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Design and Performance Analysis of Low Pull-In Voltage of Dimple Type Capacitive RF MEMS Shunt Switch for Ka-Band

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ABSTRACT This paper deals with the study of dimple type RF MEMS capacitive shunt switch using different meandering techniques for high isolation and low actuation voltage. The novelty of the proposed RF MEMS switch is it incorporates the meanders and dimples, which help to reduce the actuation voltage. The proposed switch structure is optimized, designed, and simulated with FEM analysis such as electromechanical and electromagnetic by using COMSOL and HFSS tools respectively. The best performance of the switch is observed by varying different parameters such as beam material, beam thickness, dielectric thickness, and airgap. The proposed switch with different meandering techniques attains the pull-in voltage in the range of 10.3–46 V, particularly the three uniform meander technique has low actuation voltage of 10.3 V. The RF performance of the device is particularly tuned in the range of 26.5–40 GHz frequency range and it is analyzed for all types of meanders. Among them, the non-uniform single meander has attained the best isolation of −54.13 dB at 40 GHz in the off state. The insertion and return losses of the device are −0.514 dB and −17.35 dB over 1-40 GHz frequency in on state.

INDEX TERMS RF MEMS, pull-in-voltage, capacitance ratio, dimples, switching time, insertion loss, isolation, return loss.

I. INTRODUCTION

MEMS technology based RF switches are emerges in high frequency communication applications. MEMS technology has the pretty much competition with solid state technology switches, but at high frequency range in the aspect of isolation and insertion behaviour of MEMS RF switches shows a great potential [1]. A low power consumption nature of RF MEMS switches attracting the researchers in communication industry to design the devices for 5G applications [2]. Low pull-in voltage and high isolation are the two significant research challenges in design and fabrication aspects of capacitive RF MEMS switches [3]. The serpentine structure meander helps to reduce the pull-in voltage of the switch [4]–[9]. To overcome the switch geometry and RF performance parameter challenges in the above-mentioned literature, the proposed device is selected, and it consists of semicircular arc shaped curves on either side of the switch having different flexures such as uniform and non-uniform meanders along with the etching holes created on the beam. The proposed capacitive dimple type novel switch is optimized with the bottom-up approach in order to tune the switch to operate at Ka band applications. The optimized dimensions of the switch geometry can be helpful to tune the frequency. The proposed capacitive dimple type switch is designed with uniform and non-uniform meandering techniques. The proposed switch is analyzed applying electromechanical study by varying gap between the electrodes, beam materials and materials of the switch. The switching time analysis is also done for the proposed switch as it is important factor to understand the transition time from on state to off state in the micro level. The switching time analysis are tabulated for different meandering techniques. It is necessary to carry out stress analysis by applying uniform distribution of force on the beam. Capacitance analysis is evaluated for the proposed dimple type switch to maintain minimum capacitance to pass high

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frequency in the switches. RF performance includes insertion loss, return loss and isolation. From the mentioned results it is observed that the non-uniform one meander shows good performance at 40 GHz frequency. Therefore, the proposed novel type dimple type RF MEMS switch can be used at Ka-band applications.

This paper is organized as follows, in Section II, the outlines of the design specifications of the proposed switch is presented. In Section III, the theoretical aspects of RF MEMS are discussed. In Section IV, the simulation of electromechanical and electromagnetic analysis of the proposed device are discussed. Finally, Section V is concluded at the end of the paper.

II. DETAILS OF THE PROPOSED RF MEMS SWITCH

A. CONVENTIONAL FIXED – FIXED SWITCH: WORKING MECHANISM

In RF MEMS devices, most of preferred switches are fixed-fixed capacitive shunt switches. The schematic view of the fixed-fixed shunt type switch is shown in Figure 1. This device consists of a beam, oxide layer, two anchors, dielectric layer, and a CPW transmission line which in turn consists of two ground planes and signal line.

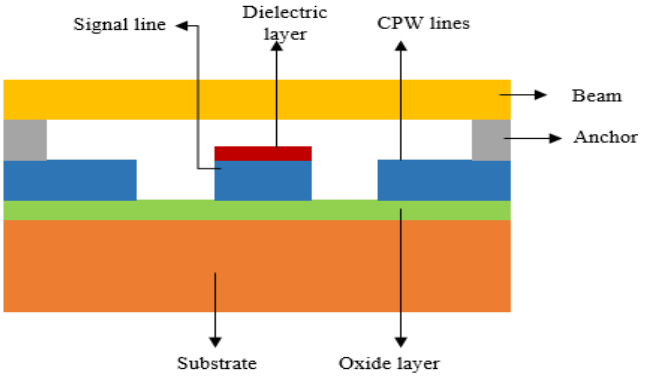


FIGURE 1. Schematic view basic fixed-fixed beam rf mems structure.

The dielectric layer is placed over the transmission line, which forms a capacitor in between the beam and the signal line. In OFF state, the capacitance developed due to actuated beam generates a short resistive path from the signal line to the ground and accordingly it bypass the transmission of RF signal to ground. In ON state position of the switch, RF signal is transmitted along the CPW line with a minimum capacitance in between the beam and the signal line. The OFF state and ON state schematic view of capacitive RF MEMS Switch is as shown in Figure 2. A DC voltage is applied to the beam to create a electric field, which ultimately forms an electrostatic force to pull the beam downwards onto the dielectric layer. The switch behaves as a pure capacitor in onstate and in offstate it depends on the frequency of the transmitting signal. If $f < f_0$, it acts as pure capacitor, pure resistor when $f=f_0$ and it acts as a pure inductor when $f > f_0$.

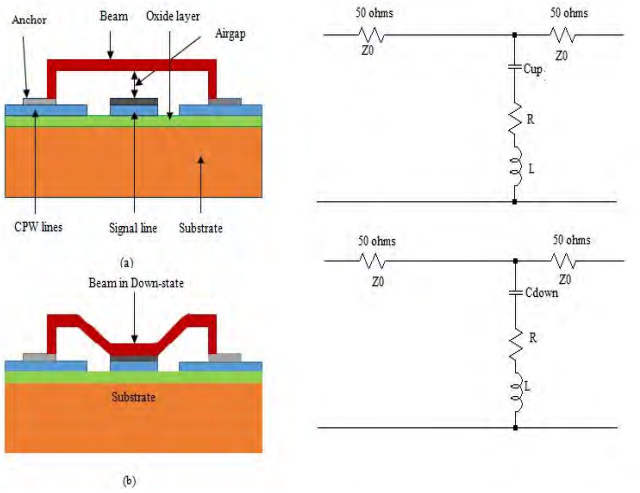


FIGURE 2. Schematic view of rf mems switch (a) on state (b) off state.

B. THE STRACTURE OF PROPOSED SWITCH

In this paper, a low pull–in voltage of capacitive RF MEMS switch is proposed along with perforations and meanders. The proposed capacitive RF MEMS switch is designed over a substrate made up of semiconductor material. Oxide layer is preferred in between the transmission line and the substrate to reduce the DC loss. The switch is made up of thin metallic beam with the both ends are fixed to the ground lines of the CPW. The dielectric layer is placed above the signal line to develop the capacitance. Anchors are placed above the ground lines of a CPW line where these are used to hold the beam through meanders. A semi-circular disc shape is selected as an anchor to hold the beam efficiently without having any displacement due to acceleration due to gravity. This proposed switch is designed with single, double, three uniform and non-uniform meandering techniques.

C. DIMPLES

Dimple is also known as perforations and are incorporated on the beam to reduce the residual stress. It improves the performance parameters like pull-in voltage, flexibility, switching speed, squeezing film damping and reliability of a switch. The beam is displaced vertically towards the substrate during an electrostatic pull-down actuation and the air gap between the dielectric layer and the beam decreases causing air to be squeezed. The dimples will reduce the mass of the beam which helps to reduce the effect of spring constant. The hole shows a great impact on up-state capacitance and its negligible if the diameter of the holes is less than $3\text{-}4g_0$. The dimples are not only used to bend the beam but also helps to regain its original position when the DC is removed which improves releasing time. The circular type of dimples are chosen for different meander of the proposed structure as shown in the figure 3.

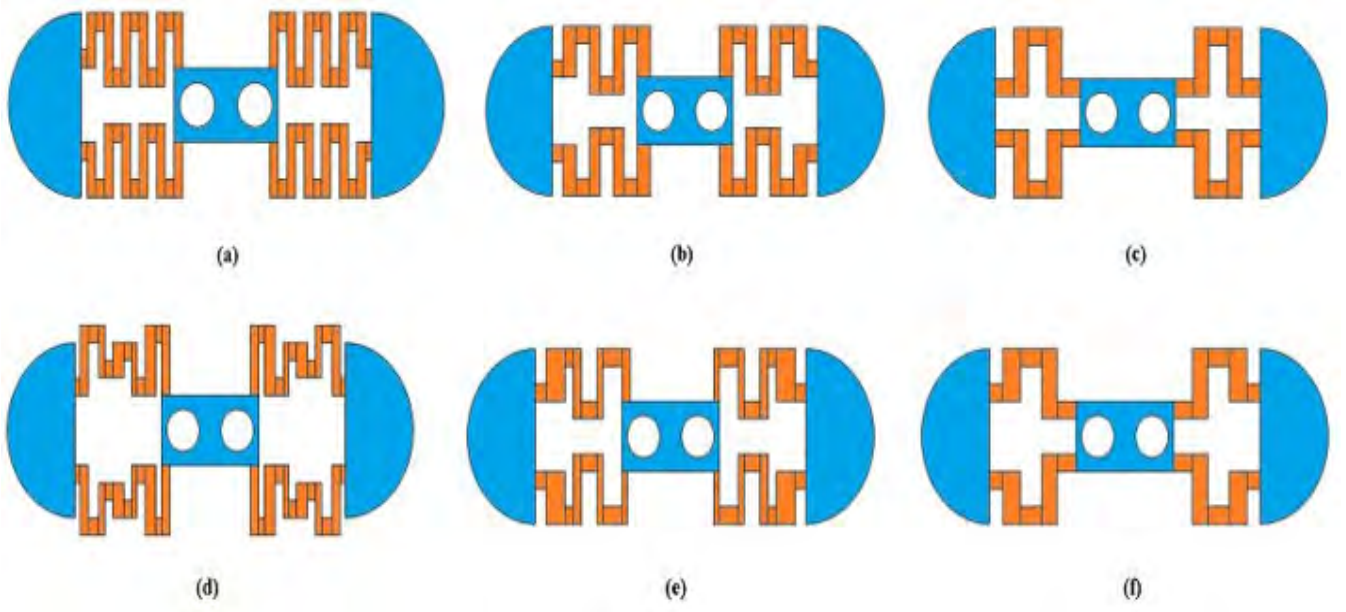


FIGURE 3. Design shows three meanders (a) three uniform meander (b) two uniform meander (c) single uniform meander (d) three non-uniform meander (e) two non-unifrom meander and (f) single non-uniform meander in proposed switches.

D. MEANDERS

Meandering technique is used to increases the switching speed and reduces the actuation voltage by decreasing spring constant. In this proposed switch comparative analysis is done for different meandering techniques. The meandering techniques includes uniform and non-uniform structures containing one, two and three meanders. The uniform and non-uniform meanders are shown in Figure 3, which shows the series combinations blocks to form meanders decreases the spring constant.

E. DIMENSIONS OF PROPOSED SWITCH

Quartz material is used for a substrate with relative permitivity ($\mathcal{E}_r$) as 3.8. Oxide layer is made up of Silicon dioxide (SiO_2) and to analyse performance of switch the CPW and beam materials are varied as gold (Au), titanium (Ti), platinum (Pl) and indium (In). Gold is preferred as best choice because of the high conductivity and less reactive with the other materials. The dielectric layer is made up of AlN (Aluminum Nitride) because of its better capacitance effect than the Si_3N_4(Silicon Nitride). The dimensions and materials for the proposed switch is shown in Table 1.

TABLE 1. Dimensions of proposed rf mems switch.

Parameters	Length	Width	Thickness	Materials
Substrate	380 µm	400 µm	25 µm	Quartz,Si,Ge
CPW (G)	140 µm	400 µm	20 µm	Au,Ti,Pl,In
CPW(S)	60 µm	400 µm	20 µm	Au,Ti,Pl,In
Anchor	30 µm	60 µm	1 µm	Gold
Dielectric	60 µm	60 µm	0.1µm	AlN,Si_3N_4
Beam	36 µm	20 µm	1 µm	Au,Ti,Pl,In

Si = Silicon, Ge = Germanium.

III. THEORETICAL ANALYSIS

A. SPRING CONSTANT

The mechanical behaviour of RF MEMS switch is mostly depends on the spring constant developed by the meandears. In RF MEMS switches, the meanders develop the inductance due to overlapping with the ground planes. These meanders increases the quality of the transmitting signal by decreasing the insertion loss and increasing isolation. Each meander comprises of rectangular blocks and the spring constant of the each block is given by [10].

$$K = \frac{Ewt^3}{l^3} \tag{1}$$

where,

E = young's modulus, w = width of the block,

t = thickness of the block, l = length of the block.

Each block in the non-uniform meander section varies with the dimensions which are shown in Table 2 and the block in uniform meanders are in same length which are separated by the identical span blocks.

TABLE 2. Dimensions of spring constant for different meanders.

Spring Constant	Three Meanders				Two Meanders		Single Meander			
	uniform		non-uniform		uniform		uniform		non-uniform	
(µm)	l	w	l	w	l	w	l	w	l	w
K_{s1}	5	2	6	2	5	4	7	5	5	5
K_{s2}	15	3	20	3	15	5	20	5.5	15	6.5
K_{s3}	5	3	5	4	5	5	7	5	8	5
K_{s4}	20	3	15	2	20	4	20	5.5	20	5.5

The formula for spring constant of each meander is denoted as K_m and is given by

$$\frac{1}{K_m} = \frac{1}{K_1} + \frac{1}{K_2} + \frac{1}{K_3} \tag{2}$$

where,
K_1, K_2 and K_3 are the stifness of each blocks in meanders. The overall spring constant (K_s) of the actuation mechanism is expressed as

$$K_s = 4K_m \tag{3}$$

Hence the spring constant is multiplied with 4 because the beam is suspended by four meanders on either side.

Spring constant is mainly depends on the young's modulus (E) and thickness of the beam. Young's modulus of the gold material is 78 GPa, titanium is having 116 GPa and platinum has 168 GPa. The spring constant of the different meanders have been evaluated and presented in Table 3.

TABLE 3. Spring constant of different beam materials for both uniform and non-uniform meanders.

Materials	Meanders			
	Uniform		Non-uniform	
	Three	single	Three	single
Gold	21.2 N/m	96.3 N/m	24.9 N/m	129 N/m
Titanium	31.8 N/m	141.7 N/m	37.4 N/m	190 N/m
Platinum	50.9 N/m	227.3 N/m	59.8 N/m	310 N/m

B. ACTUATION VOLTAGE

Electrostatic actuation has been utilized to change the mode of operation of the switch i.e., from ON to OFF state. MEMS shunt switch utilizes a DC voltage to be actuate it, and the voltage which is allowed to contact perfectly the dielectric layer and the beam is known as pull-in-voltage and it is given as [11].

$$V_p = \sqrt{\frac{8K_s g_0^3}{27\varepsilon_0 (A - A_d)}} \tag{4}$$

where,
K_s is spring constant for bridge structure, $g_0$is air gap between the beam and dielectric, $\mathcal{E}_0$ is a relative permittivity of free space value is $8.854E - 12$,

$$A = l * w \tag{5}$$

where,
l is length of the beam, w is width of the beam and A is area of the beam, A_d is area of the dimples present in the switch.

$$A_d = 2(\pi r^2) \tag{6}$$

where,
r is radius of the circular perforation which is taken as 6μ m. In this proposed switch, we have used two dimples, thus the total area occupied by the dimples is two times of the A_d mentioned in the equation 6.

1) IMPACT ON BEAM MATERIALS

Pull-in-voltage of the switch is directly proportional to spring constant offered by the meanders. The pull-in voltage of the switch is calculated for different materials. The variation in the spring constant for different materials is due to change in young's modulus. Below Table 4, shows that the properties of the beam materials which shows highly impact on spring constant and pull-in-voltage.

TABLE 4. Pull-in-voltage of different beam materials for both uniform and non-uniform meanders.

Materials	Meanders			
	Uniform		Non-uniform	
	Three	Single	Three	single
Gold	10.3 V	36.5 V	11.6 V	46.04 V
Titanium	12.6 V	44.3 V	14.2 V	55.9 V
Platinum	15.9 V	56.13 V	17.9 V	71.4 V

We observed that, among different meandering techniques the obtained best pull-In-voltage is as low as 10.3 volts for three uniform meandering technique which is having spring constant of 21.2 N/m.

2) IMPACT ON AIR GAP

The variation of the pull-in-voltage at different airgaps is tabulated in table 5. Pull-in-voltage is directly proportional to air gap of the beam. By changing the air gap such as 0.9 μm, 1 μm, 1.2 μm and 1.5 μm then pull-in-voltage is also varies and shown in Table 5. We observed that among the all meandering techniques, three uniform meanders exhibits best pull-in-voltage when compare with non-uniform meander. From the Figure III, IV and V it is observed that the pull in voltage is less for lesser air gap and low young's modulus materials having low spring constant.

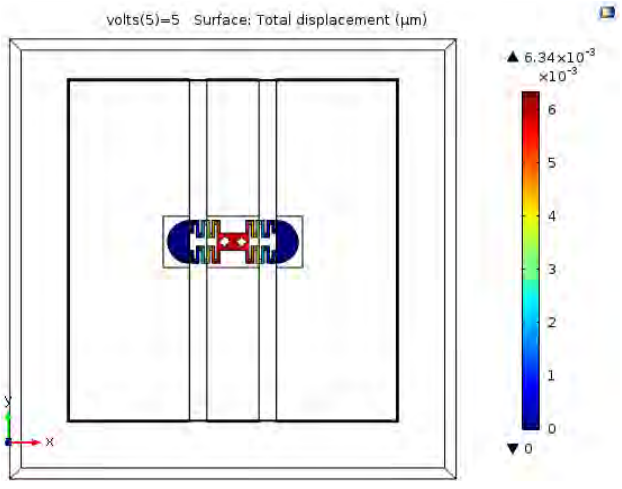


FIGURE 4. Voltage versus displacement of a proposed switch with semi circular disc using three unifrom meanders.

3) IMPACT ON BEAM THICKNESS

The thickness of the beam in the switch is directly proportional to spring constant, therefore, pull-in-voltage is also

TABLE 5. Different airgaps for different materials of uniform and non-uniform meanders.

Meanders	Air gap	Gold	Titanium	Platinum
Uniform 3 meanders	0.9 μm	10.31 V	12.6 V	15.9 V
	1 μm	12 V	15 V	19 V
	1.2 μm	15.8 V	19.4 V	24.5 V
	1.5 μm	22 V	27 V	34 V
Non-uniform 3 meanders	0.9 μm	12 V	14 V	18 V
	1 μm	14 V	17 V	21 V
	1.2 μm	18 V	22 V	28 V
	1.5 μm	25 V	30.5 V	38.5 V
Uniform single meander	0.9 μm	36.5 V	44.3 V	56.1 V
	1 μm	42.78 V	51.91 V	65.7 V
	1.2 μm	56.24 V	68.24 V	86.42 V
	1.5 μm	78.59 V	95.37 V	120.8 V
Single non-uniform meanders	0.9 μm	46.04 V	55.9 V	71.4 V
	1 μm	53.93 V	65.5 V	83.6 V
	1.2 μm	70.89 V	86.13 V	109.9 V
	1.5 μm	99.07 V	120.4 V	153.6 V

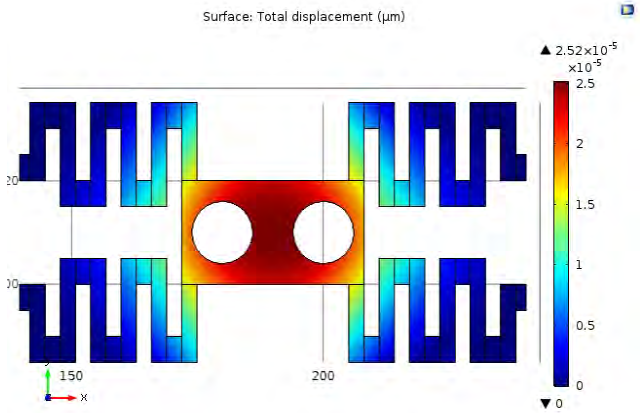


FIGURE 5. Voltage versus displacement of a proposed switch without semi circular disc using three unifrom meanders.

depending on the thickness of the beam. Then the different thickness of the beam for both meandering techniques are shown in Table 6 and Table 7.

C. VON MISES STRESS AND DEFLECTION DUE TO RESIDUAL STRESS

Mechanical behaviour analysis of the proposed switch is performed in COMSOL 5.2 software. Stress analysis is done to understand the stability of the switch during its working at different pull-in voltages. The von mises stress is evaluated to test the defelction of the beam due to stress for the choosen gap. Due to the presence of the dimples, the von mises stress is dispensation around the perforations. During actuation, an electrostatic is generated between beam and lower electrode and is given by [12]–[15].

$$f = \frac{\varepsilon_0 \varepsilon_r S V^2}{2d^2} \tag{7}$$

where,

$\mathcal{E}_r$ is relative permitivity of beam material, S area of the beam in proposed switch,V_p is acuation voltage, d is airgap between signal line and beam.

$$S = A - A_d \tag{8}$$

Force is mainly depends on the area of the beam, airgap between the beam and dielectric material. Residual stress in the beam is related to spring constant because of an beam deflection to the applied voltage is dominated and even existence of minute level in stress. Therefore , force applied on the beam is the key for the low pull-in-voltage.

Different stress analysis are carried out and presented in Table 8 to 12 by using meandering techniques with semi circular disc and vice-versa. Both uniform and non-uniform meanders are observed best results which are enough to handle higher switching to the given maximum stress when compare with other meandering techniques.

D. SWITCHING TIME ANALYSIS

Switching time states that switch is depending on the speed. The formula for switching time anaysis is

$$T_s = \frac{3.67 V_p}{V_s \omega_0} \tag{9}$$

where,

V_s is varying the supply voltage, f_0 is resonant frequency, and V_p is pull-in voltage.

The formula for the angular frequency is

$$\omega_0 = 2\pi f_0 \tag{10}$$

Switching time is directly proportional to actuation voltage and inversely proportional to the supply voltage and angular frequency. In Table 13, presents the simulated value of the resonant frequency with semicircular disc and without disc using different meandering techniques. From Table 13, we have observed that the best switching time analysis is 3.916 μs for two uniform meanders.

E. DAMPING COEFFICIENT AND QUALITY FACTOR

The damping coefficient is helps the beam to return to its original position. The damping of a parallel plate geometries is derived from Reynolds gas-film equation is [16]–[20].

$$b = \frac{3}{2\pi} \frac{\mu (A - A_b)^2}{g_0^3} \tag{11}$$

where,

μ is constant value of $1.885E-5$, $A\text{-}A_b$ is difference between the area of the beam and area of the dimple inserted in switch, g_0 is air gap between the beam and the dielectric layer Damping coefficient is mainly depends on the g_0. In beam the presence of dimples reduces the damping coefficient. The quality factor is used to measure the system energy stored. The quality factor of the beam is determining several different parameters such as intrinsic material dissipation and temperature.

The formula for quality factor is

$$Q = \frac{K_s}{2\pi f_0 b} \tag{12}$$

TABLE 6. Changing the beam thickness of uniform and non-uniform three meanders.

Materials		Three Meanders									
	parameters	Uniform Meanders					Non-uniform meanders				
		1 μm	1.2 μm	1.5 μm	2 μm	3 μm	1 μm	1.2 μm	1.5 μm	2 μm	3 μm
Gold	K_s (N/m)	21.2	36.7	71.92	169.85	573.3	24.9	43.05	84.39	199	672.62
	V_p (V)	10.3	13.5	18.9	29.08	53.45	11.6	15.19	21.27	32.67	60.05
Titanium	K_s (N/m)	31.9	55.1	107.23	254.78	859.9	37.4	64.57	126.16	298.51	1761
	V_p (V)	12.6	16.6	23.14	35.62	65.4	14.15	18.61	26.023	40.01	97.2
Platinum	K_s (N/m)	51	88.1	171.74	407.7	137.85	59.8	103.32	380.95	478.3	2212.12
	V_p (V)	15.9	20.9	29.24	45.1	82.8	17.91	23.54	45	50.6	108.9

TABLE 7. Changing the beam thickness of uniform and non-uniform single meander.

Materials		Single Meander									
	Parameters	Uniform Meanders					Non-uniform meanders				
		1 μm	1.2 μm	1.5 μm	2 μm	3 μm	1 μm	1.2 μm	1.5 μm	2 μm	3 μm
Gold	K_s (N/m)	96.25	163.3	320	756.1	2551.8	129.04	223.5	497.64	1032.4	3485.04
	V_p (V)	36.5	47.6	66.6	102	188.1	46.04	60.6	90.42	130.23	239.3
Titanium	K_s (N/m)	141.7	244.95	478.5	1134.1	3827.8	190.5	334.5	653.3	1548.6	5226.42
	V_p (V)	44.3	58.3	81.4	125.4	230.34	55.9	74.13	103.6	159.5	293
Platinum	K_s (N/m)	227.3	391.8	761.75	1814.6	6124.3	310.1	516.6	1045.3	2476	8362.13
	V_p (V)	56.1	73.7	102.8	158.6	291.35	71.4	92.1	131	201.7	370.64

TABLE 8. Stress analysis by using three unifrom meanders.

parameters	Materials	Gold			Indium			Titanium			Platinum		
	Thickness of the beam (μm)	1.0	1.2	1.5	1.0	1.2	1.5	1.0	1.2	1.5	1.0	1.2	1.5
Stress(MPa)													
(with semi circular disc)		1.89	1.26	0.62	1.89	1.27	0.62	1.92	1.19	0.62	1.9	1.20	0.62
(without semi circular disc)		1.15	0.82	0.57	1.14	0.81	0.57	1.26	0.91	0.61	1.22	0.88	0.59
Total Displacement													
(with semi circular disc)		0.01 E-2	6.9 E-3	3.6 E-3	0.07	0.04 E-2	0.02 E-3	7.1 E-3	4.2 E-3	2.2 E-3	4.9 E-3	2.9 E-3	1.5 E-3
(without semi circular disc)		0.01 E-2	6.6 E-3	3.3 E-3	0.07	0.04 E-7	0.02 E-3	6.6 E-3	4.1 E-3	2.1 E-3	4.5 E-3	2.8 E-3	1.42 E-3
Force		1.9604E-7 N											

TABLE 9. Stress analysis by using three non- unifrom meanders.

parameters	Materials	Gold			Indium			Titanium			Platinum		
	Thickness of the beam (μm)	1.0	1.2	1.5	1.0	1.2	1.5	1.0	1.2	1.5	1.0	1.2	1.5
Stress(MPa)													
(with semi circular disc)		18.4	13.4	12.6	18.4	13.5	12.8	18.1	12.8	10.2	18.2	12.9	11.2
(without semi circular disc)		17.3	12.7	8.58	17.3	12.7	8.57	17.6	12.9	8.75	17.2	12.8	8.69
Total Displacement													
(with semi circular disc)		0.2	0.12	0.07	1.28	0.78	0.44	0.12	0.07	0.04 E-2	0.08	0.05 E-2	0.03 E-2
(without semi circular disc)		0.2	0.12	0.07	1.26	0.75	0.42	0.12	0.07	0.04 E-2	0.08	0.05 E-2	0.03 E-2
Force		2.3089E-6 N											

where, K_s is spring constant, f_0 is resonant frequency and b is damping coefficient. These damping coefficient and quality factor analysis is observed in Table 14.

Here, we have observed that for three uniform and non-uniform meanders $b = 2.966E - 4$, for two meanders $b = 1.682E - 4$ and for single uniform and non-uniform meanders are $b = 3.1622E - 5, 2.72E - 5$ respectively.

TABLE 10. Stress analysis by using double unifrom meanders.

parameters	Materials	Gold			Indium			Titanium			Platinum		
	Thickness of the beam (μm)	1.0	1.2	1.5	1.0	1.2	1.5	1.0	1.2	1.5	1.0	1.2	1.5
Stress(MPa)													
(with semi circular disc)		1.27 E-6	9.38 E-7	6.21 E-7	1.27 E-6	9.26 E-7	6.18 E-7	1.38 E-6	1.04 E-6	6.65 E-7	1.34 E-6	1.02 E-6	6.44 E-7
(without semi circular disc)		1.11 E-6	7.93 E-7	5.33 E-7	1.11 E-6	7.88 E-7	5.29 E-7	1.18 E-6	8.46 E-7	5.8 E-7	1.16 E-6	8.28 E-7	5.64 E-7
Total Displacement													
(with semi circular disc)		1.07 E-8	6.7 E-9	3.7 E-9	6.77 E-8	4.24 E-8	2.35 E-8	6.85 E-9	4.26 E-9	2.34 E-9	4.65 E-9	2.9 E-9	1.59 E-9
(without semi circular disc)		7.74 E-9	4.94 E-9	2.79 E-9	4.9 E-8	3.13 E-8	1.77 E-8	4.86 E-9	3.07 E-9	1.72 E-9	3.32 E-9	2.11 E-9	1.18 E-9
Force		4.967576E-5 N											

TABLE 11. Stress analysis by using single unifrom meander.

parameters	Materials	Gold			Indium			Titanium			Platinum		
	Thickness of the beam (μm)	1.0	1.2	1.5	1.0	1.2	1.5	1.0	1.2	1.5	1.0	1.2	1.5
Stress(MPa)													
(with semi circular disc)		1.67 E-3	390	250	2.31E3	386	248	2.51E3	416	269	2.44E3	411	265
(without semi circular disc)		575	318	211	572	316	211	630	338	215	604	331	209
Total Displacement													
(with semi circular disc)		4.32	2.86	1.44	27.4	18.1	9.12	2.95	1.87	0.94	1.96	1.25	0.63
(without semi circular disc)		3.2	1.98	0.96	20.3	12.5	6.02	2.05	1.24	0.6	1.39	0.85	0.41
Force		1.44282E-4 N											

TABLE 12. Stress analysis by using single non unifrom meander.

parameters	Materials	Gold			Indium			Titanium			Platinum		
	Thickness of the beam (μm)	1.0	1.2	1.5	1.0	1.2	1.5	1.0	1.2	1.5	1.0	1.2	1.5
Stress(MPa)													
(with semi circular disc)		1.78E3	326	209	1.77E3	323	207	1.9E3	379	232	1.84E3	362	223
(without semi circular disc)		454	247	179	451	245	179	496	267	175	475	259	174
Total Displacement													
(with semi circular disc)		3.32	2.09	1.1	21	13.2	6.98	2.21	1.37	0.72	1.47	0.92	0.48
(without semi circular disc)		2.39	1.47	0.81	15.1	9.33	5.12	1.52	0.93	0.51	1.03	0.63	0.34
Force		1.187055E-4 N											

TABLE 13. Switching time analysis using uniform and non uniform meanders.

Parameters	Three meanders		Two meanders	Single meanders	
	Uniform	Non-uniform	Uniform	Uniform	Non-uniform
Resonant frequency(f_0)					
(with semicircular disc)	1.113E5	94037	1.3684E5	1.5224E5	1.133E5
(without semicircular disc)	1.1955E5	95937	1.6131E5	1.96043E5	1.408E5
Switching time (t_s)					
(with semicircular disc)	5.41 μs	3.939 μs	3.91617 μs	4.5055 μs	5.1184 μs
(without semicircular disc)	5.035 μs	3.29 μs	3.126 μs	4.4163 μs	4.15567 μs

F. EFFECT OF DAMPING AND QUALITY FACTOR IN RELEASE TINE

Damping coefficient is inversely proportional to the quality factor. This quality factor will have great influence in switching and release times. The range of the quality is given as 0.5 – 2 such that switches with quality factor less than 0.5 will suffers fast switching and if greater than 2 will suffers from low release times and quality factor is approximately

TABLE 14. Varying the values of damping coefficient and quality factor using different meanders.

Parameters & Materials	Air gap (μm)	Three Meanders								Single Meander							
		Uniform				Non-uniform				Uniform				Non-uniform			
		0.9	1	1.2	1.5	0.9	1	1.2	1.5	0.9	1	1.2	1.5	0.9	1	1.2	1.5
Damping Coefficient (b)		2.97 E-4	2.16 E-4	1.25 E-4	6.41 E-5	2.55 E-4	1.86 E-4	1.08 E-4	5.52 E-5	3.16 E-5	2.78 E-5	1.61 E-5	8.25 E-6	2.72 E-5	1.98 E-5	1.15 E-5	5.87 E-6
Quality factor(q)																	
Gold (with semicircular disc)		0.10 2	0.14	0.18	0.23	0.17	0.22	0.39	0.76	3.18	3.62	6.25	12.2	6.66	9.14	15.8	30.9
(without semicircular disc)		0.01	0.13	0.16	0.21	0.16	0.23	0.38	0.75	2.55	2.89	5.01	9.75	5.4	7.36	12.7	24.8
Titanium (with semicircular disc)		0.06	0.09	0.12	0.14	0.1	0.13	0.22	0.43	1.63	1.85	3.20	6.25	2.21	3.03	5.24	10.2
(without semicircular disc)		0.06	0.08	0.10	0.13	0.1	0.12	0.21	0.42	1.27	1.44	2.5	4.87	1.66	2.27	3.92	14.5
Platinum (with semicircular disc)		0.18	0.25	0.29	0.40	0.27	0.37	0.64	1.25	4.64	5.3	9.1	17.8	6.5	8.89	15.4	30.1
(without semicircular disc)		0.17	0.24	0.28	0.38	0.33	0.36	0.62	1.22	3.7	4.16	7.2	14.0	4.6	6.64	14.5	22.2

"1" is recommended for the best release response. The formula for settling time which is related to quality factor is [21]–[23].

$$t_s = \frac{27V_p^2}{4\omega Q V_s^2} = \frac{2bV_P^2}{g_0 V_s^2} \tag{13}$$

where,
t_s is the overestimate the switching time ,V_p is pull-in-voltage, ω_0 is angular frequency, Q is the quality factor, V_s is supply voltage, b is damping coefficient, g_0 is air gap between the beam and the dielectric layer.

G. CAPACITIVE ANALYSIS OF A SWITCH

RF MEMS Switch can develop the capacitance in terms of up state and down state.

Formula for the up-state capacitance is [6], [24]–[26].

$$C_u = \frac{\varepsilon_0(A - A_d)}{g_0 + \frac{t_d}{\varepsilon_r}} \tag{14}$$

where,
C_u is upstate capacitance, ε_r is relative Permittivity of a dielectric material, t_d is the thickness of the dielectric layer, $A\text{-}A_d$ is difference between the area of the beam and area of the dimple is inserted in switch, $\mathcal{E}_0$ is permittivity of free space and $g_0$is air gap of the given switch. Based on the relative permittivity of the dielectric material the variation in capacitance occurs. The various dielectric materials are considered to analyze the charging and discharging of switch.

The down state capacitance is

$$C_d = \frac{\varepsilon_0\varepsilon_r\,(A - A_d)}{t_d} \tag{15}$$

The capacitance ratio states that the ratio between down state to upstate capacitance. This capacitance ratio is depends on the efficiency of a switch. Then the formula for the capacitance ratio is

$$C_r = \frac{C_d}{C_u} = \frac{\frac{\varepsilon_r\varepsilon_0(A-A_d)}{t_d}}{\frac{\varepsilon_0(A-A_d)}{g_0+\frac{t_d}{\varepsilon_r}}} \tag{16}$$

where,
C_u is up state capacitance, C_d is down state capacitance and C_r is the Capacitance ratio and it is mainly depending on the relative permittivity, thickness and area of the beam. Upstate capacitance is based on both insertion and isolation losses and down state capacitance is based on the isolation. Capacitance is depending on dielectric material, dielectric thickness and beam materials.

The different beam materials have been used to determine the capacitance ratio of the proposed RF MEMS switch which decreases the losses. Gold material having relative permitivity 6.9 is chosen as beam material and capacitance ratio of 7.12, 6.17 and 5.14 is obtained for beam thickness of 1μm, 1.2μm and 1.5μm respectively whereas by varying the denominator of the Cr which is known as upstate capacitance, it can be observed as 7.12, 7.9, 9.28, 11.35 for the air gap between the dielectric layer and the beam with 0.9 μm, 1 μm, 1.2 μm and 1.5 μm respectively. These capacitance

TABLE 15. Varying thickness using uniform and non-uniform meanders.

Parameters	Three Meanders						Single Meander					
	Uniform			Non-Uniform			Uniform			Non-Uniform		
Thickness (μm)	1	1.2	1.5	1	1.2	1.5	1	1.2	1.5	1	1.2	1.5
Down state Capacitance (C_d) Units:(pico Farads(pF))	0.299	0.25	0.20	0.2774	0.232	0.185	0.108	0.0896	0.072	0.091	0.076	0.061
Upstate Capacitance(C_u) Units:(femito Farads(fF))	41.5	40.5	38.8	38.6	37.52	36.1	14.9	14.5	13.9	12.6	12.2	11.8
Capacitance ratio (C_r)	7.12	6.17	5.14	7.21	6.2	3.29	7.21	6.17	5.14	7.21	6.18	5.14

TABLE 16. Varying airgap using uniform and non-uniform meanders.

Parameters	Three Meanders								Single Meander							
	Uniform				Non-Uniform				Uniform				Non-Uniform			
Airgap (μm)	0.9	1	1.2	1.5	0.9	1	1.2	1.5	0.9	1	1.2	1.5	0.9	1	1.2	1.5
Downstate Capacitance (C_d) Units:(pico Farads(pF))	0.2994				0.2780				0.1075				0.907			
Upstate Capacitance(C_u) Units:(femito Farads(fF))	41.5	37.9	32.7	26.4	38.6	35.2	30.1	24.5	14.9	13.6	11.6	9.47	12.6	11.5	9.8	7.99
Capacitance ratio (C_r)	7.12	7.9	9.28	11.4	7.21	7.9	9.3	11.4	7.21	7.9	9.3	11.4	7.21	7.9	9.3	11.4

analyses are done with different materials in Table 15 and Table 16 respectively.

IV. RESULTS AND DISCUSSIONS

The proposed RF MEMS capacitive shunt switch is performed with different analysis such as electromechanical analysis, stress, switching time and electromagnetic analysis. By these analysis, it is clear that the best material and suitable dimensions are choosen for fabrication.

A. ELECTROMECHANICAL ANALYSIS

1) UNIFORM THREE MEANDERS

The proposed switch for uniform 3 meanders is designed and simulated by FEM tool and analysed by changing beam thickness, beam material, air gap and changing the substrate, dielectric and airgap etc.

The simulations are carried out with and without semi-circular disc as shown in Figure 4 & 5. The semicircular disc is used to reduce the residual stress and the voltage versus displacement analysis are done by using different beam materials such that gold, platinum and titanium are shown in Figure.6. Here, we have observed that platinum shows better results than gold but it is costlier than gold. Hence gold is chosen as the best material to enhance the switch characteristics. In figure 7, the dispalcement of the beam by actuation voltage for dfferent airgaps such as 0.9 μm, 1 μm, 1.2 μm and 1.5 μm and it is observed that 0.9μm gap shows better displacement having slope nearly 1. In figure 8, it can be observe that 1 μm thickness shows as a good displacement when compare with the 1.2 μm and 1.5 μm beam thickness.

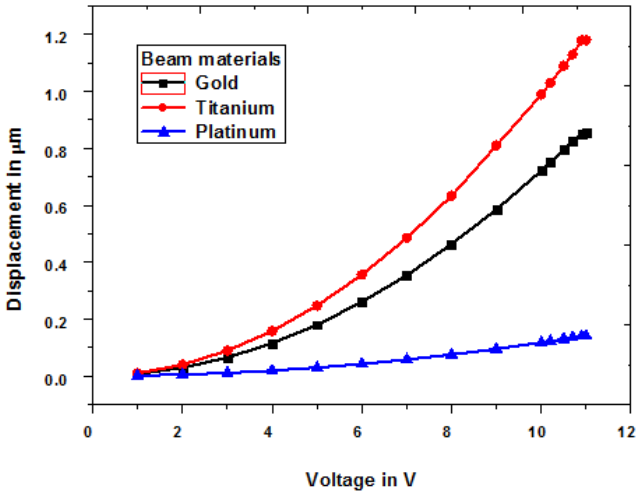


FIGURE 6. Voltage versus displacement using three unifrom meanders for different beam materials.

2) UNIFORM TWO MEANDERS

The proposed switch is implementing with uniform two meanders without changing the movable beam dimensions. The analysis are done by using different beam thickness, beam materials and airgap between the signal line and the beam and are presented in Figures from 9 to 13.

The Figure 11 and 12 illustrates the impact of semi circular disc which increases the stability of the switch during the displacement. The switch without disc shows the displacement which is greater than the gap taken.

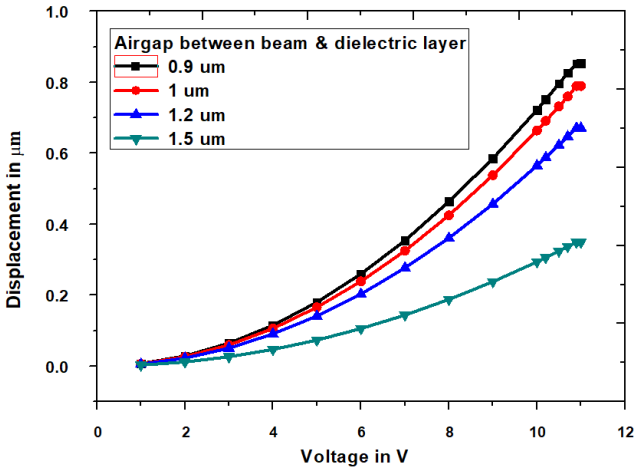


FIGURE 7. Voltage versus displacement using three unifrom meanders for different airgaps.

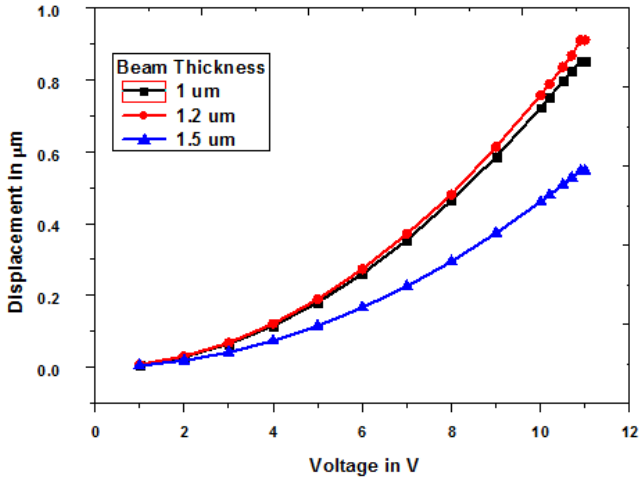


FIGURE 8. Voltage versus displacement using three unifrom meandersfor different beam thickness.

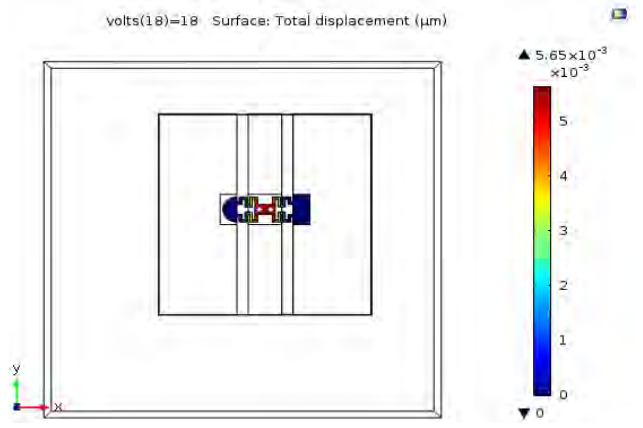


FIGURE 9. Voltage versus displacement of a proposed switch with semi circular disc using two uniform meanders.

The semicircular disc increases the stifness by firm holding the meanders gives the displacement with in the range of gap taken.

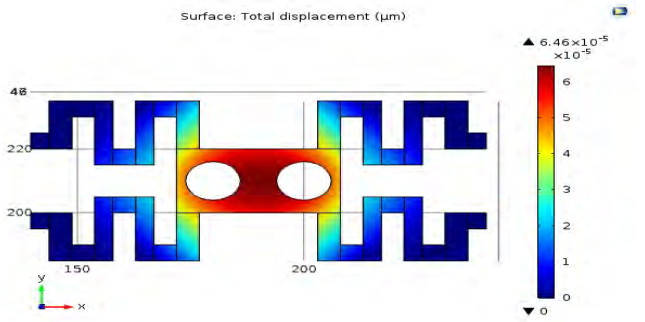


FIGURE 10. Voltage versus displacement a proposed switch without semi circular disc using two uniform meanders.

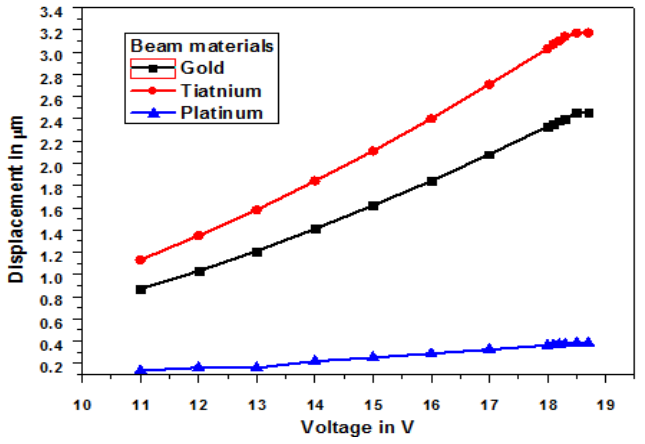


FIGURE 11. Voltage versus displacement using two meanders for different beam Materials.

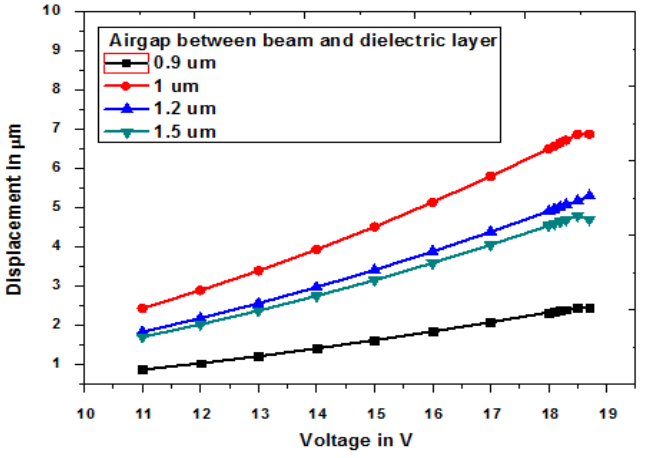


FIGURE 12. Voltage versus displacement using two meanders for different airgap.

The switch with beam thickness 1.2 μm having the air gap of 0.9 μm with the gold material is observed as the suitable parameters for better performance of switch with two meanders.

3) UNIFORM SINGLE MEANDER

The proposed switch is designed using single meander with uniform structure and the observations are discussed from the Figure 14 to Figure 18.

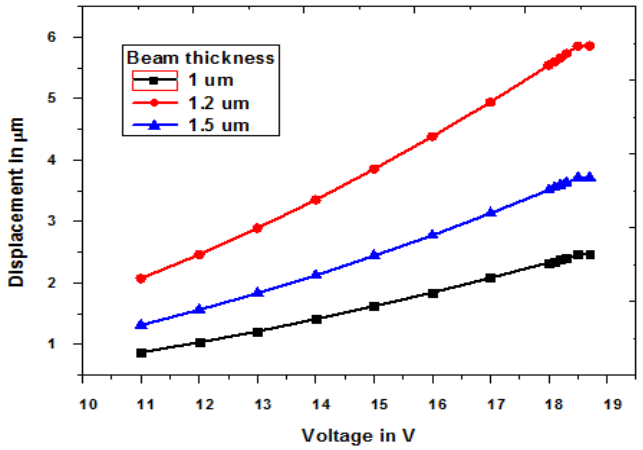


FIGURE 13. Voltage versus displacement using two meanders for different thickness.

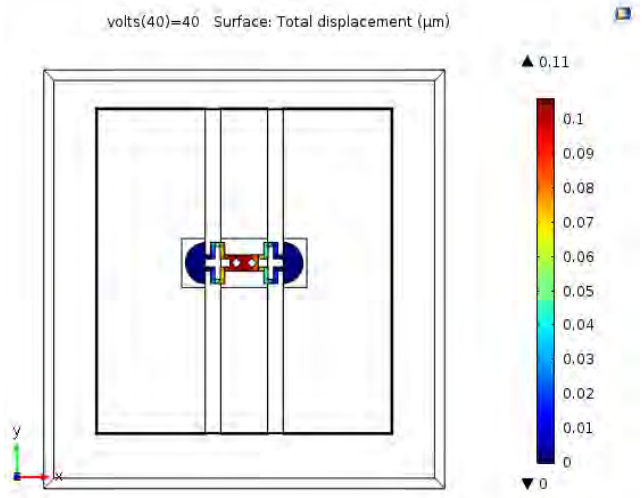


FIGURE 14. Voltage versus displacement of a switch with semi circular disc using single uniform meander.

The switch with single meander is analyzed by taking semi circular discs and observed that beam displaces the gap at pull-in voltage and it shows the displacement out of range when discs are not considered. Hence the discs are also plays a major role in uniform single meander.

The uniform one meander switch is analysed by varying the gap, thickness and material as shown in the Figures from 14 –18. The switch shows better performance with the parameters at 0.9 μm air gap with 1μm beam thickness made up of gold material.

4) NON-UNIFORM THREE MEANDERS

The proposed switch with non-uniform three meanders is used instead of uniform three meanders. By comparing this analysis for both uniform and non-uniform three meanders, it is observed that the non-uniform three meanders shows better results. This analysis is observed in Figure 19-23.

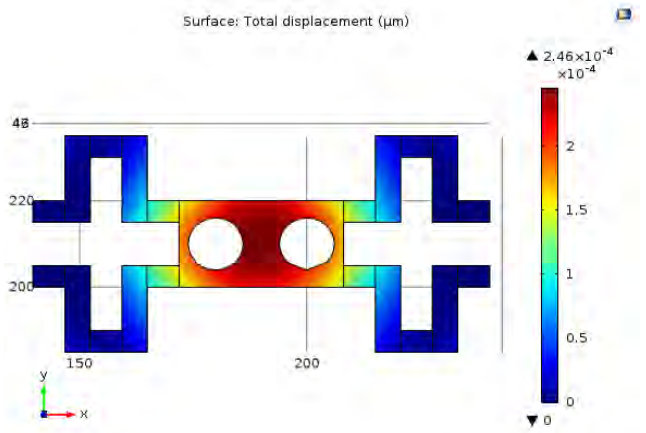


FIGURE 15. Voltage versus displacement of a switch with out semicircular disc using single uniform meander.

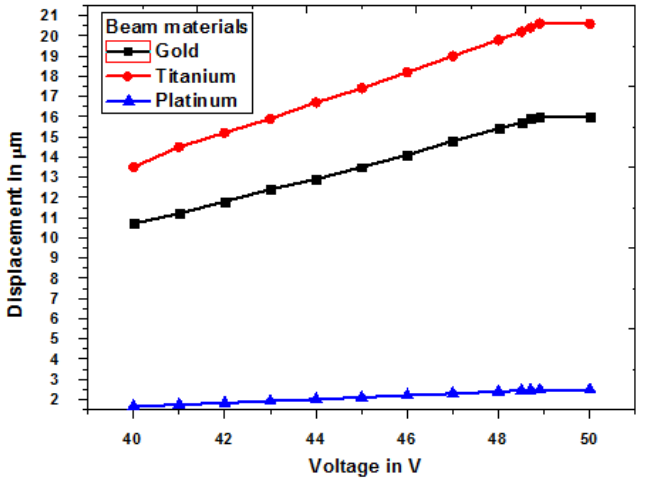


FIGURE 16. Voltage versus displacement using single uniform meander for different beam material.

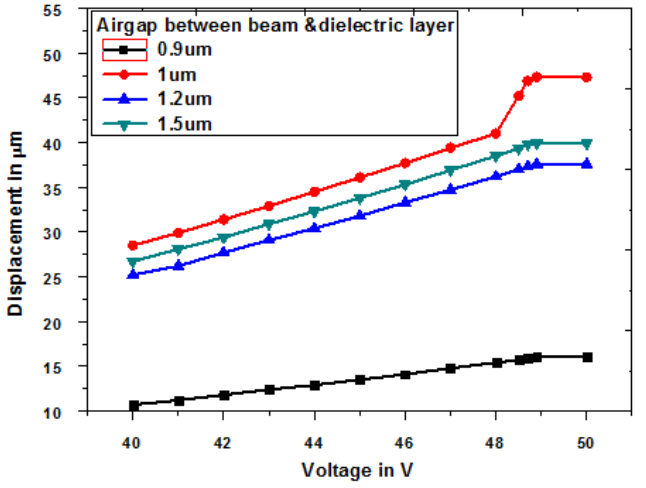


FIGURE 17. Voltage versus displacement using Single uniform meander for different airgaps.

The switch designed with non-uniform three meanders is analyzed from Figure 19 to 23 and it observed that the proposed meanders also shows good performance at 0.9 μm with platinum as a beam material having thickness 1 μm.

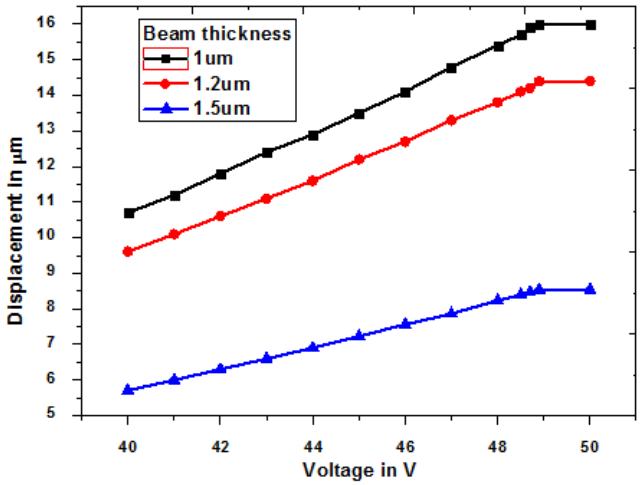


FIGURE 18. Voltage versus displacemnt using single uniform meander for different thickness.

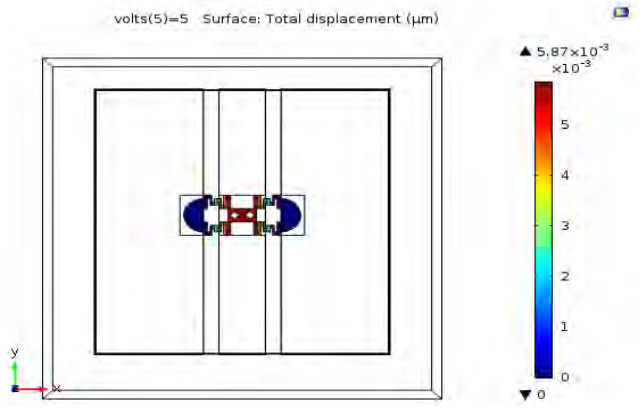


FIGURE 19. Voltage versus displacement of a proposed switch with semicircular disc using non- uniform three meanders.

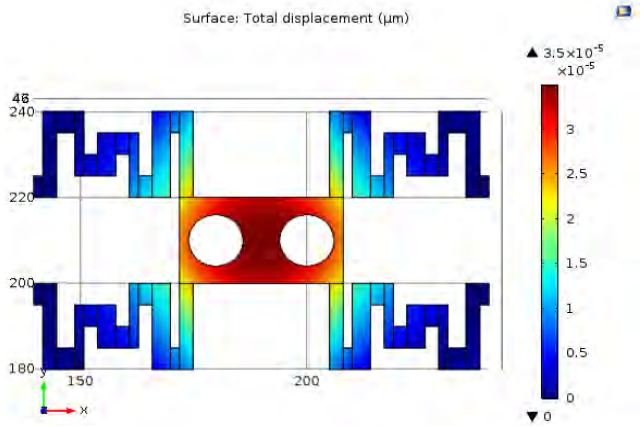


FIGURE 20. Voltage Versus displacementr a Switch without semi circular disc using Non uniform three Meanders.

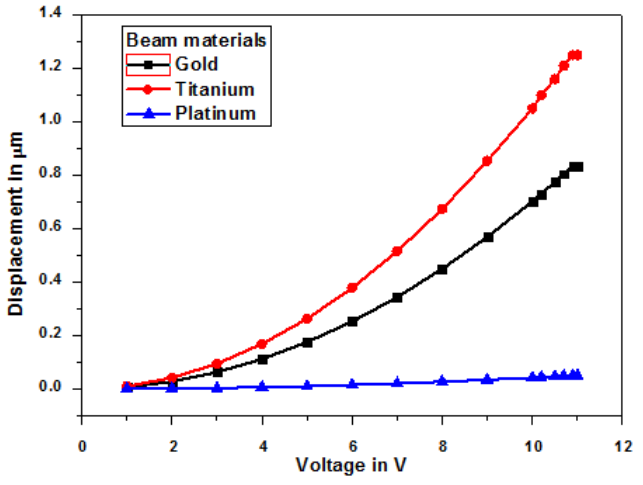


FIGURE 21. Voltage versus displacement using non -uniform three meanders for different beam material.

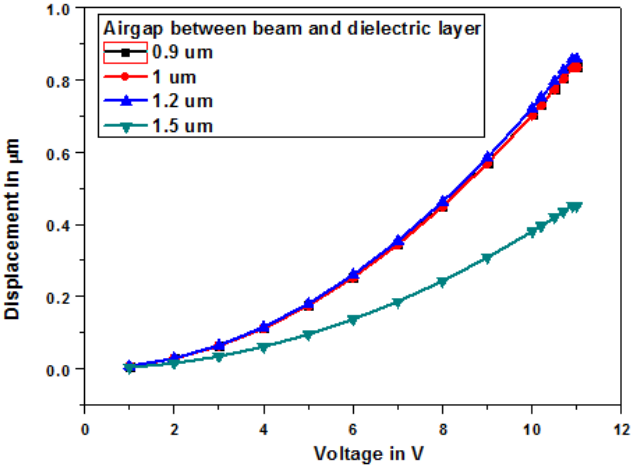


FIGURE 22. Voltage versus displacement using non -uniform three meanders for different airgaps.

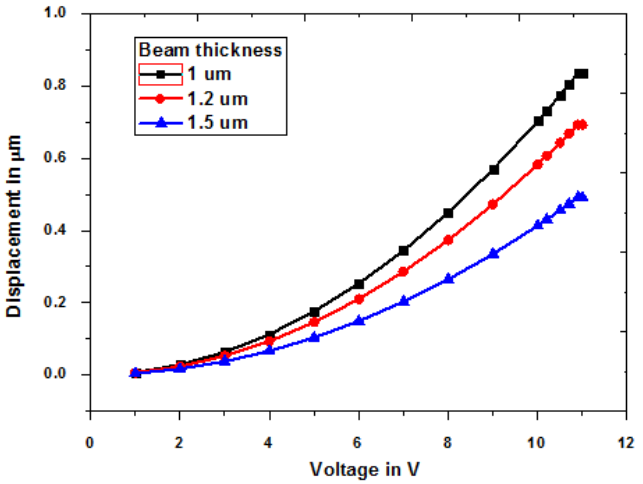


FIGURE 23. Voltage versus displacement using non -uniform three meanders for different thickness.

5) NON-UNIFORM SINGLE MEANDER

The proposed switch is implemented with non- uniform single meander instead of uniform single meanders. When compare with all uniform meanders and non-uniform three meanders, the non-uniform single meander exhibits good results. This analysis is observed in Figure 24-28.

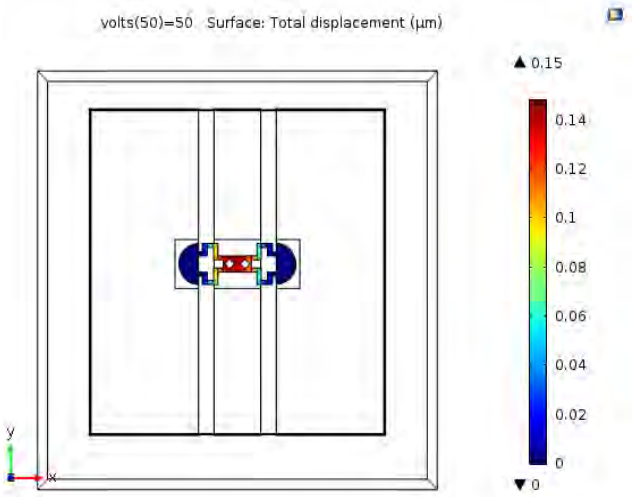


FIGURE 24. Voltage versus displacement of a proposed switch with semicircular disc using non- uniform single meander.

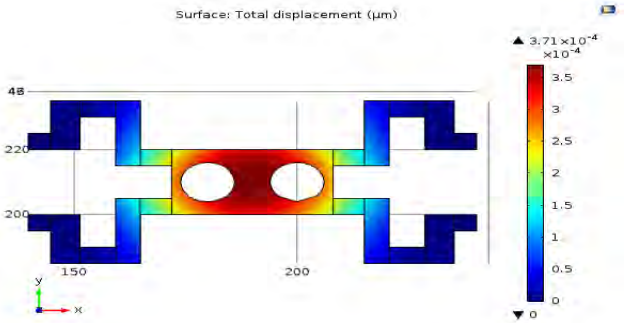


FIGURE 25. Voltage versus displacement of a proposed switch without semicircular disc using non-uniform single meander.

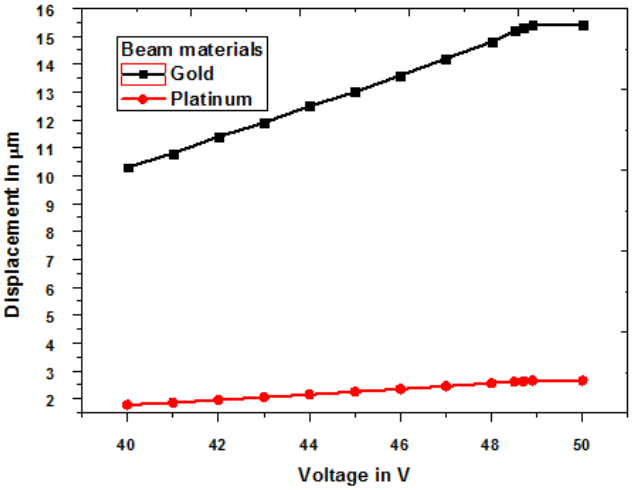


FIGURE 26. Voltage versus displacement using non- uniform single meander for different beam material.

6) COMPARISION BETWEEN BOTH UNIFORM AND NON-UNIFORM MEANDERS

Electromechanical analysis has done with voltage versus displacement comparison by using both uniform and non-uniform three, single meanders. Here we observed three uniform meanders as better results when compare with three non-uniform meanders in Fig 29.

The comparison between uniform and non-uniform meanders are shown in Figure 29 observes proper results in non-uniform three meanders when compare with uniform meanders. Similar analysis done in Figure 30 using uniform and non-uniform single meander. In figure 30, we observes single uniform meander is better when compare with single non-uniform meander.

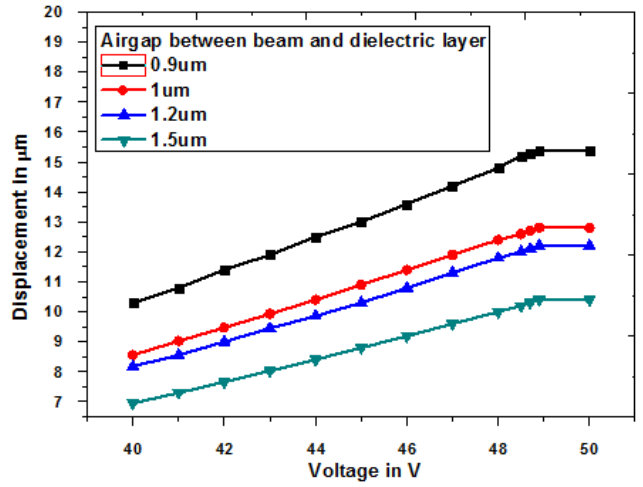


FIGURE 27. Voltage versus displacement using non -uniform single meander for different airgaps.

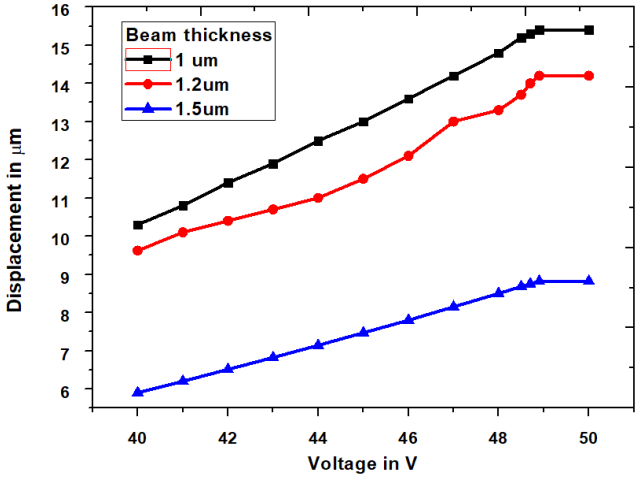


FIGURE 28. Voltage versus displacement using non- uniform single meander for different thickness.

B. STRESS ANALYSIS

The stress analysis has been carried out by considering the different beam materials and thickness of beam.

The stress analyses are carried out with uniform load and it is observed that switch can withstand by having stress 1.9 MPa by using semi-circular disc as shown in

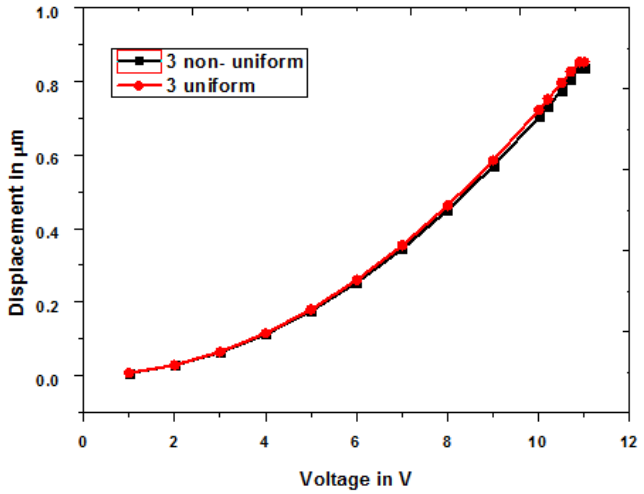


FIGURE 29. Voltage versus displacement of both uniform and non- uniform three meanders.

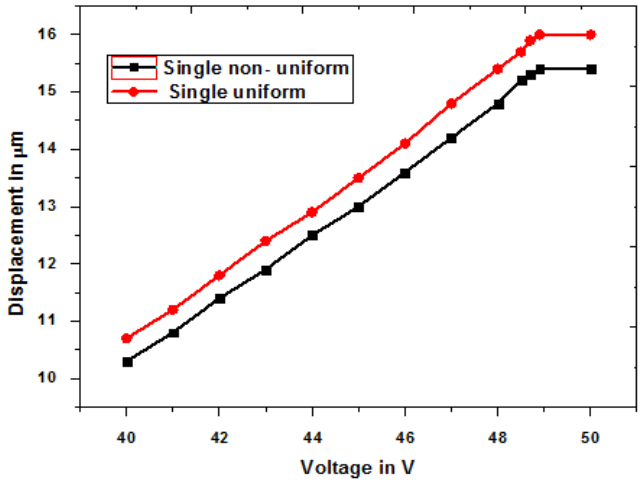


FIGURE 30. Voltage versus displacement of both non- uniform and uniform single meander.

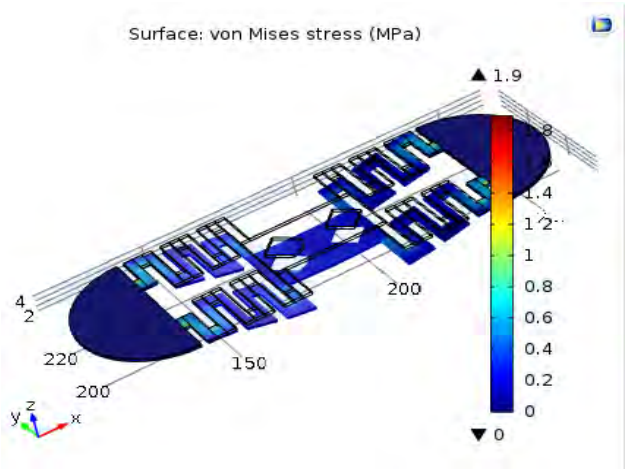


FIGURE 31. A switch having semicircular disc by using three uniform meanders for a gold material at 1μm thickness.

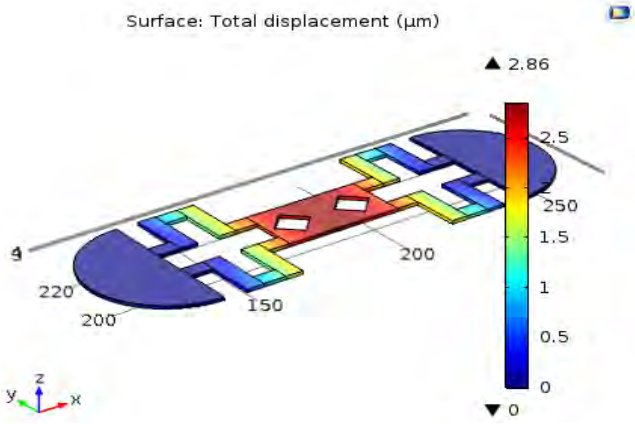


FIGURE 32. Total displacement having with semicircular disc using single uniform meanders for a gold Material at 1.2 μm thickness.

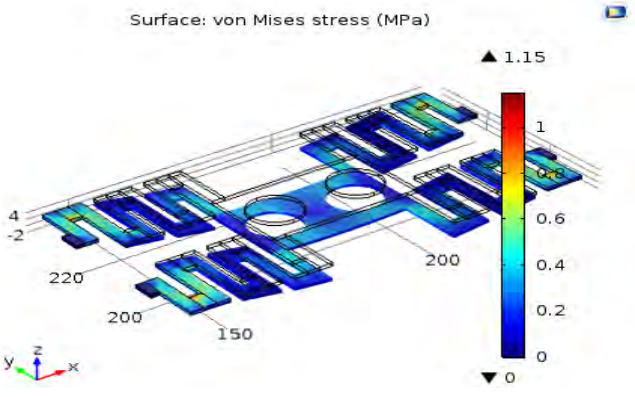


FIGURE 33. A Switch having without semicircular disc by using three uniform meanders for a gold as a beam material.

the Figure 31. The switch without the disc can withstand upto 1.15 MPa which is lower in the case of using disc.

C. SWITCHING TIME ANALYSIS

The switching time analysis have been carried out for uniform and uniform meander and the values are presented in the Table 12. Among the non-uniform meanders, the switch having three meanders takes very less time of 3.9 μsec for switching and uniform two meanders show 3.126 μsec. The low switching time of the proposed switches shows the fast transition of the switch from ON state to OFF state and the calibration of the switch is presented in the Figure 35 and 36.

D. DAMPING COEFFICIENT AND QUALITY FACTOR RELATED TO SETTLING TIME

The relation between time, quality factor and damping coefficient has shown in the equation 13. The settling time for different meandering techniques is performed and presented in the Figure 37. It shows the uniform and non–uniform single meander shows very less releasing time with low damping effect.

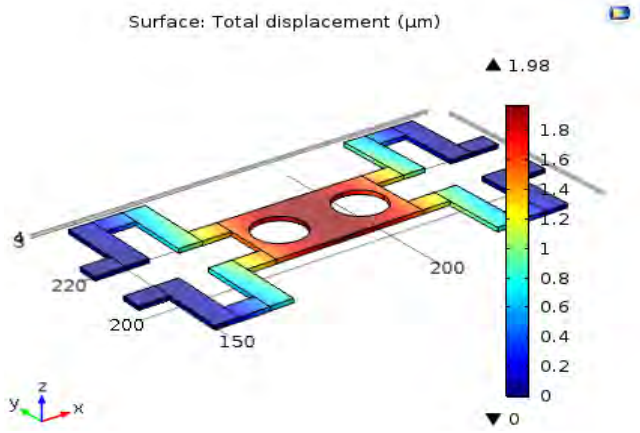


FIGURE 34. Total displacement having without semicircular disc using three uniform meanders for a gold as a beam Material.

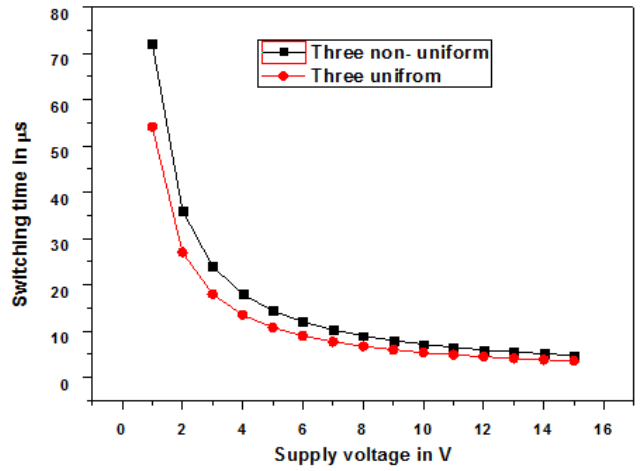


FIGURE 35. Voltage versus switching time analysis using both uniform and non-uniform three meanders.

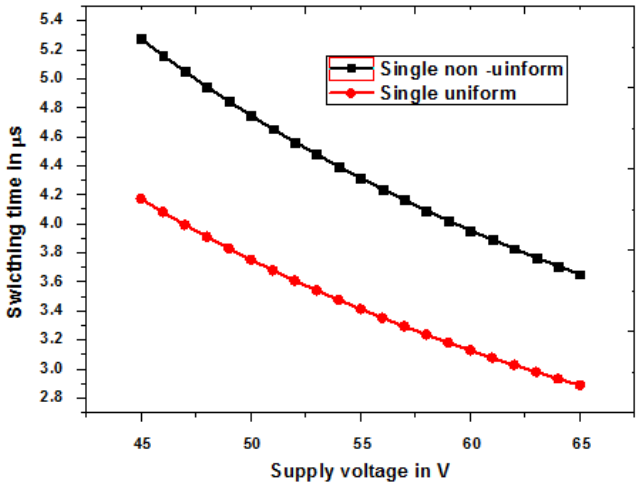


FIGURE 36. Voltage versus switching time analysis using both single uniform and non-uniform meanders.

E. CAPACITANCE ANALYSIS OF A SWICTH

The capacitance developed between the beam and lower electrode is used to regulate the transmission of RF signal.

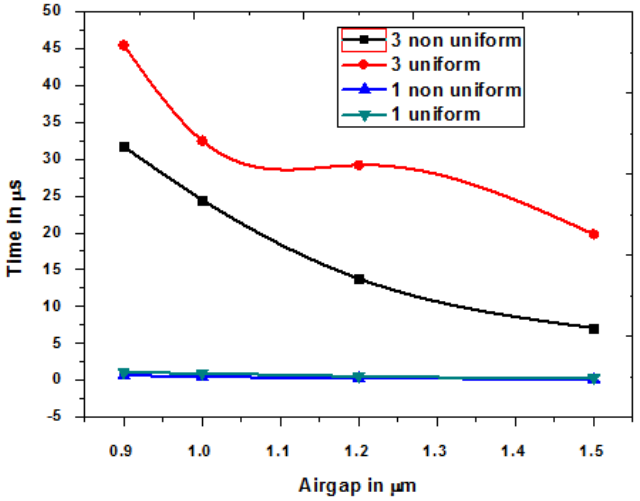


FIGURE 37. Time versus gap in damping-limited case.

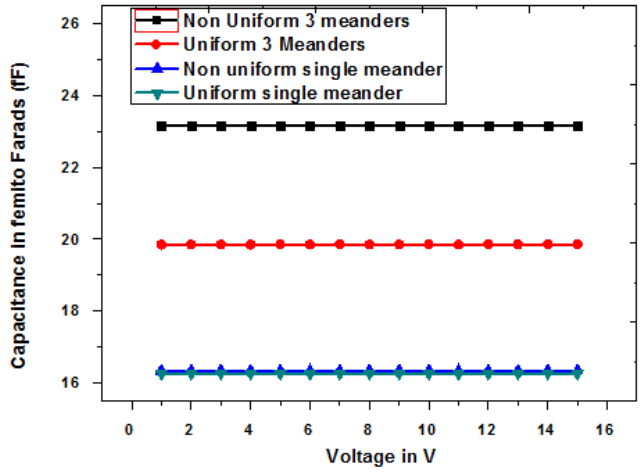


FIGURE 38. Capacitance versus voltage of all meandering techniques.

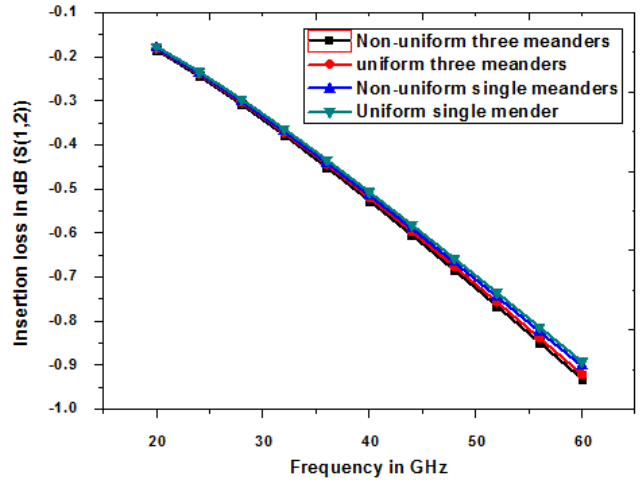


FIGURE 39. Insertion loss of a frequency at 40 GHz by using all meandering techniques.

