing development and appraisal purposes is problematic, conclude “using feedback for development only can impede the effective use of the results unless there is a requirement for the manager to be responsible to the feedback”. Despite the relatively simple technology in using the 360 degrees, its costs for the company are potentially much higher than expected. First, there seems to be some agreement that 360s are not a one-shot deal, but must be used consistently over several years [5] [15]. Second, using the simpler structured instruments that Centre for Creative Leadership puts out ($195 per assesses) can defeat the developmental purposes because the feedback and interpretation is too difficult (i.e., comparative results are complicated by a variety of situation-specific factors [10]. On the other hand, constructing a custom instrument that is specific to the performance requirements for the company demands significantly more time and money to develop. Finally, the best way to overcome the interpretation of results problem is to invest in consultants or at least invest time from support people to deliver and consult with target managers.

3. VALIDITY AND RELIABILITY OF 360-DEGREES PERFORMANCE APPRAISAL

Most employees are going to accept the results of an appraisal tool if they consider it valid. Validity refers to the notion that the appraisal is accurately tied to the performance of the individual. The validity of an appraisal tool is a matter of its job relatedness, it is the question of whether the performance appraisal system accurately assesses and reflects a person’s true performance [8]. If the employees perceive that the system is not valid, then they will lose faith and not trust the manager or the appraisal tool. The loss of faith and trust eventually leads to decline in productivity. If the appraisal tool is valid, the employees who receive high performance ratings are in fact the best performers and those employees who receive the lowest ratings are actually the poorest performers [8] According to, the five components that must be present in any performance appraisal system are: 1) Relevance, 2) Sensitivity, 3) Reliability, 4) Acceptability and 5) Practicality. Relevance refers to a correspondence between the elements identified as critical to job performance and performance standards refers to the extent to which the appraisal instrument can distinguish between good performance and poor performance [3].

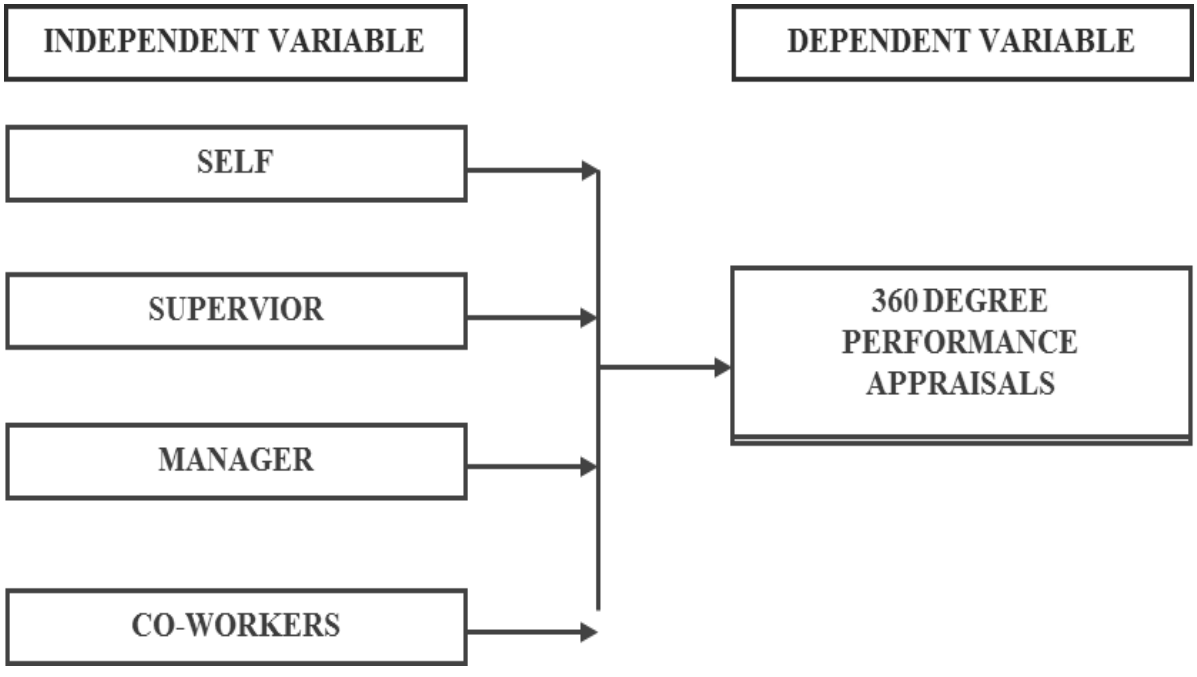
It has been found that 80% of organizations report dissatisfaction with their appraisal processes [9]. However, “effective performance appraisal systems help to create a motivated and committed workforce” [2]. In many organizations, performance appraisal is not used to guide development. In general terms, a line manager may meet with an employee once

per year to review a performance appraisal form, often without input or self appraisal from the employee being appraised. Once the form is complete, it is often used by senior managers to determine remuneration (bonus/salary) or promotion. This decision is then communicated to the employee, questions are answered, and the appraisal is concluded [13]. Although it is often overlooked, it is considered essential that those using performance appraisal instruments and conducting interviews are trained to do so (cited in [7]) [11]. Any rating scale used should be carefully designed to reduce sources of error such as central tendency error whereby a rater tends to mark at the centre of the scale (3 out of 5, for example) across the board regardless of actual performance.

4. CONCEPTUAL FRAMEWORK OF 360 DEGREE PERFORMANCE APPRAISALS

There two variables under 360 degree performance appraisals such as independent variables and dependent variable. Where in Independent variable contains self, supervior, manager and co-workers who comes into contact with the employee and can provide valuable insights and information with the help of dependent variable 360 degree performance appraisals

Fig. 4.1 Framework of 360 Degree Performance Appraisals



5. OBJECTIVES OF THE STUDY

- To know the existing satisfactory level of employees towards 360 degree performance appraisal system.
- To measure the level of employee involvement towards the job in the study area.
- To measure the effectiveness of evaluations towards employees in the study area.
- To give viable suggestion to improve satisfaction levels of 360 degree performance appraisal system.

6. NEED FOR THE STUDY

- It helps to check the effectiveness of evaluation towards employees
- It is needed to ensure that employees reach organizational standards and objectives.
- To understand the expectations of the employees
- To study about employee involvement towards the jobs and organisation.

7. RESEARCH METHODOLOGY

Research Methodology is a way to systematically solve the research problem. Research is an art of scientific investigation. The advanced learner's dictionaries of current English lay are down the meaning of research as, "a careful investigation (or) inquiry, especially through the search for new facts in any branch of knowledge".

For this analysis in the research initially the researcher used descriptive research to report the factor as such happen. Later on he used exploratory research to find the cause and effect. The primary data are those which are collected a fresh and for the first time and thus happen to be in original character. For this project, Primary data were collected with the help of a questionnaire and informal interview was also conducted to get the direct responses of the employees regarding critical factors. Secondary data are those data available already in the books of records. Secondary data was collected from company records and annual reports. The tools used for analysis of mean and standard deviation, ANOVA, factor analysis in Lotte India Corporation Ltd.

8. ANALYSIS AND INTERPRETATION

8.1 ANALYSIS OF MEAN AND STANDARD DEVIATION

PARTICULAR	MEAN	S.D	RANK
Improve employee satisfaction level	3.1100	.91998	8
Helps people set and achieve meaningful goals	3.4000	.96400	10
Helps to change employers	2.8600	.89916	4
Employee satisfaction level developed after 360 degree performance appraisal	2.9300	1.33526	5
Increment in your salary after 360 degree performance appraisal	2.8300	.88825	1
Do you get employees' involvement by this method	3.1100	1.04345	8
Equal opportunity for all employees	2.8800	.95642	3
Helps to identify the strength & weakness of the employees	2.9900	.87033	6
Promotion is purely based on 360 degree performance appraisal system	2.8700	.67652	2
The superior will identify and correct the mistake	3.0900	1.12900	7

Table 8.1 Mean & Standard Deviation Analysis

Table 8.1 exhibits the perceived value of the respondents about 360 degree performance appraisal satisfaction in the study area. It is observed from the table that the standard deviation less score obtained by the respondents that Promotion is purely based on 360 degree performance appraisal system i.e., .67652. Then the high level of score obtained in the standard deviation is that Employee satisfaction level developed after 360 degree performance appraisal i.e., 1.33526. The table infers that the statement is less deviated. Therefore, this statement is consistent the respondents are given the same opinion.

8.2 ANAYSIS USING FACTOR The purpose of investigation who to explore the factor structure underlying the employee responses of 360 degree performance appraisal system at Lotte India Corporation Ltd. A successful result is one in which a few factor can be explain a large portion of the total variability any those factors can be given meaningful name using the assortment of items that correlate the highest with it. We can feel confident when adding similar items up for total scores to represent the different dimensions of 360 degree performance appraisal system (each factor represents a dimension). The below table were shown that the Kaiser-Meyer-Olkin Measure of sampling adequacy is 0.710.

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		.710
Bartlett's Test of Sphericity	Approx. Chi-Square	415.997
	Df	36
	Sig.	.000

Table 8.2 KMO and Bartlett's Test

Bartlett's test of sphericity indicates whether the correlation matrix is an identity matrix, which would indicate that the variables are unrelated. The significance level gives the result of the test. Very small values (less than .05) indicate that there are probably significant relationships among the variables. A value higher than about .10 or so may indicate that this data are not suitable for factor analysis. Hence, the researcher concludes the data is suitable for factor analysis

Component	Initial Eigen values			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.789	30.989	30.989	2.789	30.989	30.989
2	1.857	20.637	51.626	1.857	20.637	51.626
3	1.458	16.203	67.829	1.458	16.203	67.829
4	.934	10.380	78.209			
5	.770	8.558	86.768			
6	.580	6.442	93.210			
7	.356	3.953	97.162			
8	.199	2.207	99.370			
9	.057	.630	100.000			

Table 8.3 Extraction Method: Principal Component

The above table gives three values, the variance explained, and cumulative variance explained for the factor solution. The first panel gives values based on initial three values. For the initial solution, there are as many factors as there are variables. The "Total" column gives the amount of variance in the observed variables accounted for by each factor. The "% of Variance" column gives the percent of variance accounted for by each specific factor, relative to the total variance in all the variables. The "Cumulative %" column gives the percent of variance accounted for by all factors up to and including the current one. For instance the Cumulative % for the second factor is the sum of the % of Variance for the first and second factors. In the above table, there are a few factors that explain a lot of the variance which is a sign of good factor analysis and the rest of the factors explain relatively small amounts of variance.

The Extraction Sums of Squared Loadings group gives information regarding the extracted factors or components. For Maximum Likelihood extraction method, these values will generally be smaller than the initial values, due to errors in measurements.

In the "Rotation Sums of Squared Loadings" group, the variance accounted for by rotated factors or components may be different from those reported for the extraction, but the Cumulative % for the set of factors or components will always be the same. Together they are capable of explaining roughly 69.8 % of all the variable variances. A plot three values are provided below. A review of the initial factor loadings suggests that the proper solution was attainable through maximum employees. The computer printout does not warn that the results are no positive definite, so one important condition for proceeding with the interpretation has been met.

Particulars	Component		
	1	2	3
Follow 360 degree performance appraisal system effectively	.659	-.219	-.019
Improve employee satisfaction level	.063	.360	.803
Helps people set and achieve meaningful goals	.809	-.102	-.364
Helps to change behavior of employees	.133	-.703	.393
Employee satisfaction level developed after 360 degree performance appraisal	.695	.078	.130
Do you get employees' involvement by this method	.892	-.235	.088
A better relationship with coworkers	.500	.387	-.328
Better relationship with supervisor	.372	.432	.595
Better relationship with manager	.112	.882	-.197

Table 8.4 Extraction Method: Principal Component Analysis. a. 3 components extracted.

8.3 ANAYSIS USING ANOVA

		Value Label	N
Follow 360 degree performance appraisal system effectively	1	Strongly agree	5
	2	Agree	46
	3	Neutral	44
	5	Strongly disagree	5
Age	1	Below 30	5
	2	31-40	72
	3	41-50	23

Table 8.5 Between-Subjects Factors

Dependent Variable: Monthly income				
Follow 360 degree performance appraisal system effectively	**Age**	**Mean**	**Standard Deviation**	**N**
Strongly agree	below 30	1.0000	.00000	5
	Total	1.0000	.00000	5
Agree	31-40	2.8636	.34714	44
	41-50	3.0000	.00000	2
	Total	2.8696	.34050	46
Neutral	31-40	3.0000	.00000	23
	41-50	3.4286	.50709	21
	Total	3.2045	.40803	44
Strongly disagree	31-40	1.0000	.00000	5
	Total	1.0000	.00000	5
Total	below 30	1.0000	.00000	5
	31-40	2.7778	.56224	72
	41-50	3.3913	.49901	23
	Total	2.8300	.72551	100

Table 8.6 Descriptive Statistics

Dependent Variable: Monthly income

F	df1	df2	Sig.
21.239	5	94	.000

Table 8.7 Levene's Test of Equality of Error Variances

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept + effectively + age + effectively * age

Dependent Variable: Monthly income

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	41.785[a]	5	8.357	76.086	.000	.802
Intercept	125.057	1	125.057	1.139E3	.000	.924
Effectively	17.597	2	8.799	80.106	.000	.630
Age	.520	1	.520	4.734	.032	.048
effectively * age	.139	1	.139	1.266	.263	.013
Error	10.325	94	.110			
Total	853.000	100				
Corrected Total	52.110	99				

a. R Squared = .802 (Adjusted R Squared = .791)

Table 8.8 Tests of Between-Subjects Effects

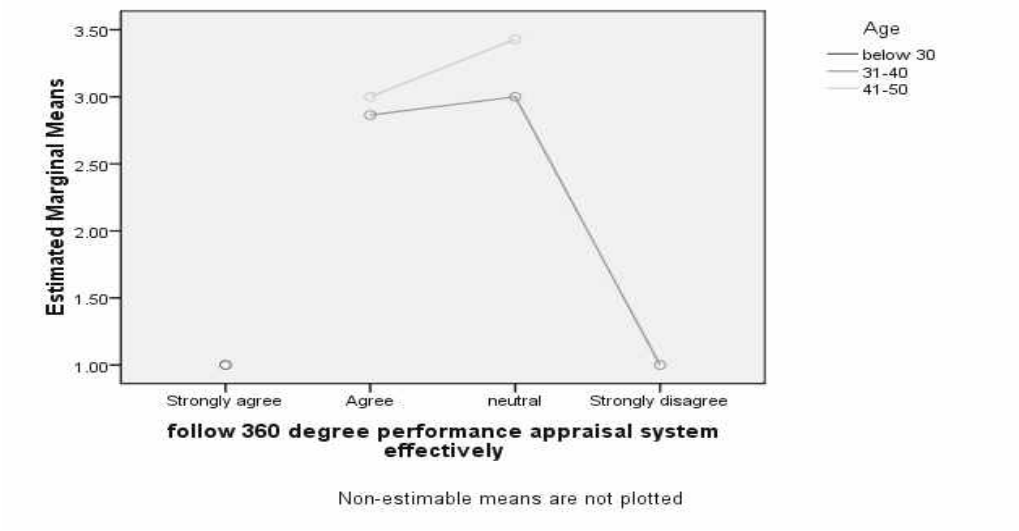


Figure 8.1 Estimated Marginal Means of Monthly Income

Since the significant level 0.26 is more than 0.05 null hypotheses is accepted and alternative hypothesis is rejected. From the table the ANOVA is calculated and the value is 0.263 (i.e.). Hence there is no significant difference between effectively and age by the company

9. CONCLUSION

A 360 degree performance appraisal is simply the process of measuring an employee's performance. It gives employee information about their performance problems and ways they can improve their performance. The purpose is to make employees know the difference between their current performance and the expected performance after appraisals so they can make changes by highlighting their weakness. It also improves the organization's performance the enhanced

performance of individuals. Here employees' behavior or skills are evaluated not only by subordinates, but also by peers, customers, bosses and self. Better relationship between manager, supervisor and co-worker. It also improves the employee satisfaction level to develop.

10. SUGGESTIONS

An organization can try and increase the level of workers participation in decision making. The employer can motivate individuals through proper counselling and guidance. The Organisation must increase employee involvement through 360 degree performance appraisal system. Majority of them feel that 360 degree performance appraisal helps to change the behaviour of employees and people set and achieve the meaningful goal.

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A MODEL FOR AUTOMATED DETECTION AND CONTROL OF AIR POLLUTION FROM VEHICLES

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ABSTRACT

The paper mainly concentrated on controlling the air pollution from vehicles by using semi-conductor gas sensor for detecting the emission level from vehicles. If the vehicle do not get service regularly, then pollution level higher than standard emission level. In this paper, smoke sensor has been used to detect carbon monoxide from vehicles. Smoke sensor senses the pollution level from vehicles. If pollution level is recorded beyond the standard values from government, then microcontroller alerts the buzzer and displays pollution level on LCD. Microcontroller also sends pollution level to service centre through text message by a GSM module. At the same time, activate the timer that indicates vehicle will be stopped after some time. During this time, GPS finds the location of vehicle in terms of latitude and longitude values and displays on LCD. GSM send GPS values to service centre through text message. When timer expires, vehicle will be stopped due to the fuel supply to engine get stop by relay circuit is controlled by microcontroller. Based on GPS values, service centre can trace and service the vehicle. The proposed system must be registered with service centre by sending text message. This paper will benefit to the society and help in controlling the air pollution.

Keywords: *ARM LPC2148, GSM, GPS, MQ-2, MQ-7, MQ-135.*

1. INTRODUCTION

The incomplete combustion in the engine of a vehicle leads to emission of different gases contributing to increase in the pollution and adversely affecting the environment. Detection and control of these gases is an important area of work. This emission from vehicles cannot be completely avoided but, it definitely can be controlled [1].

Over the years, there have been several regulations made by the Government to control the emission from vehicles; most of them being unsuccessful at the same. The government of India introduced the Bharat Stage Emission Standards to control air pollution from vehicles. Several emission norms were come to control the emission levels from vehicles since two decades. The standards and the timeline for implementation are set by the Central Pollution Control Board under the Ministry of Environment & Forests. Bharat stage emission standards are emission standards instituted by the Government of India to regulate the output of air pollutants from internal combustion engine equipment, the first emission norms were introduced in India in 1991 for petrol and 1992 for diesel vehicles. These were followed by making the Catalytic converter mandatory for petrol vehicles and the introduction of unleaded petrol in the market. On April 29, 1999 the Supreme Court of India ruled that all vehicles in India have to meet Euro I or India 2000 norms by June 1, 1999 and Euro II will be mandatory in the NCR by April 2000. Car makers were not prepared for this transition and in a subsequent judgment the

implementation date for Euro II was not enforced. The standards, based on European regulations were first introduced in 2000. Progressively stringent norms have been rolled out since then. All new vehicles manufactured after the implementation of the norms have to be compliant with the regulations. Since October 2010, Bharat stage III norms have been enforced across the country. In 13 major cities, Bharat stage IV emission norms are in place since April 2010. The phasing out of 2 stroke engine for two wheelers, the stoppage of production of various old model cars & introduction of electronic controls have been due to the regulations related to vehicular emissions.

2. DESIGN PARAMETERS

Now a day's air pollution is the biggest problem to solve/ manage due to heavy increase in number of vehicles. This air pollution may impact severely on the global environment if it is not controlled in right manner and this system is mainly designed for controlling air pollution. When the pollution/ emission level shoots beyond the already set threshold level, there will be a buzz in the vehicle to indicate that the limit has been reached and this information has been send to traffic control room which includes vehicle number, owner details and location of the vehicle by using GPS.

2.1 **Proposed system** ARM microcontroller plays a vital role in this proposed system. The remaining modules are GPS, GSM, LCD, buzzer and relay are controlled by microcontroller. Microcontroller takes input from smoke sensor output. Based on smoke sensor output, microcontroller controls the remaining modules. Based on programming the EEPROM of microcontroller, automatically microcontroller controls all the modules without any manual instructions. MQ-2 sensor is used to detect pollution levels from vehicles. If the pollution level of vehicle crosses the standard emission level, then vehicle will be stopped by microcontroller automatically. Sensor is mainly used to detect carbon monoxide (CO) concentrations in air [4]. Whenever the CO concentration increases or exists in air, then sensor conductivity is high. We use simple circuit to convert the change of conductivity to correspond output signal of gas concentration. This sensor can also detect the combustible gas or flammable gas such as, methane, hydrogen and LPG. The advantages are Long life and low cost. Good sensitivity to CO and combustible gases. It can detect combustible and smoke gases concentration from 300-10000 ppm in air. This sensor can be fixed at emission outlets of vehicle. LM35 temperature sensor monitors the engine temperature and prevents it from getting over heated. LPC2148 is the ARM 7TDMI based 32 bit microcontroller which has the maximum number of pins used to programming IO, Where the ports are mapped to virtual port. It has two 32-bit timers/ external event counters (four captures and four compare channel each). The microcontroller is used to perform four functions. First one is, compare emission values with standard values prescribed by government. Second one is, activates the timer and alerts the buzzer to indicate vehicle will be stopped after sometime due to the violation of standard emission values. Third one is, microcontroller activate the GPS to find location of vehicle and display in terms of latitude and longitude. Fourth one is, GSM module is activated by microcontroller to send GPS values to service centre through text message. The microcontroller performs functions according to the software programmed in EEPROM of microcontroller [2].

2.2 **Operation** In this paper we are implementing pollution detection and controlling system based on the amount of pollution released from vehicles. We are doing, using real time operating system, First we will find out the pollution levels that will be done using MQ7 sensor. If the pollution level detected strikes beyond the pre-defined value, then it automatically sends a message containing vehicle number using GSM and its location using GPS.

The hardware setup of proposed system is shown below.

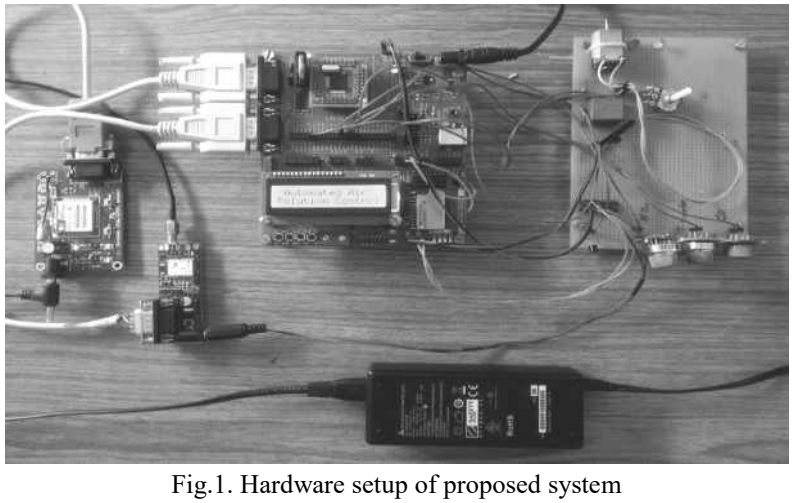


Fig.1. Hardware setup of proposed system

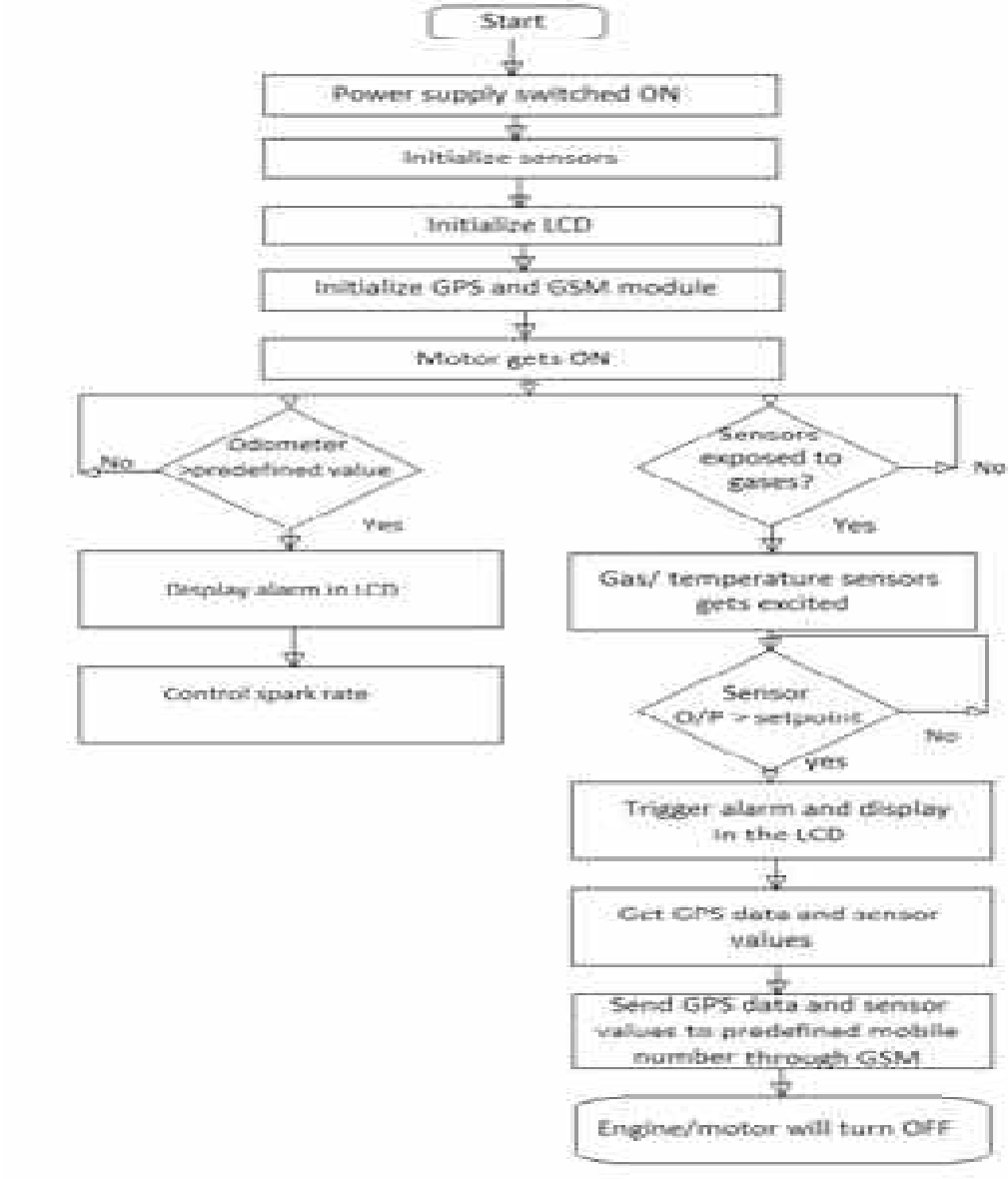


Fig.2. Flow chart of proposed system

The proposed system detects the emission level from vehicle by using mq-2 sensor. If the vehicle crosses the standard level or threshold level, immediately the system will alert the driver to service the vehicle through buzzer and also displays pollution level on LCD as well as send to service centre through text message. It also indicates after some time the vehicle will get stop. During this time, GPS find the location of vehicle in terms of latitude and longitude and also displays on LCD. The GPS values send to service centre by GSM module. When the timer expires, the vehicle will be stopped.

Whenever the level of pollution crosses the standard level or threshold level which have been prescribed by government, then fuel injector break the fuel supplied to engine using relay circuit. The fuel injector takes the input from microcontroller and gives its output to motor. The fuel pump can be on or off by using relay circuit. If there is no pollution from vehicle, then ignition switch is in on state .so, vehicle is keep moving. If the pollution level crosses standard level, then ignition switch comes in to off state by using relay to control fuel pump [3]. So, vehicle will be stopped. Whenever the pollution level reaches to maximum limit, a trigger pulse is given to GPS by microcontroller. The GPS is programmed when GPS receives a trigger pulse, it starts showing the location of vehicle continuously until the vehicle will be stopped. Whenever the GPS starts showing the location, then GSM module automatically sends a GPS values through text message to service centre by microcontroller. Max 232 provides serial communication between GSM module and microcontroller. At the time of registration with service centre number, first we have to send text message to GSM module of proposed system for storing service centre number in microcontroller. After that, the service centre received message “Number Registered” from the GSM module of proposed system [5].

2.3 Result Analysis

CASE I: If the pollution level detected is below than the pre-defined value, then vehicle is considered in a perfect condition. Initially proposed system at idle state. There is no pollution. The vehicle is keep moving.

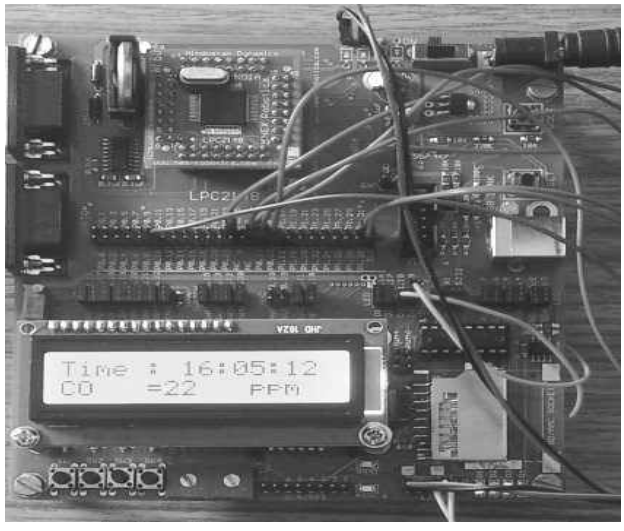


Fig.3. Detection of CO

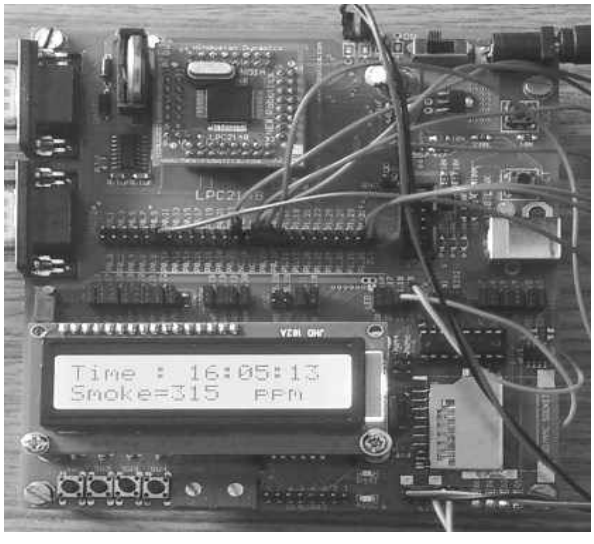


Fig.4. Detection of Smoke

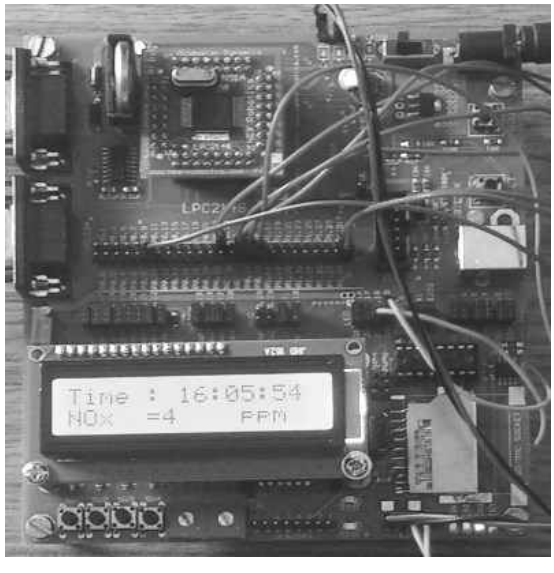


Fig.5 Detection of Nox

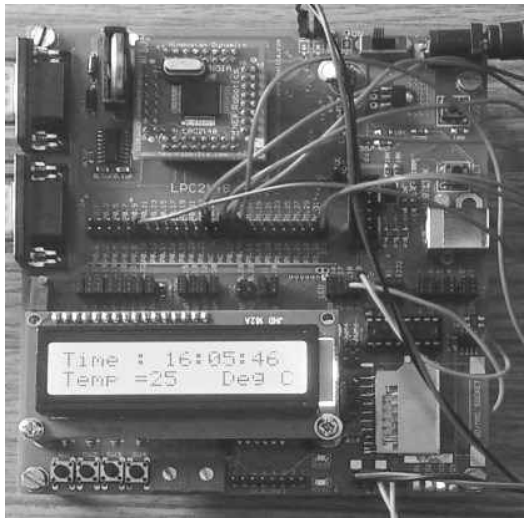


Fig.6. Detection of Temperature

If the vehicle is serviced periodically, then speed of the vehicle remains normal.

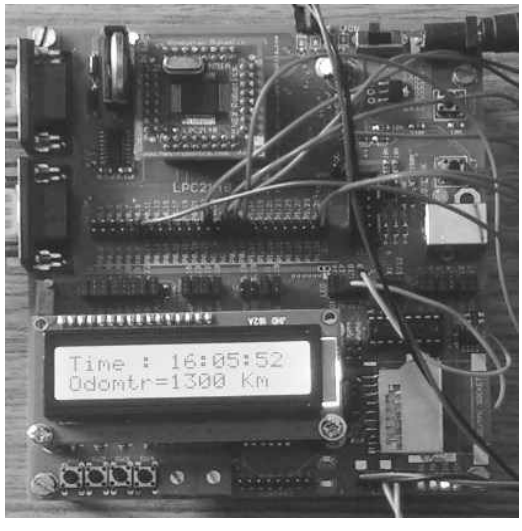


Fig.7. Detection of Odometer

CASE II:

If the pollution level detected exceeds the pre-defined value.

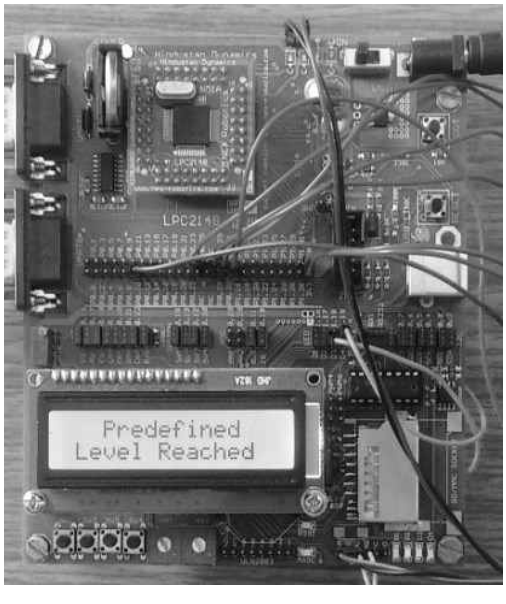
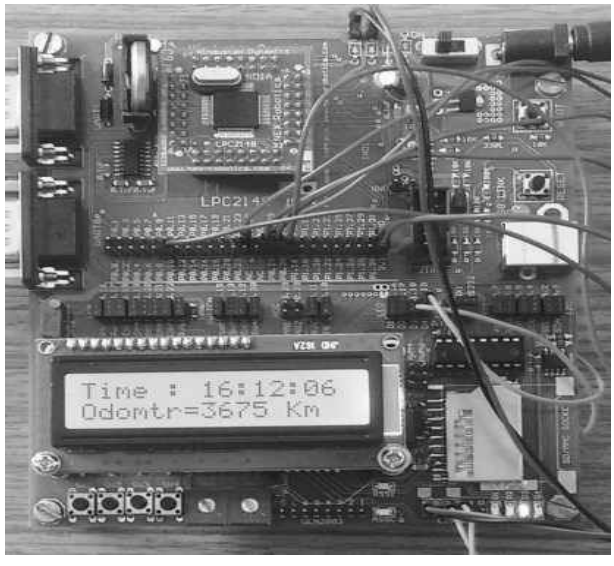


Fig.8. Detection of Smoke exceeding predefined values

If the vehicle is not serviced periodically, then the odometer alters the driver for service and the speed of the vehicle reduces as the vehicle is not serviced.



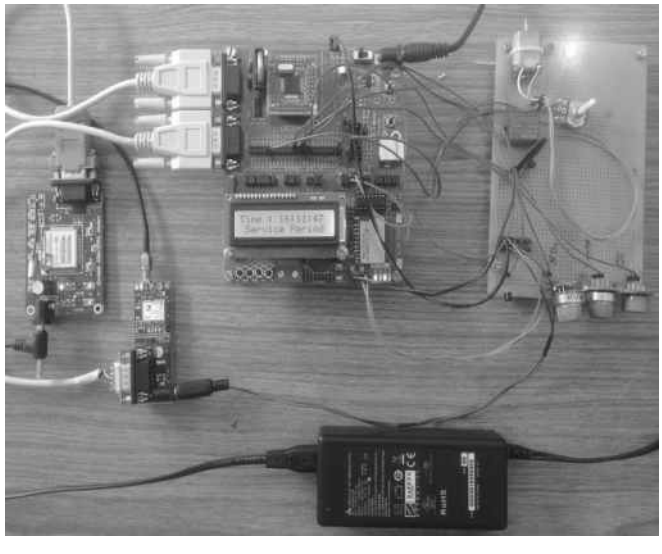


Fig.9. Detection of Odometer exceeding the predefined value

Whenever pollution emission level beyond threshold level, there will be a buzzer alert to indicate breach level in vehicle and also after some time vehicle will stop. A cushion period is given to driver to park his or her vehicle.

During this period, GPS automatically find the location of vehicle and display it through the latitude and longitude values by microcontroller. GSM module send both latitude and longitude values through text message to service centre.

After cushion period expires, the fuel is supplied to engine will be cut-off by using above relay circuit which can act as switch.

A message received to owner from vehicle control system requesting to get serviced their vehicle as soon as possible within the limited period.

In this proposed system, mq-2 gas sensor has been used to detect CO concentration in air, whenever CO concentration is raised. It can also detect flammable or combustible gas concentrations, when it is present in air.

Fig.10. A message sent to Control System

3. CONCLUSION

The results in the pollution control interfaces the modules like GSM, GPS, with the controller ARM7 offering the high end outputs .The values as output is successfully carried out. Here with the help of GSM the messages are transferred and received as well. The main focuses on three concepts. The first concept is, detecting pollution level from vehicles and represent to driver of vehicle. The second concept is, avoiding the inconvenience to driver of the vehicle by sending text message to service centre using GSM module. The proposed system can control the pollution. The third concept is, it can be easily deployed in vehicles. In this paper, mq-2 gas sensor has been used to detect CO concentrations in air. It can also detect combustible gas which can lead to heavy explosions. This kind of sensors can also more useful in industries. The same concept can also be extended to industries.

In future we can add additional futures like traffic police have an authority to stop the vehicle remotely by sending

a SMS using GSM, or by getting the driver's Driving License Number to the control system as such, When augmented as a real time project, will benefit the society and help in reducing the air pollution.

4. ACKNOWLEDGEMENT

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ANALYSIS OF TWO-WAY SLABS WITH AND WITHOUT OPENING FOR DIFFERENT BOUNDARY CONDITIONS

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ABSTRACT

Concrete slab with opening are usually designed with help of traditional rules of thumb proposed by building codes. Such methods however introduce limitations concerning size of opening and magnitude of applied loads. Furthermore there is a lack of sufficient information about the load carrying capacity of slab with opening. It is also difficult to model the complex behaviour of reinforced concrete structures analytically in its non-linear zone. This has led engineers in the past to rely heavily on empirical formulas which were derived from numerous experiments for the design of reinforced concrete structures. Nowadays, for structural design and assessment of reinforced concrete members, the non-linear finite element (FE) analysis has become an important analytical tool. This thesis investigates the structural behaviour of two way reinforced concrete slab with and without openings for different slab length ratios and different opening ratios. The effect of openings sizes on crack formation is also analysed. For this different models of slab with and without opening were modelled in finite element software ANSYS.

Keywords **:** *ANSYS, Crack pattern, Equivalent stress, Slab opening, Two-way slab.*

1. INTRODUCTION

In the design of concrete slabs with openings the building codes propose instructions that are not supported by the underlying theories such as empirical methods and strip method. The problems concerning with design of slab with opening cannot be solved by analytical methods since such structures like concrete slabs with openings, are too complicated. Nowadays, access to powerful computers and advanced software gives possibility to create accurate models by means of the finite element method. Advanced finite element modelling is in most cases time-consuming and for this reason it might be too expensive for design offices or when the number of needed openings is limited. Accurate methods obtained from academic researchers can prepare a background for evaluation of simple design methods and ready solutions for designers. Due to lack of accurate calculation methods, the size of an opening and magnitude of allowable load are limited by code. In this study, two way reinforced concrete slab with and without openings are modelled using commercial software package ANSYS to understand the behaviour of slab with different opening size. The aim of this study is to determine the effect of opening on stresses and deflection in two way reinforced concrete slab. Analysis of slabs are performed for different opening size at different location and thus to find out the variation in stresses. Finite element stresses are used to determine

the moment coefficient for different opening size. Based on these results a design guide line recommendation is prepared for the design of two way slabs with opening. The project work may offer the structural engineer with guidance on understanding the crack pattern of slab having different boundary conditions with and without opening.