From the Figure 38 we observed that 23 fF (femito Farads) of capacitance is developed for non-uniform three meanders which is higher than the other type of switches in upstate capacitance condition.

TABLE 17. Comparision between uniform and non uniform 3 meanders and single meander.

Parameters (40 GHz frequency)	Three Meanders		Single Meander	
	Unifrom	Non-uniform	Uniform	Non-uniform
Isolation	-36.37 dB	-39.973 dB	-44.64 dB	-54.171 dB
Return loss	-16.37 dB	-16.06 dB	-17.61 dB	-17.35 dB
Insertion loss	-0.52 dB	-0.52 dB	-0.51 dB	-0.514 dB

F. RF PERFORMANCE ANALYSIS

Electromagnetic analysis is done using HFSS. In these proposed switches, to analyse the performance, scattering parameters such as isolation, insertion and return loss are used for different uniform and non-uniform meandering techniques. This RF properties are analysed over the 26.5 GHz to 40 GHz frequency range. When comparing with all meandering techniques we observed good results in return loss for uniform single meander as −17.65 dB, low Insertion loss for uniform single meander as −0.51 dB and high isolation for non-uniform single mender as −54.18 dB.

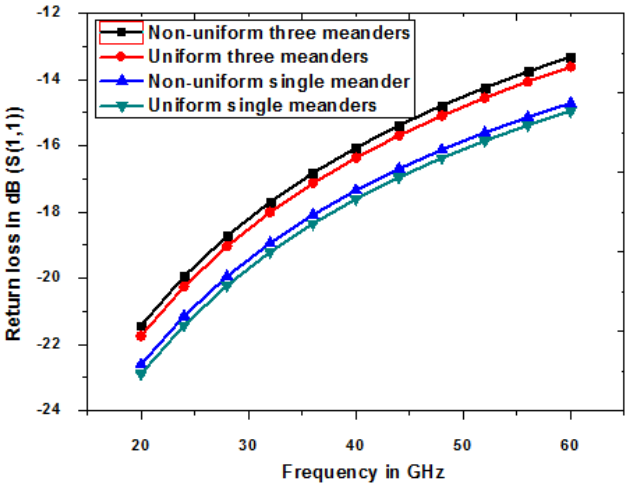


FIGURE 40. Return loss of a frequency at 40 GHz by using all meandering techniques.

This RF analysis are mainly depends on the dielectric material and thickness of the beam. The analysis presented in table 18 and table 19 are having different dielectric materials and different thickness. Finally, the proposed switches are

TABLE 18. Comparison between uniform and non uniform three meanders.

Parameters (40 GHz frequency)	Dielectric thickness	Three Meanders (3μm Beam thickness)					
		Uniform meanders			Non-unifrom meanders		
		0.1 μm	0.05 μm	0.01 μm	0.1 μm	0.05 μm	0.01 μm
Isolation		-20.6139 dB	-28.4824 dB	-36.37 dB	-20.224 dB	-27.0086 dB	-39.973 dB
Return loss		-20.372 dB	-20.6616 dB	-20.889 dB	-20.109 dB	-20.4394 dB	-20.612 dB
Insertion loss		-0.4307 dB	-0.4273 dB	-0.4266 dB	-0.4281 dB	-0.4259 dB	-0.4242 dB

TABLE 19. Comparison between uniform and non uniform single meander.

Parameters (40 GHz frequency)	Dielectric thickness	Single Meander (3μm Beam thickness)					
		uniform meanders			non-unifrom meanders		
		0.1 μm	0.05 μm	0.01 μm	0.1 μm	0.05 μm	0.01 μm
Isolation		-17.4599 dB	-24.372 dB	-44.6355 dB	-17.074 dB	-23.78 dB	-54.1771 dB
Return loss		-20.6192 dB	-20.897 dB	-21.188 dB	-20.385 dB	-20.74 dB	-21.0724 dB
Insertion loss		-0.4396 dB	-0.4365 dB	-0.4339 dB	-0.4436 dB	-0.4375 dB	-0.4355 dB

TABLE 20. Comparison of proposed capacitive rf mems shunt switch at 1 to 40 ghz with previous works.

Parameters	References			
	Reference [2]	Reference [7]	Reference [8]	Proposed switch
Meandering techniques	-----	-----	-----	Both uniform and non-uniform meanders
Actuation Mechanism	Electromagnetic analysis	Electromechanical and Electromagnetic analysis	Electromagnetic analysis	Electromechanical and Electromagnetic analysis
Substrate Material	GaAs	-----	-----	Quartz
Bridge thickness and material	Gold(2 μm)	1 μm	1 μm	Gold (μm)
Airgap	2 μm	1.2-1.6 μm	3 μm	1 μm and 3 μm
Dielectric thickness and material	0.15μm(Si3N4)	1000 μm	0.3 μm	0.1 μm (ALN)
Pull-in-Voltage	-----	18 and 25 V	18 V	10.3 V
Stress analysis	-----	15 and 25 (MPa)	-----	1.78E3 (MPa) (Gold)
Switching time	-----	3.5 μs	-----	3.126 μs
Isolation	-48 dB	-18 dB	-29 dB	-54.17 dB
Insertion loss	-0.34 dB	-0.9 dB	-0.92 dB	-0.4355 dB
Return loss	-17 dB	-24 dB	-12 dB	-21.072 dB

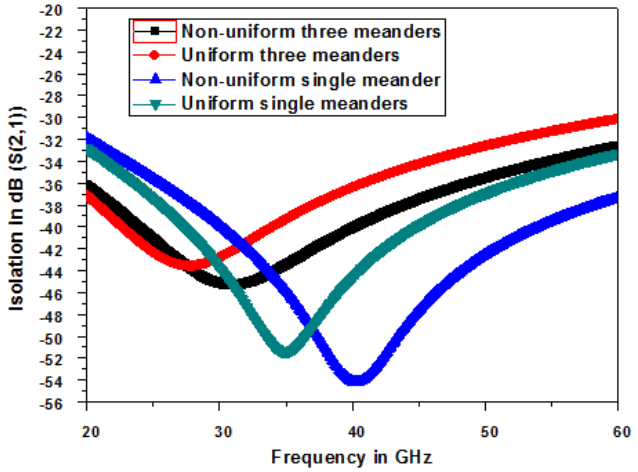


FIGURE 41. Isolation of a frequency at 40 GHz by using all meandering techniques.

comparing with both uniform and non-uniform meandering techniques compared and observed excellent RF performances in non-uniform single meander and it is highly recommended to fabricate a proposed switch.

V. CONCLUSIONS

In this paper, the design, analysis and simulation of the proposed RF MEMS shunt switch is done using different meanders along with dimples. Using electromechanical study, pull-in voltage, capacitance ratio, switching time, stress analysis is carried out. Similarly, with the help of electromagnetic study RF losses have been studied. Different materials such as gold, titanium, platinum and indium are chosen for the beam to obtain best performance. Among those above given materials gold is suited as best because of its high conductivity properties. Pull-in-voltage is obtained as 10.3 V for three uniform meanders which is having lower actuation voltage. The switching time of two uniform meander switch is 3.126 μs. The capacitance analysis of a three uniform meanders switch is having up state capacitance as 41.5 fF, down state capacitance as 0.299 pF and capacitance ratio as 7.12 in 1 μm beam thickness. Scattering parameters of the proposed switches are isolation, insertion loss and return loss. The Insertion loss obtained less than -0.514 dB, return loss as -17.34 dB over 1-40 GHz frequency and high isolation observed as -54.17 dB. Compare with other meandering techniques non-uniform meander is produce better performance and it is highly recommended to fabricate the proposed RF MEMS switch for millimetre wave satellite communications and 5G communication at 40 GHz frequency.

ACKNOWLDEGMENT

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Profitability Analysis of a Small Enterprise- A Case Study of Sri Nagavalli Solvent Oils Private Limited

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Abstract: *Owners and Managers are naturally interested in financial soundness of their Business Enterprise. Financial soundness can be measured in terms of operating efficiency. Operating efficiency of an enterprise means its ability to earn adequate returns to owners and depends ultimately on the profits earned by the enterprise. The profitability of an enterprise is measured by profitability ratios. In this paper, an attempt is made to do Profitability Analysis of Sri Nagavalli Solvent Oils Private Limited. Sri Nagavalli Solvent Oils Private Limited is a Small Enterprise located in Srikakulam district of Andhra Pradesh state in India. Sri Nagavalli Solvent Oils Private Limited is the Supplier and manufacturer of rice bran oil. Profitability analysis was done through analyzing various profit margins, Profitability ratios relating to investments and Profitability ratios relating to various expenses. Profit margins covered include Gross Profit Margin, Operating Profit Margin and Net Profit Margin. Profitability ratios relating to investments include Return on Assets (ROA), Return on Capital Employed (ROCE) and Return on Share holder's equity (ROSE). Profitability ratios relating to various expenses include Cost of Goods sold Ratio, Operating Expenses Ratio, Administrative Expenses Ratio, Selling Expenses Ratio and Financial Expenses Ratio. Chi-square test is used for testing the hypotheses formed.*

Keywords: *Financial Expenses Ratio, Net Profit Margin, Operating Profit Margin, Return on Assets (ROA), Return on Capital Employed (ROCE), Selling Expenses Ratio.*

I. INTRODUCTION

Owners and Managers are naturally interested in financial soundness of their Business Enterprise. Financial soundness can be measured in terms of operating efficiency. Operating efficiency of an enterprise means its ability to earn adequate returns to owners and depends ultimately on the profits earned by the enterprise. The profitability of an enterprise is measured by profitability ratios. There are three important profitability ratios namely profitability ratios relating to sales, profitability ratios relating to investment and profitability ratios relating to expenses. In this paper, an attempt is made to do Profitability Analysis of Sri Nagavalli Solvent Oils Private Limited. Sri Nagavalli Solvent Oils Private Limited is a Small Enterprise located in Srikakulam district of Andhra Pradesh state in India. Sri Nagavalli Solvent Oils Private Limited is the Supplier and manufacturer of rice bran oil. This is a Private Company incorporated on 17 February 1989. It is classified as Non-Government Company and is registered at Registrar of Companies, Hyderabad. Its authorized share capital is Rs. 10,000,000 and its paid up capital is Rs. 10,000,000. It has a man power of forty. This Small Enterprise has an annual turnover of Rs. 3818.1lakhs and the total current assets of the company are Rs.1742.4 lakhs as per 2015-16 Accounts.

II. REVIEW OF LITERATURE

Gangadhar (1982)[1] had conducted the profitability Analysis of large public limited cement companies in India. V. K. Purohit (1982)[2]had examined the profitability trends of manufacturing industries in Indian corporate sector during 1950-51 to 1970-71. Sindhu Rani (1998)[3] had examined the factors affecting profitability in Indian textile industry. Md. Rafiqul Islam (2000)[4] had conducted a study on the profitability of Fertilizer Industry in Bangladesh from 1985-86 to 1994-95. Manorselvi and Vijayakumar (2007)[5] had examined the trends in of profits of the selected Indian automobile companies during the period 1991-92 to 2003-04. Hyz and Gikas(2012)[6] had done profitability analysis of SME sector in Poland. Oni Timothy Olukunle (2017)[7] had done Profitability Analysis of Small scale Fishery Enterprise in Nigeria. Venkateswararao.Podile (2017)[8] had examined the recent MSME policy of Andhra Pradesh. Venkateswararao.Podile et al., (2017)[9] examined working capital management in PL Plast Pvt Ltd. Venkateswararao.Podile et al., (2017)[10] had examined various Government schemes supporting MSMEs in India. Venkateswararao.Podile et al., (2018)[11] examined working

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capital management in Sri Rama Chandra Paper Boards Ltd. Venkateswararao.Podile (2018)[12] examined working capital management in Tulasi seeds Pvt.Ltd. Venkateswararao.Podile et al., (2018)[13] studied working capital management in Sri Nagavalli solvent oils Pvt. Ltd. Venkateswararao.Podile et al., (2018)[14] analysed working capital management in Naga Hanuman Solvent Oils Private Limited. Venkateswararao.Podile (2018)[15] examined working capital management in Cuddapah Spinning Mills Ltd. Venkateswararao.Podile et al., (2018)[16] studied working capital management in Kristna Engineering Works. Venkateswararao.Podile et al., (2018)[17] examined working capital management in Radhika Vegetables Oils Pvt. Ltd. Venkateswararao.Podile et al., (2018)[18] examined working capital management in Power Plant Engineering Works in Andhra Pradesh. Venkateswararao.Podile et al., (2018)[19] examined working capital management in Nagas Elastomer Works. Venkateswararao.Podile et al., (2018)[20] had studied working capital management in M.G.Metallic Springs Pvt. Ltd. Venkateswararao.Podile et al., (2018)[21] had studied working capital management in Sri Srinivasa Spun Pipes Company. Venkateswararao.Podile et al., (2018)[22]had studied working capital management in Raghunath Dye Chem Pvt. Ltd. Venkateswararao.Podile et al., (2018)[23] had examined working capital management in Maitreya Electricals Pvt. Ltd. Venkateswararao.Podile et al., (2018)[24] had examined working capital management in Laxmi Vinay Poly Print Packs Pvt. Ltd. Venkateswararao.Podile et al., (2018)[25] had done capital structure analysis of M.G.Metallic Springs Pvt. Ltd. Venkateswararao.Podile et al., (2018)[26]had done capital structure analysis of Naga Hanuman Solvent Oils Private Limited. Venkateswararao.Podile et al., (2018)[27]had done capital structure analysis of Raghunath Dye Chem Pvt. Ltd. Venkateswararao.Podile et al., (2018)[28]had done capital structure analysis of Nagas Elastomer Works. Venkateswararao.Podile et al., (2018)[29]had done capital structure analysis of Tulasi Seeds Pvt. Ltd. Venkateswararao.Podile et al., (2018)[30]had done capital structure analysis of Maitreya Electricals Private Limited. Venkateswararao.Podile et al., (2018)[31]had done capital structure analysis of Bharat Cashew Manufacturing Company. Venkateswararao.Podile et al., (2018)[32]had done capital structure analysis of Sri Rama Chandra Paper Boards Limited. Venkateswararao.Podile et al., (2018)[33]had done capital structure analysis of Power Oxides Private Limited. Venkateswararao.Podile et al., (2018)[34]had done capital structure analysis of Laxmi Vinay Poly Print Packs Private Limited. Venkateswararao.Podile et al., (2018)[35]had studied working capital management in Power Oxides Pvt. Ltd. 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Venkateswararao.Podile (2018)[54] had done Profitability Analysis of Radhika Vegetable Oils Private Limited. Venkateswararao.Podile et al., (2018)[55] had done Profitability Analysis of Nagas Elastomer Works. It was found that most of the studies dealt with Profitability analysis of different large Enterprises and of sectors in India and abroad. Some of the studies dealt with MSME policies. Some other studies though dealt with MSMEs, they were confined to working capital management and capital structure analysis. Few studies dealt with profitability analysis. There was no study on Profitability analysis of a Small Enterprise which is the Supplier and manufacturer of rice bran oil. Hence, this study is taken up.

Objectives

The general objective of the study is to do Profitability Analysis of Sri Nagavalli Solvent Oils Private Limited. The specific objectives include the following.

1. To examine Gross profit margin, Operating profit margin and Net Profit Margin of Sri Nagavalli Solvent Oils Private Limited during the period of study.
2. To investigate into various profitability ratios relating to investment in Sri Nagavalli Solvent Oils Private Limited during the period of study.
3. To analyze various profitability ratios related to expenses in Sri Nagavalli Solvent Oils Private Limited during the period of study.

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4. To examine the overall profitability of Sri Nagavalli Solvent Oils Private Limited during the period of study.
5. To offer suggestions for improvement of profitability of the Enterprise, if required.

Hypotheses

H_{01}: Gross Profit Margin of Sri Nagavalli Solvent Oils Private Limited is uniform during the period of study.

H_{02}: Operating Profit Margin of Sri Nagavalli Solvent Oils Private Limited is uniform during the period of study.

H_{03}: Net Profit Margin of Sri Nagavalli Solvent Oils Private Limited is uniform during the period of study.

H_{04}: Return on Assets (ROA) in Sri Nagavalli Solvent Oils Private Limited is uniform during the period of study.

H_{05}: Return on Capital Employed (ROCE) in Sri Nagavalli Solvent Oils Private Limited is uniform during the period of study.

H_{06}: Return on Share holder's equity (ROSE) in Sri Nagavalli Solvent Oils Private Limited is uniform during the period of study.

H_{07}: Cost of Goods sold Ratio in Sri Nagavalli Solvent Oils Private Limited is uniform during the period of study.

H_{08}: Operating Expenses Ratio in Sri Nagavalli Solvent Oils Private Limited is uniform during the period of study.

H_{09}: Administrative Expenses Ratio in Sri Nagavalli Solvent Oils Private Limited is uniform during the period of study.

H_{10}: Selling Expenses Ratio in Sri Nagavalli Solvent Oils Private Limited is uniform during the period of study

H_{11}: Financial Expenses Ratio in Sri Nagavalli Solvent Oils Private Limited is uniform during the period of study.

III. METHODOLOGY

The present study is mainly based on secondary data. The data is taken from the financial statements including balance sheet, trading account and profit and loss account of Sri Nagavalli Solvent Oils Private Limited. The period of study is ten years covering the financial years from 2006-07 to 2015-16.The data gathered is analyzed through the ratios relating to profitability of the enterprise. Profitability analysis was done through analyzing various profit margins, Profitability ratios relating to investments and Profitability ratios relating to various expenses. Profit margins covered include Gross Profit Margin, Operating Profit Margin and Net Profit Margin. Profitability ratios relating to investments include Return on Assets (ROA), Return on Capital Employed (ROCE) and Return on Share holder's equity (ROSE). Profitability ratios relating to various expenses include Cost of Goods sold Ratio, Operating Expenses Ratio, Administrative Expenses Ratio, Selling Expenses Ratio and Financial Expenses Ratio. Chi-square test is used for testing the hypotheses formed.

Profitability Analysis with Profit Margins

Profit Margins are based on the assumption that an Enterprise should earn sufficient profit on each Rupee of sales.

Gross Profit Margin

Gross Profit Margin has varied between 5.2 and 11.2 during the period of study. Gross Profit Margin is low during the period of study. This was due to high cost of production. Management should make efforts to reduce cost of production. It is found in the significance test that Gross Profit Margin is uniform during the period of study.

Table-1: Gross Profit Margin (Figures in Lakhs)

Years	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Gross Profit	254.8	310.6	295.7	193.9	171.5	281.9	243.2	247	172.7	197.2
Sales	2437.4	2771.0	2993.4	2424.6	2956.6	4943.9	4665.2	4672.1	3128.9	3818.1
Gross Profit Margin	10.5	11.2	9.9	8.0	5.8	5.7	5.2	5.3	5.5	5.2

Source: Annual Reports of Sri Nagavalli Solvent Oils Private Limited from 2006-07 to 2015-2016.

Calculated value of Chi-Square for Gross Profit Margin = 7.4. Calculated value is less than critical Value at 5% level of Significance i.e., 7.4<16.919. Hence, H_{01} is accepted.

Operating Profit Margin

Operating Profit Margin has varied between 0.9 and 2.9 during the period of study. Operating Profit Margin is low during the period of study due to high cost of production. It is found in the significance test that Operating Profit Margin is uniform during the period of study.

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Table-2: Operating Profit Margin (Figures in Lakhs)

Years	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
EBIT	61	61.4	53.9	22.2	57.8	144.3	134.6	123.8	83	110.9
Sales	2437.4	2771.0	2993.4	2424.6	2956.6	4943.9	4665.2	4672.1	3128.9	3818.1
Operating Profit Margin	2.5	2.2	1.8	0.9	2.0	2.9	2.9	2.6	2.7	2.9

Source: Annual Reports of Sri Nagavalli Solvent Oils Private Limited from 2006-07 to 2015-2016.

Calculated value of Chi-Square for Operating Profit Margin = 1.6. Calculated value is less than critical Value at 5% level of Significance i.e., 1.6<16.919. Hence, H_{02} is accepted.

Net Profit Margin

Net Profit Margin has varied between -0.04 and 1.26 during the period of study. Net Profit Margin is low during the period of study due to high cost of production. It is found in the significance test that Net Profit Margin is uniform during the period of study.

Table-3: Net Profit Margin (Figures in Lakhs)

Years	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Net Profit	28.8	29.7	21.0	0.8	7.3	27.4	58.8	21.4	-1.1	14.2
Sales	2437.4	2771.0	2993.4	2424.6	2956.6	4943.9	4665.2	4672.1	3128.9	3818.1
Net Profit Margin	1.18	1.07	0.70	0.03	0.25	0.55	1.26	0.46	-0.04	0.37

Source: Annual Reports of Sri Nagavalli Solvent Oils Private Limited from 2006-07 to 2015-2016.

Calculated value of Chi-Square for Net Profit Margin = 3.3. Calculated value is less than critical Value at 5% level of Significance i.e., 3.3<16.919. Hence, H_{03} is accepted.

Profitability Analysis with Profitability Ratios Related to Investment

Profitability ratios relating to investment are based on the assumption that an Enterprise should earn good profit on its investment.

Return on Assets (ROA)

Return on Assets Ratio has varied between -0.1 and 8.8 during the period of study. It is found in the significance test that Return on Assets Ratio is not uniform during the period of study. Return on Assets Ratio is less than 10 during all the years of the study, which indicates that there is need for better profitability management in the enterprise.

Table-4: Return on Assets (ROA) (Figures in Lakhs)

Years	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Net Profit	28.8	29.7	21.0	0.8	7.3	27.4	58.8	21.4	-1.1	14.2
Average Total Assets	326.5	482.0	451.4	980.7	1215.9	1493.6	1677.8	1893.5	1861.3	1742.4
ROA	8.8	6.2	4.7	0.1	0.6	1.8	3.5	1.1	-0.1	0.8

Source: Annual Reports of Sri Nagavalli Solvent Oils Private Limited from 2006-07 to 2015-2016.

Calculated value of Chi-Square for ROA = 29.1. Calculated value is greater than critical Value at 5% level of Significance i.e., 29.1>16.919. Hence, H_{04} is rejected.

Return on Capital Employed (ROCE)

Return on capital employed has varied between 2.3 and 18.7 during the period of study. It is found in the significance test that Return on capital employed is not uniform during the period of study. Return on Capital Employed is less than 20 during all the years of the study, which indicates that there is need for better profitability management in the enterprise.

Table-5: Return on Capital Employed (ROCE) (Figures in Lakhs)

Years	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
EBIT	61	61.4	53.9	22.2	57.8	144.3	134.6	123.8	83	110.9
Average Total Capital	326.5	482.0	451.4	980.7	1215.9	1493.6	1677.8	1893.5	1861.3	1742.4
ROCE	18.7	12.7	11.9	2.3	4.8	9.7	8.0	6.5	4.5	6.4

Source: Annual Reports of Sri Nagavalli Solvent Oils Private Limited from 2006-07 to 2015-2016.

Calculated value of Chi-Square for ROCE = 24.7. Calculated value is greater than critical Value at 5% level of Significance i.e., 24.7>16.919. Hence, H_{05} is rejected.

Return on Share Holders' Equity (ROSE)

Return on Shareholders' Equity has varied between -0.3 and 20.6 during the period of study. Return on Shareholders' Equity is greater than 10 during 2007, 2008, 2009, 2012 and 2013 which is good for owners. It is less than 10 during other years of the study period, which is not good for owners. Positive Net Profit margin during the study period except during 2015 made owners happy with the situation. Return on Shareholders' Equity is not uniform during the period of study.

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Table-6: Return on Share Holders' Equity (ROSE) (Figures in Lakhs)

Years	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Net Profit	28.8	29.7	21.0	0.8	7.3	27.4	58.8	21.4	-1.1	14.2
Average Share Holders' Equity	155.2	177.2	190.5	191.3	199.5	226.9	285.7	327	325.9	340.1
ROSE	18.6	16.8	11.0	0.4	3.7	12.1	20.6	6.5	-0.3	4.2

Source: Annual Reports of Sri Nagavalli Solvent Oils Private Limited from 2006-07 to 2015-2016.

Calculated value of Chi-Square for ROSE = 55.3. Calculated value is greater than critical Value at 5% level of Significance i.e., 55.3>16.919. Hence, H_{06} is rejected.

Profitability Analysis with Profitability Ratios Related to Expenses

These ratios are based on the assumption that Enterprise should reduce its expenses in relation to sales.

Cost of Goods Sold Ratio

Cost of Goods Sold Ratio has varied between 88.8 and 94.8 during the period of study. Cost of Goods Sold Ratio is high during the period of study. Management should make efforts to reduce cost of production. It is found in the significance test that Cost of Goods Sold Ratio is uniform during the period of study.

Table-7: Cost of Goods Sold Ratio (Figures in Lakhs)

Years	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Cost of Goods sold	2182.6	2460.4	2697.7	2230.7	2785.1	4662.0	4422.0	4425.1	2956.2	3620.9
Sales	2437.4	2771.0	2993.4	2424.6	2956.6	4943.9	4665.2	4672.1	3128.9	3818.1
Ratio	89.5	88.8	90.1	92.0	94.2	94.3	94.8	94.7	94.5	94.8

Source: Annual Reports of Sri Nagavalli Solvent Oils Private Limited from 2006-07 to 2015-2016.

Calculated value of Chi-Square for Cost of Goods sold Ratio = 0.6. Calculated value is less than critical Value at 5% level of Significance i.e., 0.6<16.919. Hence, H_{07} is accepted.

Operating Expenses Ratio

Operating Expenses Ratio has varied between 0.6 and 4.0 during the period of study. Operating Expenses Ratio is low in the enterprise during the period of study. Management is making good efforts to reduce operating expenses. It is found in the significance test that Operating Expenses Ratio is uniform during the period of study.

Table-8: Operating Expenses Ratio (Figures in Lakhs)

Years	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Operating Expenses	98.2	95.3	114.8	60.3	39.5	45.6	26.9	43.7	33.9	42
Sales	2437.4	2771.0	2993.4	2424.6	2956.6	4943.9	4665.2	4672.1	3128.9	3818.1
Ratio	4.0	3.4	3.8	2.5	1.3	0.9	0.6	0.9	1.1	1.1

Source: Annual Reports of Sri Nagavalli Solvent Oils Private Limited from 2006-07 to 2015-2016.

Calculated value of Chi-Square for Operating Expenses Ratio = 8.1. Calculated value is less than critical Value at 5% level of Significance i.e., 8.1<16.919. Hence, H_{08} is accepted.

Administrative Expenses Ratio

Administrative Expenses Ratio has varied between 0.1 and 0.4 during the period of study. Administrative Expenses Ratio is low in the company during the period of study. Management is making good efforts to reduce Administrative expenses. It is found in the significance test that Administrative Expenses Ratio is uniform during the period of study.

Table-9: Administrative Expenses Ratio (Figures in Lakhs)

Years	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Administrative Expenses	8.7	7.9	13.2	8.8	9.7	7.1	7.0	9.9	7.0	7.2
Sales	2437.4	2771.0	2993.4	2424.6	2956.6	4943.9	4665.2	4672.1	3128.9	3818.1
Ratio	0.4	0.3	0.4	0.4	0.3	0.1	0.2	0.2	0.2	0.2

Source: Annual Reports of Sri Nagavalli Solvent Oils Private Limited from 2006-07 to 2015-2016.

Calculated value of Chi-Square for Administrative Expensive Ratio = 0.4. Calculated value is less than critical Value at 5% level of Significance i.e., 0.4<16.919. Hence, H_{09} is accepted.

Selling Expenses Ratio

Selling Expenses Ratio has varied between 0.4 and 3.7 during the period of study. A low Selling Expenses Ratio is indicating that management is making good efforts in reducing Selling expenses. It is found in the significance test that Selling Expenses Ratio is uniform during the period of study.

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Table-10: Selling Expenses Ratio (Figures in Lakhs)

Years	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Selling Expenses	89.5	87.4	101.6	51.5	29.8	38.5	19.9	33.8	26.9	34.8
Sales	2437.4	2771.0	2993.4	2424.6	2956.6	4943.9	4665.2	4672.1	3128.9	3818.1
Ratio	3.7	3.2	3.4	2.1	1.0	0.8	0.4	0.7	0.9	0.9

Source: Annual Reports of Sri Nagavalli Solvent Oils Private Limited from 2006-07 to 2015-2016.

Calculated value of Chi-Square for Selling Expenses Ratio = 8.5. Calculated value is less than critical Value at 5% level of Significance i.e., 8.5<16.919. Hence, H_{10} is accepted.

Financial Expenses Ratio

Financial Expenses Ratio has varied between 0.5 and 2.5 during the period of study. Financial Expenses Ratio is low during the period of study. Management is making good efforts for reducing financial expenses. It is found in the significance test that Financial Expenses Ratio is uniform during the period of study.

Table-11: Financial Expenses Ratio (Figures in Lakhs)

Years	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Financial Expenses	13.3	20.8	22.1	20.7	47.6	83.5	73.3	85.2	79.3	87
Sales	2437.4	2771.0	2993.4	2424.6	2956.6	4943.9	4665.2	4672.1	3128.9	3818.1
Ratio	0.5	0.8	0.7	0.9	1.6	1.7	1.6	1.8	2.5	2.3

Source: Annual Reports of Sri Nagavalli Solvent Oils Private Limited from 2006-07 to 2015-2016.

Calculated value of Chi-Square for Financial Expenses Ratio = 2.9. Calculated value is less than critical Value at 5% level of Significance i.e., 2.9<16.919. Hence, H_{11} is accepted.

IV. CONCLUSION

Gross Profit Margin, Operating Profit Margin, Net Profit Margin, Cost of Goods sold Ratio, Operating Expenses Ratio, Administrative Expenses Ratio, Selling Expenses Ratio and Financial Expenses Ratio are uniform during the period of study. Return on Assets Ratio, Return on Capital Employed Ratio and Return on Share holder's Equity Ratio are not uniform during the period of study. Gross Profit Margin, Operating Profit Margin and Net Profit Margin are low during the study period. This was due to high cost of production. Management should make efforts to reduce cost of production. Return on Assets Ratio is less than 10 during all the years of the study and Return on Capital Employed is less than 20 during all the years of the study, which indicate that there is need for better profitability management in the company. Return on Shareholders' Equity is greater than 10 during 2007, 2008, 2009, 2012 and 2013, which is good for owners. Positive Net Profit margin during the study period except during 2015 made owners happy with the situation. Management is making good efforts in reducing Administrative expenses, selling expenses and financial expenses.

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PROFITABILITY ANALYSIS OF A SMALL ENTERPRISE – A CASE STUDY OF RADHIKA EGETABLE OILS PRIVATE LIMITED

Dr.Venkateswararao.Podile *

Abstract

Owners and Managers are naturally interested in financial soundness of their Business Enterprise. Financial soundness can be measured in terms of operating efficiency. Operating efficiency of an enterprise means its ability to earn adequate returns to owners and depends ultimately on the profits earned by the enterprise. The profitability of an enterprise is measured by profitability ratios. In this paper, an attempt is made to do Profitability Analysis of Radhika Vegetable Oils Private Limited is an Indian unlisted private company in Andhra Pradesh. It was located at Garividi of Vizianagaram District. It is engaged in production, extraction and delivery of palm oil to major Vanaspati makers in India. Profitability analysis was done through analyzing various profit margins, Profitability ratios relating to investments and Profitability ratios relating to various expenses. Profit margins covered include Gross Profit Margin, Operating Profit Margin and Net Profit Margin. Profitability

Keywords:
Cost of Goods sold Ratio;
Financial Expenses Ratio;
Gross Profit Margin;
Operating Profit Margin;
Return on Assets (ROA);
Return on Capital Employed:

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ratios relating to investments include Return on Assets (ROA), Return on Capital Employed (ROCE) and Return on Share holder's equity (ROSE). Profitability ratios relating to various expenses include Cost of Goods sold Ratio, Operating Expenses Ratio, Administrative Expenses Ratio, Selling Expenses Ratio and Financial Expenses Ratio. Chi-square test is used for testing the hypotheses formed.

1. Introduction

Owners and Managers are naturally interested in financial soundness of their Business Enterprise. Financial soundness can be measured in terms of operating efficiency. Operating efficiency of an enterprise means its ability to earn adequate returns to owners and depends ultimately on the profits earned by the enterprise. The profitability of an enterprise is measured by profitability ratios. There are three important profitability ratios namely profitability ratios relating to sales, profitability ratios relating to investment and profitability ratios relating to expenses. In this paper, an attempt is made to do Profitability Analysis of Radhika Vegetable Oils Private Limited is an Indian unlisted private company in the state of Andhra Pradesh. It was located at Garividi of Vizianagaram District. It was started in 1984. It is engaged in production, extraction and delivery of palm oil to major Vanaspati makers in India. It was the first company in India to import Oil Palm sprouts and to start a 5MT per hour extraction unit. Radhika Vegetable Oils Private Limited today sources palm fruit from over Fifteen thousand acres of assisted plantations in over ten mandals within Andhra Pradesh. This Small Enterprise has an annual turnover of Rs.2723.2 lakhs as per 2015-16 accounts. The total Assets of the company are Rs.993.4 lakhs. The Enterprise had provided employment to fifty people.

2. Review of Literature

Gangadhar (1982)[1] had conducted the profitability Analysis of large public limited cement companies in India. V. K. Purohit (1982)[2]had examined the profitability trends of manufacturing

industries in Indian corporate sector during 1950-51 to 1970-71. Sindhu Rani (1998)[3] had examined the factors affecting profitability in Indian textile industry. Md. Rafiqul Islam (2000)[4] had conducted a study on the profitability of Fertilizer Industry in Bangladesh from 1985-86 to 1994-95. Manorselvi and Vijayakumar (2007)[5] had examined the trends in of profits of the selected Indian automobile companies during the period 1991-92 to 2003-04. Hyz and Gikas(2012)[6] had done profitability analysis of SME sector in Poland. Oni Timothy Olukunle (2017)[7] had done Profitability Analysis of Small scale Fishery Enterprise in Nigeria. Venkateswararao.Podile (2017)[8] had examined the recent MSME policy of Andhra Pradesh. Venkateswararao.Podile et al., (2017)[9] examined working capital management in PL Plast Pvt Ltd. Venkateswararao.Podile et al., (2017)[10] had examined various Government schemes supporting MSMEs in India. Venkateswararao.Podile et al., (2018)[11] examined working capital management in Sri Rama Chandra Paper Boards Ltd. Venkateswararao.Podile (2018)[12] examined working capital management in Tulasi seeds Pvt.Ltd. Venkateswararao.Podile et al., (2018)[13] studied working capital management in Sri Nagavalli solvent oils Pvt. Ltd. Venkateswararao.Podile et al., (2018)[14] analysed working capital management in Naga Hanuman Solvent Oils Private Limited. Venkateswararao.Podile (2018)[15] examined working capital management in Cuddapah Spinning Mills Ltd. Venkateswararao.Podile et al., (2018)[16] studied working capital management in Kristna Engineering Works. Venkateswararao.Podile et al., (2018)[17] examined working capital management in Radhika Vegetables Oils Pvt. Ltd. Venkateswararao.Podile et al., (2018)[18] examined working capital management in Power Plant Engineering Works in Andhra Pradesh. Venkateswararao.Podile et al., (2018)[19] examined working capital management in Nagas Elastomer Works. Venkateswararao.Podile et al., (2018)[20] had studied working capital management in M.G.Metallic Springs Pvt. Ltd. Venkateswararao.Podile et al., (2018)[21] had studied working capital management in Sri Srinivasa Spun Pipes Company. Venkateswararao.Podile et al., (2018)[22]had studied working capital management in Raghunath Dye Chem Pvt. Ltd. Venkateswararao.Podile et al., (2018)[23] had examined working capital management in Maitreya Electricals Pvt. Ltd. Venkateswararao.Podile et al., (2018)[24] had examined working capital management in Laxmi Vinay Poly Print Packs Pvt. Ltd. Venkateswararao.Podile et al., (2018)[25] had done capital structure analysis of M.G.Metallic Springs Pvt. Ltd. Venkateswararao.Podile et al., (2018)[26]had done capital structure analysis of Naga Hanuman Solvent Oils Private Limited. Venkateswararao.Podile et al., (2018)[27]had done

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3. Objectives

The general objective of the study is to do Profitability Analysis of Radhika Vegetable Oils Private Limited. The specific objectives include the following.

1. To examine Gross profit margin, Operating profit margin and Net Profit Margin of Radhika Vegetable Oils Private Limited during the period of study.
2. To investigate into various profitability ratios relating to investment in Radhika Vegetable Oils Private Limited during the period of study.
3. To analyze various profitability ratios related to expenses in Radhika Vegetable Oils Private Limited during the period of study.

4. To examine the overall profitability of Radhika Vegetable Oils Private Limited during the period of study.

5. To offer suggestions for improvement of profitability of the Enterprise, if required.

4. Hypotheses

H_{01}: Gross Profit Margin of Radhika Vegetable Oils Private Limited is uniform during the period of study.

H_{02}: Operating Profit Margin of Radhika Vegetable Oils Private Limited is uniform during the period of study.

H_{03}: Net Profit Margin of Radhika Vegetable Oils Private Limited is uniform during the period of study.

H_{04}: Return on Assets (ROA) in Radhika Vegetable Oils Private Limited is uniform during the period of study.

H_{05}: Return on Capital Employed (ROCE) in Radhika Vegetable Oils Private Limited is uniform during the period of study.

H_{06}: Return on Share holder's equity (ROSE) in Radhika Vegetable Oils Private Limited is uniform during the period of study.

H_{07}: Cost of Goods sold Ratio in Radhika Vegetable Oils Private Limited is uniform during the period of study.

H_{08}: Operating Expenses Ratio in Radhika Vegetable Oils Private Limited is uniform during the period of study.

H_{09}: Administrative Expenses Ratio in Radhika Vegetable Oils Private Limited is uniform during the period of study.

H_{10}: Selling Expenses Ratio in Radhika Vegetable Oils Private Limited is uniform during the period of study

H_{11}: Financial Expenses Ratio in Radhika Vegetable Oils Private Limited is uniform during the period of study.

5. Methodology

The present study is mainly based on secondary data. The data is taken from the financial statements including balance sheet, trading account and profit and loss account of Radhika Vegetable Oils Private Limited. The period of study is ten years covering the financial years

from 2006-07 to 2015-16.The data gathered is analyzed through the ratios relating to profitability of the enterprise. Profitability analysis was done through analyzing various profit margins, Profitability ratios relating to investments and Profitability ratios relating to various expenses. Profit margins covered include Gross Profit Margin, Operating Profit Margin and Net Profit Margin. Profitability ratios relating to investments include Return on Assets (ROA), Return on Capital Employed (ROCE) and Return on Share holder's equity (ROSE). Profitability ratios relating to various expenses include Cost of Goods sold Ratio, Operating Expenses Ratio, Administrative Expenses Ratio, Selling Expenses Ratio and Financial Expenses Ratio. Chi-square test is used for testing the hypotheses formed.

6. Profitability Analysis with Profit Margins

Profit Margins are based on the assumption that an Enterprise should earn sufficient profit on each Rupee of sales.

Gross Profit Margin

Gross Profit Margin has varied between -3.7 and 20.9 during the period of study. Gross Profit Margin is low during the period of study and even negative during 2013, 2015 and 2016. Management needs to put efforts in reducing cost of production. It is found in the significance test that Gross Profit Margin is not uniform during the period of study.

Table-1: Gross Profit Margin

(Figures in Lakhs)

Years	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Gross Profit	131.2	189.2	131.2	103.9	140.1	275.6	-24.9	101.3	-105.9	52.7
Sales	783.3	906.8	1223.5	838.8	1241.6	2136.6	2108.4	2746.1	2843.7	2723.2
Gross Profit Margin	16.7	20.9	10.7	12.4	11.3	12.9	-1.2	3.7	-3.7	1.9

Source: Annual Reports of Radhika Vegetable Oils Private Limited from 2006-07 to 2015-2016.

Calculated value of Chi-Square for Gross Profit Margin = 67.5. Calculated value is greater than critical Value at 5% level of Significance i.e., 67.5>16.919, Hence, H_{01} is Rejected.

Operating Profit Margin

Operating Profit Margin has varied between -6.9 and 12.8 during the period of study. Operating Profit Margin is relatively low during the period of study and even negative during 2013, 2015 and 2016. It is not due to increase in operating expenses but due to increase in cost of goods sold. Management needs to put efforts in reducing cost of production. It is found in the significance test that Operating Profit Margin is not uniform during the period of study.

Table-2: Operating Profit Margin

(Figures in Lakhs)

Years	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
EBIT	49.9	116.2	40.4	41.5	62.5	165.6	-101.9	17	-197	-65.1
Sales	783.3	906.8	1223.5	838.8	1241.6	2136.6	2108.4	2746.1	2843.7	2723.2
Operating Profit Margin	6.4	12.8	3.3	4.9	5.0	7.8	-4.8	0.6	-6.9	-2.4

Source: Annual Reports of Radhika Vegetable Oils Private Limited from 2006-07 to 2015-2016.

Calculated value of Chi-Square for Operating Profit Margin = 124.0. Calculated value is greater than critical Value at 5% level of Significance i.e., 124.0>16.919, Hence, H_{02} is Rejected.

Net Profit Margin

Net Profit Margin has varied between -6.9 and 9.4 during the period of study. Net Profit Margin is low during the period of study and even negative during 2013, 2015 and 2016. Management needs to put efforts in reducing cost of production. It is found in the significance test that Net Profit Margin is not uniform during the period of study.

Table-3: Net Profit Margin

(Figures in Lakhs)

Years	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Net Profit	41.4	84.8	40.4	31.4	44.4	110.8	-94.4	16.2	-197.4	-67.4

Sales	783.3	906.8	1223.5	838.8	1241.6	2136.6	2108.4	2746.1	2843.7	2723.2
Net Profit Margin	5.3	9.4	3.3	3.7	3.6	5.2	-4.5	0.6	-6.9	-2.5

Source: Annual Reports of Radhika Vegetable Oils Private Limited from 2006-07 to 2015-2016.

Calculated value of Chi-Square for Net Profit Margin = 131.0. Calculated value is greater than critical Value at 5% level of Significance i.e., 131.0>16.919, Hence, H_{03} is Rejected.

7. Profitability Analysis with Profitability Ratios Related to Investment

Profitability ratios relating to investment are based on the assumption that an Enterprise should earn good profit on its investment.

Return on Assets (ROA)

Return on Assets Ratio has varied between -24.0 and 25.9 during the period of study. It is found in the significance test that Return on Assets Ratio is not uniform during the period of study. Return on Assets Ratio is less than 10 during 2010, 2013, 2014, 2015 and 2016 which indicates that there is a need for better profitability management during these years.

Table-4: Return on Assets (ROA)

(Figures in Lakhs)

Years	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Net Profit	41.4	84.8	40.4	31.4	44.4	110.8	-94.4	16.2	-197.4	-67.4
Average Total Assets	213.9	327.3	381.1	375.2	418.7	775.1	786.9	863.2	822.1	993.4
ROA	19.4	25.9	10.6	8.4	10.6	14.3	-12.0	1.9	-24.0	-6.8

Source: Annual Reports of Radhika Vegetable Oils Private Limited from 2006-07 to 2015-2016.

Calculated value of Chi-Square for ROA = 431.4. Calculated value is greater than critical Value at 5% level of Significance i.e., 431.4>16.919, Hence, H_{04} is Rejected.

Return on Capital Employed (ROCE)

Return on capital employed has varied between -24.0 and 35.5 during the period of study. It is found in the significance test that Return on capital employed is not uniform during the period of study. Return on Capital Employed is less than 20 during the period of the study except during 2007, 2008 and 2012 which indicates that management needs to do better profitability management.

Table-5: Return on Capital Employed (ROCE)

(Figures in Lakhs)

Years	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
EBIT	49.9	116.2	40.4	41.5	62.5	165.6	-101.9	17	-197	-65.1
Average Total Capital	213.9	327.3	381.1	375.2	418.7	775.1	786.9	863.2	822.1	993.4
ROCE	23.3	35.5	10.6	11.1	14.9	21.4	-12.9	2.0	-24.0	-6.6

Source: Annual Reports of Radhika Vegetable Oils Private Limited from 2006-07 to 2015-2016.

Calculated value of Chi-Square for ROCE = 390.7. Calculated value is greater than critical Value at 5% level of Significance i.e., 390.7>16.919, Hence, H_{05} is Rejected.

Return on Share Holders' Equity (ROSE)

Return on Shareholders' Equity has varied between -80.2 and 28.8 during the period of study. Return on Shareholders' Equity is less than 10 during five years of the study which is not good for owners. Return on Shareholders' Equity is not uniform during the period of study.

Table-6: Return on Share Holders' Equity (ROSE)

(Figures in Lakhs)

Years	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Net Profit	41.4	84.8	40.4	31.4	44.4	110.8	-94.4	16.2	-197.4	-67.4
Average Share Holders' Equity	210	294.7	335.1	366.5	410.9	521.7	427.3	443.5	246.1	178.6
ROSE	19.7	28.8	12.1	8.6	10.8	21.2	-22.1	3.7	-80.2	-37.7

Source: Annual Reports of Radhika Vegetable Oils Private Limited from 2006-07 to 2015-2016.

Calculated value of Chi-Square for ROSE = 2916.3. Calculated value is greater than critical Value at 5% level of Significance i.e., 2916.3>16.919, Hence, H_{06} is Rejected.

8. Profitability Analysis with Profitability Ratios Related to Expenses

These ratios are based on the assumption that Enterprise should reduce its expenses in relation to sales.

Cost of Goods Sold Ratio

Cost of Goods Sold Ratio has varied between 79.1 and 103.7 during the period of study. Cost of Goods Sold Ratio is very high during the period of study and even greater than 100 during 2013 and 2015. Management needs to put efforts in reducing cost of production. It is found in the significance test that Cost of Goods Sold Ratio is uniform during the period of study.

Table-7: Cost of Goods Sold Ratio

(Figures in Lakhs)

Years	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Cost of Goods sold	652.1	717.6	1092.3	734.9	1101.5	1861.0	2133.3	2644.8	2949.6	2670.5
Sales	783.3	906.8	1223.5	838.8	1241.6	2136.6	2108.4	2746.1	2843.7	2723.2
Ratio	83.3	79.1	89.3	87.6	88.7	87.1	101.2	96.3	103.7	98.1

Source: Annual Reports of Radhika Vegetable Oils Private Limited from 2006-07 to 2015-2016.

Calculated value of Chi-Square for Cost of Goods sold Ratio = 6.3. Calculated value is less than critical Value at 5% level of Significance i.e., 6.3<16.919, Hence, H_{07} is Accepted.

Operating Expenses Ratio

Operating Expenses Ratio has varied between 1.5 and 6.3 during the period of study. A low Operating Expenses Ratio is indicating that management is making good efforts in reducing Operating expenses. It is found in the significance test that Operating Expenses Ratio is uniform during the period of study.

Table-8: Operating Expenses Ratio

(Figures in Lakhs)

Years	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Operating Expenses	49.6	40.9	33.1	26.8	41.6	42.1	39.6	46.6	41.8	60.5
Sales	783.3	906.8	1223.5	838.8	1241.6	2136.6	2108.4	2746.1	2843.7	2723.2
Ratio	6.3	4.5	2.7	3.2	3.4	2.0	1.9	1.7	1.5	2.2

Source: Annual Reports of Radhika Vegetable Oils Private Limited from 2006-07 to 2015-2016.

Calculated value of Chi-Square for Operating Expenses Ratio = 6.9. Calculated value is less than critical Value at 5% level of Significance i.e., 6.9<16.919, Hence, H_{08} is Accepted.

Administrative Expenses Ratio

Administrative Expenses Ratio has varied between 1.0 and 4.0 during the period of study. A low Administrative Expenses Ratio is indicating that management is making good efforts in reducing Administrative expenses. It is found in the significance test that Administrative Expenses Ratio is uniform during the period of study.

Table-9: Administrative Expenses Ratio

(Figures in Lakhs)

Years	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Administrative Expenses	17.2	36.6	26.1	23.0	36.0	32.6	27.5	32.5	27.2	42.5
Sales	783.3	906.8	1223.5	838.8	1241.6	2136.6	2108.4	2746.1	2843.7	2723.2
Ratio	2.2	4.0	2.1	2.7	2.9	1.5	1.3	1.2	1.0	1.6

Source: Annual Reports of Radhika Vegetable Oils Private Limited from 2006-07 to 2015-2016.

Calculated value of Chi-Square for Administrative Expensive Ratio = 3.8. Calculated value is less than critical Value at 5% level of Significance i.e., 3.8<16.919, Hence, H_{09} is Accepted.

Selling Expenses Ratio

Selling Expenses Ratio has varied between 0.4 and 4.1 during the period of study. A low Selling Expenses Ratio is indicating that management is making good efforts in reducing selling

expenses. It is found in the significance test that Selling Expenses Ratio is uniform during the period of study.

Table-10: Selling Expenses Ratio

(Figures in Lakhs)

Years	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Selling Expenses	32.4	4.3	7.0	3.8	5.6	9.5	12.1	14.1	14.6	18.0
Sales	783.3	906.8	1223.5	838.8	1241.6	2136.6	2108.4	2746.1	2843.7	2723.2
Ratio	4.1	0.5	0.6	0.5	0.5	0.4	0.6	0.5	0.5	0.7

Source: Annual Reports of Radhika Vegetable Oils Private Limited from 2006-07 to 2015-2016.

Calculated value of Chi-Square for Selling Expenses Ratio = 12.9. Calculated value is less than critical Value at 5% level of Significance i.e., 12.9<16.919, Hence, H_{10} is Accepted.

Financial Expenses Ratio

Financial Expenses Ratio has varied between 0.01 and 0.35 during the period of study. A low Financial Expenses Ratio is indicating that management is making good efforts in reducing financial expenses. It is found in the significance test that Financial Expenses Ratio is uniform during the period of study.

Table-11: Financial Expenses Ratio

(Figures in Lakhs)

Years	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Financial Expenses	0.1	3.2	2.7	1.7	0.6	0.4	0.9	0.8	0.4	2.2
Sales	783.3	906.8	1223.5	838.8	1241.6	2136.6	2108.4	2746.1	2843.7	2723.2
Ratio	0.01	0.35	0.22	0.20	0.05	0.02	0.04	0.03	0.01	0.08

Source: Annual Reports of Radhika Vegetable Oils Private Limited from 2006-07 to 2015-2016.

Calculated value of Chi-Square for Financial Expenses Ratio = 1.2. Calculated value is less than critical Value at 5% level of Significance i.e., 1.2<16.919, Hence, H_{11} is Accepted.

9. Conclusion

Gross Profit Margin, Operating Profit Margin, Net Profit Margin, Return on Assets Ratio, Return on Capital Employed Ratio and Return on Share holder's Equity Ratio are not uniform during the period of study. Cost of Goods sold Ratio, Operating Expenses Ratio, Administrative Expenses Ratio, Selling Expenses Ratio and Financial Expenses Ratio are uniform during the period of study. Gross Profit Margin, Operating Profit Margin and Net Profit Margin are low during the period of study and are even negative during 2013, 2015 and 2016. This is due to increase in cost of goods sold. Management needs to put efforts in reducing cost of production. Return on Assets Ratio is less than 10 during 2010, 2013, 2014, 2015 and 2016 which indicates that there is a need for better profitability management during these years. Return on Capital Employed is less than 20 during the period of the study except during 2007, 2008 and 2012 which indicates that management needs to do better profitability management. Return on Shareholders' Equity is less than 10 during five years of the study which is not good for owners. Low Operating expenses Ratio, low Administrative Expenses Ratio, low Selling Expenses Ratio and low Financial Expenses Ratio are indicating that management is making good efforts in reducing these expenses.

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PROFITABILITY ANALYSIS OF A SMALL ENTERPRISE – A CASE STUDY OF RADHIKA EGETABLE OILS PRIVATE LIMITED

Dr.Venkateswararao.Podile *

Abstract

Owners and Managers are naturally interested in financial soundness of their Business Enterprise. Financial soundness can be measured in terms of operating efficiency. Operating efficiency of an enterprise means its ability to earn adequate returns to owners and depends ultimately on the profits earned by the enterprise. The profitability of an enterprise is measured by profitability ratios. In this paper, an attempt is made to do Profitability Analysis of Radhika Vegetable Oils Private Limited is an Indian unlisted private company in Andhra Pradesh. It was located at Garividi of Vizianagaram District. It is engaged in production, extraction and delivery of palm oil to major Vanaspati makers in India. Profitability analysis was done through analyzing various profit margins, Profitability ratios relating to investments and Profitability ratios relating to various expenses. Profit margins covered include Gross Profit Margin, Operating Profit Margin and Net Profit Margin. Profitability

Keywords:
Cost of Goods sold Ratio;
Financial Expenses Ratio;
Gross Profit Margin;
Operating Profit Margin;
Return on Assets (ROA);
Return on Capital Employed:

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ratios relating to investments include Return on Assets (ROA), Return on Capital Employed (ROCE) and Return on Share holder's equity (ROSE). Profitability ratios relating to various expenses include Cost of Goods sold Ratio, Operating Expenses Ratio, Administrative Expenses Ratio, Selling Expenses Ratio and Financial Expenses Ratio. Chi-square test is used for testing the hypotheses formed.

1. Introduction

Owners and Managers are naturally interested in financial soundness of their Business Enterprise. Financial soundness can be measured in terms of operating efficiency. Operating efficiency of an enterprise means its ability to earn adequate returns to owners and depends ultimately on the profits earned by the enterprise. The profitability of an enterprise is measured by profitability ratios. There are three important profitability ratios namely profitability ratios relating to sales, profitability ratios relating to investment and profitability ratios relating to expenses. In this paper, an attempt is made to do Profitability Analysis of Radhika Vegetable Oils Private Limited is an Indian unlisted private company in the state of Andhra Pradesh. It was located at Garividi of Vizianagaram District. It was started in 1984. It is engaged in production, extraction and delivery of palm oil to major Vanaspati makers in India. It was the first company in India to import Oil Palm sprouts and to start a 5MT per hour extraction unit. Radhika Vegetable Oils Private Limited today sources palm fruit from over Fifteen thousand acres of assisted plantations in over ten mandals within Andhra Pradesh. This Small Enterprise has an annual turnover of Rs.2723.2 lakhs as per 2015-16 accounts. The total Assets of the company are Rs.993.4 lakhs. The Enterprise had provided employment to fifty people.

2. Review of Literature

Gangadhar (1982)[1] had conducted the profitability Analysis of large public limited cement companies in India. V. K. Purohit (1982)[2]had examined the profitability trends of manufacturing

industries in Indian corporate sector during 1950-51 to 1970-71. Sindhu Rani (1998)[3] had examined the factors affecting profitability in Indian textile industry. Md. Rafiqul Islam (2000)[4] had conducted a study on the profitability of Fertilizer Industry in Bangladesh from 1985-86 to 1994-95. Manorselvi and Vijayakumar (2007)[5] had examined the trends in of profits of the selected Indian automobile companies during the period 1991-92 to 2003-04. Hyz and Gikas(2012)[6] had done profitability analysis of SME sector in Poland. Oni Timothy Olukunle (2017)[7] had done Profitability Analysis of Small scale Fishery Enterprise in Nigeria. Venkateswararao.Podile (2017)[8] had examined the recent MSME policy of Andhra Pradesh. Venkateswararao.Podile et al., (2017)[9] examined working capital management in PL Plast Pvt Ltd. Venkateswararao.Podile et al., (2017)[10] had examined various Government schemes supporting MSMEs in India. Venkateswararao.Podile et al., (2018)[11] examined working capital management in Sri Rama Chandra Paper Boards Ltd. Venkateswararao.Podile (2018)[12] examined working capital management in Tulasi seeds Pvt.Ltd. Venkateswararao.Podile et al., (2018)[13] studied working capital management in Sri Nagavalli solvent oils Pvt. Ltd. Venkateswararao.Podile et al., (2018)[14] analysed working capital management in Naga Hanuman Solvent Oils Private Limited. Venkateswararao.Podile (2018)[15] examined working capital management in Cuddapah Spinning Mills Ltd. Venkateswararao.Podile et al., (2018)[16] studied working capital management in Kristna Engineering Works. Venkateswararao.Podile et al., (2018)[17] examined working capital management in Radhika Vegetables Oils Pvt. Ltd. Venkateswararao.Podile et al., (2018)[18] examined working capital management in Power Plant Engineering Works in Andhra Pradesh. Venkateswararao.Podile et al., (2018)[19] examined working capital management in Nagas Elastomer Works. Venkateswararao.Podile et al., (2018)[20] had studied working capital management in M.G.Metallic Springs Pvt. Ltd. Venkateswararao.Podile et al., (2018)[21] had studied working capital management in Sri Srinivasa Spun Pipes Company. Venkateswararao.Podile et al., (2018)[22]had studied working capital management in Raghunath Dye Chem Pvt. Ltd. Venkateswararao.Podile et al., (2018)[23] had examined working capital management in Maitreya Electricals Pvt. Ltd. Venkateswararao.Podile et al., (2018)[24] had examined working capital management in Laxmi Vinay Poly Print Packs Pvt. Ltd. Venkateswararao.Podile et al., (2018)[25] had done capital structure analysis of M.G.Metallic Springs Pvt. Ltd. Venkateswararao.Podile et al., (2018)[26]had done capital structure analysis of Naga Hanuman Solvent Oils Private Limited. Venkateswararao.Podile et al., (2018)[27]had done

capital structure analysis of Raghunath Dye Chem Pvt. Ltd. Venkateswararao.Podile et al., (2018)[28]had done capital structure analysis of Nagas Elastomer Works. Venkateswararao.Podile et al., (2018)[29]had done capital structure analysis of Tulasi Seeds Pvt. Ltd. Venkateswararao.Podile et al., (2018)[30]had done capital structure analysis of Maitreya Electricals Private Limited. Venkateswararao.Podile et al., (2018)[31]had done capital structure analysis of Bharat Cashew Manufacturing Company. Venkateswararao.Podile et al., (2018)[32]had done capital structure analysis of Sri Rama Chandra Paper Boards Limited. Venkateswararao.Podile et al., (2018)[33]had done capital structure analysis of Power Oxides Private Limited. Venkateswararao.Podile et al., (2018)[34]had done capital structure analysis of Laxmi Vinay Poly Print Packs Private Limited. Venkateswararao.Podile et al., (2018)[35]had studied working capital management in Power Oxides Pvt. Ltd. Venkateswararao.Podile et al., (2018)[36]had done capital structure analysis of Radhika Vegetable Oils Private Limited. Venkateswararao.Podile et al., (2018)[37]had done capital structure analysis of Sri Nagavalli Solvent Oils Private Limited. Venkateswararao.Podile et al., (2018)[38]had done capital structure analysis of P.L.Plast Private Limited. Venkateswararao.Podile (2018)[39] had done capital structure analysis of Power Plant Engineering Works. It was found that most of the studies dealt with Profitability analysis of different large Enterprises and of sectors in India and abroad. Some of the studies dealt with MSME policies. Some other studies though dealt with MSMEs, they were confined to working capital management and capital structure analysis. There was no study on Profitability analysis of a small enterprise which is engaged in production, extraction and delivery of palm oil to major Vanaspati makers in India. Hence, this study is taken up.

3. Objectives

The general objective of the study is to do Profitability Analysis of Radhika Vegetable Oils Private Limited. The specific objectives include the following.

1. To examine Gross profit margin, Operating profit margin and Net Profit Margin of Radhika Vegetable Oils Private Limited during the period of study.
2. To investigate into various profitability ratios relating to investment in Radhika Vegetable Oils Private Limited during the period of study.
3. To analyze various profitability ratios related to expenses in Radhika Vegetable Oils Private Limited during the period of study.

4. To examine the overall profitability of Radhika Vegetable Oils Private Limited during the period of study.

5. To offer suggestions for improvement of profitability of the Enterprise, if required.

4. Hypotheses

H_{01}: Gross Profit Margin of Radhika Vegetable Oils Private Limited is uniform during the period of study.

H_{02}: Operating Profit Margin of Radhika Vegetable Oils Private Limited is uniform during the period of study.

H_{03}: Net Profit Margin of Radhika Vegetable Oils Private Limited is uniform during the period of study.

H_{04}: Return on Assets (ROA) in Radhika Vegetable Oils Private Limited is uniform during the period of study.

H_{05}: Return on Capital Employed (ROCE) in Radhika Vegetable Oils Private Limited is uniform during the period of study.

H_{06}: Return on Share holder's equity (ROSE) in Radhika Vegetable Oils Private Limited is uniform during the period of study.

H_{07}: Cost of Goods sold Ratio in Radhika Vegetable Oils Private Limited is uniform during the period of study.

H_{08}: Operating Expenses Ratio in Radhika Vegetable Oils Private Limited is uniform during the period of study.

H_{09}: Administrative Expenses Ratio in Radhika Vegetable Oils Private Limited is uniform during the period of study.

H_{10}: Selling Expenses Ratio in Radhika Vegetable Oils Private Limited is uniform during the period of study

H_{11}: Financial Expenses Ratio in Radhika Vegetable Oils Private Limited is uniform during the period of study.

5. Methodology

The present study is mainly based on secondary data. The data is taken from the financial statements including balance sheet, trading account and profit and loss account of Radhika Vegetable Oils Private Limited. The period of study is ten years covering the financial years

from 2006-07 to 2015-16.The data gathered is analyzed through the ratios relating to profitability of the enterprise. Profitability analysis was done through analyzing various profit margins, Profitability ratios relating to investments and Profitability ratios relating to various expenses. Profit margins covered include Gross Profit Margin, Operating Profit Margin and Net Profit Margin. Profitability ratios relating to investments include Return on Assets (ROA), Return on Capital Employed (ROCE) and Return on Share holder's equity (ROSE). Profitability ratios relating to various expenses include Cost of Goods sold Ratio, Operating Expenses Ratio, Administrative Expenses Ratio, Selling Expenses Ratio and Financial Expenses Ratio. Chi-square test is used for testing the hypotheses formed.

6. Profitability Analysis with Profit Margins

Profit Margins are based on the assumption that an Enterprise should earn sufficient profit on each Rupee of sales.

Gross Profit Margin

Gross Profit Margin has varied between -3.7 and 20.9 during the period of study. Gross Profit Margin is low during the period of study and even negative during 2013, 2015 and 2016. Management needs to put efforts in reducing cost of production. It is found in the significance test that Gross Profit Margin is not uniform during the period of study.

Table-1: Gross Profit Margin

(Figures in Lakhs)

Years	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Gross Profit	131.2	189.2	131.2	103.9	140.1	275.6	-24.9	101.3	-105.9	52.7
Sales	783.3	906.8	1223.5	838.8	1241.6	2136.6	2108.4	2746.1	2843.7	2723.2
Gross Profit Margin	16.7	20.9	10.7	12.4	11.3	12.9	-1.2	3.7	-3.7	1.9

Source: Annual Reports of Radhika Vegetable Oils Private Limited from 2006-07 to 2015-2016.

Calculated value of Chi-Square for Gross Profit Margin = 67.5. Calculated value is greater than critical Value at 5% level of Significance i.e., 67.5>16.919, Hence, H_{01} is Rejected.

Operating Profit Margin

Operating Profit Margin has varied between -6.9 and 12.8 during the period of study. Operating Profit Margin is relatively low during the period of study and even negative during 2013, 2015 and 2016. It is not due to increase in operating expenses but due to increase in cost of goods sold. Management needs to put efforts in reducing cost of production. It is found in the significance test that Operating Profit Margin is not uniform during the period of study.

Table-2: Operating Profit Margin

(Figures in Lakhs)

Years	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
EBIT	49.9	116.2	40.4	41.5	62.5	165.6	-101.9	17	-197	-65.1
Sales	783.3	906.8	1223.5	838.8	1241.6	2136.6	2108.4	2746.1	2843.7	2723.2
Operating Profit Margin	6.4	12.8	3.3	4.9	5.0	7.8	-4.8	0.6	-6.9	-2.4

Source: Annual Reports of Radhika Vegetable Oils Private Limited from 2006-07 to 2015-2016.

Calculated value of Chi-Square for Operating Profit Margin = 124.0. Calculated value is greater than critical Value at 5% level of Significance i.e., 124.0>16.919, Hence, H_{02} is Rejected.

Net Profit Margin

Net Profit Margin has varied between -6.9 and 9.4 during the period of study. Net Profit Margin is low during the period of study and even negative during 2013, 2015 and 2016. Management needs to put efforts in reducing cost of production. It is found in the significance test that Net Profit Margin is not uniform during the period of study.

Table-3: Net Profit Margin

(Figures in Lakhs)

Years	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Net Profit	41.4	84.8	40.4	31.4	44.4	110.8	-94.4	16.2	-197.4	-67.4

Sales	783.3	906.8	1223.5	838.8	1241.6	2136.6	2108.4	2746.1	2843.7	2723.2
Net Profit Margin	5.3	9.4	3.3	3.7	3.6	5.2	-4.5	0.6	-6.9	-2.5

Source: Annual Reports of Radhika Vegetable Oils Private Limited from 2006-07 to 2015-2016.

Calculated value of Chi-Square for Net Profit Margin = 131.0. Calculated value is greater than critical Value at 5% level of Significance i.e., 131.0>16.919, Hence, H_{03} is Rejected.

7. Profitability Analysis with Profitability Ratios Related to Investment

Profitability ratios relating to investment are based on the assumption that an Enterprise should earn good profit on its investment.

Return on Assets (ROA)

Return on Assets Ratio has varied between -24.0 and 25.9 during the period of study. It is found in the significance test that Return on Assets Ratio is not uniform during the period of study. Return on Assets Ratio is less than 10 during 2010, 2013, 2014, 2015 and 2016 which indicates that there is a need for better profitability management during these years.

Table-4: Return on Assets (ROA)

(Figures in Lakhs)

Years	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Net Profit	41.4	84.8	40.4	31.4	44.4	110.8	-94.4	16.2	-197.4	-67.4
Average Total Assets	213.9	327.3	381.1	375.2	418.7	775.1	786.9	863.2	822.1	993.4
ROA	19.4	25.9	10.6	8.4	10.6	14.3	-12.0	1.9	-24.0	-6.8

Source: Annual Reports of Radhika Vegetable Oils Private Limited from 2006-07 to 2015-2016.

Calculated value of Chi-Square for ROA = 431.4. Calculated value is greater than critical Value at 5% level of Significance i.e., 431.4>16.919, Hence, H_{04} is Rejected.

Return on Capital Employed (ROCE)

Return on capital employed has varied between -24.0 and 35.5 during the period of study. It is found in the significance test that Return on capital employed is not uniform during the period of study. Return on Capital Employed is less than 20 during the period of the study except during 2007, 2008 and 2012 which indicates that management needs to do better profitability management.

Table-5: Return on Capital Employed (ROCE)

(Figures in Lakhs)

Years	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
EBIT	49.9	116.2	40.4	41.5	62.5	165.6	-101.9	17	-197	-65.1
Average Total Capital	213.9	327.3	381.1	375.2	418.7	775.1	786.9	863.2	822.1	993.4
ROCE	23.3	35.5	10.6	11.1	14.9	21.4	-12.9	2.0	-24.0	-6.6

Source: Annual Reports of Radhika Vegetable Oils Private Limited from 2006-07 to 2015-2016.

Calculated value of Chi-Square for ROCE = 390.7. Calculated value is greater than critical Value at 5% level of Significance i.e., 390.7>16.919, Hence, H_{05} is Rejected.

Return on Share Holders' Equity (ROSE)

Return on Shareholders' Equity has varied between -80.2 and 28.8 during the period of study. Return on Shareholders' Equity is less than 10 during five years of the study which is not good for owners. Return on Shareholders' Equity is not uniform during the period of study.

Table-6: Return on Share Holders' Equity (ROSE)

(Figures in Lakhs)

Years	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Net Profit	41.4	84.8	40.4	31.4	44.4	110.8	-94.4	16.2	-197.4	-67.4
Average Share Holders' Equity	210	294.7	335.1	366.5	410.9	521.7	427.3	443.5	246.1	178.6
ROSE	19.7	28.8	12.1	8.6	10.8	21.2	-22.1	3.7	-80.2	-37.7

Source: Annual Reports of Radhika Vegetable Oils Private Limited from 2006-07 to 2015-2016.

Calculated value of Chi-Square for ROSE = 2916.3. Calculated value is greater than critical Value at 5% level of Significance i.e., 2916.3>16.919, Hence, H_{06} is Rejected.

8. Profitability Analysis with Profitability Ratios Related to Expenses

These ratios are based on the assumption that Enterprise should reduce its expenses in relation to sales.

Cost of Goods Sold Ratio

Cost of Goods Sold Ratio has varied between 79.1 and 103.7 during the period of study. Cost of Goods Sold Ratio is very high during the period of study and even greater than 100 during 2013 and 2015. Management needs to put efforts in reducing cost of production. It is found in the significance test that Cost of Goods Sold Ratio is uniform during the period of study.

Table-7: Cost of Goods Sold Ratio

(Figures in Lakhs)

Years	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Cost of Goods sold	652.1	717.6	1092.3	734.9	1101.5	1861.0	2133.3	2644.8	2949.6	2670.5
Sales	783.3	906.8	1223.5	838.8	1241.6	2136.6	2108.4	2746.1	2843.7	2723.2
Ratio	83.3	79.1	89.3	87.6	88.7	87.1	101.2	96.3	103.7	98.1

Source: Annual Reports of Radhika Vegetable Oils Private Limited from 2006-07 to 2015-2016.

Calculated value of Chi-Square for Cost of Goods sold Ratio = 6.3. Calculated value is less than critical Value at 5% level of Significance i.e., 6.3<16.919, Hence, H_{07} is Accepted.

Operating Expenses Ratio

Operating Expenses Ratio has varied between 1.5 and 6.3 during the period of study. A low Operating Expenses Ratio is indicating that management is making good efforts in reducing Operating expenses. It is found in the significance test that Operating Expenses Ratio is uniform during the period of study.

Table-8: Operating Expenses Ratio

(Figures in Lakhs)

Years	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Operating Expenses	49.6	40.9	33.1	26.8	41.6	42.1	39.6	46.6	41.8	60.5
Sales	783.3	906.8	1223.5	838.8	1241.6	2136.6	2108.4	2746.1	2843.7	2723.2
Ratio	6.3	4.5	2.7	3.2	3.4	2.0	1.9	1.7	1.5	2.2

Source: Annual Reports of Radhika Vegetable Oils Private Limited from 2006-07 to 2015-2016.

Calculated value of Chi-Square for Operating Expenses Ratio = 6.9. Calculated value is less than critical Value at 5% level of Significance i.e., 6.9<16.919, Hence, H_{08} is Accepted.

Administrative Expenses Ratio

Administrative Expenses Ratio has varied between 1.0 and 4.0 during the period of study. A low Administrative Expenses Ratio is indicating that management is making good efforts in reducing Administrative expenses. It is found in the significance test that Administrative Expenses Ratio is uniform during the period of study.

Table-9: Administrative Expenses Ratio

(Figures in Lakhs)

Years	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Administrative Expenses	17.2	36.6	26.1	23.0	36.0	32.6	27.5	32.5	27.2	42.5
Sales	783.3	906.8	1223.5	838.8	1241.6	2136.6	2108.4	2746.1	2843.7	2723.2
Ratio	2.2	4.0	2.1	2.7	2.9	1.5	1.3	1.2	1.0	1.6

Source: Annual Reports of Radhika Vegetable Oils Private Limited from 2006-07 to 2015-2016.

Calculated value of Chi-Square for Administrative Expensive Ratio = 3.8. Calculated value is less than critical Value at 5% level of Significance i.e., 3.8<16.919, Hence, H_{09} is Accepted.

Selling Expenses Ratio

Selling Expenses Ratio has varied between 0.4 and 4.1 during the period of study. A low Selling Expenses Ratio is indicating that management is making good efforts in reducing selling

expenses. It is found in the significance test that Selling Expenses Ratio is uniform during the period of study.

Table-10: Selling Expenses Ratio

(Figures in Lakhs)

Years	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Selling Expenses	32.4	4.3	7.0	3.8	5.6	9.5	12.1	14.1	14.6	18.0
Sales	783.3	906.8	1223.5	838.8	1241.6	2136.6	2108.4	2746.1	2843.7	2723.2
Ratio	4.1	0.5	0.6	0.5	0.5	0.4	0.6	0.5	0.5	0.7

Source: Annual Reports of Radhika Vegetable Oils Private Limited from 2006-07 to 2015-2016.

Calculated value of Chi-Square for Selling Expenses Ratio = 12.9. Calculated value is less than critical Value at 5% level of Significance i.e., 12.9<16.919, Hence, H_{10} is Accepted.

Financial Expenses Ratio

Financial Expenses Ratio has varied between 0.01 and 0.35 during the period of study. A low Financial Expenses Ratio is indicating that management is making good efforts in reducing financial expenses. It is found in the significance test that Financial Expenses Ratio is uniform during the period of study.

Table-11: Financial Expenses Ratio

(Figures in Lakhs)

Years	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Financial Expenses	0.1	3.2	2.7	1.7	0.6	0.4	0.9	0.8	0.4	2.2
Sales	783.3	906.8	1223.5	838.8	1241.6	2136.6	2108.4	2746.1	2843.7	2723.2
Ratio	0.01	0.35	0.22	0.20	0.05	0.02	0.04	0.03	0.01	0.08

Source: Annual Reports of Radhika Vegetable Oils Private Limited from 2006-07 to 2015-2016.

Calculated value of Chi-Square for Financial Expenses Ratio = 1.2. Calculated value is less than critical Value at 5% level of Significance i.e., 1.2<16.919, Hence, H_{11} is Accepted.

9. Conclusion

Gross Profit Margin, Operating Profit Margin, Net Profit Margin, Return on Assets Ratio, Return on Capital Employed Ratio and Return on Share holder's Equity Ratio are not uniform during the period of study. Cost of Goods sold Ratio, Operating Expenses Ratio, Administrative Expenses Ratio, Selling Expenses Ratio and Financial Expenses Ratio are uniform during the period of study. Gross Profit Margin, Operating Profit Margin and Net Profit Margin are low during the period of study and are even negative during 2013, 2015 and 2016. This is due to increase in cost of goods sold. Management needs to put efforts in reducing cost of production. Return on Assets Ratio is less than 10 during 2010, 2013, 2014, 2015 and 2016 which indicates that there is a need for better profitability management during these years. Return on Capital Employed is less than 20 during the period of the study except during 2007, 2008 and 2012 which indicates that management needs to do better profitability management. Return on Shareholders' Equity is less than 10 during five years of the study which is not good for owners. Low Operating expenses Ratio, low Administrative Expenses Ratio, low Selling Expenses Ratio and low Financial Expenses Ratio are indicating that management is making good efforts in reducing these expenses.

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Profitability Analysis of a Small Enterprise - A Case Study of Maitreya Electricals Private Limited

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Abstract: *Owners and Managers are naturally interested in financial soundness of their Business Enterprise. Financial soundness can be measured in terms of operating efficiency. Operating efficiency of an enterprise means its ability to earn adequate returns to owners and depends ultimately on the profits earned by the enterprise. The profitability of an enterprise is measured by profitability ratios. In this paper, an attempt is made to do Profitability Analysis of Maitreya Electricals Private Limited. Maitreya Electricals Private Limited is a small enterprise located in Andhra Pradesh state of India. This company is a manufacturer and repairer of Electrical Transformers. Its head office is located in Vijayawada of Krishna district. It was established in the year 1990. Profitability analysis was done through analyzing various profit margins, Profitability ratios relating to investments and Profitability ratios relating to various expenses. Profit margins covered include Gross Profit Margin, Operating Profit Margin and Net Profit Margin. Profitability ratios relating to investments include Return on Assets (ROA), Return on Capital Employed (ROCE) and Return on Share holder's equity (ROSE). Profitability ratios relating to various expenses include Cost of Goods sold Ratio, Operating Expenses Ratio, Administrative Expenses Ratio, Selling Expenses Ratio and Financial Expenses Ratio. Chi-square test is used for testing the hypotheses formed.*

Keywords*: Financial Expenses Ratio, Net Profit Margin, Operating Profit Margin, Return on Assets (ROA), Return on Capital Employed (ROCE), Selling Expenses Ratio.*

I. INTRODUCTION

Owners and Managers are naturally interested in financial soundness of their Business Enterprise. Financial soundness can be measured in terms of operating efficiency. Operating efficiency of an enterprise means its ability to earn adequate returns to owners and depends ultimately on the profits earned by the enterprise. The profitability of an enterprise is measured by profitability ratios. There are three important profitability ratios namely profitability ratios relating to sales, profitability ratios relating to investment and profitability ratios relating to expenses. In this paper, an attempt is made to do Profitability Analysis of Maitreya Electricals Private Limited. Maitreya Electricals Private Limited is a small enterprise located in Andhra Pradesh state of India. This company is a manufacturer and repairer of Electrical Transformers. Its head office is located in Vijayawada of Krishna district. It was established in the year 1990. It is having branches with well established infrastructure and technical persons at Madanapalli of Chitoor District and Srikakaulam of Srikakulam district. The reputed customers of the company are Andhra Pradesh Southern Power Distribution Company Ltd. (APSPDCL), Andhra Pradesh Eastern Power Distribution Company Ltd. (APEPDCL), Andhra Pradesh Northern Power Distribution Company Ltd. (APNPDCL), Singareni Collieries Company Ltd. (SCCL), Regional Electrical Corporations (RECs), Indian railways and other government organisations. It has a man power of twenty five. This Enterprise has an annual turnover of Rs. 224.0 lakhs as per 2015-16 annual accounts. The total assets of the company are Rs. 192.3lakhs and total liabilities are Rs. 192.3lakhs.

II. REVIEW OF LITERATURE

Gangadhar (1982)[1] had conducted the profitability Analysis of large public limited cement companies in India. V. K. Purohit (1982)[2]had examined the profitability trends of manufacturing industries in Indian corporate sector during 1950-51 to 1970-71. Sindhu Rani (1998)[3] had examined the factors affecting profitability in Indian textile industry. Md. Rafiqul Islam (2000)[4] had conducted a study on the profitability of Fertilizer Industry in Bangladesh from 1985-86 to 1994-95. Manorselvi and Vijayakumar (2007)[5] had examined the trends in of profits of the selected Indian automobile companies during the period 1991-92 to 2003-04. Hyz and Gikas(2012)[6] had done profitability analysis of SME sector in Poland. Oni Timothy Olukunle (2017)[7] had

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done Profitability Analysis of Small scale Fishery Enterprise in Nigeria. Venkateswararao.Podile (2017)[8] had examined the recent MSME policy of Andhra Pradesh. Venkateswararao.Podile et al., (2017)[9] examined working capital management in PL Plast Pvt Ltd. Venkateswararao.Podile et al., (2017)[10] had examined various Government schemes supporting MSMEs in India. Venkateswararao.Podile et al., (2018)[11] examined working capital management in Sri Rama Chandra Paper Boards Ltd. Venkateswararao.Podile (2018)[12] examined working capital management in Tulasi seeds Pvt.Ltd. Venkateswararao.Podile et al., (2018)[13] studied working capital management in Sri Nagavalli solvent oils Pvt. Ltd. Venkateswararao.Podile et al., (2018)[14] analysed working capital management in Naga Hanuman Solvent Oils Private Limited. Venkateswararao.Podile (2018)[15] examined working capital management in Cuddapah Spinning Mills Ltd. Venkateswararao.Podile et al., (2018)[16] studied working capital management in Kristna Engineering Works. Venkateswararao.Podile et al., (2018)[17] examined working capital management in Radhika Vegetables Oils Pvt. Ltd. Venkateswararao.Podile et al., (2018)[18] examined working capital management in Power Plant Engineering Works in Andhra Pradesh. Venkateswararao.Podile et al., (2018)[19] examined working capital management in Nagas Elastomer Works. Venkateswararao.Podile et al., (2018)[20] had studied working capital management in M.G.Metallic Springs Pvt. Ltd. Venkateswararao.Podile et al., (2018)[21] had studied working capital management in Sri Srinivasa Spun Pipes Company. Venkateswararao.Podile et al., (2018)[22]had studied working capital management in Raghunath Dye Chem Pvt. Ltd. Venkateswararao.Podile et al., (2018)[23] had examined working capital management in Maitreya Electricals Pvt. Ltd. Venkateswararao.Podile et al., (2018)[24] had examined working capital management in Laxmi Vinay Poly Print Packs Pvt. Ltd. Venkateswararao.Podile et al., (2018)[25] had done capital structure analysis of M.G.Metallic Springs Pvt. Ltd. Venkateswararao.Podile et al., (2018)[26]had done capital structure analysis of Naga Hanuman Solvent Oils Private Limited. Venkateswararao.Podile et al., (2018)[27]had done capital structure analysis of Raghunath Dye Chem Pvt. Ltd. Venkateswararao.Podile et al., (2018)[28]had done capital structure analysis of Nagas Elastomer Works. Venkateswararao.Podile et al., (2018)[29]had done capital structure analysis of Tulasi Seeds Pvt. Ltd. Venkateswararao.Podile et al., (2018)[30]had done capital structure analysis of Maitreya Electricals Private Limited. Venkateswararao.Podile et al., (2018)[31]had done capital structure analysis of Bharat Cashew Manufacturing Company. Venkateswararao.Podile et al., (2018)[32]had done capital structure analysis of Sri Rama Chandra Paper Boards Limited. Venkateswararao.Podile et al., (2018)[33]had done capital structure analysis of Power Oxides Private Limited. Venkateswararao.Podile et al., (2018)[34]had done capital structure analysis of Laxmi Vinay Poly Print Packs Private Limited. Venkateswararao.Podile et al., (2018)[35]had studied working capital management in Power Oxides Pvt. Ltd. Venkateswararao.Podile et al., (2018)[36]had done capital structure analysis of Radhika Vegetable Oils Private Limited. Venkateswararao.Podile et al., (2018)[37]had done capital structure analysis of Sri Nagavalli Solvent Oils Private Limited. Venkateswararao.Podile et al., (2018)[38]had done capital structure analysis of P.L.Plast Private Limited. Venkateswararao.Podile (2018)[39] had done capital structure analysis of Power Plant Engineering Works. Venkateswararao.Podile (2018)[40] had done Profitability Analysis of Bharat Cashew Manufacturing Company. Venkateswararao.Podile (2018)[41] had done Profitability Analysis of Sri Ramachandra Paper Boards Private Limited. Venkateswararao.Podile (2018)[42] had done Profitability Analysis of Tulasi Seeds Private Limited. Venkateswararao.Podile (2018)[43] had done Profitability Analysis of Power Plant Engineering Works. It was found that most of the studies dealt with Profitability analysis of different large Enterprises and of sectors in India and abroad. Some of the studies dealt with MSME policies. Some other studies though dealt with MSMEs, they were confined to working capital management and capital structure analysis.Few studies dealt with profitability analysis. There was no study on Profitability analysis of a small Enterprise which is a manufacturer and repairer of Electrical Transformers. Hence, this study is taken up.

Objectives

The general objective of the study is to do Profitability Analysis of Maitreya Electricals Private Limited. The specific objectives include the following.

1. To examine Gross profit margin, Operating profit margin and Net Profit Margin of Maitreya Electricals Private Limited during the period of study.
2. To investigate into various profitability ratios relating to investment in Maitreya Electricals Private Limited during the period of study.
3. To analyze various profitability ratios related to expenses in Maitreya Electricals Private Limited during the period of study.
4. To examine the overall profitability of Maitreya Electricals Private Limited during the period of study.
5. To offer suggestions for improvement of profitability of the Enterprise, if required.

Hypotheses

H_{01}: Gross Profit Margin of Maitreya Electricals Private Limited is uniform during the period of study.

H_{02}: Operating Profit Margin of Maitreya Electricals Private Limited is uniform during the period of study.

H_{03}: Net Profit Margin of Maitreya Electricals Private Limited is uniform during the period of study.

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H_{04}: Return on Assets (ROA) in Maitreya Electricals Private Limited is uniform during the period of study.

H_{05}: Return on Capital Employed (ROCE) in Maitreya Electricals Private Limited is uniform during the period of study.

H_{06}: Return on Share holder's equity (ROSE) in Maitreya Electricals Private Limited is uniform during the period of study.

H_{07}: Cost of Goods sold Ratio in Maitreya Electricals Private Limited is uniform during the period of study.

H_{08}: Operating Expenses Ratio in Maitreya Electricals Private Limited is uniform during the period of study.

H_{09}: Administrative Expenses Ratio in Maitreya Electricals Private Limited is uniform during the period of study.

H_{10}: Selling Expenses Ratio in Maitreya Electricals Private Limited is uniform during the period of study

H_{11}: Financial Expenses Ratio in Maitreya Electricals Private Limited is uniform during the period of study.

III. METHODOLOGY

The present study is mainly based on secondary data. The data is taken from the financial statements including balance sheet, trading account and profit and loss account of Maitreya Electricals Private Limited. The period of study is ten years covering the financial years from 2006-07 to 2015-16.The data gathered is analyzed through the ratios relating to profitability of the enterprise. Profitability analysis was done through analyzing various profit margins, Profitability ratios relating to investments and Profitability ratios relating to various expenses. Profit margins covered include Gross Profit Margin, Operating Profit Margin and Net Profit Margin. Profitability ratios relating to investments include Return on Assets (ROA), Return on Capital Employed (ROCE) and Return on Share holder's equity (ROSE). Profitability ratios relating to various expenses include Cost of Goods sold Ratio, Operating Expenses Ratio, Administrative Expenses Ratio, Selling Expenses Ratio and Financial Expenses Ratio. Chi-square test is used for testing the hypotheses formed.

Profitability Analysis with Profit Margins

Profit Margins are based on the assumption that an Enterprise should earn sufficient profit on each Rupee of sales.

Gross Profit Margin

Gross Profit Margin has varied between 22.7 and 39.7 during the period of study. Gross Profit Margin is low except during 2007, 2010 and 2011. This was due to high cost of production. Management should make efforts to reduce cost of production. It is found in the significance test that Gross Profit Margin is uniform during the period of study.

Table-1: Gross Profit Margin (Figures in Lakhs)

Years	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Gross Profit	42.3	42.6	44.6	45.8	59.2	48.7	42.1	31.3	53.5	59.9
Sales	119.6	188.0	165.0	115.3	188.0	193.2	157.1	132.6	219.5	224.0
Gross Profit Margin	35.4	22.7	27.0	39.7	31.5	25.2	26.8	23.6	24.4	26.7

Source: Annual Reports of Maitreya Electricals Private Limited from 2006-07 to 2015-2016.

Calculated value of Chi-Square for Gross Profit Margin = 9.7. Calculated value is less than critical Value at 5% level of Significance i.e., 9.7<16.919, Hence, H_{01} is Accepted.

Operating Profit Margin

Operating Profit Margin has varied between 2.9 and 9.8 during the period of study. Operating Profit Margin is low during the period of study due to high cost of production and high operating charges during 2007, 2010 and 2011. It is found in the significance test that Operating Profit Margin is uniform during the period of study.

Table-2: Operating Profit Margin (Figures in Lakhs)

Years	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
EBIT	10.5	11.1	16.1	11.0	5.4	15.9	14.0	6.0	13.7	13.4
Sales	119.6	188.0	165.0	115.3	188.0	193.2	157.1	132.6	219.5	224.0
Operating Profit Margin	8.8	5.9	9.8	9.5	2.9	8.2	8.9	4.5	6.2	6.0

Source: Annual Reports of Maitreya Electricals Private Limited from 2006-07 to 2015-2016.

Calculated value of Chi-Square for Operating Profit Margin = 6.8. Calculated value is less than critical Value at 5% level of Significance i.e., 6.8<16.919, Hence, H_{02} is Accepted.

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Net Profit Margin

Net Profit Margin has varied between 0.6 and 4.1 during the period of study. Net Profit Margin is low during the period of study due to high cost of production and high operating expenses during 2007, 2010 and 2011. Positive Net Profit Margin indicates that the firm is covering its financial expenses. It is found in the significance test that Net Profit Margin is uniform during the period of study.

Table-3: Net Profit Margin (Figures in Lakhs)

Years	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Net Profit	3.8	5.2	5.0	4.7	1.2	5.5	6.1	2.1	7.1	6.1
Sales	119.6	188.0	165.0	115.3	188.0	193.2	157.1	132.6	219.5	224.0
Net Profit Margin	3.2	2.8	3.0	4.1	0.6	2.8	3.9	1.6	3.2	2.7

Source: Annual Reports of Maitreya Electricals Private Limited from 2006-07 to 2015-2016.

Calculated value of Chi-Square for Net Profit Margin = 3.4. Calculated value is less than critical Value at 5% level of Significance i.e., 3.4<16.919, Hence, H_{03} is Accepted.

Profitability Analysis with Profitability Ratios Related to Investment

Profitability ratios relating to investment are based on the assumption that an Enterprise should earn good profit on its investment.

Return on Assets (ROA)

Return on Assets Ratio has varied between 0.8 and 5.5 during the period of study. It is found in the significance test that Return on Assets Ratio is uniform during the period of study. Return on Assets Ratio is less than 10 during all the years of the study which indicates that there is need for better profitability management in the enterprise.

Table-4: Return on Assets (ROA) (Figures in Lakhs)

Years	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Net Profit	3.8	5.2	5.0	4.7	1.2	5.5	6.1	2.1	7.1	6.1
Average Total Assets	85.3	94.0	130.3	121.9	153.4	140.5	174.6	168.2	175.3	192.3
ROA	4.5	5.5	3.8	3.9	0.8	3.9	3.5	1.2	4.1	3.2

Source: Annual Reports of Maitreya Electricals Private Limited from 2006-07 to 2015-2016.

Calculated value of Chi-Square for ROA = 5.4. Calculated value is less than critical Value at 5% level of Significance i.e., 5.4<16.919, Hence, H_{04} is Accepted.

Return on Capital Employed (ROCE)

Return on capital employed has varied between 3.5 and 12.4 during the period of study. It is found in the significance test that Return on capital employed is uniform during the period of study. Return on Capital Employed is less than 20 during all the years of the study which indicates that there is need for better profitability management in the enterprise.

Table-5: Return on Capital Employed (ROCE) (Figures in Lakhs)

Years	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
EBIT	10.5	11.1	16.1	11.0	5.4	15.9	14.0	6.0	13.7	13.4
Average Total Capital	85.3	94.0	130.3	121.9	153.4	140.5	174.6	168.2	175.3	192.3
ROCE	12.3	11.8	12.4	9.0	3.5	11.3	8.0	3.6	7.8	7.0

Source: Annual Reports of Maitreya Electricals Private Limited from 2006-07 to 2015-2016.

Calculated value of Chi-Square for ROCE = 11.6. Calculated value is less than critical Value at 5% level of Significance i.e., 11.6<16.919, Hence, H_{05} is Accepted.

Return on Share Holders' Equity (ROSE)

Return on Shareholders' Equity has varied between 1.8 and 9.6 during the period of study. Return on Shareholders' Equity is less than 10 during all the years of the study which is not good for owners. Positive Net Profit made owners happy with the situation. Return on Shareholders' Equity is uniform during the period of study.

Table-6: Return on Share Holders' Equity (ROSE) (Figures in Lakhs)

Years	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Net Profit	3.8	5.2	5.0	4.7	1.2	5.5	6.1	2.1	7.1	6.1
Average Share Holders' Equity	50.0	54.2	59.2	63.8	65.0	70.5	76.7	78.7	85.9	91.9
ROSE	7.6	9.6	8.4	7.4	1.8	7.8	8.0	2.7	8.3	6.6

Source: Annual Reports of Maitreya Electricals Private Limited from 2006-07 to 2015-2016.

Calculated value of Chi-Square for ROSE = 8.5. Calculated value is less than critical Value at 5% level of Significance i.e., 8.5<16.919, Hence, H_{06} is Accepted.

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Profitability Analysis with Profitability Ratios Related to Expenses

These ratios are based on the assumption that Enterprise should reduce its expenses in relation to sales.

Cost of Goods Sold Ratio

Cost of Goods Sold Ratio has varied between 60.3 and 77.3 during the period of study. Cost of Goods Sold Ratio is high during the period of study except during 2007, 2010 and 2011. Management should make efforts to reduce cost of production. It is found in the significance test that Cost of Goods Sold Ratio is uniform during the period of study.

Table-7: Cost of Goods Sold Ratio (Figures in Lakhs)

Years	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Cost of Goods sold	77.3	145.4	120.4	69.5	128.8	144.5	115	101.3	166	164.1
Sales	119.6	188.0	165.0	115.3	188.0	193.2	157.1	132.6	219.5	224.0
Ratio	64.6	77.3	73.0	60.3	68.5	74.8	73.2	76.4	75.6	73.3

Source: Annual Reports of Maitreya Electricals Private Limited from 2006-07 to 2015-2016.

Calculated value of Chi-Square for Cost of Goods sold Ratio = 3.8. Calculated value is less than critical Value at 5% level of Significance i.e., 3.8<16.919, Hence, H_{07} is Accepted.

Operating Expenses Ratio

Operating Expenses Ratio has varied between 15.1 and 27.7 during the period of study. Operating Expenses Ratio is low in the enterprise except during 2007, 2010 and 2011. Management is making good efforts to reduce Administrative expenses. It is found in the significance test that Operating Expenses Ratio is uniform during the period of study.

Table-8: Operating Expenses Ratio (Figures in Lakhs)

Years	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Operating Expenses	30.2	30.6	24.9	31.9	50.0	29.7	25.4	18.7	36.1	41.2
Sales	119.6	188.0	165.0	115.3	188.0	193.2	157.1	132.6	219.5	224.0
Ratio	25.3	16.3	15.1	27.7	26.6	15.4	16.2	14.1	16.4	18.4

Source: Annual Reports of Maitreya Electricals Private Limited from 2006-07 to 2015-2016.

Calculated value of Chi-Square for Operating Expenses Ratio = 12.9. Calculated value is less than critical Value at 5% level of Significance i.e., 12.9<16.919, Hence, H_{08} is Accepted.

Administrative Expenses Ratio

Administrative Expenses Ratio has varied between 11.1 and 25.8 during the period of study. Administrative Expenses Ratio is low in the company except during 2007, 2010 and 2011. Management is making good efforts to reduce Administrative expenses. It is found in the significance test that Administrative Expenses Ratio is uniform during the period of study.

Table-9: Administrative Expenses Ratio (Figures in Lakhs)

Years	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Administrative Expenses	28.9	29.5	23.6	29.8	45.2	25.4	21.8	14.7	31.6	36.5
Sales	119.6	188.0	165.0	115.3	188.0	193.2	157.1	132.6	219.5	224.0
Ratio	24.2	15.7	14.3	25.8	24.0	13.1	13.9	11.1	14.4	16.3

Source: Annual Reports of Maitreya Electricals Private Limited from 2006-07 to 2015-2016.

Calculated value of Chi-Square for Administrative Expensive Ratio = 14.7. Calculated value is less than critical Value at 5% level of Significance i.e., 14.7<16.919, Hence, H_{09} is Accepted.

Selling Expenses Ratio

Selling Expenses Ratio has varied between 0.6 and 3.0 during the period of study. A low Selling Expenses Ratio is indicating that management is making good efforts in reducing Selling expenses. It is found in the significance test that Selling Expenses Ratio is uniform during the period of study.

Table-10: Selling Expenses Ratio (Figures in Lakhs)

Years	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Selling Expenses	1.3	1.1	1.3	2.1	4.8	4.3	3.6	4.0	4.5	4.7
Sales	119.6	188.0	165.0	115.3	188.0	193.2	157.1	132.6	219.5	224.0
Ratio	1.1	0.6	0.8	1.8	2.6	2.2	2.3	3.0	2.1	2.1

Source: Annual Reports of Maitreya Electricals Private Limited from 2006-07 to 2015-2016.

Calculated value of Chi-Square for Selling Expenses Ratio = 3.0. Calculated value is less than critical Value at 5% level of Significance i.e., 3.0<16.919, Hence, H_{10} is Accepted.

Financial Expenses Ratio

Financial Expenses Ratio has varied between 1.3 and 4.4 during the period of study. Financial Expenses Ratio is low during the period of study. Management is making good efforts for reducing financial expenses. It is found in the significance test that Financial Expenses Ratio is uniform during the period of study.

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Table-11: Financial Expenses Ratio (Figures in Lakhs)

Years	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Financial Expenses	4.5	3.3	7.3	4.2	2.4	7.5	4.6	2.4	2.9	3.3
Sales	119.6	188.0	165.0	115.3	188.0	193.2	157.1	132.6	219.5	224.0
Ratio	3.8	1.8	4.4	3.6	1.3	3.9	2.9	1.8	1.3	1.5

Source: Annual Reports of Maitreya Electricals Private Limited from 2006-07 to 2015-2016.

Calculated value of Chi-Square for Financial Expenses Ratio = 5.1. Calculated value is less than critical Value at 5% level of Significance i.e., 5.1<16.919. Hence, H_{11} is accepted.

IV. CONCLUSION

Gross Profit Margin, Operating Profit Margin, Net Profit Margin, Return on Assets Ratio, Return on Capital Employed Ratio, Return on Share holder's Equity Ratio, Cost of Goods sold Ratio, Operating Expenses Ratio, Administrative Expenses Ratio, Selling Expenses Ratio and Financial Expenses Ratio are uniform during the period of study. Gross Profit Margin is low except during 2007, 2010 and 2011. This was due to high cost of production. Management should make efforts to reduce cost of production. Operating Profit Margin and Net Profit Margin are low during the period of study due to high cost of production and high operating expenses during 2007, 2010 and 2011. Return on Assets Ratio, Return on Capital employed Ratio and Return on Share holders equity are at low level during all the years of the study which indicate that there is need for better profitability management in the enterprise. Management is making good efforts in reducing Administrative expenses, selling expenses and financial expenses.

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Profitability Analysis of a Micro and Partnership Enterprise - A Case Study of Bharat Cashew Manufacturing Company

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Abstract: *Owners and Managers are naturally interested in financial soundness of their Business Enterprise. Financial soundness can be measured in terms of operating efficiency. Operating efficiency of an enterprise means its ability to earn adequate returns to owners and depends ultimately on the profits earned by the enterprise. The profitability of an enterprise is measured by profitability ratios. In this paper, an attempt is made to do Profitability Analysis of Bharat Cashew Manufacturing Company. Bharat Cashew Manufacturing Company is a Micro and Partnership Enterprise belongs to Andhra Pradesh state of India. This is located in vetapalem, Prakasam District. It is engaged in the business of purchase and sale of raw cashew nut and manufacturing of cashew kernel. Profitability analysis was done through analyzing various profit margins, Profitability ratios relating to investments and Profitability ratios relating to various expenses. Profit margins covered include Gross Profit Margin, Operating Profit Margin and Net Profit Margin. Profitability ratios relating to investments include Return on Assets (ROA), Return on Capital Employed (ROCE) and Return on Share holder's equity (ROSE). Profitability ratios relating to various expenses include Cost of Goods sold Ratio, Operating Expenses Ratio, Administrative Expenses Ratio, Selling Expenses Ratio and Financial Expenses Ratio. Chi-square test is used for testing the hypotheses formed.*

Keywords*: Cost of Goods sold Ratio, Financial Expenses Ratio, Gross Profit Margin, Operating Profit Margin, Return on Assets (ROA), Return on Capital Employed (ROCE)*

I. INTRODUCTION

Owners and Managers are naturally interested in financial soundness of their Business Enterprise. Financial soundness can be measured in terms of operating efficiency. Operating efficiency of an enterprise means its ability to earn adequate returns to owners and depends ultimately on the profits earned by the enterprise. The profitability of an enterprise is measured by profitability ratios. There are three important profitability ratios namely profitability ratios relating to sales, profitability ratios relating to investment and profitability ratios relating to expenses. In this paper, an attempt is made to do Profitability Analysis of Bharat Cashew Manufacturing Company. Bharat Cashew Manufacturing Company is a Micro and Partnership Enterprise belongs to Andhra Pradesh state of India. This is located in vetapalem, Prakasam District. Bharat Cashew Manufacturing Company was established in 1949 by three partners. It is engaged in the business of purchase and sale of raw cashew nut and manufacturing of cashew kernel. This Micro and Partnership Enterprise has been doing cashew exports since inception. This Micro and Partnership Enterprise has an annual turnover of Rs. 68.8 lakhs as per 2015-16 annual accounts. The total assets of the Micro and Partnership Enterprise are Rs. 251.6 lakhs and total liabilities are Rs. 251.6 lakhs as per 2015-16 annual accounts.

II. REVIEW OF LITERATURE

Gangadhar (1982)[1] had conducted the profitability Analysis of large public limited cement companies in India. V. K. Purohit (1982)[2]had examined the profitability trends of manufacturing industries in Indian corporate sector during 1950-51 to 1970-71. Sindhu Rani (1998)[3] had examined the factors affecting profitability in Indian textile industry. Md. Rafiqul Islam (2000)[4] had conducted a study on the profitability of Fertilizer Industry in Bangladesh from 1985-86 to 1994-95. Manorselvi and Vijayakumar (2007)[5] had examined the trends in of profits of the selected Indian automobile companies during the period 1991-92 to 2003-04. Hyz and Gikas(2012)[6] had done profitability analysis of SME sector in Poland. Oni Timothy Olukunle (2017)[7] had done Profitability Analysis of Small scale Fishery Enterprise in Nigeria. Venkateswararao.Podile (2017)[8] had examined the recent MSME policy of Andhra Pradesh. Venkateswararao.Podile et al., (2017)[9] examined working capital management in PL Plast Pvt Ltd. Venkateswararao.Podile et al., (2017)[10] had examined various Government schemes supporting MSMEs in India. Venkateswararao.Podile et al., (2018)[11] examined working capital management in Sri Rama Chandra Paper Boards Ltd. Venkateswararao.Podile (2018)[12] examined working capital management in Tulasi seeds Pvt.Ltd. Venkateswararao.Podile et al., (2018)[13] studied working capital management in Sri Nagavalli solvent oils Pvt. Ltd. Venkateswararao.Podile et al., (2018)[14] analysed

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working capital management in Naga Hanuman Solvent Oils Private Limited. Venkateswararao.Podile (2018)[15] examined working capital management in Cuddapah Spinning Mills Ltd. Venkateswararao.Podile et al., (2018)[16] studied working capital management in Kristna Engineering Works. Venkateswararao.Podile et al., (2018)[17] examined working capital management in Radhika Vegetables Oils Pvt. Ltd. Venkateswararao.Podile et al., (2018)[18] examined working capital management in Power Plant Engineering Works in Andhra Pradesh. Venkateswararao.Podile et al., (2018)[19] examined working capital management in Nagas Elastomer Works. Venkateswararao.Podile et al., (2018)[20] had studied working capital management in M.G.Metallic Springs Pvt. Ltd. Venkateswararao.Podile et al., (2018)[21] had studied working capital management in Sri Srinivasa Spun Pipes Company. Venkateswararao.Podile et al., (2018)[22]had studied working capital management in Raghunath Dye Chem Pvt. Ltd. Venkateswararao.Podile et al., (2018)[23] had examined working capital management in Maitreya Electricals Pvt. Ltd. Venkateswararao.Podile et al., (2018)[24] had examined working capital management in Laxmi Vinay Poly Print Packs Pvt. Ltd. Venkateswararao.Podile et al., (2018)[25] had done capital structure analysis of M.G.Metallic Springs Pvt. Ltd. Venkateswararao.Podile et al., (2018)[26]had done capital structure analysis of Naga Hanuman Solvent Oils Private Limited. Venkateswararao.Podile et al., (2018)[27]had done capital structure analysis of Raghunath Dye Chem Pvt. Ltd. Venkateswararao.Podile et al., (2018)[28]had done capital structure analysis of Nagas Elastomer Works. Venkateswararao.Podile et al., (2018)[29]had done capital structure analysis of Tulasi Seeds Pvt. Ltd. Venkateswararao.Podile et al., (2018)[30]had done capital structure analysis of Maitreya Electricals Private Limited. Venkateswararao.Podile et al., (2018)[31]had done capital structure analysis of Bharat Cashew Manufacturing Company. Venkateswararao.Podile et al., (2018)[32]had done capital structure analysis of Sri Rama Chandra Paper Boards Limited. Venkateswararao.Podile et al., (2018)[33]had done capital structure analysis of Power Oxides Private Limited. Venkateswararao.Podile et al., (2018)[34]had done capital structure analysis of Laxmi Vinay Poly Print Packs Private Limited. Venkateswararao.Podile et al., (2018)[35]had studied working capital management in Power Oxides Pvt. Ltd. Venkateswararao.Podile et al., (2018)[36]had done capital structure analysis of Radhika Vegetable Oils Private Limited. Venkateswararao.Podile et al., (2018)[37]had done capital structure analysis of Sri Nagavalli Solvent Oils Private Limited. Venkateswararao.Podile et al., (2018)[38]had done capital structure analysis of P.L.Plast Private Limited. Venkateswararao.Podile (2018)[39] had done capital structure analysis of Power Plant Engineering Works. It was found that most of the studies dealt with Profitability analysis of different large Enterprises and of sectors in India and abroad. Some of the studies dealt with MSME policies. Some other studies though dealt with MSMEs, they were confined to working capital management and capital structure analysis. There was no study on Profitability analysis of a Micro and Partnership enterprise which is engaged in the business of purchase and sale of raw cashew nut and manufacturing of cashew kernel. Hence, this study is taken up.

Objectives

The general objective of the study is to do Profitability Analysis of Bharat Cashew Manufacturing Company. The specific objectives include the following:

1. To examine Gross profit margin, Operating profit margin and Net Profit Margin of Bharat Cashew Manufacturing Company during the period of study.
2. To investigate into various profitability ratios relating to investment in Bharat Cashew Manufacturing Company during the period of study.
3. To analyze various profitability ratios related to expenses in Bharat Cashew Manufacturing Company during the period of study.
4. To examine the overall profitability of Bharat Cashew Manufacturing Company during the period of study.
5. To offer suggestions for improvement of profitability of the Enterprise, if required.

Hypotheses

H_{01}: Gross Profit Margin of Bharat Cashew Manufacturing Company is uniform during the period of study.

H_{02}: Operating Profit Margin of Bharat Cashew Manufacturing Company is uniform during the period of study.

H_{03}: Net Profit Margin of Bharat Cashew Manufacturing Company is uniform during the period of study.

H_{04}: Return on Assets (ROA) in Bharat Cashew Manufacturing Company is uniform during the period of study.

H_{05}: Return on Capital Employed (ROCE) in Bharat Cashew Manufacturing Company is uniform during the period of study.

H_{06}: Return on Share holder's equity (ROSE) in Bharat Cashew Manufacturing Company is uniform during the period of study.

H_{07}: Cost of Goods sold Ratio in Bharat Cashew Manufacturing Company is uniform during the period of study.

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H_{08}: Operating Expenses Ratio in Bharat Cashew Manufacturing Company is uniform during the period of study.

H_{09}: Administrative Expenses Ratio in Bharat Cashew Manufacturing Company is uniform during the period of study.

H_{10}: Selling Expenses Ratio in Bharat Cashew Manufacturing Company is uniform during the period of study

H_{11}: Financial Expenses Ratio in Bharat Cashew Manufacturing Company is uniform during the period of study.

III. METHODOLOGY

The present study is mainly based on secondary data. The data is taken from the financial statements including balance sheet, trading account and profit and loss account of Bharat Cashew Manufacturing Company. The period of study is ten years covering the financial years from 2006-07 to 2015-16.The data gathered is analyzed through the ratios relating to profitability of the enterprise. Profitability analysis was done through analyzing various profit margins, Profitability ratios relating to investments and Profitability ratios relating to various expenses. Profit margins covered include Gross Profit Margin, Operating Profit Margin and Net Profit Margin. Profitability ratios relating to investments include Return on Assets (ROA), Return on Capital Employed (ROCE) and Return on Share holder's equity (ROSE). Profitability ratios relating to various expenses include Cost of Goods sold Ratio, Operating Expenses Ratio, Administrative Expenses Ratio, Selling Expenses Ratio and Financial Expenses Ratio. Chi-square test is used for testing the hypotheses formed.

Profitability Analysis with Profit Margins

Profit Margins are based on the assumption that an Enterprise should earn sufficient profit on each Rupee of sales.

Gross Profit Margin

Gross Profit Margin has varied between 45.2 and 76.4 during the period of study. A high Gross Profit Margin is indicating that management is making good efforts in reducing cost of production. It is found in the significance test that Gross Profit Margin is uniform during the period of study.

Table-1: Gross Profit Margin (Figures in Lakhs)

Years	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Gross Profit	11.4	18.5	18.2	16.8	23.6	33.4	48.3	48.1	61.5	45.8
Sales	25.2	27.4	24.6	22.9	41.5	43.7	75.5	68.4	89.0	68.8
Gross Profit Margin	45.2	67.5	74.0	73.4	56.9	76.4	64.0	70.3	69.1	66.6

Source: Annual Reports of Bharat Cashew Manufacturing Company from 2006-07 to 2015-2016.

Calculated value of Chi-Square for Gross Profit Margin = 11.7. Calculated value is less than critical Value at 5% level of Significance i.e., 11.7<16.919, Hence, H_{01} is Accepted.

Operating Profit Margin

Operating Profit Margin has varied between 16.8 and 50.4 during the period of study. Operating Profit Margin is high during the period of study due to low cost of production. It had shown wide fluctuations. Hence, it is found in the significance test that Operating Profit Margin is not uniform during the period of study.

Table-2: Operating Profit Margin (Figures in Lakhs)

Years	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
EBIT	4.5	4.6	12.4	11.7	16.7	16.2	28.2	26.7	37.1	27.4
Sales	25.2	27.4	24.6	22.9	41.5	43.7	75.5	68.4	89.0	68.8
Operating Profit Margin	17.9	16.8	50.4	51.1	40.2	37.1	37.4	39.0	41.7	39.8

Source: Annual Reports of Bharat Cashew Manufacturing Company from 2006-07 to 2015-2016.

Calculated value of Chi-Square for Operating Profit Margin = 32.2. Calculated value is greater than critical Value at 5% level of Significance i.e., 32.2>16.919, Hence, H_{02} is Rejected.

Net Profit Margin

Net Profit Margin has varied between 1.2 and 10.5 during the period of study. Net Profit Margin is maintained relatively at low level even though the operating profit margin is high, which indicates that financial expenses are high in the enterprise during the period of study. Positive Net Profit Margin indicates that the firm is covering its financial expenses. It is found in the significance test that Net Profit Margin is uniform during the period of study.

Table-3: Net Profit Margin (Figures in Lakhs)

Years	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Net Profit	0.3	0.9	1.3	1.8	3.9	4.6	6.0	6.0	6.9	6.6
Sales	25.2	27.4	24.6	22.9	41.5	43.7	75.5	68.4	89.0	68.8
Net Profit Margin	1.2	3.3	5.3	7.9	9.4	10.5	7.9	8.8	7.8	9.6

Source: Annual Reports of Bharat Cashew Manufacturing Company from 2006-07 to 2015-2016.

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Calculated value of Chi-Square for Net Profit Margin = 11.2. Calculated value is less than critical Value at 5% level of Significance i.e., 11.2<16.919, Hence, H_{03} is Accepted.

Profitability Analysis with Profitability Ratios Related to Investment

Profitability ratios relating to investment are based on the assumption that an Enterprise should earn good profit on its investment.

Return on Assets (ROA)

Return on Assets Ratio has varied between 1.0 and 3.7 during the period of study. It is found in the significance test that Return on Assets Ratio is uniform during the period of study. Return on Assets Ratio is less than 10 during all the years of the study which indicates that there is need for better profitability management in the enterprise.

Table-4: Return on Assets (ROA) (Figures in Lakhs)

Years	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Net Profit	0.3	0.9	1.3	1.8	3.9	4.6	6.0	6.0	6.9	6.6
Average Total Assets	28.6	79.5	116.4	94.3	104.2	183.9	244.6	290.4	297.2	251.6
ROA	1.0	1.1	1.1	1.9	3.7	2.5	2.5	2.1	2.3	2.6

Source: Annual Reports of Bharat Cashew Manufacturing Company from 2006-07 to 2015-2016.

Calculated value of Chi-Square for ROA = 3.1. Calculated value is less than critical Value at 5% level of Significance i.e., 3.1<16.919, Hence, H_{04} is Accepted.

Return on Capital Employed (ROCE)

Return on capital employed has varied between 5.8 and 16.0 during the period of study. It is found in the significance test that Return on capital employed is uniform during the period of study. Return on Capital Employed is less than 20 during all the years of the study which indicates that there is need for better profitability management in the enterprise.

Table-5: Return on Capital Employed (ROCE) (Figures in Lakhs)

Years	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
EBIT	4.5	4.6	12.4	11.7	16.7	16.2	28.2	26.7	37.1	27.4
Average Total Capital	28.6	79.5	116.4	94.3	104.2	183.9	244.6	290.4	297.2	251.6
ROCE	15.7	5.8	10.7	12.4	16.0	8.8	11.5	9.2	12.5	10.9

Source: Annual Reports of Bharat Cashew Manufacturing Company from 2006-07 to 2015-2016.

Calculated value of Chi-Square for ROCE = 7.5. Calculated value is less than critical Value at 5% level of Significance i.e., 7.5<16.919, Hence, H_{05} is Accepted.

Return on Share Holders' Equity (ROSE)

Return on Shareholders' Equity has varied between 2.4 and 8.4 during the period of study. Return on Shareholders' Equity is less than 10 during all the years of the study which is not good for owners. Positive Net Profit made owners happy with the situation. Return on Shareholders' Equity is uniform during the period of study.

Table-6: Return on Share Holders' Equity (ROSE) (Figures in Lakhs)

Years	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Net Profit	0.3	0.9	1.3	1.8	3.9	4.6	6.0	6.0	6.9	6.6
Average Share Holders' Equity	6.9	26.2	54.1	26.5	56.7	61.3	95.4	71.2	170.5	159.1
ROSE	4.3	3.4	2.4	6.8	6.9	7.5	6.3	8.4	4.0	4.1

Source: Annual Reports of Bharat Cashew Manufacturing Company from 2006-07 to 2015-2016.

Calculated value of Chi-Square for ROSE = 6.7. Calculated value is less than critical Value at 5% level of Significance i.e., 6.7<16.919, Hence, H_{06} is Accepted.

Profitability Analysis with Profitability Ratios Related to Expenses

These ratios are based on the assumption that Enterprise should reduce its expenses in relation to sales.

Cost of Goods Sold Ratio

Cost of Goods Sold Ratio has varied between 23.6 and 54.8 during the period of study. A low Cost of Goods Sold Ratio is indicating that management is making good efforts in reducing cost of production. It is found in the significance test that Cost of Goods Sold Ratio is not uniform during the period of study.

Table-7: Cost of Goods Sold Ratio (Figures in Lakhs)

Years	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Cost of Goods sold	13.8	8.9	6.4	6.1	17.9	10.3	27.2	20.3	27.5	23
Sales	25.2	27.4	24.6	22.9	41.5	43.7	75.5	68.4	89.0	68.8
Ratio	54.8	32.5	26.0	26.6	43.1	23.6	36.0	29.7	30.9	33.4

Source: Annual Reports of Bharat Cashew Manufacturing Company from 2006-07 to 2015-2016.

Calculated value of Chi-Square for Cost of Goods sold Ratio = 23.1. Calculated value is greater than critical Value at 5% level of Significance i.e., 23.1>16.919, Hence, H_{07} is Rejected.

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Operating Expenses Ratio

Operating Expenses Ratio has varied between 16.1 and 50.0 during the period of study. Operating Expenses Ratio is in high range in the company except during 2011. Management should make efforts to reduce Operating expenses. There are wide fluctuations in this ratio for two years. Hence, it is found in the significance test that Operating Expenses Ratio is not uniform during the period of study.

Table-8: Operating Expenses Ratio (Figures in Lakhs)

Years	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Operating Expenses	6.7	13.7	5.6	4.9	6.7	16.6	19.9	21.1	24.2	17.9
Sales	25.2	27.4	24.6	22.9	41.5	43.7	75.5	68.4	89.0	68.8
Ratio	26.6	50.0	22.8	21.4	16.1	38.0	26.4	30.8	27.2	26.0

Source: Annual Reports of Bharat Cashew Manufacturing Company from 2006-07 to 2015-2016.

Calculated value of Chi-Square for Operating Expenses Ratio = 28.4. Calculated value is greater than critical Value at 5% level of Significance i.e., 28.4>16.919, Hence, H_{08} is Rejected.

Administrative Expenses Ratio

Administrative Expenses Ratio has varied between 15.7 and 49.3 during the period of study. Administrative Expenses Ratio is in high range in the company except during 2011. Management should make efforts to reduce Administrative expenses. It is found in the significance test that Administrative Expenses Ratio is not uniform during the period of study.

Table-9: Administrative Expenses Ratio (Figures in Lakhs)

Years	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Administrative Expenses	6.5	13.5	5.4	4.7	6.5	16.4	19.5	20.9	23.9	17.6
Sales	25.2	27.4	24.6	22.9	41.5	43.7	75.5	68.4	89.0	68.8
Ratio	25.8	49.3	22.0	20.5	15.7	37.5	25.8	30.6	26.9	25.6

Source: Annual Reports of Bharat Cashew Manufacturing Company from 2006-07 to 2015-2016.

Calculated value of Chi-Square for Administrative Expensive Ratio = 29.0. Calculated value is greater than critical Value at 5% level of Significance i.e., 29.0>16.919, Hence, H_{09} is Rejected.

Selling Expenses Ratio

Selling Expenses Ratio has varied between 0.3 and 0.9 during the period of study. A low Selling Expenses Ratio is indicating that management is making good efforts in reducing Selling expenses. It is found in the significance test that Selling Expenses Ratio is uniform during the period of study.

Table-10: Selling Expenses Ratio (Figures in Lakhs)

Years	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Selling Expenses	0.2	0.2	0.2	0.2	0.2	0.2	0.4	0.2	0.3	0.3
Sales	25.2	27.4	24.6	22.9	41.5	43.7	75.5	68.4	89.0	68.8
Ratio	0.8	0.7	0.8	0.9	0.5	0.5	0.5	0.3	0.3	0.4

Source: Annual Reports of Bharat Cashew Manufacturing Company from 2006-07 to 2015-2016.

Calculated value of Chi-Square for Selling Expenses Ratio = 0.7. Calculated value is less than critical Value at 5% level of Significance i.e., 0.7<16.919, Hence, H_{10} is Accepted.

Financial Expenses Ratio

Financial Expenses Ratio has varied between 13.5 and 45.1 during the period of study. Financial Expenses Ratio is high during the period of study except during 2007 and 2008. Management should make good efforts for reducing financial expenses. It is found in the significance test that Financial Expenses Ratio is not uniform during the period of study.

Table-11: Financial Expenses Ratio (Figures in Lakhs)

Years	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Financial Expenses	4.2	3.7	11.1	9.9	12.8	11.6	22.2	20.7	30.2	20.8
Sales	25.2	27.4	24.6	22.9	41.5	43.7	75.5	68.4	89.0	68.8
Ratio	16.7	13.5	45.1	43.2	30.8	26.5	29.4	30.3	33.9	30.2

Source: Annual Reports of Bharat Cashew Manufacturing Company from 2006-07 to 2015-2016.

Calculated value of Chi-Square for Financial Expenses Ratio = 29.4. Calculated value is greater than critical Value at 5% level of Significance i.e., 29.4>16.919, Hence, H_{11} is Rejected.

IV. CONCLUSION

Gross Profit Margin, Net Profit Margin, Return on Assets Ratio, Return on Capital Employed Ratio, Return on Share holder's Equity Ratio and Selling Expenses Ratio are uniform during the period of study. Operating Profit Margin, Cost of Goods sold Ratio, Operating Expenses Ratio, Administrative Expenses Ratio and Financial Expenses Ratio are not uniform during the period of study. High Gross Profit Margin and Operating Profit Margin are indicating that management is making good efforts in reducing cost of production. Net Profit Margin is maintained relatively at low level even though the operating profit margin is high, which

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indicates that financial expenses are high in the enterprise during the period of study. Low Return on Assets Ratio, low Return on Capital Employed Ratio and low Return on Share holder's Equity Ratio during all the years of the study indicate that there is need for better profitability management in the enterprise. The management should make efforts to reduce Administrative and financial expenses. Management is making good efforts in reducing selling expenses.

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CAPITAL STRUCTURE ANALYSIS OF A SMALL ENTERPRISE – A CASE STUDY OF SRI NAGAVALLI SOLVENT OILS PRIVATE LIMITED

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ABSTRACT

Finance decision is one of the important decisions of financial management in any Enterprise. Capital structure refers to the combination of debt and equity. The financial manger has to strike a balance between various sources of funds so as to maximise return of an Enterprise without affecting risk composition in the business. An optimal capital structure is very much essential to maximise the owner's wealth of any Enterprise. In this paper, an attempt is made to analyse the capital structure in Sri Nagavalli Solvent Oils Private Limited. Sri Nagavalli Solvent Oils Private Limited is a Small Enterprise located in Srikakulam district of Andhra Pradesh state in India. Sri Nagavalli Solvent Oils Private Limited is the Supplier and manufacturer of rice bran oil. In this paper composition of capital structure in the enterprise for a period of ten years is analysed. Leverage analysis was also done. Debt- Equity ratio, Proprietary Ratio, Solvency Ratio, Fixed Assets to Net worth Ratio, Fixed Assets Ratio, Current Assets to Proprietary Ratio and Interest Coverage Ratio are calculated for the study period. Chi-square test is used for testing Hypotheses.

KEY WORDS: Capital structure, Debt-Equity ratio, Degree of Financial Leverage, Degree of Operating Leverage, Interest Coverage Ratio, Solvency ratio .

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Working Capital Management in a Small Enterprise - A Case Study of Power Oxides Pvt. Ltd

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ABSTRACT

This paper deals with working capital management in Power Oxides Pvt. Ltd. Power Oxides Pvt. Ltd., is a small private Enterprise located in Guntur district of Andhra Pradesh state in India. It is involved in Mining of non-ferrous metal ores, except uranium and thorium ores. It is classified as Non-govt Company and is registered at Registrar of Companies, Hyderabad. Its authorized share capital is Rs. 25, 00,000 and its paid up capital is Rs. 25, 00,000. This Enterprise has an annual turnover of Rs.104.46 lakhs. The total Current Assets of the company are Rs.117.96 lakhs and the current liabilities are Rs. 104.5 lakhs as per 2015-16 annual accounts. The company has man power of 250. In this paper an attempt is made to analyse the structure and composition of the working capital during the period of study covering ten years from 2006-07 to 2015-16. Attempt is also made to assess the liquidity position of the organisation, to examine gross working capital turnover, to study net working capital turnover and to examine the efficiency in utilisation of various current assets. Different ratios are calculated. Chi-square test is used to test the hypotheses formed.

KEY WORDS: Small Enterprise, Working capital, Current ratio, Debtors turnover, Average collection period

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INTRODUCTION

Efficient Working capital management is required for better maintenance of liquidity and profitability trade-off in any Enterprise. In this paper, an attempt is made to examine working capital management in Power Oxides Pvt. Ltd. Power Oxides Pvt. Ltd., is a small private Enterprise located in Guntur district of Andhra Pradesh state in India. It was started in 1983. It is involved in Mining of non-ferrous metal ores, except uranium and thorium ores. It is classified as Non-govt Company and is registered at Registrar of Companies, Hyderabad. Its authorized share capital is Rs. 25, 00,000 and its paid up capital is Rs. 25, 00,000. This Enterprise has an annual turnover of Rs.104.46 lakhs. The total Current Assets of the company are Rs.117.96 lakhs and the current liabilities are Rs. 104.5 lakhs as per 2015-16 annual accounts. The company has man power of 250. Power Oxides Pvt. Ltd possesses the latest ISO 9001, ISO/TS 16949 and ISO 14001 quality certification.

REVIEW OF LITERATURE

Mishra (1975)[1] studied the efficiency of working capital management in six sample public sector units. The study identified that management of various components of working capital in sample units was highly unsatisfactory. Suk, Seung and Rowland (1992)[2] in their research conducted an in-depth survey to analyze the liquidity practices of ninety four sample Japanese companies operating in the United States. Sivarama (1999)[3] in his study on working capital management in the Indian paper industry, found a close association between profitability and working capital efficiency. Ghosh and Maji (2003)[4] made an empirical study on the relationship between utilization of current assets and operating profitability in the Indian cement and tea industries. Bardia (2004)[5] conducted a study on the issue pertaining to the relationship between working capital management and profitability of a Navaratna steel manufacturing public sector enterprise. Prof. B.P.Singh (2012)[6] investigated the relationship between the components of working capital and profitability. He observed that the telecom industry is operating below average so far as working capital is concerned. Pasupathi (2013)[7] conducted a comparative study of WCM performance in commercial vehicles, passenger cars and multi utility vehicles and two and three wheelers sectors of Indian automobile industry. Utkarsh Goel et al. (2015)[8] conducted a study to explore the impact of corporate governance practices on Working capital Management (WCM) in Indian firms. S. Selvanayaki et al. (2015)[9] focused on evaluating the WCM practices adopted by the rice milling firms and analyzed its impact on profitability. Venkateswararao.P, Surya Chandra Rao.D and Hema Venkata Siva Sree.Ch (2017)[10] examined working capital management in PL Plast Pvt Ltd. Venkateswararao.P, and Hema Venkata Siva Sree.Ch (2018)[11] examined working capital management in Sri Rama Chandra Paper

Boards Ltd. Venkateswararao.P (2018)[12] examined working capital management in Tulasi seeds Pvt.Ltd. Venkateswararao.P, and Hema Venkata Siva Sree.Ch (2018)[13] studied working capital management in Sri Nagavalli solvent oils Pvt. Ltd. Venkateswararao.P, and Hema Venkata Siva Sree.Ch (2018)[14] analysed working capital management in Naga Hanuman Solvent Oils Private Limited. Venkateswararao.P (2018)[15] examined working capital management in Cuddapah Spinning Mills Ltd. Venkateswararao.P, and Hema Venkata Siva Sree.Ch (2018)[16] studied working capital management in Kristna Engineering Works. Venkateswararao.P, and Hema Venkata Siva Sree.Ch (2018)[17] examined working capital management in Radhika Vegetables Oils Pvt. Ltd. Venkateswararao.P, and Hema Venkata Siva Sree.Ch (2018)[18] examined working capital management in Power Plant Engineering Works in Andhra Pradesh. It was found that there was no study on working capital management in a mining company. Hence, this study is taken up.

OBJECTIVES

The general objective of the study is to examine the working capital management in Power Oxides Pvt. Ltd. The specific objectives include the following.

1. To examine the structure and composition of working capital in Power Oxides Pvt. Ltd. during the period of study.
2. To analyze the liquidity position of Power Oxides Pvt. Ltd. during the period of study.
3. To find the gross working and networking turnover in Power Oxides Pvt. Ltd.
4. To examine the efficiency in cash, debtors and inventory management in the Small Enterprise under study.
5. To offer suggestions for effective working capital management if required.

HYPOTHESES

H_{01}: Current ratio in Power Oxides Pvt. Ltd. is uniform during the period of study.

H_{02}: Quick ratio in Power Oxides Pvt. Ltd. is uniform during the period of study.

H_{03}: Super quick ratio in Power Oxides Pvt. Ltd. is uniform during the period of study.

H_{04}: Gross working capital turnover ratio in Power Oxides Pvt. Ltd. is uniform during the period of study.

H_{05}: Net working capital turnover ratio in Power Oxides Pvt. Ltd. is uniform during the period of study.

H_{06}: Cash turnover ratio in Power Oxides Pvt. Ltd. is uniform during the period of study.

H_{07}: Inventory turnover ratio in Power Oxides Pvt. Ltd. is uniform during the period of study.

H_{08}: Debtors turnover ratio in Power Oxides Pvt. Ltd. is uniform during the period of study.

H_{09}: Average collection period in Power Oxides Pvt. Ltd. is uniform during the period of study.

METHODOLOGY

The present study is mainly based on secondary data. The data is taken from the financial statements including balance sheet, trading account and profit and loss account of Power Oxides Pvt. Ltd. The period of study is ten years covering the financial years from 2006-07 to 2015-16.The data gathered is analyzed through the technique of percentages and certain appropriate ratios relating to working capital management. The ratios covered includes current ratio, quick ratio, super quick ratio, gross working capital turnover ratio, net working capital turnover ratio, cash turnover ratio, inventory turnover ratio, debtors turnover ratio and average collection period. Chi square test is used for testing the hypotheses formed.

ANALYSIS AND DISCUSSION OF RESULTS

Working capital structure of Power Oxides Pvt. Ltd is presented in table-1. It is observed that Inventory was 9.75 percent of total current assets during 2011. It is the lowest percentage during the period of study. Its percentage was highest at 69.23 during 2015. It is observed that inventory occupied highest percentage of current assets during the year 2015. Debtors as a percentage of total current assets varied in between 15.82 during 2015 and 81.30 during 2016. Of all current assets debtors occupied highest percentage during the period of study except 2008, 2010, 2012 and 2015.It is also observed that cash and bank balance as a percentage of current assets varied between 1.94 during 2016 and 47.55 during 2010. Loans and advances as a percentage of current assets varied between 1.78 during 2010 and 10.28 during 2009. There were no loans and advances during the last five years of the study. Other current assets as a percentage of total current assets varied between 2.95 during 2016 and 11.02 during 2011. Sundry creditors as a percentage of total current liabilities varied between 2.56 during 2011 and 78.79 during 2016. Short-term borrowings by the Business organisation were made during the years 2012, 2013, 2015 and 2016. Short-term borrowings as a percentage of current liabilities varied between 18.34 during 2016 to 85.09 during 2015. Short-term provisions were maintained only for the first five years of the study. Short-term provisions as a percentage of current liabilities were 81.17 during 2008 and 97.44 during 2011. Other current liabilities were nil during the first five years of study. They varied in between 2.86 during 2016 and 95.52 during 2014. It is observed that Net Working Capital in the company varied between Rs.13.46

Lakhs during 2016 to Rs.60.95 Lakhs during 2008. It was maintained at high levels during 2007 and 2008.

Table-1: Working Capital structure of Power Oxides Pvt. Ltd, during 2006-2007 to 2015-2016

(Figures in Lakhs)

Particulars	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Current Assets										
Cash & Bank balances	2.96	4.16	2.35	28.38	6.06	4.01	2.04	1.85	3.44	2.29
% of TCA	4.74	5.09	4.51	47.55	14.51	6.52	3.64	4.06	6.21	1.94
Debtors	38.7	33.73	31.34	13.49	25.6	26.26	29.6	36.12	8.76	95.9
% of TCA	62.00	41.28	60.11	22.60	61.32	42.71	52.84	79.33	15.82	81.30
Loans & Advances	1.97	3.99	5.36	1.06	1.42	0	0	0	0	0
% of TCA	3.16	4.88	10.28	1.78	3.40	0.00	0.00	0.00	0.00	0.00
Other Current Assets	3.58	3.87	4.09	4.31	4.6	3.06	4.75	2.54	4.84	3.48
% of TCA	5.74	4.74	7.84	7.22	11.02	4.98	8.48	5.58	8.74	2.95
Inventory	15.21	35.97	9	12.44	4.07	28.16	19.63	5.02	38.33	16.29
% of TCA	24.37	44.02	17.26	20.84	9.75	45.80	35.04	11.03	69.23	13.81
Total Current Assets (TCA)	**62.42**	**81.72**	**52.14**	**59.68**	**41.75**	**61.49**	**56.02**	**45.53**	**55.37**	**117.96**
Current Liabilities										
Sundry Creditors	1.75	3.91	2.15	0.59	0.13	13.45	10.08	0.3	0.57	82.34
% of TCL	16.25	18.83	11.90	4.38	2.56	41.56	38.31	4.48	2.69	78.79
Other current liabilities	0	0	0	0	0	2.26	3.18	6.39	2.58	2.99
% of TCL	0.00	0.00	0.00	0.00	0.00	6.98	12.09	95.52	12.18	2.86
Short term borrowings	0	0	0	0	0	16.65	13.05	0	18.03	19.17
% of TCL	0.00	0.00	0.00	0.00	0.00	51.45	49.60	0.00	85.09	18.34
Short term provisions	9.02	16.86	15.92	12.87	4.95	0	0	0	0	0
% of TCL	83.75	81.17	88.10	95.62	97.44	0.00	0.00	0.00	0.00	0.00
Total Current Liabilities (TCL)	**10.77**	**20.77**	**18.07**	**13.46**	**5.08**	**32.36**	**26.31**	**6.69**	**21.19**	**104.5**
NWC	**51.65**	**60.95**	**34.07**	**46.22**	**36.67**	**29.13**	**29.71**	**38.84**	**34.18**	**13.46**

Source: Annual Reports of Power Oxides Pvt. Ltd. Guntur from 2006-07 to 2015-2016.

CURRENT RATIO

Table-2: Current Ratio

(Figures in Lakhs)

Years	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Current Assets	62.42	81.72	52.14	59.68	41.75	61.49	56.02	45.53	55.37	117.96
Current Liabilities	10.77	20.77	18.07	13.46	5.08	32.36	26.31	6.69	21.19	104.5
Current ratio	**5.79**	**3.93**	**2.88**	**4.43**	**8.21**	**1.90**	**2.13**	**6.81**	**2.61**	**1.13**

Source: Annual Reports of Power Oxides Pvt. Ltd. Guntur from 2006-07 to 2015-2016.

The current ratio in the company was maintained at normal level in the company. It has varied between 1.13 during 2016 and 8.21 during 2011 was shown in the table. The current ratio of the company is maintained at normal levels. It is found in the significance test that current ratio is uniform during the period of study.

Calculated value of $\chi 2$for current ratio =12.140.

The Critical value of $\chi 2$ at 9 degrees of freedom at 5% level of Significance is 16.919 Calculated value is less than Critical Value i.e., 12.140<16.919.

Hence H_{01} is accepted.

QUICK RATIO

The quick ratio of the company as shown in the table has varied between 0.80 during 2015 to 7.42 during 2011. It is found in the significance test that quick ratio is uniform during the period of study.

Table-3: Quick Ratio

(Figures in Lakhs)

Years	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Liquid Assets	47.21	45.75	43.14	47.24	37.68	33.33	36.39	40.51	17.04	101.67
Current Liabilities	**10.77**	20.77	18.07	13.46	5.08	32.36	26.31	6.69	21.19	104.5
Quick ratio	**4.38**	**2.20**	**2.39**	**3.51**	**7.42**	**1.03**	**1.38**	**6.06**	**0.80**	**0.97**

Source: Annual Reports of Power Oxides Pvt. Ltd. Guntur from 2006-07 to 2015-2016.

Calculated value of $\chi 2$ for Quick ratio =15.773.

The Critical value of $\chi 2$ at 9 degrees of freedom at 5% level of Significance is 16.919 Calculated value is less than Critical Value i.e., 15.773<16.919.

Hence, H_{02} is accepted.

SUPER QUICK RATIO

Table-4: Super Quick Ratio

(Figures in Lakhs)

Years	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Cash	2.96	4.16	2.35	28.38	6.06	4.01	2.04	1.85	3.44	2.29
Current Liabilities	**10.77**	20.77	18.07	13.46	5.08	32.36	26.31	6.69	21.19	104.5
Super Quick ratio	**0.27**	**0.20**	**0.13**	**2.11**	**1.19**	**0.12**	**0.08**	**0.28**	**0.16**	**0.02**

Source: Annual Reports of Power Oxides Pvt. Ltd. Guntur from 2006-07 to 2015-2016.

The super quick ratio of the company as shown in the table has varied between 0.02 during 2016 and 2.11 during 2010. It is found in the significance test that super quick ratio is uniform during the period of study

Calculated value of $\chi 2$ for Super Quick ratio =8.868.

The Critical value of $\chi 2$ at 9 degrees of freedom at 5% level of Significance is 16.919. Calculated value is less than Critical Value i.e., 8.868<16.919.

Hence, H_{03} is accepted.

GROSS WORKING CAPITAL TURNOVER RATIO

The Gross working capital turnover ratio of the company as shown in the table has varied between 0.59 during 2008 and 6.85 during 2010. It is found in the significance test that Gross working capital turnover ratio is uniform during the period of study.

Table-5: Gross Working Capital turnover Ratio

(Figures in Lakhs)

Years	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Sales	86.81	48.75	165.76	409.39	203.92	50.51	155.07	93.15	159.36	104.46
Gross working capital	62.42	81.72	52.14	59.68	41.75	61.49	56.02	45.53	55.37	117.96
Ratio	**1.39**	**0.59**	**3.18**	**6.85**	**4.88**	**0.82**	**2.77**	**2.05**	**2.88**	**0.89**

Source: Annual Reports of Power Oxides Pvt. Ltd. Guntur from 2006-07 to 2015-2016.

Calculated value of $\chi 2$ for Gross Working Capital turnover ratio =13.534.

The Critical value of $\chi 2$ at 9 degrees of freedom at 5% level of Significance is 16.919 Calculated value is less than Critical Value i.e., 13.534<16.919.

Hence, H_{04} is accepted.

NET WORKING CAPITAL TURNOVER RATIO

The net working capital turnover ratio of the company as shown in the table has varied between 0.80 during 2008 and 8.86 during 2010. It is found in the significance test that net working capital turnover ratio is uniform during the period of study.

Table-6: Net Working Capital Turnover Ratio

(Figures In lakhs)

Years	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Sales	86.81	48.75	165.76	409.39	203.92	50.51	155.07	93.15	159.36	104.46
Net Working Capital	51.65	60.95	34.07	46.22	36.67	29.13	29.71	38.84	34.18	13.46
Ratio	**1.68**	**0.80**	**4.87**	**8.86**	**5.56**	**1.73**	**5.22**	**2.40**	**4.66**	**7.76**

Source: Annual Reports of Power Oxides Pvt. Ltd. Guntur from 2006-07 to 2015-2016.

Calculated value of $\chi 2$ for Net Working capital turnover ratio =14.918. The Critical value of $\chi 2$ at 9 degrees of freedom at 5% level of Significance is 16.919 Calculated value is greater than Critical Value i.e., 14.918<16.919.

Hence, H_{05} is accepted.

CASH TURNOVER RATIO

The cash turnover ratio of the company as shown in the table has varied between 10.02 during 2012 and 60.14 during 2015. It is found in the significance test that cash turnover ratio is not uniform during the period of study.

Table-7: Cash Turnover Ratio

(Figures In lakhs)

Years	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Sales	86.81	48.75	165.76	409.39	203.92	50.51	155.07	93.15	159.36	104.46
Average Cash Balance	3.60	3.56	3.26	15.37	17.22	5.04	3.03	1.95	2.65	2.87
Cash Turnover Ratio	**24.11**	**13.69**	**50.85**	**26.64**	**11.84**	**10.02**	**51.18**	**47.77**	**60.14**	**36.40**

Source: Annual Reports of Power Oxides Pvt. Ltd. Guntur from 2006-07 to 2015-2016.

Calculated value of $\chi 2$ for Cash turnover ratio =92.680.

The Critical value of $\chi 2$ at 9 degrees of freedom at 5% level of Significance is 16.919 Calculated value is greater than Critical Value i.e. 92.680>16.919.

Hence, H_{07} is rejected.

INVENTORY TURNOVER RATIO

The inventory turnover ratio of the company as shown in the table has varied between 1.91 during 2008 to 38.19 during 2010. It is found in the significance test that Inventory turnover ratio is not uniform during the period of study.

Table-8: Inventory Turnover Ratio

(Figures In lakhs)

Years	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Sales	86.81	48.75	165.76	409.39	203.92	50.51	155.07	93.15	159.36	104.46
Average Inventory	16.26	25.59	22.49	10.72	8.26	16.12	23.90	12.33	21.68	27.31
Ratio	**5.34**	**1.91**	**7.37**	**38.19**	**24.69**	**3.13**	**6.49**	**7.55**	**7.35**	**3.82**

Source: Annual Reports of Power Oxides Pvt. Ltd. Guntur from 2006-07 to 2015-2016.

Calculated value of $\chi 2$ for Inventory turnover ratio =114.500.

The Critical value of $\chi 2$ at 9 degrees of freedom at 5% level of Significance is 16.919 Calculated value is greater than Critical Value i.e. 114.500>16.919, Hence, H_{07} is rejected.

DEBTORS TURNOVER RATIO

The debtor's turnover ratio of the company as shown in table10 has varied between 1.35 during 2008 to 18.26 during 2010. It is found in the significance test that Debtors turnover ratio is not uniform during the period of study.

Table-9: Debtors Turnover Ratio

(Figures In lakhs)

Years	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Sales	86.81	48.75	165.76	409.39	203.92	50.51	155.07	93.15	159.36	104.46
Average debtors	36.26	36.215	32.535	22.415	19.545	25.93	27.93	32.86	22.44	52.33
Debtors Turnover Ratio	**2.39**	**1.35**	**5.09**	**18.26**	**10.43**	**1.95**	**5.55**	**2.83**	**7.10**	**1.99**

Source: Annual Reports of Power Oxides Pvt. Ltd. Guntur from 2006-07 to 2015-2016.

Calculated value of $\chi 2$ for Debtors turnover ratio = 43.629.

The Critical value of $\chi 2$ at 9 degrees of freedom at 5% level of Significance is 16.919 Calculated value is greater than Critical Value i.e., 43.6289>16.919.

Hence, H_{08} is rejected.

AVERAGE COLLECTION PERIOD

Table-10: Average Collection Period

(Figures In lakhs)

Years	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Days in a year	365	365	365	365	365	365	365	365	365	365
Debtors Turnover Ratio	2.39	1.35	5.09	18.26	10.43	1.95	5.55	2.83	7.10	1.99
Average Collection Period	**153**	**270**	**72**	**20**	**35**	**187**	**66**	**129**	**51**	**183**

Source: Annual Reports of Power Oxides Pvt. Ltd. Guntur from 2006-07 to 2015-2016.\

The average collection period as shown in the table has varied between 20 days during 2010 to 270 days during 2008. It is found in the significance test that Average collection period is not uniform during the period of study.

Calculated value of $\chi 2$ for Average collection period =507.877.

The Critical value of $\chi 2$ at 9 degrees of freedom at 5% level of Significance is 16.919 Calculated value is greater than Critical Value i.e. 507.877>16.919.

Hence, H_{09} is rejected.

CONCLUSION

It is clear that debtors occupied first place followed by inventory as a percentage of current assets in Power Oxides Pvt. Ltd. during the period of study. The Business organisation has credit worthiness because there is a significant increase in creditors and short term borrowings during the study period. Current ratio of the company is too high during some years of study which indicates that the company is not using its current assets or its short term financing facilities efficiently. Debtors' turnover ratio was very less during five years of the study which reflects in high Average collection period. Cash turnover ratio, Inventory turnover ratio, debtor turnover ratios and average

collection periods are not uniform during the period of study and showed wide fluctuations. Collection of debts and cash utilization was poorly done in the company during the period of study. Current ratio, Quick ratio, super quick ratio, Gross working capital to total assets ratio, Gross working turnover ratio, Net working capital turnover ratio are uniform during the period of study.

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Capital Structure Analysis of a Small Enterprise - A Case Study of Power Oxides Private Limited

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Abstract: *Capital structure refers to the combination of debt and equity. The financial manger has to strike a balance between various sources of funds so as to maximise return of an Enterprise without affecting risk composition in the business. An optimal capital structure is very much essential to maximise the owner's wealth of any Enterprise. In this paper, an attempt is made to analyse the capital structure in Power Oxides Private Limited. Power Oxides Private Limited is a small private Enterprise located in Guntur district of Andhra Pradesh state in India. It is involved in Mining of non-ferrous metal ores, except uranium and thorium ores. This Enterprise has an annual turnover of Rs.104.46 lakhs. The total Assets of the company are Rs.138.9 lakhs and the as per 2015-16 annual accounts. In this paper composition of capital structure in the enterprise for a period of ten years is analysed. Leverage analysis was also done. Debt- Equity ratio, Proprietary Ratio, Solvency Ratio, Fixed Assets to Net worth Ratio, Fixed Assets Ratio, Current Assets to Proprietary Ratio and Interest Coverage Ratio are calculated for the study period. Chi-square test is used for testing Hypotheses.*

Keywords*: Capital structure, Degree of Combined leverage, Degree of Financial Leverage, Fixed Assets ratio, Interest coverage ratio, Solvency ratio*

I. INTRODUCTION

Finance decision is one of the important decisions of financial management in any Enterprise. It deals with capital structure or finance mix of an Enterprise. Capital structure refers to the combination of debt and equity. The financial manger has to strike a balance between various sources of funds so as to maximise return of an Enterprise without affecting risk composition in the business. An optimal capital structure is very much essential to maximise the owner's wealth of any Enterprise. In this paper, an attempt is made to analyse the capital structure in Power Oxides Private Limited. Power Oxides Private Limited is a small private Enterprise located in Guntur district of Andhra Pradesh state in India. It was started in 1983. It is involved in Mining of non-ferrous metal ores, except uranium and thorium ores. It is classified as Non-govt Company and is registered at Registrar of Companies, Hyderabad. Its authorized share capital is Rs. 25, 00,000 and its paid up capital is Rs. 25, 00,000. This Enterprise has an annual turnover of Rs.104.46 lakhs. The total Assets of the company are Rs.138.9 lakhs and the as per 2015-16 annual accounts. Power Oxides Pvt. Ltd possesses the latest ISO 9001, ISO/TS 16949 and ISO 14001 quality certification.

II. REVIEW OF LITERATURE

J. H. Chua et al., (1993)[1] made a study on the capital structure of forty three private companies in Canada from 1993-1998. Shyam-Sunder, L. et al., (1999)[2] studied on the pecking order Models for corporate financing in one hundred fifty seven industrial units in US existed between 1971 and 1989. Kaur, R. et al., (2009)[3] investigated on the determinants of capital structure in eight best doing Textile units in India from 2003-04 to 2007-08. Bhayani, S. J (2009)[4] had conducted study on impact of Financial Leverage on cost of capital and valuation of Indian cement Industry. Dr. A.Vijayakumar (2011)[5] examined the trade-off and pecking order hypotheses in twenty automobile firms in India and found that more profitable companies had less debt. S. Ramaratnam et al., (2013)[6] examined the determinants of capital structure in Pharmaceutical companies in India. Thomas, A. E (2013)[7] examined the capital structure of twenty one units in Indian cement industry from 2003-04 to 2007-08. Srivastava, N., (2014)[8] had examined the determinants of leverage in ten cement companies in India over a period of 2008-2012. Lyubomira Koeva-Dimitrova (2016)[9] had analyzed the capital structure of the medical diagnostic-consultative centres in Varna city for the purpose of assessing their long-term solvency and existence of financial risk. Radojko Lukić et al., (2016)[10] investigated the determinants of capital structure in Serbia's commercial sector. Venkateswararao.Podile (2017)[11] had examined the recent MSME policy of Andhra Pradesh. Venkateswararao.Podile et al., (2017)[12] examined working capital management in PL Plast Pvt Ltd.

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Venkateswararao.Podile et al., (2017)[13] had examined various Government schemes supporting MSMEs in India. Chandrika Prasad Das et al., (2018)[14] had conducted a study in India to find out the determinants of capital structure and their impact on financial performance by using secondary data taken from fifty top manufacturing companies and by using regression model. Venkateswararao.Podile et al., (2018)[15] examined working capital management in Sri Rama Chandra Paper Boards Ltd. Venkateswararao.Podile (2018)[16] examined working capital management in Tulasi seeds Pvt.Ltd. Venkateswararao.Podile et al., (2018)[17] studied working capital management in Sri Nagavalli solvent oils Pvt. Ltd. Venkateswararao.Podile et al., (2018)[18] analysed working capital management in Naga Hanuman Solvent Oils Private Limited. Venkateswararao.Podile (2018)[19] examined working capital management in Cuddapah Spinning Mills Ltd. Venkateswararao.Podile et al., (2018)[20] studied working capital management in Kristna Engineering Works. Venkateswararao.Podile et al., (2018)[21] examined working capital management in Radhika Vegetables Oils Pvt. Ltd. Venkateswararao.Podile et al., (2018)[22] examined working capital management in Power Plant Engineering Works in Andhra Pradesh. Venkateswararao.Podile et al., (2018)[23] examined working capital management in Nagas Elastomer Works. Venkateswararao.Podile et al., (2018)[24] had studied working capital management in M.G.Metallic Springs Pvt. Ltd. Venkateswararao.Podile et al., (2018)[25] had studied working capital management in Sri Srinivasa Spun Pipes Company. Venkateswararao.Podile et al., (2018)[26]had studied working capital management in Raghunath Dye Chem Pvt. Ltd. Venkateswararao.Podile et al., (2018)[27] had examined working capital management in Maitreya Electricals Pvt. Ltd. Venkateswararao.Podile et al., (2018)[28] had examined working capital management in Laxmi Vinay Poly Print Packs Pvt. Ltd. Venkateswararao.Podile et al., (2018)[29] had done capital structure analysis of M.G.Metallic Springs Pvt. Ltd. Venkateswararao.Podile et al., (2018)[30]had done capital structure analysis of Naga Hanuman Solvent Oils Private Limited. Venkateswararao.Podile et al., (2018)[31]had done capital structure analysis of Raghunath Dye Chem Pvt. Ltd. Venkateswararao.Podile et al., (2018)[32]had done capital structure analysis of Nagas Elastomer Works. Venkateswararao.Podile et al., (2018)[33]had done capital structure analysis of Tulasi Seeds Pvt. Ltd. Venkateswararao.Podile et al., (2018)[34]had done capital structure analysis of Bharat Cashew Manufacturing Company. It was found that most of the studies dealt with capital structure in large companies. Some of the studies dealt with MSME policies. Some other studies though dealt with MSMEs, they were confined to working capital management. Few studies dealt with capital structure analysis in MSMEs. There was no study on capital structure analysis of a Small enterprise involved in Mining of non-ferrous metal ores, except uranium and thorium ores. Hence, this study is taken up.

Objectives

The general objective of the study is to analyze the capital structure of Power Oxides Private Limited. The specific objectives include the following.

1. To examine composition of capital structure in Power Oxides Private Limited during the period of study.
2. To analyze the status of Degree of Operating Leverage, Degree of Financial Leverage and Degree of Combined Leverage in Power Oxides Private Limited during the period of study.
3. To investigate long term solvency position Power Oxides Private Limited during the period of study.
4. To examine the coverage of financial expenses in the small enterprise during the period of study.
5. To offer suggestions for improvement of capital structure decisions, if required.

Hypotheses

H_{01}: Degree of Operating Leverage in Power Oxides Private Limited is uniform during the period of study.

H_{02}: Degree of Financial Leverage in Power Oxides Private Limited is uniform during the period of study.

H_{03}: Degree of Combined Leverage in Power Oxides Private Limited is uniform during the period of study.

H_{04}: Debt - Equity Ratio in Power Oxides Private Limited is uniform during the period of study.

H_{05}: Proprietary Ratio in Power Oxides Private Limited is uniform during the period of study.

H_{06}: Solvency Ratio in Power Oxides Private Limited is uniform during the period of study.

H_{07}: Fixed Assets to Net worth Ratio in Power Oxides Private Limited is uniform during the period of study.

H_{08}: Fixed Assets Ratio in Power Oxides Private Limited is uniform during the period of study.

H_{09}: Current Assets to Proprietary funds Ratio in Power Oxides Private Limited is uniform during the period of study.

H_{10}: Interest Coverage Ratio in Power Oxides Private Limited is uniform during the period of study.

III. METHODOLOGY

The present study is mainly based on secondary data. The data is taken from the financial statements including balance sheet, trading account and profit and loss account of Power Oxides Private Limited. The period of study is ten years covering the financial years from 2006-07 to 2015-16.The data gathered is analyzed

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through the technique of percentages and certain appropriate ratios relating to capital structure of the enterprise. Degree of Operating Leverage, Degree of Financial Leverage and Degree of Combined Leverage are calculated during study period for leverage analysis. The ratios covered include Debt – Equity Ratio, Proprietary Ratio, Solvency Ratio, Fixed Assets to Net worth Ratio, Fixed Assets Ratio, Current Assets to Proprietary Ratio and Interest Coverage Ratio. Chi-square test is used for testing the hypotheses formed.

Composition of capital structure

The data in table-1 represent the fact that Share capital as a percentage of total equity capital has varied between 46.6 during 2011 and 102.0 during 2016. The share capital as a percentage of total equity capital is 102 during 2016 due to the fact that reserves and surpluses are negative during the year. It is also observed that reserves and surplus as a percentage of total equity capital had varied between -2.0 during 2016 and 53.4 during 2011. Total equity capital as a percentage of total capital has varied between 17.6 during 2016 and 79.8 during 2014. It is also observed that long term debt as a percentage of total debt had varied between 8.6 during 2016 and 58.0 during 2007. On the other hand, short term debt as a percentage of total debt has varied between 42.0 during 2007 and 91.4 during 2016. Total debt capital as a percentage of total capital has varied between 20.2 during 2014 and 82.4 during 2016.

Table-1: Structure and Composition of Capital structure in Power Oxides Private Limited during 2006-2007 to 2015-2016 (Figures in Lakhs)

Particulars	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Equity capital										
Share Capital	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0
% of Total Equity capital	58.7	51.7	48.9	47.9	46.6	55.1	48.2	46.8	52.4	102.0
Reserves & Surplus	17.6	23.4	26.1	27.2	28.6	20.4	26.9	28.4	22.7	-0.5
% of Total Equity capital	41.3	48.3	51.1	52.1	53.4	44.9	51.8	53.2	47.6	-2.0
Total Equity Capital	42.6	48.4	51.1	52.2	53.6	45.4	51.9	53.4	47.7	24.5
% of Total Capital	40.5	40.0	59.4	54.3	73.9	49.2	62.4	79.8	60.6	17.6
Debt Capital										
Long Term Debt	36.3	34.0	8.4	20.9	2.9	14.6	5.0	6.8	9.8	9.8
% of Total Debt capital	58.0	46.9	24.1	47.6	15.3	31.1	16.0	50.4	31.6	8.6
Short Term Debt	26.3	38.5	26.5	23.0	16.0	32.3	26.3	6.7	21.2	104.6
% Total Debt capital	42.0	53.1	75.9	52.4	84.7	68.9	84.0	49.6	68.4	91.4
Total Debt Capital	62.6	72.5	34.9	43.9	18.9	46.9	31.3	13.5	31.0	114.4
% of Total Capital	59.5	60.0	40.6	45.7	26.1	50.8	37.6	20.2	39.4	82.4
Total Capital	105.2	120.9	86.0	96.1	72.5	92.3	83.2	66.9	78.7	138.9

Source: Annual Reports of Power Oxides Private Limited from 2006-07 to 2015-2016.

Leverage Analysis

Leverage analysis is useful for understanding the ability of the enterprise to magnify the effect of changes in sales on operating profit, the effect of changes in operating profit on Net Income and the effect of changes in sales on Net Income.

Degree of Operating Leverage

The Degree of Operating Leverage has varied between -18.41 and 2.09. Operating leverage is favourable during 2011, 2012 and 2014 as DOL is greater than one. Operating leverage is un-favourable during other seven years as DOL is less than one. It is found in the significance test that Degree of Operating Leverage is not uniform during the period of study.

Table-2: Degree of Operating Leverage (Figures in Lakhs)

Years	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Percentage change in EBIT	24.5	87.1	-19.4	-12.1	-54.9	-157.0	-297.8	-51.7	-162.8	633.3
Percentage Change in Sales	40.0	-43.8	239.8	146.9	-50.2	-75.2	207.1	-39.9	71.0	-34.4
DOL	0.61	-1.99	-0.08	-0.08	1.09	2.09	-1.44	1.30	-2.29	-18.41

Source: Annual Reports of Power Oxides Private Limited from 2006-07 to 2015-2016.

Calculated value of $\chi 2$ for Degree of Operating Leverage = 167.2. The Critical value of $\chi 2$ at 9 degrees of freedom at 5% level of Significance is 16.919. Calculated value is greater than Critical Value i.e., 167.2>16.919, Hence, H_{01} is Rejected.