2. LITERATURE REVIEW

Chee Khoon Ng et.al (2008) [3] carried out, a study on simply-supported and fixed-end, square slabs with opening at ultimate limit state using the yield line method. A study on the effect of opening on the load carrying capacity of simply-supported and fixed-end slabs was presented. After their analysis they came to a conclusion that, since most of the slabs have small opening of size up to 0.3 times the slab dimension, a simply-supported slab would have a reduction in ultimate area load of up to 11% and a reduction of ultimate total load of up to 19% and a fixed-end slab would experience less significant reduction in both ultimate area load and ultimate total load capacities of 4% and 7%, respectively. They also presented charts in normalized load capacity and opening size which could be e used as guidelines for predicting the load capacity of simply- supported and fixed-end slabs with openings.

Koh Heng Boon.et.al (2009) [5] carried out an experimental work to determine the structural performance of one way reinforced concrete slabs with rectangular opening. Five types of RC slab which consist of two panels for each type were tested by four points bending test. These include one control slab without opening and other four with rectangular opening at the center. Based on the experiment result it was found that the reduction of 15% area due to the rectangular opening located at the centre of RC slabs reduces 36.6% of flexural strength. The crack pattern obtained for slab with opening and without additional reinforcement around was found to be same as that of slabs with opening and additional reinforcement of either rectangular bars or diagonal bars around opening. The provision of additional reinforcements surrounding the opening increases the flexural capacity of the RC slab. Also the cracking pattern found in the opening slab shows a high concentration stress occurred at the corner of the opening when vertical load applied.

Hosam A. Daham (2010) [4] carried out finite element analysis by using ANSYS 5.4 program with a non linear concrete model satisfying complex support condition to predict the ultimate load for different types of RC slabs. The effects of openings for different types of boundary conditions were studied. Effect of supports status on the deflection of the slabs with and without opening was studied and the results shows that the opening in slabs supported on four edges have little effects on slab. Results obtained from the analysis carried out for different boundary conditions shows that the deflection for slabs with opening fixed on all four sides was about 5.6% of that of slab simply supported at all four sides. Also the deflection of slab with opening fixed at two opposite side and fixed free at other two opposite side was about 9.6% of that of slab simply supported at two opposite sides and simply supported free at other two opposite sides. The values distributions of normal stresses were also greatly affected by opening in slabs especially at opening region.

Ahmed Ibrahim et.al.(2011) [1] used numerical simulations using ANSYS to study the response of waffle slabs with and without openings and the design coefficients for the column and the field strips of the internal panel of a waffle slab. He also studied the effect of openings and stiffening ribs on the design coefficients. The linear modeling results were used to study the moment coefficients before cracking, whereas the nonlinear models were used to calculate the moment coefficients at ultimate loads. Finite element models were used to study the effect of column size, slab thickness, solid portion size, and opening size and location on the moment coefficients. By comparing the results it was found that the linear analyses gave higher values for the moment coefficients than the ones obtained from the nonlinear analyses and the ACI code coefficients. Also by increasing the solid portion size, it was found that the negative moment coefficient of the column and field strips increased for column strips and field strips, whereas the positive moment coefficient of the column and field strips decreased for column strips and field strips.

Sheetal Gawas and Dr. S.V.Itti (2013) [7] presented finite element analysis of RCC slab models to study variation of displacement and stresses, in slab with different boundary conditions. Non-Linear static analysis was carried out using ANSYS 10 Software and a rectangular RC slabs with tensile reinforcement was analyzed. Comparing the slabs with different boundary conditions both with and without opening, the slab simply supported on all the edges shows highest displacement and slab fixed all the edges shows least displacement. The slab having fixed support on all the edges with and without opening shows highest stresses, whereas slab simply supported on all edges shows least stresses among all other slabs.

Prof. Dr.Nazar K. Oukaili, and Thaar Saud Salman,(2014) [6] conducted an experimental test on six half-scale reinforced concrete flat plates connections with an opening in the vicinity of the column. The tests were designed to study the effect of openings on the punching shear behaviour of the slab-column connections. From the results it was found that

all the specimens have failed in punching shear mode. The capacity of the flat plate was greatly affected by size of the opening. The ultimate strength of the flat plate with the larger opening decreased by 29.25% with respect to the ultimate strength of solid specimen. For the specimen with a smaller opening, the decrease in capacity was 12.42%. For the specimen with opening at distance *h* (70mm) from the front face of the column, the shear capacity decreased by 13.47% from control one. For specimen with the opening next to the column, the decrease in capacity was 19.65%. The opening located at the front of the column decreases the shear capacity of the flat plate more than the same size opening located at the corner of the column. The opening location adjacent to the front column face decreased the shear capacity by 19.65% from control one, while that adjacent to the column corner decreased the capacity by 11.43%**.** The presence of openings in flat plates decreases the stiffness depending on the sizes and locations of these openings.

Anjaly Somasekhar and Preetha Prabhakaran (2015) [2] examined the structural behaviour of waffle slabs (ribbed flat slabs) with and without openings and the effect of openings sizes and locations on the ultimate loads. These items were studied using finite element software by analyzing nonlinear finite element models of an internal panel of waffle slab under uniform loading. Results obtained from numerical study showed that opening dimensions and its locations have a significant effect in the structural behaviour of waffle slab. The size of openings in the region bounded by two column strips should be limited to 10% of the column strip width while in the region bounded by a column strip and a middle strip, size limit is 20% of the column strip width. But for the region bounded by two middle strips, no such limitation has been found in opening size leading to a conclusion that in this region, opening size can be even up to 40% of the width of column strip. It was concluded from the results that special measures have to be taken to improve the performance of waffle slabs having large openings in the regions bounded by two column strips and that bounded by a column strip and middle strip.

3. MATERIAL AND METHODOLOGY

ANSYS is a general purpose software, used to simulate interactions of all disciplines of physics, structural, vibration, fluid dynamics, heat transfer and electromagnetic for engineers. So ANSYS, which enables to simulate tests or working conditions, enables to test in virtual environment before manufacturing prototypes of products. Furthermore, determining and improving weak points, computing life and foreseeing probable problems are possible by 3D simulations in virtual environment. ANSYS can work integrated with other used engineering software on desktop by adding CAD and FEA connection modules. ANSYS can import CAD data and also enables to build a geometry with its "preprocessing" abilities. Similarly in the same preprocessor, finite element model (a.k.a. mesh) which is required for computation is generated. After defining loadings and carrying out analyses, results can be viewed as numerical and graphical.

A. Modelling of Concrete Element geometric modelling of concrete has been done using 3D 8 noded solid brick element shown in Figure 1. The solid element (Solid 65) has eight nodes with three degrees of freedom at each node and translations in the nodal x, y, and z directions. The element is capable of plastic deformation, cracking in three orthogonal directions, and crushing. The geometry and node locations for this element type are shown in the figure.

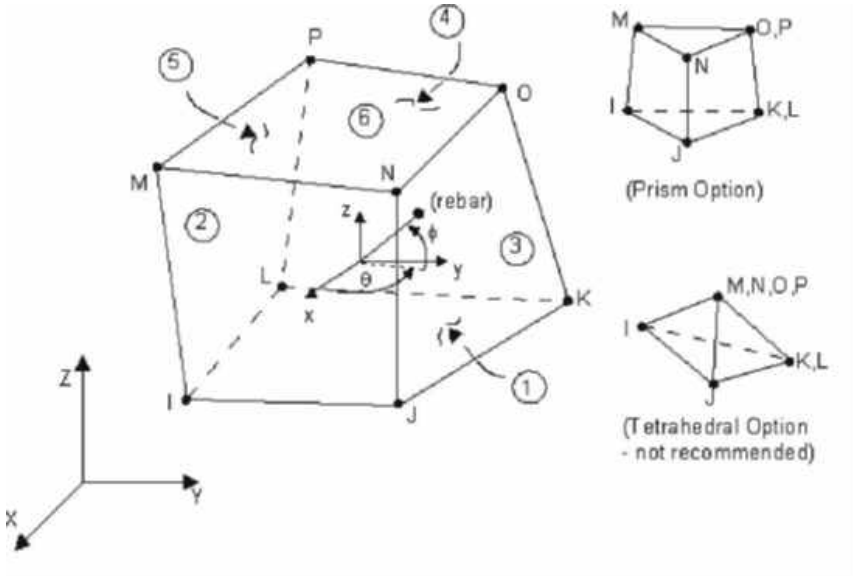

Fig 1. Solid 65 element

Table-1 lists concrete properties within Solid65 element prior to initial yield surface. The solid65 element is capable of cracking in tension and crushing in compression. The multi linear isotropic concrete model uses the von Mises failure to define the failure of concrete.

Table-1.
Concrete properties prior to initial yield
Surface

Material	Material model	Modulus of elasticity (MPa)	Poisons ratio
concrete	Linear elastic	25000	0.2

Table-2
Concrete parameters beyond initial yield surface.

Open shear transfer coefficient, βt	0.3
Closed shear transfer coefficient, βc	0.9
Uniaxial cracking stress	2.5 Mpa
Uniaxial crushing stress f'c	25 Mpa

The compressive uni-axial stress-strain relationship for the concrete model was obtained using the following equations to compute the multi-linear isotropic stress-strain curve for the concrete.

$$f = \frac{E_c \varepsilon}{1 + \left(\frac{\varepsilon}{\varepsilon_0}\right)^2} \quad (1)$$

$$E_c = \frac{f}{\varepsilon} \quad (2)$$

$$\varepsilon_0 = \frac{2 \times f_c'}{E_c} \quad (3)$$

B. Modelling of steel reinforcement

Reinforcement modelling could be discrete or smeared. In our work, a discrete modelling of reinforcement has been done. The reinforcement has been modelled using link elements in ANSYS. LINK180 is a 3-D spar that is useful in a variety of engineering applications. The element can be used to model trusses, sagging cables, links, springs, and so on. The element is a uniaxial tension-compression element with three degrees of freedom at each node: translations in the nodal x, y, and z directions. Tension- only (cable) and compression-only (gap) options are supported. As in a pin- jointed structure, no bending of the element is considered. Plasticity, creep, rotation, large deflection, and large strain capabilities are included.

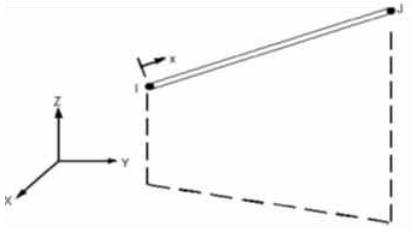

Fig 2: Link 180 – 3-D spar

Table-3
Reinforcement properties within link180 element

Material	Material model	Modulus of elasticity (MPa)	Poisons ratio
Sructural steel	Linear elas-tic	200000	0.3

The bilinear law, elastic-perfectly plastic, is assumed as shown in Figure 6.The initial elastic part has the elastic modulus of steel Es. The second line represents the plasticity of the steel with hardening and its slope is the hardening modulus Esh. In case of perfect plasticity Esh =0. Limit strain εL represents limited ductility of steel.

Table-4.
Reinforcement parameters beyond initial yield surface.

Yeild strength	415 MPa
Tangent Modulus	0

4. RESULTS AND DISCUSSION

In the present work, slabs with and without opening for two boundary conditions are being analyzed and studied. The opening varies as the length of opening as 12.5% , 25%, 37.5%, and 50% of length of slab and each opening varying in opening length to breadth to ratio as 2, 1.8, 1.6, 1.4, 1.2, and 1.

A. *Slab with fixed support on all four edges*

The variation in stress due to slab opening for a load of 17KN/m^2 is graphically shown in figure 3. From the figure it is clear that the stress for a slab with opening is higher than that without opening, also the stresses are high for the slab with large length to breadth ratio. Here the stress is more for *l* by *b* ratio 2 and less for *l* by *b* ratio 1, which is when the opening is a square.

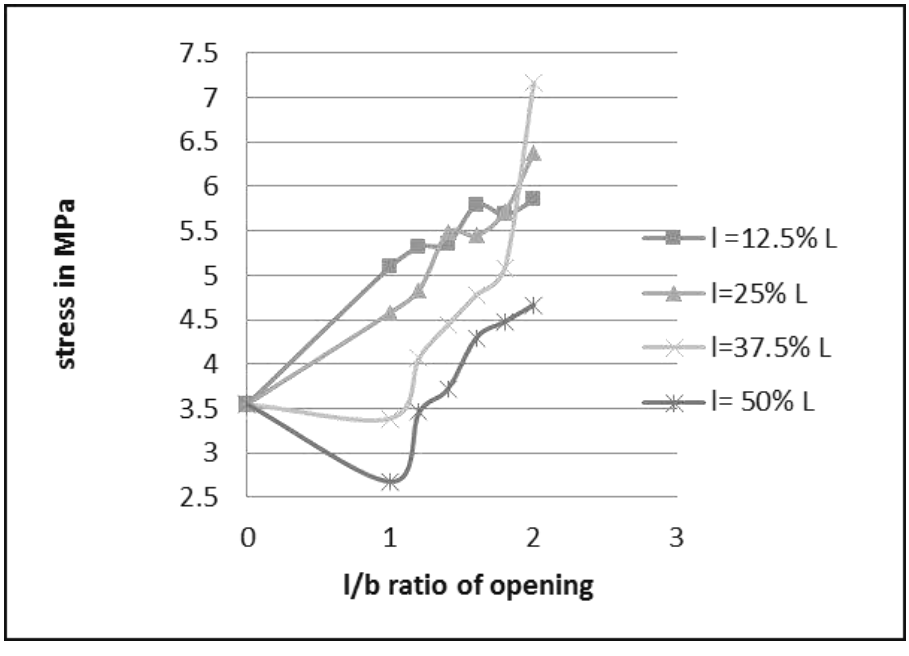

Fig: 3 Stress versus opening length to breadth ratio for interior slab

In this project the slabs with and without hole are also analysed for the load at which the slab shows first crack. . The variations in load carrying capacity of the slabs are tabulated in table 5. From the table it is clear that presence of opening have reduced the load carrying capacity of slab. Also the load carrying capacity increases when the opening length to breadth ratio decreases and attains a maximum value when length to breadth ratio is equal to one, which is when opening is a square. The results also shows that the first crack occurs at the edge of hole up to a particular value of *l* by *b* ratio, after

that the crack is mainly concentrated at the edges of slab. This is due to the reason that the area of slab on which load is applied decreases as the size of opening increases and hence the load transferring is mainly concentrated at the edge of slab.

Table-5.
The load and position at which the first crack form for a slab with fixed support on all four edges having varying opening size

l/b	*l/L (%)*	*Load (KN/m2)*	*first crack at the edge of*	*l/L (%)*	*Load (KN/m2)*	*first crack at the edge of*
0	*12.5*	*29*	*hole*	*37.5*	*29*	*slab*
1		*25*	*hole*		*28.8*	*slab*
1.2		*24*	*hole*		*27.6*	*slab*
1.4		*23.5*	*hole*		*26.5*	*slab*
1.6		*23*	*hole*		*26*	*slab*
1.8		*22.5*	*hole*		*24.9*	*slab*
2		*22*	*hole*		*17*	*hole*
0	*25*	*29*	*slab*	*50*	*29*	*slab*
1		*28*	*slab*		*30.9*	*slab*
1.2		*27.5*	*slab*		*30.5*	*slab*
1.4		*27*	*slab*		*28.6*	*slab*
1.6		*26.8*	*slab*		*26.8*	*slab*
1.8		*25*	*hole*		*25.2*	*slab*
2		*22.5*	*hole*		*24*	*slab*

B. Slab simply supported on all four edges

The effect of opening on stresses for slabs having all four sides are discontinuous is shown in figure 4. The load applied is 17KN/m^2. From the figure it is clear that the stress for a slab with opening is higher than that without opening and also the stress is more when *l/b* ratio is 2 and is least when *l/b* ratio is 1, which is when the opening is a square.

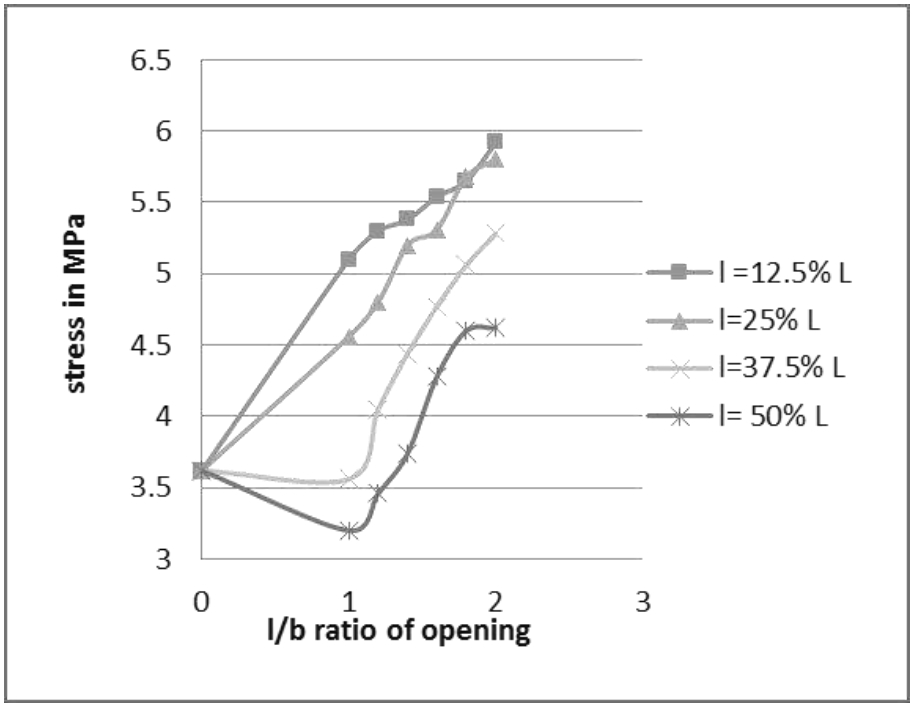

Fig: 4 Stress versus opening length to breadth ratio for slab discontinuous at all four edges

The load at which crack pattern appears on slab are analysed for slab with different opening size and without opening. The variations in load carrying capacity of the slabs are graphically shown in figure 4. From the figure it is clear that presence of opening have reduced the load carrying capacity of slab without any crack formation. Also the load

carrying capacity increases when the opening length to breadth ratio decreases and it is maximum when this ratio is equal to one, which is when opening is a square.

Table-6.
The load and position at which the first crack form for a slab with simply supported on all four edges and having varying opening size

l/b	*l/L (%)*	*Load (KN/m2)*	*first crack at the edge of*	*l/L (%)*	*Load (KN/m2)*	*first crack at the edge of*
0	*12.5*	*30.1*	*hole*	*37.5*	*0*	*30.1*
1		*25.1*	*hole*		*1*	*28.5*
1.2		*24*	*hole*		*1.2*	*27.7*
1.4		*23.7*	*hole*		*1.4*	*26.5*
1.6		*22.5*	*hole*		*1.6*	*25.8*
1.8		*22*	*hole*		*1.8*	*25*
2		*18.8*	*hole*		*2*	*24.7*
0	*25*	*30.1*	*slab*	*50*	*0*	*30.1*
1		*28.4*	*slab*		*1*	*31*
1.2		*27.8*	*slab*		*1.2*	*30.5*
1.4		*27.3*	*slab*		*1.4*	*28.4*
1.6		*26.4*	*slab*		*1.6*	*26.6*
1.8		*24.8*	*hole*		*1.8*	*25.2*
2		*24.6*	*hole*		*2*	*23.8*

5. CONCLUSION

For slabs continues at all the four edges (fixed support) having opening length about 12.5% of slab length, the reduction in load carrying capacity due to change in opening length to breadth ratio from 2 to 1 is about 24 to 13.8%. For the same boundary condition when the opening length is about 25% slab length the reduction is from 22 to 4% and when the opening length is about 37.5% of slab length the reduction is 20 to 1% and for opening length 50% slab length the reduction in load carrying capacity due to change in opening length to breadth ratio from 2 to 1.4 is about 17 to 2%.

For slabs discontinues at all the four edges (simply support) having opening length about 12.5% of slab length, the reduction in load carrying capacity due to change in opening length to breadth ratio from 2 to 1 is about 39.5 to 19%. For the same boundary condition when the opening length is about 25% slab length the reduction is from 20.7 to 8.7% and when the opening length is about 37.5% of slab length the reduction is 20.3 to 8% and for opening length 50% slab length reduction in load carrying capacity due to change in opening length to breadth ratio from 2 to 1.2 is about 23 to 2%.

When area of opening greater than 35% of slab area, the slab shows cracks at higher load than that shown by slab without opening.

Analysis of stress variation for the two boundary conditions shows that stress is higher for opening with *l/b* ratio 2 and *l/L* ratio 0.125 and it decreases as *l/b* ratio decreases and reaches the value 1 and *l/L* ratio increases and reaches the value 0.5.

For slabs with *l/L* value 0.375 and *l/b* ratio1, *l/L* value 0.5 *and l/b* ratio 1.2 and 1, the stress is less than that of slab without opening for both boundary conditions.

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PERFORMANCE EVALUATION OF INDIRECT TYPE SOLAR DRYER FOR DRYING HERBALS

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ABSTRACT

Drying is one of the methods to preserve food item other than freezing, canning etc. During drying process the moisture content present in the food particle will be removed and it can be stored for long time. Drying has many types like open sun drying, shadow drying, oven drying and solar drying. From the above methods solar drying is the most efficient and less expensive of drying and this way of drying can protect the food particle from rain, wind, dust, insects. In this present a simple and less expensive solar dryer can be designed and the product chosen for drying is herbals.

The conventional method of drying herbals is open drying and sometimes shadow drying for siddha and yunani treatments. The important phenomenon is the process of reduction moisture up to the safe limit of medical use. Based on the theoretical calculations, the length of the air collector is 1.5 m and width of the air collector is 0.5 m was chosen. To find the effective length and width of the solar dryer the various parameters like solar intensity, height of the collector and intensity of the day will be varied and calculated. The efficiency of the solar dryer for the effective area of 0.75 m^2 is 25.46%. By drying herbals in solar drying will provide the 3.5% more moisture.

Key words: *Solar dryer, moisture content, open drying, herbals, solar intensity*

1. INTRODUCTION

Drying is one of the most efficient methods used to preserve food products for longer periods. A solar dryer is an enclosed unit, to keep the food safe from damage, birds, insects, and unexpected rainfall too. The food is dried using solar thermal energy in a clean and healthier way [2]. Solar dryers are usually classified according to the mode of air flow as, natural convection and forced convection dryers. Natural convection dryers do not require a blower(external aid) to pump the air through the dryer. Therefore research efforts will be focused on designing and constructing a simple natural convection dryer [3]. The use of solar technology has often been suggested for the dried fruit industry both to reduce energy costs and economically speed up drying which would be beneficial to final quality.

This type of solar dryer has a solar collector for heating air and a drying chamber to accommodate trays over which products are spread. The drying chamber is covered by a transparent glass which protects the products from dust. The solar collector collects the solar rays from the sun and heats the air entering through an inlet. Heated air enters the drying chamber from beneath to tray and flows upwards through the products carrying moisture with it. This moist air goes out of the opening provided at the top. Ventilation is provided by natural convection inside the drying chamber. It is used for improving food stability, since it decreases considerably the water activity of the material, reduces microbiological activity and minimizes physical, chemical changes during its storage period, lighter weight, less storage space, lower packing and transportation costs and encapsulates original flavor. Dried products have almost unlimited shelf life in proper packages and substantially lower transportation, handling and storage costs compared to products of other preservation methods. When

herbs are dried they are safe from bacteria, mold and yeast, and will remain potent for at least one year. Use the sun heat to dry herbs but don't expose herbs too much direct sunlight as this could cause them to bleach. Solar drying can be as low-tech as placing drying screens outside until your herbs are brittle. Herbs are dry under the windshield or rear window of your car on a hot day [1]. A solar food dryer with stackable drying screens, a glass top to trap radiation, an absorber plate to transmit heat and a vent for air circulation is useful too.To remove moisture all you need is air circulations.Washing herbals usually is not necessary if they are grown organically.

2. THEORITICAL ANALYSIS

DRYING RATE (DR)

The Drying Rate (DR), kg/s is normally defined as the ratio between the mass of the moisture lost and the time taken during drying to achieve the said moisture loss [1].

The drying rate is given as,

$$DR = \frac{m_i - m_f}{t_d}$$

where,

m_i Mass of sample before drying, kg
m_f Mass of sample after drying, kg
t_d Drying time duration, s

MOISTURE LOSS (ML)

The Moisture Loss (ML), kg is defined as the difference between the mass of sample before and after drying [1].

The moisture loss is given by

$$ML = m_i - m_f$$

where,

m_i Mass of sample before drying, kg
m_f Mass of sample after drying, kg

EFFICIENCY OF SOLAR DRYING

The efficiency (%) of solar drying can be studied under two contexts: Collector efficiency (η_c) and the System efficiency (η_s). The Collector efficiency (η_c) measures how effectively the incident solar energy (on the collector) is transferred to the air flowing through the collector and is given by the ratio of the useful energy output (over a specified time period) to the total radiation energy (I) available during the same period: The thermal performance of the solar collector is determined by obtaining the values of instantaneous efficiency using the measured values of incident radiation, ambient temperature, and inlet air temperature. This requires continuous measurement of incident solar radiation on the solar collector as well as the rate of energy addition to the air as it passes through the collector, all under steady state or quasi-steady state conditions.

The Thermal efficiency of the PV/T collector (η_{th})

$$\eta_{th} = \frac{q_u}{I \times A_p}$$

where,

q_u Useful heat gain, W

I Solar intensity, W/m²

A_p Area of the absorber plate, m²

The Electrical efficiency of the PV/T collector (η_{el})

$$\eta_{el} = \frac{P_{max}}{I \times A_p}$$

where,

P_{max} Maximum power produced from PV panel, W

The Total efficiency of PV/T collector (η_T)

$$\eta_T = \eta_{th} + \eta_{el}$$

Top Loss Coefficient (U_t)

$$U_t = \left(\frac{M}{\left(\frac{c}{T_{pm}}\right)\left(\frac{T_{pm} - T_a}{M+f}\right)^{0.33}} + \frac{1}{h_w} \right)^{-1} + \left(\frac{\sigma\left(T_{pm}^{\ 2} - T_a^{\ 2}\right)\left(T_{pm} + T_a\right)}{\frac{1}{\varepsilon_p + 0.05M\left(1-\varepsilon_p\right)} + \frac{(2M+f-1)}{\varepsilon_c} - M} \right)$$

where,

M Number of glass cover

T_a Ambient temperature, K

T_{pm} Plate mean temperature, K

V wind velocity (m/s)

$c = 365.91\ (1-0.00883\beta+0.0001298\beta^2)$

$f = (1-0.04h_w+0.0005h_w^{\ 2})(1+0.091M)$

$h_w = 5.7 + 3.8\ V$

Bottom Loss Coefficient (U_b)

$$U_b = \frac{k_i}{\delta_i}$$

where,

k_i Thermal conductivity of the insulator, W/mK

δ_i Insulation thickness m

USEFUL HEAT GAIN (q_u)

$$q_u = A_p F_R \left[I\left(\tau \times \alpha\right)_e - U_o\left(T_i - T_a\right) \right]$$

where,

Fr Heat removal factor

$(\tau \times \alpha)_e$ Transmittance of cover

MODELLING

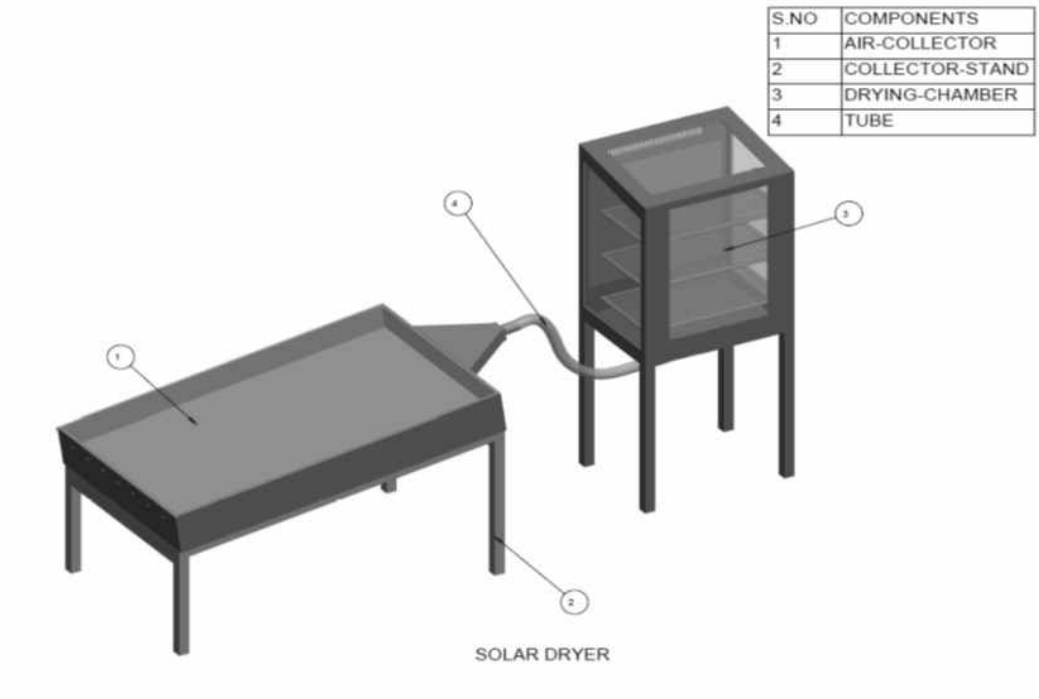

Figure 1.1 PRO-E modeling of solar dryer setup

3. RESULTS AND DISCUSSION

MAXIMUM THERMAL EFFICIENCY, USEFUL WITH RESECT TO MASS FLOW RATE

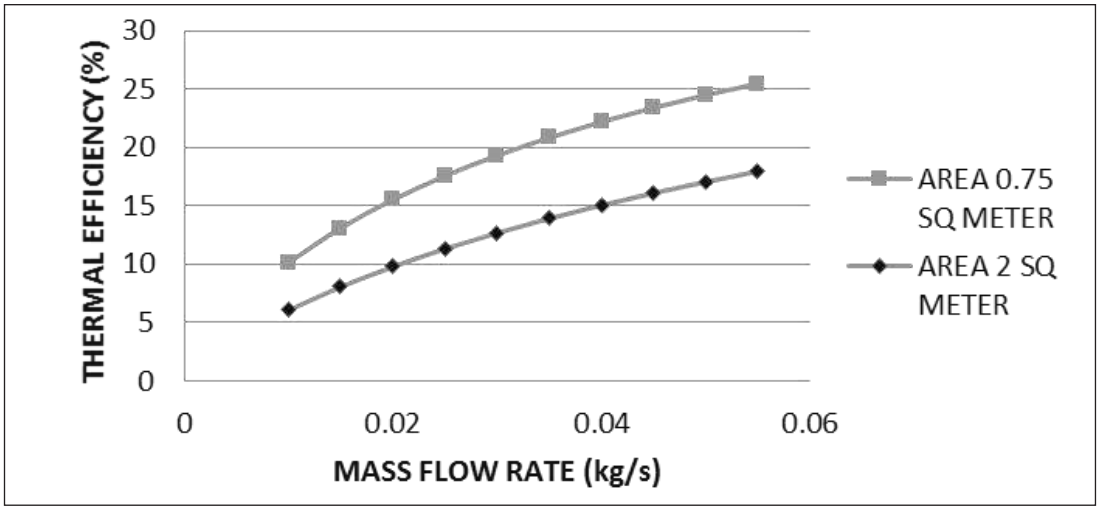

Figure 1.2 Thermal Efficiency with respect to mass flow rate

The thermal efficiency will be increase with increases in mass flow rate . But when the area of the collector decreases the thermal efficiency will increases because when the area rate decreases the cumulative heat gain be will higher compared to large area of collector. The Figure 1.2 show the variation of thermal efficiency with mass flow rate.

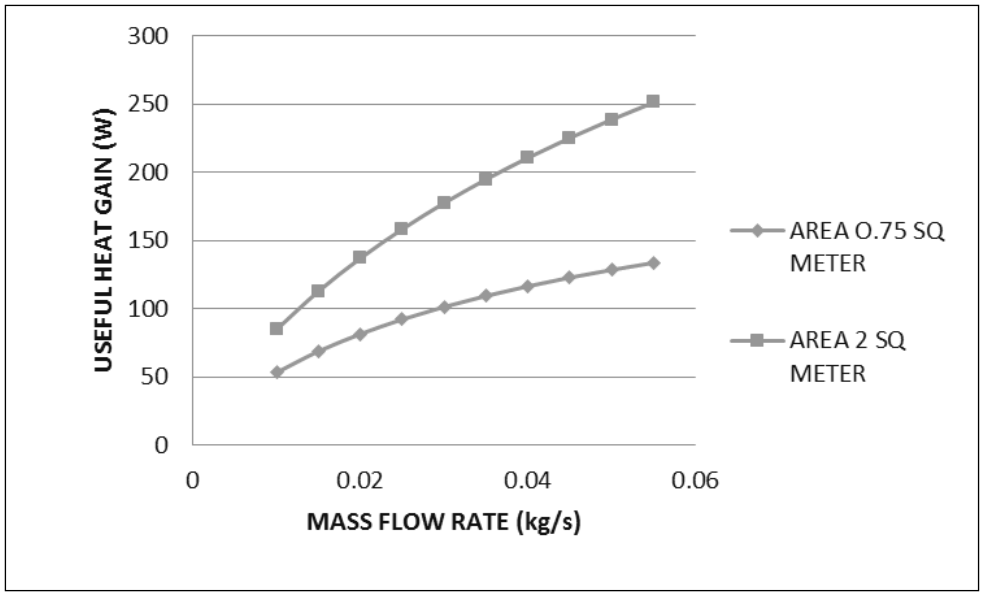

Figure 1.3 mass flow rate with respect to useful heat gain

The useful heat gain will be increase with increases in mass flow rate . But when the area of the collector decreases the will useful heat gain increases because when the area rate decreases the cumulative heat gain be will higher compared to large area of collector. The Figure 1.3 show the variation of useful heat gain with mass flow rate.

MAXIMUM THERMAL EFFICIENCY, USEFUL HEAT GAIN WITH RESPECT TO SOLAR INTENSITY

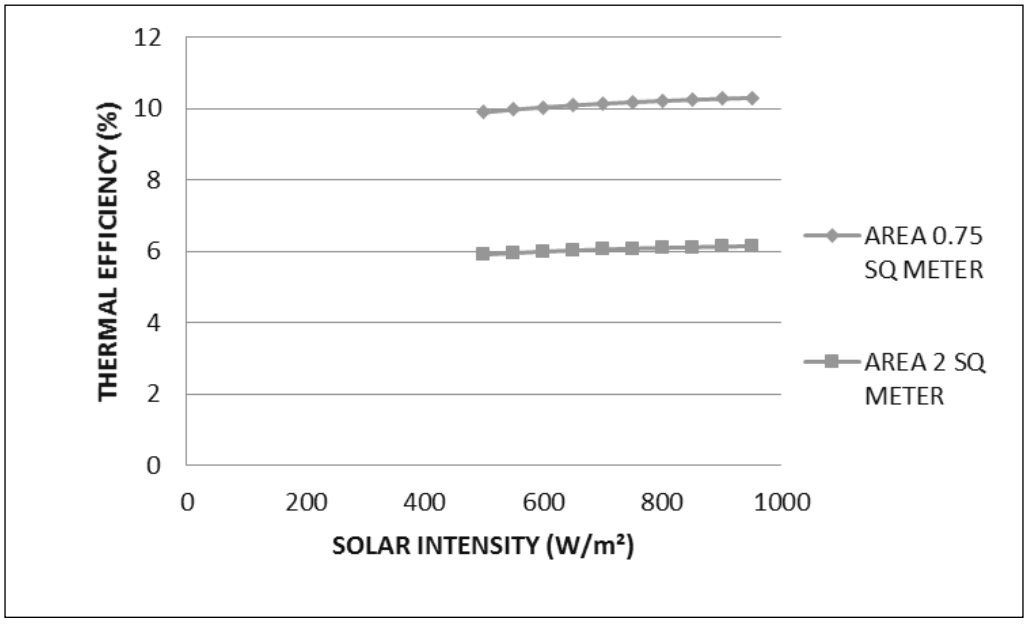

Figure 1.4 Thermal Efficiency with respect to solar intensity

The Thermal efficiency will be increase with increases of intensity . But when the area of the collector decreases the will thermal efficiency increases because when the area rate decreases the cumulative heat gain be will higher compared to large area of collector. The Figure 1.4 show the variation of thermal efficiency with solar intensity .

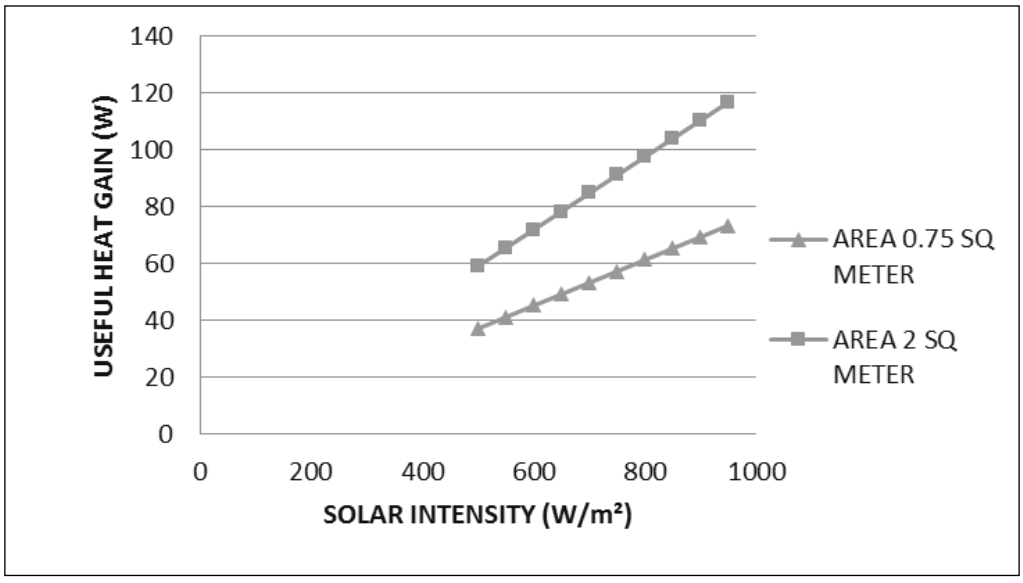

Figure 1.5 useful heat gain with respect to solar intensity

The useful heat gain will be increase with increases in solar intensity . But when the area of the collector decreases the will useful heat gain increases because when the area rate increasese the cumulative heat gain be will higher compared to large area of collector. The Figure 1.5 show the variation of useful heat gain with mass flow rate.

EXPERIMANTAL ANALYSIS

The moisture removal rate of the Nillavembu can be compared with both open and shadow drying.

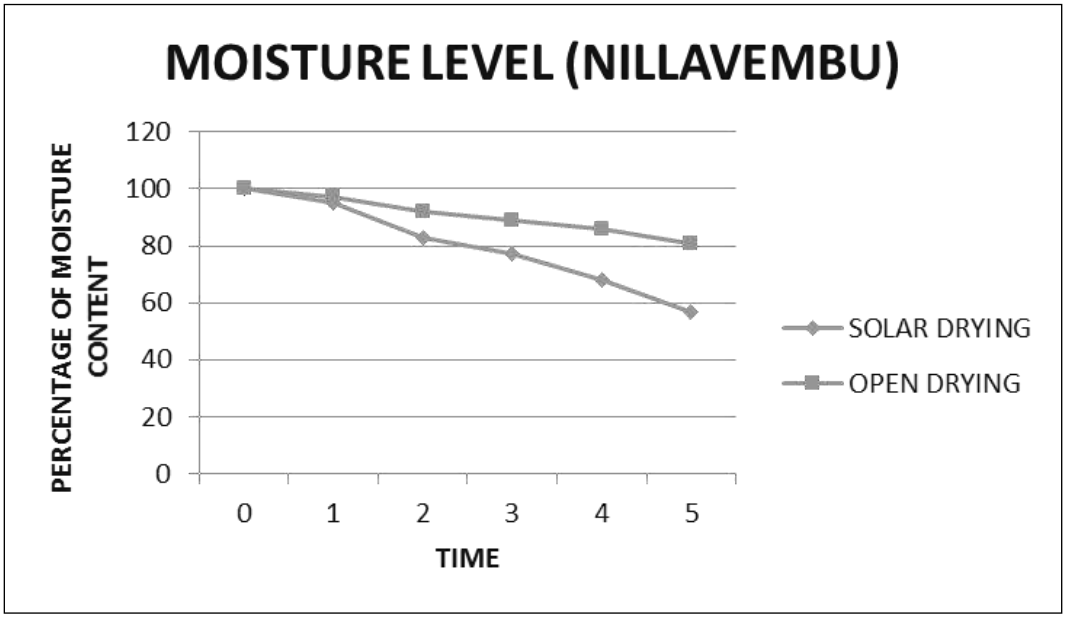

Figure 1.6 moisture level variation of solar drying and open drying

Solar drying can have the higher range of moisture removal rate when compared to open drying for drying herbals because of hirher heat gain accumulated in the system.