Degree of Financial Leverage

The Degree of Financial Leverage has varied between -0.50 and 7.21. Financial leverage is favourable during 2008, 2009, 2010, 2012, 2014 and 2015 as DFL is greater than one. Financial leverage is neither favourable nor un-favourable during 2014. Financial leverage is un-favourable during other four years as DFL is less than one. It is found in the significance test that Degree of Financial Leverage is not uniform during the period of study.

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Table-3: Degree of Financial Leverage (Figures in Lakhs)

Years	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Percentage change in Net income	15.4	160.0	-26.5	-87.2	27.3	-692.9	-178.3	-75.4	-450.0	314.3
Percentage change in EBIT	24.5	87.1	-19.4	-12.1	-54.9	-157.0	-297.8	-51.7	-162.8	633.3
DFL	0.63	1.84	1.37	7.21	-0.50	4.41	0.60	1.46	2.76	0.50

Source: Annual Reports of Power Oxides Private Limited from 2006-07 to 2015-2016.

Calculated value of $\chi 2$ for Degree of Financial Leverage = 23.0. The Critical value of $\chi 2$ at 9 degrees of freedom at 5% level of Significance is 16.919. Calculated value is greater than Critical Value i.e., 23.0>16.919, Hence, H_{02} is Rejected.

Degree of Combined Leverage

The Degree of Combined Leverage has varied between -9.14 and 9.21. Combined leverage is favourable during 2012 and 2014 as DCL is greater than one. Combined leverage is un-favourable during other eight years as DCL is less than one. It is found in the significance test that Degree of Combined Leverage is not uniform during the period of study.

Table-4: Degree of Combined Leverage (Figures in Lakhs)

Years	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Percentage change in Net income	15.4	160.0	-26.5	-87.2	27.3	-692.9	-178.3	-75.4	-450.0	314.3
Percentage Change in Sales	40.0	-43.8	239.8	146.9	-50.2	-75.2	207.1	-39.9	71.0	-34.4
DCL	0.39	-3.65	-0.11	-0.59	-0.54	9.21	-0.86	1.89	-6.34	-9.14

Source: Annual Reports of Power Oxides Private Limited from 2006-07 to 2015-2016.

Calculated value of $\chi 2$ for Degree of Combined Leverage = 223.3. The Critical value of $\chi 2$ at 9 degrees of freedom at 5% level of Significance is 16.919. Calculated value is greater than Critical Value i.e., 223.3>16.919, Hence, H_{03} is Rejected.

Capital structure Ratios

Capital structure ratios are useful for understanding long term solvency of the Enterprise. Long term solvency means ability of the enterprise to meet long term obligations.

Debt-Equity Ratio

The Debt-Equity ratio of the Enterprise varied between 0.25 during 2014 and 4.67 during 2016. It is found in the significance test that Debt-Equity ratio is uniform during the period of study. Debt- Equity ratio is less than one during 2009, 2010, 2011, 2013, 2014 and 2015 ensuring high margin of safety for lenders. It is in the reasonable range during 2007, 2008 and 2012. It is 4.67 during 2016 which reduced margin of safety for lenders.

Table-5: Debt-Equity Ratio (Figures in Lakhs)

Years	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Outside funds	62.6	72.5	34.9	43.9	18.9	46.9	31.3	13.5	31.0	114.4
Share Holders funds	42.6	48.4	51.1	52.2	53.6	45.4	51.9	53.4	47.7	24.5
Debt-Equity Ratio	1.47	1.50	0.68	0.84	0.35	1.03	0.60	0.25	0.65	4.67

Source: Annual Reports of Power Oxides Private Limited from 2006-07 to 2015-2016.

Calculated value of $\chi 2$ for Debt-Equity Ratio = 12.4. The Critical value of $\chi 2$ at 9 degrees of freedom at 5% level of Significance is 16.919. Calculated value is less than Critical Value i.e., 12.4<16.919, Hence, H_{04} is accepted.

Proprietary Ratio

The Proprietary ratio of the Enterprise varied between 0.18 during 2016 and 0.80 during 2014. It is found in the significance test that Proprietary ratio is uniform during the period of study. Proprietary ratio is more than 0.5 during six years ensured good long term solvency of the enterprise. Low proprietary ratio during last year decreased long term solvency position.

Table-6: Proprietary Ratio (Figures in Lakhs)

Years	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Share Holders funds	42.6	48.4	51.1	52.2	53.6	45.4	51.9	53.4	47.7	24.5
Total Assets	105.2	120.9	86.0	96.1	72.5	92.3	83.2	66.9	78.7	138.9
Proprietary Ratio	0.40	0.40	0.59	0.54	0.74	0.49	0.62	0.80	0.61	0.18

Source: Annual Reports of Power Oxides Private Limited from 2006-07 to 2015-2016.

Calculated value of $\chi 2$ for Proprietary ratio = 0.5. The Critical value of $\chi 2$ at 9 degrees of freedom at 5% level of Significance is 16.919 Calculated value is less than Critical Value i.e., 0.5<16.919, Hence, H_{05} is accepted.

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Solvency Ratio

The Solvency ratio of the Enterprise varied between 0.20 during 2014 and 0.82 during 2016. It is found in the significance test that Solvency ratio is uniform during the period of study. Solvency ratio is comparatively high during last year of the study.

Table-7: Solvency Ratio (Figures in Lakhs)

Years	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Total Liabilities to outsiders	62.6	72.5	34.9	43.9	18.9	46.9	31.3	13.5	31.0	114.4
Total Assets	105.2	120.9	86.0	96.1	72.5	92.3	83.2	66.9	78.7	138.9
Solvency Ratio	0.60	0.60	0.41	0.46	0.26	0.51	0.38	0.20	0.39	0.82

Source: Annual Reports of Power Oxides Private Limited from 2006-07 to 2015-2016.

Calculated value of $\chi 2$ for Solvency ratio = 0.6. The Critical value of $\chi 2$ at 9 degrees of freedom at 5% level of Significance is 16.919 Calculated value is less than Critical Value i.e., 0.6<16.919, Hence, H_{06} is accepted.

Fixed Assets to Net worth Ratio

The Fixed Assets to Net worth ratio of the Enterprise varied between 0.31 during 2014 and 1.0 during 2007. It is found in the significance test that Fixed Assets to Net worth ratio is uniform during the period of study. Fixed Assets to Net-worth ratio is always less than one or equal to one during all the years of the study, indicating that owner funds are more than fixed assets in the enterprise. During last nine years of the study part or majority of share holders funds are available to finance working capital. This is good for the enterprise.

Table-8: Fixed Assets to Net worth Ratio (Figures in Lakhs)

Years	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Fixed Assets	42.8	39.2	33.8	36.4	30.7	26.0	22.2	16.5	18.3	15.9
Share Holders funds	42.6	48.4	51.1	52.2	53.6	45.4	51.9	53.4	47.7	24.5
Ratio	1.00	0.81	0.66	0.70	0.57	0.57	0.43	0.31	0.38	0.65

Source: Annual Reports of Power Oxides Private Limited from 2006-07 to 2015-2016.

Calculated value of $\chi 2$ for Fixed Assets to Net worth ratio = 0.6. The Critical value of $\chi 2$ at 9 degrees of freedom at 5% level of Significance is 16.919. Calculated value is less than Critical Value i.e., 0.6<16.919, Hence, H_{07} is accepted.

Fixed Assets Ratio

The Fixed Assets ratio of the Enterprise varied between 0.27 during 2014 and 0.57 during 2009. It is found in the significance test that Fixed Assets ratio is uniform during the period of study. Fixed Assets ratio is less than one during all the years of the study indicating that long term funds are also available for financing working capital requirements. This is good for the enterprise.

Table-9: Fixed Assets Ratio (Figures in Lakhs)

Years	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Fixed Assets	42.8	39.2	33.8	36.4	30.7	26.0	22.2	16.5	18.3	15.9
Total Long Term funds	78.9	82.4	59.5	73.1	56.5	60	56.9	60.2	57.5	34.3
Fixed Assets Ratio	0.54	0.48	0.57	0.50	0.54	0.43	0.39	0.27	0.32	0.46

Source: Annual Reports of Power Oxides Private Limited from 2006-07 to 2015-2016.

Calculated value of $\chi 2$ for Fixed Assets ratio = 0.2. The Critical value of $\chi 2$ at 9 degrees of freedom at 5% level of Significance is 16.919 Calculated value is less than Critical Value i.e., 0.2 <16.919, Hence, $H_{08}$is accepted.

Current Assets to Proprietary Funds Ratio

The Current Assets to Proprietary Funds ratio of the Enterprise varied between 0.8 during 2011 and 4.8 during 2016. It is found in the significance test that Current Assets to Proprietary Funds ratio is uniform during the period of study. Current assets to proprietary ratio is always greater than one except during 2009, 2011 and 2013.

Table-10: Current Assets to Proprietary Funds Ratio (Figures in Lakhs)

Years	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Current Assets	62.4	81.7	52.1	59.7	41.8	61.5	56.0	45.5	55.4	118.0
Share Holders funds	42.6	48.4	51.1	52.2	53.6	45.4	51.9	53.4	47.7	24.5
Ratio	1.5	1.7	1.0	1.1	0.8	1.4	1.1	0.9	1.2	4.8

Source: Annual Reports of Power Oxides Private Limited from 2006-07 to 2015-2016.

Calculated value of $\chi 2$ for Current Assets to proprietary funds ratio = 8.0. The Critical value of $\chi 2$ at 9 degrees of freedom at 5% level of Significance is 16.919 Calculated value is less than Critical Value i.e., 8.0<16.919, Hence, H_{09} is accepted.

Interest Coverage Ratio

The Interest Coverage ratio of the Enterprise varied between -5.8 during 2016 and 3.7 during 2008. It is found in the significance test that Interest Coverage ratio is not uniform during the period of study. Interest

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coverage ratio is negative during 2012, 2015 and 2016. This is not good long term creditors. It is high during 2007, 2008, 2009 and 2013, which is a good phenomenon for long term creditors. It is in reasonable range during other three years.

Table-11: Interest Coverage Ratio (Figures in Lakhs)

Years	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
EBIT	13.2	24.7	19.9	17.5	7.9	-4.5	8.9	4.3	-2.7	-19.8
Interest	5.7	6.6	6.7	15.6	5.6	3.9	2.5	2.7	2.9	3.4
Interest Coverage Ratio	2.3	3.7	3.0	1.1	1.4	-1.2	3.6	1.6	-0.9	-5.8

Source: Annual Reports of Power Oxides Private Limited from 2006-07 to 2015-2016.

Calculated value of $\chi 2$ for Interest coverage ratio = 85.0. The Critical value of $\chi 2$ at 9 degrees of freedom at 5% level of Significance is 16.919 Calculated value is less than Critical Value i.e., 85.0>16.919, Hence, H_{10} is Rejected.

IV. CONCLUSION

Operating leverage is favourable for three years, financial leverage is favourable for six years and combined leverage is favourable for only two years during the period of study. Degree of Operating Leverage, Degree of Financial Leverage and Degree of Combined Leverage are not uniform during the period of the study. All capital structure ratios except Interest coverage ratio are uniform during the period of study. Debt- Equity ratio is less than one during six years of the study ensuring high margin of safety for lenders. It is very high during last year of the study, which reduced margin of safety for lenders. Low proprietary ratio and high solvency ratio during last year decreased long term solvency position. Fixed Assets to Net-worth ratio is always less than one or equal to one during all the years of the study, indicating that owner funds are more than fixed assets in the enterprise. Fixed Assets ratio is less than one during all the years of the study indicating that long term funds are also available for financing working capital requirements. Interest coverage ratio is negative during last two years and also in 2012. To conclude, there is further scope to improve capital structure management in the enterprise.

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Capital Structure Analysis of a Micro and Proprietary Enterprise - A Case Study of Nagas Elastomer Works

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Abstract: *The financial manger has to strike a balance between various sources of funds so as to maximise return of an Enterprise without affecting risk composition in the business. An optimal capital structure is very much essential to maximise the owner's wealth of any Enterprise. In this paper, an attempt is made to analyse the capital structure in Nagas Elastomer Works. Nagas Elastomer Works is a Micro and Proprietary Enterprise in Andhra Pradesh state of India. Nagas Elastomer Works was started in 2002. This Micro and Proprietary Enterprise is manufacturing Retread Rubber. It has a man power of eight. It procures raw materials from Kerala, Tamil Nadu and Telangana. The total assets of the enterprise are Rs. 129.9 lakhs and total liabilities are Rs. 129.9 lakhs as per 2015-16 annual accounts. The turnover of this Company is 68.12 lakhs. In this paper composition of capital structure in the enterprise for a period of ten years is analysed. Leverage analysis was also done. Debt- Equity ratio, Proprietary Ratio, Solvency Ratio, Fixed Assets to Net worth Ratio, Fixed Assets Ratio, Current Assets to Proprietary Ratio and Interest Coverage Ratio are calculated for the study period. Chi-square test is used for testing Hypotheses.*

Keywords*: Capital structure, Degree of Financial Leverage, Degree of Operating Leverage, Fixed Assets to Net-Worth ratio, Solvency ratio*

I. INTRODUCTION

The financial manger has to strike a balance between various sources of funds so as to maximise return of an Enterprise without affecting risk composition in the business. An optimal capital structure is very much essential to maximise the owner's wealth of any Enterprise. In this paper, an attempt is made to analyse the capital structure in Nagas Elastomer Works. Nagas Elastomer Works is a Micro and Proprietary Enterprise in Andhra Pradesh state of India. Nagas Elastomer Works was started in 2002. This Micro and Proprietary Enterprise is manufacturing Retread Rubber. It has a man power of eight. It procures raw materials from Kerala, Tamil Nadu and Telangana. The total assets of the enterprise are Rs. 129.9 lakhs and total liabilities are Rs. 129.9 lakhs as per 2015-16 annual accounts. The turnover of this Company is 68.12 lakhs.

II. REVIEW OF LITERATURE

J. H. Chua et al., (1993)[1] made a study on the capital structure of forty three private companies in Canada from 1993-1998. Shyam-Sunder, L. et al., (1999)[2] studied on the pecking order Models for corporate financing in one hundred fifty seven industrial units in US existed between 1971 and 1989. Kaur, R. et al., (2009)[3] investigated on the determinants of capital structure in eight best doing Textile units in India from 2003-04 to 2007-08. Bhayani, S. J (2009)[4] had conducted study on impact of Financial Leverage on cost of capital and valuation of Indian cement Industry. Dr. A.Vijayakumar (2011)[5] examined the trade-off and pecking order hypotheses in twenty automobile firms in India and found that more profitable companies had less debt. S. Ramaratnam et al., (2013)[6] examined the determinants of capital structure in Pharmaceutical companies in India. Thomas, A. E (2013)[7] examined the capital structure of twenty one units in Indian cement industry from 2003-04 to 2007-08.

Srivastava, N., (2014)[8] had examined the determinants of leverage in ten cement companies in India over a period of 2008-2012. Lyubomira Koeva-Dimitrova (2016)[9] had analyzed the capital structure of the medical diagnostic-consultative centres in Varna city for the purpose of assessing their long-term solvency and existence of financial risk. Radojko Lukić et al., (2016)[10] investigated the determinants of capital structure in Serbia's commercial sector.

Venkateswararao.Podile (2017)[11] had examined the recent MSME policy of Andhra Pradesh. Venkateswararao.Podile et al., (2017)[12] examined working capital management in PL Plast Pvt Ltd. Venkateswararao.Podile et al., (2017)[13] had examined various Government schemes supporting MSMEs in

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India. Chandrika Prasad Das et al., (2018)[14] had conducted a study in India to find out the determinants of capital structure and their impact on financial performance by using secondary data taken from fifty top manufacturing companies and by using regression model. Venkateswararao.Podile et al., (2018)[15] examined working capital management in Sri Rama Chandra Paper Boards Ltd. Venkateswararao.Podile (2018)[16] examined working capital management in Tulasi seeds Pvt.Ltd. Venkateswararao.Podile et al., (2018)[17] studied working capital management in Sri Nagavalli solvent oils Pvt. Ltd. Venkateswararao.Podile et al., (2018)[18] analysed working capital management in Naga Hanuman Solvent Oils Private Limited. Venkateswararao.Podile (2018)[19] examined working capital management in Cuddapah Spinning Mills Ltd. Venkateswararao.Podile et al., (2018)[20] studied working capital management in Kristna Engineering Works. Venkateswararao.Podile et al., (2018)[21] examined working capital management in Radhika Vegetables Oils Pvt. Ltd. Venkateswararao.Podile et al., (2018)[22] examined working capital management in Power Plant Engineering Works in Andhra Pradesh. Venkateswararao.Podile et al., (2018)[23] examined working capital management in Nagas Elastomer Works. Venkateswararao.Podile et al., (2018)[24] had studied working capital management in M.G.Metallic Springs Pvt. Ltd. Venkateswararao.Podile et al., (2018)[25] had studied working capital management in Sri Srinivasa Spun Pipes Company. Venkateswararao.Podile et al., (2018)[26]had studied working capital management in Raghunath Dye Chem Pvt. Ltd. Venkateswararao.Podile et al., (2018)[27] had examined working capital management in Maitreya Electricals Pvt. Ltd. Venkateswararao.Podile et al., (2018)[28] had examined working capital management in Laxmi Vinay Poly Print Packs Pvt. Ltd. Venkateswararao.Podile et al., (2018)[29] had done capital structure analysis of M.G.Metallic Springs Pvt. Ltd. Venkateswararao.Podile et al., (2018)[30]had done capital structure analysis of Naga Hanuman Solvent Oils Private Limited. Venkateswararao.Podile et al., (2018)[31]had done capital structure analysis of Raghunath Dye Chem Pvt. Ltd. It was found that most of the studies dealt with capital structure in large companies. Some of the studies dealt with MSME policies. Some other studies though dealt with MSMEs, they were confined to working capital management. Few studies dealt with capital structure analysis in MSMEs. There was no study on capital structure analysis of a Micro and Proprietary enterprise which is manufacturing Retread Rubber. Hence, this study is taken up.

Objectives

The general objective of the study is to analyze the capital structure of Nagas Elastomer Works. The specific objectives include the following:

1. To examine composition of capital structure in Nagas Elastomer Works during the period of study.
2. To analyze the status of Degree of Operating Leverage, Degree of Financial Leverage and Degree of Combined Leverage in Nagas Elastomer Works during the period of study.
3. To investigate long term solvency position Nagas Elastomer Works during the period of study.
4. To examine the coverage of financial expenses in the Micro and Proprietary enterprise during the period of study.
5. To offer suggestions for improvement of capital structure decisions, if required.

Hypotheses

H_{01}: Degree of Operating Leverage in Nagas Elastomer Works is uniform during the period of study.
H_{02}: Degree of Financial Leverage in Nagas Elastomer Works is uniform during the period of study.
H_{03}: Degree of Combined Leverage in Nagas Elastomer Works is uniform during the period of study.
H_{04}: Debt - Equity Ratio in Nagas Elastomer Works is uniform during the period of study.
H_{05}: Proprietary Ratio in Nagas Elastomer Works is uniform during the period of study.
H_{06}: Solvency Ratio in Nagas Elastomer Works is uniform during the period of study.
H_{07}: Fixed Assets to Net worth Ratio in Nagas Elastomer Works is uniform during the period of study.
H_{08}: Fixed Assets Ratio in Nagas Elastomer Works is uniform during the period of study.
H_{09}: Current Assets to Proprietary funds Ratio in Nagas Elastomer Works is uniform during the period of study.
H_{10}: Interest Coverage Ratio in Nagas Elastomer Works is uniform during the period of study

III. METHODOLOGY

The present study is mainly based on secondary data. The data is taken from the financial statements including balance sheet, trading account and profit and loss account of Nagas Elastomer Works. The period of study is ten years covering the financial years from 2006-07 to 2015-16.The data gathered is analyzed through the technique of percentages and certain appropriate ratios relating to capital structure of the enterprise. Degree of Operating Leverage, Degree of Financial Leverage and Degree of Combined Leverage are calculated during study period for leverage analysis. The ratios covered include Debt – Equity Ratio, Proprietary Ratio, Solvency Ratio, Fixed Assets to Net worth Ratio, Fixed Assets Ratio, Current Assets to Proprietary Ratio and Interest Coverage Ratio. Chi-square test is used for testing the hypotheses formed.

Composition of capital structure

The data in table-1 represent the fact that Share capital as a percentage of total equity capital is 100 during all the years of study. It is also observed that reserves and surplus as a percentage of total equity capital is

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zero during all the years of the study. Net income of every previous financial year is added to the capital account of the proprietor in the current year. This is the reason for reserves and surpluses in the micro and proprietary enterprise to be zero during all the years. Total equity capital as a percentage of total capital has varied between 52.5 during 2007 and 99.7 during 2015. It is also observed that long term debt as a percentage of total debt had varied between zero during 2009, 2012, 2014, 2015 and 2016 and 8.9 during 2010. On the other hand, short term debt as a percentage of total debt has varied between 59.2 during 2010 and 100 during 2009, 2012, 2014, 2015 and 2016. Total debt capital as a percentage of total capital has varied between 0.3 during 2015 and 47.5 during 2007. The enterprise much depended on owner funds during the period of study.

Table-1: Structure and Composition of Capital structure in Nagas Elastomer Works during 2006-2007 to 2015-2016 (Figures in Lakhs)

Particulars	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Equity capital										
Hare Capital	30.7	34.5	39.3	45.5	48.7	56.3	64.3	71.1	118.3	129.1
% of Total Equity capital	100	100	100	100	100	100	100	100	100	100
Reserves & Surplus	0	0	0	0	0	0	0	0	0	0
% of Total Equity capital	0	0	0	0	0	0	0	0	0	0
Total Equity Capital	30.7	34.5	39.3	45.5	48.7	56.3	64.3	71.1	118.3	129.1
% of Total Capital	52.5	61.8	65.5	67.6	70.6	81.0	75.3	92.0	99.7	99.4
Debt Capital										
Long Term Debt	1.6	6.9	0	8.9	7.5	0	7.5	0	0	0
% of Total Debt capital	5.8	32.4	0.0	40.8	36.9	0.0	35.5	0.0	0.0	0.0
Short Term Debt	26.2	14.4	20.7	12.9	12.8	13.2	13.6	6.2	0.4	0.8
% Total Debt capital	94.2	67.6	100.0	59.2	63.1	100.0	64.5	100.0	100.0	100.0
Total Debt Capital	27.8	21.3	20.7	21.8	20.3	13.2	21.1	6.2	0.4	0.8
% of Total Capital	47.5	38.2	34.5	32.4	29.4	19.0	24.7	8.0	0.3	0.6
Total Capital	58.5	55.8	60	67.3	69.0	69.5	85.4	77.3	118.7	129.9

Source: Annual Reports of Nagas Elastomer Works from 2006-07 to 2015-2016.

Leverage Analysis

Leverage analysis is useful for understanding the ability of the enterprise to magnify the effect of changes in sales on operating profit, the effect of changes in operating profit on Net Income and the effect of changes in sales on Net Income.

Degree of Operating Leverage

The Degree of Operating Leverage has varied between -0.75 and 9.68. Operating leverage is favourable during 2009, 2010 and 2016 as DOL is greater than one. Operating leverage is un-favourable during other seven years as DOL is less than one. It is found in the significance test that Degree of Operating Leverage is not uniform during the period of study.

Table-2: Degree of Operating Leverage (Figures in Lakhs)

Years	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Percentage change in EBIT	2.6	-15.0	114.7	39.7	-2.0	-3.0	2.1	-10.1	-24.7	25.4
Percentage Change in Sales	-5.7	20.0	20.3	4.1	7.0	-3.3	-2.8	-31.9	-38.9	24.7
DOL	-0.46	-0.75	5.65	9.68	-0.29	0.91	-0.75	0.32	0.63	1.03

Source: Annual Reports of Nagas Elastomer Works from 2006-07 to 2015-2016

Calculated value of $\chi 2$ for Degree of Operating Leverage = 65.1. The Critical value of $\chi 2$ at 9 degrees of freedom at 5% level of Significance is 16.919. Calculated value is greater than Critical Value i.e., 65.1>16.919, Hence, H_{01} is Rejected.

Degree of Financial Leverage

The Degree of Financial Leverage has varied between -7.31 and 1.34. Financial leverage is favourable during 2009, 2015 and 2016 as DFL is greater than one. Financial leverage is un-favourable during other seven years as DFL is less than one. It is found in the significance test that Degree of Financial Leverage is not uniform during the period of study

Table-3: Degree of Financial Leverage (Figures in Lakhs)

Years	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Percentage change in Net income	-19.0	52.9	153.8	30.3	10.5	1.1	0.0	-9.4	-25.3	26.2
Percentage change in EBIT	2.6	-15.0	114.7	39.7	-2.0	-3.0	2.1	-10.1	-24.7	25.4
DFL	-7.31	-3.53	1.34	0.76	-5.25	-0.37	0.00	0.93	1.02	1.03

Source: Annual Reports of Nagas Elastomer Works from 2006-07 to 2015-2016

Calculated value of $\chi 2$ for Degree of Financial Leverage = 75.6. The Critical value of $\chi 2$ at 9 degrees of freedom at 5% level of Significance is 16.919. Calculated value is greater than Critical Value i.e., 75.6>16.919, Hence, H_{02} is Rejected.

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Degree of Combined Leverage

The Degree of Combined Leverage has varied between -0.33 and 7.58. Combined leverage is favourable during 2007, 2008, 2009, 2010, 2011 and 2016 as DCL is greater than one. Combined leverage is un-favourable during other four years as DCL is less than one. It is found in the significance test that Degree of Combined Leverage is not uniform during the period of study.

Table-4: Degree of Combined Leverage (Figures in Lakhs)

Years	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Percentage change in Net income	-19.0	52.9	153.8	30.3	10.5	1.1	0.0	-9.4	-25.3	26.2
Percentage Change in Sales	-5.7	20.0	20.3	4.1	7.0	-3.3	-2.8	-31.9	-38.9	24.7
DCL	3.33	2.65	7.58	7.39	1.50	-0.33	0.00	0.29	0.65	1.06

Source: Annual Reports of Nagas Elastomer Works from 2006-07 to 2015-2016.

Calculated value of $\chi 2$ for Degree of Combined Leverage = 31.5. The Critical value of $\chi 2$ at 9 degrees of freedom at 5% level of Significance is 16.919. Calculated value is greater than Critical Value i.e., 31.5>16.919, Hence, H_{03} is Rejected

Capital structure Ratios

Capital structure ratios are useful for understanding long term solvency of the Enterprise. Long term solvency means ability of the enterprise to meet long term obligations.

Debt-Equity Ratio

The Debt-Equity ratio of the Enterprise varied between zero during 2015 and 0.91 during 2007. It is found in the significance test that Debt-Equity ratio is uniform during the period of study. The enterprise has not used substantial debt in the capital structure during the period of study. Debt- Equity ratio is less than one during the period of study indicating good long term solvency.

Table-5: Debt-Equity Ratio (Figures in Lakhs)

Years	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Outside funds	27.8	21.3	20.7	21.8	20.3	13.2	21.1	6.2	0.4	0.8
Share Holders funds	30.7	34.5	39.3	45.5	48.7	56.3	64.3	71.1	118.3	129.1
Debt-Equity Ratio	0.91	0.62	0.53	0.48	0.42	0.23	0.33	0.09	0.00	0.01

Source: Annual Reports of Nagas Elastomer Works from 2006-07 to 2015-2016.

Calculated value of $\chi 2$ for Debt-Equity Ratio = 2.1. The Critical value of $\chi 2$ at 9 degrees of freedom at 5% level of Significance is 16.919. Calculated value is less than Critical Value i.e., 2.1<16.919, Hence, H_{04} is accepted.

Proprietary Ratio

The Proprietary ratio of the Enterprise varied between 0.52 during 2007 and one during 2015. It is found in the significance test that Proprietary ratio is uniform during the period of study. Proprietary ratio is relatively high during the period of study and it is very high during last five years of the study which is good for creditors of the company.

Table-6: Proprietary Ratio (Figures in Lakhs)

Years	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Share Holders funds	30.7	34.5	39.3	45.5	48.7	56.3	64.3	71.1	118.3	129.1
Total Assets	58.5	55.8	60	67.3	69.0	69.5	85.4	77.3	118.7	129.9
Proprietary Ratio	0.52	0.62	0.66	0.68	0.71	0.81	0.75	0.92	1.00	0.99

Source: Annual Reports of Nagas Elastomer Works from 2006-07 to 2015-2016.

Calculated value of $\chi 2$ for Proprietary ratio = 0.3. The Critical value of $\chi 2$ at 9 degrees of freedom at 5% level of Significance is 16.919 Calculated value is less than Critical Value i.e., 0.3<16.919, Hence, H_{05} is accepted.

Solvency Ratio

The Solvency ratio of the Enterprise varied between zero during 2015 and 0.48 during 2007. It is found in the significance test that Solvency ratio is uniform during the period of study. Solvency ratio is relatively low during the period of study and very low during last five years of the study. Margin of safety is very high for lenders and creditors.

Table-7: Solvency Ratio (Figures in Lakhs)

Years	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Total Liabilities to outsiders	27.8	21.3	20.7	21.8	20.3	13.2	21.1	6.2	0.4	0.8
Total Assets	58.5	55.8	60	67.3	69.0	69.5	85.4	77.3	118.7	129.9
Solvency Ratio	0.48	0.38	0.35	0.32	0.29	0.19	0.25	0.08	0.00	0.01

Source: Annual Reports of Nagas Elastomer Works from 2006-07 to 2015-2016

Calculated value of $\chi 2$ for Solvency ratio = 1.0. The Critical value of $\chi 2$ at 9 degrees of freedom at 5% level of Significance is 16.919 Calculated value is less than Critical Value i.e., 1.0<16.919, Hence, H_{06} is accepted.

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Fixed Assets to Net worth Ratio

The Fixed Assets to Net worth ratio of the Enterprise varied between 0.15 during 2016 and 0.84 during 2007. It is found in the significance test that Fixed Assets to Net worth ratio is uniform during the period of study. Fixed Assets to Net worth ratio is always less than one during all years of the study. Owner funds are more than fixed assets in the enterprise and low ratio indicates that more of owner funds are available for working capital finance.

Table-8: Fixed Assets to Net worth Ratio (Figures in Lakhs)

Years	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Fixed Assets	25.7	24.6	23.2	22.6	21.5	20.5	20.6	20.6	19.7	18.9
Share Holders funds	30.7	34.5	39.3	45.5	48.7	56.3	64.3	71.1	118.3	129.1
Ratio	0.84	0.71	0.59	0.50	0.44	0.36	0.32	0.29	0.17	0.15

Source: Annual Reports of Nagas Elastomer Works from 2006-07 to 2015-2016.

Calculated value of $\chi 2$ for Fixed Assets to Net worth ratio = 1.1. The Critical value of $\chi 2$ at 9 degrees of freedom at 5% level of Significance is 16.919 Calculated value is less than Critical Value i.e., 1.1<16.919, Hence, H_{07} is accepted.

Fixed Assets Ratio

The Fixed Assets ratio of the Enterprise varied between 0.15 during 2016 and 0.80 during 2007. It is found in the significance test that Fixed Assets ratio is uniform during the period of study. Fixed Assets ratio is always less than one indicating that part long term funds are also available for financing working capital requirements. This is good for the enterprise.

Table-9: Fixed Assets Ratio (Figures in Lakhs)

Years	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Fixed Assets	25.7	24.6	23.2	22.6	21.5	20.5	20.6	20.6	19.7	18.9
Total Long Term funds	32.3	41.4	39.3	54.4	56.2	56.3	71.8	71.1	118.3	129.1
Fixed Assets Ratio	0.80	0.59	0.59	0.42	0.38	0.36	0.29	0.29	0.17	0.15

Source: Annual Reports of Nagas Elastomer Works from 2006-07 to 2015-2016.

Calculated value of $\chi 2$ for Fixed Assets ratio = 0.9. The Critical value of $\chi 2$ at 9 degrees of freedom at 5% level of Significance is 16.919 Calculated value is less than Critical Value i.e., 0.9 <16.919, Hence, $H_{08}$is accepted.

Current Assets to Proprietary Funds Ratio

The Current Assets to Proprietary Funds ratio of the Enterprise varied between 0.31 during 2015 and 2016 and 1.06 during 2007. It is found in the significance test that Current Assets to Proprietary Funds ratio is uniform during the period of study. Current assets to proprietary ratio is always less than one except in the year 2007.

Table-10: Current Assets to Proprietary Funds Ratio (Figures in Lakhs)

Years	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Current Assets	32.6	31.0	28.8	37.4	39.2	38.0	50.4	39.4	36.6	39.4
Share Holders funds	30.7	34.5	39.3	45.5	48.7	56.3	64.3	71.1	118.3	129.1
Ratio	1.06	0.90	0.73	0.82	0.80	0.67	0.78	0.55	0.31	0.31

Source: Annual Reports of Nagas Elastomer Works from 2006-07 to 2015-2016.

Calculated value of $\chi 2$ for Current Assets to proprietary funds ratio = 0.8. The Critical value of $\chi 2$ at 9 degrees of freedom at 5% level of Significance is 16.919 Calculated value is less than Critical Value i.e., 0.8<16.919, Hence, H_{09} is accepted.

Interest Coverage Ratio

The Interest Coverage ratio of the Enterprise varied between 2.11 during 2007 and 89 during 2014. Higher interest coverage ratio is very good for long term creditors as well as for short term creditors. This ratio had shown wide fluctuations during the study period. It is found in the significance test that Interest Coverage ratio is not uniform during the period of study.

Table-11: Interest Coverage Ratio (Figures in Lakhs)

Years	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
EBIT	4.0	3.4	7.3	10.2	10.0	9.7	9.9	8.9	6.7	8.4
Interest	1.9	0.4	0.4	0.4	0.5	0.3	0.2	0.1	0.1	0.1
Interest Coverage Ratio	2.11	8.50	18.25	25.50	20.00	32.33	49.50	89.00	67.00	84.00

Source: Annual Reports of Nagas Elastomer Works from 2006-07 to 2015-2016.

Calculated value of $\chi 2$ for Interest coverage ratio = 220.2. The Critical value of $\chi 2$ at 9 degrees of freedom at 5% level of Significance is 16.919 Calculated value is less than Critical Value i.e., 220.2>16.919, Hence, H_{10} is Rejected.

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IV. CONCLUSION

Operating leverage is favourable for three years, financial leverage is favourable for three years and combined leverage is favourable for six years during the period of study. Degree of Operating Leverage, Degree of Financial Leverage and Degree of Combined Leverage are not uniform during the period of the study. All capital structure ratios except interest coverage ratio are uniform during the period of study. The enterprise has not used substantial debt in the capital structure during the period of study. Proprietary ratio is relatively high during the period of study which is good for creditors of the company. Margin of safety is very high for lenders and creditors. Owner funds are more than fixed assets in the enterprise and low fixed assets to Net-worth ratio indicates that more of owner funds are available for working capital finance. Interest coverage ratio is high and had shown wide fluctuations during the study period. To conclude, the micro and proprietary enterprise had not utilised the substantial debt in the capital structure. In other words, it had not exploited the leverage.

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Working Capital Management in M.G.Metallic Springs Pvt. Ltd. - A Case Study in Andhra Pradesh

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Abstract: *Working Capital Management refers to Management of Current Assets and Current Liabilities. It is an important decision in Financial Management. Efficient Working capital management is required for better maintenance of liquidity and profitability trade-off in any Company. In this paper, an attempt is made to examine working capital management in M.G. Metallic Springs Pvt. Ltd. M.G. Metallic Springs Pvt. Ltd. is a Small Enterprise located in Anantapur district of Andhra Pradesh state in India. M.G. Metallic Springs Pvt. Ltd. was started in 1980. M.G. Metallic Springs Pvt. Ltd. is a Spring Manufacturing Company. Main products include Compression Springs, Tension Springs, Torsion Springs, Spiral Springs and Wire Forms. In this paper structure and composition of working capital in the enterprise for a period of ten years is analysed. Current ratio, quick ratio, super quick ratio, gross working capital turnover ratio, net working capital turnover ratio, cash turnover ratio, inventory turnover ratio, debtors turnover ratio and average collection period are calculated for the study period. Chi-square test is used for testing Hypotheses.*

Keywords: *Small Enterprise, Quick Ratio, Gross working capital, Net working capital, Inventory turnover, Average collection period*

I. INTRODUCTION

Working Capital Management refers to Management of Current Assets and Current Liabilities. It is an important decision in Financial Management. Efficient Working capital management is required for better maintenance of liquidity and profitability trade-off in any Company. In this paper, an attempt is made to examine working capital management in M.G. Metallic Springs Pvt. Ltd. M.G. Metallic Springs Pvt. Ltd. is a Small Enterprise located in Anantapur district of Andhra Pradesh state in India. M.G. Metallic Springs Pvt. Ltd. was started in 1980. M.G. Metallic Springs Pvt. Ltd. is a Spring Manufacturing Company. Main products include Compression Springs, Tension Springs, Torsion Springs, Spiral Springs and Wire Forms. It has adopted the policy to manufacture high quality precision springs. M.G. Metallic Springs Pvt. Ltd. has an annual turnover of Rs.2178.4 lakhs as per annual accounts of 2015-16. The total Current Assets of the company are Rs.1072.83 lakhs and the current liabilities are Rs. 557.31 lakhs. The company has man power of 127. The company's Quality System is ISO 9002 approved and regularly audited both internally and by the RVC Standards authority. All products are produced in the company as per DIN standards.

II. REVIEW OF LITERATURE

Mishra (1975)[1] studied the efficiency of working capital management in six sample public sector units. The study identified that management of various components of working capital in sample units was highly unsatisfactory. Suk, Seung and Rowland (1992)[2] in their research conducted an in-depth survey to analyze the liquidity practices of ninety four sample Japanese companies operating in the United States. Sivarama (1999)[3] in his study on working capital management in the Indian paper industry, found a close association between profitability and working capital efficiency. Ghosh and Maji (2003)[4] made an empirical study on the relationship between utilization of current assets and operating profitability in the Indian cement and tea industries. Bardia (2004)[5] conducted a study on the issue pertaining to the relationship between working capital management and profitability of a Navaratna steel manufacturing public sector enterprise. Prof. B.P.Singh (2012)[6] investigated the relationship between the components of working capital and profitability. He observed that the telecom industry is operating below average so far as working capital is concerned. Pasupathi (2013)[7] conducted a comparative study of WCM performance in commercial vehicles, passenger cars and multi utility vehicles and two and three wheelers sectors of Indian automobile industry. Utkarsh Goel et al. (2015)[8] conducted a study to explore the impact of corporate governance practices on Working capital Management (WCM) in Indian firms. S. Selvanayaki et al. (2015)[9] focused on evaluating the WCM practices adopted by the rice milling firms and analyzed its impact on profitability. Venkateswararao.P, Surya Chandra Rao.D and Hema

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Venkata Siva Sree.Ch (2017)[10] examined working capital management in PL Plast Pvt Ltd. Venkateswararao.P, and Hema Venkata Siva Sree.Ch (2018)[11] examined working capital management in Sri Rama Chandra Paper Boards Ltd. Venkateswararao.P (2018)[12] examined working capital management in Tulasi seeds Pvt.Ltd. Venkateswararao.P, and Hema Venkata Siva Sree.Ch (2018)[13] studied working capital management in Sri Nagavalli solvent oils Pvt. Ltd. Venkateswararao.P, and Hema Venkata Siva Sree.Ch (2018)[14] analysed working capital management in Naga Hanuman Solvent Oils Private Limited. Venkateswararao.P (2018)[15] examined working capital management in Cuddapah Spinning Mills Ltd. Venkateswararao.P, and Hema Venkata Siva Sree.Ch (2018)[16] studied working capital management in Kristna Engineering Works. Venkateswararao.P, and Hema Venkata Siva Sree.Ch (2018)[17] examined working capital management in Radhika Vegetables Oils Pvt. Ltd. Venkateswararao.P, and Hema Venkata Siva Sree.Ch (2018)[18] examined working capital management in Power Plant Engineering Works in Andhra Pradesh. Venkateswararao.P, Hema Venkata Siva Sree.Ch and N.Janardhanarao (2018)[19] examined working capital management in Nagas Elastomer Works. It was found that there was no study on working capital management in an enterprise, which is manufacturing metallic springs. Hence, this study is taken up.

Objectives

The general objective of the study is to examine the working capital management in M.G. Metallic Springs Pvt. Ltd. The specific objectives include the following.

1. To examine the structure and composition of working capital in M.G. Metallic Springs Pvt. Ltd. during the period of study.
2. To analyze the liquidity position of M.G. Metallic Springs Pvt. Ltd. during the period of study.
3. To find the gross working and networking capital turnover in M.G. Metallic Springs Pvt. Ltd.
4. To examine the efficiency in cash, debtors and inventory management in the Small Enterprise under study.
5. To offer suggestions for effective working capital management if required.

Hypotheses

H_{01}: Current ratio in M.G. Metallic Springs Pvt. Ltd. is uniform during the period of study.

H_{02}: Quick ratio in M.G. Metallic Springs Pvt. Ltd. is uniform during the period of study.

H_{03}: Super quick ratio in M.G. Metallic Springs Pvt. Ltd. is uniform during the period of study.

H_{04}: Gross working capital turnover ratio in M.G. Metallic Springs Pvt. Ltd. is uniform during the period of study.

H_{05}: Net working capital turnover ratio in M.G. Metallic Springs Pvt. Ltd.is uniform during the period of study.

H_{06}: Cash turnover ratio in M.G. Metallic Springs Pvt. Ltd. is uniform during the period of study.

H_{07}: Inventory turnover ratio in M.G. Metallic Springs Pvt. Ltd. is uniform during the period of study.

H_{08}: Debtors turnover ratio in M.G. Metallic Springs Pvt. Ltd. is uniform during the period of study.

H_{09}: Average collection period in M.G. Metallic Springs Pvt. Ltd. is uniform during the period of study.

III. METHODOLOGY

The present study is mainly based on secondary data. The data is taken from the financial statements including balance sheet, trading account and profit and loss account of M.G. Metallic Springs Pvt. Ltd. The period of study is ten years covering the financial years from 2006-07 to 2015-16.The data gathered is analyzed through the technique of percentages and certain appropriate ratios relating to working capital management. The ratios covered includes current ratio, quick ratio, super quick ratio, gross working capital turnover ratio, net working capital turnover ratio, cash turnover ratio, inventory turnover ratio, debtors turnover ratio and average collection period. Chi-square test is used for testing the hypotheses formed.

Structure and Composition of working capital

Working capital structure of M.G. Metallic Springs Pvt. Ltd. is presented in table-1. It is observed that Inventory was 4.93 percent of total current assets during 2007. It is the lowest percentage during the period of study. Its percentage was highest at 48.55 during 2013. It is observed that inventory occupied highest percentage of current assets during the year 2013. Debtors as a percentage of total current assets varied in between 38.10 during 2013 and 58.28 during 2010. Of all current assets debtors occupied highest percentage during the period of study except 2013.It is also observed that cash and bank balance as a percentage of current assets varied between 0.87 during 2009 and 22.16 during 2011. Loans and advances as a percentage of current assets varied between 5.88 during 2016 and 34.22 during 2009. Other current assets as a percentage of total current assets is nil during the period of study. Sundry Creditors and Short-term provisions are the only current liabilities during the first five years of the study. Sundry Creditors and Provisions occupied 100 percent of current liabilities during first five years. Sundry creditors as a percentage of total current liabilities occupied major share ie 71.73 during the year 2016. They varied between 21.48 during 2008 and 71.73 during 2016. Short-term borrowings by the Business organisation were made during the years 2012, 2013, 2014 and 2015. Short-term borrowings as a percentage of current liabilities varied between 80.94 during 2013 to 162.82 during 2015. Short-term provisions

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are maintained throughout the study. Short-term provisions as a percentage of current liabilities were 2.08 during 2013 and 78.52 during 2013. Other current liabilities were nil during the first five years of study. It varies between 6.21 during 2012 and 200.4 during 2013. It is observed that Net Working Capital in the company varied between Rs.145.64 Lakhs during 2013 to Rs.538.36 Lakhs during 2011. It was maintained at high levels during 2011 and 2016.

Table1: Working Capital structure of M.G. Metallic Springs Pvt. Ltd. during 2006-2007 to 2015-2016 (Figures in Lakhs)

Particulars	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Current Assets										
Cash & Bank balances	48.46	23.9	4.16	49.85	151.89	43.77	44.93	14.23	65.16	66.65
% of TCA	11.83	4.94	0.87	8.18	22.16	8.74	6.19	1.76	6.46	6.21
Debtors	217.16	280.07	254.42	355.28	328.41	247.85	276.79	421.6	495.06	566.77
% of TCA	53.02	57.93	53.43	58.28	47.91	49.51	38.10	52.11	49.11	52.83
Loans & Advances	123.73	148.35	162.96	151.19	141.24	78.34	51.09	65.68	69.63	63.08
% of TCA	30.21	30.68	34.22	24.80	20.61	15.65	7.03	8.12	6.91	5.88
Other Current Assets	0	0	0	0	0	0	0	0	0	0
% of TCA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Inventory	20.21	31.18	54.59	53.33	63.91	130.7	352.7	307.51	378.22	376.31
% of TCA	4.93	6.45	11.46	8.75	9.32	26.11	48.55	38.01	37.52	35.08
Total Current Assets (TCA)	409.56	483.5	476.15	609.66	685.46	500.57	726.42	809.04	1008.08	1072.83
Current Liabilities										
Sundry Creditors	82.49	41.15	58.17	58.1	39.56	182.64	287.37	262.97	380.81	399.75
% of TCL	43.93	21.48	51.94	37.27	26.89	62.22	49.48	54.85	58.28	71.73
Other current liabilities	0	0	0	0	0	6.21	200.4	41.4	14.21	30.55
% of TCL	0.00	0.00	0.00	0.00	0.00	2.12	34.51	8.64	2.17	5.48
Short term borrowings	0	0	0	0	0	81.61	80.94	146.36	162.82	0
% of TCL	0.00	0.00	0.00	0.00	0.00	27.80	13.94	30.53	24.92	0.00
Short term provisions	105.29	150.42	53.82	97.81	107.54	23.09	12.06	28.69	95.61	127.01
% of TCL	56.07	78.52	48.06	62.73	73.11	7.87	2.08	5.98	14.63	22.79
Total Current Liabilities (TCL)	187.78	191.57	111.99	155.91	147.1	293.56	580.78	479.43	653.38	557.31
NWC	221.78	291.93	364.16	453.75	538.36	207.01	145.64	329.61	354.7	515.52

Source: Annual Reports of M.G. Metallic Springs Pvt. Ltd. from 2006-07 to 2015-2016

Current Ratio

The current ratio in the company was maintained at normal level in the company. It has varied between 1.25 during 2013 and 4.65 during 2011 was shown in the table. The current ratio of the company is maintained at normal levels. It is found in the significance test that current ratio is uniform during the period of study.

Table2: Current Ratio (Figures in Lakhs)

Years	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Current Assets	409.56	483.5	476.15	609.66	685.46	500.57	726.42	809.04	1008.08	1072.83
Current Liabilities	187.78	191.57	111.99	155.91	147.1	293.56	580.78	479.43	653.38	557.31
Current ratio	2.18	2.52	4.25	3.91	4.65	1.70	1.25	1.68	1.54	1.92

Source: Annual Reports of M.G. Metallic Springs Pvt. Ltd. from 2006-07 to 2015-2016.

Calculated value of $\chi 2$for current ratio = 5.419. The Critical value of $\chi 2$ at 9 degrees of freedom at 5% level of Significance is 16.919 Calculated value is less than Critical Value i.e., 5.419<16.919. Hence H_{01} is accepted.

Quick Ratio

The quick ratio of the company as shown in the table has varied between 0.74 during 2013 to 4.22 during 2011. It is found in the significance test that quick ratio is uniform during the period of study.

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Table3: Quick Ratio (Figures in Lakhs)

Years	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Liquid Assets	389.35	452.32	421.56	556.33	621.55	369.87	373.72	501.53	629.86	696.52
Current Liabilities	187.78	191.57	111.99	155.91	147.1	293.56	580.78	479.43	653.38	557.31
Quick ratio	2.07	2.36	3.49	3.56	4.22	1.74	0.74	1.50	1.28	1.24

Source: Annual Reports of M.G. Metallic Springs Pvt. Ltd. from 2006-07 to 2015-2016.

Calculated value of $\chi 2$forQuick ratio =5.511. The Critical value of $\chi 2$ at 9 degrees of freedom at 5% level of Significance is 16.919. Calculated value is less than Critical Value i.e., 5.511<16.919, Hence, H_{02} is accepted.

Super Quick Ratio

The super quick ratio of the company as shown in the table has varied between 0.02 during 2014 and 1.03 during 2011. It is found in the significance test that super quick ratio is not uniform during the period of study.

Table4: Super Quick Ratio (Figures in Lakhs)

Years	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Cash	48.46	23.9	4.16	49.86	151.89	43.77	44.93	14.23	65.16	66.65
Current Liabilities	187.78	191.57	111.99	155.91	147.1	293.56	580.78	479.43	653.38	557.31
Super Quick ratio	0.25	0.12	0.03	0.31	1.03	0.14	0.07	0.02	0.09	0.11

Source: Annual Reports of M.G. Metallic Springs Pvt. Ltd. from 2006-07 to 2015-2016.

Calculated value of $\chi 2$ for Super Quick ratio =3.728. The Critical value of $\chi 2$ at 9 degrees of freedom at 5% level of Significance is 16.919. Calculated value is less than Critical Value i.e., 3.728<16.919, Hence, H_{03} is accepted.

Gross Working Capital Turnover Ratio

The Gross working capital turnover ratio of the company as shown in the table has varied between 0.34 during 2007 and 2.36 during 2013. It is found in the significance test that net working capital turnover ratio is uniform during the period of study.

Table5: Gross Working Capital turnover Ratio (Figures in Lakhs)

Years	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Sales	141.65	195.55	216.68	314.24	463.37	906.92	1721.22	1827.85	1873.06	2178.4
Gross working capital	409.56	483.5	476.15	609.66	685.46	500.57	726.42	809.04	1008.08	1072.83
Ratio	0.34	0.40	0.45	0.51	0.67	1.81	2.36	2.25	1.85	2.03

Source: Annual Reports of M.G. Metallic Springs Pvt. Ltd. from 2006-07 to 2015-2016.

Calculated value of $\chi 2$ for Gross Working Capital turnover ratio =5.198. The Critical value of $\chi 2$ at 9 degrees of freedom at 5% level of Significance is 16.919. Calculated value is less than Critical Value i.e., 5.198<16.919, Hence, H_{04} is accepted.

Net Working Capital Turnover Ratio

The net working capital turnover ratio of the company as shown in the table has varied between 0.59 during 2009 and 11.81 during 2013. It is found in the significance test that net working capital turnover ratio is not uniform during the period of study.

Table-6: Net Working Capital Turnover Ratio (Figures In lakhs)

Years	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Sales	141.65	195.55	216.68	314.24	463.37	906.92	1721.22	1827.85	1873.06	2178.4
Net Working Capital	221.78	291.93	364.16	453.75	538.36	207.01	145.64	329.61	354.7	515.52
Ratio	0.63	0.66	0.59	0.69	0.86	4.38	11.81	5.54	5.28	4.22

Source: Annual Reports of M.G. Metallic Springs Pvt. Ltd. from 2006-07 to 2015-2016.

Calculated value of $\chi 2$ for Net Working capital turnover ratio =33.844. The Critical value of $\chi 2$ at 9 degrees of freedom at 5% level of Significance is 16.919. Calculated value is greater than Critical Value i.e., 33.844>16.919, Hence, H_{05} is rejected.

Cash Turnover Ratio

The cash turnover ratio of the company as shown in the table has varied between 4.59 during 2011 and 61.79 during 2014. It is found in the significance test that cash turnover ratio is not uniform during the period of study.

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Table7: Cash Turnover Ratio (Figures In lakhs)

Years	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Sales	141.65	195.55	216.68	314.24	463.37	906.92	1721.22	1827.85	1873.06	2178.4
Average Cash Balance	25.35	36.18	14.03	27.00	100.87	97.83	44.35	29.58	39.69	65.9
Cash Turnover Ratio	5.58	5.40	15.44	11.63	4.59	9.27	38.80	61.79	47.19	33.05

Source: Annual Reports of M.G. Metallic Springs Pvt. Ltd. from 2006-07 to 2015-2016.

Calculated value of $\chi 2$ for Cash turnover ratio =161.846. The Critical value of $\chi 2$ at 9 degrees of freedom at 5% level of Significance is 16.919. Calculated value is greater than Critical Value i.e. 161.846>16.919, Hence, H_{06} is rejected.

Inventory Turnover Ratio

The inventory turnover ratio of the company as shown in the table has varied between 5.05 during 2009 to 9.33 during 2012. It is found in the significance test that Inventory turnover ratio is uniform during the period of study.

Table8: Inventory Turnover Ratio (Figures In lakhs)

Years	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Sales	141.65	195.55	216.68	314.24	463.37	906.92	1721.22	1827.85	1873.06	2178.4
Average Inventory	26.59	25.69	42.89	53.96	58.62	97.2	241.6	330.05	342.86	377.26
Ratio	5.32	7.61	5.05	5.82	7.9	9.33	7.12	5.53	5.46	5.77

Source: Annual Reports of M.G. Metallic Springs Pvt. Ltd. from 2006-07 to 2015-2016.

Calculated value of $\chi 2$ for Inventory turnover ratio =2.788. The Critical value of $\chi 2$ at 9 degrees of freedom at 5% level of Significance is 16.919. Calculated value is less than Critical Value i.e. 2.788<16.919, Hence, H_{07} is accepted.

Debtors Turnover Ratio

The debtor's turnover ratio of the company as shown in the table has varied between 0.73during 2007 to 6.56 during 2013. It is found in the significance test that Debtors turnover ratio is uniform during the period of study.

Table9: Debtors Turnover Ratio (Figures In lakhs)

Years	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Sales	141.65	195.55	216.68	314.24	463.37	906.92	1721.22	1827.85	1873.06	2178.4
Average debtors	193.95	248.61	267.24	304.84	341.84	288.13	262.32	349.19	458.33	530.91
Ratio	0.73	0.78	0.97	1.03	1.35	3.14	6.56	5.23	4.08	4.10

Source: Annual Reports of M.G. Metallic Springs Pvt. Ltd. from 2006-07 to 2015-2016.

Calculated value of $\chi 2$ for Debtors turnover ratio =14.457. The Critical value of $\chi 2$ at 9 degrees of freedom at 5% level of Significance is 16.919. Calculated value is less than Critical Value i.e., 14.457 <16.919, Hence, H_{08} is accepted.

Average Collection Period

The average collection period as shown in the table has varied between 56 days during 2013 to 500 days during 2007. It is found in the significance test that Average collection period is not uniform during the period of study.

Table10: Average Collection Period (Figures In lakhs)

Years	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Days in a year	365	365	365	365	365	365	365	365	365	365
Debtors Turnover Ratio	0.73	0.78	0.97	1.03	1.35	3.14	6.56	5.23	4.08	4.10
Average Collection Period	500	468	376	354	270	116	56	70	89	89

Source: Annual Reports of M.G. Metallic Springs Pvt. Ltd. from 2006-07 to 2015-2016.

Calculated value of $\chi 2$ for Average collection period =1154.504. The Critical value of $\chi 2$ at 9 degrees of freedom at 5% level of Significance is 16.919. Calculated value is greater than Critical Value i.e. 1154.504>16.919, Hence, H_{09} is rejected.

IV. CONCLUSION

It is clear that debtors occupied first place followed by inventory as a percentage of current assets in M.G. Metallic Springs Pvt. Ltd. during the period of study. The Business organisation has credit worthiness because there is a significant increase in creditors and short term borrowings during the study period. Current ratio of the company is high which indicates that the company is more likely to meet its current liabilities. Debtors' turnover ratio was very less in the first five years of the study which reflects in high Average collection

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period. Net working capital turnover ratio, Cash turnover ratio and average collection periods are not uniform during the period of study and showed wide fluctuations. Collection of debts and cash utilization was poorly done in the company during the period of study. Current ratio, Quick ratio, super quick ratio, Gross working turnover ratio, Inventory turnover and debtor turnover ratios are uniform during the period of study.

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DEMONETIZATION: A POLICY ASSESSMENT WITH REFERENCE TO INDIAN ECONOMY

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ABSTRACT

The Indian economy is one of the world's fastest growing economies which is consistently maintaining a growth rate of around 7percent. On the other hand tax to Gross Domestic Product ratio at around 18 percent is amongst the lowest in the world probably because India was mentioned as a tax non-compliant country in the Union Budget of 2017-18. Tax evasion, corruption, black money and fake notes are deterrent to economic growth. The government of India for that reason introduced an income declaration scheme whereby it gave tax evaders an opportunity to pay tax on their unaccounted wealth and fall in line with the honest tax payers. At the same time the Indian took a daring step of demonetizing currency notes of Rs.500 and Rs. 1000 so as to pull the loop around the neckline of tax evaders. The present study is going to assess the policy assessment of demonetization with reference to Indian economy under the methodology of qualitative study.

KEY WORDS: **Black money, Demonetization, Fake Currency, Digital Economy.**

INTRODUCTION

Demonetization is the act of stripping a currency unit of its status as legal tender on November 8, 2016, the Government of India stripped Rs.500 and Rs.1000 denomination currency notes of their legal tender status. According to Reserve Bank of India Report on 31st March 2016, Rs.500 and Rs.1000 banknotes consist around 86.40% of total cash circulation having value of Rs.15.44 lakh crore. In this process 97 percent of old notes around Rs. 14.98 lakh crore were deposited in bank before 31st December 2016. The primary goals were to rid the economy from corruption, black money, terror financing, fake currency, increase tax base income, boost cashless transactions and stop the operation of invisible parallel economies.

History of Demonetization

In India, there were many occasions when high denomination bank notes demonetized. Reserve Bank of India printed the highest denomination notes of Rs.10, 000 in 1938. later than that government demonetize Rs.10, 000 and higher denomination banknotes in 1946. Higher denomination banknotes (Rs. 1,000, Rs.5, 000 and Rs. 10,000) reintroduced in 1954 and all of them were introduced in 1987 in order to restrain over increasing banknotes, due to inflation and in Rs.2,000 again Rs. 1,000 banknotes came back in circulation in order to contain the volume of bank notes in circulation, due to inflation. However, Rs. 2,000 banknotes were first time introduced in November 2016.

Along with India many countries in the world had done demonetization in the history. Almost countries that had done demonetization had some general objectives of demonetization which were to control corruption and black money and their government decided to demonetize their higher denomination currency notes to clear of these problems. At this point is the list of some countries that had done demonetization.

Table: 1 Historical Evidences of Demonetization

Country Name	Year	Motive	Outcome
Nigeria	1984	To fight black money.	Move back to physical assets and foreign currency.
Soviet Union	1991	Fight against unfair income, Smuggling and corruption	The economic system of the USSR was essentially crushed
Ghana	1982	To monitor money laundering and corruption.	People turned to foreign currency
Myanmar	1987	To curb black money	Led political dispute and died thousands of people
North Korea	2010	To lower down the market of black money	Economy breakdown
Zimbabwe	2010	Sliding out from Hyper inflation	Failed

Source: Rakesh Jangid, Demonetization and Its Impact on Indian Economy, Technical Report · February 2017.

OBJECTIVES OF THE STUDY

To understand the comprehensive overview of the demonetization, to study the government motives behind the demonetization and to investigate the challenges of demonetization in Indian economy.

METHODOLOGY OF THE STUDY

The aim of this paper is to study the policy assessment of demonetization on Indian economy. The Present study is qualitative as well as Descriptive in nature. Research is based on secondary data. Secondary data was collected from various sources like journals, research articles, working papers, Government of India reports, Reserve Bank of India Annual reports and websites.

RESULTS AND DISCUSSION

Demonetization was introduced to attempt three main issues which are fake currency, terrorist funding and black money. These are the major evils which hinders the nation economic growth. With the help of demonetization of high denomination notes government had planned to control black money with that government will reduce economic inequalities and promote a sustainable growing economy. India is facing serious problem of poverty because of social evils like corruption, and invisible parallel economies, because of this reason the needy people will not get full benefits from the welfare activities continuing by the government. Hence, demonetization will prevent parallel economies, fake notes and also helps to maintain transparency with cash less transactions.

The demonetization hits the terrorist's actions by destroying fake currency and making them monetary weak. With demonetization the country can reach digital economy and reduce corruption. Through this government will also promote and extent financial inclusion to the unbanked rural economy and increase transparency in financial transactions. By the way of demonetization government expected more money will be deposited in the banks, so that the banks will extent financial support to the needy people with low interest rates and it helps for the upliftment of the economy.

One of the main positive impact of demonetization was the brought more people on to the leading economic grid, where those were easily looked upon and taxed and generation of the more revenue was the result. The true tax payers will get reward in the form of lower price of real estate as most of the black money is in the form of assets like real estate and gold. Demonetization will

be an opportunity for financial innovations in the economy. Rural India need more support from financial innovations for providing cost effective financial services and implementation of financial inclusion in the Indian financial system.

The huge amount deposited by the people in the financial institutions became a problem to the banks to make efficient investment decisions. In the year 2015-16 Reserve Bank of India spent Rs. 34.21 billion for printing of various denominated currencies and it has reached to Rs. 79.65 billion in 2016-17. Deficiency of money in the hands of the public has mostly reduced the consumption which has badly affected the trading activities. Micro small and medium enterprises are mostly depending on cash based transactions; due to demonetization business transactions sharply affected the productivity due to lack of cash in hand.

Agriculture is the primary sector of Indian economy. Indian agriculture sector accounts for 18 percent of India's Gross Domestic Product and provides employment to 50 percent of the country labor force. Cash is the main mode of transaction in agriculture and allied sectors which contributes 15 percent to India's total yield, almost all the trade in agricultural based commodities was in cash and now the farmers are facing problems. The prices of their production have fallen due to lack of sales and they are likely to face losses and it will affect the country's Gross Domestic Product.

Industry is staring at temporary job losses due to demonetization, as production gets hit, especially in labor intensive sectors like agriculture and allied sectors, textiles, garments, leather and jewellery. The unorganized sector in India employs more workers and almost all of their dealings are in cash. Hence, demonetization disrupts the functioning of this segment and put them

in to this system could put them in trouble regarding employment and livelihood of weaker sections of the society.

In India majority of the rural people do not have bank account and they are not accessing financial transactions with banks. So, it is very difficult to promote cashless economy in the essence of demonetization. Cyber security, online fraud, hacking and lack of financial literacy are the other major problem for cashless digital economy.

CONCLUSION

Demonetization of highly denominated old currency notes has had some positive impact like reducing the cash flow to terror organizations, dismantling of counterfeit currency infrastructure to some extent, better income and indirect taxation, boost to digital economy however, it has come at some social and economic cost like agriculture and allied sectors affected in a large extent in terms of production and employment. Most of the firms in unorganized sector touched sickness due to non-availability of cash to meet day to day financial obligations. It is very difficult to trace the black money held and hidden in the form of foreign currency, god, real estate investment and other illegal transactions. Lack of financial literacy in India made the system somewhat difficult to promote cashless economy. By using the accumulated funds after demonetization for the overall economic growth and development, demonetization surely will have a positive impact in the long run.

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Social Adjustment, Parental Involvement and Academic Motivation as Predictors of Academic Achievement among Adolescents

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ABSTRACT

Several researchers tried to relate students' academic performance to social adjustment problems, study habits, hard work, commitment, events, perseverance and pre conceived convictions others associate students' achievements in school to instructional methods, teaching strategies and techniques. In general, teaching and learning as well as achievement in school are affected by social adjustment problems, study habits and strategies of instruction adopted by the teacher**.** Students in secondary schools exhibit various social adjustment problems and these in effect affect their academic achievement. **Objectives:** 1.To assess the social adjustment as predictors of academic achievement among adolescents. 2. To assess the parental involvement as predictor of academic achievement adolescents. 3. To assess academic motivation as predictors of academic achievement among adolescents. **Sample:** participants in the presented are consisted of 200 students studying 9th class in government and private schools both boys (100) and girls (100) **Tools:** 1. Parental involvement Parental involvement scale developed by Prof.K. Chandraiah and Madhavi Devi (2011) used in the present study. 2. Social adjustment is factor of the Culturally Relevant Bell Adjustment Inventory "Student Form"developed by (Indian Adaption) A. Ashok, K. Madhu, K. Suneeta & K.V. Ramana (2009). 3. Academic motivation scale developed by Blaich, C. F., & Wise, K. S. (2011). **Results:** results indicated that the personal adjustment and parental involvement are the best predictors of academic achievement.

1. Introduction

Several researchers tried to relate students' academic performance to social adjustment problems, study habits, hard work, commitment, events, perseverance and pre conceived convictions (Ugwuegbu, 1975) others associate students' achievements in school to instructional methods, teaching strategies and techniques. In general, teaching and learning as well as achievement in school are affected by social adjustment problems, study habits and strategies of instruction adopted by the teacher**.** Manju Gehlawat (2011) observed no significant differences in the emotional, social, educational and the total adjustment of students with respect to their gender. significant difference between male and female college students in terms of total scores obtained Ganai and Muhammad Ashraf Mir (2013) found no on the adjustment scale. The two groups also do not differ in terms of scores obtained separately on any dimension of the adjustment scale. Yellaiah (2012 Defined that Education is the ability to meet life's situation. All human beings possess the ability to stand back and observe themselves. Now in the field of education it seems to have become very important, as many other factors seem to depend on this reflective quality.

Parental involvement in education (Fan & Chen, 2001; Hill & Chao, 2009; Seginer, 2006). Indeed, family-school relations and parental involvement in education have been identified as a way to close demographic gaps in achievement and maximize students' potential (Dearing, Kreider, Simpkins, & Weiss, 2006; Hampton, Mumford, & Bond, 1998; Hara, 1998). As such, federal policies like the No Child Left behind Act (NCLB; 2002) mandate parental involvement in education and family-school relations across elementary and secondary school levels. parental involvement in education is positively associated with adolescents' academic outcomes throughout middle and high school (e.g., Catsambis, 2001). However, other research found that parental involvement is not related to achievement (e.g., Balli, Wedman, & Demo, 1997; Bronstein, Ginsberg, & Herrera, 2005).

A useful way of understanding student motivation has been to investigate the purposes for students 'achievement behaviour through the goals they pursue in learning situations. indeed goal theory (ames, 1992; ames & archer, 1988) at this time can have significant implications on employment or career opportunities, understanding adolescents 'motivation is vital ensuring students to achieve academic success adopting a goal theory perspective research has generated a wealth of understandings about why students might want to achieve at school as well as the individual and contextual factors that are critical to success. goal theorists have investigated both the achievement goals (ames & archer, 1988;elliot, 1999) and the social goals (l. h. anderman, 1999b; urdan & maehr, 1995) that influence adolescents' motivation at school. research shows that adolescents are concerned about developing and demonstrating competence (achievement goals) and that social goal to form relationships, demonstrate responsibility and achieve status within the peer group also influence students' motivation.

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2. Objectives

1. To study the contribution of social adjustment to Academic achievement of adolescents.
2. To assess parental involvement as predictor of academic achievement of adolescents**.**
3. To assess the academic motivation as predictor of academic achievement of adolescents.

3. Hypotheses

1. There would be significant contribution to social adjustment to Academic achievement of adolescents.
2. The parental involvement would be a significant predictor academic achievement among adolescents.
3. The academic motivation would be a significant predictor of academic achievement among adolescents.

4. Methodology of the Study

Sample

The sample for the present study is consisted of 200 students studying 9th class in government and private schools both boys (100) and girls (100).

Variables

Independent variables

1. Social adjustment
2. Parental involvement
3. Academic motivation

Dependent variable

1. Academic achievement.

Tools

1. Social adjustment is factor of the Culturally Relevant Bell Adjustment Inventory "Student Form"developed by (Indian Adaption) A. Ashok, K. Madhu, K. Suneeta & K.V. Ramana (2009).
2. Parental involvement: Parental involvement scale developed by K. Chandraiah and Madhavi Devi (2011) used in the present study.
3. Academic motivation scale developed by blaich, c. f., & wise, k. s. (2011)

5. Results and Discussion

Table: - 1
Summary of regression analysis between the predictor variables and academic achievement

Predictors	Regression analysis		Analysis of variance			
	r. 0.333(d)	**Source of variation**	**Degree of Freedom**	**Sum of Squares**	**Mean Square**	**F- ratio**
A	r^2. 0.111	Regression	4	333143.414	83285.853	12.439**
	s.e 81.82487	Residual	476	2671428.388	6695.309	
	r. 0.175(a)	**Source of variation**	**Degree of Freedom**	**Sum of Squares**	**Mean Square**	
B	r^2 0.031	Regression	1	92496.380	92496.380	12.806**
	s.e 85.11151	Residual	479	2912075.422	7243.969	
	r. 0.383(f)	**Source of variation**	**Degree of Freedom**	**Sum of Squares**	**Mean Square**	
C	r square. 0.147	Regression	6	440715.085	73452.514	11.374**
	s.e 80.36216	Residual	474	2563856.717	6458.077	

Significant at 0.01 levels
A: Predictors: social adjustment
B: Predictors: parental involvement
C: Predictors: academic motivation

Inference: show values of the parameters of regression analysis between predictors' variables and academic achievement. The results of the analysis shows as predicted. Total academic achievement of pupils in high school. The predictors' variables taken against the criterion variable. That social adjustment, parental involvement and social adjustment had 'r' and 'r' square value of .333,.175, and .383 respectively. the 'r' square value translated into11.1, 3.1,and 14.7 Percentage of the observed variance in the total academic achievement scores. the analysis also provided 'f' value of 12.439, 12.806 and 11.374.significant at level o.o1 level. therefore, it can be concluded that the social adjustment, parental involvement and academic motivation are best predictors of academic achievement among adolescents.

Table: - 2
The betas of the predictor of academic achievement

Model	Variable	B	seb	beta	t	Sign. T
1	(constant)	566.767	25.170	15.4	22.517**	.000
	Hostility vs friendliness,	13.125	4.064		3.230**	
2	(constant)	566.767	25.170	15.4	22.517**	.000
	Hostility vs friendliness,	13.125	4.064		3.230**	
	Parental involvement	1.742	.451	18.5	3.860**	

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3	(constant)	562.431	39.139	16.2	14.370**	.000
	Hostility vs friendliness,	13.833	3.996		3.462**	
	Parental involvement	1.391	.452	14.8	3.079**	
	Academic motivation	.478	1.198	17.6	3.738**	.001

A. Dependent variable: Academic achievement

Inference: provides the prediction variables in regression equation, the beta values and significant' corresponding to be variables regresses against the dependent variable. table-2 reveals beta values for social adjustment (b=15.4) and (t=3.230) significant at 0.001 level parental involvement (b= 18.5) and (t= 3.860) significant at 0.001 level and academic motivation (b= 17.6) and (t= 3.738) significant at 0.001 level by observing at the results in table-2 beta values indicate prediction of all the variables entered into equation found to be significantly higher this conforms. The results in table-2 where social adjustment, parental involvement and academic are the best predictors of pupil's academic achievement.

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Impact of College Environment, Emotional Adjustment and Parent's Education on Academic Achievement among Socially Disadvantaged and Advantaged Adolescents

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Abstract: *Socially disadvantaged children to be more concerned with the present and that they had vague and indefinite notions about future. This lack of orientation to future may have its adverse impact on the school performance of the socially disadvantaged children academic achievement, emotional and social maturity of early adolescent boarder and no boarder girls was explored results indicated that the academic motivation and emotional intelligence are the best predictors of academic achievement. Recently researchers are coming up with identification of genes responsible for certain emotional - dispositions like aggression and depression emotional intelligence develops over time, changes throughout life, and car be improved through training and remedial programs as well as through therapeutic interventions*

Keywords: *College environment, Emotional adjustment, Academic achievement.*

I. INTRODUCTION

Investigators like Jensen (1969, 1972, 1973), Shockly (1966) and Herrinstein (1971) take an extreme stand that the inferior intellectual functioning of the socially disadvantaged child has an inferior genetic basis. Terrell, durkinand and wiesby (1959), riessman(1962), cameron and storm(1965) Havighurst (1964) and spence (1971) found the socially disadvantaged children to be more concerned with the present and that they had vague and indefinite notions about future. This lack of orientation to future may have its adverse impact on the academic performance of the socially disadvantaged children academic achievement, emotional and social maturity of early adolescent boarder and no boarder girls was explored.

Emotional adjustment or maturity, like any other behavioral phenomenon is a product of interaction between heredity and environment, recently researchers are coming up with identification of genes responsible for certain emotional - dispositions like aggression and depression emotional intelligence develops over time, changes throughout life, and car be improved through training and remedial programs as well as through therapeutic interventions. Emotional intelligence combines with other important determinants of one's ability to succeed in coping with) environmental demands, such as basic personality traits and cognitive intellectual capacity.

E. Paul torrance university of Georgia both in defining and in measuring satisfactorily academic achievement and emotional adjustment have always made it impossible to make firm, clear-cut statements about the relationship between these two variables. It is well known that all kinds of success and failure influence physical, mental, and emotional functioning. Success generally improves all three kinds of functioning; failure, if severe or prolonged, impairs or interferes with them. It is also generally agreed that emotions affect all kinds of mental functioning-perception, memory, reasoning, creative thinking, judgment, and decision making- and thus influence academic achievement.

The literature on achievement consistently has shown that parent education is important in predicting children's achievement (Klebanov, Brooks-Gunn, & Duncan, 1994; Haveman & Wolfe, 1995; Smith, Brooks-Gunn, & Klebanov, 1997). The mechanisms for understanding this influence, however, have not been well studied. In general, family process models (Linver, Brooks-Gunn, & Kohen, 2002; Yeung, Linver, & Brooks-Gunn, 2002) have examined how parenting behaviors, such as the structure of the home environment, influence children's achievement outcomes.

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Objectives of the study

1. T o examine the differences if any in academic achievement of socially advantaged and disadvantaged adolescents.
2. To assess the differences if any in academic achievement among socially disadvantaged and advantaged adolescents relation to good and poor emotional adjustment.
3. To examine the contribution of demographic variable parents' education in relation to academic achievement among socially disadvantaged and advantaged adolescents.
4. To assess the contribution of other demographic variable college environment in relation to academic achievement among socially disadvantaged and advantaged adolescents.

Hypotheses

1. There would be significant difference between socially advantaged and disadvantaged adolescents with regard to their academic achievement
2. There would be significant impact emotional adjustment with regard to socially advantaged and disadvantaged adolescent's academic achievement.
3. There would be significant contribution of demographic variable parent's education towards academic achievement of socially advantaged and disadvantaged adolescents.
4. There would be significant influence of college environment on academic achievement of socially advantaged and disadvantaged adolescents.

Sample

Selection of the sample for the study was done in two phases. In the first phase six junior colleges out of ten available in and around Tirupathi town of Chitoor district, Andhra Pradesh, were selected randomly for each category i.e., forward caste and backward caste are socially advantaged , scheduled castes and scheduled tribes are socially disadvantaged adolescence boys and girls. Thus a sample of 100 boys and 100 girls were selected.

Variables

Independent variables

1. Emotional adjustment

Demographic variables

1. Social class (socially advantaged, socially disadvantaged)
2. College environment
3. Parent's education

Dependent variable

1. Academic achievement.

Tools

Emotional adjustment scale: the adjustment inventory *student* form developed by Hugh M.bell, Ph.D. (1962) with 6 sub-scales of 4th sub scale is factor"d": emotionality (emotional adjustment).

Social Class

Socially disadvantaged students belonging to SC/ST communities and socially advantaged belonging to backward and forward communities were chosen.

College Environment

Perceived college environment by the students was considered as variable with poor, fair, good and very good ratings.

Parent's Education

Father's education level was considered as parents' education in the present study

II. RESULTS AND DISCUSSION

The data were collected and subjected to a suitable statistical methods by Employing 2x2x2 Analysis of variance (ANOVA) with 2 (Socially Disadvantaged and Advantaged) x 2 (Government and Private) x 2(Male and Female).The main objective of the present study is to examine the impact of Social Class (Socially Disadvantaged and socially Advantaged), Sector (Government and Private) and Gender (Male and Female) on Academic Achievement of the junior college students.

Table: - 1 Shows Mean and standard deviations And Standard error mean for the Scores on Academic achievement obtained by socially advantaged and socially disadvantaged adolescents

Sources	Academic achievement	N	Mean	Standard Deviation	Standard deviation Error mean
	Socially disadvantaged	100	64.88	13.259	1.326

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Social class	Socially Advantaged	100	67.33	14.419	1.442
Emotional adjustment	Good	66	68.35	14.043	1.728
	Poor	134	65.00	13.704	1.183

The above table revealed that the findings further show that there is no any significant interaction effect of independent variable social class on academic achievement. Emotional adjustment were obtained and divided into two groups as good and poor adjustment in each area as per the test norms, it has been widely observed that students with learning difficulties, students whose academic achievement is low, students who drop out, generally have problems of emotional adjustment. But the students with good and poor emotional adjustment did not differ significantly in the present study.

Table 2: Shows mean and standard deviations for the scores on academic achievement obtained socially advantaged and socially disadvantaged adolescents

Sources	Academic achievements	N	Mean	Standard Deviation	Standard deviation Error mean
Parents Education	Up to tenth	88	62.37	11.646	1.244
	Up to graduation	112	69.04	14.797	1.398
College Environment	Good	96	65.00	13.385	1.366
	Very good	104	67.12	14.294	1.402

It is observed from the table 2 that the students whose parents education is up to graduation have performed better (mean= 69.04) than the students whose parents education level is only up to 10^{th} class (mean=62.37). Next, with regard to college environment was taken as another independent variable. The students who graded as good (mean=65.00) and the students who graded very well (mean=67.12) found to be similar in their academic achievement.