The moisture content of the Thuthuvalai can be compared with open and solar drying. The moisture removal rate of the solar drying can be higher than the open drying. The variation of moisture level are ploted in the graphs with respect to day.

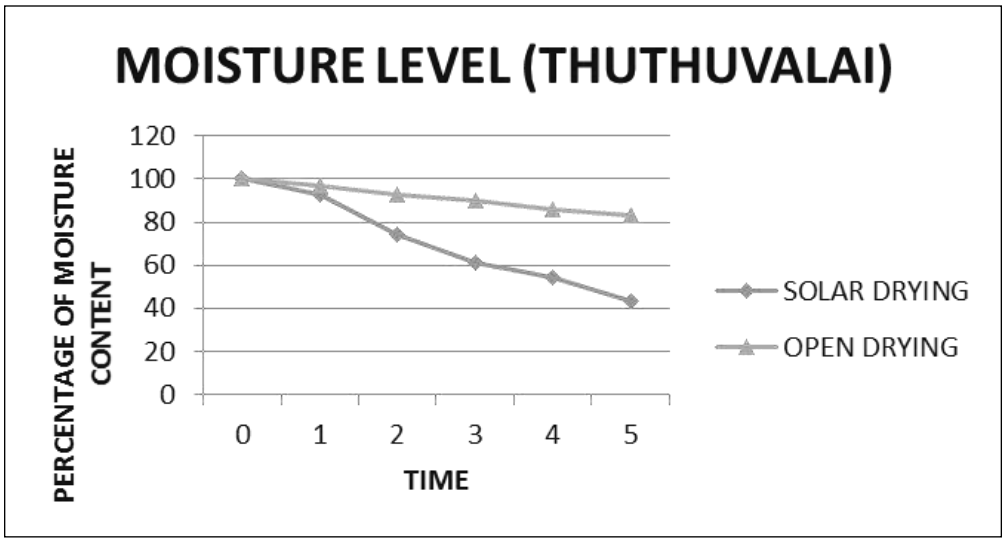

Figure 1.7 Moisture level variation of solar and open drying

4. CONCLUSION

Based on the theoretical calculation following conclusions were arrived,

i. Maximum thermal efficiency of solar dryer was achieved 10.14% and 8.65% for 0.75m² and 2m² respectively for the mass flow rate of 0.01 kg/sec.

ii. Two sizes of design each having size of 0.75 m² & 2m². the maximum overall efficiency of dryer obtained from the area of 0.75m².

iii. The MRR level for drying herbals will be 3.5 higher than the open drying.

iv. Conventional method of open type of solar drying can be purely changed into solar drying.

v. The safe limits can be obtained in hours in solar drying and it will take some days in solar drying.

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ANALYSIS AND SIMULATION OF OUTPUT RIPPLE VOLTAGE IN TWO DEVICE INTERLEAVED BOOST DC-DC CONVERTER

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ABSTRACT

Nowadays, power electronic converters are widely used in renewable energy applications. In such cases, dc conversion with efficiency is needed. But the conventional boost converter produces output with high ripple current and ripple voltage. The conventional boost converter needs a high level of duty cycle to produce step up voltage which causes high switching losses in the converter. To overcome this, interleaved technique is used. Even by using interleaving technique with single device connected per phase, there are limitations of boost voltage. In this paper, comparative analysis of output ripple voltage of conventional and two device interleaved boost dc-dc converter is presented. The simulation was carried out with the help of Matlab/simulink.

Keywords: *Conventional and Two device Interleaved boost dc-dc converter, Comparative analysis, Output Ripple voltage, Matlab/simulink.*

1. INTRODUCTION

Boost dc-to-dc converters are widely used in renewable energy applications. In these converters, the input inductor makes the source current smooth and hence these converters will provide very good EMI performance. Due to this good property, the boost converter is also the most used converter for off-line UPF rectifiers. These converters have the limitations like large size of the storage capacitor on the dc link[2]. The boost converter suffers from the disadvantage of discontinuous current injected to the load. The size of the capacitor is therefore large. Further, the ripple current in the capacitor is as much as the load current; hence the ESR specification of the tank capacitor is quite demanding. This is used in the emerging application areas of automotive power conversion.

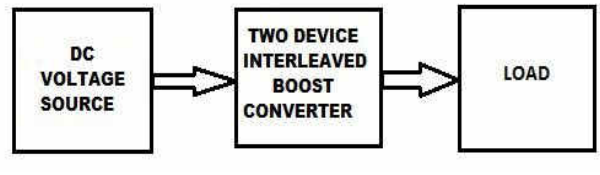

Fig.1.Block diagram of interleaved boost dc-dc converter

The fig.1 shows the Block diagram of two device interleaved boost dc-dc converter. In this paper, Literature review [2] of various previous researchers is presented in part 2. Analysis and Simulation of Conventional interleaved boost dc-dc converter is presented in part 3. Analysis and Simulation of two device interleaved boost dc-dc converter[1] is presented in part 4.

2. LITERATURE REVIEW

AnR.Mirzaei and V.Ramanarayanan discussed about the poly-phase boost converter, which overcomes the problem of high ripple current in the tank capacitor. Digital control is more convenient for such a topology on account of the requirement of synchronization, phase shifted operation, current balancing etc. [2] [3].

Laszlo Balogh and Richard Redl discussed about the operation and design trade-offs of the interleaved boost converter in continuous inductor-current mode in a high power factor pre regulator circuit. By using interleaved converters an overall reduction of boost inductor and EM1 filter volume can be achieved, together with reduced switching losses [4]-[5].

Roberto Giral, Luis Martinez-Salamero and Sigmond Singer discussed about a converter family generated by connecting N-identical boost converters in parallel is presented. The proposed control uses interleaving techniques based on a binary statetransition diagram [6].

Nikhil Jain, Praveen Jain and Geza Joos have presented a Zero-Voltage-Transition (ZVT) boost converter using a soft switching auxiliary circuit. The improvement over existing topologies lies in the structure and position of the auxiliary circuit capacitors and the subsequent reduction in the main switch resonant current. They analyzed the operation of this converter and presented the characteristic curves [7].

Bo Feng at el. [8] have proposed a PFC converter employing compound active clamping technique. It can effectively reduce the loss caused by diode reverse recovery. The parasitic oscillation caused by the parasitic capacitance of the boost diode is eliminated. The maximum voltage stress of switches and the soft-switching region with relation to the resonant inductor and resonant capacitance are investigated.

3. ANALYSIS AND SIMULATION OF CONVENTIONAL INTERLEAVED BOOST DC-DC CONVERTER

In low power converters, the main purpose is to increase the switching frequency to reduce the size of reactive components and also the size of the converter. As the switching losses are directly proportional to switching frequency, At low power and high power applications, soft switching techniques are generally used in high frequency converters. At higher power levels, increasing the switching frequency is limited practically due to having higher switching losses. In high power applications, the stress on the power switches and the rectifiers can be so high that it is impossible to obtain the required power using a single converter [1]. Hence, parallel operation of converters is necessary. The reliability, fault tolerance can be increased by sharing the input current among paralleled converters.

In interleaving technique or multiphase operation of converters provides both of the features of paralleling operation, and increasing frequency. In multiphase operation, converters are connected in parallel and they are controlled by interleaved switching signals, which have the same switching frequency and the same phase shifting. The switching instants are sequentially phase shifted by equal fractions of a switching period[2]. This arrangement lowers the net ripple amplitude and raises the effective ripple frequency of the overall converter without increasing switching losses or device stresses. The resulting cancellation of low-frequency harmonics allows eventually the reduction of size and losses of the filtering stages. The advantage is an increase in the power density without reducing power conversion efficiency. Even there is a drawback like increased circuit complexity such as greater number of power handling components, protection and synchronized control and their drives, etc. Fig.2 shows the circuit diagram of interleaved boost dc-dc converter.

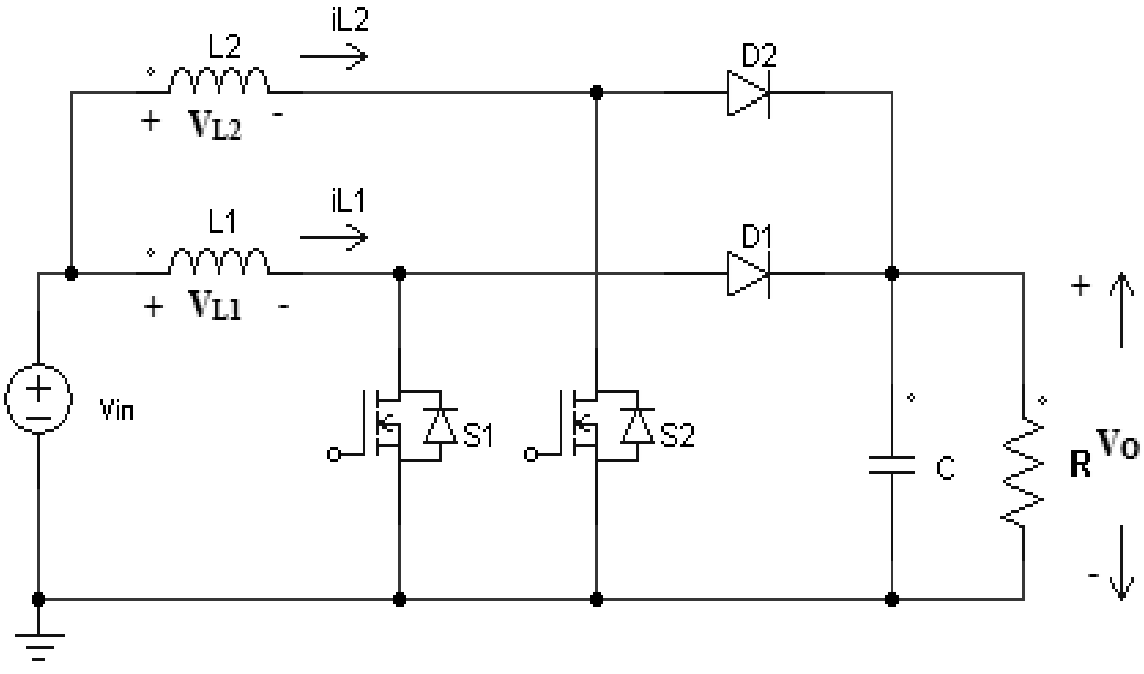

Fig.2.Circuit diagram of Conventional interleaved boost dc-dc converter

The interleaved boost converter consists of two stage parallel connected switches S1,S2; inductors L1,L2 diodes D1,D2 Capacitor C and load resistor R with single input source(Vin). The switches are controlled by phase shifted switching function known as interleaving operation. The interleaved boost converter can operated in continuous current mode (CCM) and discontinuous current mode (DCM).The Fig.3 shows .Simulation model of conventional interleaved boost dc-dc converter using MATLAB/Simulink

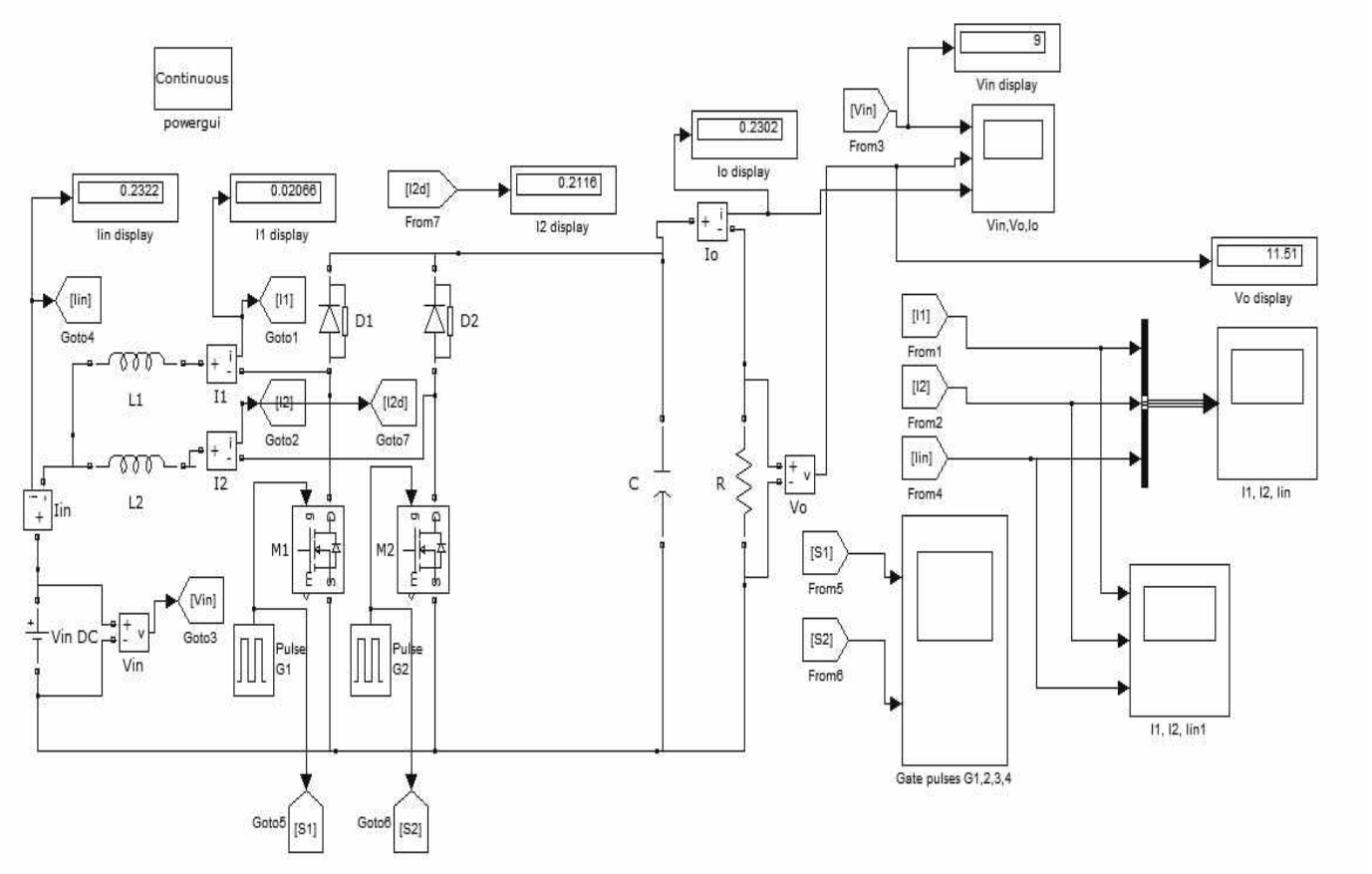

Fig.3.Circuit diagram of Conventional interleaved boost dc-dc converter using MATLAB/Simulink

Fig.4 shows the Switching Waveforms of interleaved boost dc-dc converter operated at 180 deg phase shift and Duty cycle (D1=D2=0.25).

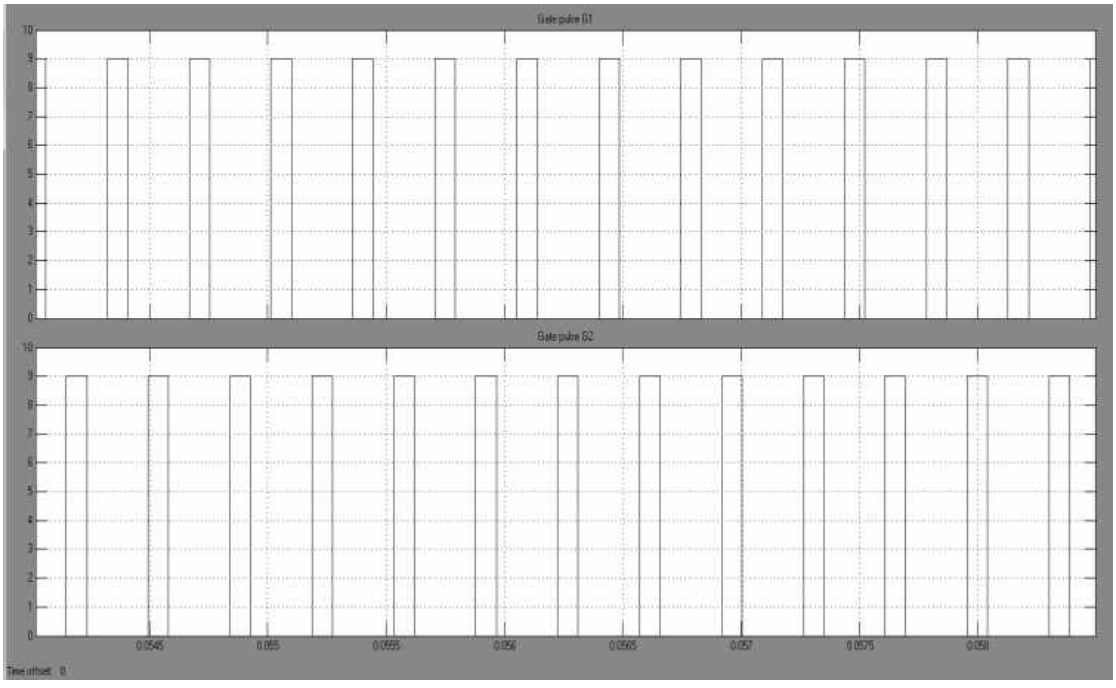

Fig.4.Switching Pulses of Conventional interleaved boost dc-dc converter operated at 180 deg phase shift and 0.25 duty cycle

The converter consumes Input current of 0.23 Amps and Inductor currents (I1=0.021Amps I2=0.21 Amps), and load current(Io) is 0.23 amps, With Input voltage=9 volts and Output voltage Vo = 11.51 volts as shown in Figs.5 & 6.