Table -3: Shows summary of ANOVAs for the scores on academic achievement

Sources	Type iii sum of Squares	Degree of Freedom	Mean square	F-ratio	Sig.
Social class	.010	1	.010	.000	Ns
Emotional adjustment	174.17	1	174.173	0.94	Ns
Parent's education	2030.917	1	2030.917	10.997	0.01
College environment	321.069	1	321.069	1.739	Ns
Parent's education * college environment	28.811	1	28.811	.156	Ns

Ns: Not significant at 0.05 levels

Table -3 the data were analyzed the results of the study was presented in table-3. The 'f' value (0.01) indicating no significant difference between socially disadvantaged and socially advantaged junior college students which indicates no impact of social class on academic achievement. It shows both the groups found to be similar in their academic achievement (see table-3). Previous studies in the literature show that social class position seemed to prevent children from advancing educationally but it seem that the influence of family socialization process, family interest and support are more important than purely on socioeconomic status factors of the students. Emotional adjustment and the results were presented in the table no-3. The findings in the above table reveals that there is no significant impact of emotional adjustment on academic achievement (f=0.935 respectively) among students. The 'f' value of 10.99 which is significant at 0.001 levels indicates that there is significant impact of parent's education on academic achievement of junior college students. The 'f' value of 1.739 indicates no significant impact of college environment on academic achievement. The difference between the students who graded their college as good and very good with regard to their academic

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achievement. Further, it is also observed from the results (table-3) that there is no any interaction effect of parent's education with parent's income and college environment.

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A STUDY ON OPERATIONAL EFFICIENCY OF BANKING SECTOR WITH SPECIAL REFERENCE TO SELECTED FOREIGN BANKS IN INDIA

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ABSTRACT

Financial institutions particularly banks were considered as a backbone to the economy as well as financial system. The growth of banking sector plays a key role in the economical and social uplifting of the economy. Banks are acting as a channel to implement financial inclusion in the nation and reducing poverty. The economical development of the nation is largely associated with banking sector contribution. An efficient and sound banking system of nations has significant positive externalities, which increase the efficiency of financial transactions and extending financial support to the needy people. For the last couple of years the Indian banking sector banks are facing serious challenges in terms of raising non-performing assets, frauds, misuse of funds and competition with Financial Technology start-ups (Fin Tech). The purpose of this study is to assess the operational efficiency of the selected foreign banks based on the selected financial indicators. Hence these study constituting two year period commencing from 2016-17 to 2017-18.

Key words: Financial Institutions, Financial inclusion, Operational efficiency.

INTRODUCTION

The foreign banks play a significant role in economic resource mobilization of an economy. A sound banking system is recognized as a basic need for the social and economical upliftment of the developing economy. Indian financial system is dominated by large number of public sectors banks, private sector banks and foreign banks. Since the banking sector reforms in 1991, a number of significant reforms brought about a tough competition among different sectors of banks both at national and international level. An efficient and sound banking system is also

required for sustainable economic development. Today banking sector in India becoming more complex due to raising non-performing assets, frauds, misuse of funds, decreasing operating revenue and decreasing interest income meanwhile banks are struggling in their core activity.

SCOPE OF THE STUDY

As far as the scope of the study is concerned, the study covers the composition of operational efficiency of selected foreign banks is operating in the country.

OBJECTIVES OF THE STUDY

1. To study the operational performance of the selected foreign banks operating in the country.
2. To assess the financial soundness of the selected foreign banks with the help of selected financial indicators.

HYPOTHESIS

Null hypothesis (H_0): There is no significant difference between the operational efficiency of selected foreign banks.

Alternative Hypothesis (H_A): There is a significant difference between the operational efficiency of selected foreign banks.

METHODOLOGY OF THE STUDY

Methodology describes the research route to be followed, the tools to be used, sample of the study for the date to be collected and the tools of analysis.

Tools for data collection

This study is based on secondary sources of data, the data required for the study has been collected form annual reports of respective banks, Journals, Magazines, Reserve bank of India website and Business Standard-Banking annual February 2019.

Period of the study

The present study covers a period of two years i.e. 2016-17 to 2017-18 financial years.

Sample selection

There are 12 foreign banks are operating in India. The present study was conducted on four selected foreign banks namely Bank of America, BNP Paribas, HSBC and MUFG Bank based on convenience sampling technique.

Tools for data analysis

Data gathered from different sources is analyzed by using the statistical tests of Mean, Standard Deviation and Two-way Analysis of Variance (ANOVA) without replication.

ANALYSIS AND RESULTS

Table-1
Operating Profit, Deposits, Total Income and Gross Non-performing assets of selected foreign Banks

(In Rs. Crore)

Year	Financial Indicator (Variable)	Bank of America	BNP Paribas	HSBC	MUFG Bank
2016-17	Operating Profit	1,433	679	4,259	710
2017-18		1,206	736	4,274	587
2016-17	Deposits	19,156	23,080	87,024	11,327
2017-18		19,073	24,637	92,169	10,731
2016-17	Total income	2,781	2,643	11,065	1,683
2017-18		2,655	2,490	10,471	1,579
2016-17	Gross Non Performing Assets	110	7	897	10
2017-18		0	7	924	75

Source: Business Standard-Banking Annual, February 2019.

Hypotheses

Null Hypotheses:

$\mathbf{H_{0A}} = \mu_1 = \mu_2 = \mu_3$ i.e. Operating profit do not differ significantly between the banks.

$\mathbf{H_{0B}} = \mu_1 = \mu_2 = \mu_3$ i.e. Operating profit do not differ significantly between the years.

Alternative Hypotheses:

H_{AA} at least two of the means are different i.e. Operating profit differ significantly between the banks.

H_{BB} at least two of the means are different i.e. Operating profit differ significantly between the years.

Table-2
Two-way ANOVA-Operating Profit in Selected Foreign Banks

Source of Variation	Sum of Squares	Degree of Freedom	Mean Square	F-ratio	P-value	F-Critical Value
Between Banks	17634740	3	5878247	694.13	9.26	9.28
Between Years	9660.5	1	9660.5	1.14	0.36	10.13
Error	25405.5	3	8468.5			
Total	17669806	7				

Critical value $\mu_1 = 3$ and $\mu_2 = 3 = 9.28$ at 5% level of significance.

Critical value of $\mu_1 = 1$ and $\mu_2 = 3 = 10.13$ at 5% level of significance.

Inference

From the output we know that the calculated value of test statistic $F_A = 694.13$ is greater than the critical value of 9.28. Hence we reject null hypothesis at 5% level of significance and accept alternative hypothesis. We concluded that operating profit differ significantly between the banks.

The calculated value of the test statistic $F_B = 1.14$ is less than the critical value of 10.13. Hence we accept null hypothesis at 5% level of significance and reject alternative hypothesis. We conclude that operating profit do not differ significantly between the years.

Hypotheses

Null Hypotheses:

H_{0A} $= \mu_1 = \mu_2 = \mu_3$ i.e. Deposits do not differ significantly between the banks.

H_{0B} $= \mu_1 = \mu_2 = \mu_3$ i.e. Deposits do not differ significantly between the years.

Alternative Hypotheses:

H_{AA} at least two of the means are different i.e. Deposits differ significantly between the banks.

H_{BB} at least two of the means are different i.e. Deposits differ significantly between the years.

Table-3
Two-way ANOVA-Deposits in Selected Foreign Banks

Source of Variation	Sum of Squares	Degree of Freedom	Mean Square	F-ratio	P-value	F-Critical Value
Between Banks	7.86	3	2.62	778.40	7.80	9.28
Between Years	4534566	1	4534566	1.35	0.33	10.13
Error	10094123	3	3364708			
Total	7.87	7				

Critical value $\mu_1 = 3$ and $\mu_2 = 3 = 9.28$ at 5% level of significance.

Critical value of $\mu_1 = 1$ and $\mu_2 = 3 = 10.13$ at 5% level of significance.

Inference

From the output we know that the calculated value of test statistic $F_A = 778.40$ is greater than the critical value of 9.28. Hence we reject null hypothesis at 5% level of significance and accept alternative hypothesis. We concluded that deposits differ significantly between the banks.

The calculated value of the test statistic $F_B = 1.35$ is less than the critical value of 10.13. Hence we accept null hypothesis at 5% level of significance and reject alternative hypothesis. We conclude that deposits do not differ significantly between the years.

Hypotheses

Null Hypotheses:

$H_{0A} = \mu_1 = \mu_2 = \mu_3$ i.e. Total Income do not differ significantly between the banks.

$H_{0B} = \mu_1 = \mu_2 = \mu_3$ i.e. Total Income do not differ significantly between the years.

Alternative Hypotheses:

H_{AA} at least two of the means are different i.e. Total Income differ significantly between the banks.

H_{BB} at least two of the means are different i.e. Total Income differ significantly between the years.

Table-4
Two-way ANOVA-Total Income in Selected Foreign Banks

Source of Variation	Sum of Squares	Degree of Freedom	Mean Square	F-ratio	P-value	F-Critical Value
Between Banks	1.09	3	36271925	1324.56	3.52	9.28
Between Years	119316.1	1	119316.1	4.36	0.13	10.13
Error	82152.38	3	27384.13			
Total	1.09	7				

Critical value $\mu_1 = 3$ and $\mu_2 = 3 = 9.28$ at 5% level of significance.

Critical value of $\mu_1 = 1$ and $\mu_2 = 3 = 10.13$ at 5% level of significance.

Inference

From the output we know that the calculated value of test statistic $F_A = 1324.56$ is greater than the critical value of 9.28. Hence we reject null hypothesis at 5% level of significance and accept alternative hypothesis. We concluded that total income differ significantly between the banks.

The calculated value of the test statistic $F_B = 4.36$ is less than the critical value of 10.13. Hence we accept null hypothesis at 5% level of significance and reject alternative hypothesis. We conclude that total income do not differ significantly between the years.

Hypotheses

Null Hypotheses:

H_{0A} $= \mu_1 = \mu_2 = \mu_3$ i.e. Gross non-performing assets do not differ significantly between the banks.

H_{0B} = $\mu_1 = \mu_2 = \mu_3$ i.e. Gross non-performing assets do not differ significantly between the years.

Alternative Hypotheses:

H_{AA} at least two of the means are different i.e. Gross non-performing assets differ significantly between the banks.

H_{BB} at least two of the means are different i.e. Gross non-performing assets differ significantly between the years.

Table-5
Two-way ANOVA-Gross non-performing assets in Selected Foreign Banks

Source of Variation	Sum of Squares	Degree of Freedom	Mean Square	F-ratio	P-value	F-Critical Value
Between Banks	1152669	3	384222.8	135.82	0.001	9.28
Between Years	40.5	1	40.5	0.01	0.91	10.13
Error	8486.5	3	2828.83			
Total	1161196	7				

Critical value $\mu_1 = 3$ and $\mu_2 = 3 = 9.28$ at 5% level of significance.

Critical value of $\mu_1 = 1$ and $\mu_2 = 3 = 10.13$ at 5% level of significance.

Inference

From the output we know that the calculated value of test statistic $F_A = 135.82$ is greater than the critical value of 9.28. Hence we reject null hypothesis at 5% level of significance and accept alternative hypothesis. We concluded that gross non-performing assets differ significantly between the banks.

The calculated value of the test statistic $F_B = 0.01$ is less than the critical value of 10.13. Hence we accept null hypothesis at 5% level of significance and reject alternative hypothesis. We conclude that gross non-performing assets do not differ significantly between the years.

FINDINGS AND DISCUSSION

- From the study it was found that operational efficiency has been measured with the help of operating profit, deposits, total income and gross non-performing assets. Hence, as per the study the operational efficiency of all selected private sectors banks has been fluctuated and there was ample change happened in the value of gross non-performing assets especially in HSBC and MUFG Bank. The non-performing assets are largely influence the operational efficiency and overall financial position of the banking sector.

- It is observed that operating profit of BNP Paris Bank has been increased by 8.3% and HSBC by 0.4%, the other hand operating profit of Bank of America has been decreased by 15.8% and MUFG Bank by 17.3%. It shows operating profit of BNP Paribas and HSBC was in increasing trend where as operating profit of Bank of America and MUFG Bank was in decreasing trend in the financial year 2017-18 compare to that off 2016-17.

- In terms of total deposits BNP Paribas stood first place with a growth rate of 6.7%, followed by HSBC with a growth rate of 5.9.0% and Bank of America and MUFG Banks recorded a negative growth rate of -0.4% and -5.3% respectively.

- In terms of total income all the selected foreign banks were recorded a negative growth rates, Bank of America (-4.6%), BNP Paribas (-5.8%), HSBC (-5.4%) and MUFG Bank (-6.2%). In terms of total income all the selected foreign banks performance is not satisfactory.

- It is found that the gross non-performing assets increased in two foreign banks, which include MUFG Bank by 632.9%, HSBC by 3.0% and in the remaining two banks there was no growth in gross non-performing assets. The two banks namely Bank of America and BNP Paribas initiatives are good to control the non-performing assets.

- It is found that the operating profit differs significantly between the banks and do not differ significantly between the years.

- It is found that there is a statistically significant difference between the banks in terms of deposits and there is no significant difference between the years.

- It is found that there is a statistically significant difference between the banks in terms of total income and there is no significant difference between the years.

- It is clear that gross non-performing assets differ significantly between the banks and do not differ significantly between the years.

- The overall financial performance of the selected foreign banks in India is not up to the mark, because all the selected banks were facing a tough competition with domestic banks. And they are filed to generate business. Hence the foreign banks should make more initiatives to attract the customer segments for improving the operational soundness.

CONCLUSION

The non-performing assets are not a serious problem to the foreign banks in India but the banks are struggling with high competition with domestic public and private sector. The foreign banks are not up to the mark to attract the local segment. Hence the foreign banks should make more initiatives, strategies to compete with domestic for improving the operational efficiency and overall financial performance.

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INVERSE DOMINATION IN FUZZY PLANAR GRAPHS

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INVERSE DOMINATION IN FUZZY PLANAR GRAPHS

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Abstract

This paper is a study about Inverse domination in fuzzy planar graph. Various properties of Inverse domination in fuzzy planar graph are obtained. Also Inverse domination in strong fuzzy planar graph is also studied. Many results are established.

***Keywords*:** Fuzzy graphs, fuzzy planar graphs, Domination in fuzzy planar graph, Inverse Domination in fuzzy planar graphs.

1 INTRODUCTION

Fuzzy graph was introduced by Rosenfield [2]. The concept of Dominating in graphs studied by quite a few authors like Orge, Berge [7] ckayne and Hedetniemi[3]. Sampathkumar and Pushpalatha [4] premeditated about point set domination in graphs. Fuzzy Planar Graph was introduced by Abdul-Jabbar et al, [5]and studied by Sovan Samantaa and Madhumangal Palb. The present study is the improvement of the concept of fuzzy planar graph . In this current study we introduced and studied about fuzzy planarity value and Inverse domination number of a planar fuzzy graph.

2 PRELIMINARIES

A fuzzy graph(f-graph) is a triplet $\xi : (V, \sigma, \mu)$ where V the vertex set, σ is a fuzzy subset of V and μ is a fuzzy relation on σ such that $\mu(u, v) \leq \sigma(u)\Lambda\sigma(v)$ for all $u, v\epsilon V$. A fuzzy graph $H : (V, \tau,)$ is called a partial fuzzy sub-graph of $G : (V, \sigma, \mu)$ if $\tau(u) \leq \sigma(u)$ for all $u, v\epsilon\tau^* and(u, v) \leq \mu(u, v)$ for all edges $(u, v)\epsilon$. In particular, we call $H : (V, \tau, \nu)$ a fuzzy sub-graph of $G : (V, \sigma, \mu)$. The order p and size q of a fuzzy graph $\xi = (V, \sigma, \mu)$ are defined to be $p = \Sigma_{x\epsilon V}\sigma(x)$ and $q = \Sigma_{xy\epsilon E}\mu(xy)$ The fuzzy cardinality of a fuzzy graph $\xi : (V, \sigma, \mu)$ be a fuzzy graph on V and $S \subseteq V$. Then the fuzzy cardinality of S is defined to be $\Sigma_{\nu\epsilon S}\sigma(\nu)$ The edge cardinality of a set $M \subseteq E$ of a fuzzy graph $\xi : (V, \sigma, \mu)$ is defined as $\Sigma_{\sigma\epsilon M}\mu(e)$. Let $\xi : (V, \sigma, \mu)$ be a fuzzy graph. A set D of vertices in a graph G is a dominating set if every vertex not in D is adjacent to at least one vertex in D. Let D be a minimum dominating set of G. If V D contains a dominating set say D' of G, then D' is called an inverse dominating set with respect to D. The inverse domination number $\gamma^{-1}(G)$ of G is the order of a smallest inverse dominating set of G. Fuzzy Planar Graph is an important subclass of fuzzy graph. For any fuzzy graph $\xi : (V, \sigma, \mu)$ the degree of a vertex v can be defined as $d(v) = \Sigma_{\mu\neq\nu}\mu(u, v)$ The minimum degree of G is $\delta(G) = \wedge\{d(v)/v\epsilon V\}$ and maximum degree of G is $\Delta(G) = \vee\{d(v)/v\epsilon V\}$. We can say a graph embedded on a surface, if the geometric representation of a graph on that surface is such that no two of its edges intersect each other. A planar is a graph G drawn in plane with any two of its edges intersecting

with each other. So the graph is non-planar if it cannot be drawn without crossings. For a non-empty set V, let $\sigma : V \to [0,1]$ be a mapping, $E = \{((x,y),(x,y)\mu_j), j = 1,2,...,p_{xy}/(x,y)\epsilon V \times V\}$ and $p_{xy} = maxj/(x,y)\mu_j 0$. The degree of a vertex $v\epsilon V$ is denoted by d(v) and is defined by $d(v) = \Sigma_{u\epsilon V} \sum_{j=1}^{p_{xy}}$. A fuzzy planar graph is called strong fuzzy planar graph if the fuzzy planarity value of the graph is greater than 0.5. Otherwise it is called weak fuzzy planar graphs.

3 INVERSE DOMINATION IN FUZZY PLANAR GRAPH

Definition: 3.1 Let $\xi : (V, \sigma, \mu)$ be a fuzzy graph. A subset D of V is said to be a dominating set of G if for every $v\epsilon V$ D there exists an element $u\epsilon D$ such that $\mu(u,v) = \sigma(u) \wedge \sigma(v)$. A dominating set D of G is called minimal dominating set of G if every node $v\epsilon D, D\{v\}$ is not a dominating set. The domination number and it is denoted by $\gamma(G)$.

Definition: 3.2 Let G be fuzzy planar graph with planarity value f, [5] where $f = \frac{1}{1+\{I_{P_1}+I_{P_2}+...I_{P_n}\}}$. The range of f is $0 < f \leq 1$. Here P1, P2,..., Pn be the points of intersections between the edges. In a graph $G = (V, \sigma, E)$, E contains two edges $\mu(a,b)$ and $\mu(c,d)$, which are intersected at a point P. Strength of the fuzzy edge $I_{(a,b)} = \frac{\mu(a,b)}{\{\sigma(a)\wedge\sigma(b)\}}$.
The intersecting point at p is $I_p = \frac{I_{(a,b)}+I_{(c,d)}}{2}$.

Definition: 3.3 If a graph G is said to be domination in fuzzy planar graph if
i. $G = (V, \sigma, \mu)$ be a fuzzy planar graph with planarity value f.
ii. Let $x, y\epsilon V$, x dominates y in G then $\mu(x,y) \leq \mu(x) \wedge \sigma(y)$
iii. A subset D of V is called a dominating set in G if for every y not belonging to D, there exist $x\epsilon D$ such that x dominates y.
iv. The minimum fuzzy cardinality of a dominating set in G is called the dominating number of G and is denoted by γ_{FP}.

Results: 3.4: (i). If there is no point of intersection for a geometrical representation of a fuzzy planar graph, then its fuzzy planarity value is 1. (ii) If $\mu(w,x) = 1$(or near to 1) and

$\mu(y,z) = 0$ (near to 0), then we say that the fuzzy graph has no crossing. Then the crossing will not be important for planarity. (iii) If $\mu(w,x) = 1$ (or near to 1) and $\mu(y,z) = 1$ (near to 1), then the crossing will be important for planarity. Strong fuzzy planar graph if f is greater than or equal 0.5 otherwise weak.

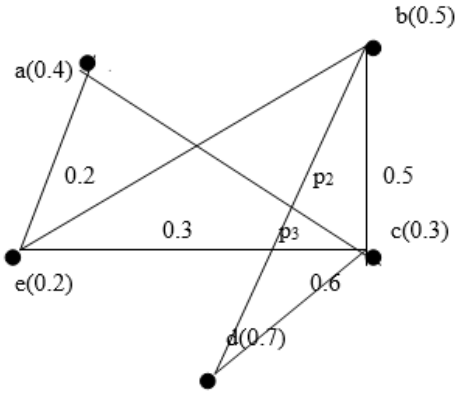


Figure 1: Fuzzy Planar Graph G1 with Intersection

Here G1 and G2 are same fuzzy planar graphs. Strength of the edges (a, c), (b, d),(b, e) and(e, c) are
$I_{(a,c)} = \frac{0.4}{0.3} = 1.3333, I_{(b,d)} = \frac{0.5}{0.5} = 1, I_{(b,e)} = \frac{0.2}{0.2} = 1,$
$I_{(e,c)} = \frac{0.3}{0.2} = 1.5$

Intersecting values are $I_{p1} = (1.3333 + 1)/2 = 1.6666, I_{p2} = (1.3333 + 1)/2 = 1.6666, I_{p3} = (1.5 + 1)/2 = 1.25$ Planarity value is f = 0.17910. Dominating sets are $D_1 = a, b, D_2 = a, d, D_3 = e, d, D_4 = c$. Here D_4 is the minimum dominating set. Minimum dominating number $\gamma_{FP} = 0.3$.

Definition: 3.5 Let D be a minimum dominating set of a Fuzzy graph G. If V- D contains a dominating set D' of G, then D' is called an Inverse Dominating set of G with respect to D. The Inverse domination number $\gamma^{-1}(G)$ of G is the minimum cardinality of an Inverse dominating set of G. For a Fuzzy planar graph G1 in Fig 1. Inverse Dominating sets are

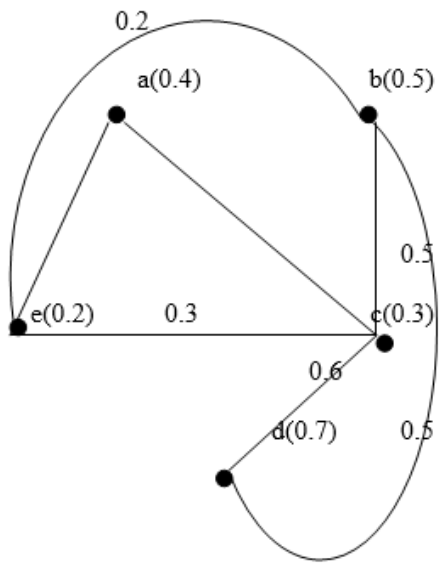


Figure 2: Fuzzy Planar Graph G2 without Intersection

$D_1^* = (c), D_2^* = (b, e), D_3^* = (c), D_4^* = (a, d)$. Minimal Dominating set it c then V-D contains a, b, d, e. Minimal Dominating set in V-D is $D' = a, b$. Minimum cardinality of an Inverse dominating set of a Fuzzy graph G1 is $\gamma_{FP} = 0.9$.

Definition: 3.6 Let $\xi : (V, \sigma, \mu)$ be a fuzzy graph and $m(0 < m < 0.5)$ be a given rational number. An edge (u, v) is said to considerable edge if $\frac{\mu(u,v)}{min\{\mu(u),\mu(v)\}} \geq m$. If an edge is not considerable, it is said to be non-considerable edge. For fuzzy multi graph (V, σ, μ) a multi edge (u, v) is said to be considerable edge if $\frac{(u,v)\mu^j}{min\{\mu(u),\mu(v)\}} \geq m$ for all $j = 1, 2, ...$

If $\frac{\mu(u,v)}{min\{\mu(u),\mu(v)\}} \geq m$ for all edges (u, v) of a fuzzy graph $\xi : (V, \sigma, \mu)$, then the number m is said to be considerable number of fuzzy graph. Considerable number of a fuzzy graph may not be unique.

Definition: 3.7 A graph G is said to be Inverse domination in strong fuzzy planar graph if
(i).$\xi : (V, \sigma, \mu)$ be a fuzzy planar graph with planarity value f greater than 0.5.
(ii). If V- D contains a dominating set D' of G, then D' is called an Inverse Dominating set of G with respect to D.
(iii). The minimum fuzzy cardinality of a Inverse dominating set in G is called the Inverse dominating number of G and is denoted by γ_{SFP}^{-1}.

4 BASIC RESULTS ON INVERSE DOMINATION

Proposition 1: If a graph G has no isolated vertices, then $\gamma(G) \leq \gamma^{-1}(G)$.
Proposition 2: If a graph G has no isolated vertices, then $\gamma(G) + \gamma^{-1}(G) \leq p$.
Proposition 3: For any fuzzy graph G = (σ, μ), $\gamma^{-1}(G) \leq \Gamma(G)$.
Proposition 4: For any fuzzy graph G = (σ, μ), $\gamma^{-1}(G) \leq p - \delta_N$.
Proposition 5: For any fuzzy graph G = (σ, μ) with at least one inverse dominating set, $\gamma(G) - \Delta_N(G) \leq \gamma^{-1}(G) - \Delta_E(G)$.
Proposition 6: For any fuzzy graph G = (σ, μ) with at least one inverse dominating set, $\gamma(G) \leq (p + \gamma^{-1}(G)) / 3$.

THEOREM 1: For any fuzzy graph $\xi : (V, \sigma, \mu)$ with at least one isolated vertex, (G) = 0.
Proof: Let D be a dominating set of G and $u \epsilon D$ be an isolated vertex. Then $\mu(uv) < \sigma(u) \wedge \sigma(v)$ for all $v \epsilon V$ D. Thus $\gamma^{-1}(G) = 0$.

THEOREM 2: For any fuzzy planar graph $\xi = (V, \sigma, \mu), \gamma^{-1}(G) \leq \Gamma(G)$.
Proof: Let D be a minimal dominating set of fuzzy planar graph G.
Case 1: If V D contains no dominating set. Then $\gamma_{FP}(G) = \Gamma(G)$
Case 2: If V D contains only one dominating set.
Clearly in this situation $\gamma_{FP}^{-1}(G) = \Gamma(G)$.
Case 3: If V D contains at least two dominating sets. Then minimum dominating set in V D with minimum fuzzy cardinality is $\gamma_{FP}^{-1}(G)$.
Therefore $\gamma_{FP}^{-1}(G) \leq \Gamma(G)$.

THEOREM 3: For any fuzzy graph G, $\frac{n}{1+\Delta(G)} \leq \gamma^{-1}(G) \leq \frac{n\Delta(G)}{1+\Delta(G)}$.

Proof: We know that $\gamma(G) \leq \gamma^{-1}(G)$.....(i) and $\frac{n}{1+\Delta(G)} \leq \gamma(G)$ .....(ii)

From (i) and (ii) we have $\frac{n}{1+\Delta(G)} \leq \gamma(G) \leq \gamma^{-1}(G)$ On the other hand $\gamma^{-1}(G) \leq n - \gamma(G)$.

Hence $\frac{n}{1+\Delta(G)} \leq \gamma^{-1}(G) \leq \frac{n\Delta(G)}{1+\Delta(G)}$.

THEOREM 4: For any fuzzy planar graph $\xi = (V, \sigma, \mu)$, $\gamma_{FP}^{-1}(G) \leq p - \delta_N$.
Proof: Let $v \in V$ with $d_N(v) = \delta_N$. Suppose D' be an Inverse dominating set of G. Clearly $v \in D'$ and $D' \subseteq V - N(v)$. Therefore $\gamma_{FP}^{-1}(G) = |D'| \leq |V - N(v)| = p - |N(v)| \leq p - \delta_N$.

THEOREM 5: For any fuzzy planar graph $\xi = (V, \sigma, \mu)$ with at least one Inverse dominating set, $\gamma_{FP}(G) - \Delta_N(G) \leq \gamma_{FP}^{-1}(G) - \Delta_E(G)$.

THEOREM 6: For fuzzy planar graph, $p-q \leq \gamma_{FP}^{-1} \leq p-\delta_E$. Where γ_{FP}^{-1} be the minimum dominating number in fuzzy planar graph and p, q and δ_E are the order, size and minimum effective incident degree of G respectively.

Proof: Let G be a fuzzy planar graph and D be a dominating set and γ_{FP}^{-1} be a minimum Inverse dominating number in G. Then the scalar cardinality of Inverse Dominating set D' of V – D is γ_{FP}^{-1} and we know that the scalar cardinality of V X V is $p-q$. $p - q \leq \gamma_{FP}^{-1}$ .....(i)
Let x be the vertex with minimum effective incident degree δ_E. Clearly V – {x} is a dominating set and $\gamma_{FP}^{-1} \leq p - \delta_E$.....(ii). From (i) and (ii) $p - q \leq \gamma_{FP}^{-1} \leq p - \delta_E$.

Theorem 7: Let ψ be a fuzzy planar graph with fuzzy planarity value greater than 0.5 and considerable number m. The number of points of intersection between considerable edges in Ψ is at most $[\frac{1}{m}]$ or $\frac{1}{m}$ -1 according as $\frac{1}{m}$ is not an integer respectively.

Proof: Let ψ = (V, σ, |μ) be a fuzzy planar graph with fuzzy planarity value greater than 0.5, where E = {((u, v), (u,v)μ^j), j =1,2,.....,p_{uv}/(u, v) ϵ V X V } and p_{uv}= max{ j / (u, v) $\mu^j \neq 0$}. Let 0 <m<.5 be the considerable number and f be the fuzzy planarity value. For any considerable edge ((x, y),(x, y) μ^j), (x, y) $\mu^j \geq$ min{ σ(x), σ(y)}.

In this case $I_{(x,y)} \geq$ m.

Let $P_1, P_2, \ldots\ldots P_k$ be the k points of intersection between the considerable edges. Thus the point P_1 between two intersecting considerable edges ((x, y), (x, y) μ^j) and ((a, b), (a, b) μ^i), $I_{P_1} = \frac{I_{(a,b)}+I_{(c,d)}}{2} \geq$ m. So $\sum_{i=1}^{k} I_{P_i} \geq$ km.

Hence f $\leq \frac{1}{1+km}$. As ψ is fuzzy planar graph with fuzzy planarity value greater than 0.5, 0.5 < f $\leq \frac{1}{1+km}$. Hence 0.5 < $\frac{1}{1+km}$. This implies k < $\frac{1}{m}$.

This inequality will be satisfied for some integral values

$$K = \begin{cases} \left[\frac{1}{m}\right] & if\ \frac{1}{m}\ is\ not\ an\ integer \\ \frac{1}{m} - 1, & if\ \frac{1}{m}\ is\ an\ integer \end{cases}$$

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PARENTAL INVOLVEMENT, ACADEMIC MOTIVATION AND EMOTIONAL INTELLIGENCE AS PREDICTORS OF ACADEMIC ACHIEVEMENT AMONG HIGH SCHOOL STUDENTS.

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ABSTRACT

Research in the past has demonstrated that classroom environment has great influence on students' achievement goals reported that emotional intelligence skills are key factors in the academic achievement and test performance of high school that influence adolescents' motivation at school. ***Objectives: 1.*** *To assess the parental involvement as predictor of academic achievement of adolescents.* ***2****. To assess the academic motivation as predictor of academic achievement of adolescents. 3. To assess the emotional intelligence as predictor of academic achievement of adolescents.* ***Sample:*** *Participants in the presented is consisted of 200 students studying 9th class in government and private schools both boys (100) and girls (100)* ***Tools****: 1****. Parental involvement scale*** *developed by* ***Prof.*** *K. Chandraiah and Madhavi devi (2011) used in the present study. 2.* ***Academic motivation scale*** *developed by blaich, c. F., & wise, k. S. (2011). And 3****. Emotional intelligence scale*** *developed by nutan kumar thingujam and usha ram (1999). Were used in the present study.* ***Results:*** *Results indicated that the parental involvement, academic motivation and emotional intelligence are the best predictors of academic achievement.*

Key words: *Parental involvement, Academic motivation emotional intelligence academic achievement, High school students.*

INTRODUCTION

Parental involvement in education (fan & chen, 2001; hill & chao, 2009; seginer, 2006). Indeed, family-school relations and parental involvement in education have been identified as a way to close demographic gaps in achievement and maximize students' potential (dearing, kreider, simpkins, & weiss, 2006; hampton, mumford, & bond, 1998; hara, 1998). As such, federal policies like the no child left behind act (nclb; 2002) mandate parental involvement in education and family-school relations across elementary and secondary school levels. Parental involvement in education is positively associated with

adolescents' academic outcomes throughout middle and high school (e.g., catsambis, 2001). However, other research found that parental involvement is not related to achievement (e.g., balli, wedman, & demo, 1997; bronstein, ginsberg, & Herrera, 2005).

A useful way of understanding student motivation has been to investigate the purposes for students 'achievement behavior through the goals they pursue in learning situations. Indeed goal theory (Ames, 1992; Ames & archer, 1988) at this time can have significant implications on employment or career opportunities, understanding adolescents 'motivation is vital ensuring students to achieve academic success adopting a goal theory perspective research has generated a wealth of understandings about why students might want to achieve at school as well as the individual and contextual factors that are critical to success. Goal theorists have investigated both the achievement goals (ames & archer, 1988; elliot, 1999) and the social goals (l. H. Anderman, 1999b; urdan & maehr, 1995) that influence adolescents' motivation at school. Research shows that adolescents are concerned about developing and demonstrating competence (achievement goals) and that social goal to form relationships, demonstrate responsibility and achieve status within the peer group also influence students' motivation.

In addition, relevant research has demonstrated that classroom environment has great influence on students' achievement goals (Ames, 1992; Ames & archer, 1988: Elliot & reis, 2003). Classroom environments which help students realize the personal relevance of the task, help them develop effective task strategies, and help them realize the link between their effort and accomplishments are expected to promote development of mastery approach goals. Indeed, Ames (1990) suggested that in order to promote adoption of mastery approach goals, the tasks offered to students should be novel and challenging. There should be variety in tasks and students should be encouraged to set short-term goals and concentrate on the meaningful aspects of activities. In addition, classroom environments should promote student autonomy and control in the learning process and focus on individual improvement and mastery (Ames, 1992). In fact, student predicts that classroom environments which encourage student autonomy help the development of autonomous motivation, which is closely linked to the adoption of achievement goals leading to adaptive academic outcomes (deci et al., 1991). On the other hand, classroom environments which emphasize competition and behavioral management causing students to perceive the tasks as a potential threat for themselves are likely to promote the adoption of avoidance goals (Elliot & reis, 2003).

Emotional intelligence is the ability to perceive emotions, to access and generate emotions so as to assist thought, to understand emotions and emotional knowledge and to reflectively regulate emotions so as to promote emotional and intellectual growth – (Mayer & salovery, 1997) emotional intelligence (EQ) is emerging as a critical factor for sustaining high achievement, retention, and positive behavior as well as improving life success. Increasingly, schools and educational organizations are turning to emotional intelligence seeking a systemic solution to improve outcomes-both academic and social (such as school attrition, student satisfaction peer relationships, and health).most people first heard the term" emotional intelligence" around with the publication of Daniel goleman (1995) laid out a

powerful case that such factors as self-awareness, self-discipline, and empty determine personal and professional success. Some people just know how to get along with others; some people are more self-confident and some are great at inspiring people.

Emotional intelligence is a cross-section of interrelated emotional and social competencies, skills and facilitators that determine how effectively we understand and express ourselves, understand others and relate with them and cope with daily demands and pressures (bar-on, 2006). It is that part of the human spirit which motivates us to perform, which gives us energy to demonstrate behaviors such as intentionality, persistence, creativity, impulse control, social deftness, compassion, intuition and integrity (Kapp, 2002). Lam and kirby (2002) are of the opinion that emotional intelligence involves perceiving, understanding, and regulating emotions. High emotional intelligence can contribute to a student in the learning process (Goleman, 1996; Elias, ubriaco, reese et al., 1992, Svetlana, 2007). Students low on emotional intelligence may find failure more difficult to deal with, which undermines their academic motivation (Drago, 2004).

OBJECTIVES OF THE STUDY

1. To investigate the contribution of parental involvement to academic achievement among adolescents.
2. To assess the academic motivation as predictor of academic achievement of adolescents.
3. To assess emotional intelligence as predictor of academic achievement of adolescents**.**

Hypotheses

1. There would be significant contribution of parental involvement to academic achievement among adolescents.
2. The academic motivation would be a significant predictor of academic achievement among adolescents.
3. The emotional intelligence would be a significant predictor academic achievement among adolescents.

Sample:

The sample for the present study is consisted of 200 students studying 9th class in government and private schools both boys (100) and girls (100).

Variables:

Independent variables

1. Parental involvement.
2. Academic motivation and
3. Emotional intelligence.

Dependent variable

4. Academic achievement.

Tools:

1. parental involvement scale developed by Prof K. Chandraiah and Madhavi devi (2011)
2. Academic motivation scale: developed by blaich, c. F., & wise, k. S. (2011).
3. Emotional intelligence scale: developed by Nutan KumarTthingujam and Usha ram (1999). Were used in the present study.

RESULTS AND DISCUSSION

The present study is aimed at investigating the Parental involvement, emotional intelligence and academic motivation. An attempt was also made to know whether there is any significant contribution of demographic variables viz. The data were collected and analyzed by using multiple stepwise regression, ANOVA tests and correlation coefficients. The results were presented in two sections. Section I deals with the multiple regression analyses between predictor variables viz. parental involvement, emotional intelligence , academic motivation and Dependent variable i.e academic achievement for (total as well as subject wise i.e. languages, science, mathematics and social sciences). Section II deals with the contribution of demographic variables on academic achievement. The results were presented in the following tables followed by discussion.

Table –1: Parental involvement, Academic motivation and emotional intelligence are the best predictors of academic achievement.

Predictors	**Regression analysis**		**Analysis of variance**			
Parental involvement	**R. 0.175(a)**	**Source**	**Df**	**S.s**	**M.s**	**F- ratio**
	R^2 0.031	**Regression**	1	92496.380	92496.380	12.769**
	S.e 85.11151	**Residual**	479	2912075.422	7243.969	
Emotional intelligence	**R. 0.383(f)**	**Source**	**Df**	**S.s**	**M.s**	
	R^2. 0.147	**Regression**	6	440715.085	73452.514	11.374**
	S.e 80.36216	**Residual**	474	2563856.717	6458.077	
Academicmotivation	**R. 0.296(c)**	**Source**	**Df**	**S.s**	**M.s**	
	R^2. 0.088	**Regression**	3	263293.359	87764.453	12.806**
	S.e 82.78403	**Residual**	477	2741278.443	6853.196	

Significant at 0.01 levels

A) Predictors: parental involvement

B) Predictors: academic motivation

C) Predictors: emotional intelligence

Inference: Show values of the parameters of regression analysis between predictors' variables and academic achievement. The results of the analysis shows as predicted. Total academic achievement of pupils in high school. The predictors' variables taken against the criterion variable. That parental involvement, academic motivation and emotional intelligence had 'r' and 'r' square value of.175 .383, and .296, and 031, .147, and.088 respectively. The 'r' square value translated into3.1, 14.7 and 8.8. Percentage of the observed variance in the total academic achievement scores. The analysis also provided 'f' value of 12.769, 11.374 and 12.806 significant at level o.o1 level. Therefore, it can be concluded that the parental involvement, academic motivation and emotional intelligence are best predictors of academic achievement among adolescents.

Table 2: Results of stepwise multiple regression analysis of variables significantly Contributing to the overall academic achievement.

Model	Variable	B	Seb	Beta	t
1	(constant)	491.134	14.775		33.242**
	Parental involvement	1.654	.463	17.5	3.573**
2	(constant)	585.414	24.787		23.618**
	Parental involvement	1.554	.453	16.5	3.431**
	Academic motivation	4.217	1.233	16.6	3.421**
3	(constant)	562.431	39.139		14.370**
	Parental involvement	1.391	.452	14.8	3.079**
	Academic motivation	.478	1.198	17.6	3.738**
	Emotional intelligence	.769	.289	12.5	2.662**

Dependent variable: academic achievement ** p< 0.01 level

Inference: Provides the prediction variables in regression equation, the beta values and significant' corresponding to be variables regresses against the dependent variable. Table-2 reveals beta values for parental involvement (b=17.5) found to be highly significant (t= 3.573) at 0.01level, academic motivation (b = 16.6) and (t=3.421) significant at 0.01 level and emotional intelligence (b = 12.5) and (t= 2.662) significant at 0.01 level. By observing at the results in table-3 beta values indicate prediction of all the variables entered into equation found to be significantly higher this conforms. The results in table-2 where parental

involvement, academic motivation and emotional intelligence are the best predictors of pupil's academic achievement.

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Impact of College Environment, Emotional Adjustment and Parent's Education on Academic Achievement among Socially Disadvantaged and Advantaged Adolescents

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Abstract: *Socially disadvantaged children to be more concerned with the present and that they had vague and indefinite notions about future. This lack of orientation to future may have its adverse impact on the school performance of the socially disadvantaged children academic achievement, emotional and social maturity of early adolescent boarder and no boarder girls was explored results indicated that the academic motivation and emotional intelligence are the best predictors of academic achievement. Recently researchers are coming up with identification of genes responsible for certain emotional - dispositions like aggression and depression emotional intelligence develops over time, changes throughout life, and car be improved through training and remedial programs as well as through therapeutic interventions*

Keywords: *College environment, Emotional adjustment, Academic achievement.*

I. INTRODUCTION

Investigators like Jensen (1969, 1972, 1973), Shockly (1966) and Herrinstein (1971) take an extreme stand that the inferior intellectual functioning of the socially disadvantaged child has an inferior genetic basis. Terrell, durkinand and wiesby (1959), riessman(1962), cameron and storm(1965) Havighurst (1964) and spence (1971) found the socially disadvantaged children to be more concerned with the present and that they had vague and indefinite notions about future. This lack of orientation to future may have its adverse impact on the academic performance of the socially disadvantaged children academic achievement, emotional and social maturity of early adolescent boarder and no boarder girls was explored.

Emotional adjustment or maturity, like any other behavioral phenomenon is a product of interaction between heredity and environment, recently researchers are coming up with identification of genes responsible for certain emotional - dispositions like aggression and depression emotional intelligence develops over time, changes throughout life, and car be improved through training and remedial programs as well as through therapeutic interventions. Emotional intelligence combines with other important determinants of one's ability to succeed in coping with) environmental demands, such as basic personality traits and cognitive intellectual capacity.

E. Paul torrance university of Georgia both in defining and in measuring satisfactorily academic achievement and emotional adjustment have always made it impossible to make firm, clear-cut statements about the relationship between these two variables. It is well known that all kinds of success and failure influence physical, mental, and emotional functioning. Success generally improves all three kinds of functioning; failure, if severe or prolonged, impairs or interferes with them. It is also generally agreed that emotions affect all kinds of mental functioning-perception, memory, reasoning, creative thinking, judgment, and decision making- and thus influence academic achievement.

The literature on achievement consistently has shown that parent education is important in predicting children's achievement (Klebanov, Brooks-Gunn, & Duncan, 1994; Haveman & Wolfe, 1995; Smith, Brooks-Gunn, & Klebanov, 1997). The mechanisms for understanding this influence, however, have not been well studied. In general, family process models (Linver, Brooks-Gunn, & Kohen, 2002; Yeung, Linver, & Brooks-Gunn, 2002) have examined how parenting behaviors, such as the structure of the home environment, influence children's achievement outcomes.

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Objectives of the study

1. T o examine the differences if any in academic achievement of socially advantaged and disadvantaged adolescents.
2. To assess the differences if any in academic achievement among socially disadvantaged and advantaged adolescents relation to good and poor emotional adjustment.
3. To examine the contribution of demographic variable parents' education in relation to academic achievement among socially disadvantaged and advantaged adolescents.
4. To assess the contribution of other demographic variable college environment in relation to academic achievement among socially disadvantaged and advantaged adolescents.

Hypotheses

1. There would be significant difference between socially advantaged and disadvantaged adolescents with regard to their academic achievement
2. There would be significant impact emotional adjustment with regard to socially advantaged and disadvantaged adolescent's academic achievement.
3. There would be significant contribution of demographic variable parent's education towards academic achievement of socially advantaged and disadvantaged adolescents.
4. There would be significant influence of college environment on academic achievement of socially advantaged and disadvantaged adolescents.

Sample

Selection of the sample for the study was done in two phases. In the first phase six junior colleges out of ten available in and around Tirupathi town of Chitoor district, Andhra Pradesh, were selected randomly for each category i.e., forward caste and backward caste are socially advantaged , scheduled castes and scheduled tribes are socially disadvantaged adolescence boys and girls. Thus a sample of 100 boys and 100 girls were selected.

Variables

Independent variables

1. Emotional adjustment

Demographic variables

1. Social class (socially advantaged, socially disadvantaged)
2. College environment
3. Parent's education

Dependent variable

1. Academic achievement.

Tools

Emotional adjustment scale: the adjustment inventory *student* form developed by Hugh M.bell, Ph.D. (1962) with 6 sub-scales of 4th sub scale is factor"d": emotionality (emotional adjustment).

Social Class

Socially disadvantaged students belonging to SC/ST communities and socially advantaged belonging to backward and forward communities were chosen.

College Environment

Perceived college environment by the students was considered as variable with poor, fair, good and very good ratings.

Parent's Education

Father's education level was considered as parents' education in the present study

II. RESULTS AND DISCUSSION

The data were collected and subjected to a suitable statistical methods by Employing 2x2x2 Analysis of variance (ANOVA) with 2 (Socially Disadvantaged and Advantaged) x 2 (Government and Private) x 2(Male and Female).The main objective of the present study is to examine the impact of Social Class (Socially Disadvantaged and socially Advantaged), Sector (Government and Private) and Gender (Male and Female) on Academic Achievement of the junior college students.

Table: - 1 Shows Mean and standard deviations And Standard error mean for the Scores on Academic achievement obtained by socially advantaged and socially disadvantaged adolescents

Sources	Academic achievement	N	Mean	Standard Deviation	Standard deviation Error mean
	Socially disadvantaged	100	64.88	13.259	1.326

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Social class	Socially Advantaged	100	67.33	14.419	1.442
Emotional adjustment	Good	66	68.35	14.043	1.728
	Poor	134	65.00	13.704	1.183

The above table revealed that the findings further show that there is no any significant interaction effect of independent variable social class on academic achievement. Emotional adjustment were obtained and divided into two groups as good and poor adjustment in each area as per the test norms, it has been widely observed that students with learning difficulties, students whose academic achievement is low, students who drop out, generally have problems of emotional adjustment. But the students with good and poor emotional adjustment did not differ significantly in the present study.

Table 2: Shows mean and standard deviations for the scores on academic achievement obtained socially advantaged and socially disadvantaged adolescents

Sources	Academic achievements	N	Mean	Standard Deviation	Standard deviation Error mean
Parents Education	Up to tenth	88	62.37	11.646	1.244
	Up to graduation	112	69.04	14.797	1.398
College Environment	Good	96	65.00	13.385	1.366
	Very good	104	67.12	14.294	1.402

It is observed from the table 2 that the students whose parents education is up to graduation have performed better (mean= 69.04) than the students whose parents education level is only up to 10^{th} class (mean=62.37). Next, with regard to college environment was taken as another independent variable. The students who graded as good (mean=65.00) and the students who graded very well (mean=67.12) found to be similar in their academic achievement.

Table -3: Shows summary of ANOVAs for the scores on academic achievement

Sources	Type iii sum of Squares	Degree of Freedom	Mean square	F-ratio	Sig.
Social class	.010	1	.010	.000	Ns
Emotional adjustment	174.17	1	174.173	0.94	Ns
Parent's education	2030.917	1	2030.917	10.997	0.01
College environment	321.069	1	321.069	1.739	Ns
Parent's education * college environment	28.811	1	28.811	.156	Ns

Ns: Not significant at 0.05 levels

Table -3 the data were analyzed the results of the study was presented in table-3. The 'f' value (0.01) indicating no significant difference between socially disadvantaged and socially advantaged junior college students which indicates no impact of social class on academic achievement. It shows both the groups found to be similar in their academic achievement (see table-3). Previous studies in the literature show that social class position seemed to prevent children from advancing educationally but it seem that the influence of family socialization process, family interest and support are more important than purely on socioeconomic status factors of the students. Emotional adjustment and the results were presented in the table no-3. The findings in the above table reveals that there is no significant impact of emotional adjustment on academic achievement (f=0.935 respectively) among students. The 'f' value of 10.99 which is significant at 0.001 levels indicates that there is significant impact of parent's education on academic achievement of junior college students. The 'f' value of 1.739 indicates no significant impact of college environment on academic achievement. The difference between the students who graded their college as good and very good with regard to their academic

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achievement. Further, it is also observed from the results (table-3) that there is no any interaction effect of parent's education with parent's income and college environment.

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An Efficient System for Secret Information Sharing Through SPIHT Coding and Zigzag Scanning

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Abstract— Starting late, the transmission of data through structure is growing rapidly, which gives minute access or scattering of bleeding edge data. Secret information sharing is the basic subject in the field of correspondence progress, information security and age. At any rate security can be introduced from various perspectives like transmitting question state, picture stowing unendingly, watermarking framework, certification and seeing confirmation. Many secure and amassed data things like military maps and business noticeable bits of check are sent over the web. While using conundrum records (pictures, content, etc.) for sending over the framework, the security issue is to be considered, since there is a chance of taking the riddle information by the item works by excellence of delicate relationship in the open structure. In order to deal with the security is sue of riddle information, we need a fitting secure count by which we can avow our data over the web. With the help of Visual Cryptography, the system visual information can be securely sent over the web.

Keywords: Visual cryptography, Security, Watermarking

I. INTRODUCTION

It is the claim to fame of sending and getting encoded messages that can be unscrambled just by the sender or the recipient. Encryption and unraveling are made by using numerical estimations with the target that no one yet the proposed recipient can unscramble and take a gander at the message. VCS puzzle sharing game-plan was appeared by Naor and shamir[8], the puzzler picture is part up into number of offers and transmit to the proportion of individuals. A visual puzzle sharing approach is a framework used to encode the enigma picture by splitt ing the contemplations into a few piece and pass on it into the relating individuals. A colossal measure of qualified individuals can almost certainly recoup the secret picture by covering the contemplations in right . T he essential piece of their strategy is that the conundrum picture can be decoded just by the human visual structure without swinging to any sublime figuring [9,10]. Critical section of visual cryptography scheme (VCS) is that it does not need mathematical computation to get the original secret [11,12]. During the past decade, Visual Secret Sharing (VSS) has attracted the attention of many researchers. Some of the literature has been related to the construction of a visual secret scheme [13, 14]. Based on the concept of sharing composed puzzle pictures, masters have ex - tended the visual inquiry sharing hope to suit the sharing of decrease secret pictures [15, 16, 17, 18] and shading enigma pictures [19, 20, 21, 22]. T here have been different cases of joining into secret information sharing and Detection. Question sharing structures have a spot with the more vital region of information covering that consolidates watermarking [23, 24]. Recursive hidin g of insider surenesses is proposed in [25, 26, 27-29]. T he thought included is recursive stowing ceaselessly of progressively unassuming puzzlers in offers of increasingly vital advantaged bits of data with secret sizes creating at every improvement. While the course of action showed up in [25] is a non-edge plan, plots in [26, 27 - 29] are edge plans. Correspondingly, in shading visual cryptography the offers made is striking. T he visual release sharing joined secretes is cleared up in [30]. To the degree the proportion of offer baffle pictures, the creation has been recently stressed over sharing only a particular secret picture. Notwithstanding, it wo uld be basic to have the capacity to share more than one puzzle picture meanwhile. Plainly, it is useful to develop a visual riddle sharing strategy for various insider surenesses

II. LIT ERAT URE SURVEY

Diverse emanate sharing systems have been proposed in the making using visual cryptography and their elucidations are recorded around there. Peng Li et al. [1] have cleared up the Sharing more information in decrease visual cryptography scheme.Visual cryptography scheme (VCS) shares a parallel question picture into a few twofold shado ws a d the riddle picture can be obviously revealed by stacking qualified shado ws without check. From the point of view of sharing riddle information, VCS was not sensibility because of the giant size movement and low visual quality. Here, they cleared up a general reduce visual cryptography plot, which was share more information, called Sharing More Information Gray Visual Cryptography Scheme (SMIGVCS). All the shadow pixels of VCS em bed additional information to make decrease shado ws of SMI GVCS, and the embedded information starts from the shadows of a polynomial-based secret sharing scheme (PSSS).. In the basic framework, a diminish problem picture is clearly decoded by stacking qualified shado ws, and more information was revealed by count.

Likewise, Yu-Chi Chen et al. [2] have secluded the criticalness of deluding slaughtering activity and exhibited a6 International Journal of Pure and Applied Mathematics Special Issue attestation based deluding want plot. T his approach was made with Naor-Shamir‟s VC plot. T hi

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developed a support based misleading sidestepping plot which was made with Naor-Shamir‟s 2-out - of-nvisual cryptography. T he proposed plot understood the dull perspectives especially implanted into the demanded stacking result. It was in like manner shown to expel misleading after a short time. T he number of the dull models was used to check whether an offer straightforwardness was fake or not . Finally, the proposed strategy is progressively profitable and beneficial to avoid tricking than past plans.

Furthermore, Sanjay Rawat et al. [3] have appeared liberal copyright confirmation plot subject to for the most part Fourier change (FrFT) and visual cryptography (VC). Un like the standard plans, in our course of action, the fundamental picture was not changed by carrying the watermark into the significant picture. T howdy used the visual conundrum sharing intend to fabricate two offers, to be express, master offer and ownership share. Features of the fundamental picture were separated using SVD, and were used to make the master offer. Ownership share was made with the help of puzzle picture (watermark) and the ace offer, using VC framework. T he two offers straightforwardly give no information about the secret picture, yet for ownership ID, the riddle picture was revealed by stacking the ace offer and the ownership share. To achieve the constitution and security, the properties of VC, FrFT and SVD were used in their strategy. T he exploratory results showed that the made strategy was sufficient arranged to confine indisputable flag overseeing attempts.

In [4], Duanhao Ou et al. have clarified the Non-expansible XOR-based visual cryptography plan with essential offers. XOR-based visual cryptography (VC), a spic and range kind of VC, was sensible for esteeming the low picture quality and approach issues in VC structure. Notwithstanding, purposeless offer and pixel improvement remain to continue with troubles in existing XOR-based VC. T o fix those referenced flaws, XOR-based VC with essential offers was appeared. A principal estimation executed by a quick picture framework for structure a (n,n) XOR-based VC was first cleared up. In the going with stage, a (n,n) XOR-based VC with fundamental offers was gotten some information about by enduring the basic count, where the critical offer was truly made without extra method. Wide groundwork results were addressed, showing the abundancy and focal motivations behind the methodology. Further, satisfactory hypothetical checks were obliged tending to the exactness of the proposed XOR-based VC.

In like manner, Jun g-San Lee et al. [5] have cleared up the Preserving direct shado w and high-separate quality for various visual puzzle sharing systems. T raditional bewilder sharing game-plan that scrambles riddle picture subject to numerical estimation to produce shadows regularly requires the baffled figuring to oust the inquiry . Later on, standard visual cryptography plot was made to deal with the perplexed estimation in encryption and extraction of past plans. T he stack - to-see technique was used plausibly to reveal the secret by human visual structure, which was lessen estimation time. In any case, the advancement of picture measure and the noise favored contemplations of past plans lead to the weight in transmission and cutoff. Here, uses a pre-portrayed codebook to encode two puzzle pictures into two immense transparencies without pixel progress. As showed up by the turning structure, two secret pictures were embedded into two contemplations in the interim. T he interpreting process empowers the customer to get two insider substances by methods for turning and stacking.

Also, M. Jenila Vincent and E. Angeline Helena [6] have cleared up the Securin g Multiple Color Secrets Using Visual Cryptography. Visual secret sharing was an encryption reasoning that blessings recuperating the enigma picture where the riddle picture was cryptographically encoded into offers. The (n,n) visual problem sharing arrangement proposed by Naor and shamir was used to scramble the question picture into n shares and by stacking the offers together, the puzzle was recouped back. Shading visual cryptography coordinates shading pictures as puzzle, where the shading insider truths are embedded into n shares .In this paper, they cleared up a (2,2) shading visual enigma sharing game-plan for various shading advantaged bits of learning reliant on Wu and Chen's code book. An exploratory result was show that the structure recuperates diverse shading insider certainties by stacking under various turn edges.

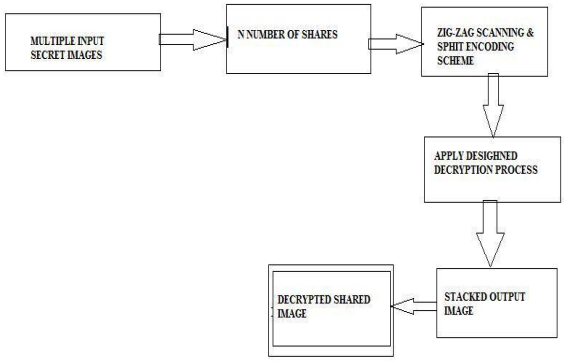
III. PROPOSED METHODOLOGY

A. Objective Formulation

The essential objective of my examination is to structure and develop a figuring for visual cryptography with the joining of fake particular affirmation of wrongly shared pictures. As necessities be, the issue is figured as searches for after: T wo input befuddle data should be revealed in the wake of offering it to various individuals with the criteria of disclosure of the phony idea whether it happens at the stacking end.

In light of the objective point by point, a computation will be made for visual cryptography close to the zone of false offers. At first, extraordinary data secret pictures will be detached into n number of offers. T hen, n offers will be given to the encoding estimation, and which will be done by making use, botch detaching, and SPIHT encoding plan. When we get the various considerations through the proposed encoding framework, the stacked yield picture will be gotten using the dealt with unraveling process that will pass on the unscrambled offer picture. Finally, extraordinary visual secret pictures will be gotten from decoded share picture. T he use will be done usin g MAT LAB and the execution of the proposed system will be analyzed with the power structure. Proposed plot yields Experiment results which is feasible and efficient . Proposed scheme is more efficient and effective to prevent cheating than previous schemes.

IV.RESULTS & DISCUSSIONS



Step-1: Multiple Input secret pictures of structure JPEG.
Step-2: Make „N‟ number of offers of pictures.
Step-3: Apply Zig-Zag looking SPHIT encoding Scheme.
Step-4: Apply sorted out unraveling process for the yield passed on from step-3.
Step-5: Create stacked yield picture.
Step-6: yield will be in unscrambled shared picture.

V. CONCLUSION AND FUTURE WORK

My examination is to plan and develop a computation for visual cryptography with the joining of dubious ID of wrongly shared pictures. An estimation will be made for visual cryptography close to the area of phony offers. T he execution part will be done using MAT LAB and the execution of the proposed structure will be neediness hit down with the present system.

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Robotic Wheel Chair using Sensors and Voice Control

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Abstract **-** This project describes about a controlling wheelchair using EEG, Eye blink, MEMS and voice. Being responsible to our society we are trying to give a wheel chair for those who are suffering from paralysis disease known as tetraplegia, paraplegia. It is very difficult to move the wheelchair for elderly and disabled people from one place to another place. So, to avoid the support from care takers this is one of the best solutions to implement it for the society. Here we are presenting a wheelchair in which simple unipolar electrode is used to capture the EEG signals from the brain to find whether the patient is in active (conscious, attention) state or inactive (drowsy, meditation) state which produces the movement in wheelchair when patient is in active state otherwise there will be no motion. In the second technique, a patient sitting on the wheel chair looking in a straight way where infrared sensors receive the signals from the eyes which leads to movement of the wheel chair. In the third technique, by using MEMS sensor tilting positions the movement of the wheelchair is produced. Similarly, in the case of fourth technique wheelchair movements are controlled by the voice instructions made by the patient using android mobile. The signals are monitored by a serial monitor, which will guide the motors wired to the ATMEGA328 micro controller over the serial interface to move in a particular direction. The system is cost effective and thus can be used by patients spread over a large economy.

Keywords **-** Atmega-328, mind wave sensor, infrared sensors, ultrasonic sensors,Accelerometer HC-05 bluetooth.

I. INTRODUCTION

We are trying to improve the quality of life for elderly and disabled people. The wheelchair has developed significantly with a variety of guidance systems alongside like using the joystick where the patients effected to the nerves of the hands can't be used and systems based on the voice recognition alone are not be able to used by the patients for those effected by the paralysis to throat and also dumb people.And also some. But here we are presenting a device where it can be used in multiple ways simply a multiple purpose wheelchair. By this the patients who are effected with any types of paralysis to their different parts of body which the patients with any type of praralysis.

Here we are developed a wheelchair which can be used by patients suffering from paralysis .In the first case, we are using mindwave headset to sense the EEG signals from the brain that is transferred to the arduino microcontroller through HC-05 bluetooth. Based on the data Produced through the headset the wheelchair movement is Produced. In the second case, we are using two IR sensors to monitor the eye lid movements. So, that when two eyes are opened movement will be obtained based on the property of IR radiation. Those systems however are of use to those with a certain amount of upper body mobility. We have designed in such a way that wheelchair navigates with the possibility of avoiding collisions and holes. In this case, we propose a new methodology to control the wheelchair using infrared radiation It is a hand free technology which will drive based on movement of eye lids of the user.

In this type of controlling mode the user can look around the surroundings freely during the navigation to their goal point. In this case the patient is unable to navigate through arena those who are suffering with greater degree of Paralysis.

II. SYSTEM MODEL

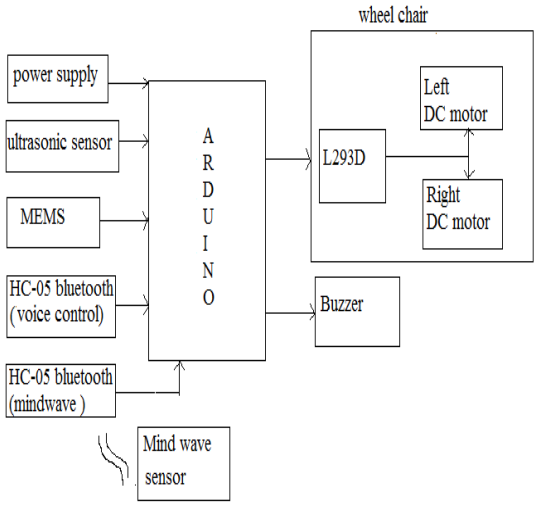


Figure1: Block diagram of system

Figure1 shows that there will be four ultrasonic sensors on the wheel chair for detecting obstacles. In this system we have design an optical using infrared sensor which Provides input to the microcontroller for driving a wheel chair IR sensors using reflected light intensity to estimate the distance from an object. Infrared rays Produced by transmitter Led and are received by the receiver led.

Signal acquit ion are mainly two types;

A. Invasive acquisition - This technique acquires the brain signals to electrodes that are implanted directly in the brain tissue. Surgery is required to implant the electrode on the cortex. This technique gives excellent quality of signals with very delay. However, as the electrodes are Pieces of wires Pins they are not completely reliable when placed inside the brain. Additionally, the invasive acquit ion technique may Prove to be an ethical controversy

B. Non-Invasive acquisition- The non-invasive technique on the other Hans uses the electrophysiological signals from

the scalp and takes measurements using that technique. The electroencephalogram is most commonly used due to its simplicity and ease in using other than meeting with the requirements for BCI systems. In the Paper electroencephalogram is used as the signal capturing technology.

Table 1: Wheel chair direction

Wheelchair direction	Left motor movement	Right motor movement
Forward	Forward	Forward
Backward	Backward	Backward
Left	Stop	Forward
Right	Forward	Stop
Stop	Stop	Stop

III. FEATURE EXTRACTION

Classification - There is a certain amount of discrepancy in classifying the waves, since the signals are continuously being captured but the many electrodes Present on the scalp. These waves are therefore classified into the following types:

A. Alpha waves - These waves generally range from 8HZ TO 13HZ with a very low voltage of about 5micro volts to 30 micro volts. These waves are generally by the brain it is in an empty or inactive state.

B. Beta wave - These waves generally range from 13HZ to30HZ with a voltage of about 30uv.They are released by the brain is active and thinking, solving a problem.

C. Theta waves - These waves generally range from 4HZ to 7HZ with a voltage of about 20uv.these waves are generally generated by the brain under stress, emotional tension, disappointment etc. these waves are also generated when the user is in deep meditation or unconscious.

D. Gamma wave - These e waves are released by the brain when the user is conscious and are generally of a frequency of 35HZ or greater.

E. Mu waves - These waves generally range from 8HZ to 12HZ. They are generally released when the brain responds to spontaneous activities such as motor activities etc.

Flow chart -

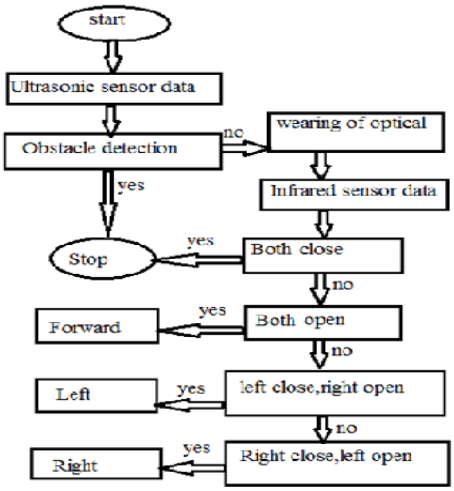


Figure 2: Flow chart of the EYE blink controlling system

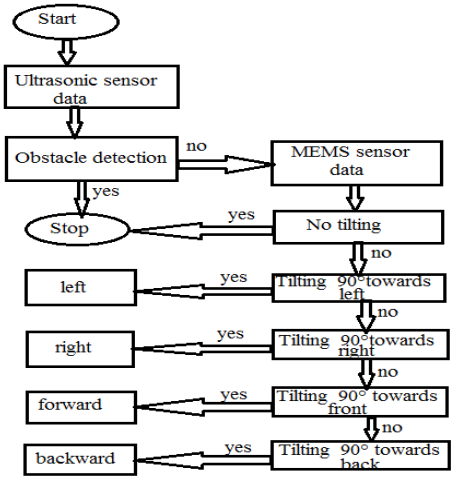


Figure 3: Flow chart of the MEMS controlling system

IV. METHODOLOGY

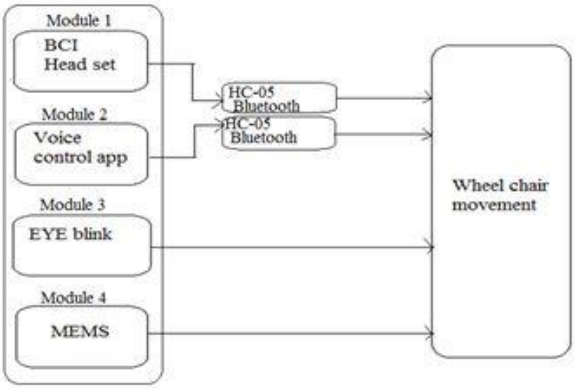


Figure 4: Proposed system

A. Neurosky mind wave mobile headset - The mind wave mobile safely measures and outputs the EEG Power spectrums in the form of alpha waves, neurosky sense meter and eye blinks. The device consists of a headset, an ear-clip, and a sensor arm. The headset reference and ground electrodes are on the ear clip and the EEG electrode is on the sensor arm, resting on the forehead above the eye. It uses a single AAA battery with 8hours of life.

B. HC-05 Bluetooth Module - HC-05 embedded serial communication module has two work modes: order response work model by and automatic connection work mode, and three work roles at the connection work mode. When the module is at the automatic connection work mode. When the module is at the automatic connection at the work mode, it will follow the default way set lastly to transmit the data automatically. When the module is at the order-response work mode, user can send the AT command to module can be switched by controlling the module.

C. Arduino UNO - The Arduino uno is a microcontroller board based on theATmega328.It has 14 digital input\output pin,6 analog Pins,16MHZ ceramic resonator, a USB

connection, a Power jack, an ICSP header, and a reset button. The main reason for selecting this specific model of arduino was that it satisfies our basic requirement of connection.

D. Accelerometer - An accelerometer is an electromechanical device that will measure acceleration force. It shows acceleration, only due to cause of gravity i.e. g force. It measures acceleration in g unit. Accelerometer can be used for tilt-sensing applications as well as dynamic acceleration resulting from motion, shock, or vibration.

V. CONCLUSION

This paper proposed the design of new concept of motion control of wheelchair using eye lids movement . The main purpose of this study is to develop a prototype that can detect obstacle and make disables self-dependent by increasing their range of mobility. There are four broad beam angle ultrasonic sensors integrated in order to detect obstacle and to obtain detailed regarding disable's environment. We have developed some logics to control the wheelchair through infrared sensors as if any user wants to drive the wheelchair forward, simply he should open both the eyes. If he wants to drive it backward, he should close both the eyes. Similarly if he wants it to turn left, he should close his left eye and open his right eye. And if he wants it to turn right, he should close his right eye and open his left eye. The movement of the wheelchair will be solely configured to the signals generated by the mind thus negating any physical force required. User based or specific modules can be created thus generating a unique footprint. It uses upcoming and ever evolving technology that will enable easy and manageable iterations. The components used are very low cost yet have an optimum performance level .External help may be required by people who suffer from paralysis of the upper torso for placement/adjustment of the headset. Exact thoughts cannot be measured using the current headset.Similarly through the MEMS sensor and voice the wheelchair can be controlled.Finally, our wheelchair can be multiple ways by those patients who are effected with different types of paralysis like Paraplegia,Tetraplegia.

VI. FUTURE SCOPE

An obstacle in the way could be detected automatically by the wheelchair forcing it to stop. Acceleration sensors could be added onto the wheelchair to calculate the amount of acceleration tilt to help navigate on ramps and slopes. The wheel chair could be integrated with head movements to control factors such as speed and brakes.

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Object Tracking in Video Sequence

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Abstract- Today, there is a number of applications based on image processing and video processing. For instance, in surveillance systems, in security systems, etc., Object detection and tracking in real time is a complex area of research in computer vision. Object tracking definition is to track the required object over a sequence of images. There are mainly three steps in video analysis, detection of the required object, tracking of that object from frame to frame, and analysis of the tracked object to recognize their behavior. In this paper, we are trying to track the required object continuously in a video sequence. To track the object we selected TLD(Tracking-Learning-Detection)framework which is used for long term tracking. For feature extraction of the object, which we want to track, we apply SIFT(Shift Invariance Feature Transform). By using both TLD and SIFT algorithms we tracked the object. After feature extraction of the object the tracker follows the object from frame to frame. The detector will corrects the error if any error occurred in the tracker. The learning can identify the detector's errors.

Keywords- video processing, computer vision, TLD, SIFT.

I. INTRODUCTION

Object tracking in a video sequence, is one of the important research areas due to its commercial applications such as surveillance systems, security systems, mobile robots. The problem and difficulty to track the object depend on several factors such as the amount of important knowledge about the target and the number of type of parameters being tracked (scale, area, weight, rotation angle, shape).

Based on the classification of object tracking, video tracking can be divided into single target video tracking and multi-target video tracking. In this paper, we are going to track a single target. The single target tracking mainly consists of three steps, detection of required moving object, tracking of that object from frame to frame, and analysis of the tracked object to observe their behavior.

To get the long term tracking, there are a number of problems which need to be rectified. The main problem is the detection of the object when it reappears in the video, next a successful long-term tracker should handle the scale and illumination changes, background clutter, occlusions. The long-term tracking can be achieved either from tracking or from detection perspectives. Tracking algorithms identify object motion. Trackers require initialization, are fast and it produces smooth trajectories. On the other hand, trackers accumulate error during run-time and it fails if the object disappears from the video. Detection algorithms estimate the object location in every frame independently. Detectors do not mound and do not fail if the object disappears from the video.

The first contribution of this paper is the design of a TLD framework that divides the long-term tracking task into three sub-tasks: tracking, learning and detection. Each sub-task is addressed by a single component and these components operate simultaneously. In the TLD framework tracker follows the object from frame to frame. The detector detects the object and corrects the tracker if necessary. The learning expects the detector's error and updates it to avoid these errors in the future.

II. RELATED WORK

This section reviews the related approaches for each of the component of our system. Section 2.1 reviews object tracking. Section 2.2 reviews object detection.

A. OBJECT TRACKING

Object tracking is the task of estimation of the object motion. Trackers assume that object is visible throughout the sequence. Various representations of the object are used in practice, for example: points [1], [2], articulated models [3], contours [4], or optical flow [5]. In this paper we focus on the methods that represent the objects by geometric shapes and their motion is estimated between consecutive frames, i.e. so called frame-to-frame tracking. Template tracking is the most straightforward approach in frame-to-frame tracking. The object will be described by a target template.

B. OBJECT DETECTION

Object detection is the task of localization of objects in an input image. The object may be human, vehicle, missiles, etc. The definition of an object varies based on our requirement. It can be a single instance or a whole class of objects. The feature based approaches usually follow the pipeline of: (i) feature detection, (ii) feature recognition.

III. TLD FRAMEWORK

TLD is designed for long-term tracking of an unknown object in a video. TLD block diagram is shown in the below figure. Tracker expects objects motion between consecutive frames under the assumption that the object is visible. The trackers never recover if object moves out of video. Detector treats every frame as independent.

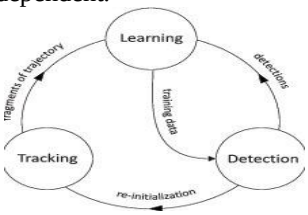


Fig.1: Block diagram of TLD framework

While a wide range of trackers and detectors exist but we are not aware of any learning method that would be suitable for the TLD framework.. The learning method[6] should: (i) deal with arbitrarily complex video streams where the tracking failures are frequent, (ii) never degrade the detector if the video does not contain relevant information and (iii) operate in real time.

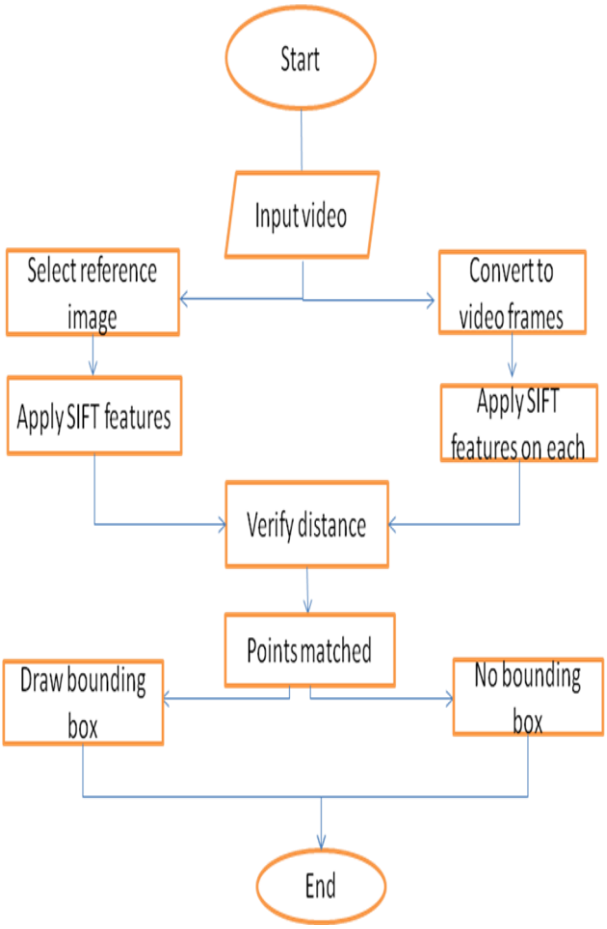


Fig.2: Flow chart of proposed algorithm

IV. SIFT ALGORITHM

SIFT stands for Scale Invariance Feature Transform. By using this algorithm we can extract the required features. Matching features across different images is a common problem in object tracking. When we have images of different scales and rotations, we need to use the Scale Invariant Feature Transform. SIFT is feature extraction algorithm in computer vision.

In this paper we selected scale, rotation angle and weights as the main features to detect the object.

The steps to extract the main features are as follows:

1. Let us consider

   L- Original image

   I- Gaussian filtered image

And take the difference between the L and I that should be considered as Difference of Gaussian.

DOG=L-I

2. Now apply the convolution between the original image and DOG

   K= DOG * I

   By using this we can extract some key points

3. After that do the localization of key points

   X= (DOG)□

   If I * X > 0.5 then that point should be considered as main key point

4. Now find out the magnitude and rotation angle

$\sqrt{(L(x+1,y)-L(x-1,y))^2+(L(x,y+1)-L(x,y-1))^2}$ this formula is used to calculate the magnitude and it is denoted as m(x,y).

$\theta(x,y)=\tan^{-1}((L(x,y+1)-L(x,y-1))/(L(x+1,y)-L(x-1),y)))$th is formula is used to calculate the rotation angle.

5. If number matched features are greater than three then the bounding box formed.

6. Based on the matched features the object will be tracked and if more feature are matched then accuracy will be more.

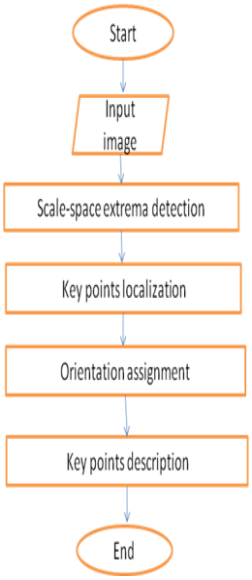


FIG.3: Flow chart for SIFT algorithm

V. RESULTS

The results for the object tracking in video sequence using TLD (Tracking-Learning-Detection) framework are as follows. Initially we have to select the interest object and by using SIFT algorithm features are calculated. After that the object is tracked.

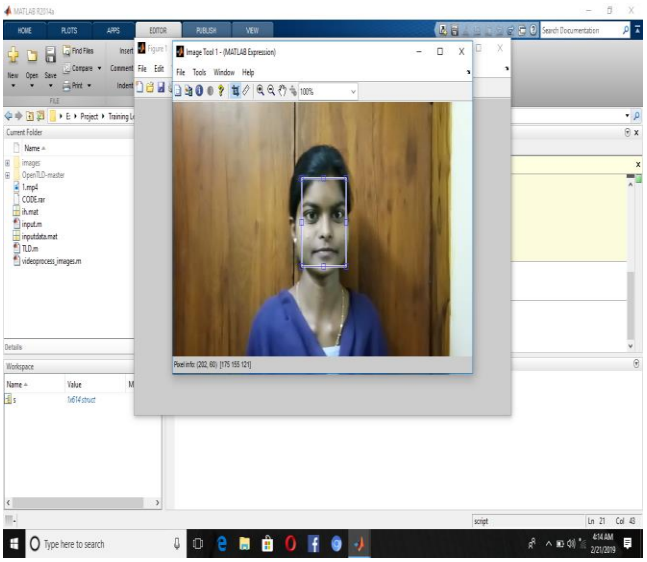


Fig.4: OBJECT SELECTION



Fig.5: TRACKING RESULTS

VI. CONCLUSION

In this paper, we studied the problem of tracking of an unknown object in a video stream. We designed a framework that divides the task into tracking, learning and detection.