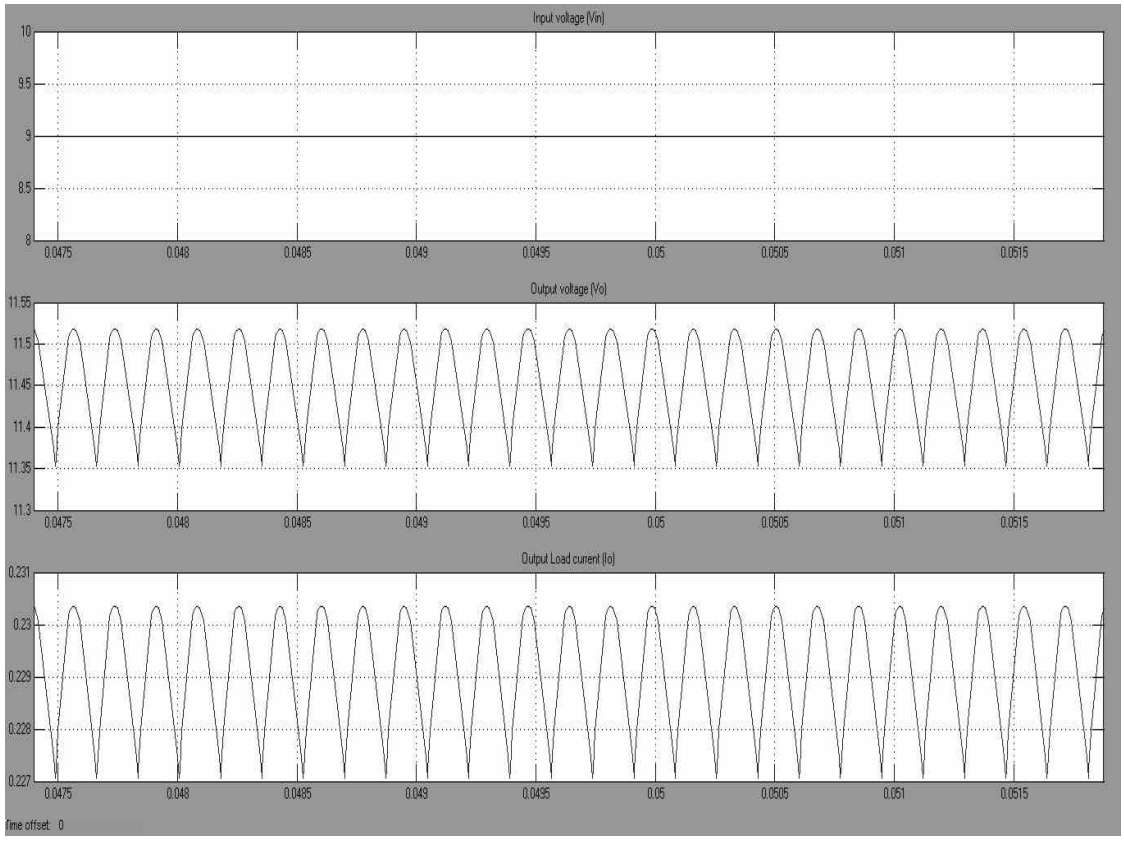

Fig.5.Input and Output voltage Waveforms of Conventional interleaved boost dc-dc converter operated at 0.25 duty cycle

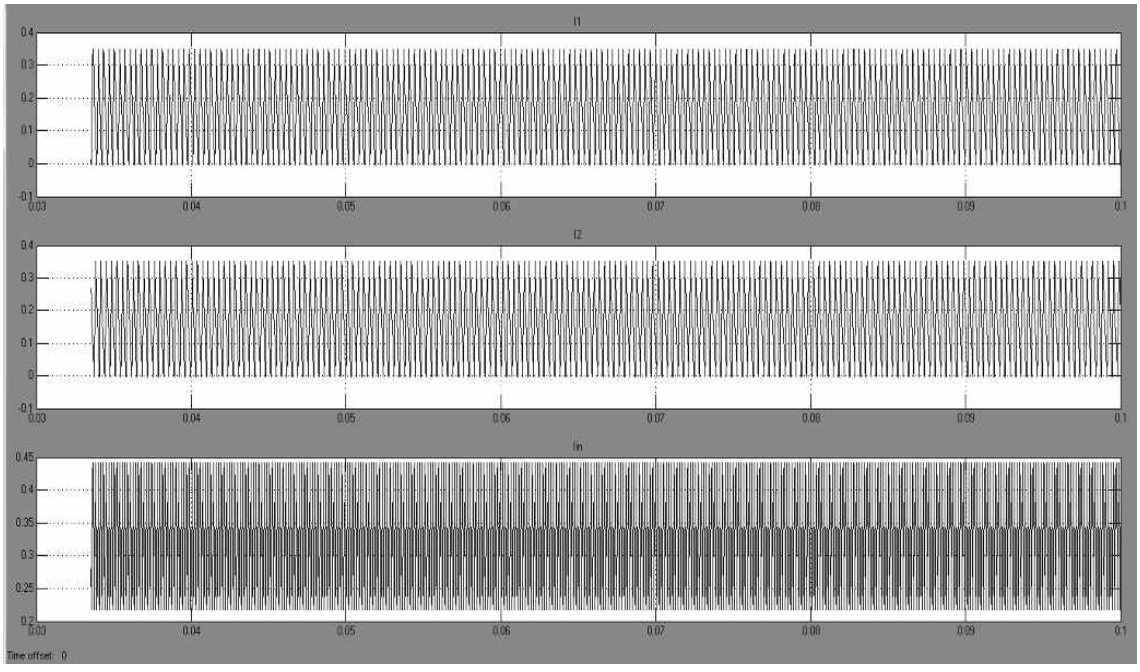

Fig.6. Input current, Inductor current of Conventional interleaved boost dc-dc converter operated at 0.25 duty cycle

The minimum value of the inductor will determine the continuous current mode (CCM) operation of boost converter and the capacitor acts as a filter to reduce the voltage ripple. The minimum value of the inductance and the minimum value of capacitor for continuous current mode can be written as

$$L_{min} = \frac{D(1-D)^2 R}{2f} \tag{1}$$

Where f is the switching frequency, R is the Load resistance.

The ripple factor and the minimum value of capacitor for continuous current mode can be written as

$$r = \frac{\Delta V_o}{V_o} = \frac{D}{RCf} \tag{2}$$

$$C_{min} = \frac{V_o D}{\Delta V_o R f} \tag{3}$$

r is the ripple factor, ΔV_0 is the change in output voltage.

$$V_o = \frac{V_{in}}{(1-D)} \tag{4}$$

Where D is duty cycle, T is the total time period for one cycle, V_{in} is the input voltage and V_o is the output voltage of the converter, i_{L1} i_{L2} is current through the inductors L1,L2. From the equation above, we can say that the output voltage will be higher than the input voltage.

Table 1.Simulated and Theoretical values Of Conventional Interleaved Boost Dc-Dc Converter at 0.25 duty cycle.

Input voltage (V_{in})	Output voltage (Theoritical) (V_o)	Output voltage (Simulated) (V_o)	Output ripple voltage (V_{or}) (p-p)	Ripple factor (r)
9	12	11.27	0.17	0.015

4. ANALYSIS AND SIMULATION OF TWO DEVICE INTERLEAVED BOOST DC-DC CONVERTER

This converter is constructed by two diodes and two switches connected in parallel per phase of the conventional interleaved boost dc-dc converter[1] .The conventional converter has two inductors so it has two phase. The main objective is to reduce the paasive components in the converter design. This two device interleaved boost dc-dc converter will give twice of ripple frequency in the inductor current at the same switching frequency, also provides higher system bandwidth. Switching pattern is shifted by $360°/(n\times m)$, where m is the number of parallel switches per phase, n is the number of phases. Input current is $(n\times m)$ times of the switching frequency. So passive components can be reduced by m times compared to n-phase interleaved dc-dc converter. In this paper n=2 m= 2 is selected. Fig.7 shows the circuit diagram of two device interleaved boost dc-dc converter

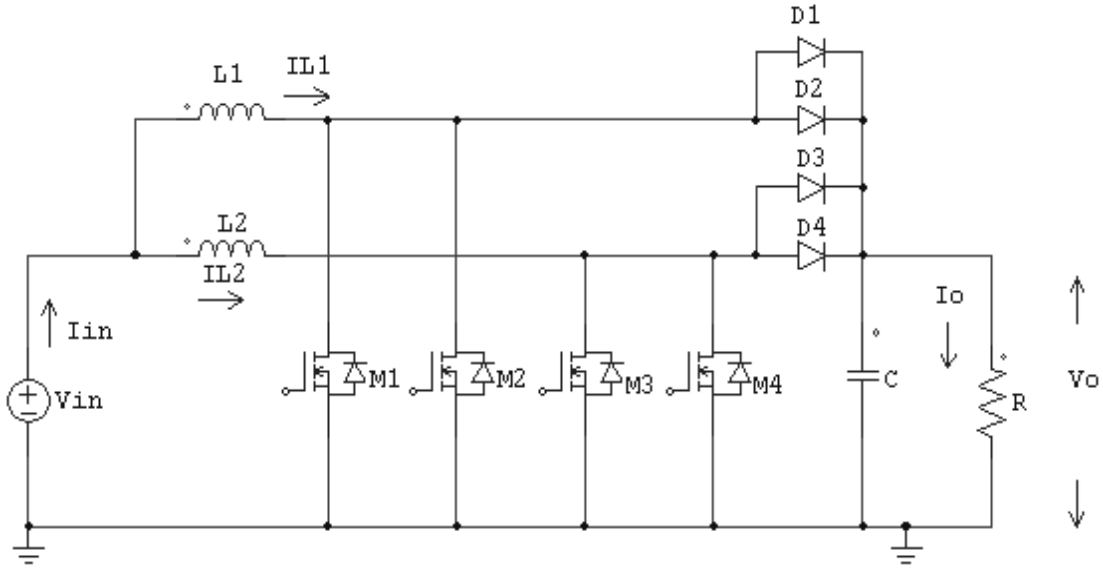

Fig.7.Circuit diagram of two phase two device boost dc-dc converter

Fig.8 shows the Simulation model of two device interleaved boost dc-dc converter. Fig.9 shows the Switching Pulses of Two device Interleaved boost dc-dc converter operated at 0.25 duty cycle and phase of each switch is shifted by 90 deg. Input voltage, Output voltage and Output load current of two phase two device boost dc-dc converter is shown in Fig.10. Input current and inductor currents of two phase two device boost dc-dc converter Figs.11 & 12.

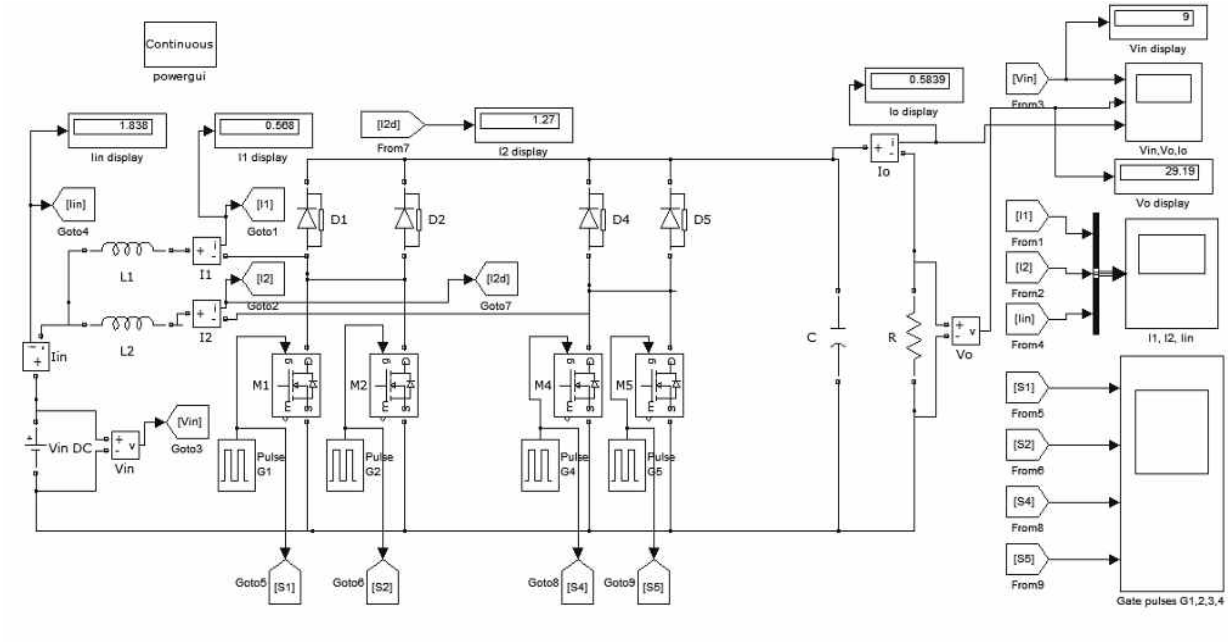

Fig.8.Circuit diagram of Two device Interleaved boost dc-dc converter using MATLAB/simulink

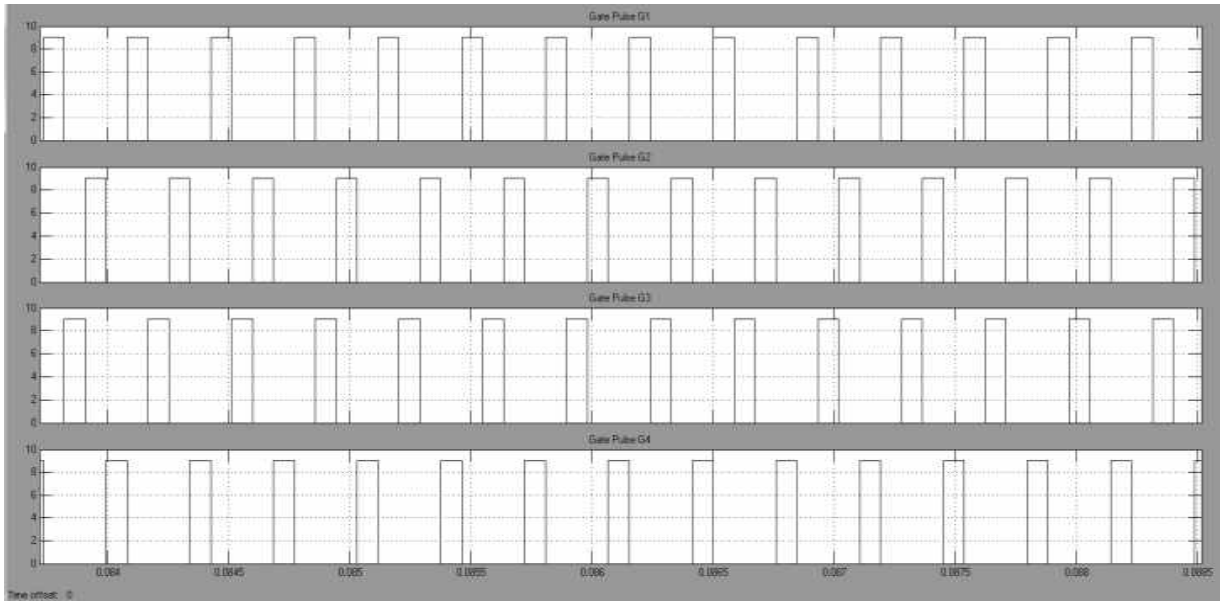

Fig.9.Switching Pulses of Two device Interleaved boost dc-dc converter operated at 90 deg phase shift(0.25 duty cycle)

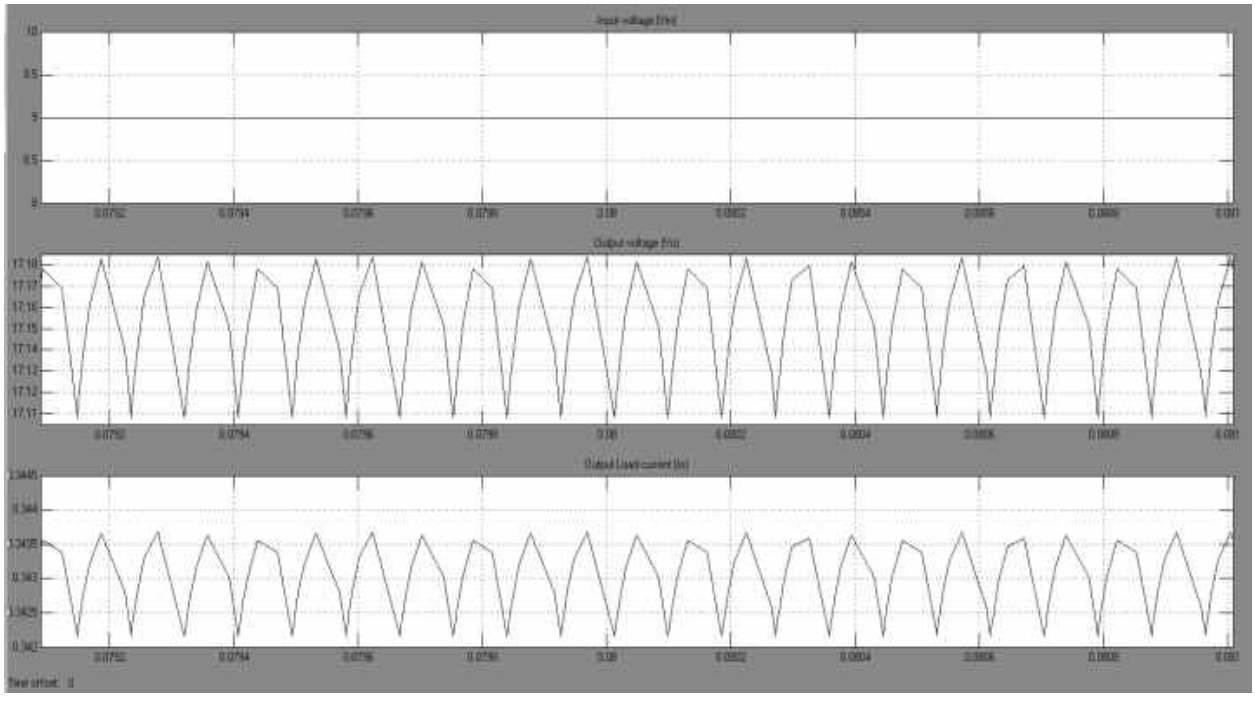

Fig.10. Input voltage, Output voltage and Output load current of two phase two device boost dc-dc converter operated at 0.25 duty cycle

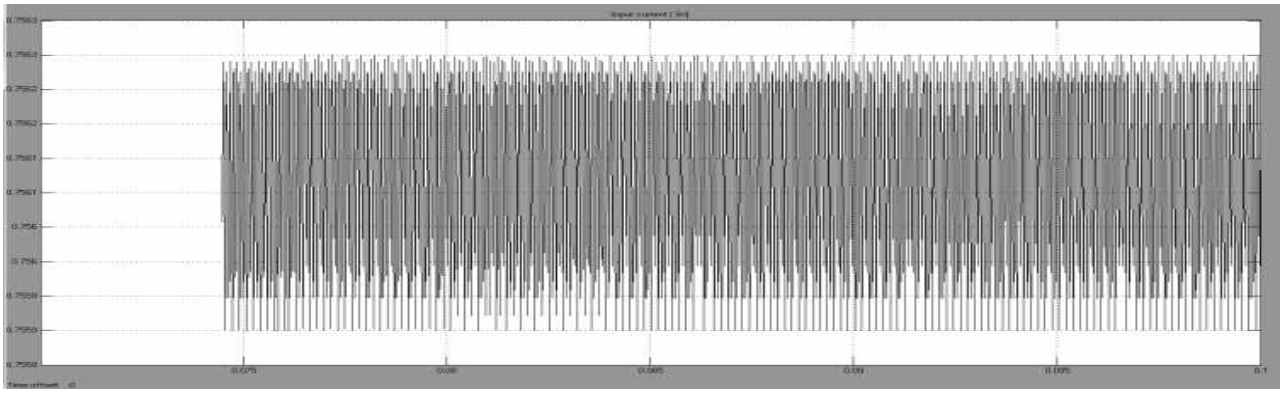

Fig.11. Input current of two phase two device boost dc-dc converter operated at 0.25 duty cycle

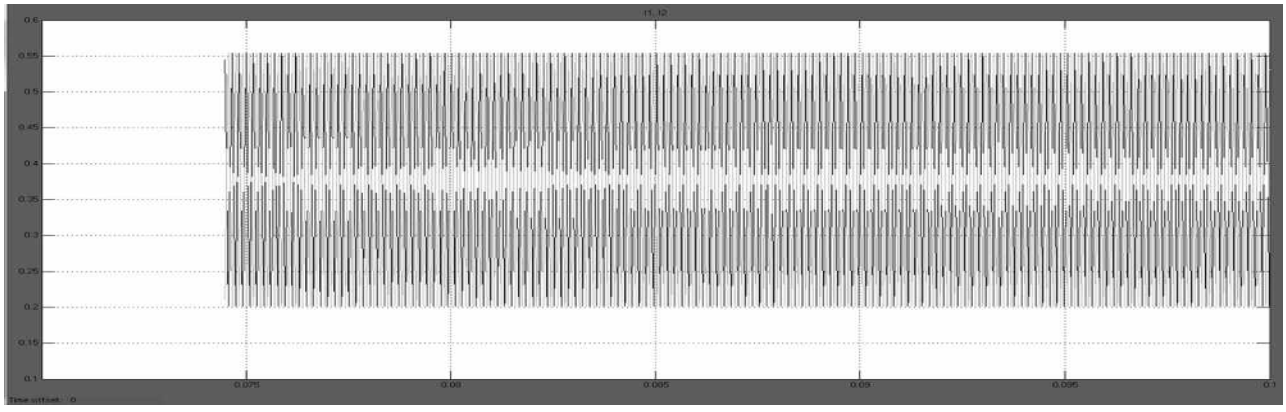

Fig.12. Inductor currents of two phase two device boost dc-dc converter operated at 0.25 duty cycle

The output voltage and output load current of the two phase two device interleaved boost dc-dc converter is given in eqn (5)

$$V_o = \frac{V_{in}}{(1-mD)} \tag{5}$$

$$I_L = \frac{V_o}{n(1-mD)R} \tag{6}$$

Where D is duty cycle, V_{in} is the input voltage and V_o is the output voltage of the converter, I_L is current through the inductor L. *m* is the number of parallel power switches per channel. *n* is the number of channels or phases. R is the load resistance.