First we have to select the required object from one frame. By using SIFT algorithm for feature extraction we extracted the required object features from reference image and by using that features of reference image we compare all frames with reference image. Based on the results of matched features the object will be tracked.

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A Novel Hardware Security Mechanism Using Hybrid Cryptography Algorithms

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Abstract- Data security is a primary concern for every communication system.The security techniques, today the most wide spread,and based on coding algorithms.Communication becomes an essential tool for any business,education,defence services etc.It is essential to transfer data safe and secure. At present various cryptography algorithms have been proposed and implemented. Those algorithms are classified into symmetric and asymmetric algorithms based on number of keys used. Even though several algorithms are used for data security,they compromise the security at the certain period Now the idea is to combine the several secure algorithms to provide a highly secure environment for data transmission.The algorithms that are going to be combined are SHA1 hashing algorithm and AES symmetric cryptographic algorithm.In which SHA1 is used for authentication of the trojan presence and AES is used for the diagnosis .With these two algorithms we ensure the security for the mobile communication while receiving a call.

Keywords- Hardware Trojan, AES, SHA-1, Message digest, cyper text.

I. INTRODUCTION

As today is the era of wireless communication which gives rise to mobile communication. Internet and network usage are increasing rapidly .Everyday a lot of digital data have been exchanging among users. Some of the data is sensitive that need to be protected from intruders.

Smart phones are valuable targets for hackers – more so than laptops or personal computers. This is because they can be used as a "pivot point" to attack heavily protected environments such as banks or critical national infrastructure. Hackers can redirect their malicious traffic through your phone and store collected data on it. This means that all forensics traces would point to you as the hacker rather than the real culprit.

Encryption algorithms play vital role to protect original data from unauthorized access. Since semiconductor manufacturing demands a large capital investment, the role of contract foundries has dramatically grown, increasing exposure to theft of masks, attacks by insertion of malicious circuitry, and unauthorized excess fabrication .

II. LITERATURE REVIEW

Komal Rege et.al [4] proposed a hybrid encryption scheme for Bluetooth communication security, using AES and RSA. The key of 128-bit is encrypted using RSA algorithm, similarly the message of sender is encrypted using AES cipher. Both encrypted AES-key and cipher text of message is used to generate a complex message, which is transmitted over the network. The decryption is exactly the reverse process of encryption algorithm. Palanisamy et.al [5] proposes a hybrid cryptography technique using RSA and AES algorithms. RSA algorithm uses a key size of 128-bytes. It uses two pairs of keys: public key and private key. One pair is used at sender site for encryption/decryption and the other one at receiver's site. Ali E. TakiEl_Deen [3] has proposed a hybrid encryption algorithm using AES and Blowfish. Plaintext of 64-bit is encrypted using Blowfish algorithm generating 64-bit cipher text which is again encrypted using same algorithm, thus generating a new 64-bit cipher text. The two outputs 64+64=128-bit cipher text is now given as an input to AES algorithm, generating the final 128-bit cipher text. Blowfish and AES algorithms make use of 32-bit and 128-bit key size respectively for their rounds. A statistical comparison of AES, DES, RSA, and Blowfish algorithms has been also provided. RituPahal et.al [6] proposes an efficient implementation of AES. Instead of conventional 128-bit input, 200-bit input is copied into an array of 5*5 matrixes. The first nine rounds are same consisting of four transformations: Substitute Bytes, Shift Rows, Mix Columns, and Add Round Key, but in the final (10th) round transformation Mix Columns is not used. The results of proposed scheme are compared with 128-bit, 192-bit, and 256-bit AES techniques at the end.

III. HTH ATTACK MODEL

A Hardware Trojan Horse (HTH) is an intentional hardware alteration of the design specification or of the corresponding implementation. These alterations only affect the circuit's functionality in a few specific circumstances and are hidden otherwise. HTHs are more difficult to detect, diagnose, and mask than design bugs or manufacturing faults since they are intentionally implanted to be unperceivable by the current debugging and testing methodologies and tools. The vast number of possibilities for implementing HTHs further complicates their detection. Diagnosis of HTHs can be especially intricate since a large number of Trojans may be present simultaneously in an IC. In addition, HTHs are not necessarily present in all ICs coming from a design. Since HTHs are embedded within the circuit and are active only under certain, very rare conditions, detection methods must be complex.

Here we present specific HTH, in an attempt to describe the nature of HTH attacks in general. A simple, yet powerful HTH attack is presented in Figure 1, which shows how ghost circuitry can be activated in a cell phone when specific inputs

or data are detected at specific memory locations. The unshaded portion of the circuit represents the HTH circuitry when it is activated by a HTH caller ID number. Upon activation, the attacker bitstream (ABS) is activated and the initial cell phone design is corrupted. In this example, HTHs will either cause the cell phones to malfunction or cause confidential information to be leaked. Important information can be disclosed after activation of the HTH. The exploited phone can automatically dial a hidden spy third party when certain numbers are dialed.

Even though the number and types of potential hardware attacks are essentially unlimited, we currently classify HTH attacks into the seven following categories: (i) damage objectives; (ii) components and mechanisms of the attack; (iii) components of the IC under attack; (iv) duration and initiation mechanisms; (v) design phase implantation and usage phase; (vi) optimization level; and (vii) customization level. The HTH attackers desiderata may include alteration of the computed results, slowing the IC, increasing the power consumption, releasing confidential data, and facilitating sidechannel attacks by making the gates' power consumptions observable at output. Attackers can employ various techniques including excessive switching, interconnect resizing, and substrate noise addition. Components, such as gates, clocks, and memory are vulnerable to physical attacks. Attacks may be randomly or actively initiated, e.g., event triggered.

IV. PROPOSED METHODOLOGY

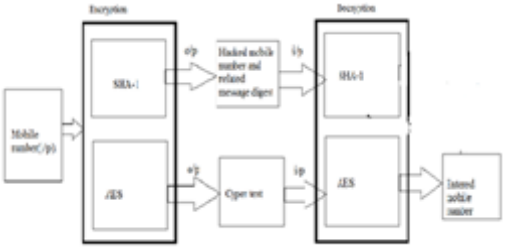


Fig.1: BLOCK DIAGRAM

i. Encryption Process

Mobile number is given as an input to both SHA-1 and AES.SHA generates the message digest to the dialled mobile number and on the other hand AES generates the cyper text to the mobile number.And these outputs are given to the SHA and AES decoders respectively.

ii. Decryption Process

At the decryption side SHA-1 again generates the message digest based on the received mobile number ,then a comparision circuit is used at the decoderto compare the newly generated message digest and the received message digest.

- If both the message digests are same then using the single SHA algorithm call gets forwarded to the original user.
- If both the message digests are not same then SHA receives the input from AES decoder and call gets forwaded.Here AES is used as a synchronizing signal.

SHA-1:

Secure Hash Algorithm (SHA-1) is a major message digest function developed by NSA. SHA-1 processes the data blocks of 512-bit and generates a message digest of 160-bit.The message digest is produced on similar principles used in MD4 and MD5, but SHA-1 has more conservative design. SHA-1 is used in several widely used protocols and security applications like TLS, SSL, PGP, SSH, S/MIME, and IPSEC. Secure Hash Algorithms comes in various flavors like SHA224, SHA256, SHA384, and SHA512.

AES :

AES Advanced Encryption Standard (AES) is a symmetric-key cryptographic technique. Unlike its predecessor DES, the structure of AES does not resemble to that of Feistel Structure. AES has a fixed block size of 128-bit and the key length must be 128, 192, or 256 bits. A 128-bit key thus gives a key space of 2128 keys. Number of rounds in AES is determined by the key size used in the process. Number of rounds will be 10, 12, 14 for key sizes of 128, 192, 256 bits respectively. First n-1 rounds contain four distinct transformations: Substitute Bytes, Shift Rows, Mix Columns, and Add Round Key. The final round contains only three transformations: Substitute Bytes, Shift Rows, and Add Round Key. AES offers a very high security and performance.The proposed scheme consists of two processes, encryption process and decryption process. Both processes make use of AES and SHA1. The reason we have selected these particular algorithms is discussed as:

AES is not only a secure cipher but it offers a very high performance and makes better use of resources. It is strong enough to be certified for use by the US government for top secret information Encryption Process .. SHA-1 a message digest function with a block size of 512- bit generates 160-bit message digest.So all the essential features of these algorithms are made available in our proposed hybrid algorithm. Better encryption of AES, along with the digital signature by making use of SHA-1 are included in a single hybrid system.

The figure below shows the process of the design .Whenever Trojan has been inserted with in the circuitary then it dials to the third party ,if not dials to the original number.And here we propose the detection mechanism through the hybrid algorithm techniques(SHA-1 and AES).

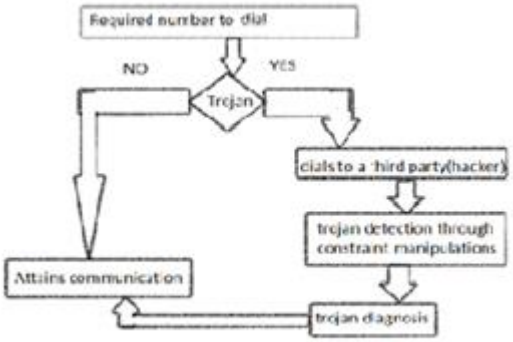


Fig.2: Flow chart of the design

V. RESULTS

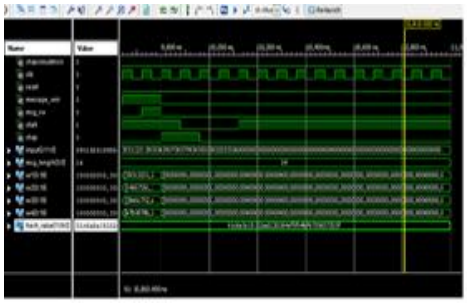


Fig.3:Output for original input

- Message digest for the given mobile number is as follows: **"01c6a3a15152ca0230384af5f64b76735637253f".**

Sha algorithm majorly has five steps and based on the input(mobile number) given it takes around 80 iterations and generates a 160 bit message digest value as shown above.

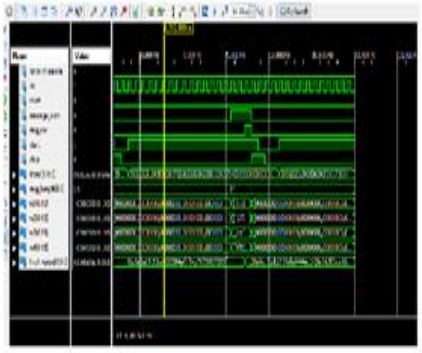


Fig.4: Output for hackedinput

- This represents the output at the decoder (BTS) .Such that in presence of malware it receives two different message digests one from the encoder and other from the received (hacked) mobile number. This case represents malware presence and call gets disconnected.

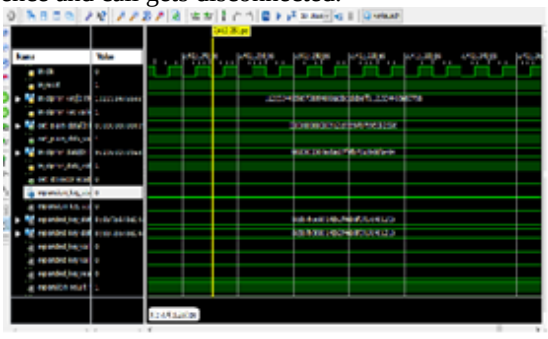


Fig.5:Output after diagnosis(aes decoder output)

- Whenever the message digests are unequal then AES inputs the original mobile number to the SHA decoder inorder to forward the call to the original user.



Fig.6:Output after diagnosis(sha decoder output)

- In presence of Trojan SHA decoder receives the output from the AES and forwards call to the original user.

VI. CONCLUSION

By making use of this hybrid cryptographic algorithms based on SHA and AES provides a very high security.In case of mobile communication by adding the extra feature called comparision of message digest generated by SHA algorithm prevents the mobile from malware insertion and thus provides high security. And AES acts as a synchronizing signal to divert the call to the original user whenever the malware insertion is identified.Thus,the combination of these two algorithms(AES and SHA) provides a high security to attain communication.

VII. FUTURE SCOPE

A software can be built for this purpose consisting many algoriyhms and then as soon as it receives password and data,it computes the algorithms to be used and their sequence based on the password and apply it to the data and during decryption, follow the same process and input the encrypted text and passwords to decrypt.This would improve the efficiency of hybrid system greatly.

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Eye Blink Detection Using MATLAB

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Abstract-In olden days Face Recognition is very popular for security applications. But security against face spoofing attacks requires the increased attention, such attacks can be easily done by printed photos, video replays and 3D mask of a face. To avoid such things the proposed paper is an "Eye Blink Detection using MATLAB". The proposed method has a low computational complexity and high accuracy such that it is an efficient and effective to run not only on mobile device but also on other platforms. The proposed method detects the movement of an eye ball and the number of eye blinks to improve face recognition. To reduce the risk of securing personal information an eye blinking detection is associated into the system. Using the front camera of the phone and different machine learning algorithms, user's eye movements are being tracked and detected by the mobile phones. Eye Blink detection plays a very important role in the field of human computer interaction. The proposed method has a wide range of application such as object selection, driver drowsiness detection, financial transactions, border and airport control, home or building security military applications, persons with disabilities and so on. Eye blinking detection is hand free interfacing system that removes the gap between the real and electronic world. It is great importance in today's world where implicit commands become more useful and attractive that the explicit on.

Keywords-*MATLAB2013; Face Detection; Eye Detection; Eye Blinking Detection.*

I. INTRODUCTION

According to the statistics of Seong won Han [1], As new applied services related to smart mobile devices associated with social network are emerging constantly, in order to prevent non-owner from being able to operate directly the built-in system of mobile device, screen unlock function is gradually applied. However, due to today's social network popularity, some interested people might be able to steal personal data from the network, and this function became easier to be broken. Therefore, in this study, "eye blink" function is associated into the system to make sure that the user in front of the mobile device is the right person instead of a photo so as to protect personal data within the mobile device and to reduce cheating issue from human face.

II. LITERATURE REVIEW

The aim of this paper [1] is to help people for improvement of the door security of sensitive locations by using face detection and recognition. Face is a complex multidimensional structure and needs enhanced computing techniques for detection and recognition. If a face is recognized, it is authenticated. The door will open automatically for the authenticated person due to the command of the microcontroller.

The paper[2] presents a methodology for recognizing the human face based on the features derived from the image. The proposed methodology is implemented in two stages. Better accuracy in recognition is realized with the proposed method.

The work in [3] is consisting of web camera which placed in a way that it records driver's head movements in order to detect drowsiness. As drowsiness is detected, a signal is issued to alert the driver. The system is implemented using cascade object identifier from vision toolbox of MAT lab, which detects face, eyes, nose and mouth from the image which is captured from web camera.

The work in [4] claims that the face recognition systems in applications from de-duplication to mobile device unlocking, security against face spoofing attacks requires increased attention; such attacks can be easily launched via printed photos, video replays and 3D masks of a face. We address the problem of facial spoof detection against print (photo) and replay (photo or video) attacks based on the analysis of image aliasing (e.g., surface reflection, more pattern, color distortion, ´and shape deformation) in spoof face images (or video frames).

III. PROPOSED METHOD

A. System Architecture

In this section, an eye blink technique in association with face recognition is proposed to improve the application of cheating of screen unlocking by a human face. For that eye blink technique is associated into the system. Blinking method [7] did not need any complicated procedure to user identity and the user just blinks his/her eyes to fast unlock the screen on mobile devices. Eye blink detection help in future purpose to store some important information in the mobile phone such as bank information, customer data and photos, etc., Human eyes will complete eye [8] blink action unconsciously or

autonomously within a second. The system architecture can be divided into five blocks, which are respectively face detection, face recognition, face database, eye detection, eye blink detection. The function of each function is described as follows:

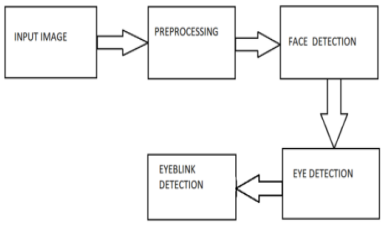


Fig .1: Block Diagram of Proposed method

B. Face Detection:

The viola-Jones object detection algorithm is the first object detection to provide competitive object detection rates in real time proposed in 2001 by Paul viola and Michael Jones [2]. Although it can be trained to detect a variety of object classes, it was motivated primarily by the problem of face detection. The Viola-Jones algorithm has four stages: They are

1) Haar feature selection.
2) Creating an integral image.
3) Ada boost training.
4) Cascading classifiers.

Face Detection [3] is the process of locating a face region in an image. The face detection does not care who the person is, just that it is a human face. Face detection [4] is a computer technology used to identify human faces in digital images by determining the location of the faces in the image and extract sub images for each face. It will find a face from the face image with face samples on a face database to achieve user' identification. If she/he is identified, the eye detection will start.



Fig 2: Detection of face

C. Eye Detection:

Given an arbitrary face image, the goal of eye detection is to determine the location of the eyes. Simply in eye detection, the areas where both eyes are located are found. As a result of this process usually eye areas [6] are indicated by a rectangle. For detecting of eyes from a face we used viola-Jones algorithm.



Fig .3: Face and Eye Detection

D. Eye Blink Detection:

Our Eye blink [5] algorithm comprises of, Taking eye blink video as a input, converting video into frames. Here we are taking 8sec video as input. Now the video obtains a 290 frames. The obtained frames based on the time consumed by the video. Based on these frames select the three different states (i.e..open state ,closed state and half blink state) i.e.. frame1,frame79, frame192. From the above selected states, it plots the graphs respectively. Based on the plotted graphs determine the threshold values, to show authentication differences between the persons.

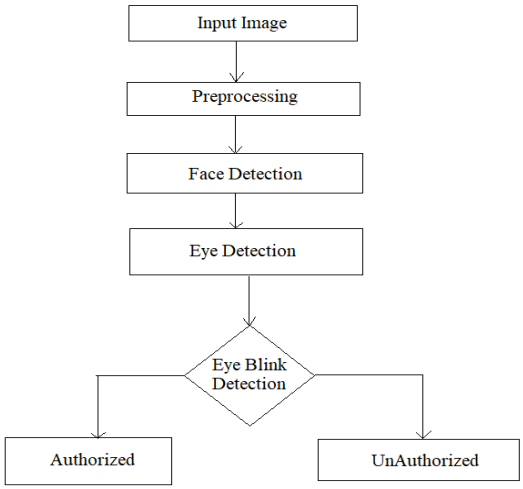


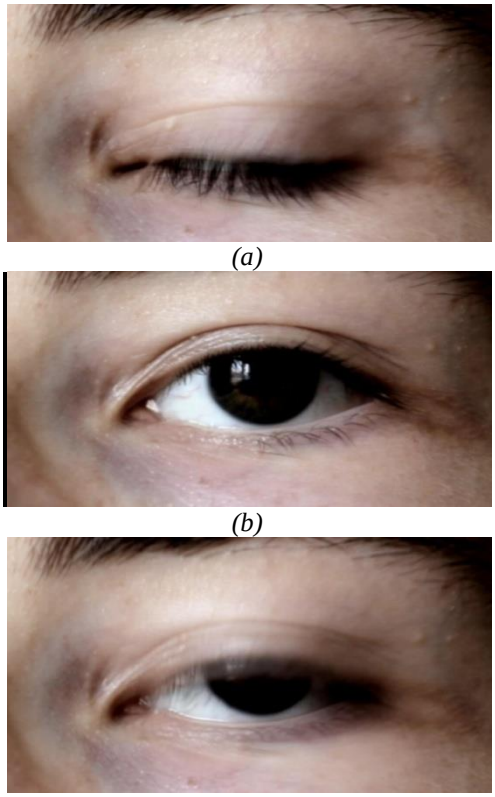
Fig .4: Flow chart for proposed method

Eye blinking can be detected with high reliability. Eye blink detection, which finds eyes through the human face. Eye blink detects the number of eye blinking to improve face recognition for screen unlock on mobile devices.

Blinking method did not need any complicated procedure to user identity and the user just blinks his/her eyes to fast unlock the screen on mobile devices. In a video, we detect an eye blink if several consecutive frames capture the quick motion of closing and opening the eyelids.

E. Closed and open eye detection:

Based on the obtained frames we selected the different states of the eye. The respective frames and graphs are shown below:

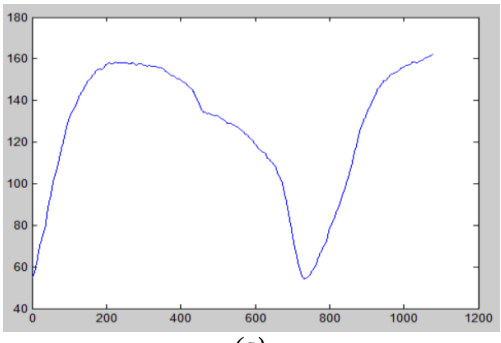


(a)

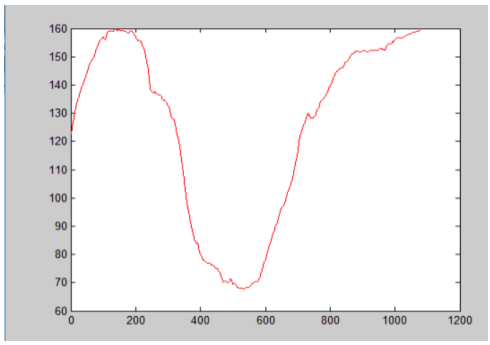
(b)

(c)

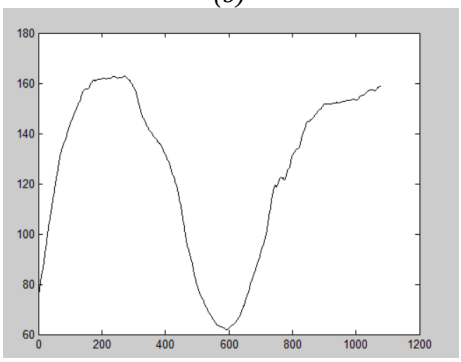
Fig .5: (a) closed eye image (b) open eye image (c) half blink image



(a)



(b)



(c)

Fig .6: Results for eye blink detection (a) Graph for closed eye (b) Graph for open eye (c) Graph for half blink

If consider three threshold values based on above graphs i.e. y1, y2, y3. If y1>120, y2>54 and y3>74 then it shows as authenticated, otherwise it is unauthenticated. When we give eye blink video as an input it converts into frames and then based on the obtained graphs it compares the graph values with the threshold values given. If the obtained graph values are matched with the threshold values then only it is authenticated, otherwise it is unauthenticated.

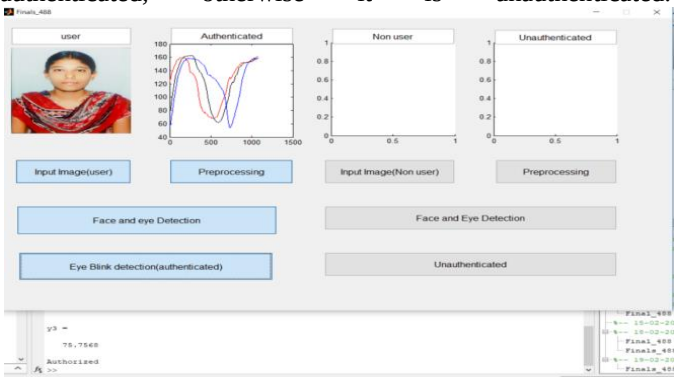


Fig.7: Result for Authentication

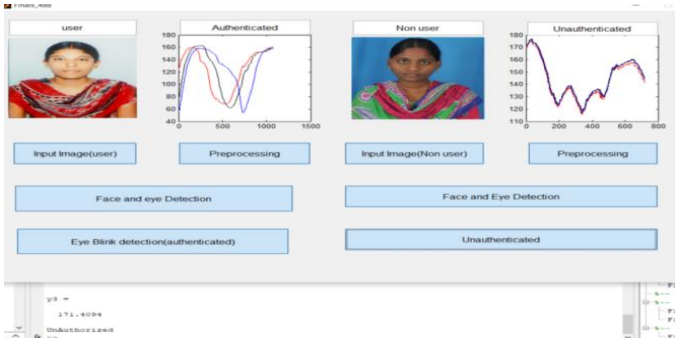


Fig.8: Result for unauthentication

IV. CONCLUSION

Due to the popularity of smart phone, people tend to store some important information in the mobile phone such as bank information, photos, customer data, and subscription information, and so on. However, when the information was stored in the mobile phone; it will need strong protection methods to avoid the theft of related information by others. Face Recognition can be easily cheated by using the color photos of the users on the mobile devices. Therefore, in this paper, the eye blink was proposed to improve the face recognition on mobile screen unlocking. Our method did not need any complicated procedure to authenticate user identity, and the user just blinks his/her eyes to fast unlock the screen on mobile devices.

V. FUTURE SCOPE

Eye blink detection help in future purpose to store some important information in the mobile phone such as bank information, customer data and photos, etc., by implementing a screen unlock as well as app unlock. The proposed algorithm will also detect eye blink with wearing glasses.

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A Novel System for Automated College Attendance using Face Recognition with GSM Notification

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Abstract **-** Student attendance in the classroom is very important task and if taken manually wastes a lot of time. Face is the primary identification for any human. This project describes the method of detecting and recognizing the face in real-time using Raspberry Pi. The system is at first trained with the student`s faces that is called Data base creation. Whenever student enters in front of the camera it captures the image and detect the face by employing the PCA and Haar classifier algorithms. Haar Cascades was proposed by Viola- Jones for face detection. The system will automatically update the student's presence in the class to the student's database and sends message to the parents, class teachers also to the Head of department through GSM module and student information whether he/she was present/absent was taken from Excel sheet at the end of the college hours. This project also used for several different applications wherever face recognition are often used for authentication.

Keywords **-** Open CV, Raspberry Pi, Haar cascade, Face recognition, Viola-Jones framework, PCA Algorithm, Data base, GSM module.

I. INTRODUCTION

Present days attendance system is manual. It wastes a considerable amount of time both for teachers and students. Still there are chances of getting mistakes if the attendance was taken manually. Manual attendance may have human error. Face is that the essential recognizable proof for any human. So automatic attendance method can increase the reliability. To make it obtainable for each platform we've chosen the Raspberry pi for face recognition. This module may be utilized for various applications wherever face acknowledgment may be utilized for validation. In this planned system we tend to take the attending mistreatment face recognition that acknowledges the face of every student throughout the working hours of the college.

II. LITERATURE SURVEY

a) Navesh Sallawar, Shubham Yende, Vaibhav Padgilwar, Vishal Kale, Parag Gorlewar Gaurav presented a paper on Attendance system by using face recognition.This project works on PCA Algorithm principal and update the attendance automatically without any human intervention.

b) Priya Pasumarti, P,Purna Sekhar presented a paper on Classroom Attendance Using Face Detection And Raspberry. This project describes the method of detecting and recognizing the face in real time using Raspberry pi. This project describes an efficient algorithm using open cv. In this system is initially trained with the student images and store these images in the data base, whenever student enters in front of camera it captures the image and compare with the data base images. If there is any match found it will update the attendance to the respective students.

c) Mangesh Owandkar, AkshKolt, Devendra Peshave, Mrs Savita Jadhav presented a project on Attendance Monitoring System using Face Recognition. This paper describes a method for student's attendance system which will integrate with the face recognition technology using Principal component analysis algorithm. The attendance was marked based on the face recognition of the person. The segmented faces are compared with a predefined data base of all the students.

III. BLOCK DIAGRAM

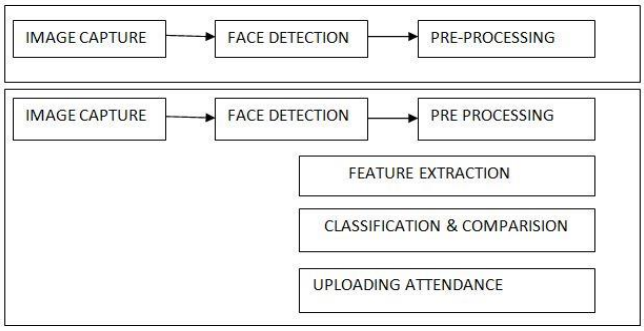


Figure 1: Block diagram for Proposed Approach

IV. HARDWARE COMPONENTS

A. Raspberry Pi 3 - The Raspberry Pi may be a low price, credit-card sized circuit that plugs into a laptop and uses keyboard and mouse. We can capable to write program in languages like Scratch and Python in Raspberry. This Raspberry pi equipped with ENC28J60 which is an Ethernet chip to get connected with internet. Raspberry can be used for many tasks that your computer does processing, spreadsheets and also to play HD video. The raspberry pi comes with a set of open source technology, i.e. communication and multimedia web technologies.



Figure 2: Raspberry Pi

B. Camera - A camera is associate instrument for recording or capturing pictures, which can be hold on regionally, transmitted to a different location, or both. The pictures is also individual still pictures or sequences of images constituting videos. The camera could be a remote sensing device because it senses subjects without any contact.



Figure 3: Camera

C. GSM module - The SIM card mounted GSM electronic equipment upon receiving digit command by SMS from any mobile phone send that information to the mega cycle through serial communication. While the program is dead, the GSM electronic equipment receives command 'STOP' to develop AN output at the mega cycle ,the contact purpose of that are not to disable the electric



Figure 4: GSM module

V. PROPOSED APPROACH

The total system is split into three modules- info creation, coaching the dataset, Testing, causation alert messages as associate degree extension. 1. Database creation a) Initialize the camera and set an alert message to grab the attention of the students. b) Camera captures the image c) Convert the image into gray scale, detect the face d) Store it in database by using PCA algorithm. 2. Training a) These gray scale images are converted into Eigen values b) Then these Eigen values or Eigen vectors were stored in the form of matrix c) Through this matrix we can find the feature vector length 3. Testing Load Haar classifier, LBPH face recognizer and trained data from xml file

Each feature is depicted as one worth obtained from the distinction of the totals of pixels in white parallelogram from the sum of all pixels within the black parallelogram. All completely different doable sizes and locations of classifier is employed for conniving of lots of options. As the number of classifiers increase the arithmetic computations seems to take a long time. To avoid this, we have a tendency to use the conception of Integral Image. In Image process Integral image may be a arrangement that is totaled space table and algorithmic program for quickly and expeditiously generating sum of values in exceedingly rectangular grid set.

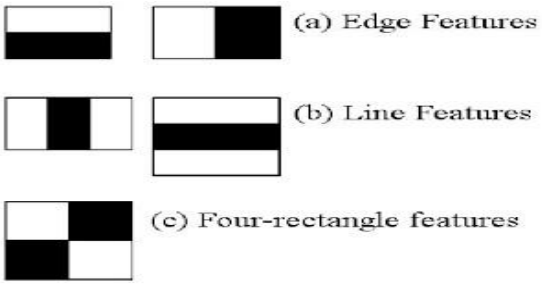


Figure 5: Haar Cascade

VI. FLOW CHART

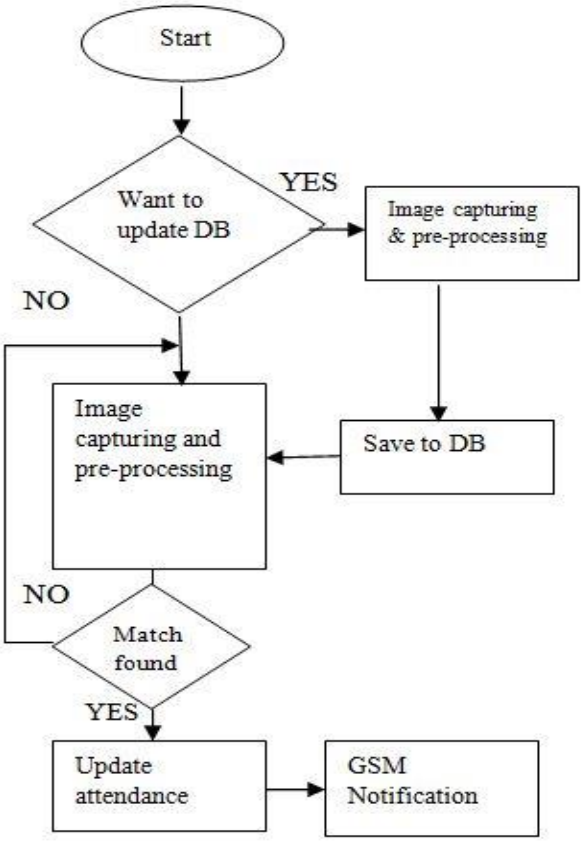


Figure 6: Flow chart

VII. IMPLEMENTATION

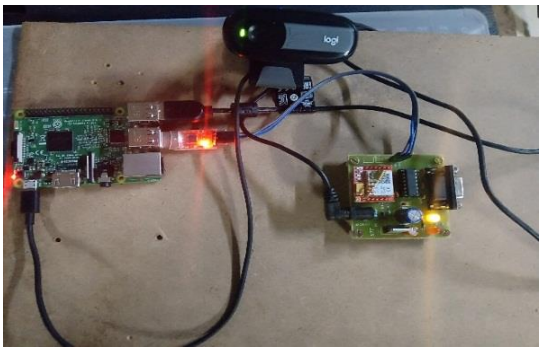


Figure 7: Implementation

VIII. RESULTS

This algorithm includes Haar feature selection process. All human faces share some similar properties. These regularities may be matched using HaarFeatures.A few properties common to human faces:

- The eye region is darker than the upper-cheeks.
- The nose bridge region is brighter than the eyes

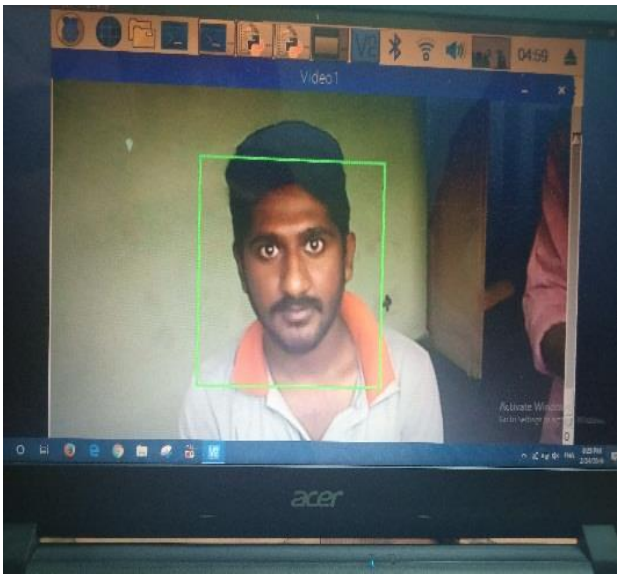


Figure 8: Face Identified

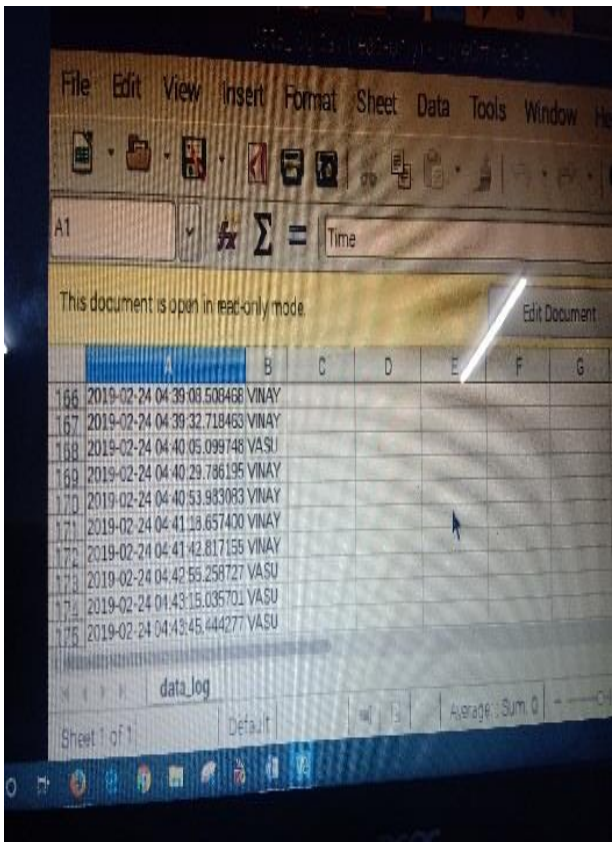


Figure 9: Excel sheet with student timings



Figure 10: message alert to the parents

IX. CONCLUSION

We came to realize that there are extensive variety of methods, for example, biometric, RFID based and so on which are tedious and non-productive. So to defeat this above framework is the better and solid arrangement from each keen of time and security. Hence we have accomplished to build up a solid and productive participation framework to actualize an image handling algorithm to identify faces in classroom and to check the attendance.

X. SCOPE & FUTURE WORK

The same project can be utilized for several security applications where authentication is needed to access the privileges of the respective system. It can be used in recognizing guilty parties involving in unauthorized business. Face recognition algorithm can be improved with respect to the utilization of resources so that the project can recognize more number of faces at a time which can make the system far better. Many variants of the project can be developed and utilized for home security and personal or organizational benefits. We can also trace a particular student in an organization quickly with the help of this system.

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A Novel Technique for Brain Tumor Detection and Analysis Using Image Segmentation

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***Abstract*-**BRAIN TUMOR extraction and its analysis are challenging tasks for medical image processing because brain image is complicated. Segmentation plays a very important role in the medical image processing. So it becomes difficult for doctors to identify tumor and their causes. In this project, first we present a comparative study of different methods implemented for tumor detection. After a brief review different segmentation methods used for detection of tumor from Magnetic Resonance Imaging (MRI) of brain has been discussed. Finally we will propose a technique for detection of tumor using image segmentation. The brain is the most important part of the central nervous system. The main task of the doctors is to detect the tumor which is a very time consuming task for which they feel burden. The only optimal solution for this problem is the use of image segmentation. Extraction and classification of brain tumor from MRI scan images of brain which incorporates segmentation and morphological function which are the basic functions of image processing. Here we detect the tumor, segment the tumor and we calculate the area of the tumor and also the Severity of the disease can be known, through classes of brain tumor.

Keywords*-Brain Tumor; Image Segmentation; Magnetic Resonance Imaging.*

I. INTRODUCTION

Tumor is an uncontrolled growth of cancer cells in any part of the body. Brain tumor segmentation is one of the crucial procedures in surgical and treatment planning. Brain tumor segmentation using MRI has been an intense- research area. Brain tumors can have various sizes and shapes and may appear at different locations. Varying intensity of tumors in brain magnetic resonance images (MRI) makes the automatic segmentation of tumors extremely challenging. There are various intensity based techniques which have been proposed to segment tumors on magnetic resonance images. A texture based image segmentation using GLCM (Gray-Level Co-occurrence Matrix) combined with classifier is proposed here. From the MRI images of brain, the optimal texture features of brain tumor are extracted by utilizing GLCM. This method provides more efficient brain tumor segmentation compared to the segmentation technique will provide more accurate result. Tumor is the abnormal growth of the tissues. A brain tumor is a mass of unnecessary cells growing in the brain. Brain cancer can be counted among the most deadly and intractable diseases. Today, tools and methods to analyses tumors and their behavior are becoming more prevalent. Magnetic Resonance Imaging (MRI) has become a widely-used method of high-quality medical imaging, especially in brain imaging where MRI's soft tissue contrast and non-invasiveness are clear advantages. An important use of MRI data is tracking the size of brain tumor as it responds treatment. The MRI-scan images an ideal source for detecting, identifying and classifying the right infected regions of the brain. Applying digital image processing ensures the quick and precise detection of the tumor. One of the most effective techniques to extract information from complex medical images that has wide application in medical field is the segmentation process. The main objective of the image segmentation is to partition an image into mutually exclusive and exhausted regions such that each region of interest is spatially contiguous and the pixels within the region are homogenous with respect to a pre defined criteria. In this thesis, the major novel approaches for analyzing tumor-bearing brain images in an accurate way are presented as convolution neural network classification. The method has been evaluated with good results on a large number of clinical and synthetic images.

II. LITERATURE SURVEY

A. Manoj K Kowar and Sourabh Yadav presented a aper on detection& segmentation using histogram thresholding. This paper presents a technique for the detection of tumor in the brain using segmentation and histogram thresholding. The proposed method can be successfully applied to detect the contour of the tumor and its geometrical dimension this gave an idea of segmentation and thresholding on brain tumor image.

B. Jawad Haider Kazmi, Kalim Qureshi, and Haroon Rashid presented a paper on Enhanced MRA images quality using structure adaptive noise filter and edge sharpening methods This paper presented a new enhancement technique namely SAN filter. The ordinary image filters blur the image and also remove important structural information like lines and edges. This loss of structural

information could be dangerous in a clinical environment and could leads to incorrect diagnosis. To address this problem, a structure preserving noise filter is designed.

III. BRAIN TUMOR SEGMENTATION

In this paper, we segmented the tumor structure into three intra-tumoral regions: peri tumoral edema, necrotic and non enhancing tumor core, and enhancing tumor region. Each of these regions has different radiological properties [4], which facilitates recognition by image processing techniques. Different biological structures that have similar radiological properties may be identified as one region. Thus, all brain biological structures are categorized into four broad regions -the three tumor regions and the healthy tissues region, each region contains similar looking structures. These regions are labeled into four classes for the segmentation task: class 0 for the healthy tissues and background, class 1 for the necrotic and non-enhancing region, class 2 for the edema, and class 4 for the enhancing tumor region.

IV. NEURAL NETWORKS

Neural networks are powerful machine learning tools that try to mimic the way the brain processes data. A typical neural network aims to represent a mapping between its input and output, deep neural networks have a multilayer structure where data are processed in each layer. Convolution neural network is a variant of the deep forward neural network, it is highly inspired by the way the human visual cortex work, it has multiple receptive fields that capture data and then it detects features in the data at multiple scales. Patch-wise convolution neural networks can be used for segmentation, in which the image t\4 be segmented is divided into small patches and each patch is used to classify the pixel at the center to determine the region to which it belongs. Neural networks were used extensively for brain tumor segmentation, although they had achieved high accuracies we believe there is still a room for improvements. In this paper, we focus on patch-wise CNN models to segment brain tumor in MRI images and point out some decisions that can help in improving existing models, and designing-and-training of new patch-wise CNNs for Brain tumor segmentation.

V. PROPOSED METHODOLOGY

The implementation of brain tumor detection involves following steps:

A. Input Image-

An image is a rectangular array of values (pixels). Each pixel represents the measurement of some property of a scene measured over a finite area. The property could be many things, but we usually measure either the average brightness (one value) or the bright nesses of the image filtered through red, green and blue filters (three values). The values are normally represented by an eight bit integer, giving a range of 256 levels of brightness. We talk about the resolution of an image: this is defined by the number of pixels and number of brightness values

B. Image Pre-Processing-

In photography, computing, and colorimetric, a grayscale or grey scale image is one in which the value of each pixel is a single sample representing only an amount of light, that is, it carries only intensity information. Images of this sort, also known as black-and-white or monochrome, are composed exclusively of shades of gray, varying from black at the weakest intensity to white at the strongest.

C. Segmentation-

In computer vision, image segmentation is the process of partitioning a digital image into multiple segments (sets of pixels, also known as super-pixels). The goal of segmentation is to simplify and/or change the representation of an image into something that is more meaningful and easier to analyze. Image segmentation is typically used to locate objects and boundaries (lines, curves, etc.) in images. More precisely, image segmentation is the process of assigning a label to every pixel in an image such that pixels with the same label share certain characteristics

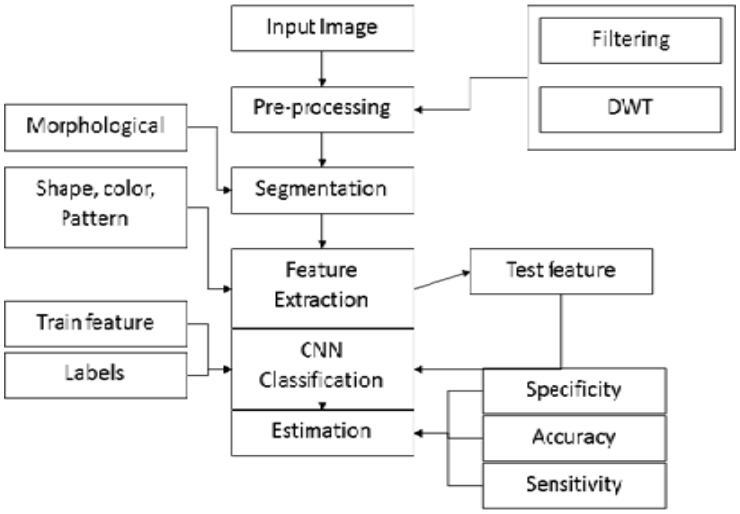


Fig.1: Flow Chart for Proposed Methodology

D. Feature Extraction-

The GLCM is a well-established statistical device for extracting second order texture information from images. A GLCM is a matrix where the number of rows and columns is equal to the number of distinct gray levels or pixel values in the image of that surface. GLCM is a matrix that describes the frequency of one gray level appearing in a specified spatial linear relationship with another gray level within the area of investigation. Given an image, each with an intensity, the GLCM is a tabulation of how often different combinations of gray levels co-occur in an image or image section. Texture feature calculations use the contents of the GLCM to give a measure of the variation in intensity at the pixel of interest.

E. Cnn Classification-

In pattern recognition, the k-nearest neighbors algorithm (k-NN) is a non-parametric method used for classification and regression. In both cases, the input consists of the k closest training examples in the feature space. The output depends on whether k-NN is used for classification or regression. In k-NN classification, the output is a class membership. An object is classified by a majority vote of its neighbors, with the object being assigned to the class most common among its k nearest neighbors (k is a positive integer, typically small). If k = 1, then the object is simply assigned to the class of that single nearest neighbor.

F. Estimation-

1) True positive (TP) = the number of cases correctly identified as patient.
2) False positive (FP) = the number of cases incorrectly identified as patient.
3) True negative (TN) = the number of cases correctly identified as healthy.
4) False negative (FN) = the number of cases incorrectly identified as healthy.

VI. RESULTS AND DISCUSSIONS

A. Input Image-

The MRI Images are collected from database.

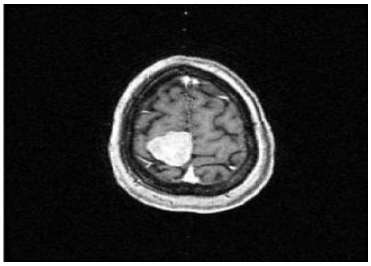


Fig. 2: Input image 1

B. Pre-Processing-

It performs high degree of noise reduction in an image and equalizes all the intensity of the pixel values in the image without any loss.

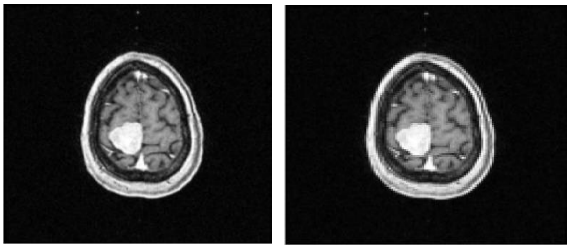


Fig. 3: Filtered and DWT images

C. Segmented Image-

The process of dividing an image into multiple parts. This is typically used to identify objects in digital image.



Fig. 4: Segmented image

D. Feature Extraction-

It is used to transforming the input data into set of features like shape, size and area etc.,

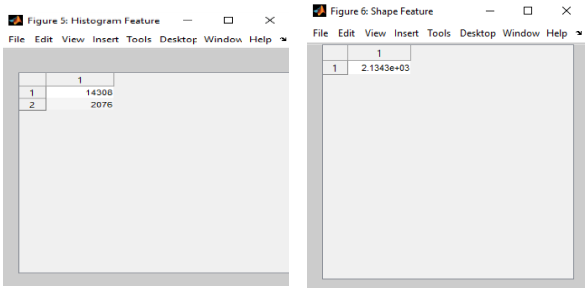


Fig.5: Histogram Features And Shape Extraction

E. Cnn Classification-

It is a type of artificial neural network used in image recognition and processing, that is specifically designed to process a pixel data.

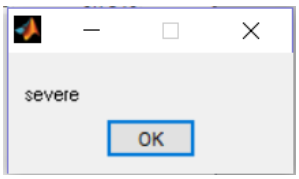


Fig. 6: Classification image

F. Estimation-

In this process we calculate the accuracy, sensitivity and specificity of the output image.

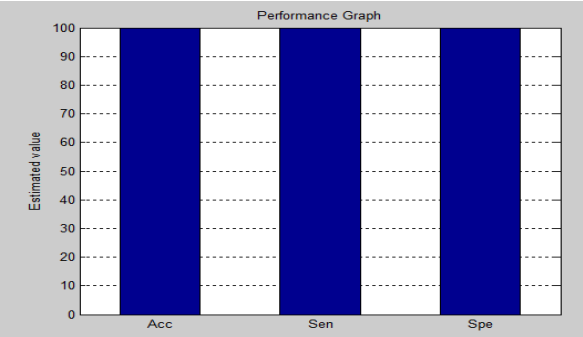


Fig. 7: Estimated Histogram image

G. Input Image-

The another MRI Images are collected from database.

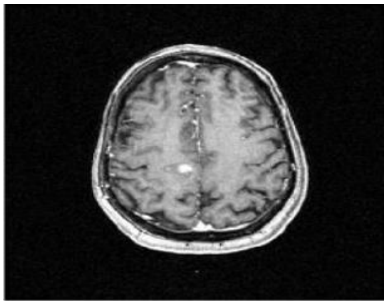


Fig. 8: Input image 2

H. Pre-Processing-

It performs high degree of noise reduction in an image and equalizes all the intensity of the pixel values in the image without any loss.

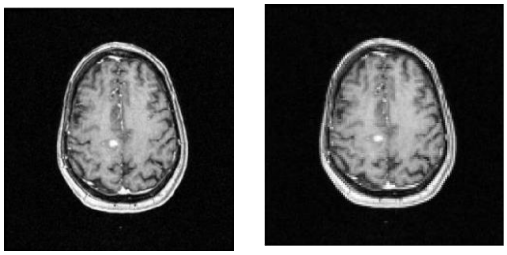


Fig. 9: Filtered and DWT images 2

I. Segmented Image-

The process of dividing an image into multiple parts. This is typically used to identify objects in digital image.



Fig. 10: Segmented image 2

J. Feature Extraction-

It is used to transforming the input data into set of features like shape, size and area etc.,

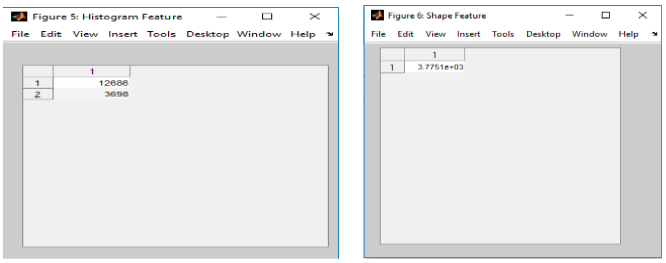


Fig. 11: Histogram Features and Shape Extraction

K. Cnn Classification-

It is a type of artificial neural network used in image recognition and processing, that is specifically designed to process a pixel data.

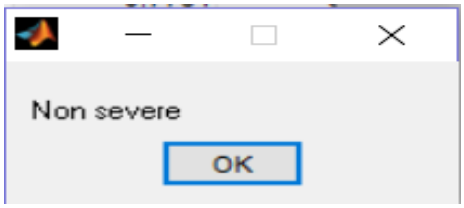


Fig. 12: Classified Output 2

L. Estimation-

In this process we calculate the accuracy, sensitivity and specificity of the output image

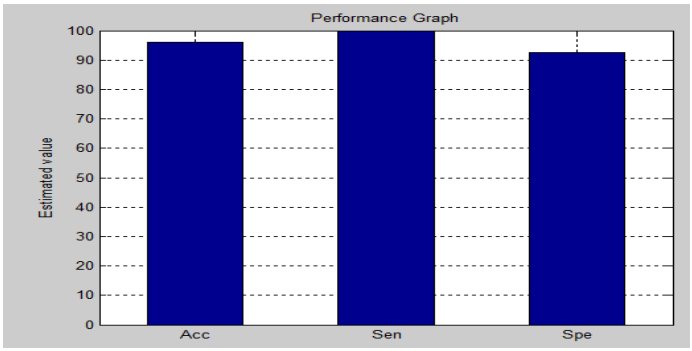


Fig. 13: Estimated image 2

VII. CONCLUSION

This paper has provided a comprehensive overview of the state of the art MRI-based brain tumor segmentation methods. Although most of brain tumor segmentation algorithms have relatively good results in the field of medical image analysis, there is a certain distance in clinical applications. Due to a lack of interaction between researchers and clinicians, clinicians still rely on manual segmentation for brain tumor in many cases. The existence of many tools aims to do pure research and is hardly useful for surgeons. In summary, we propose a novel CNN-based method for segmentation of brain tumors in MRI images. In this project various existing segmentation methods for brain MR image have been discussed. Using the knowledge from the above discussions our project proposes a Tumour Detection from MRI Images using Image Segmentation.

VIII. FUTURE SCOPE

We have worked on gray images in this project. We can also work on color images directly. We can implement a training set and classify the tumor according to its grades. In this project we have detected the location of the tumor in the MRI scanned image. The next step will be classifying the tumor according to its features. We can also predict the tumor growth by using this method.

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Design and Implementation of an Embedded Home Surveillance System Using Arduino and Node MCU

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Abstract- This paper proposes the design of Internet of Things (IOT) based home automation system using Node MCU. Currently in day today's life we can hardly find a house without a home automation system This project is intended toconstruct a home automation system that uses any Smart Phone to control the home appliances. This home automation system is based on IOT. Home automation is very exciting field when it uses technologies like Internet of Things (IOT). Node MCU is credit card size computer. Node MCU supports large number of peripherals.User required to use different mobile devices like smart phones, Laptops, Tablets to operate the home appliances.

Keywords- Home automation, Internet of Things(IOT),Arduino, Node MCU, Current sensor Relay, Mobile**.**

I. INTRODUCTION

Internet of Things is a concept where each device is assign to an IP address and through that IP address anyone makes that device identifiable on internet. The Internet is an evolving entity. It started as the "Internet of Computers." Research studies have forecast an explosive growth in the number of "things" or devices that will be connected to the Internet. The resulting network is called the "Internet ofThings" (IOT) . IOT is having the potential to change the lifestyle of peoples. In day today's life, people prefer more of automation systems rather than any manual systems. The major elements of IOT based home automation system are Node MCU and the Relay along with their driving circuitry. Home automation can be defined as a mechanism removing as much human interaction as technically possible and desirable in various domestic processes and replacing them with programmed electronic systems.



Fig.1: Home Automation

II. LITERATURE SURVEY

This paper provides a simple introduction to the IOT, its application and potential benefits to the society.[2] IOT has received much attention from scientists, industry and government all over the world for its potential in changing modern day living.[3] IOT is envisioned as billions of sensors connected to the internet through wireless communication technologies. [4]The sensors would generate large amount of data analysed, interpreted and utilized. [5]Home Automation System uses the technology of Internet of Things for monitoring and controlling of the electrical and electronic appliances at home from any remote location by simply using a Smartphone.[6] Implementation of a low cost, flexible home automation system is presented.[7] It enhances the use of wireless communication which provides the user with remote control of various electronic and electrical appliances.

III. HOME AUTOMATION & HISTORY

In 19th century, concept of home automation came into the picture. The Electronic Computing Home Operator was developed in the April 1968 and has been enhanced from a set of spare electronics. Further X10 standard was developed to allow transmitters and receivers to broadcasting messages such as "turn ON" and "turn OFF" via radio frequency. X10 system has number of disadvantages. With the invention of the Raspberry pi which is small credit card size computer having large number of peripherals along with communication ports like Ethernet, USB ports, HDMI port, now a day's home automation is become very easy and interesting. Home automation includes all that a building automation provides like door and window controls, climate controls, control of multimedia home theatres, pet feeding, plant watering and so on. Home automation is nothing but 'Smart home' or 'Intelligent home'. Such smart homes or intelligent homes are controlled with the help of various technologies. GSM, WIFI, Bluetooth, Zig bee and so on are used for the purpose of home automation.

IV. SYSTEM DESIGN

A. Arduino UNO

A microcontroller board, contains on-board power supply, USB port to communicate with PC, and an Atmel microcontroller chip. It simplify the process of creating any control system by providing the standard board that can be programmed and connected to the system without the need to any sophisticated PCB design and implementation. It is an open source hardware, any one can get the details of its design and modify it or make his own one himself.

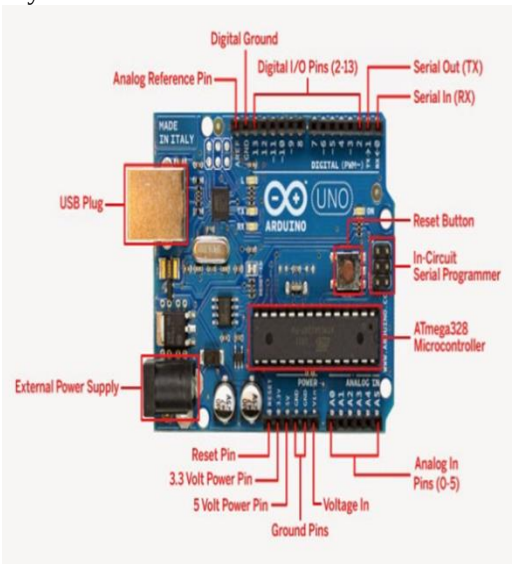


Fig.2: A:Arduino UNO

B. Relay

Relay is nothing but it is the electromagnetic switch. Relay allows one circuit to switch another circuit while they are separated. Relay is used when we want to use a low voltage circuit to turn ON and OFF the device which required high voltage for its operation. For example, 5V supply connected to the relay is sufficient to drive the bulb operated on 230V AC mains. Relays are available in various configurations of operating voltages like 6V, 9V, 12V, 24V and so on. Relay is divided into two parts, one is input and other is output. Input side is nothing but a coil which generate magnetic field when small input voltage is given to it. Relay having three contactors: Normally closed (NC), Normally opened (NO) and common (COM). By using the proper combinations of the contactors electrical appliances may turn ON or OFF.

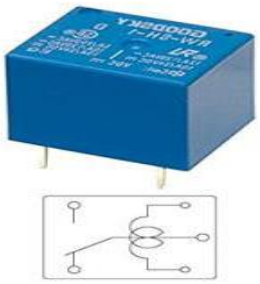


Fig.3: B: Relay Module

C. Node MCU

Node MCU was created shortly after the ESP8266 came out. On December 30 2013, Espressi system production of the ESP8266. The ESP8266 is a Wi-Fi SOC integrated with a Tensilika Xtensa LX106 core, widely used in IOT applications. Node MCU started on 13 Oct 2014, when Hong committed the first file of node MCU-firmware to Git Hub. Two months later, the project expanded to include an open-hardware platform when developer Huang R committed the gerber file of an ESP8266 board, named devkit v0.9. Later that month, Tuan PM ported MQTTclient library from Contikato the ESP8266 SOC platform, and committed to Node MCU project, then Node MCU was able to support the MQTT IOT protocol, using Lua to access the MQTT broker. Another important update was made on 30 Jan 2015, when Devsaurus ported the u8glib to Node MCU project, enabling Node MCU to easily drive LCD, Screen, OLED, even VGA displays



Fig.4: C: Node MCU

V. BLOCK DIAGRAM

To make the system hardware we gone through below block diagram.

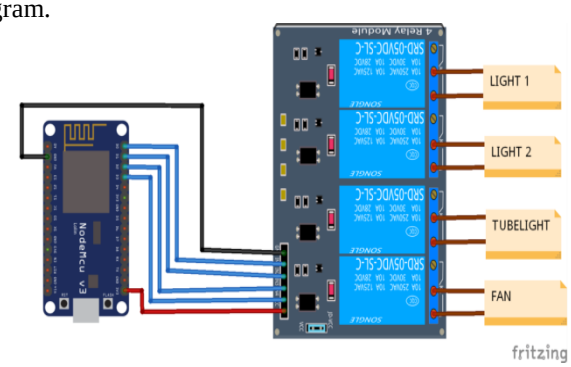


Fig.5: block diagram

VI. METHODOLOGY

A. Hardware Implementation

Once the user connects mobile device in network and after putting the IP address of the Node MCU in the browser of Mobile device will be able to see the web page which contains UI to control home appliances in each room. UI simply shows the number of rooms and home appliances present in each room. It also contains buttons to toggle the status of home appliances of each room.

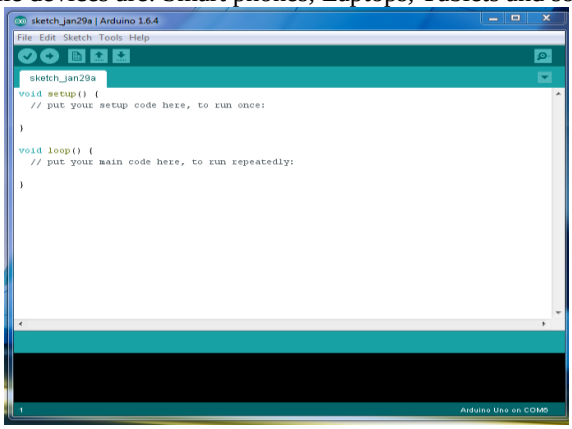


Fig.5: A: Hardware Connections

B. Software Implementation

It usually takes years and years of studying to get even the most basic concepts down and it's especially difficult to apply these codes to real work devices. Nowadays, however, knowing how to code and program is a very useful skill to have. Arduino IDE is a coding software that makes the programming world more accessible to beginners with its simple interface and community-driven system.

Mobile devices are noting but small computing devices. They are small enough so that we can operate and hold in hand. They are also having their own operating systems. Mobile device can be move from one location to other. Example of mobile devices are: Smart phones, Laptops, Tablets and so on.



VII. SIMULATION AND RESULT

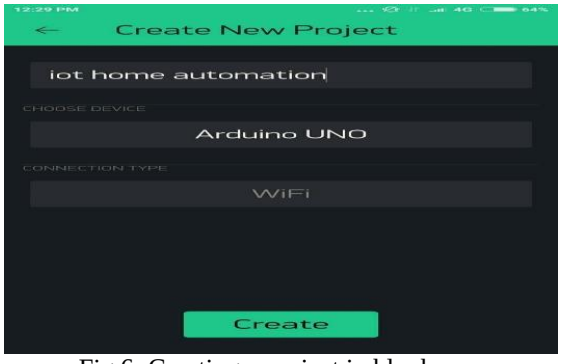


Fig.6: Creating a project in blynk app

A .Turn On Home Appliances

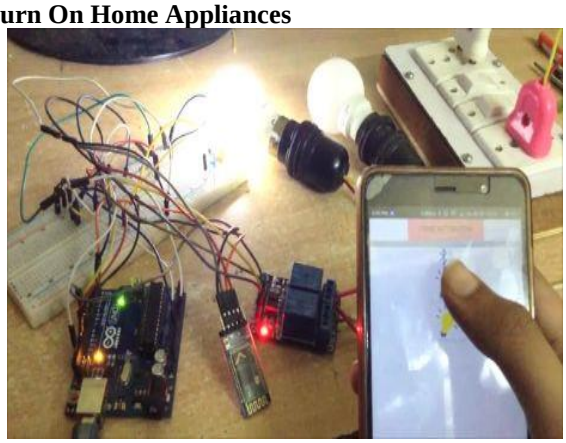


Fig.7: A: Bulb ON

B. Turn OFF Home Appliances

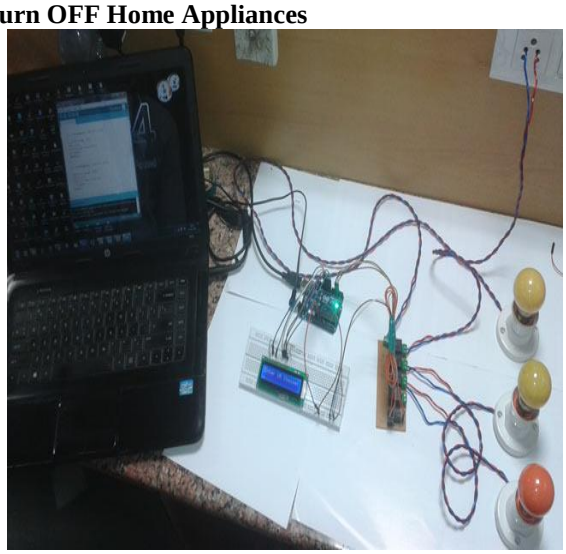


Fig.8: B: Bulb OFF

VIII. CONCLUSION

The work for IOT based home automation is completed successfully using internet source and Node MCU. It is reliable and scalable home automation system with low cost and easy to implement. It makes human life easy and comfortable. It is possible to operate home appliances from any part of the globe.

IX. FUTURE SCOPE

The future of home automation is very vast. We can add many more new features in it, in future to make it more efficient to fulfill users requirement. Some features are given below:

1. Home security system.
2. It can be operated through voice command.
3. User can add new appliances by their own in a given interface without any external support.

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An Intelligent Detection and Notification to Avoid Potholes on Road to Aid Drivers

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Abstract - This paper discusses about the pothole detection techniques that have been developed and proposes a cost reduced solution to identify pothole and humps on roads and provide timely alerts to drivers to avoid accidents or vehicle damages. Ultrasonic sensors are used to identify pothole and also to measure their depth and height respectively.The proposed system captures images of potholes and the geographical location coordinates of potholes and humps using GPS receiver. The sensed-data includes pothole depth, height of hump and exact images and geographic location, which is stored in the database (cloud). This uses as a valuable source of information about road condition to the Government authorities and to vehicle drivers. An android application is used to alert drivers so that precautionary measures can be taken to avoid accidents. Alerts are given in the form of images and also with a flash messages on android app with an audio beep.

Keywords **-** Android application, GSM SIM900, GPS, Raspberry pi,Ultrasonic sensors, USB camera.

I. INTRODUCTION

Concise, formed due to heavy rains and movement of heavy vehicles, also become a major reason for traumatic accidents and loss of human lives. According to the survey report "Road Accidents in India, 2011", by the ministry of road transport and highways, a total of 1,42,485 people had lost their lives due to fatal road accidents. Of these, nearly 1.5 per cent or nearly 2,200 fatalities were due to poor condition of roads.

Roads in India normally have speed breakers so that the vehicle's speed can be controlled to avoid accidents. However, these speed breakers are unevenly distributed with uneven and unscientific heights. Potholes, formed due to heavy rains and movement of heavy vehicles, also become a major reason for traumatic accidents and loss of human lives. Poor condition of roads.With the proposed system an attempt has been made to endorse drivers to ward off the accidents caused due to potholes and raised humps.

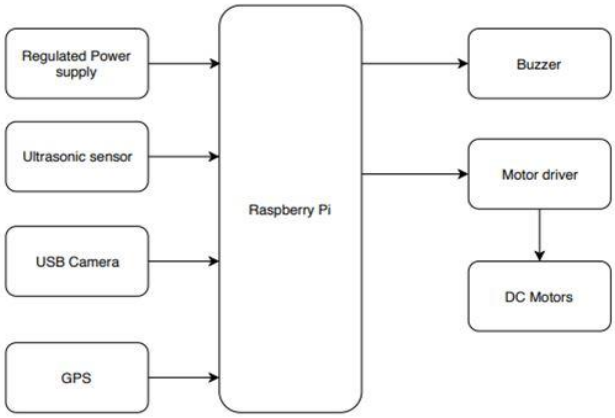


Figure 1: Proposed System Block Diagram



Figure 2: Condition of roads with potholes.

Figure 2 portrays the condition of roads with killer potholes. To address the above mentioned problems, a cost effective solution is needed that collects the information about the severity of potholes and humps and also helps drivers to drive safely.

II. LITERATURE SURVEY

Implementing Intelligent Control System for Congestion Control, Ambulance Clearance and Stolen Vehicle Detection - Each individual vehicle is supplied with special RFID tag (placed at a strategic location), that makes it not possible to get rid of or destroy. We use RFID reader, NSK EDK-125–TTL and PIC16F877A system-on-chip to read the RFID tags attached to the vehicle. It counts range of vehicles that passes on a selected path throughout a given length. It additionally determines the network congestion, and hence the green light duration for that path. If the RFID-tag-read belongs to the taken vehicle, then a message is sent

using GSMSIM300 to the police control room. Also, once AN auto is approaching the junction, it will communicate to the traffic controller in the junction to turn on the green light. This module uses Sigsbee modules on CC2500 and PIC16F877A system-on-chip for wireless communications between the auto and traffic controller. The paradigm was tested below totally different combos of inputs in our wireless communication laboratory and experimental results were found needless to say.

Metrology and Visualization of Potholes using the Microsoft Kinect Sensor - Pavement distress and wear detection is of prime importance in transportation engineering. Due to degradation, potholes and different types of cracks are formed and they have to be detected and repaired in due course. Estimating the number of filler material that's required to fill a hole is of nice interest to forestall any shortage or excess, thereby wastage, of filler material that usually needs to be transported from a distinct location. Metrological and visualisation properties of a hole play a crucial role during this regard. Using an inexpensive Kinect sensing element, the pavement depth images are collected from concrete and asphalt roads. Meshes are generated for better visualization of potholes. Area of pothole is analysed with respect to depth. The approximate volume of hole is calculated mistreatment quadrilateral rule on area-depth curves through pavement image analysis. In addition whole space, length, and dimension square measure calculable**.**

III. COMPONENTS OF PROPOSED SYSTEM

Raspberry pi - As well because the 'standard' Raspberry Pi, the Raspberry Pi two Model B, there's also a smaller version of the Raspberry Pi that you can use. The Raspberry Pi Model A+ may be a cut-down version of the initial Raspberry Pi, with a little less power at its disposal and fewer connections on it.also has just one USB port and no LAN port, making it slightly less useful to some.



Figure 3

Ultrasonic Sensors HC-SR - The ultrasonic sensor transmits high frequency sound waves and waits for the reflected wave to hit the receiver. The distance is calculated based on the time taken by the ultrasonic pulse to travel a particular distance. There are different types of ultrasonic sensors with different transmission ranges and angles of detection. The HC-SR04 sensor work at frequency of 40 KHz and can measure distances of the objects in the range2 to 400 cm with a 15o angle of detection.

GPS Receiver - It obtains the GPS information from satellites in National Marine Electronics Association (NMEA) format. The NMEA has defined a standard format for the GPS information. This is followed by all thesatellites. The standard defines various codes such as GLL- Latitude/Longitude data, GSV – Detailed satellite data and RMC- Minimum Recommended Data.

Camera - Now a days we see a lot of advanced cameras that are used to capture motion as well as images from a very far distance. During the time of its invention images could be taken only in a room and could not be portable. The instrument should be kept in a dark chamber or box and the room should function as a real-time imaging system. Thus the camera was earlier called "camera-obscure" which meant "dark chamber".



Figure 4: (a) proposed model fixed on two wheeler bike for testing. (b) Detection of hump. (c) Detection of pothole

GSM SIM 900 - Global Standards for Mobile Communication (GSM) is a set of standards for Second Generation (2G) cellular networks. The GSM SIM 900 module uses any network provider's SIM to cover too per communicate over the telecommunication network. This modem can be used to send and receive text messages and to make and receive voice calls. GSM SIM 900 is a quad-band GSM modem that functions at 850, 900, 1800 and 1900 MHz frequencies. This modem also supports features like transferring voice data, integrated support for GPRS and TCP/IP stack.

IV. ARCHITECTURE & IMPLEMENTATION

The architecture of the proposed system consists of 3 parts Raspberry pi, server module and the mobile application module.

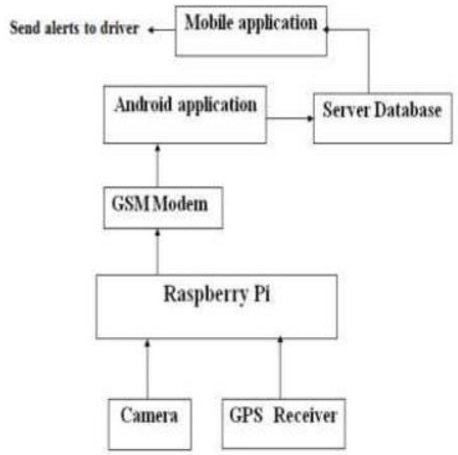


Figure 5: Architecture & implementation diagram

Raspberry Pi - Potholes and Humps on the Road are detected using Image Processing and for that Raspberry PI is used in which a camera is attached to capture the images of the roads and side by side the potholes and humps are detected on the road and the data of the same is uploaded to the server. The GPS used will locate the exact longitudinal and latitudinal margin i.e. the exact longitude and latitude of the potholes and humps detected. Also one Beep will be turning ON whenever the humps of potholes are detected to Aid the driver.

We are designing cost efficient system. Ultrasonic sensors are used to identify the potholes and humps and also to measure their depth and height respectively. In this proposed system to overcome all the circumstances, ULTRASONIC SENSOR and GPS RECEIVER are placed at the bottom of vehicle were ULTRASONIC SENSOR is used to measure the distance between the road and the sensor and the data is received by the microcontroller. The GPS RECEIVER captures the location of the detected pothole or the hump and sends messages to the registered mobile SIM using GSM modem.

Server Module - This module consists of two parts; the android device and the database. It acts as an intermediary layer between the microcontroller module and the mobile application. The server module is implemented as an android application that runs on a device and is responsible for reading messages sent by the registered mobile SIM present in the microcontroller module. It processes the contents of this message and stores it in the database (cloud). Integrating sensor networks with cloud and Internet of Things, it is possible to allow broader access to sensor data.

Mobile Application Module - This module is implemented as an android application that is installed on the vehicle driver's mobile phone to provide timely alerts about the presence of potholes and humps .Figure 5 shows the workflow of this application. The application continuously runs in the phone background. It first captures the current geographic location of the vehicle and then accesses the locations of potholes and humps stored in the server database. The distance between the vehicle location and the pothole location stored in database is computed. If the distance between the two is within 100meters, an alert message pops up on the mobile screen. This message is accompanied with an audio beep so that the driver can differentiate it from other flash messages.

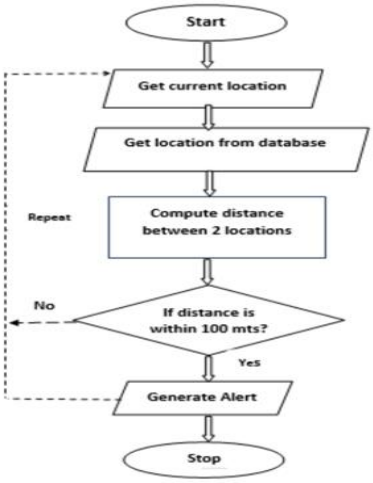


Figure 6: Workflow of mobile application.

V. EXPERIMENTAL RESULTS

It was tested in a simulated environment with artificial potholes and humps. Tests were carried out in two phases. In the first phase, information about potholes and humps was received by the image processing and for that Raspberry PI is used in which a camera is attached to capture the images of the roads and side by side the potholes and humps are detected on the road and the data of the same is uploaded to the server.In second phase, alerts were generated based on the pothole and the hump information were given to the driver through Gsm,while testing in the simulated environment, The module is fixed on a toy car and the threshold value is configured to 5cms.During the tests it was found that the module was worked as expected to detect the potholes.

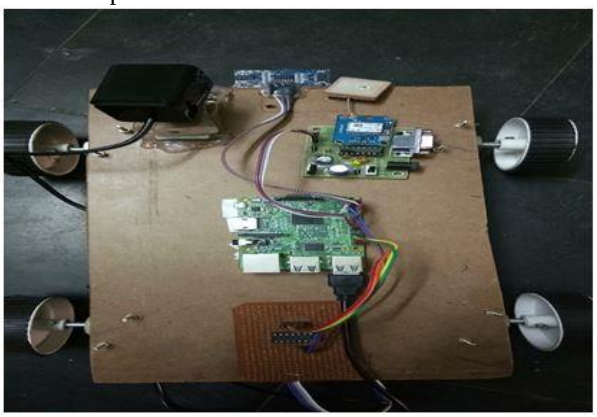


Figure 7: working model of proposed system

Table 1: formation about Potholes and Humps collected in Simulated Test Environment

Sr.No.	Obstacle Type	Height/Depth in cms	Latitude	Longitude
1	P	19.35	12.9563	77.5544
2	H	3.1	12.9406	77.5661
3	H	3.8	12.9421	77.5668
4	P	13.2	12.9434	77.5669
5	P	8.7	12.9411	77.5654

VI. CONCLUSIONS

In this paper, we have proposed system which will detect the potholes on the road and save the information in the server. Due to the rains and oil spills potholes are generated which will cause the accidents. The potholes are detected and its height, depth and size are measured using ultrasonic sensor. The GPS is used to find the location of pothole. All the information is saved in the database. This timely information can help to recover the road as fast as possible. Hence the system will help road accidents. The mobile application used in this system is an additional advantage as it provides timely alerts about potholes and humps. This serves as a valuable source of information to the government authorities and to vehicle drivers. It will save many lives and ailing patients who suffer from tragic accidents .Well maintained roads contribute a major portion of the country's economy.

VII. FUTURE SCOPE

In our project we are using single node. In future it may require one data base server. if we are using n number of nodes we have to make a cloud. It can be integrate in the proposed system to improve user experience. After successful completion of this project we can conclude that, Thus we have successfully made a working model of Automatic Detection and Notification of Potholes and humps on roads to aid drivers. This model is simple and less complex as compared to others it has very vast future development scope.

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Implementation of FMCW Radar

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Abstract- In this paper we are discussing about implementation of FMCW Radar .The entire system is designed using MATLAB software with version 2016a. The FMCW Radar has several benefits and advantages over the continuous wave radar. Now a day's FMCW Radar plays an important role. It is Radar which radiates continuous transmission power like continuous wave radar. This is an advanced version of CW radar where the delay is taken into consideration. If the delay is more the target is farer, if the delay is less the target is nearer to the radar. The difference between transmitted signal and the received signal is called beat note.This radar differs from pulsed radar which emits an RF signal that is usually swept linearly in frequency. In this project we are measuring the range between target and radar system, phase error correction, Doppler frequency range, and we are also designed Patch antenna array for FMCW radar applications.

Keywords- FMCW Radar, CW Radar, Phase error correction, Doppler frequency range, Patch array antenna for FMCW radar, directivity

I. INTRODUCTION

Radar is an instrument that radiates electromagnetic wave in the space, which detects and locates of objects. Today, it is widely used for velocity estimation, imaging, and many other functions. The principle of radar operates likes to sound wave reflection. If any wave sound incident on the object (target) (like rocky canyon and cave), it will be reflected and heard, this sound wave reflecting is called echo. If sound speed is known, we can estimate the distance and direction of the objects. Radar systems are composed of a transmitter that radiates electromagnetic waves of a particular waveform and a receiver that detects the echo returned from the target. Only a small portion of the transmitted energy is re-radiated back to the radar. These echoes will processed by the radar receiver to extract target information such as (range, speed, direction, position and others).

The range to the target is evaluated from the travelling time of the wave. The direction of the target is determined by the arrival angle of the echoed wave. The relative velocity of the target is determined from the Doppler shift of the returned signal. Radar can be classified in terms of ground based, air borne and ship based radar systems .Also can be classified into numerous categories based on the specific radar characteristics, such as the frequency band, antenna type, and waveforms utilized, also classified by the types of waveforms or operating frequency. The goal of this paper includes a discussion of several forms of the radar equations, and one of the equations of radar theory is the radar range equation, including those most often used in predicting radar performance. In this paper, we use MATLAB simulation program to representing the radar range equation, and how to model a 77 GHz 2x4 antenna array for FMCW applications. The presence of antennas and antenna arrays in and around vehicles has become a commonplace with the introduction of wireless collision detection, collision avoidance, and lane departure warning systems. The two frequency bands considered for such systems are centered around 24 GHz and 77 GHz, respectively. In this paper, we will investigate the micro strip patch antenna as a phased array radiator. The di-electric substrate is air.

II. EXISTED METHOD

Continuous-wave radar is a type of radar system where known stable frequency continuous wave radio energy is transmitted and then received from any reflecting objects. Continuous-wave (CW) radar uses Doppler, which renders the radar immune to interference from large stationary objects and slow moving clutter. CW radar can still provide ranging information. We have to use a frequency modulation on the CW signal, typically a linear FM. Then when we mix the returned signal with a reference signal, the difference in signals will tell us where in the linear sweep we are and we can use that to infer time which equates to radar distance. However, the primary drawback of CW is power. If we say we have a 10 kW transmitter, and you have CW radar, then that means that you are transmitting 10 kW continuously.

III. PROPOSED METHOD

FMCW Radar has traditionally been used in short range applications. Conventional FMCW radar requires the use of expensive microwave mixers and low noise amplifiers. A uniquely inexpensive solution was created, using inexpensive Gunn oscillator based microwave transceiver modules that consist of 3 diodes inside of a resonant cavity. However these transceiver modules have stability problems which cause them to be unsuitable for use in precise FMCW radar applications, when just one module is used. In order to overcome this problem, a unique radar solution was developed which uses a combination of 2 transceiver modules to create a precise FMCW radar system. This unique solution to FMCW radar power is proven to be capable of determining range target, and creating Synthetic Aperture Radar images, FMCW Gunn Oscillator, SAR, Linear SAR, Radar Imaging, and Measurement Systems FMCW radar has been around for ages. In this paper, a novel method to FMCW radar design is

explored. In this paper a brief explanation of FMCW will be presented. FMCW radar was first widely used in radio altimeters, starting in the mid 1930's. FMCW has a number of design advantages, including a high average power and short range capabilities. FMCW is unique in its ability to range targets extremely close to the radar transmit and receive antennas. The major disadvantage It makes a contribution towards the understanding of these spurioussignals by analyzing and simulating the effects of digital phase errors on the beat spectrum of a FCMW-Doppler radar employing a direct digital chirp synthesizer.

IV. BLOCK DIAGRAM

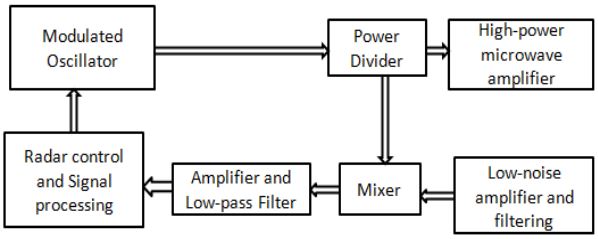


Fig.1: FMCW Radar

Principle of measurement:-

Characteristics of FMCW radar are:

The distance measurement is accomplished by comparing the frequency of the received signal to a reference (usually directly the transmission signal). The duration of the transmitted waveform T is substantially greater than the required receiving time for the installed distance measuring range. If the change in frequency is linear over a wide range, then the radar range can be determined by a simple frequency comparison. The frequency difference is proportional to the distance R. Since only the absolute amount of the difference frequency can be measured (negative numbers for frequency doesn't exist), the results are at a linearly increasing frequency equal to a frequency decreasing (in a static scenario: without Doppler effects). If the reflecting object has a radial speed with respect to the receiving antenna, then the echo signal gets a Doppler frequency (caused by the speed) measurement is performed with a sawtooth then the received echo signal is moved not only by the run time to the right, but also by the Doppler frequency down.

V. Theoretical Minimum Detection Range and Maximum SNR

The radar range equation is not derived from first princ ple, but it has been developed from several steps. The total peak power (watts) developed by the radar transmitter(P_t) is applied to the antenna system. Consider the antenna had an isotropic or omnidirectional radiation pattern (one that radiates energy equally in directions), the power density (P_0) (Watt per square meter) at a distance(R)(meter) from the radiating antenna would be the total power divided by the surface area of a sphere of radiuds(R).

$$P_D = \frac{Peak\ transmitted\ power}{Sphere\ area} \quad \frac{Watt}{m^2}$$

The power density at range(R) away from the radar:

$$P_D = \frac{P_t}{4\pi R^2}$$

Where (P_t) is the peak transmitted power and ($4\Pi R^2$) is area of sphere of radius (R). Radar system uses a directional antenna pattern in order to concentrate the power density in a certain direction, which is usually characterized by the gain (G) and the antenna effective aperture (A_e) they are related by:

$$A_e = \frac{G\lambda^2}{4\pi}$$

The antenna gain (G) is directly proportional to aperture, and the dimensions of an antenna depend on the gain (G) and wavelength (λ) . The higher the frequency, the smaller the antenna, or the higher is its gain by equal dimensions.

The relationship between the effective of antenna aperture (A_e) and the physical aperture (A) is

$$A_e = \rho A, \quad where \quad 0 \le \rho \le 1$$

ρ is indicated to aperture efficiency, when ρ=1 gain in transmitting is equal to receipting. When using a directive antenna of gain (G), then the power density is given by

$$P_D = \frac{P_t G}{4\pi R^2}$$

When the incident transmitted signal collide on the target, the signal will induce time varying currents on the target so that the target now becomes a source of radio waves, part of which will propagate return at the radar, the power reflected by the target toward the radar (P_r) is defined as the (RCS), which is symbolized (σ) of the target, and is given by

$$P_r = P_D \times \sigma$$

By substituting above equation, we get

$$P_r = \frac{P_t G \sigma}{4\pi R^2}$$

When the signal reflected from the target toward the radar systems over a distance(R), the power density (P_{Dr}) return at the radar is:

$$P_{Dr} = \frac{P_r}{4\pi R^2}$$

By substituting above equation, we get

$$P_{Dr} = \frac{P_t G \sigma}{(4\pi)^2 R^4}$$

The total power received (S) by antenna receiving of effective area of (A_e) from a target at range(R):

$S = P_{Dr} \times A_e$

From above equations, we get

$$S = \frac{P_t G^2 \lambda^2 \sigma}{(4\pi)^3 R^4}$$

The received power (s), can be written in terms of signal-to-noise ratio (SNR), and thermal noise power ($BFkT_0$) where (k) is Boltzmann's constant and is equal to1.38×10^{23}, (T_0) is the noise temperature of the radar, (B) is the noise bandwidth of the radar receiver, and noise figure (F)

$$S_{\min} = kT_0 BF(SNR)_{0_{\min}}$$

From the above equations, we get

$$R_{\max} = \left[\frac{P_t G^2 \lambda^2 \sigma}{(4\pi)^3 kT_0 BF(SNR)_{\min}}\right]^{1/4}$$

Or, equivalently

$$(SNR)_{\min} = \frac{P_t G^2 \lambda^2 \sigma}{(4\pi)^3 kT_0 BFR^4}$$

Where, (S_{min}) SNR is the minimum detectable SNR of the system. It is an important relationship for radar designers. If greater detection range is desired, then significant improvements to antenna gain or transmitted power must be realized, and the other parameters are often fixed.

Doppler range:

The radar measures not only the difference frequency to the current frequency (caused by the runtime), but additional a Doppler frequency (caused by the speed). The radar then measures depending on the movement direction and the direction of the linear modulation only the sum or the difference between the difference frequencies as the carrier of the distance information, and of the Doppler frequency as a carrier of the velocity information. If the measurement is made during a falling edge of a saw tooth, then the Doppler frequency is subtracted of by the runtime frequency change. If the reflecting object is moving away from the radar, then the frequency of the echo signal is reduced by the Doppler frequency additionally.

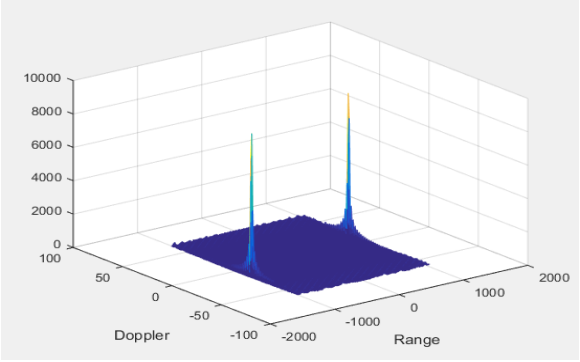


Fig.2: Doppler range

Design Realistic Patch Antenna:

The Antenna Toolbox has several antenna elements that could provide hemispherical coverage and resembles a pattern of cosine shape. Choose a patch antenna element with typical radiator dimensions. The patch length is approximately half-wavelength at 77 GHz and the width is 1.5 times the length to improving the bandwidth. The ground plane is λ on each side and the feed offset from centre in the direction of the patch length is about a quarter of the length.

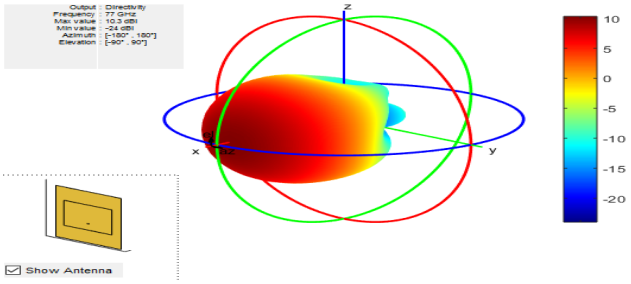


Fig.3: D pattern of patch antenna

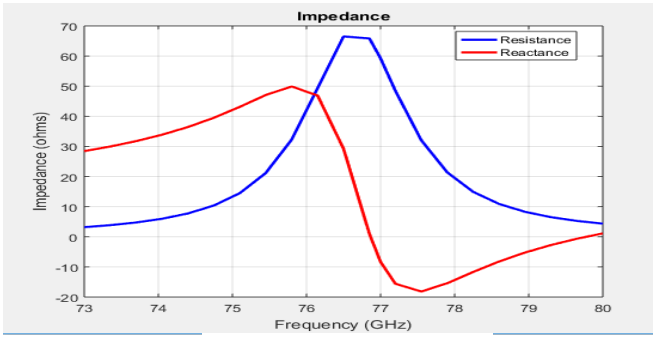


Fig5: Impedance behaviour

According to the figure, the patch antenna has its first resonance (parallel resonance) at 74 GHz. It is a common practice to shift this resonance to 77 GHz by scaling the length of the patch.

Create Array from Isolated Radiators and Plot Pattern:

Next, creates a uniform rectangular array (URA) with the patch antenna. The spacing is chosen to be $\lambda/2$, where λ is the wavelength at the upper frequency of the band (77.6 GHz)

The following figure shows the pattern of the resulting patch antenna array. The pattern is computed using a 5 degree separation in both azimuth and elevation.

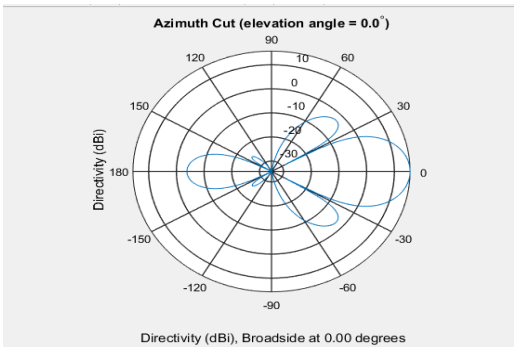


Fig.6: azimuth angle

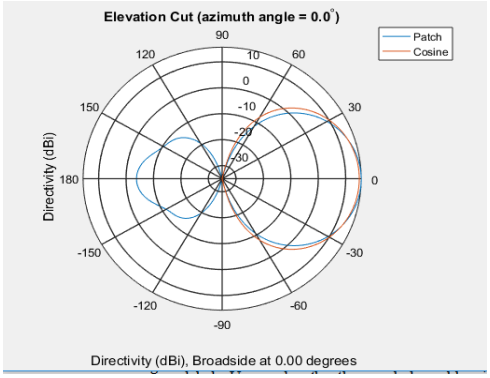


Fig.7: Elevation angle

The figures show that both arrays have similar pattern behavior around the main beam in the elevation plane (azimuth = 0 deg). The patch-element array has a significant backlobe as compared to the cosine-element array.

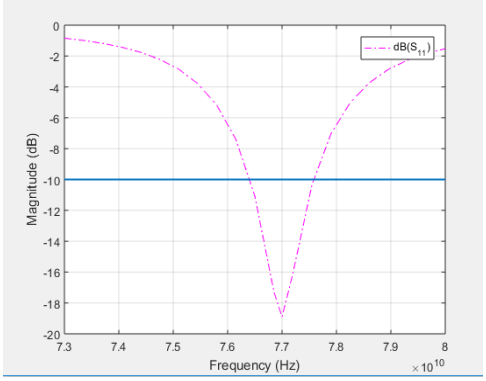


Fig.8: Frequency Plot

VI. RESULTS AND DISCUSSION

One of the main advantages of FMCW radars is their "homodyne" architecture and discussed Doppler radar, phase error correction. Hence, the design of antenna array for FMCW radar with an ideal cosine antenna and then uses a patch antenna to form the real array. It compares the patterns from the two arrays to show the design tradeoff. From the comparison, it can be seen that using the isolated patch element is a useful first step in understanding the effect that a realistic antenna element would have on the array pattern.

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Design and Implementation of Slotted Circular Patch Antenna for MIMO Applications

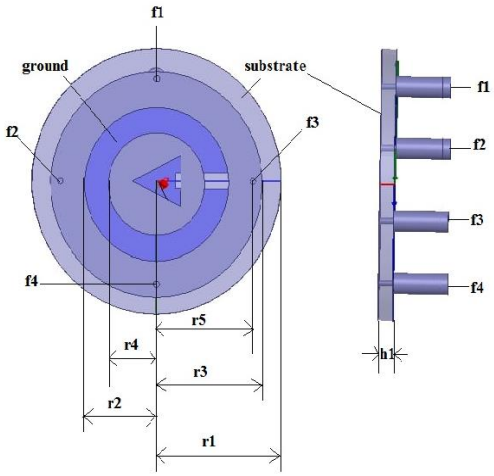
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Abstract - This paper includes a design of a four-port patch antenna with bandwidth enhancement for MIMO application. The proposed antenna consists of two micro-strip patches printed on the substrate. The two patches are inner patch and the outer ring. We have obtained four different radiation patterns when the outer ring is excited by the resonant modes with the help of coaxial feeds. The proposed antenna is operating at 5.8 GHz frequency band with at least 10.7% in measurement impedance bandwidth for each port with low profile. By taking all the four ports into consideration the bandwidth of the proposed antenna is enhanced. Numerical and experimental results illustrate the validity of the design. In this project we are designing and analyzing antenna using HFSS tool of version 15.0
Key words: MIMO antenna, Radiation pattern, four port patch antenna.

I. INTRODUCTION

Multiple-input and multiple-output (MIMO) is a method for multiplying the capacity using multiple transmission and receiving antennas to exploit multipath propagation. In modern usage, MIMO specifically refers to a practical technique for sending and receiving more than one data signal simultaneously over the same band by exploiting multipath propagation. It improves wireless communication capacity and robustness by exploiting multipath effects. Performances of these multiple antenna systems largely depend on the correlation between received signals [1]. To maximize the capacity, this correlation must be as low as possible. Spatial diversity is commonly used to reduce it. This is not always compatible with the limited volume available on a wireless terminal [1]. By using antennas with different radiation patterns, it is possible to reduce the size of the multiple antenna system while keeping a low correlation between received signals. To achieve this pattern diversity, the concept of co-located antennas has been introduced [6]. Nowadays, with the rapid development of microwave technology, there is a growing demand on the bandwidth [1]. Instead of using different antennas for different applications, we are going use the MIMO antenna for different applications. In order to achieve that, we try to enhance the bandwidth such that the four ports resonant at nearby frequencies [1].

There are many antenna designs for MIMO application based upon the multi-mode concepts, including slot antenna, spiral antenna, and dielectric resonator antenna. Microstrip antenna has also been widely investigated for MIMO application due to its low profile. Low profile means less complexity i.e, small height and width, ease of integration and fabrication. To enhance the bandwidth we have different options like increasing the height of the substrate, increasing the number of slots, including the partial grounds, choosing circular shapes. We have opted for circular shapes as other choices have their own disadvantages.



r1=25.9mm, r2=15mm, r3=22mm, r4=10.017mm, r5=20mm, h1=3mm

Figure1: Proposed model

In a rectangular patch antenna which consists of rectangular slots is considered which is used for MIMO applications. It is resonated at 2.45GHz and has impedance bandwidth of only 0.13%-0.25% .Here frequency convergence concept is used but it has the drawback of providing low bandwidth and introduction of slots result in overlapping. Hence the antenna cannot be used for many applications at the same time.

II. LITERATURE SURVEY

Four Port Disk Shaped Compact Mimo Antenna - The structure is composed of a circle patch with cross slot combined to an annular ring patch. This antenna is proposed for vehicular applications. In vehicular applications the large ground plane is necessary and the bandwidth of the antenna must be wide enough to cover the interested band. When the antenna is operated we get four different radiation patterns. When the antenna is simulated we get -16db in simulation and -18db in measurement in the frequency band. In this design a conventional ring and disc are used[2].

Dual-Band Multi-Port Mimo Slot Antenna - A compact dual-band multi-mode multiple input multiple output antenna design can be used for IEEE 802.11 applications. The antenna operates at 4.9-5.725GHz with 4-ports and at 2.4-2.5 GHz with 2 ports and utilizes a dual-port MIMO antenna to cover the 2.4/5GHz bands alongside two single band antennas to cover the 5GHz band. The overall antenna size is compact and is printed on an FR-4 printed –circuit-board. To achieve good performance in MIMO systems, the antenna ports should be uncorrelated and in most scenarios, this can be shown to be equivalent to good isolation or sufficiently low isolation between radiators. A major advantage of this design is that it does not require reconfiguration and the same or higher total efficiency and gain is achieved [3].

III. PROPOSED MODEL

The circular patch MIMO antenna is designed using EM simulator software Ansoft's HFSS v15, which works on the principle of Finite Element Method (FEM). The proposed model consists of substrate, ground and two patches. Substrate is made of material FR_4 epoxy of permittivity 4.4 and height 3mm.It uses FR4 epoxy substrate which has good fabrication characteristics and for a wide variety of applications, which offer significant cost savings. Ground plane and other two patches are perfectly conducting material. Ground is of radius 20.7mm and it consists of a rectangular slot of length 16.7mm and breadth 3mm. There are two patches in which, one is of outer annular ring and other is of inner circular patch. The inner circular patch consists of triangular slot. The triangular slot is introduced in order to the decrease the area of the circular patch. This circular patch's area is to be decreased in order to obtain unified bandwidth and identical resonant frequency. The triangular sides of length 5mm is introduced in inner patch, with median of (0,0,0) and area of $10.18mm^2$

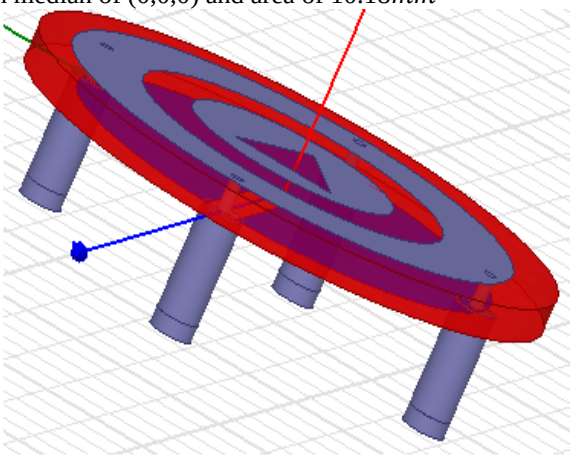


Figure 2: Four feed antenna designed in HFSS

The antenna is excited with coaxial feeds as it has its own advantages over other types of feeds. The outer patch is excited by the coaxial feeds symmetrically by assigning the wave port to it whose impedance is of 50Ω. The four feeds are given to the outer ring in order to distribute the field uniformly.

IV. SIMULATION RESULTS

In the context of S-parameters, scattering refers to the way in which the traveling currents and voltages in a transmission line are affected when they meet a discontinuity caused by the insertion of a network into the transmission line As there are 4 ports, we have to simulate the output i.e s-parameters of each port individually.

The s-parameters S_{11} of port 1 are simulated and it is resonated at 5.8GHz frequency and return loss of around -12.5db

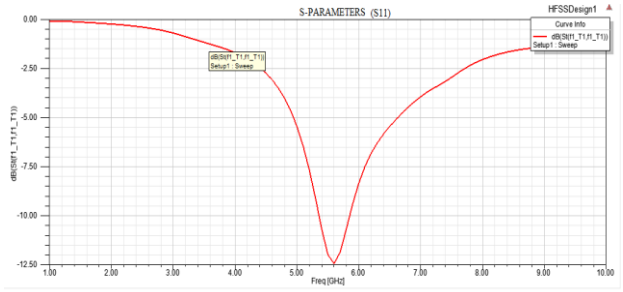


Figure 3: Frequency v/s Return loss for ant1

The s-parameters S_{22} of port 2 are simulated and it is resonated at 4.8GHz frequency and return loss of around -9.5db

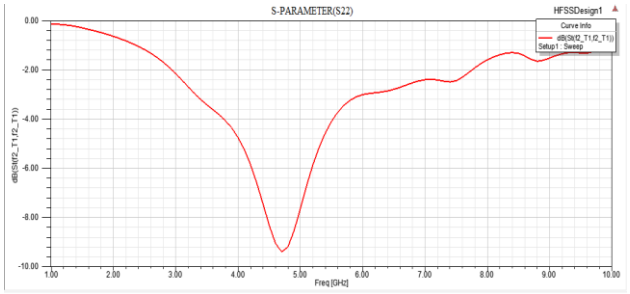


Figure 4: Frequency v/s Return loss for ant2

The s-parameters S_{33} of port 3 are simulated and it is resonated at 4.8GHz frequency and return loss of around -7.9db

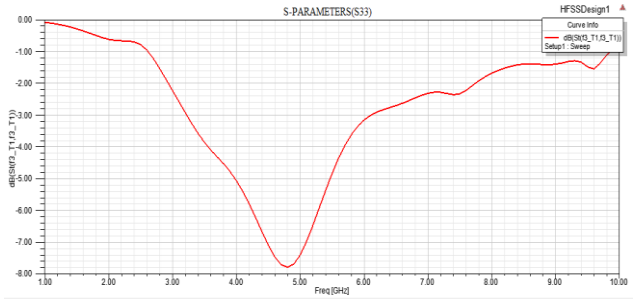


Figure 5: Frequency v/s Return loss for ant3

The s-parameters S_{44} of port 4 are simulated and it is resonated at 4.8GHz frequency and return loss of around -7.9db

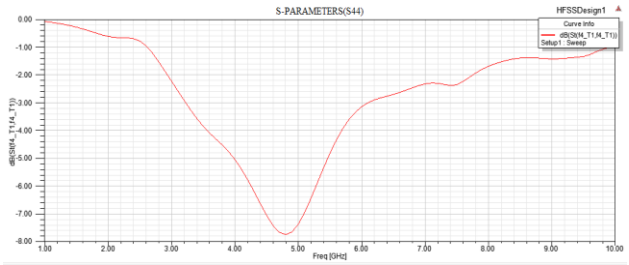


Figure 6: Frequency v/s Return loss for ant4

The 3D polar plot of the four port circular patch antenna is also observed

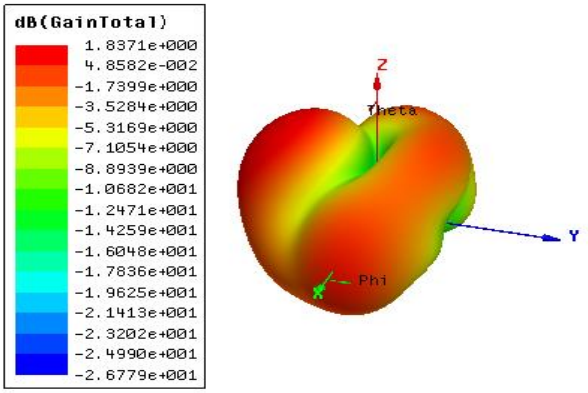


Figure 7: 3D polar plot

The radiation pattern of circular patch antenna is also observed from which gain is maximum at 90^0can be concluded. It a slice of 3D pattern of the antenna at a particular angle/ plane. From the plot below, it seems that there are four resonant frequencies for which Radiation pattern 2D is presented. The values on the perimeter of the circle is values for Theta while the values inside the circle such as -1 dB, -7 dB, -10 dB and -19 dB are the radiation intensity values.

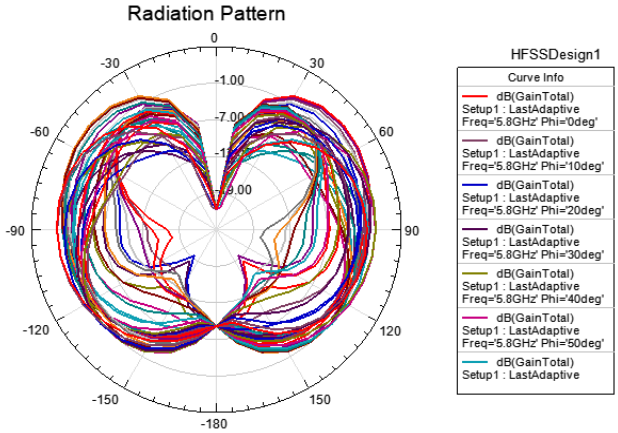


Figure 8: Gain of the antenna estimated from radiation pattern

The electric field distribution of the four port antenna is analyzed and observed.

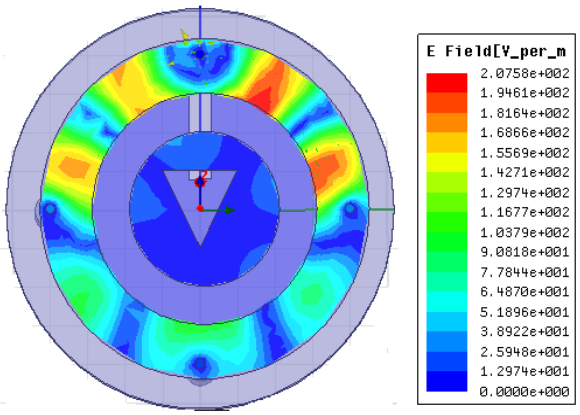


Figure 9: electric field pattern

The frequency bandwidth and percentage bandwidth can be obtained for circular Microstrip patch antenna as

$$frequency\ bandwidth = f_h - f_l \qquad (1)$$

And,

$$bandwidth\ percentage = \frac{f_h - f_l}{f_r} * 100 \qquad (2)$$

Where f_h *and* f_l are higher frequency and lower frequency, f_r is the resonant frequency

Hence from the four ports s-parameters graph we can infer that total bandwidth of the antenna is enhanced of about 10.7%

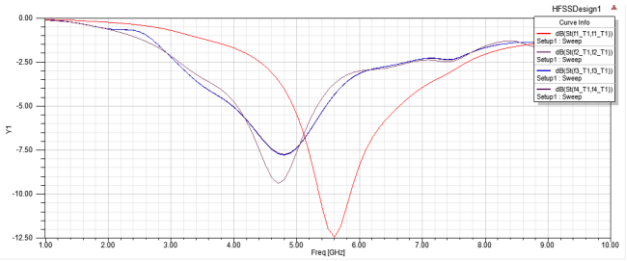


Figure 10: Combined bandwidth of the circular patch antenna

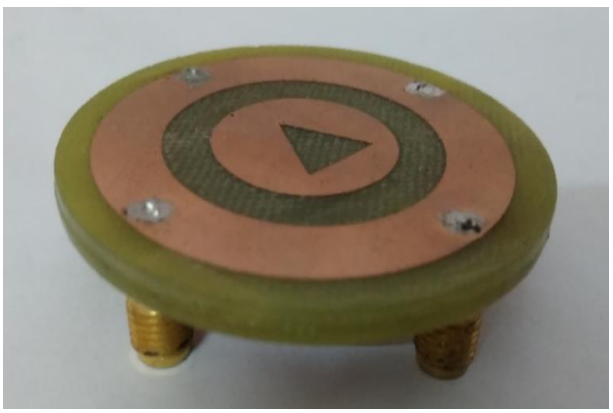


Figure 11: Prototype of proposed circular patch antenna

Figure 11 shows the prototype of circular patch antenna which is fabricated with four inputs for four ports. The patch design has been etched on a FR4 epoxy substrate of permittivity ε_r = 4.4 and thickness h = 3 mm. The feedings are given at the four sides welded via holes with coaxial feeding. The results obtained when we analyze the prototype may differ from simulation results due to antenna orientation and environmental changes.

The S_{11} graph for circular path antenna using prototype is shown in the figure12.The value is measured in the presence of noise absorbers. The S_{11} graph for prototype is shown in the figure for port1 is 4.9GHz.But, the simulated value is 5.8GHz .Due to the environmental changes and the orientation of the antenna, values may differ and return loss of -12.5db in simulated and -20db as in prototype.

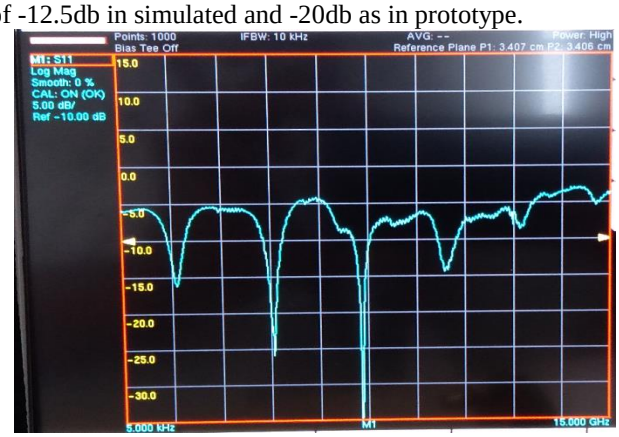


Figure 12: S_{11} parameter measured in combinational analyzer

V. COMPARISION

Table1: Comparative results between antennas

Parameters	Ant1	Ant 2	Ant 3	Ant 4
Operating frequency	5.8GHz	4.7GHz	4.8GHz	4.8GHz
Return loss	-12.5db	-9.5db	-7.9db	-7.9db

VI. CONCLUSION

The designing of four port circular patch is done. We analyzed the circular patch antenna to observe the parameters like gain, bandwidth and s-parameters. When compared to the rectangular patch antenna the overall bandwidth is increased to 10.7%.Therefore the concept of circular antenna resulted in better performance.

VII. FUTURE SCOPE

The further extension for this design is to implement the concept of modal analysis.

An important characteristic of micro-strip patch antenna can be significantly improved by using multilayered dielectric configuration, bandwidth can be further enhanced.

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VHDL IMPLEMENTATION OF COMBINATIONAL CIRCUITS BY USING REVERSIBLE DECODER

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***Abstract*—**In present era reversible logic is the emerging field for research. The aim of this paper is to realize different types of combinational circuits like multiplexer and code converters using reversible logic gates with minimum quantum cost. Reversible decoder is designed using reversible logic gates with minimum Quantum cost. There are many reversible logic gates like Fredkin Gate, Feynman Gate, Double Feynman Gate, Peres Gate, TR Gate and many more. Reversible logic is defined as the logic in which the number output lines are equal to the number of input lines i.e., the n-input and k-output is said to be reversible if and only if (i) n is equal to k and (ii) each input pattern is mapped uniquely to output pattern. The gate must run forward and backward that is the inputs can also be retrieved from outputs. Fan-out and Feed-back are not allowed in Logical Reversibility. Reversible Logic owns its applications in various fields which include Quantum Computing, Nano- technology, Computer Graphics, low power VLSI Etc., The comparative study in terms of garbage outputs, Quantum Cost, numbers of gates are also presented. The Circuit has been designed and simulated by using Xilinx software.

Keywords- *Number of Gates; Reversible Gates; Garbage Outputs; Quantum Cost.*

I. INTRODUCTION

Power Consumption has become a very important factor for consideration in present VLSI technology. Designing Combinational circuits by using reversible decoder power consumption is reduced. Ralf Launduer told heat dissipation is not because process in the operation, which is equal to KTln2 joules. Later in 1973 C.H. Bennett described the Power dissipation due to the bit loss each computation in circuit was carried out in reversible manner. Each gate perform a unitary operation, wouldn't occur if the computation is carried out in reversible manner. The amount of heat dissipated in the system holds a direct relationship. Reversible Logic finds its own application in Quantum
computing, Nano-technology, optical computing, computer graphics and low Power VLSI. The amount of heat dissipated in the system holds a direct relationship to the

number of bits erased or lost during the computation.

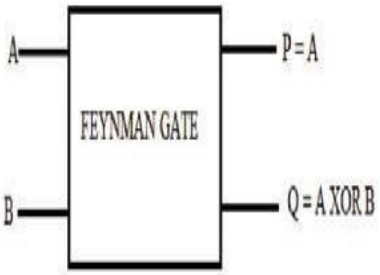
II. CONCEPT

The Reversible Logic involves the use of Reversible Gates consists of the same number of inputs and outputs i.e., there should be one to one mapping between input vectors and output vectors. Certain limitations are to be considered when designing circuits based on reversible logic (i) Fan out is not permitted in reversible logic and (ii) Feedback is also not permitted in reversible logic. In Reversible logic using outputs we can obtain full knowledge of inputs. Reversible logic conserves information. Garbage outputs are the extra outputs which help to make inputs and outputs equal in order to maintain reversibility. They are kept alone without performing any operations. Number of gates count is not a good metric since more number of gates can be taken together to form a new gate. Quantum Cost is the number of elementary or primitive gates needed to implement the gate. It is nothing but the number of reversible gates (1×1 or 2×2) required to construct the circuit. Delay is one of the important cost metrics. In Digital Electronics the binary decoder is a combinational logic circuit that converts the binary integer value to the associated output pattern. Various proposals are given to design of combinational and sequential circuits in the undergoing research.In this paper, the design of different combinational circuits like Multiplexer circuits, Code converters using Reversible logic gates is proposed with optimum Quantum cost.

Fig. 1: NOT Gate and its Truth Table

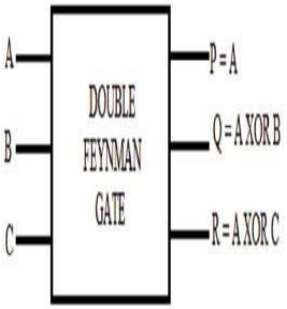


A	P
0	1
1	0



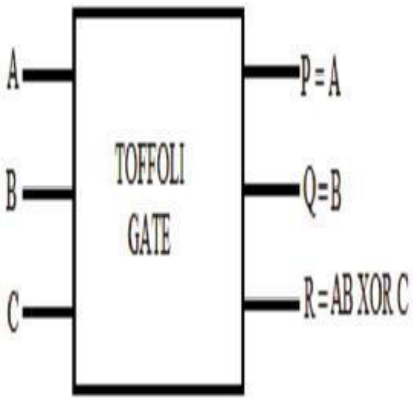
A	B	P	R
0	0	0	0
0	1	0	1
1	0	1	1
1	1	1	0

Fig. 2: Feynman Gate and its Truth Table



A	B	C	P	Q	R
0	0	0	0	0	0
0	0	1	0	0	1
0	1	0	0	1	0
0	1	1	0	1	1
1	0	0	1	1	1
1	0	1	1	1	0
1	1	0	1	0	1
1	1	1	1	0	0

Fig.3:Double Feynman Gate and its Truth Table Fig.4 :Toffoli Gate and its Truth Table



A	B	C	P	Q	R
0	0	0	0	0	0
0	0	1	0	0	1
0	1	0	0	1	0
0	1	1	0	1	1
1	0	0	1	0	0
1	0	1	1	0	1
1	1	0	1	1	1
1	1	1	1	1	0

Reversible Logic Gates

The basic Reversible Logic Gates present in the literature are briefed below. The gates that are suitable for the design with optimum quantum cost can be selected.

NOT GATE: The NOT GATE is the simple Reversible Logic gate. It is 1×1 Reversible Logic Gate with the quantum cost zero as shown in the figure1. Feynman Gate (Fg): Feynman Gate Is A 2×2 Reversible Gate As Shown In Below Figure2. The Feynman Gate Is Also Called As CNOT Gate I.E., Controlled NOT Gate. The Feynman Gate Is Used To Duplicate Of The Required Outputs. The Quantum Cost Of FG Is 1. This Is Also The Primitive Gate Owing Its Importance In Determining Quantum Cost Metric.

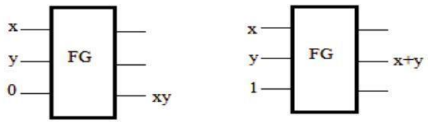
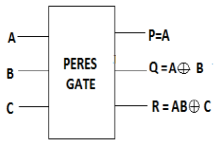


Fig.5: Fredkin Gate and its Truth Table

Double Feynman Gate (Dfg): Double Feynman Gate is a 3×3 reversible gate. The outputs are defined as shown in the below figure3. The quantum cost of DFG is 2. *Toffoli Gate(Tg): Toffoli Gate is 3×3 reversible gate. The outputs are defined as shown in the below figure4. The Quantum Cost of TG is 4*

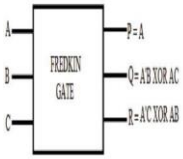
Fredkin Gate (Fdg): Fredkin Gate is a 3×3 reversible gate. The outputs are defined as shown in the below figure4. The Quantum Cost of FDG is 5. Peres Gate (Pg): Peres Gate is a is a 3×3 reversible gate. The outputs are defined as shown in the below figure6. The Quantum Cost of PG is 4.



A	B	C	P	Q	R
0	0	0	0	0	0
0	0	1	0	0	1
0	1	0	0	1	0
0	1	1	0	1	1
1	0	0	1	1	0
1	0	1	1	1	1
1	1	0	1	0	1
1	1	1	1	0	0

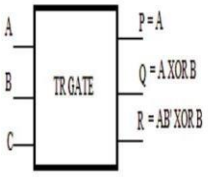
Fig.6 :Peres Gate and its Truth Table

TR GATE: TR Gate is a 3×3 reversible gate. The outputs are defined as shown in the below figure7. The quantum cost of TRG gate is given by 4



A	B	C	P	Q	R
0	0	0	0	0	0
0	0	1	0	0	1
0	1	0	0	1	0
0	1	1	0	1	1
1	0	0	1	0	0
1	0	1	1	1	0
1	1	0	1	0	1
1	1	1	1	1	1

Fig.7 :TR Gate and its Truth Table



A	B	C	P	Q	R
0	0	0	0	0	0
0	0	1	0	0	1
0	1	0	0	1	0
0	1	1	0	1	1
1	0	0	1	1	1
1	0	1	1	1	0
1	1	0	1	0	0
1	1	1	1	0	1

Fig.8: AND Gate and OR Gate using fredkin

Considering our circuit requirements we need to design AND gate and OR gate using reversible gates. Here we used fredkin gate to design AND and OR gates as shown in figure. Importance is given to fredkin gate because it gives optimistic performance at less Quantum Cost for designing AND and OR gates.

III. EXISTING METHOD

The Design of Combinational and Sequential Circuits has been ongoing in research. Various proposals are given for the design of combinational circuits like code converters, multiplexers, decoders etc., in the existing method the author has given a novel design of 2x4 decoder whose Quantum Cost is less than the previous design. Using fredkin gates for designing 3×8 decoder as shown in figure9. The whole design is done using Fredkin, Feynman gates which give better Quantum Cost when compared to the other reversible Logic gates. The number of gates required to design 3x8 decoder are 12 in which there are 6 fredkin gates and 6 feynman gates. The sum of all the quantum costs of each gate gives total quantum cost of 3x8 decoder.

Basic Gates Using Reversible Gates

Different Reversible Decoder circuits like 2×4, 3×8 decoders are designed using Fredkin Gates, Feynman gates. Some combinational circuits like code convrters, multiplexers etc., are designed using these decoders. The concept of duplicating a single output to required number of outputs using Feynman gate is introduced where Fan-out was not allowed.

IV. SIMULATION RESULTS OF PROPOSEDCIRCUITS

A. 2×4 Decoder



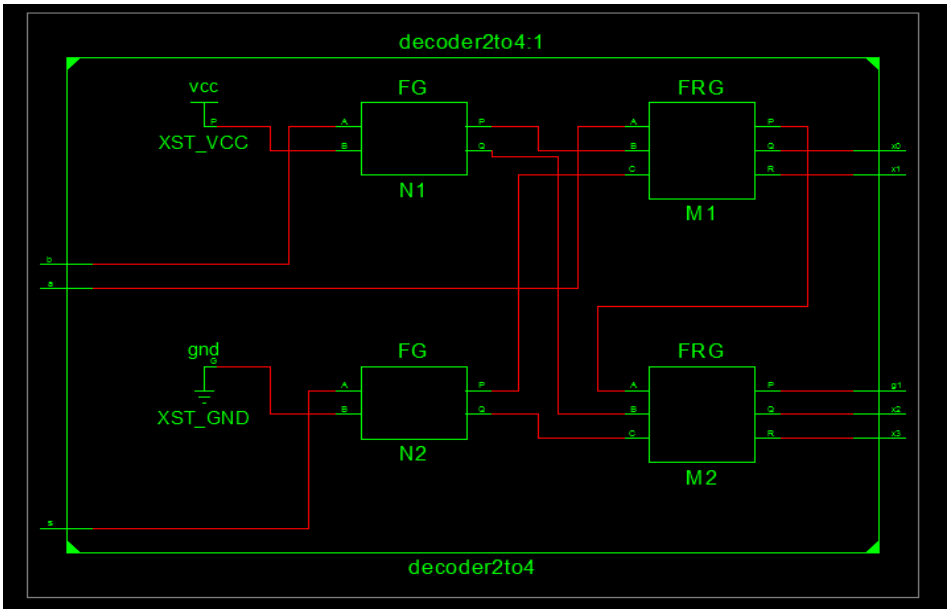


Fig.10: RTL Schematic of 2×4 reversible decode

A. 3×8 Decoder

Fig.12: RTL Schematic of 3×8 decoder

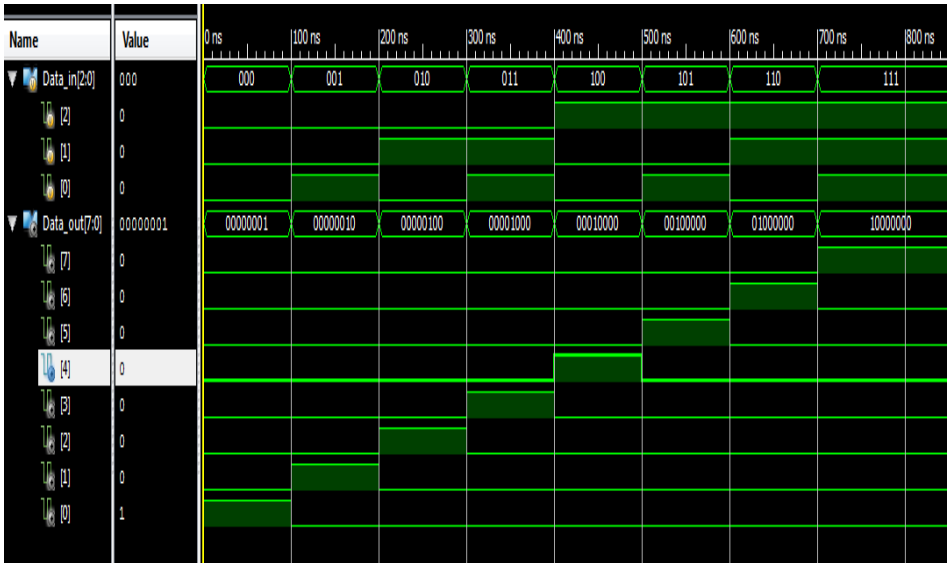


Fig.11: simulated output for 2×4 decoder

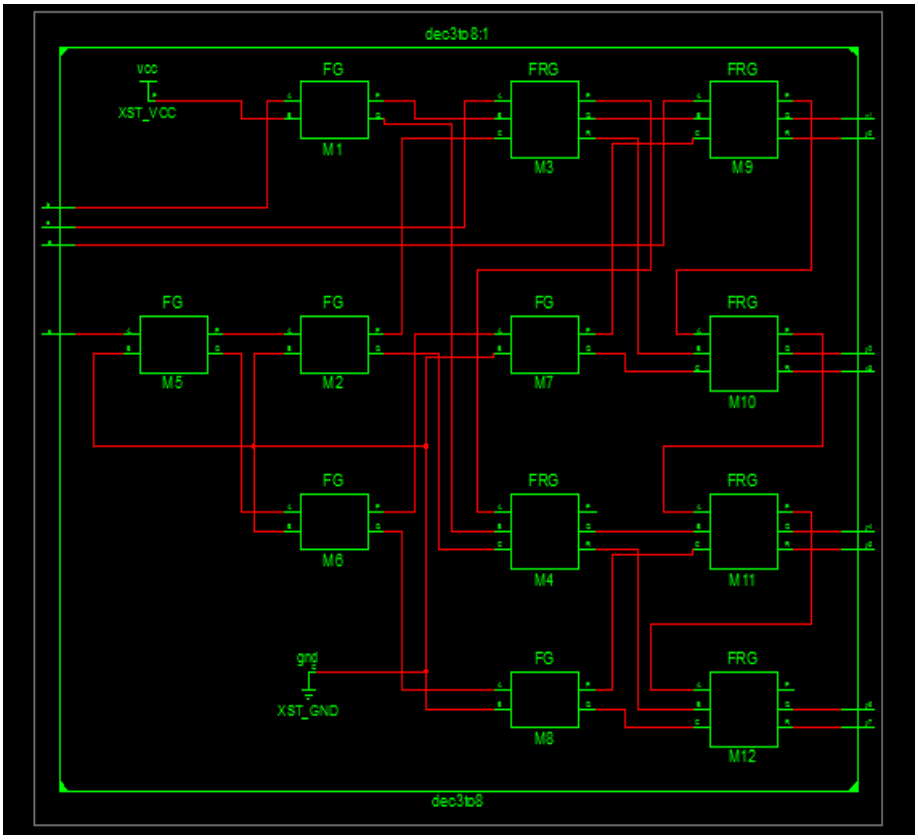


Fig.13 :Simulated output for 3×8 decoder

B. Gray To Binary Converter

Designing of reversible logic circuit is challenging task, since not enough number of gates are available for design. Reversible processor design needs its building blocks should be reversible in this view the designing of reversible code converters became essential one.

The Most Significant Bit (MSB) of the binary code is always equal to the MSB of the given binary number.To get the next straight binary bit, it uses the XOR operation among the primary bit or MSB bit of binary to the next bit of the gray code. Similarly, to get the third straight binary bit, it uses the XOR operation among the second bit or MSB bit of binary to the third MSD bit of the gray code and so on.



Fig.15: Simulated output for gray to binary

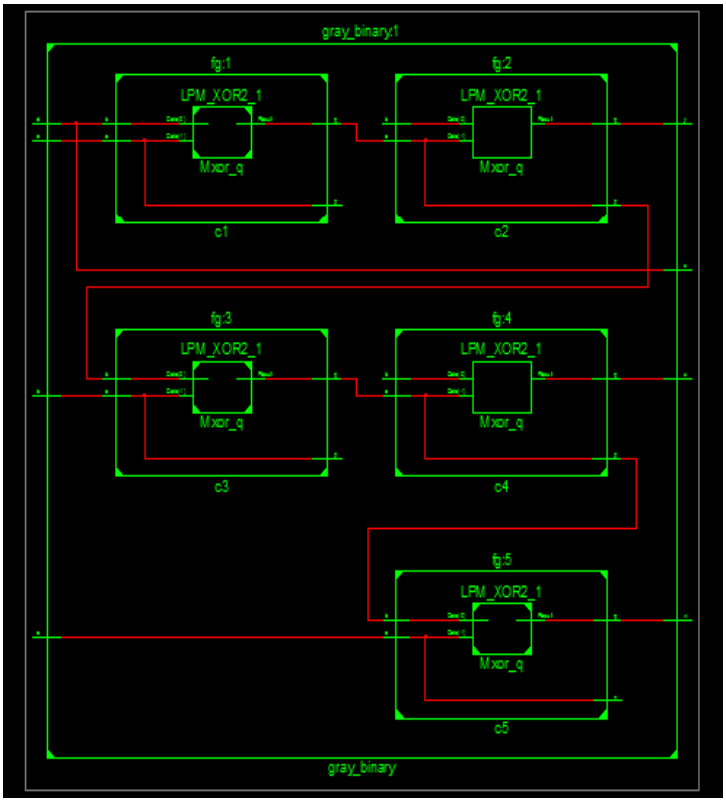


Fig 14: RTL Schematic of gray to binary

C. Binary To Gray Converter

Binary to Gray code converters used to reduce switching activity by achieving single bit transition between logical sequences. In the digital domain, data or information is represented by a combination of 0's and 1's. A code is basically the pattern of these 0's and 1's used to represent the data. Code converters are a class of combinational digital circuits that are used to convert one type of code in to another.

If Input vector is I(D,C,B,A) then the output vector o(Z,Y,X,W). The circuit is constructed with the help of Feynman Gate (FG) gate. The Most Significant Bit (MSB) of the gray code is always equal to the MSB of the given binary code. Other bits of the output gray code can be obtained by XORing binary code bit at that index and previous index.

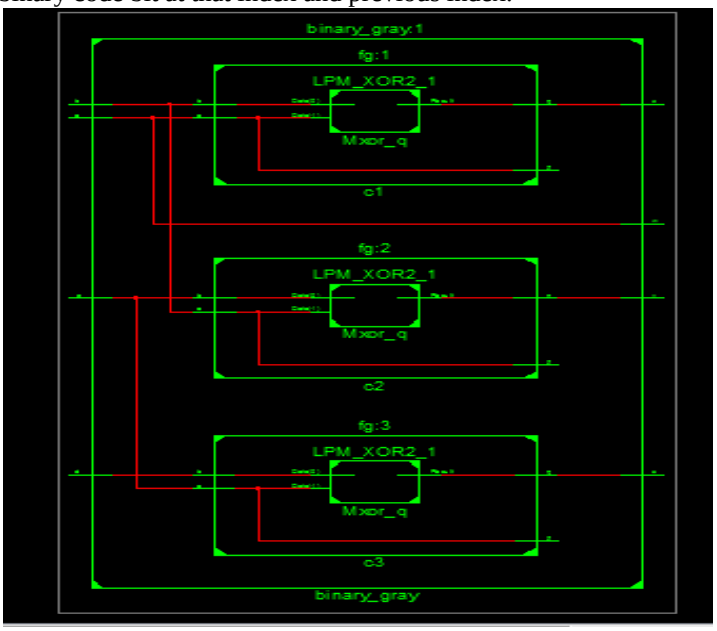


Fig.16: RTL Schematic of binary to gray

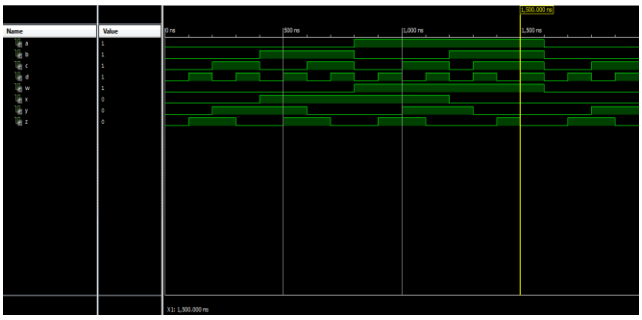


Fig.17: Simulated output for binary to gray

D. Multiplexer

To design a multiplexer using reversible decoder, reversible 2 input AND gates, 2 input OR gates are required. The 2 input AND Gate and OR gate are designed using Fredkin gate. By using these designed gates we can improve those gates to the required number of input gate. Each output line from decoder is driven to 2 input AND gate along with multiplexer input. The outputs of all AND gates are made to drive to that particular input OR gate. The input binary integer values act as the selection lines. Similarly by using 16×1mux and 2×1mux a 32×1 multiplexer is designed.

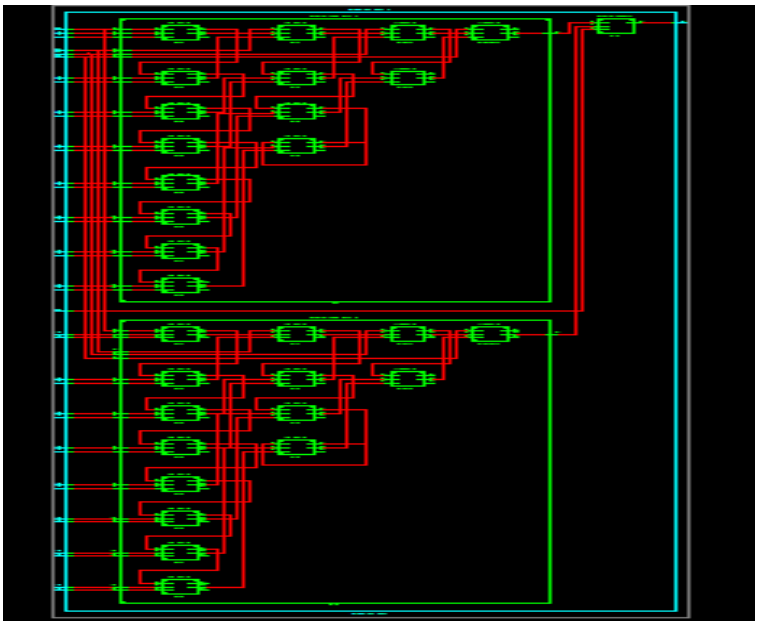


Fig.18: RTL Schematic of 32×1 multiplexer

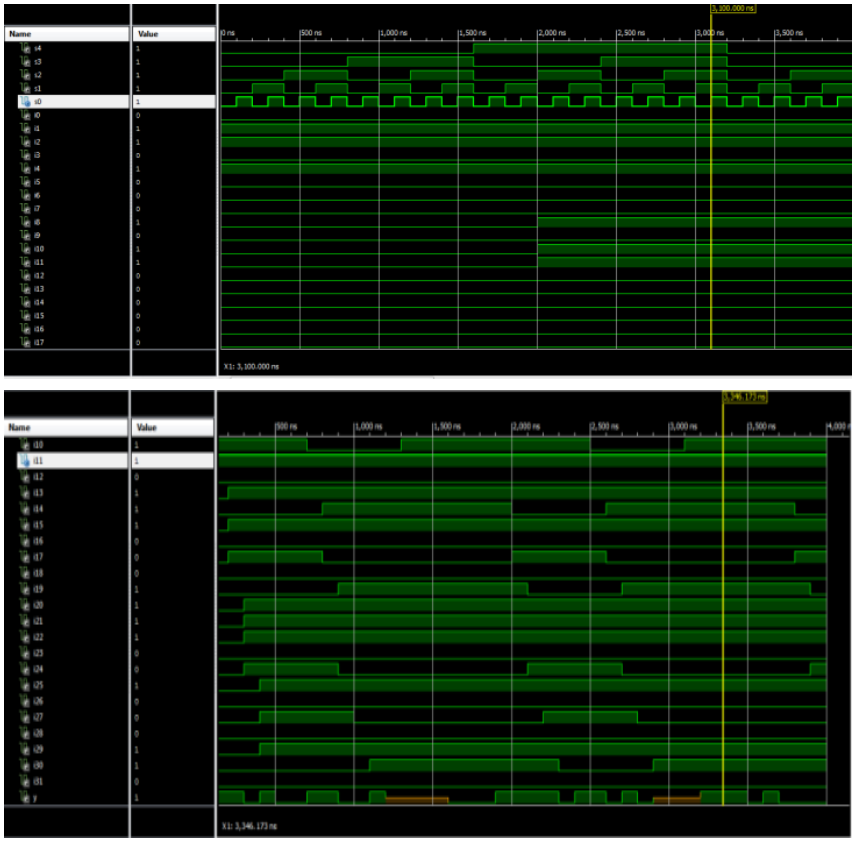


Fig.19: Simulated output for 32×1 multiplexer

V. COMPARATIVE STUDY

The combinational circuits designed using reversible decoder are analyzed in terms of Quantum cost and Garbage outputs.

CIRCUIT	QUANTUM COST	GARBAGE OUTPUTS
2 TO 4 DECODER	12	3
3 TO 8 DECODER	36	6
GRAY TO BINARY	5	3
BINARY TO GRAY	3	3
32×1 MULTIPLEXER	81	54

VI. CONCLUSION

In this paper, different combinational circuits like multiplexer, code converters circuits constructed using reversible decoder are designed. These circuits are designed for minimum quantum cost and minimum garbage outputs. The method proposed for designing the decoder circuit can be generalized. The concept of duplicating the single output to required number of outputs is utilized to overcome the fan-out limitation in reversible logic circuits. This method of designing combinational circuits helps to implement many digital circuits with better performance for minimum quantum cost.

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Multi Broadband Circularly Polarized Annular Slot Antenna for WLAN Applications

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Abstract- In this study we generate a multi broadband circularly polarized antenna which operates at 5.7G, 8.3G, 9G and 12.3GHZ for Wireless Local Area Networks (WLAN) applications. To cover the X-band, the inner circular patch of the aforementioned design is modified as an inner ring patch loaded with a varying position of a narrow U-shaped strip. A crescent parasitic element is embedding into the circular slot of the inner ring patch; the cp band is drastically broadened to 5.7G, 8.3G, 9G and 12.3GHZ. This design shows two wide 3dB axial ratio bands of 44.64% (4.5-7GHZ) and 11.1% (8.5-9.5GHZ) and their corresponding 10dB impedance bandwidths are 17.5%(6.1-5.1GHZ) and 8.43%(8-8.7GHZ). For WLAN applications this proposed designs having compact size, low cost, easy integration and multi-broad bands are more suitable.

Keywords- Ring slot, lightning shaped slot, ARSA (Annular Ring Slot Antenna), Circular Polarization, U-shaped strip line, impedance matching.

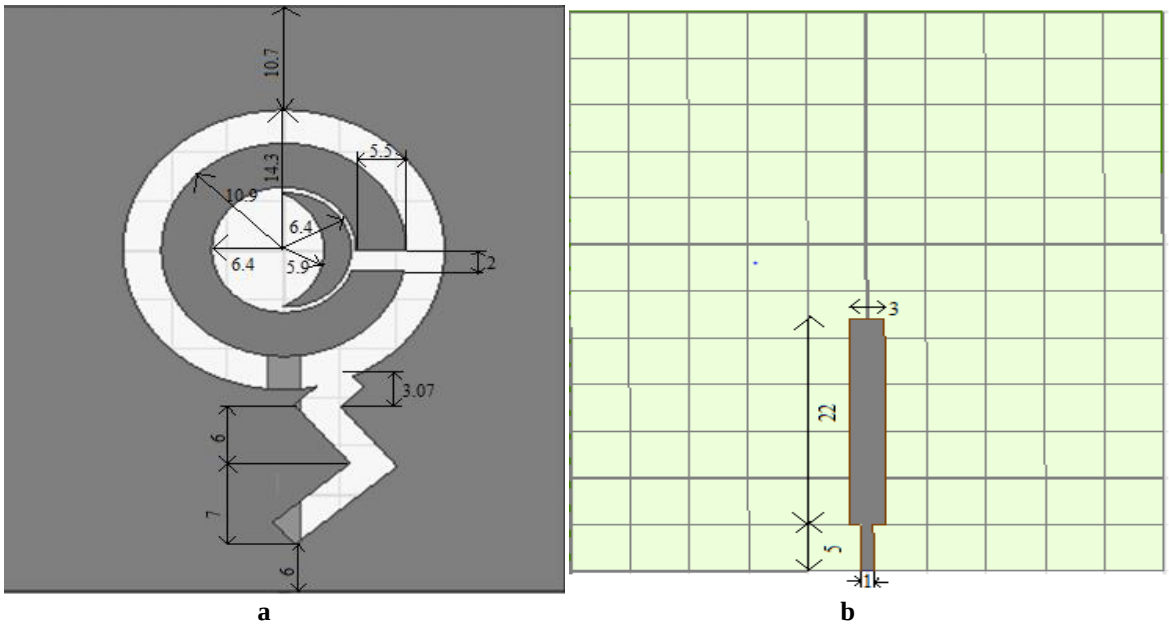
I. INTRODUCTION

The circularly polarized antennas are very useful for many wireless communication applications because they can overcome Faraday rotation effects and mitigate multipath interferences. From the reference antenna we observed that it Generates 2.4/5.2/5.8 GHz. With some modifications we generate the frequencies Such as 5.7/8.3/9/12.3 GHz which operates in X-band. By the use of high frequency bands in wireless applications the existing designs are not satisfied.

This design has the advantages of low cost, compact size; easy integration & the distance communication are most suitable for wireless technologies. Therefore, it is a big challenge to realize a Multi band cp antenna to cover the entire WLAN band by using this structure. Most works are based on the stacked method. However, these antennas are more in use but this structure is slightly difficult.

Some printed designs for multi band are shown in Fig: 1 (a) and (b) these are based on patch antennas, slot antennas, monopole antennas. Even though these designs satisfies the requirements of WLAN (5.7/8.3)GHz but they are unable to cover the upper band in WLAN 9/12.3GHz. Unfortunately, these bands are not enough for WLAN.

By loading a lightning shaped slot at the bottom of the ring slot we observed that it has the cp bandwidth of 44.64% (4.5-7) GHz and 11.1% (8.5-9.5) GHz. To achieve multi band operation, the inner circular patch of the annular ring structure is modified and an additional higher band to cover the WLAN 12.3GHz, this modified multi band is referred as proposed antenna 1(a). Crescent parasitic element is loaded into the circular slot of the inner ring patch, then the cp band is significantly broadened and their corresponding bandwidth. This band of frequencies can cover the entire X-band.



a **b**

Fig.1: (a). Proposed Antenna (b). Micro Strip Feed

By loading a lightning shaped slot at the bottom of the ring slot we observed that it has the cp bandwidth. To achieve multi band operation, the inner circular patch of the annular ring structure is modified and an additional higher band to cover the WLAN 9GHz. This modified multi band is referred as proposed antenna 1(a) crescent parasitic element is loaded into the circular slot of the inner ring patch, then the cp band is significantly broadened to cover the 12.3 and their Corresponding 10dB bandwidths are 17.5%(6.1-5.1GHZ) and 8.43%(8-8.7GHZ). These bands of frequencies can cover the entire X-band.

II. PRPOSED ANTENNA "WLAN" 5.7/8.3/9/12.5 GHz:

A. Geometry of Proposed Antenna

Proposed antenna is a modified version of ARSA as mentioned in the Previous discussion. The geometry of proposed antenna shown in Fig 1. It is fabricated on a thin FR4 substrate with a relative permittivity of 4.4 and a loss tangent of 0.02 with a size of 60mm×50mm. The micro-strip feeding consists of two sections namely upper and lower sections. The length and width of upper and lower sections are 22×3mm and 3×1mm. The feed line works as an impedance transformer and connects directly to a 50Ω SMA connector. The radii of inner outer slots are 14.3and 10.9mm respectively. The full inner circular patch in has been modified as a ring patch by inserting a circular slot with a radius of 6.4mm in proposed antenna. A narrow U-shaped strip line, composed of two horizontal strip lines (w=4.4mm) and a vertical strip line (2mm in length), is used to reconnect this open gap. Detailed dimensions of the lightning slot (LS) is ¼ wavelength at 2.4GHz, and the connecting

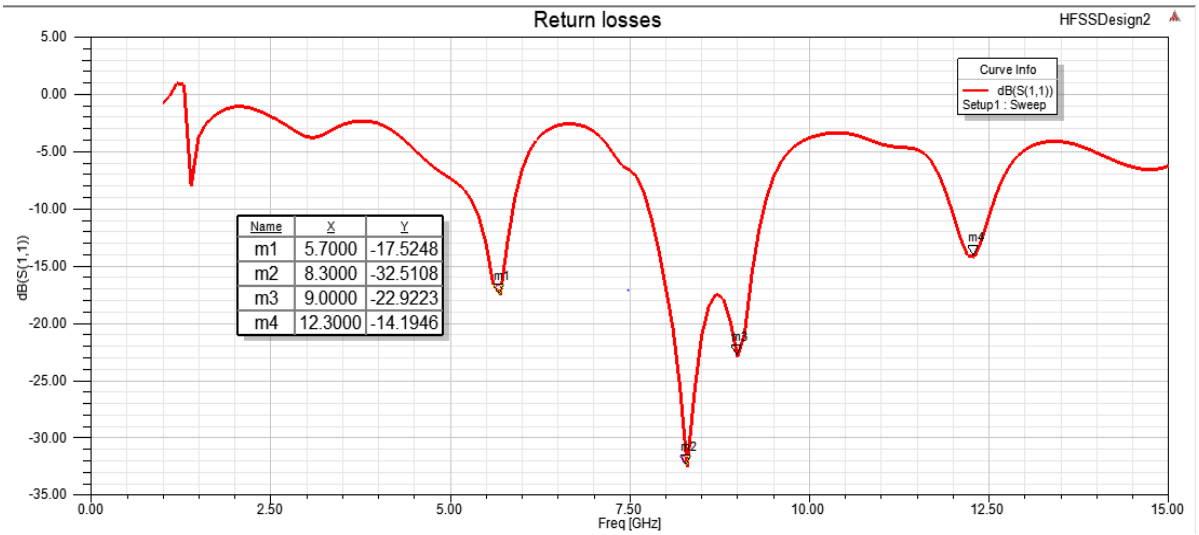


Fig.2: Simulated Results for Return Losses

Angle between the LS and angular slot is 45°. The narrow protruded slot section extended from the bottom of the LS slot, with the size of tuning the cp frequency in the low band. The design process of proposed antenna is shown in Fig 1. The simulated return losses of both proposed has exhibited an additional resonant mode at 5.7/8.3GHz, without affecting the performances in the low band.

An additional crescent parasitic element is loaded into the circular slot of proposed antenna to increase the cp bandwidth in the high band, and two symmetric stubs protruded from the bottom of the micro strip line with a length of ws and a width of 0.5mm are introduced for achieving good impedance matching.

The upper and lower sections of the micro strip line are altered to (22mm×3mm and (5mm×1mm), respectively, which are also for the impedance matching in the high band. The crescent parasitic element is designed by drawing a circle with a radius of 6.4mm centered at coordinate q(25 and -25mm), followed by drawing another circle With a radius of 5.9mm centered at coordinate P (25,-22mm). Their interested area is the crescent parasitic element. This crescent parasitic element can introduce a Higher order slot mode at 12.3GHz which contributes to the cp radiation at 12.5 GHz. With the crescent parasitic element, better cp performances can be achieved in the high band. Detailed parametric studies of Ws will be given later.

B. Parametric Studies Of Proposed Antenna

The simulation conducted in this work is realized by commercial electromagnetic software- Ansys HFSS. The first parameter is the length w of the U-shaped strip line. Since the value of w does not affect the return losses of the antenna, it is shown for brevity. Optimum w is chose as 5.5*2mm. The geometry of proposed antenna is shown in Fig.1 (a) and (b).

According to the aforementioned parametric analysis, the following conclusions are obtained. (i) Adjusting the position of lightning shape can control the cp frequency in the low band and the cp bandwidth in the high band.(ii).tuning w can slightly control the cp frequencies in the low and high bands.(iii).By placing proper radius to the crescent parasitic element we can control the CP frequencies in high band.

III. RESULTS AND DISCUSSION OF PROPOSED ANTENNA

Fig.2. shows the simulated and measured return losses of proposed antenna. The return losses are shown the band of frequencies which can generate by the proposed antenna. The simulation and measurement agree well with each other, and the slight difference is due to the fabrication tolerance. As shown in Fig.2, the measured 10 dB impedance bandwidths for 5.7 and 8.3 in the low and high bands were (4.5-7) GHZ and (8.5-9.5) GHZ respectively. Fig 3 also shows the VSWR (Voltage Standing Wave Ratio) of the proposed antenna. As shown in Fig. 3, the measured peak gains in the low band across 5.7 and 8.3GHz were between 0.37 and 3.9dB, and its corresponding efficiencies for axial ratio are 44.64% and 11.1%. Notably, the Radiation pattern in 2D and 3D plots of proposed antenna was performed. Fig. 5.

Shows the magnetic current distributions (at phases 0°, 90°, 180° and 270°) of proposed at 5.7 and 8.3GHz respectively. As observed from these figures, the operating mode in the low band can be considered as the fundamental mode, and the mode in the high band can be considered as the higher order mode.

Here the sense of rotation of proposed antenna (in the low and high bands) is left handed circular polarization (LHCP), because the magnetic current flows in a left hand orientation (counter clockwise direction) along the z-axis. The simulated and measured radiation patterns in two principle planes (x-z and y-z axis) shown in Figs 4 broadside radiation pattern (LHCP) were observed in both low and high bands at the z-axis direction. The magnetic current distributions of antenna are shown in fig.4.

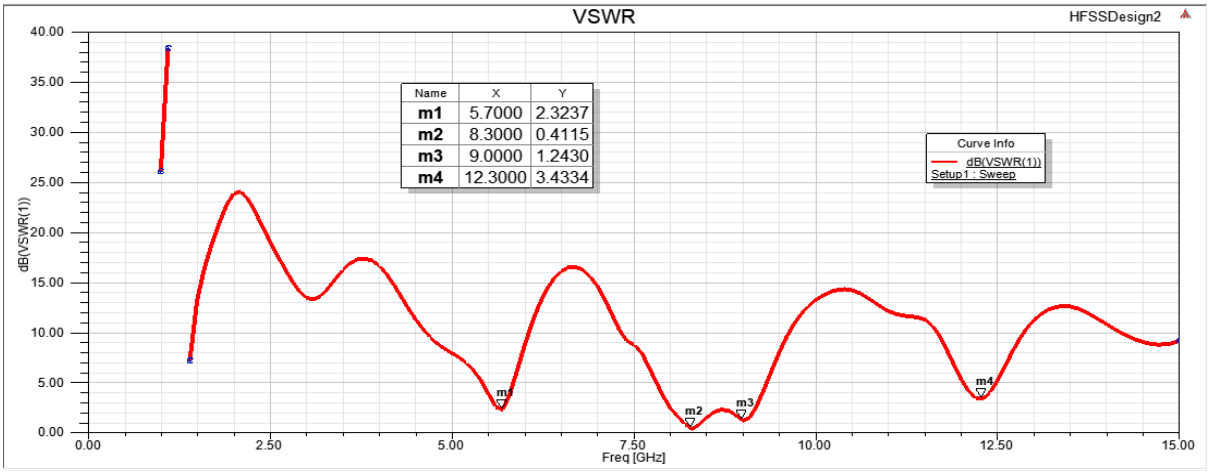
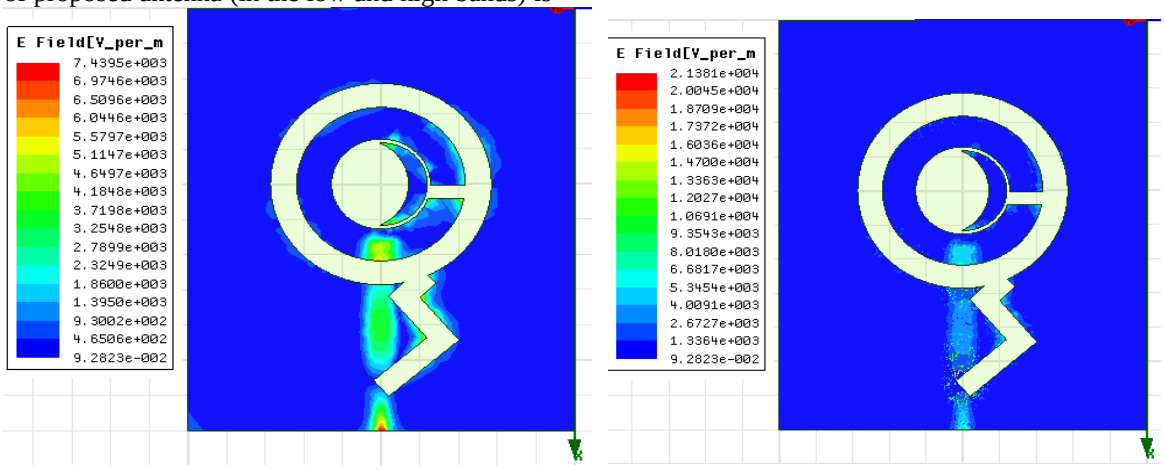
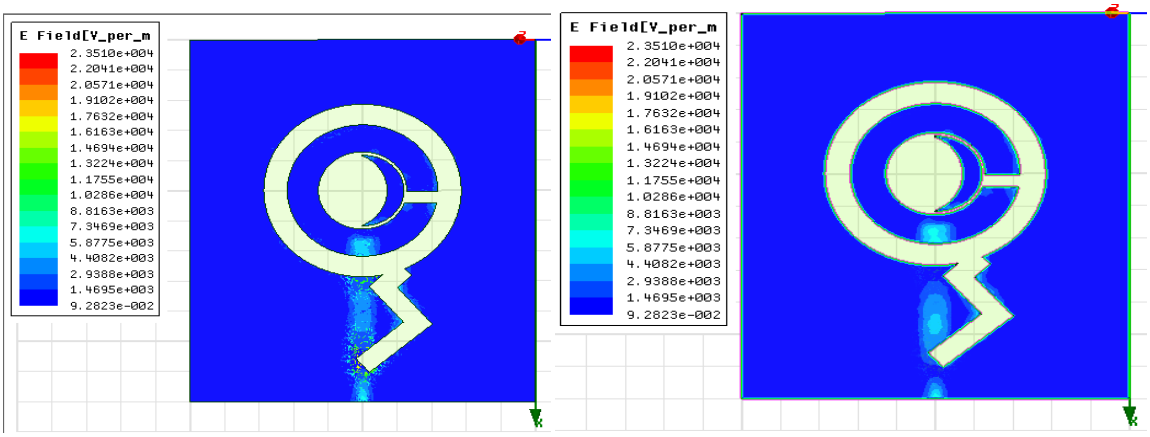


Fig.3: Simulated Results of VSWR (Voltage standing wave ratio)

Figs. 4 show the magnetic current distributions (at phases 0°, 90°, 180° and 270°) of proposed antenna at 5.7 and 8.3GHz respectively. As observed from these figures, the operating mode in the low band can be considered as the fundamental mode (TM11 mode), and the mode in the high band can be considered as the higher order mode (TM21). Here the sense of rotation of proposed antenna (in the low and high bands) is left handed circular polarization (LHCP), because the magnetic current flows in a left hand orientation (counter clockwise direction) along the z-axis. Fig .5shows the magnetic current distributions



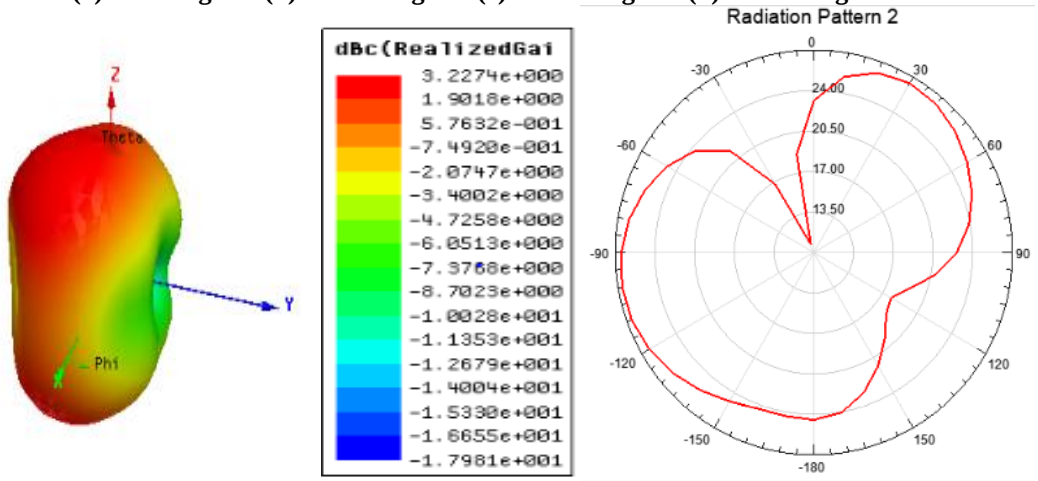
a **b**



c **d**

Fig.4: Magnetic Current Distributions

(a). at 0^0 degrees (b). At 90^0 degrees (c). At 90^0 degrees (d). At 90^0 degrees



a **b**

Fig.5: (a): Radiation pattern in 3D Plot (b). 2D Plot

IV. FABRICATED RESULTS



a **b**

Fig.6: (a): Proposed Antenna Front View (b): Back View

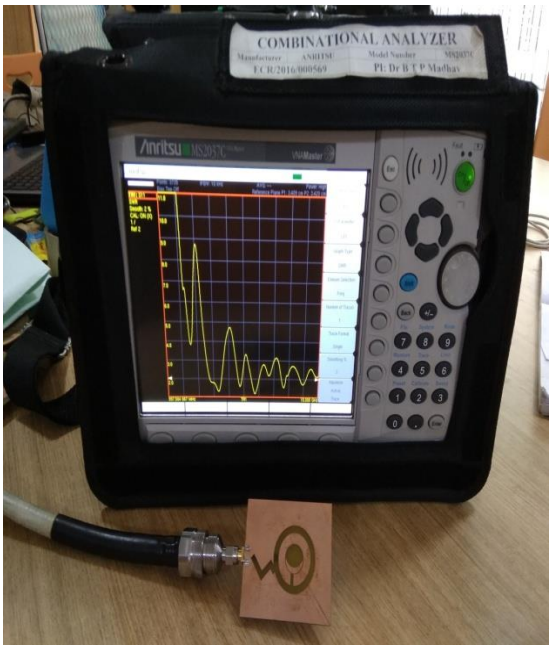


Fig.7: Characterization Results for VSWR

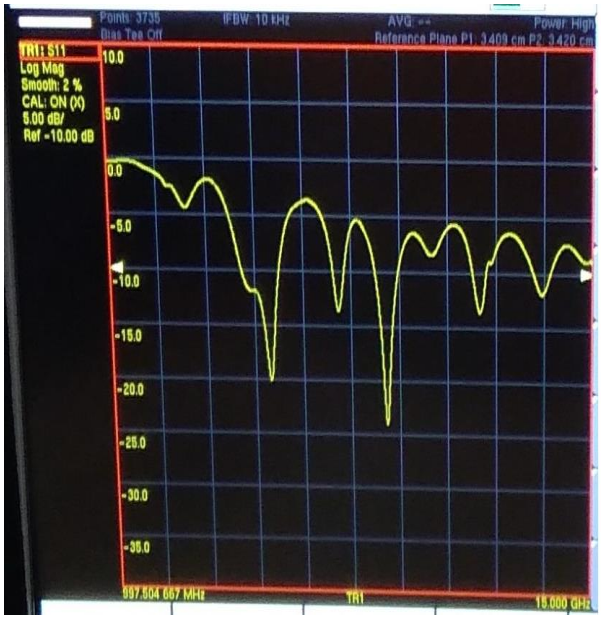


Fig.8: Return Losses

V. CONCLUSTION

This paper has successfully proposed two dual-band annular-slot antennas for WLAN operations. The first design (reference antenna) has successfully achieved CP operation over the WLAN 2.4/5.2/5.8 GHz band. Unfortunately, it is Unable to cover the CP high bands in WLAN. Modified from the first design, the second design has been proposed to exhibit two broad CP bands to cover the whole WLAN 5.7/8.3/6/12.3 GHz band. Desirable gains and efficiencies across the entire WLAN band of interest are obtained.