Table 2. Simulated and Theoretical values Of Two Device Interleaved Dc-Dc Boost Converter

Input voltage (V_{in})	Output voltage (Theoritical)(V_o)	Output voltage (Simulated) (V_o)	Output ripple voltage(V_{or}) (p-p)	Ripple factor(r)
9	18	17.13	0.07	0.004

Table 3.Component Specifications

COMPONENT	SPECIFICATION
INDUCTOR	2.2 m H
CAPACITOR	47µF
RESISTOR	50Ω
DUTY CYCLE	25%
INPUT VOLTAGE	9V
SWITCHING FREQUENCY	2890 HZ

From the Table 1, 2 one can conclude that by using two device interleaving boost dc-dc converter, the output ripple voltage can be reduced when compared to conventional interleaved boost dc-dc converter. Specification of components selected for this work is shown in Table 3. Comparative chart for Theoretical and simulated Output voltage of two phase two device and Conventional boost dc-dc converter is shown in fig.13.

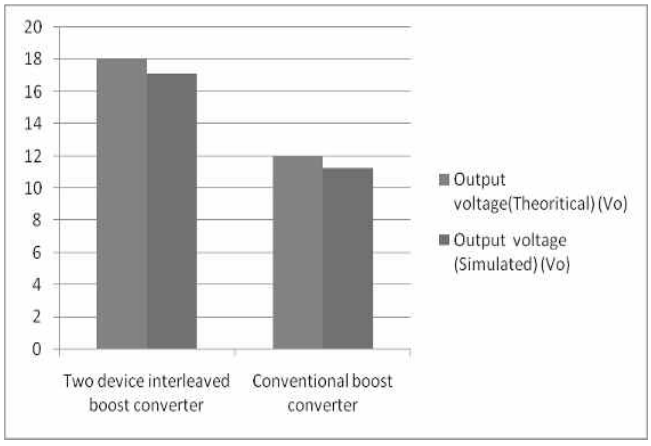

Fig.13. Comparison of Theoretical voltage and simulated Output voltage of two phase two device and Conventional boost dc-dc converter

Comparative chart for ripple voltage and ripple factor of two phase two device and Conventional boost dc-dc converter is shown in fig.14.

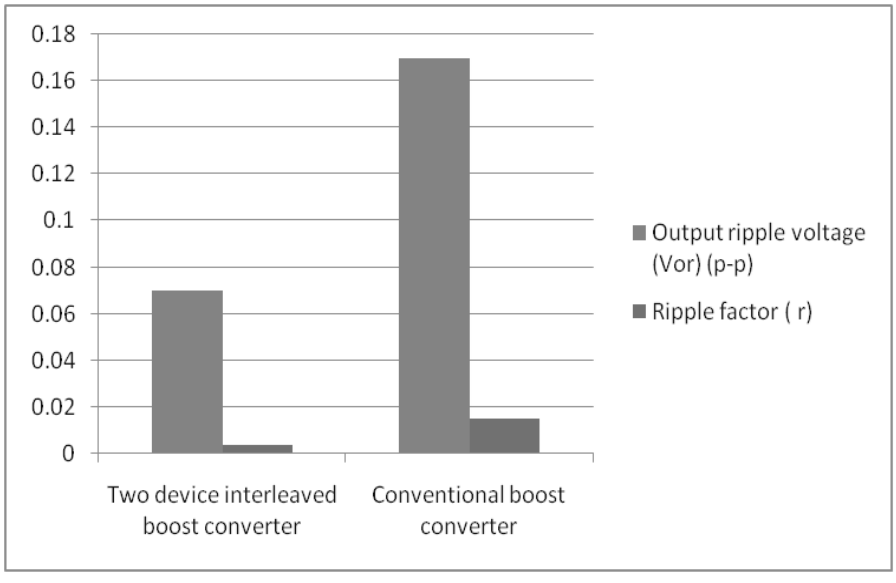

Fig.14. Comparison of Ripple voltage and ripple factor of two device and Conventional boost dc-dc converter

5. CONCLUSION

Analysis of output ripple voltage of two device interleaved boost dc-dc converter was carried out with input voltage of 9 Volts. By using interleaving technique, the output ripple voltage was reduced, and also further reduced by using two device interleaved boost dc-dc converter. Two device interleaved boost dc-dc converter has reduced ripple and high step up voltage capability, when compared to conventional converter.

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GREEN MOBILE MARKET – CHALLENGES AND OPPORTUNITY

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ABSTRACT

The present scenario of pollution and then added effects of mobile networks inspired us to have a research on Green Mobile Market. This added to understand the effects of carbon emitted by the mobile tower networks. It is increasing abruptly with the increasing number of mobile and internet users. The research is carried by analyzing the awareness of the people about the factors effecting the environment, about their awareness regarding TRAIs recommendation of maximum value of radiation, carbon emission and reduction factors. After the analysis, the opportunities are calculated to be in the field of RET (Renewable energy technology) which reduces carbon emission, 4G and 5G technology where there may be LTE and other future technologies.

Keywords: *Green Mobile Market, Green Telecom, Carbon Emission, TRAI, RET, CEER.*

1. INTRODUCTION

Wireless communication industries have brought in a tremendous increase of mobile networks globally. With the development of technology and systems, there has been a rapid growth in the energy consumption by the users. As a globally responsible nation, India accords responsibility to seek in this area. The reason behind this is the emission of carbon by the mobile networks. The amount of carbon emission currently has increased abruptly by the result of increasing Telecom Industries and their poor power situation with the increased data services. To improve the Quality of Service (QoS), the Telecom Service Provider (TSP) increase the level of energy transmission which uplifts the performance but also affects the environment by the increased Carbon Emission.

TRAI (Indian Telecom Regulatory Authority) has timely introduced its recommendations on Green Telecom and Green Mobile Networks. Timely initiative of Indian Telecom Regulatory Authority (TRAI) of releasing its "Recommendations on Green Telecom" in consolidating entire telecom sector stakeholders opinion and providing clear direction for achieving green telecom objectives and later transforming them into mandatory operational requirements to Telecom Service Providers (TSP) is a strong step in the direction. (Krishna Sirohi,2013).Various industries and government have stated their comprehensive efforts for creating new protocols and algorithms, energy efficient architectures etc. they are focusing to create this by using various network types. Smartphone and increment in internet usage is another reason behind abrupt raise in emission of carbon because of internet data service functionalities to user which includes 2G network (GSM, CDMA), 3G (UTMS,CDMA2000), 3G+(HSDPA, EV-DO,WiMax) and 4G networks(LTE-Advanced and WiMax2).

Adopting green energy sources is required. Renewable Energy Technology (RET) Development will improvise this condition from the present scenario of Diesel Power Generated Energy Sources. All the TSPs must now urgently create and Telecom Carbon Emission Platform that understands the Carbon Emission from all TSPs and provide a Carbon Emission Estimation and Reduction (CEER) planning.

2. REVIEW OF LITERATURE

Among the energy-consuming industries, the Information and Communication Technology (ICT) industry takes 2% of global total CO2 emissions and 3% of global energy expenditure [2, 3]. In particular, 57% of the energy consumption of the ICT industry is attributed to users and network devices in mobile and wireless networks [4], the scale of which is still growing explosively [1]. According to [5], the global mobile traffic is expected to reach 6.3 exabytes per month by year 2015, which is more than 26 times as much as the traffic load per month in 2010.Therefore the government of India has shown a keen interest in regarding this issue.(XiaofeiWang ,Athanasios V, Vasilakos ,Min Chen ,Yunhao Liu ,Ted Taekyoung Kwon,2011).The country needs a frame-work that establishes TSPs Carbon emission estimation of Telecom Service Providers which will draw useful intelligence required for the national statistical determination which eventually will help achieve a goal of higher energy efficiency resulting sustainable telecom infrastructure in India. Achieving the energy efficiency in telecom operation and also by converting the present dirty sources of energy (diesel power generated sources) into greener energy sources will be a step ahead in this direction.

A closer view on study of various network segments suggests that mobile networks are the major portion that emits high amount of carbon. Statistically, the base stations in the mobile network contribute about 59% of the total carbon emission while the rest of the percentage participation by the entire mobile network is 41%. The Carbon Emission estimates depends on some factors i.e. power consumption and carbon emission factor. The power consumption along with its mandatory cooling system requirements and emission factor associated with power source being used for powering the telecom equipment plays major role in carbon contribution. An appropriate method for right measurement of power consumption required by telecom equipment over a cycle of 24hours need be calculated. The accurate power consumption measurement will realize exact Carbon Emission taking place. It is important to note that the average dynamic power consumption of any telecom equipment is significantly lower than the static maximum power consumption.(Krishna Sirohi,2013).The second part deals with the development of Renewable Energy Technology. The problem with this is that the reduction of diesel operated or other expensive power source is not really possible.There are about 5,88,000 mobile Base Transceiver Stations (BTS) towers in the country and each BTS is having 15–20 KVA diesel generators as power back-up. One liter diesel emits 2.68 kg of CO2. More than two billion liters diesel is being consumed every year in mobile tower stations generating 10 million tons of carbon.(Pratap Kumar Panigrahi,2011)

The estimation of CEER (Carbon Emission Estimation and Reduction) value will lead to understanding the traffic and requirements of the signals. Because, it happens that during some peak hours only there is much traffic otherwise the congestion isn't always there but the supply of signals driven by diesel operated power supply is always in the quantity not needed every time.

Some of green mobile network technologies are given in the Fig 1 which is currently going on globally:

Project	Organizer	Region	Participants	Targets	Working Emphasis
EARTH	European Commission FP7 IP (3 years / 15 million €)	Europe	European main mobile operators and research organizations	Mobile networks	• energy aware radio and network technology • energy-efficient deployment, architecture, adaptive management • multi-cell cooperation
Green IT	METI & JEITA (Japan)	Japan	Over 100 companies, institutes and organizations	IT	• power efficiency at data centers, networks, displays • policy and mechanisms to encourage green IT • collaboration of industry, academia and government
GreenTouch	GreenTouch Consortium	Global	Experts form industry and academia	Telecom networks and mobile networks	• reinvention of telecom networks • sustainable data networks • optical, wireless, electronics, routing, architecture, etc.
OPERA-Net	CELTIC / EUREKA (3 years / 5 million€)	Europe	European main mobile operators	Mobile networks	• heterogeneous broadband wireless network • mobile radio access network • link-level power efficiency, amplifier, test bed
GREEN-T	CELTIC (3 years / 6 million€)	Europe	European main mobile operators	Mobile networks (particularly 4G)	• multi-standard wireless mobile devices • cognitive radio and cooperative strategies • QoS guarantee
GreenRadio	MVCE (3 years)	UK	UK universities	Base station and handsets of mobile data service	• power amplifier, power efficient processing • backhaul redesign, multi-hop routing, relaying, • resource allocation, dynamic spectrum access
Cool Silicon	Silicon Saxony Management	Global	Over 60 global ICT companies and institutes	ICT	• micro-/nano-technology • media communication • sensor newtork.
Green Grid	8 Main Contributor Companies	Global	Global ICT Companies	Data centers	• data center energy efficiency (design, measurement, metrics)
GSMAMEE	GSM Association Congress	Global	Over 800 mobile operators and 200 companies	Mobile networks	• benchmarking of mobile energy efficiency networks
Green500	Virginia Tech	US	Virginia Tech	Supercomputer	• benchmarking of greenest & fastest supercomputers
Cool IT	GreenPeace	Global	GreenPeace	IT	• leaderboard of IT brands on the contributions to the green IT

Fig 1: Summary of green mobile network project

3. OBJECTIVES OF STUDY

The objectives of the study were:

1. To know about green mobile market in India.
2. Find out or identify awareness of green mobile market in India.
3. What are the main problems which is influencing the implementation about green mobile market.
4. To analyse the factors affecting green mobile market and
5. To explore the solution and opportunities of green mobile market.

4. METHODOLOGY

Green mobile market is a big step for reducing carbon emission and mobile radiation. We have conducted a survey and the method used to analyze the data is Factor Analysis. Factor analysis is used to identify, assumptions underline dimension to reduce the number of variable by eliminating redundancy.

The main objective is to know the knowledge, awareness and study the issues in implementation of a green mobile market. The study has been conducted in a short duration of time from January to March 2016. A self-designed questionnaire was used for analysis. The study mainly focused from India. The responses were received on email and thorough social networking websites and through google forms. The sample size was 133 respondents. The questionnaire consisting of 12 statements with demographic was used for the study. It resulted with alpha coefficient of 0.688 in the study. The data was collected from 133 respondents from various IT sector firm employees, bank and financial institutions and other professional institute. The primary data for research project is collected through Self-structured questionnaire where respondents' degree of satisfaction is recorded on scale of 1 to 5. The scale measured from 1 as strongly disagree and 4 as strongly agree and 5 as neutral. The Kaiser- Meyer- Olkin measure of sampling adequacy resulted in 0.698. The collected data is coded, filtered, tabulated using MS-Excel and analyzed with the help of SPSS software using Principal Component Factor Analysis with Varimax rotation.

Data collection: Data was collected from the employees of different organisations through survey questionnaire containing statements on five point like scale. Survey was done through online, email and others. The data collected was summarised and analysed with the help of IBM SPSS version 20 following inferences were drawn after analysing data:

Sampling Frame: 133 Respondent

5. ANALYSIS AND FINDINGS OF THE STUDY

Case Processing Summary

		N	%
Cases	Valid	132	100.0
	Excluded[a]	0	.0
	Total	132	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
.688	17

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.698
Bartlett's Test of Sphericity	Approx. Chi-Square	414.525
	df	136
	Sig.	.000

Total Variance Explained

Component	Initial Eigen values			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.556	20.918	20.918	3.556	20.918	20.918	2.591	15.242	15.242
2	1.545	9.087	30.004	1.545	9.087	30.004	1.984	11.670	26.912
3	1.394	8.202	38.206	1.394	8.202	38.206	1.448	8.518	35.430
4	1.348	7.932	46.138	1.348	7.932	46.138	1.393	8.192	43.622
5	1.234	7.256	53.394	1.234	7.256	53.394	1.285	7.558	51.179
6	1.100	6.472	59.866	1.100	6.472	59.866	1.268	7.457	58.636
7	1.047	6.161	66.027	1.047	6.161	66.027	1.256	7.391	66.027
8	.904	5.315	71.342						
9	.787	4.627	75.969						
10	.726	4.271	80.240						
11	.642	3.779	84.018						
12	.614	3.611	87.629						
13	.532	3.128	90.757						
14	.463	2.726	93.483						
15	.433	2.549	96.032						
16	.376	2.210	98.242						
17	.299	1.758	100.000						

Extraction Method: Principal Component Analysis.

Rotated Component Matrix[a]

	Component						
	1	2	3	4	5	6	7
VAR00010	.704						
VAR00011	.675						
VAR00013	.620						
VAR00009	.616						
VAR00012	.612						
VAR00015		.836					
VAR00014		.792					
VAR00016		.623					
VAR00007			.688				
VAR00004			.622				
VAR00001							
VAR00006				.740			
VAR00017				.581			
VAR00002					.802		
VAR00003						.846	
VAR00005							.727
VAR00008							.716

Extraction Method: Principal Component Analysis.

a. Rotation converged in 14 iterations.

S.NO.	NAME	FACTOR LOADING	FACTOR NAME
1.	Renewable energy resource used in green mobile market	0.704	Energy efficiency, Eigen value of 2.519 having 15.242 % of variance
2.	Green telecom technology which leads to minimum energy consumption.	0.675	
3.	Name	0.620	
4.	Green Mobile Market	0.616	
5.	TRAI	0.612	
6.	Gender	0.836	Social group, Eigen value of 1.984 having 11.670 % of variance
7.	Age	0.792	
8.	Educational qualification	0.623	
9.	Harmful effect of carbon emission on environment.	0.688	Harmful effect of carbon emission, Eigen value of 1.448 having 8.518 % of variance
10.	SAR	0.622	
11.	Carbon emission of mobile network	0.740	Overall Network, Eigen value of 1.393 having 8.192 % of
12.	Occupation	0.581	
13.	Mobile radiation	0.802	Radiation, Eigen value of 1.285 having 7.558 % of variance
14.	Side effect of mobile radiation	0.846	Side effect of radiation, Eigen value of 1.268 having 7.457 % of variance
15.	Maximum limit of SAR value allowed is below 1.6w/kg.	0.727	SAR limit,Eigen value of 1.256 having 7.391 % of variance
16.	Carbon footprint	0.716	

6. LIMITATIONS OF THE STUDY

Green Mobile Market is a new concept and further work is going on in this area. Since the time of study was limited due to academics, so further study could not be done and is limited only to India. Further cross sectional study can be done on judgmental sampling.The study was purely exploratory and further longitudinal and horizontal study can be done on the topic.

7. CONCLUSION

In this paper we have presented a survey of green mobile market. What all technologies are used in India for making our environment free from carbon. In our paper we have discussed issues related to carbon emission and mobile radiation from telecom towers and how much it is damaging our environment. We have also conducted a survey about knowing the awareness of people about green mobile and found out that still a lot of work is needed in building new technologies and making people aware and the green network. The current technology used in India for green mobile network is the use of Renewable Energy Technology (like solar, wind etc) to give power to mobile towers and make it energy efficient hence reducing carbon emission in environment, and technologies like 4G and 5G . However still a lot of work is required to be done in this field and government authorities like TRAI and TSP are working to build a good platform for better implementation of green mobile market in urban and rural parts of India and reducing the carbon emission in environment, and making people aware about the green mobile and its benefits and long term sustainability in environment and telecom providers.

4. CONCLUSION

The current work emphasizes increased number of whorl, decreased number of loops and arch in type II diabetes mellitus patients as equated with non-diabetic population.

The study was conducted in and around Coimbatore city. Dermatoglyphic studies related to diabetes have to be conducted in different cities to exactly complete the features of dermatoglyphic pattern in type 2 diabetes mellitus. This can also be done for various other diseases.

Therefore, this study can be used as a screening tool for the analysis of individuals who are more prone to increase diabetes mellitus and thus preventing the future diabetic problem.

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INTERNATIONAL ENTREPRENEURSHIP: A STUDY WITH REFERENCE TO MICRO, SMALL AND MEDIUM ENTERPRISES IN KERALA

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ABSTRACT

The research was conducted to study 'International Entrepreneurship: A study with reference to Micro, Small and Medium Enterprises in Kerala'. International entrepreneurship is a emerging concept and number of studies are undergone based on this concept. International entrepreneurship help increased profit, increased resources procurement, increased marketing functions, increased entrepreneurial activities. The research is helpful for study different types of risk affecting international entrepreneurship, level of innovation needed at international level, importance of motivation and entrepreneurial learning for the success of entrepreneurship and financing aspects of micro and small sector enterprises. Also this research examined homogeneity between Micro and Small scale enterprise in the base of risk, innovation and financial constraint. The study helps to know the international entrepreneurship methods used and to identify what are the factors which affect the international entrepreneurship. Entrepreneurs as sample for data collection, were used to study the international entrepreneurship in micro and small scale industries in Kerala through questionnaire and from the study it is understood that majority of the respondents are thinking that international entrepreneurship is only about marketing side. Still majority of them holding old concept of entrepreneurs and giving more importance to some areas only. There is necessity to provide a proper awareness program to give a holistic picture of the international entrepreneurship.

Key word: *entrepreneurs, entrepreneurship, international entrepreneurship, micro small and medium enterprises.*

1. INTRODUCTION

Human life in 20th Century have come not from large corporations but from independent small firms- revolutionized through a study by US Department of Commerce. Micro and small enterprises are playing an important role in the industrial economy of the world. It has strength to ensure regional balanced development by providing large employment opportunities and industrialization. Micro and small enterprises are easily establish and maintain it's sustained development anywhere in any situation. The world industrial economy is mainly depending on micro, small and medium enterprises. While comparing on employment opportunity, gross domestic product, per capita income, industrial output etc, it is clear that micro, small and medium enterprises are contribute more than any other categorical enterprises. Kerala is the best suitable place for the MSMEs. Kerala is the one of the well developed state in the case of human recourses and enriched with different natural resources and providing with well educated and skilled people. The MSME sector has

contributed significant contribution to the economy of Kerala. The trend in growth of SSI's for the last ten years in employment, investment and production is given below.

STATEMENT OF PROBLEM

The research is titled as "International Entrepreneurship: A study with reference to Micro, Small and Medium Enterprises in Kerala". Few years ago, there was existing international business. Later business world identifies the need of involvement of entrepreneurs in international level. International entrepreneurship means whatever he/she doing in domestic market same functions are performing in international level. In other words, entrepreneur expands his/her entrepreneurial activities beyond the national boundaries.

IMPORTANCE OF THE STUDY

It is worldwide accepted truth that is MSMEs as an engine of economic growth for balanced development. At present the central and state government giving more importance for the growth of MSMEs. Because it is playing a vital role for the equitable development of the country through upliftment of backward areas through industrialisation, increased rate of different job opportunities, increase the standard of living etc... For the sustainability of MSMEs, The entrepreneur starts to think about go for internationalisation of entrepreneurial activities. If the entrepreneur hesitates to go for internationalisation, he can't be successful business man in industry.

OBJECTIVES OF STUDY

The main objective of this study is to analyse the factors influencing international entrepreneurship. The specific objectives are:

1. To study different types of risk affecting international entrepreneurship.
2. To study the level of innovation needed at international level.
3. To study importance of motivation and entrepreneurial learning for the success of entrepreneurship
4. To examine the financing aspects of micro and small sector enterprises.

HYPOTHESIS

Hypothesis 1: There is homogeneity between risk in Micro enterprise and risk in Small scale enterprise.

Hypothesis 2: There is homogeneity between Micro and Small scale enterprise in Innovation.

Hypothesis 3: There is homogeneity between Micro and Small scale enterprise in financial constraint.

METHODOLOGY

The study uses primary and secondary source of data for the analysis and interpretation. The primary information is collected through field survey with the help of well structured questionnaire. The secondary information is collected from the different company's website, books, periodicals or journals. The total of 50 samples were taken for the study, the respondents included international entrepreneurs from Ernakulam and Thrissur district.

SCOPE OF THE STUDY

The present study focuses on international entrepreneurship of MSMEs in Kerala, concentrated on few micro and small scale enterprises from Thrissur and Ernakulam district specially Chalakudy and Aluva taluk. It also enables to know the factors influencing of internationalised entrepreneurial activities such as risk, innovation, motivation, entrepreneurial learning and financial constraints. The study tries to cover as many areas as possible in order to come with the best and accurate conclusions.

LIMITATIONS OF THE STUDY

- During the sample collection stage it was difficult to identify entrepreneurs engaged in international entrepreneurship.
- Some of the respondents were reluctant to exact details required in the questionnaire and some of them are not cooperative.

LITERATURE REVIEW

- K. Narayanan and Savita Bhat(2008) was conducted on IT based companies both hard ware and software in India. Here study about determinants of internationalisation such as export intensity, overseas investment and role of technological outsourcing from internal and external. Most of IT companies were experienced in international dealings. It helps to attain competitive advantages and leads to establishment of niche market.

- Antonin ricard, Abrara Ali(2013) were make attempt to find out factor of speeding up internationalization behaviour, which is attitude toward Internationalization. The research can be concluded attitude has a small but significance influence in speed on internationalisation of business. Indian SMEs have more tendencies for internationalizing the business than French SMEs.

- Prof. B Urban focused on entrepreneurial orientation and its role in the internationalization of multinational enterprises in the emerging markets. The study is resulted in EO prevalence is linked to success, while firms are engaged in several modes such as networks, knowledge, resources, branding etc...

2. ANALYSIS

Chi-Square Tests-level of risk

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	1.211[a]	2	.546
Likelihood Ratio	1.225	2	.542
Linear-by-Linear Association	.725	1	.394
N of Valid Cases	50		

0 cells (.0per cent) have expected count less than 5 count is 6.44.
Source: Primary Survey (2016)

The level of business increases from micro to small there is no significance increase in level of risk involved. There exist high as well as low risks in both micro and small enterprises.

Chi-Square Tests-implemented innovation

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	.087[a]	2	.958
Likelihood Ratio	.087	2	.958
Linear-by-Linear Association	.031	1	.860
N of Valid Cases	50		

a. 0 cells (.0per cent) have expected count less than 5. The minimum expected count is 5.98.
Source: Primary Survey (2016)

The level of business increases from micro to small there is no significance increase in level of innovation implemented. There exist different levels of innovation implemented in both micro and small enterprises

Chi-Square Tests- Importance of motivation

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	.016[a]	2	.992
Likelihood Ratio	.016	2	.992
Linear-by-Linear Association	.006	1	.938
N of Valid Cases	50		

0 cells (.0per cent) have expected count less than 5. The minimum expected count is 5.98.
Source: Primary Survey (2016)

The level of business increases from micro to small there is no significance increase in level of motivation. There exist different levels of recommended motivation irrespective of nature enterprises.

Chi-Square Tests- Entrepreneurial learning

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	4.971[a]	4	.290
Likelihood Ratio	5.353	4	.253
Linear-by-Linear Association	.688	1	.407
N of Valid Cases	50		

a. 5 cells (55.6per cent) have expected count less than 5. The minimum expected count is 2.34.
Source: Primary Survey (2016)

There is existing policies for availing credit at faster phase for internationalisation of entrepreneurial activities. Most of the entrepreneurs are aware about these facilities and some of them are not.

FINDINGS AND SUGGESTIONS

- The level of business increases from micro to small there is no significance increase in level of risk involved. There exist high as well as low risks in both micro and small enterprises.
- The level of business increases from micro to small there is no significance increase in level of innovation implemented. There exist different levels of innovation implemented in both micro and small enterprises.
- The level of business increases from micro to small there is no significance increase in level of motivation. There exist different levels of recommended motivation irrespective of nature enterprises.
- A variety of programs should be provided to the entrepreneurs to make them more competent and efficient in their area of operations.
- Give a proper awareness program to entrepreneurs on entrepreneurship development.

3. CONCLUSION

Enterprises in Kerala'. Data were collected by means of giving structured questionnaire to the employees. The The research was conducted to study 'International Entrepreneurship: A study with reference to Micro, Small and Medium results can help to create a holistic picture of the international entrepreneurship and allow leveraging its strengths.

The study helps to know the international entrepreneurship methods used and to identify what are the factors which affect the international entrepreneurship. International entrepreneurship help increased profit, increased resources procurement, increased marketing functions, increased entrepreneurial activities.

Entrepreneurs as sample for data collection, were used to study the international entrepreneurship in micro and small scale industries in Kerala through questionnaire and from the study it is understood that majority of the respondents are thinking that international entrepreneurship is only about marketing side. Still majority of them holding old concept of entrepreneurs and giving more importance to some areas only. There is necessity to provide a proper awareness program to give a holistic picture of the international entrepreneurship.

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A STUDY ON DERMATOGLYPHIC PATTERNS FOR IDENTIFICATION OF HIGH RISK POPULATION IN DIABETES MELLITUS

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ABSTRACT

Dermatoglyphic pattern refers to the configuration of physically occurring ridge on certain body parts specifically palms, finger, soles and toes. The fingerprints of both hands are not the unique. They do not vary among size or character throughout a person's life, apart from cases of serious injury that wound the dermis. Dermatoglyphics which are allied with hereditary abnormality are valuable in diagnose of these disorders at birth or soon after. Diabetes Mellitus is the silent killer of manhood and public health problem. The main intent was to classify patterns of dermal ridges on the fingertips and palms of both diabetic patient and the normal individual. From the observation of earlier researcher, if there is increase in number of whorls, decrease in number of loops and arches in type II diabetes mellitus patients compared with normal individual. There are significant differences in diabetic patients in various dermatoglyphic features when compared to normal. Therefore it is possible to identify the risk in population with the help of dermatoglyphic pattern. Therefore, Dermatoglyphics is extensively useful for the early identification of type II diabetes mellitus mainly in a heap selection of a population as a further diagnostic tool. Hence, it may be effectively employed as a screening process in prospect and may help in the early revealing of diabetes mellitus.

Keywords: *Dermatoglyphic, Diabetes mellitu, whorls, loops, arches*

1. INTRODUCTION

Dermatoglyphics is the study of the forms of the ridged skin of the digits, palms and soles. It is formed during the thirteenth week of the developing embryo and remain unchanged throughout the life. There stays a connection between dermatoglyphics and some diseases, similar schizophrenia, Down's syndrome, Alzheimer, Multiple Sclerosis, diabetes, congenital spinal cord anomalies. Diabetes mellitus is a non-communicable disease and major public health problem. Among all types of Diabetes Mellitus, Non-Insulin Dependent Diabetes Mellitus (NIDDM) is leading in India. NIDDM results from a contact between genetic and environmental factors. Family history is a strong danger factor and it specifies genetic predisposition. Diabetes has a strong hereditary background. Offspring of two diabetic parents have an 80% lifespan risk of diabetes (Kenny et al., 1995). The atypical patterns of the epidermal ridges serve as a diagnostic tool in a number of diseases that have a strong hereditary background. Dermatoglyphic examination is absolutely cost effective and requires no hospitalization, and it can help in predicting the phenotype of a possible future illness. The present study was undertaken to determine the reliability of dermatoglyphic as a predictive diagnostic tool for diabetes.

Dermatoglyphics offers following major advantages.

1) The epidermal ridge patterns on the hand and sole are entirely developed at birth and therefore, remain unchanged for life.

   Subjects with undiagnosed Type 2 diabetes are at superior risk of developing coronary artery disease and stroke. Therefore it is significant to screen for diabetes in a cost efficient manner in subjects who demonstrate major risk factors for diabetes.

2) Scanning of the ridge patterns or recordings these permanent imitations can be accomplished rapidly, inexpensively and without any strain to the patient.

3) Finally, the relevance of dermatoglyphics is not to diagnose, but it is preventive by predicting a disease. Similarly it is not for defining an existing disease, but for identifications of people with the genetic predisposition to develop certain diseases.

The current study is aimed to compare the dermatoglyphic patterns of patients belonging to Coimbatore origin suffering from diabetes mellitus with normal persons of the similar district. The result were compared with earlier studies.

2. MATERIALS AND METHODS

The current study was carried out on 100 patients of Type 2 diabetes mellitus in the age group of above 40 years confirmed by clinical and laboratory assessment obtained from outpatient department of Department of Medicine from government hospital, Coimbatore. The control group for study consists of 100 subjects and was obtained from local residents of Coimbatore, teaching and non-teaching staff from our hospital. Cases and controls were carefully chosenafter a brief history of any known genetic disorder, without any congenital disease or fingerprint or other dermatoglyphic abnormalities. The controls group persons were selected after ruling out the history of polyuria, polyphagia, and polydipsia. The determination of this study was explained to both cases and controls. Then suitable information regarding the process of recording prints was given to members of both groups who decided for the study. After their written agreement, the palm and finger prints were taken.

To collect the finger prints, blue colored duplicating ink or carbon sheet, bond paper were used. Patients were asked to wash their both hands with soap water. Then ink was spread on the finger and were taken on the bond paper by using 'Purvis-Smith method'. The palm print were taken by the digital camera with high resolution. The fingertip pattern recognized and counted for each hand, the results were recorded, snapped and compared the data with non-diabetics population of similar age group. Qualitative and quantitative parameters were considered.

Fingerprint pattern configuration:

Galton F (1892)10, divided fingertip patterns into 3 groups – Arch, Loop, Whorl.

Finger Tip Patterns:

a) Arch (A):

An arch is the simplest pattern. It consists of more or less parallel ridges. The ridges curve the pattern area. The curve is proximally concave. The curve is gentle in low arch and sharp in high arch.

1. Simple or Plain Arch: Ridges cross fingertip from one side to the other without recurring. It is not a true pattern.

Fig. 1.1: Plain arch

2. Tented arch (At) - It appears like arch but has sharp up thrusting spike at the center.

b) Loop (L) – It is the most frequent pattern on fingertip. In this configuration series of sides enter and leave the pattern are on same side.

1. Ulnar loop: In Ulnar loop sides open on the ulnar side.

2. Radial loop: In Radial loop sides open on the radial side.

Fig. 1.2: Loop

c) Whorl (W) - It is a ridge configuration in which ridges actually encircle core and more complex patterns are called as composites.

Fig. 1.3: Whorl

Types

A.Concentric Whorl (Wc): The ridges are arranged as concentric rings or ellipse (around the core).

B. Spiral Whorl (Ws): The ridges spiral around the core in clockwise or anti-clockwise direction.

C. Mixed Whorl (Wmix): It contains circles and ellipse or spirals in the same pattern.

D. Central Pocket Whorl (Wcp): It contains a smaller whorl within a loop . It is sub-classified as ulnar or radial according to the side on which outer loop opens.

E. Lateral Pocket Whorl (Wlp) or Twin Loop (Wtl): These types are morphologically similar, have 2 triradii. In lateral pocket whorl both ridges emanating from each core emerge on the same side of the pattern. In twin loop whorl the ridges emanating from each core open towards the opposite margin of the finger.

F. Accidental whorl (Acc) – Two deltas are present, one is related to up thrusting curve and another with recurring ridges.

The present study is aimed to analyse the fingertip patterns of the patients having type II diabetes mellitus and compare with a random non diabetic population. The inference of the present study may apply clinically to identify diabetic mellitus patients in a random population, in addition blood glucose level.

ATD angle

The most important one is that the atd angle tends to decrease with age because the palm grows more in length than in breadth. The size of the angle is also affected by the amount of spreading of the fingers when the patterns are printed. The pressure exerted while the palm is printed also can affect the atdangle.The most widely used method to interpret the location of axial triradius in the palm is the atd angle. The atd angle is an indication of the degree of distal displacement of axial triradius. This angle is formed by lines drawn from the digital triradius ‘a’ to axial triradius ‘t’ and to digital triradius ‘d’. A triradius situated near the centre of the palm is term ‘t’’. An extremely distally placed triradius (distal to proximal transverse crease) is termed as ‘t"’ (Fig.2).

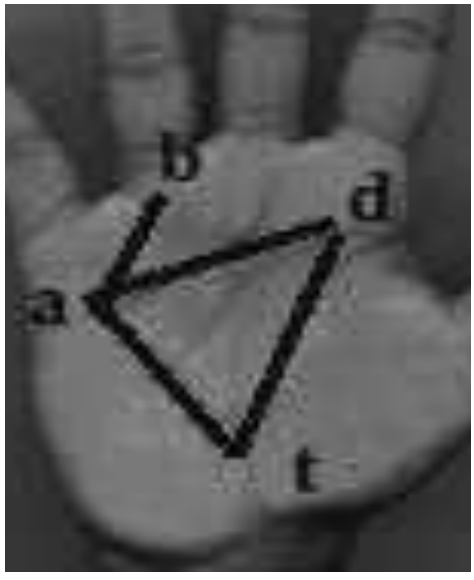

Fig. 2: A-B line, ATD angle

System Architecture

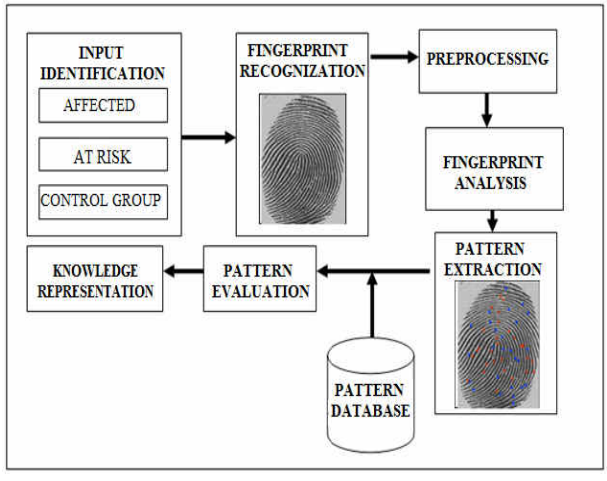

Fig.3: System Architecture

3. DISCUSSION

Dermatoglyphics deals with the learning of epidermal ridges on fingertips, palms and soles. Dermatoglyphic patterns shows relative comparison among close relatives especially monozygotic twins suggesting that patterns are hereditarily determined. It can be valuable in predicting the hereditary diseases in patients.

In a study by Sant et al. it was noted that the frequency of whorls was increased and frequency of loops was decreased in both hands of male and female diabetic patients and both findings were significant [1] coinciding with the present study.

In a study by Sengupta S et al. it was found that there was an increased frequency of whorls in male diabetics [2] which matches with present study. Srivastava S et al found that there was increase frequency of whorl pattern in both sexes [3] which correlates with present study.

In present study whorls were significantly increased and loops were significantly decreased in male and female diabetics as compared to controls. Arches were significantly decreased in both hands of male diabetics as compared to controls. Also arches were significantly decreased in left hand of female diabetics.

Pathan F et al observed significantly increased in whorls and significantly decreased loops in diabetics. Arches were significantly decreased in right hand of male diabetics and left hand of female diabetics [4]. Thus, coinciding with present study.

4. CONCLUSION

The current work emphasizes increased number of whorl, decreased number of loops and arch in type II diabetes mellitus patients as equated with non-diabetic population.

The study was conducted in and around Coimbatore city. Dermatoglyphic studies related to diabetes have to be conducted in different cities to exactly complete the features of dermatoglyphic pattern in type 2 diabetes mellitus. This can also be done for various other diseases.

Therefore, this study can be used as a screening tool for the analysis of individuals who are more prone to increase diabetes mellitus and thus preventing the future diabetic problem.

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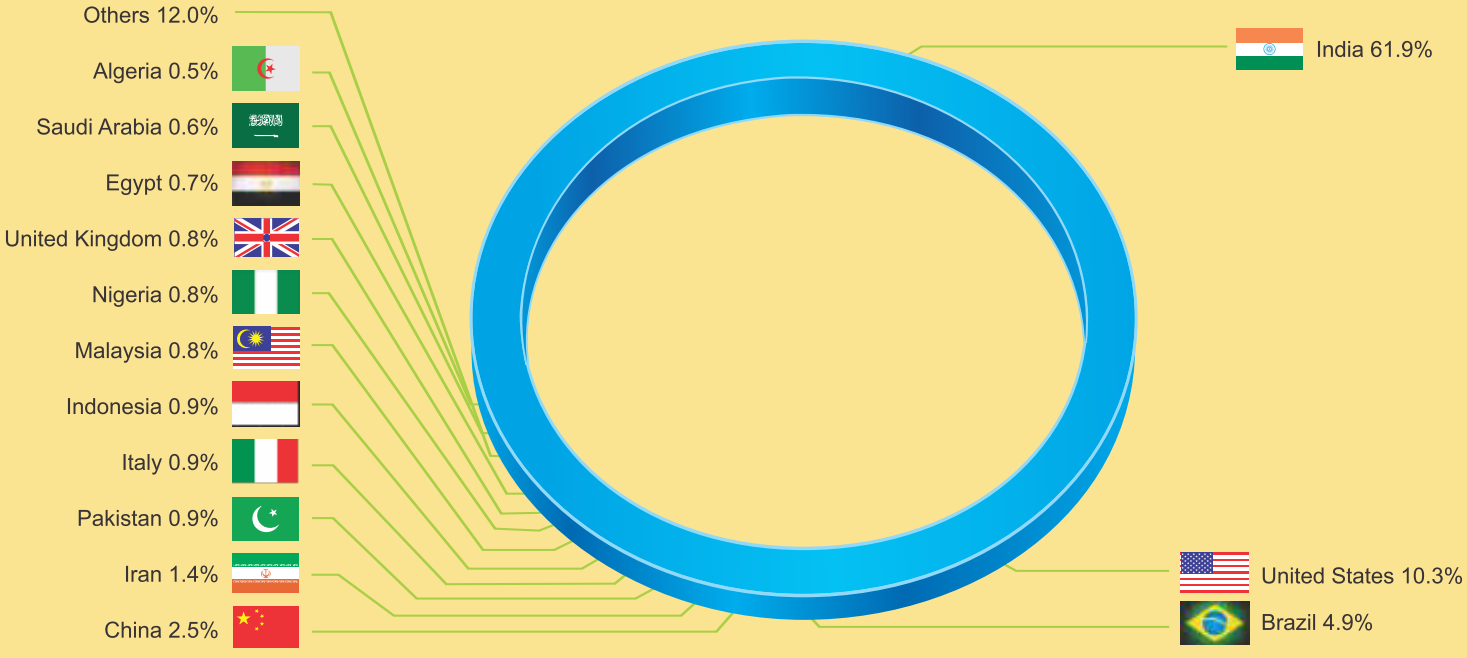

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