In addition, the proposed designs are fabricated by only a low-cost single-layer substrate. With the advantages of compact size, low-cost, easy integration and dual-broad CP bands, the proposed designs are very attractive for modern wireless communication systems, especially for WLAN applications.

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An Emotion Recognition System in Matlab

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Abstract - Emotion recognition Analysis is an interesting and challenging problem, and impacts important applications in many areas such as human-computer interaction and data- driven. Deriving an effective facial expressions from the original images is plays a vital step for successful facial emotion recognition. An emotion recognition system should be in real time and highly accurate. In this paper, we propose an emotion recognition system with high performance from the original face images. Face detection can be done by viola-jones algorithm to extract the face regions in the frames. The Bandlet transform is realized on the face regions, and the resultant sub-band is divided into non-overlapping blocks. For an emotion recognition system svm algorithm is used, The Kruskal-Wallis feature selection is applied to select the most dominant bins of the concatenated histograms. The dominant bins are then fed into a Gaussian mixture model based classifier to classify the emotion.

Keywords - Emotion Recognition, Feature selection, Classifier, Bandlet Transform.

I. INTRODUCTION

Due to the ongoing growth along with the extensive use of smart phones, services and applications, emotion recognition is becoming an essential part of providing emotional care to people.

Provisioning emotional care can greatly enhance users' experience to improve the quality of life. The conventional method of emotion recognition may not cater to the need of mobile application users for their value added emergent services. Moreover, because of the dynamicity and heterogeneity of mobile applications and services, it is a challenge to provide an emotion recognition [1] system that can collect, analyze, and process emotional communications in real time and highly accurate [2] manner with a minimal computation time. There exist a number of emotion recognition [5] systems in the literature. The emotion can be recognized from speech, image, video, or text. There are many applications of the emotion recognition in mobile platforms. In mobile applications, for example, the text of the SMS can be analyzed to detect the mood or the emotion [6] of the users. Once the emotion is detected, the system can automatically put a corresponding 'emoji' in the SMS. By analyzing a video in the context of emotion [8], a smart phone can automatically change the wallpaper, or play some favourite songs to coop with the emotion of the user. The same can be applied using oral conversation through a smart phone; an emotion can be detected from the conversational speech [12], and an appropriate filtering can be applied to the speech. To realize an emotion recognition engine must be in real-time, should be computationally less expensive, and give high recognition accuracy[15] with the experimental result.

II. PROPOSED SYSTEM

Figure:1 shows a block diagram of the proposed emotion recognition system in matlab. In the following subsections, we describe the components of the proposed system.

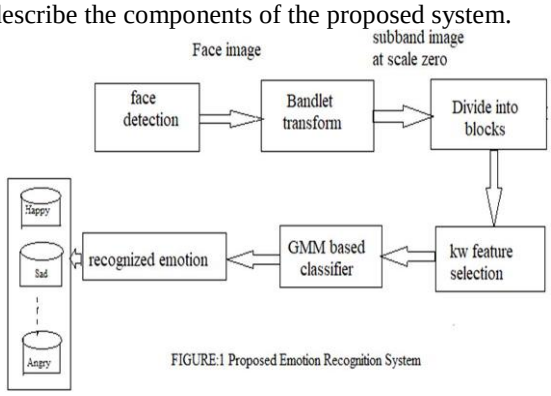


Figure 1: Proposed Emotion Recognition System

In the below section we have to explain the each and every process of this emotion recognition system in matlab by using a flowchart preprocessing steps involved. Flow chart contains the two steps those are real time process and training process [13] through the steps the whole paper should be done. we explain the processes of face detection, facial feature extraction, and the classification method, all of which are important for recognizing emotions from facial expressions.

III. FLOW CHART

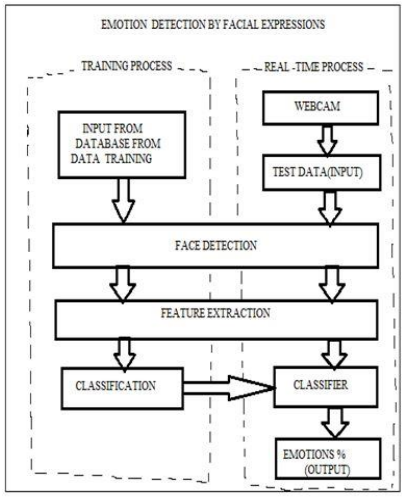


Figure 2: Work flow for real time emotion detection by facial expression

Emotion detection by facial expressions recognizes and interprets human emotions from facial textures, and the movement of facial muscles, eyes, mouth or eyebrows. The workflow of real-time emotion detection by facial expressions proceeds as follows (FIGURE. 2).

- The emotion detection finds a user's face from the video frames (input).
- The detection extracts the facial features [4] and normalizes them to form feature vectors.
- It then classifies the user emotions into one of seven classes (neutral, happiness, sadness, anger, disgust,fear and surprise) using a classifier that is generated from a training process.
- Finally, it calculates the percentage of each emotion for further analysis.

IV. RELATED WORKS

a) Face Detection - Once we select the frames, the face areas in the frames are detected by the Viola-Jones algorithm [16]. This algorithm works fast, and is suitable for a real-time implementation. Now a day, many smart phones have the face detection functionality embedded into the mobile system.

b) Bandlet Transform - The Bandlet transform is applied to the detected face area. A face image has many geometric structures that carry valuable information about the identity[3], the gender, the age, and the emotion of the face. A traditional wavelet transform does not take care much about the geometric structure of an image, especially in sharp transitions; however, represent sharp transitions using geometrical structures can improve the representation of image. One of the major obstacles of using geometrical structure is a high computation complexity. The Bandlet transform overcomes the obstacle to represent geaometric structure of an image by calculating the geometric flow in the form of Bandlet bases.

c) KW feature selection - The number of features for the image is very huge; many features slow down the process, and they also bring the 'curse of dimensionality'. Therefore, a feature selection technique can be applied to reduce the dimension of the feature vector. There are many feature selection techniques [7], each of which has its own advantage and disadvantage. In our proposed system, we adopt the KW technique for its simplicity and low computational complexity, keeping in mind that the system is to deploy in mobile applications.

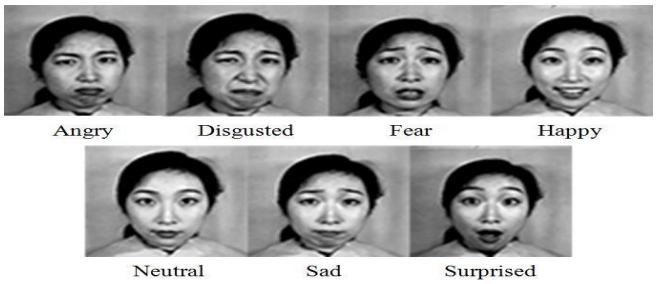
d) GMM based classifier - The selected features are fed into a GMM based classifier. During training, models of different emotions [9] are created from the feature set. During testing, log-likelihood scores are obtained for each emotion using the feature set and the models of the emotion. The emotion corresponding to the maximum score is the output of the system. In the experiments, different numbers of Gaussian mixtures are investigated. We choose the GMM based classifier [14] because it can operate in real-time, it is more stable than the neural network based classifiers.

V. EXPERIMENTAL RESULTS AND ANALYSIS

To validate the proposed system, we used a number of experiments using two publicly available databases, namely CanadeKohn(CK) and the Japanese female facial expression (JAFFE) databases. In the following subsections, we briefly describe the databases, and present the experimental results and discussion.

a) Databases in our experiments - we used two databases. The JAFFE database consists of emotional face images of Japanese actresses. There are total 213 face images of 10 female Japanese. All the images are gray, and have a resolution of 256×256. The original images were printed, scanned, and digitized. The faces are frontal. There are seven emotion classes, which are anger, happiness, sadness, disgust, afraid, and surprise, in addition to neural. The CK database was created by the faces of 100 university-level students. After careful observations, the faces of four students were discarded because they were not properly showing the emotions.

b) Experimental results - We used the JAFFE database in our experiments to set up different parameters of the proposed system. We chose this because it a smaller size database than the CK database. Once we fix the parameters using the JAFFE database, we used the CK database. During classification, we adopted a 5-fold approach, where the database was divided into five equal groups. In each iteration , four groups were trained and the rest was tested. After five iterations, all the five groups were tested.



VI. CONCLUSION

An emotion recognition system for mobile applications has been proposed. The emotions are recognized by face images. The Bandlet transform which are then selected by the KW feature selection method. The GMM based classifier is applied to recognize the emotions. Two publicly available databases are used to validate the system. The proposed system achieved 99.8% accuracy using the JAFFE database, and 99.7% accuracy using the CK database. It takes less than 1.4 seconds to recognize one instance of emotion. The high performance and the less time requirement of the system make it suitable to any emotion-aware mobile applications. In a future study,we want to extend this work to incorporate different input modalities of emotion.

VII. FUTURE SCOPE

The use of spherical canonical images allows us to perform matching in the spherical harmonic transform domain,

which does not require preliminary alignment of the images. The errors introduced by embedding into an expressional space with some predefined geometry are avoided. In this facial expression recognition setup, end-to-end processing comprises the face surface acquisition and reconstruction, smoothening, sub sampling to approximately 2500 points. Facial surface cropping measurement of large positions of distances between all the points using a parallelized parametric version is utilized. The general experimental evaluation of face expressional system guarantees better face recognition rates. Having examined techniques to cope with expression variation, in future it may be investigated in more depth about the face classification problem and optimal fusion of color and depth information. Further study can be laid down in the direction of allele of gene matching to the geometric factors of the facial expressions. The genetic property evolution framework for facial expressional system can be studied to suit the requirement of different security models such as criminal detection, governmental confidential security breaches etc

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Dual Band Microstrip Patch Antenna Array Incorporated with Split Ring Resonators

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Abstract- Antennas act as the driving force behind the recent advances in wireless communication technology. Since technology has never been static its trends goes on changing with the advent of microstrip patch antennas the size, weight and fabrication cost has been minimized. In this paper a unique miniaturized structure element is developed to achieve the dual band behavior of antennas. When no additional structures are added, traditional patch antenna array resonates at 2.4GHz with gain of 5.6dBi and bandwidth of 290MHz. when the same structure is incorporated with split ring resonator (SRR) which constitutes the properties of Metamaterial then an additional frequency is added up which resonates at 8.4GHz.All in all this proposed microstrip patch antenna array possess considerable gain and bandwidth.

Keywords- Antenna, SRR, Metamaterial

I. INTRODUCTION

A multiband microstrip patch antenna is preferred in most of the wireless applications because it squeezes the resonant dimensions of the antenna, and having an advantage of low profile, less weight, low fabrication cost , portability, integrability with millimeter and microwave circuits multiband operation[1]. Not only this, but also it replaces the usage of multiple antennas for different resonant frequencies. In the literature several traditional approaches have been reported to achieve multiband operation. The techniques include-by truncating the ground plane of conventional patch antenna, introduction of perturbation by cutting slots into the radiator etc. But, most of the techniques results in the increase of size of antennas thus making them bulky[2]. So in order to overcome the drawbacks faced by these conventional techniques a novel structure is proposed.

This proposed microstrip patch antenna resonates simultaneously at the frequencies of 2.45GHz and 8.4GHz respectively. This novel method of dual band microstrip patch antenna is obtained by incorporating some additional design structures to the conventional patch antenna array. The dual band operation is achieved by placing vias and inserting split ring resonator (SRR) to each of the rectangular microstrip patches of the array.

These split ring resonators (SRR) are artificially engineered single or double negative metamaterials which are also called zero index materials. These artificial materials are characterized by either dispersion relations or by constitutive electromagnetic parameters. In 1968, Veselago first time in his paper gave the theoretical explanation on materials with negative permittivity and permeability, simultaneously and also predicted some peculiar phenomena obtained from them. Smith et al. were the first to experimentally demonstrate the negative materials.[3]

Antenna designs incorporating metamaterials can setup the radiated power of an antenna. The newest metamaterial antennas radiate as much as 95% of an input radio signal. In general, standard antennas need to be at least half the size of the signal wavelength to operate efficiently[4]. Therefore in metamaterial loaded conventional antennas, matching of impedence occurs at frequency which is lower than the initial resonant frequency of their conventional counterparts. These interesting anomalous electromagnetic features result in size reduction and performance improvement of conventional antennas at no extra hardware cost and size.[5]

The proposed structure is analyzed using ansoft HFSS.V.14.

II. PAST RESEARCH

In the literature, various techniques are used to load the microstrip patch antennas with metamaterials have been reported [6–14]. In [6], Chen and Alu combined two resonances to enhance the antenna bandwidth by loading the elliptical patch antenna with mu-negative metamaterial. In [8], Andrea Alu et al. enhanced the radiation performance of the circular patch antenna by using metamaterial inclusions that fit in the dielectric region between the patch and the ground plane. Joshi et al. [9], embedded the SRR into the slot of a slotted patch antenna to match the impedance at the desired frequency band. In [10], Arora et al. loaded the feed line of the conventional patch antenna array with a pair of split ring resonators to enhance its bandwidth. The same group [12],designed a metamaterial superstrate to improve the gain of patch antenna array. These artificially engineered materials can also be directly connected to the antenna for reduction in size and enhancement of gain and bandwidth, like [13], where Palandoken et al. directly connected the unit cell of left handed metamaterial to a dipole antenna for obtaining the broadband performance and [13], where Du et al. connected the modified S-shaped resonator directly to the monopole antenna to achieve the multiband operation. However, most of these researches were associated with the performance enhancement of single patch antennas only. Therefore, a method is required, which should not only improve the performance of the antenna, but should also be capable to reduce its dimensions by lowering the existing resonant frequency or by generating an additional lower resonant frequency band.

Organization of the article:

This paper is organized into eight different sections. Introduction and past research has been discussed in first two

sections of the paper. Design of metamaterial is discussed in third section. Fourth section presents the physical parameters of the antenna. The detailed design of conventional and proposed antenna array is presented in section five. Simulation results as well as the fabrication process are discussed in sixth and seventh sections of the paper. Finally, the communication is concluded in section eight.

III. DESIGN OF METAMATERIAL UNIT CELL

The structure of the split ring resonator unit cell is shown in fig 1. The dimensions of this split ring resonator unit cell are; length of outer split ring (Ls) =11.95mm, ring width (w) =0.2mm, split gap (g) =0.3mm and the gap between inner and outer split rings(s) =1mm.The dimensions of the split ring resonator unit cell are chosen in such a way that the overall size of the proposed antenna array does not increase at all.

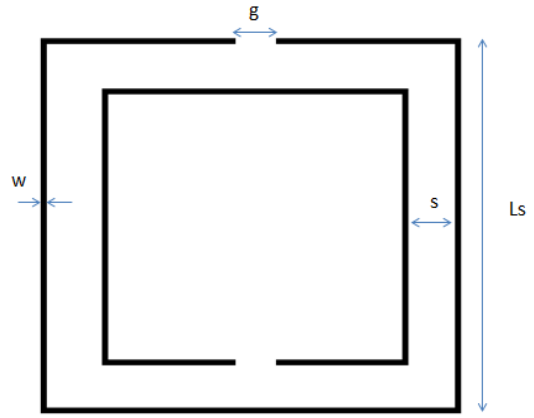


Fig.1: Metamaterial unit cell

IV. THEORITICAL ANALYSIS FOR DESIGN OF BASIC ANTENNA

Microstrip patch antennas are characterized by a large number of physical parameters than conventional microwave antennas.[14]

The basic antenna is designed for a resonating frequency of 2.45GHz.

Selection of substrate:

The dielectric materials play important role in antenna designing process. The thick substrate with low dielectric constant gives good performance and provides better efficiency, larger bandwidth, but large antenna element. While thin substrate with higher dielectric constant provides smaller element size however because of their greater losses they are less efficient and have relatively smaller bandwidth. The performance of antenna improves when the value of dielectric constant reduces The antenna is designed on a fibre reinforced (FR-4) epoxy and its dielectric constants ranges within

$2.2 \leq \varepsilon_r \leq 12$.

The antenna which we are using should have minimum power losses. FR-4 epoxy has the possibility dielectric constant of $\varepsilon_r = 4.4$. The material for the patch is copper and material for radiation box is air

Selection of patch dimensions:

The patch dimensions also place a crucial role on defining the performance of the microstrip patch antenna. The following dimensions using reference equations for the proposed microstrip patch antenna are

1. Calculation of Width (W) of patch:

$$W=\frac{c}{2f_0}\left(\sqrt{\frac{2}{\varepsilon_r+1}}\right)$$

Where w=width of the patch
c=velocity of light
f_0=resonant frequency
ε_r =dielectric constant

2. Actual length of the patch (L):

$$L=L_{eff}-2\Delta L$$

Where $L_{eff}=\frac{c}{2f_0\sqrt{\varepsilon_{eff}}}$
ΔL=change in length

3. Calculation of Length Extension:

$$\Delta L=\frac{0.412h(\varepsilon_{eff}+0.3)(\frac{W}{h}+0.264)}{(\varepsilon_{eff}-0.258)(\frac{W}{h}+0.8)}$$

Where h=1.4mm
ΔL=change in length

4. Effective dielectric constant of rectangular patch antenna:

$$\varepsilon_{eff}=\frac{\varepsilon_r+1}{2}+\frac{\varepsilon_r-1}{2}\left[1+12\frac{h}{w}\right]^{\frac{-1}{2}}$$

Where ε_{eff}=effective dielectric constant
L_{eff}=effective length
L=length of the patch
h=height of the substrate
ΔL=change in length

5. Feed location design:

The coaxial cable position can be obtained by using

$$X_f=\frac{L}{\sqrt[2]{\varepsilon_{reff}}}$$

Where
X_f is the desire input impedance to match the coaxial cable
ε_{reff} is the effective dielectric constant.

$Y_f=\frac{W}{2}$

6. Ground dimensions:

It is essential to have a finite ground plane in practical conditions ,if the size of the ground plane is greater than the patch dimensions by approximately six times the substrate thickness all around the periphery. Therefore the ground plane dimensions would be given as

L_g=6h+L

W_g=6h+w

V. DESIGN OF BASIC ANTENNA

A basic microstrip patch antenna is designed by using copper as aconducting material and FR-4 Epoxy as a substrate i.e, dielectric material.the feeding that is used here is coaxial feeding technique.

Table 1

Dimensions of basic rectangular patch antenna:

PARAMETERS	VALUE
Length of patch(L)	40
Width of patch(W)	30
Height of substrate(h)	1.4
Length of substrate	100
Width of substrate	90

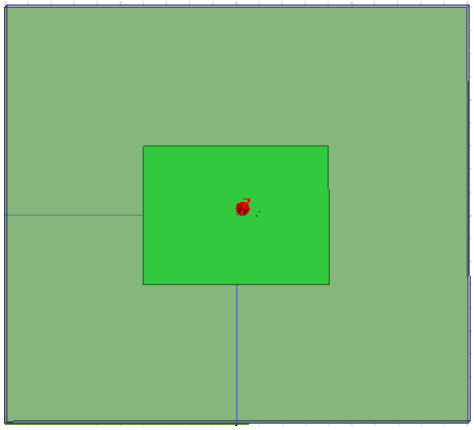


Fig.2: Basic rectangular patch antenna

Simulated results of basic antenna:

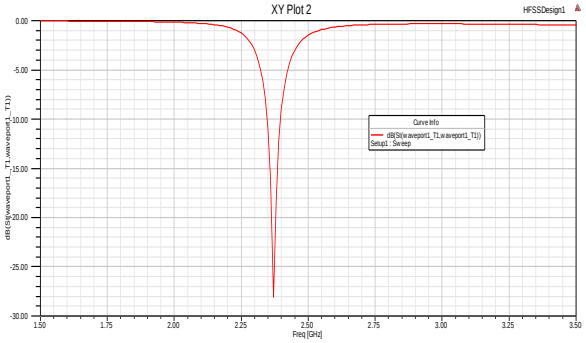


Fig.3: S11 Parameter

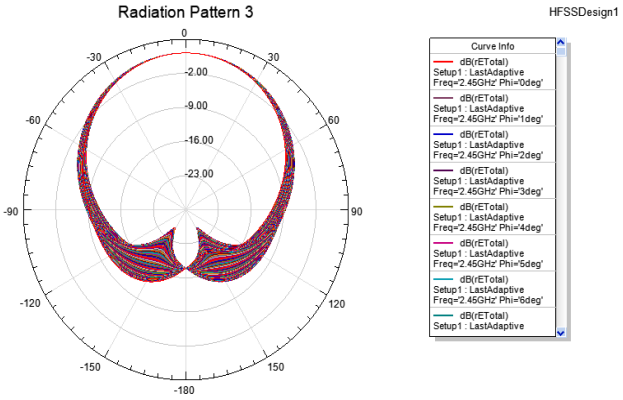


Fig.4:Radiation pattern

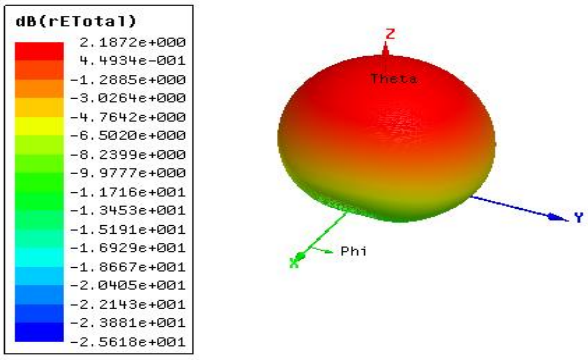


Fig.5: 3D Polar plot

VI. DESIGN OF THE CONVENTIONAL AND PROPOSED MICROSTRIP PATCH ANTENNA

The first part of this section deals with the design of a conventional microstrip patch antenna array. To improve this performance to achieve dual band behavior for its miniaturization, each patch of it is directly connected to an SRR. The design of this proposed metamaterial loaded shorted pin dual band patch antenna array is presented in the later part of this section.

The length of the quarter wave transformer and fifty ohm line is calculated as a=7.55mm, b =8.00mm also their widths are determined as c=0.5237mm and d=2.8758mm respectively.

Table 2

Dimensions of a conventional microstrip patch antenna aarray:

PARAMETERS	VALUE
Length of patch(L)	11.95mm
Width of patch(W)	15.88mm
Height of substrate(H)	1.48mm
Length of substrate	63.88mm
Width of substrate	63.88mm

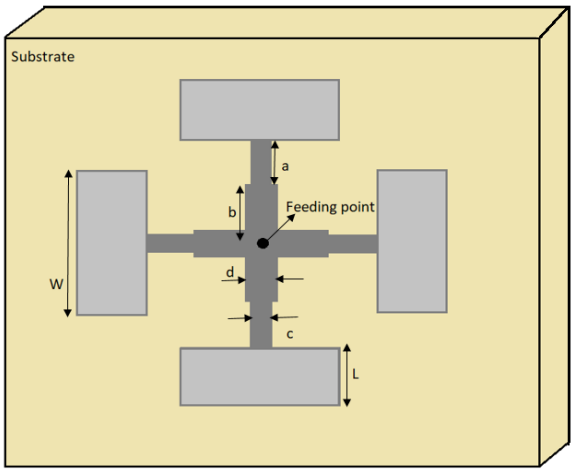


Fig.6: Conventional microstrip patch antenna array

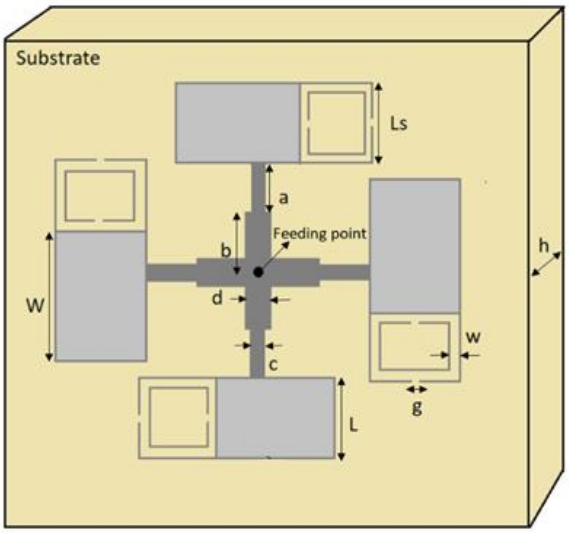


Fig.7: Conventional microstrip patch antenna array with SRR and vias.

IV. SIMULATION AND RESULTS

The three analytical parameters S11,VSWR and radiation pattern were observed and compared for both simulation results and laboratory measurements.

The return loss(S11) was simulated for proposed patch over a frequency range from(0 to 10GHz). As in figure ,

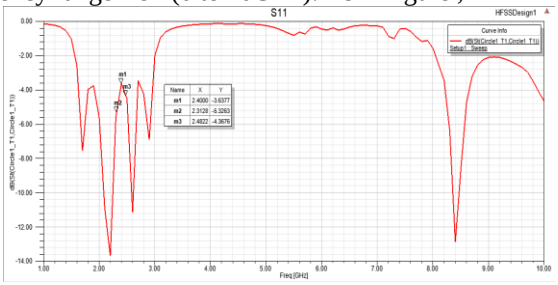


Fig.8: S11 parameter

The voltage standing wave ratio(VSWR) is a measure of how efficiently radio frequency power is transmitted from a power source ,through a transmission line into a load. The VSWR for the proposed antenna as shown in figure.5

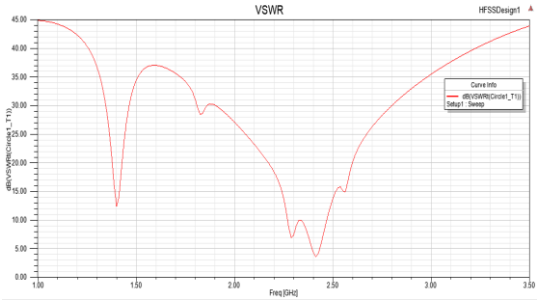


Fig.9: VSWR Measurement

V. CONCLUSION

In this paper, a novel approach of a dual band microstrip patch antenna array is designed with metamaterial and via holes to reduce the cost, size and enhancement of gain. For this, a coaxial feeding is provided to the proposed antenna array to match the impedence. The designed antenna array has been fabricated and tested to validate the design and it is observed that the simulated and measured results quite well agree with each other.

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A Novel and Efficient Low Power 8-Bit Arithmetic Logic Unit Using FS-GDI Technique

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***Abstract*— Power dissipation and area of the circuit are the main issues in the electronics industry.This paper provides a design of 8-Bit Arithmetic Logic Unit (ALU) using Full-Swing GDI and CMOS techniques.The proposed ALU design consists of 2x1 Multiplexer, 4x1 Multiplexer and low power Full Adder circuits to realize the arithmetic and logic operations. The simulation carried out using Tanner EDA Tools V13.0. The results show that the GDI design consume less power using less number of transistors, while achieving full swing operation compared to CMOS design.**

***Keywords*— Arithmetic Logic Unit (ALU); Gate Diffusion Input (GDI); Full-Swing GDI,CMOS.**

I. INTRODUCTION

We use a lot of portable electronic devices in our daily life,; which are basically low power high speed VLSI circuits. One of these circuits is the Arithmetic logic unit (ALU) which considered as an essential component in many applications such as Microprocessor, digital signal processing, image processing, etc.

ALU is used to perform both the logical and arithmetic operations.The power and area are the major problems in ALU implementation,so that we preferred low power logic design style i.e..,GDI.But in the GDI technology,output voltage swing degradation,fabrication complexity & power consumption are the disadvantages.Due to this reason Modified GDI was proposed.The Modified gate diffusion input (MOD-GDI) technology is more efficient in terms of power consumption,fabrication complexity and low output voltage swing degradation when compared to GDI technology.

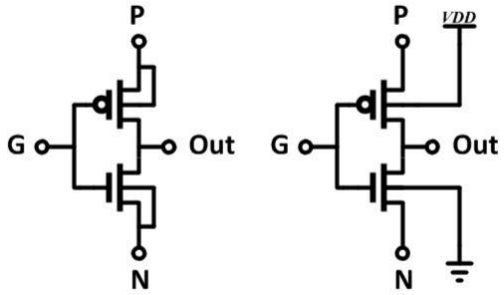
In this paper, an 8-bit alu is designed using an adder,logic block and multiplexers which are realized by the Full-Swing GDI technique and compared to CMOS work in terms of power dissipation and transistor count.

Simulations are carried out using S-EDIT,T-SPICE and W-EDIT in the Tanner EDA Tools V13.0.

This paper is organized as follows: Section II overviews the GDI methodology and presents its benefits and limitations. The circuits needed to design Arithmetic logic unit are discussed in Section III. The design of the arithmetic logic unit is discussed in Section IV.Section V presents simulation results and comparison. Section VI concludes the paper.

II. GATE DIFUSSION INPUT (GDI) TECHNIQUE

GDI Technique was first proposed by Arkadiy Morgenshtein, IdanShwartz and Alexander Fish [1] this technique allows implementation of various complex logic functions using only two transistors as listed in Table I. The original GDI was based on using a simple cell, as shown in Fig. 1(a)



(a) *(b)*

GDI cell; (a) originally proposed, (b) standard CMOS compatible

However, it was proposed for fabrication in twin-well CMOS or silicon on insulator (SOI) processes, it allowed improvement in power consumption, delay and area of digital circuits compared to CMOS and PTL techniques. The drawback in GDI cell was it suffered from reduced voltage swing due to threshold drops, which leads to performance degradation and increasing static power dissipation.

To improve the output of the GDI cells Swing restoration circuits utilized. Morgenshtein et al. [2] Proposed the Modified -GDI approach, shown in Fig. 1 (b) where the substrate terminals of NMOS and PMOS transistors connected permanently to GND and VDD, respectively. This modification enables fabrication of GDI cell in standard CMOS processes which is cost efficient compared to twin-well and (SOI) processes.

TABLE I. DIFFERENT LOGIC FUNCTIONS REALIZATION USING GDI CELL

N	P	G	OUT	Function
0	B	A	$\bar{A}B$	F1
B	1	A	$\bar{A}$+B	F2
1	B	A	A+B	OR
B	0	A	AB	AND
C	B	A	$\bar{A}$B+AC	MUX
0	1	A	$\bar{A}$	NOT

III.CIRCUITS IN ARITHMETIC LOGIC UNIT

In this section, the Full-Swing GDI technique is used to realize the circuits required to design the ALU as follows:

A. 2x1 Multiplexer

A multiplexer is a digital switch which chooses the output from several inputs based on a select signal[4]as shown in Fig. 2 .A 2x1 multiplexer consists 2 inputs and 1 selection line and 1 output.It is realized using GDI technique with 6 transistors.

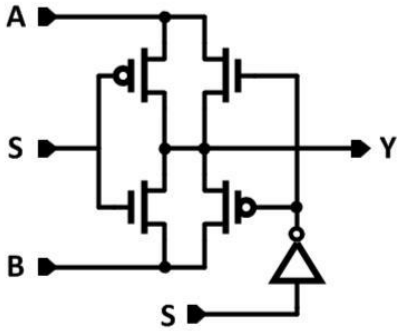


Fig. 2. Full-Swing GDI 2x1 Multiplexer

B. 4x1 Multiplexer

Using the previously discussed 2x1 multiplexer a 4x1 multiplexer realized as shown in Fig. 3.It consists only of 16 transistors.A count of 3 2x1 multiplexers are required to realize a 4x1 multiplexer.

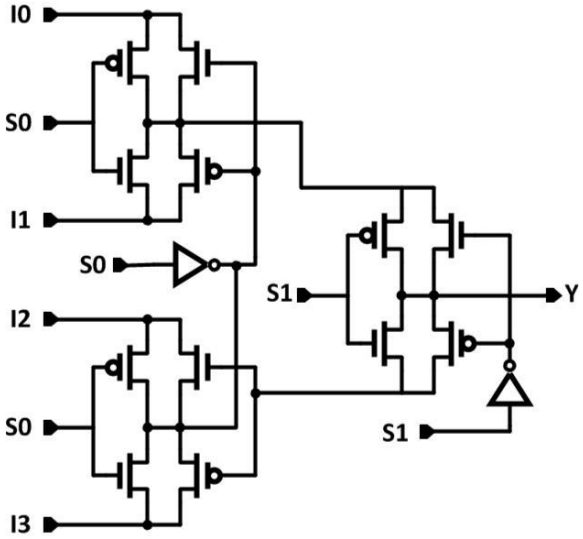


Fig. 3. Full-Swing GDI 4x1 Multiplexer

C. Full Adder

A full adder is a combinational circuit that performs the arithmetic sum of three input bits. It consists of three inputs and two outputs.

Adders are widely used in digtal VLSI systems.By improving the performance of adder cell,we can increase the performance of the ALU.Here Adder is the key component in the ALU to perform arithmetic operations.By realizing the full adder in less transistors reduces the area of the ALU.Full adder is realized using 18 transistors.

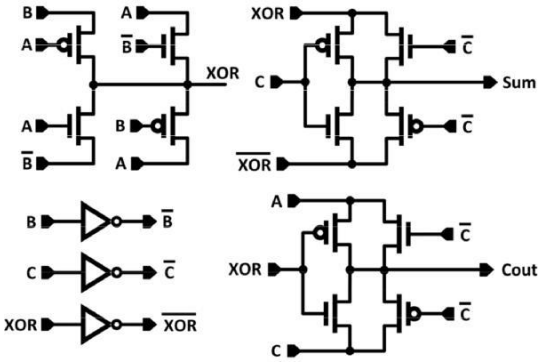
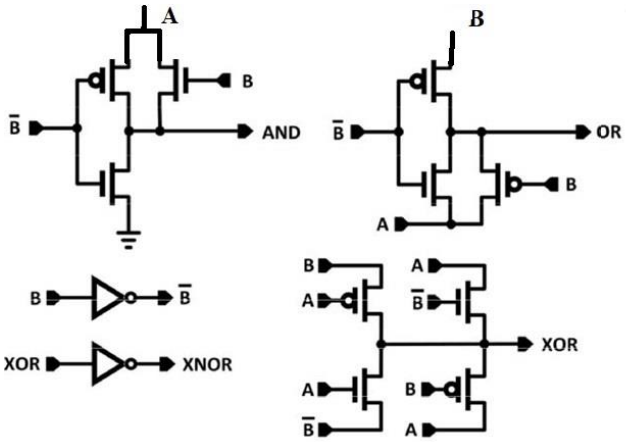


Fig. 4. Full-Swing Full Adder cell

E.Logic Block

Logic block is used to perform logical operations in the ALU.We can take these operations in the full adder cell also but,the circuit becomes complex and delay becomes high.So,we take a separate block in order to reduce the delay time .The Logic block can mainly perform 4



operations i.e..,AND,OR,XOR and XNOR.

Fig. 5.Logic block

IV. Arithmetic Logic Unit

An ALU is a key component in the Central Processing Unit (CPU) of a computer.It is a combinational circuit which performs arithmetic operations such as addition, subtraction, increment, decrement and logic operations such as AND, OR, XOR and XNOR .

The proposed design of the 8-Bit ALU consists of 2 stages, each stage is an 4-Bit ALU tand 4-bit consists 4 stages,each stage is an 1-Bit ALU realized using the previously discussed circuits as follows:

Each 1-Bit ALU stage consists of two 2x1 multiplexers, two 4x1 multiplexers and one full adder cell,one logic block and one invertor as shown in fig 6..It has a number of selection lines(S0-S2) used to determine the operation to be performed.S2 selects between Arithmetic and Logic operaton.If S2=0,Arithmetic operations are realized and If

S2=1, Logical operations are realized.S0 and S1 specify the operation.

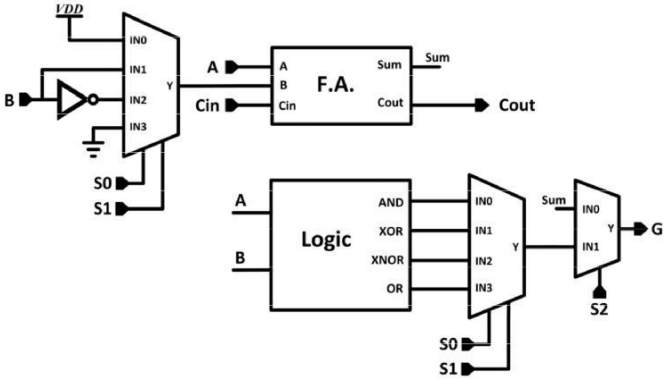


Fig. 6. Schematic of 1-Bit ALU Stage

The first 4x1 multiplexer is responsible for the B operand based on the values of S0 and S1 selection lines it selects from logic 1, B, B and logic 0 to generate the decrement,addition,subtraction and the increment operations respectively.

The output of first multiplexer is given to the operand B input of the full adder alongside with operand A and C output of the arithmetic operation is calculated form the next equation.

$$G = A + B + CIN$$

For decrement operation operand A is summed with logic 1 which represents -1 in 2's complement with C = 0, this gives G = A – 1. In addition operation operand A is summed with operand B with C = 0, this gives G = A + B. Subtraction is achieved using 2's complement operand A is summed with the complement of operand B with C = 1, this gives G = A +B+1 which is equivalent to A – B. And for increment operation operand A is summed with logic 0 with C = 1, this gives G = A + 1.

The second 4x1 multiplexer used for selection of logic operation according to S0 and S1, while the second 2x1 multiplexer used to selects between arithmetic and Logic operation. Table II summarizes the truth table of the proposed 8-Bit ALU.

The 4-bit ALU design consists of four stages of 1-bit ALU and one 2x1 Multiplexer as shown in Fig. 7.

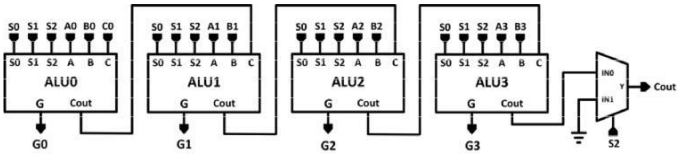


Fig. 7. Schematic of 4-Bit ALU Stage

The proposed 8-Bit ALU consists of 2 stages of 4-Bit ALU.It can perform a total of 12 operations as shown in TABLE II. Out of those,8 are Arithmetic and 4 are Logical. In Arithmetic operations,CIN plays an important role but in in logical operations,it does not needed because logical operations only depend upon both A and B inputs only.

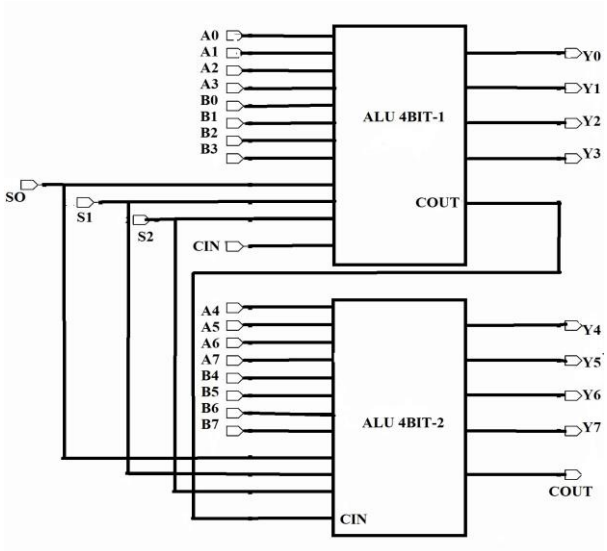


Fig. 8. Proposed 8-Bit ALU block diagram

TABLE II. TRUTH TABLE OF THE PROPOSED 8-BIT ALU

S2	S1	S0	CIN	OPERATION
0	0	0	0	DECREMENT OF A
0	0	0	1	TRANSFER OF A
0	0	1	0	A+B
0	0	1	1	A+B+CIN
0	1	0	0	A-B-CIN BAR
0	1	0	1	A-B
0	1	1	0	TRANSFER OF A
0	1	1	1	INCREMENT OF A
1	0	0	0	LOGICAL AND
1	0	1	0	LOGICAL XOR
1	1	0	0	LOGICAL XNOR
1	1	1	0	LOGICAL OR

IV. SIMULATION RESULTS

The proposed 8-Bit ALU designed using 250nm CMOS process.The simulations were done using the S-EDIT,T-SPICE and W-EDIT in Tanner EDA Tools V13.0 Using A=01111111, B=01010101 as test inputs. The proposed design compared to CMOS design in terms of power consumption and transistor count. Simulation results for the proposed 8-bit ALU are shown in Table III.

TABLE III .SIMULATION RESULTS OF THE 8-BIT ALU DESIGN

Design	Technology	No. of Transistors	Power(μW)
CMOS design	250nm	1194	4800.05.μW
GDI design	250nm	464	2100.40 μW

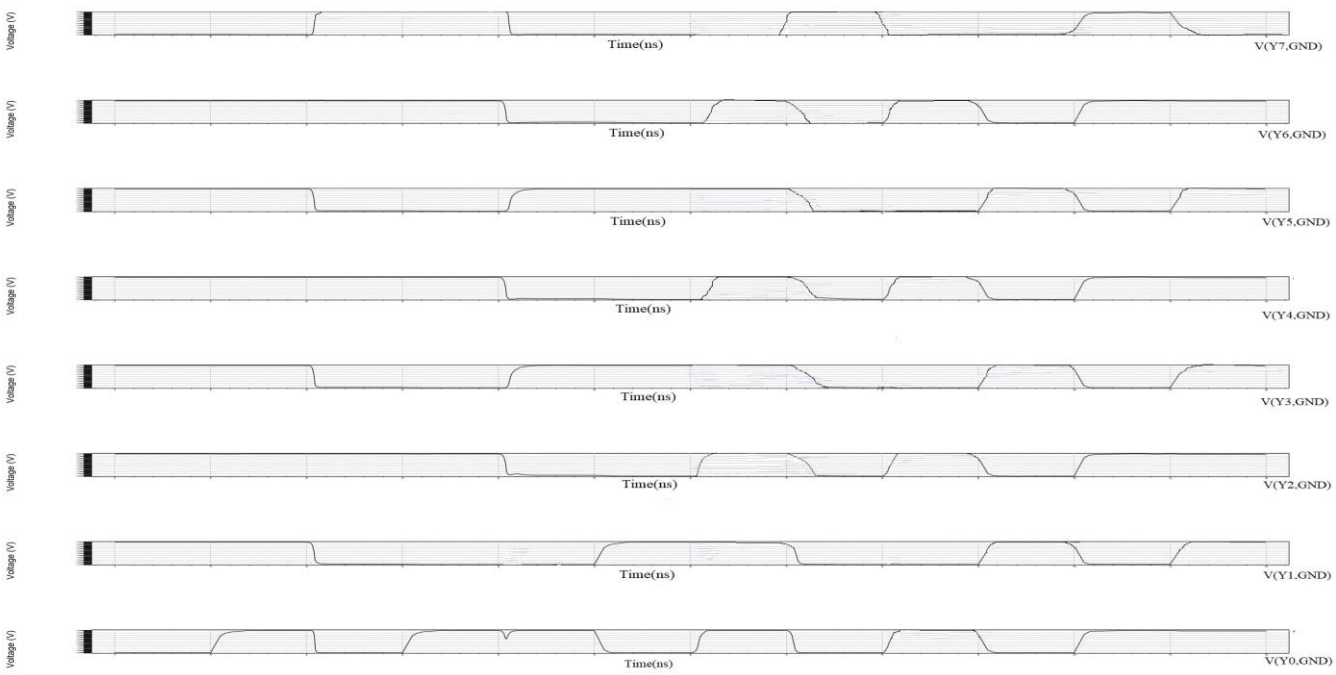


Fig. 9.The waveform of the Proposed 8-Bit ALU

The analysis and simulation indicate that the proposed ALU design technique optimized and reduced the area by 61% compared to the CMOS design, while maintaining full-swing operation and the power consumption of the 8-bit ALU is reduced by 52%.

CONCLUSION

In this paper a 8-Bit ALU is designed using the full-swing GDI technique optimized and reduced the area by 61% compared to the CMOS design, while maintaining full-swing operation. Hence the power consumption of the 8-bit ALU reduced by 52%.The proposed design consists of 464 transistors compared to CMOS 1184 transistors.Based on the results, it can be concluded that the proposed 8-bit ALU in full-swing GDI technique is suitable for low energy high - speed VLSI applications. Further study in this work would be using the 8-bit ALU as a building block to implement 16-bit and 32-bit ALU.

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Automated Identification and Rejection of Defective Ceramic tile using a Machine learning Approach

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***Abstract* — Ceramic tiles come in a wide variety of colours, textures, and sizes. The process of crack detection and rejection is very laborious, costly and time consuming and is less efficient due to harsh industrial environment and human errors.The quality control plays major role in delivering a quality tile and yet it is done manually. Manual inspection is labor intensive, costly and less efficient.Hence, some fast, efficient and reliable automated process is required to perform tile crack detection and rejection. Many methods are used viz., simple visual image analysis, infrared visionand ultrasonic characterizations. This paper proposes an automated defect detection and rejection system for ceramic tile using machine learning approach. A dataset containing 80 images with crack of different sizes and different orientations, 60 images with different textures, and 60 images without crack for training a neural network and Support vector Machine (SVM) classifiers are used. A set of 50 independent test images are used to test the results and found to be promising. A comparative study among different methods i. e Threshold based detection, neural network based and SVM based classifier is carried out. SVM classifier works faster in comparison with neural network based method. The efficiency of these methods is compared.**

Keywords—Image processing, Feature extraction, Defect detection, classifiers, neural networks.

I. INTRODUCTION

The main compounds used to make the ceramic tiles are clay and other natural materials such as sand, quartz and water. Proper mixtures of all these compounds are then pressed under very high pressure into squares, rectangles, or even ovals then these blocks are baked for particular time at controlled temperature[1].

On large scale preparation there may always be a possibility of non-uniformity. Hence, not all the tiles get the required treatment which causes the development of flaws and the type of Flaws varies depending on the factors that have been compromised. Quality control in ceramic tile manufacturing is hard, labour intensive and it is performed in a harsh industrial environment with noise, extreme temperature and humidity and inspection contains variety measurements such as colour analysis, dimension verification, and surface defect detection.In this paper an efficient defect detection technique has been proposed. The second section explains about the Literature Survey. The third section proposes robust detection of defective ceramic tiles,the fourth section describes the hardware setup. The fifth section presents the results and the sixth section presents the conclusions and future scope..

II. LITERATURE SURVEY

G.M. Atiqurrahamanet. al[1]proposed a defect detection method which uses pre-processing followed bysobel edge detection. After the edge detection method the number of white pixels of reference image and the number of white pixels of test image are counted. If the count of white pixels is greater than the reference image, a defect is detected.

Yasantha c. samrachakrawam et.al [2]proposed that after pre-processing, a canny edge detection is performed and then counted the number of white pixels of reference and test images. If the count is greater than in reference image, it will predict it as defective otherwise non-defective.

These methods fail to differentiate between the defective tiles and textured tiles and require a reference image to supplied every time, which may not be possible.

Baig et.al [3] proposes image pre-processing steps such as resizing. The RGB image is converted into a grey scale Contrast of the image is is to be enhanced and a median filter is applied to remove noise. Morphological operations like dilation and skeletenizition is done. A canny edge detector is used to identify holes (cracks).These holes are filled e. The number of these white pixels is counted and stored in variable count. If the count is greater than a threshold, a defective tile is detected.The main fault in this method is it is not possible to calculate an adaptable threshold value for all kinds of tiles. Threshold value varies for different kinds of tiles. Selection of threshold itself is a difficult problem

III. PROPOSED METHOD:

Machine learning plays a very important role in detection and classification problems. In this section two methods are proposed to detect the defective tile. They are:

1) Using SVM classifier
2) Using Neural network (feed forward probabilistic neural network)

Method 1- Using SVM Classifier

Support Vector Machine (SVM) is a classification technique. It uses a supervised learning algorithm. It is mainly used for classification problems. The steps involved in classification are as mentioned below

a) Image pre-processing*:*Image processing is a method to perform some operations on an image, in order to get an enhanced image.

b) Featureextraction:Contrast,Mean,Variance,Entropy , Homogeneity,Energy,RMS,IDM,smoothness of these are the features extracted from the image.

c) Training: The SVM classifier is trained with these 9 features for 200 images. A dataset is generated by the classifier with these inputs.
d) Testing:During testing an image is chosen from test set, same 9 features are extracted, which are fed to the SVM classifier for classification.

When this method has been tested with textured images some of the textured ceramic tile images resulted to be defective even thougl
that SVM classifier dc

S.NO	FEATURE	
1	Contrast	
2	Energy	
3	Entropy	$\sum_{i,j=0}^{N-} p(i,j)^2 \log p(i,j)$
4	Homogenity	$\sum_{i,j=0}^{N-1} \frac{p(i,j)}{1+(i-j)^2}$
5	IDM	$\sum_{i,j=0}^{N-1} \frac{p(i,j)}{1+(i-j)^2}$
6	Mean	$\frac{\sum_{i-0}^{l-1}(i,j)*p(i,j)}{\sum_{i=0}^{l-1}(xi*p(xi))}$
7	Variance	$\sum_{i,j=0}^{l-1} p(i,j)*(i-\mu i)^2$
8	RMS	$\sqrt{\frac{1}{T}\int_{t0}^{t0-T} v(t)^2 dt}$

Table.1 Statistical Features

Method 2- Using Neural networks

A feed forward perceptron neural network is used for classification. Various steps involved are as described

a) Image pre-processing: Image Pre-processing is a method to perform some operations on an image, in order to get an enhanced image.
b) Featureextraction:Statistical features like Contrast,Mean,Variance,Entropy, Homogeneity,Energy,RMS,IDM,smoothness are being extracted from the image.
c) Training: The Neural network (NN) classifier is trained with these nine features for 200 images.
d) Testing: A random image from test set is picked up, all the nine features are extracted and fed as input to neural-network classifier for classification

METHODOLOGY:

Data-set plays an important role in efficiency of a neural network. A dataset of 200 images consisting of cracked,textured and plain images has been collected. The process is explained with the help of a block diagram has been shown in Fig.1.

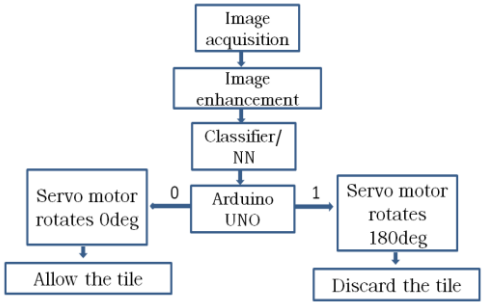


Figure 1: system block diagram

The flow of process for training is as shown below.

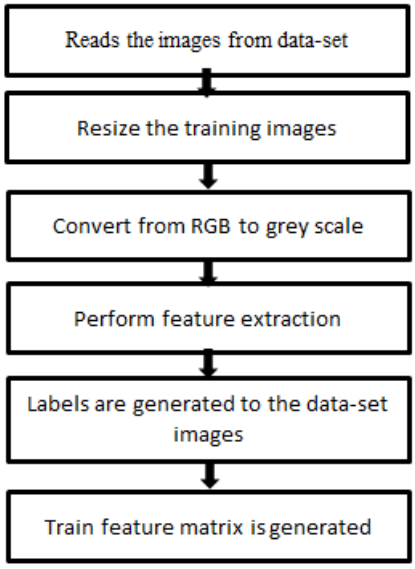


Figure: 2 SVM classifier flowchart

As in fig. 2, the images from dataset are resized after reading. Resizing means the scaling down of the image. Due to this the execution is reduced considerably. Images are converted from RGB to grey scale. This is important because calculation of features becomes simpler for grey scale values compared to RGB because of its complexity. The next step is to extract the features. Here statistical features are extracted to train neural network with the characteristics of tile images. Contrast, mean, variance, RMS, IDM, smoothness, homogeneity, entropy and energy are calculated for every image. The mathematical reference to these features is given in table 1. A matrix of size 9x200

is created to store 9 features of 200 images. This matrix is used as the data by neural network during its testing. During training of the neural network the images in dataset are allotted with a label, i. e, images from 1-70 (defective ceramic tile images) are labeled as 1 and the rest (non-defective) as 2.

A) Testing phase:

The flow of process for testing is as shown below.

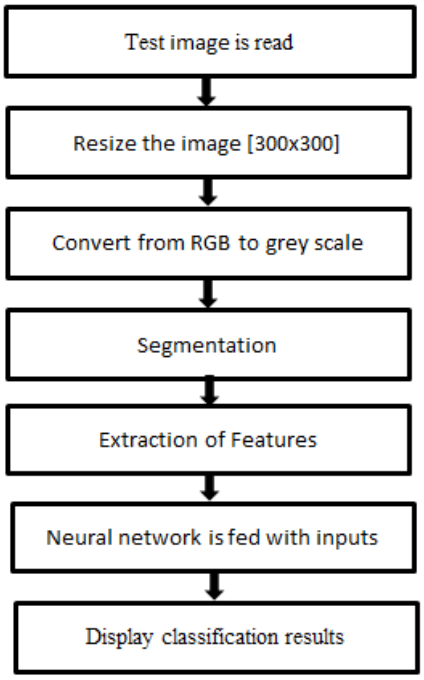


Figure: 3 Neural Network classifier flowchart

As shown in fig. 2, the image that is to be tested is read and resized to same size as the training images are sized to. RGB image is converted into grey scale as features have to be extracted here also. To increase the efficiency of the system, pre-processing operations are done during testing. Contrast stretching is done to improve an image by stretching the range of intensity values it contains to make full use of possible values. This image is passed through a median filter; it is used to remove noise from images. This preserves the edges and removes the noise from image. Canny edge detector is used on image to detect the cracks on a test image. This is done by identifying the discontinuities in the image. Next, image is skeletonized, Skeletonization is the process for reducing the fore-ground regions in a binary image. After pre-processing operations are done same features as of training are extracted. These features again form a matrix of order 1/9. The two matrices generated are fed to neural network and a result is obtained.

IV. RESULTS

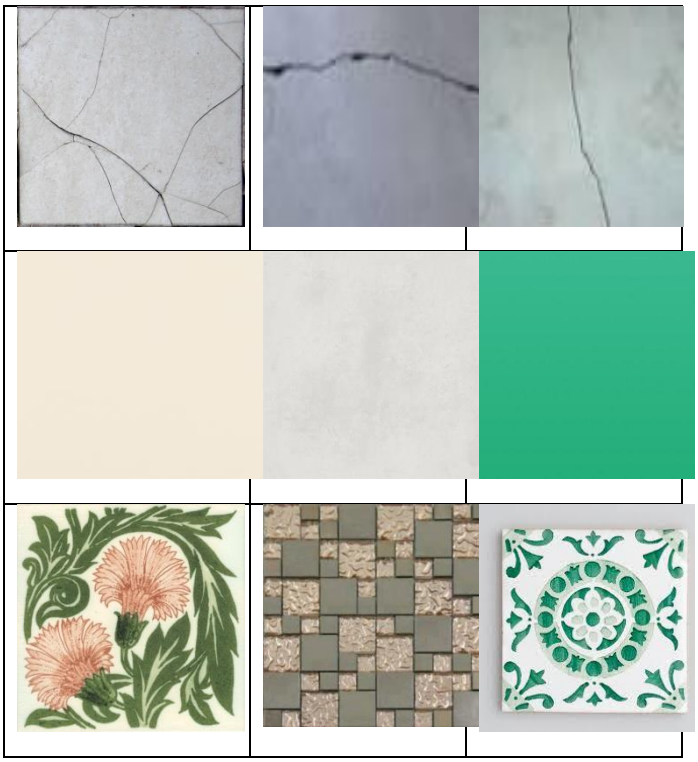


Figure: 4 Training Sample



Figure: 5 Testing Sample

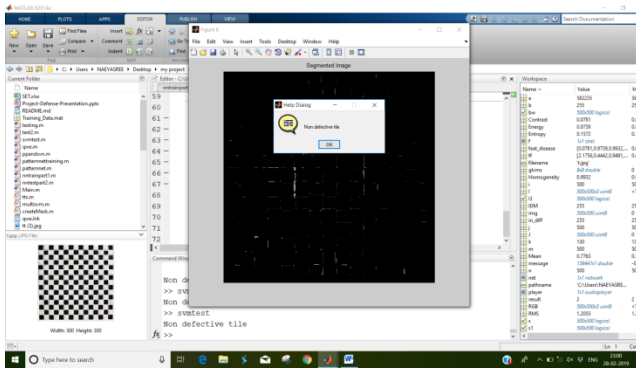


Figure: 6 SVM result

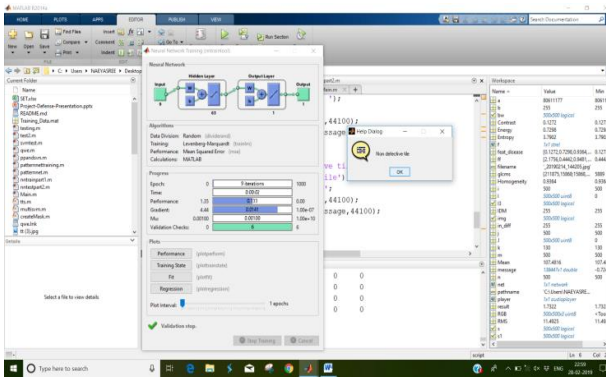


Figure: 7NN result

COMPARISION

A confusion matrix is drawn to analyze the performance of the classifiers. The accuracy is calculated.

$$Accuracy = \frac{TP+TN}{TP+TN+FP+FN} * 100$$

Recall is the ratio between the total number of correctly classified positive inputs to total number of positive inputs.

$$\text{Recall} = \frac{TP}{TP+FN}$$

Precision is the ration between the total number of correctly classified positive inputs to total number of predicted positive inputs.

$$\text{Precision} = \frac{TP}{TP+FP}$$

classifiers	Accuracy	Recall	Precision
SVM	89%	0.89	0.89
NN	95%	0.95	0.95

Table: 2 performance chart

HARDWARE:

The hardware is used to capture the test image and also to reject/allow the tested tile. The image is chosen while testing the ceramic tile. A servo motor is connected via arduino to a computer. When result is 0(non-defective tile) the servo stands still and allows the tile to move forward and when the result is 1(defective tile) the tile is rejected by rotating servo by 180 degrees.

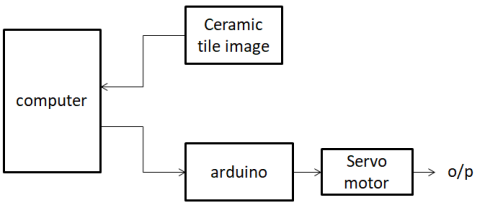


Figure: 7 Hardware setup

The time taken for the complete process to be done is 8seconds. MATLAB software is used to interface hardware to software programme.

s.no	components	specifications
1	Arduino	UNO
2	Servo motor	MG995

Table: 3 Hardware specifications

V. CONCLUSION AND FUTURE WORK :

In conclusion, this system has fulfilled the main aim of detecting a defective ceramic tile. The main aim was achieved by this automated inspection system for ceramic tile industry solving drawbacks of the existing methods. Further enhanced accuracy and efficiency, ability to detect surface defections such as middle cracks, edge damages and corner damages are achieved significantly.

As a continuation to this work, it is recommended to categorize the defects. This system can just segregate between defective and non defective but as an enhancement the number of categorizations can be increased. Categories like middle cracked tiles, edge defected tile, tiles consisting of blobs etc can be done.

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SEGMENTATION OF INDIAN ROAD SIGNS USING MATLAB

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Abstract-Driving in unknown roads and terrains is a difficult task. Traffic signs play a vital role in warning and guiding the driver towards a safe journey. The traffic signs which are located at predefined positions on the road guide the drivers and warn them of possible complexities. But the fatigue of the driver may lead to miss some of the signs which may cause accidents to occur. The various environmental conditions like haze, fog, poor light, rain, mist, occlusions, speed of the vehicle will make the detection of traffic signs a very difficult task for a normal observer. The driver assistance system located on board in the vehicle will monitor the traffic signs and alert the driver about the environment ahead and help in preventing possible accidents.On Indian Roads, the main focus of the driver is on the current traffic, while focussing on traffic there might be a chance of ignoring the traffic signs, which can lead to accidents if not been careful.Traffic Sign recognition system is a part of driving assistance system that automatically alerts and informs the driver of the traffic sign ahead.

Keywords-*Driver assistance system; traffic sign detection; lucy-richrardson algorithm; median filter*.

I. INTRODUCTION

Driverless cars are becoming more popular and common in near future because of advancements in Artificial Intelligence, Machine learning, deep learning etc.,. Intelligent transport systems play a vital role in saving the life of pedestrians and also minimising damage due to accidents [1-3]. These systems widely depend on smart sensors, Geographical Information systems (GIS), Global Positioning Systems (GPS) etc. The driver assistance systems onboard should be robust and should work in real time[4].

In this paper we implement a robust Indian traffic sign recognition system using MATLAB. A high resolution camera mounted on the vehicle captures the road scene ahead and sends it to the processor on board. The processor processes the information and alerts the driver with the sign information. Indian road traffic signs are designed such that they are easily detectable and recognizable. Indian traffic signs are 92 in total which may be divided mainly into four types, viz warning signs(40), compulsory signs(27), regulatory(10) and informatory signs (15). There are mainly two distinguishable phases for automatic traffic sign recognition system. First is the detection phase and the second is recognition phase. In the detection phase system searches the image for road sign. Detection algorithms are based on colour or shape or both for segmentation we use

colour segmentation in YCbCr colour space. Afterobtaining a frame with possible traffic sign it is pre processed for removal of atmospheric noise and de-blurred. It is further converted to gray scale, segmented it using threshold based segmentation, Morphological operations are performed to remove unwanted portions of

the image and highlighted the image with the sign information which is extracted using a bounding box and

the information is presented to the driver on the onboard display unit.

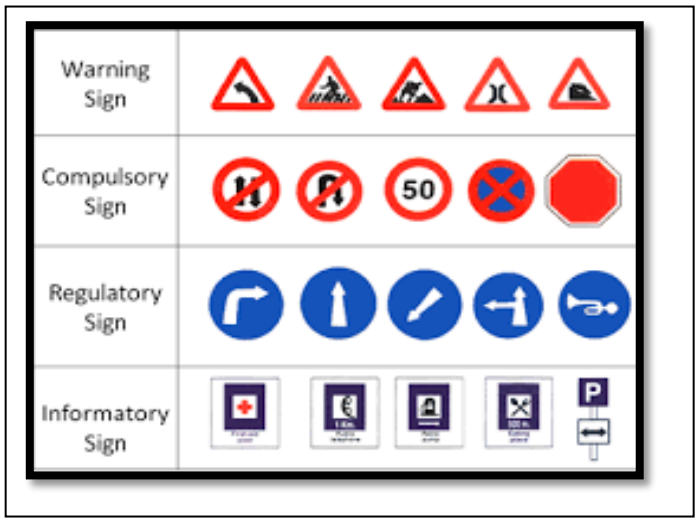


Fig. 1:Various classes of Traffic Signs

In section II a study about the characteristics of traffic signs have been done. Then, in Section III, we outline the methodology used, which includes detection and recognition of the signs from videos. In Section IV, we describe the experimental results to illustrate the performance of the system. Finally, conclusions are drawn in Section V.

II. CHARACTERISTICS OF ROAD SIGNS

Traffic signs have been designed so that they are easily recognisable from natural and driving environment. The colour for traffic sign is chosen such that, it serves different purposes and is also distinguishable for the driver while driving[5-6]. The signs are represented by fixed shapes like triangle, circle, octagon, and rectangle. The combined feature of colour and shape are used by driver to distinguish a traffic sign. Hence an automated system also uses the same principle of 'the colour and shape property of traffic signs'. With respect to the road the traffic signs are located at well-defined locations so that the drivers can more or less expect the position of the sign. The road sign may contain text as a string of characters or pictogram or both to represent the meaning of the sign. They are characterised by using fixed text fonts and character heights.

There are a number of traffic signs in India categorized as warning (40), compulsory (27), regulatory (10) and informatory (15). This makes a total of 92 traffic signs all together. These signs are mainly characterized by colour and shape. Figure 1 shows the different

types of Indian traffic sign and their description are discussed below.

A. *Warning Sign*: A triangle with red coloured border and white background represents a warning sign. Different pictograms in black are used to represent the various warnings. These signs alert the driver with hazards ahead.

B. *Compulsory Sign*: Compulsory signs uses circle with red border and white background. These signs restrict the action of drivers depending on the pictogram represented on the sign. Signs with a cross prohibit the driver from certain decision such as no left turn or no 'U' turn etc. Speed limit signs are also included in this category of traffic signs, with speed limit as the pictogram. Another exception is octagon with red background with STOP in white and blue circle with red border and cross represents 'no parking sign'.

C. *Regulatory Sign*: They are mandatory sign to control the action of the drivers on road. They are used to regulate the traffic flow and vehicles moving on road. Blue circle with white border represents a regulatory sign. While the arrows within it represent the movement of the vehicle on road.

D. *Information Sign*: Important information like nearby hospitals, telephone booth, first aid, petrol pumps etc. come under this category. This information helps the driver in emergency in need. White rectangle with thick blue border and the necessary pictogram represents the required pictogram. Parking information is also included in this category.

III. METHODOLOGY

A block diagram of the proposed system for the detection of the traffic signs is as shown below.

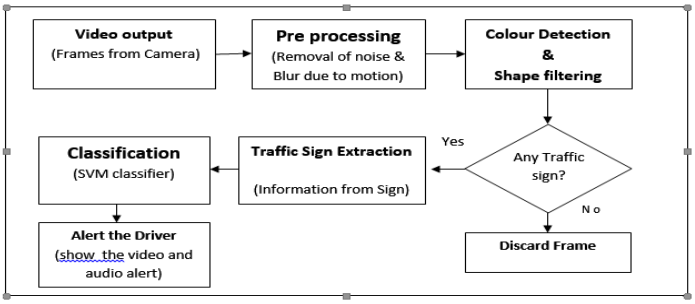


Fig .2: Block diagram of the proposed system

The on board camera acquires the video scene for the traffic ahead which is divided into frames and fed to on board processor for further processing. The frame acquired is contaminated by acquisition noise (Gaussian), the frame may be disoriented, damaged faded or occluded and may suffer with blur because of different environmental and speed of the vehicle. This frame is fed to pre-processing stage to remove the effects of environment. A median filtering is performed to remove the noise and wiener filtering is performed to remove the blur. The weiner filter being a linear filter and the blur being non linear, it is not effective. A lucy-richardson filter (non linear) is applied on the image and the results are promising. A comparative study is as shown below.

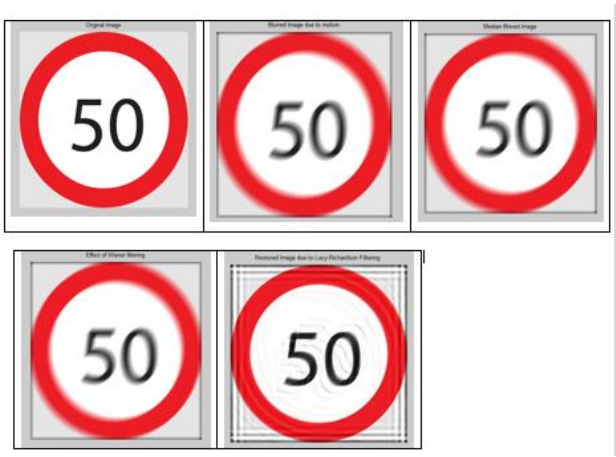


Fig. 3:Effect of median, weiner and Lucy- Richardson filters on the speed limit sign Image

Since the colours to be detected in the traffic signs are mostly red, black, blue and white, A YCbCr plane is very suitable for processing the images. The Y component(luma) represents brightness, while Cb (Blue Chroma) component represents how close the colour of the pixel is to blue and the Cr (Red Chroma) component represents how close the colour of the pixel is to red. In the colour detection and shape filtering the image is converted to binary image using otstu thresholding. Then the image is subjected to morphological operations and removed all objects containing less than 30 pixels using bwareaopen. The result is further processed using bwlabel that is the connected components using 8 connected components and region props operation in MATLAB. A bounding box is drawn and the objects are extracted. The extracted objects are displayed on the video screen. A multiclass SVM classifier is used to classify the extracted symbols and an audio output is played corresponding to the extraction

IV. EXPERIMENTAL RESULTS

The driver assistance system is fed with a plane consisting of a speed limit symbol which is corrupted with motion blur and which is removed by Lucy- Richardson filter which is further converted to a gray scale image and then converted to a binary image using otsu thresholding. Morphological filling is applied to any area lesser than 30 pixels. A bounding box is drawn on the remaining clean binary image is applied to the traffic sign extractor and finally fed to the svm classifier to identify the correct symbol

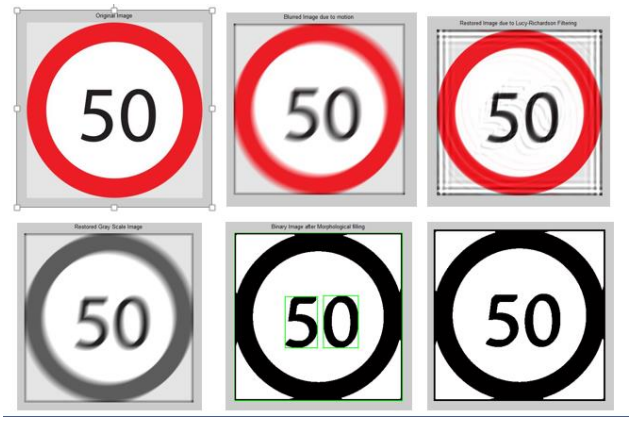


Fig. 4: Experimental Results

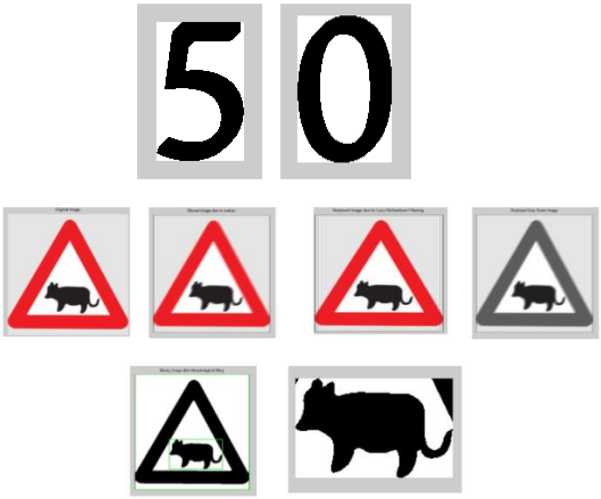


Fig. 5: Sample Segmented outputs

V. CONCLUSIONS AND FUTURE SCOPE

Traffic sign detection based on color and shape is presented in this work. YCbCrcolor space is used for color segmentation to overcome the illumination sensitive characteristic of RGB space. The corrupted frame is preprocessed and nullified atmospheric and other noises using lucy-richardson filtering. The otsuthresholdedimage is applied with morphological operations removing unwanted areas. 8 connected component analysis is performed to identify the potential symbols and they are extracted and a multi class SVM classifier is used to classify the symbols.

The recognition rate can be improved further by increasing training data or by going for neural network classifier or deep learning classifier. Deep learning classifier demands for more training data. Transfer learning can be applied to reduce the data requirements for training and improve the overall accuracy of the system

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Smart Parking Reservation System using IOT

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Abstract **-** Internet of Things (IOT) plays a vital role in connecting the surrounding environmental things to the network and made easy to access the things from any remote location. It's inevitable for the people to update with the growing technology. And generally, people are facing problems on parking vehicles in parking slots in a city. In this paper we designed a Smart Parking Reservation System which gives availability of parking slots in that respective parking area with the help of Mobile app and it mainly focuses on reducing the time in finding the parking slots and also it avoids the unnecessary travelling through filled parking slots in a parking area by making use of sensor which continuously detects the parking slots and with the help of android app user comes to know the status of the parking area. Thus it reduces the fuel consumption which is eco-friendly and in turn reduces carbon footprints in an atmosphere.

Keywords **-** Smart Parking, IR Sensors, Wi-Fi Module, LCD display, Internet of Things (IOT), Android Mobile**.**

I. INTRODUCTION

Finding a parking slot to park their vehicle has ended up being a disappointing issue to the drivers all the time. It has saved the way for traffic congestion which has turned out to be an alarming problem on a global scale. Also, it has been found that it has led to the burning of world's oil over a million. According to a report, Smart Parking system could benefit in saving 2,20,000 gallons of gas till 2030 and 3,00,000 gallons of gas by 2050 , if it is executed perfectly. In order to alleviate this condition, many smart parking facilities evolved but failed to bring relief to all. They could only give the parking information but didn't prove to "smart" enough. For example, if they could publish the vacant parking slots many drivers rush to fill the limited spaces. So, we have tried to address these issues in this paper. Here, we propose an idea to realize Smart Parking structure in perspective of reservation using Internet of Things (IOT).

Real Objects + Internet + Sensors and Controllers = Internet of Things

Internet of Things plays a vital role in the creation of Smart Cities. The most important factors for the emergence of smart cities are cozy parking facilities and efficient transportation and management. According to the latest report made by The International Parking Institute, we found that many innovative parking ideas have been developed. They were able to deliver the parking information about the vacant parking lots. These systems used effective sensors in the parking areas and by tracking information from various sources and also deployed active data processing units. Here our proposed idea could be implemented using a mobile application so the drivers could get their parking information and reserve the vacant spaces of their wish as per their vehicle's width via Wi-Fi or Internet because today almost everyone can possess a smart phone with them.

II. LITERATURE REVIEW

[1] Smart Parking System using optic Wireless Sensor Network - This system experienced the use of video cameras where they are deployed in the parking slots and are able to capture the license plate of the car and also monitor the parking spaces.

Advantages:

1. They are cost-efficient.
2. Optic WSNs are easy to maintain and to install.

Disadvantages:

1. They are not much powerful as there is a high chance of failure in the device.
2. Accuracy of the license plate detection is quite impossible.

[2] Smart parking reservation system using Bluetooth and Zigbee sensors -This system uses a Bluetooth communication technique which is used for verifying the driver's identity and also to book a slot by identifying the vacant spaces. Zigbee sensors are used to detect the vehicle.

Advantages:

1. Internet usage is not necessary.
2. It is a decentralized system.

Disadvantages:

1. Range of Bluetooth is limited.
2. Installation and maintenance is difficult.
3. Connection gets disconnected if the driver is inactive and again a new slot has to be booked.

[3] Smart Parking System using RFID - This system uses RFID to match the vehicle's unique RFID tag with the value in the database when it is read by the RFID reader in the parking lot entrance.

Advantages:

1. This is a fast method of identification and quite cost efficient.

Disadvantages:

1. If the RFID tags are damaged or more than one tags are read at a time, the system fails to work accurately.

III. SYSTEM ARCHITECTURE

Basic components need for the smart parking with reservation system is:

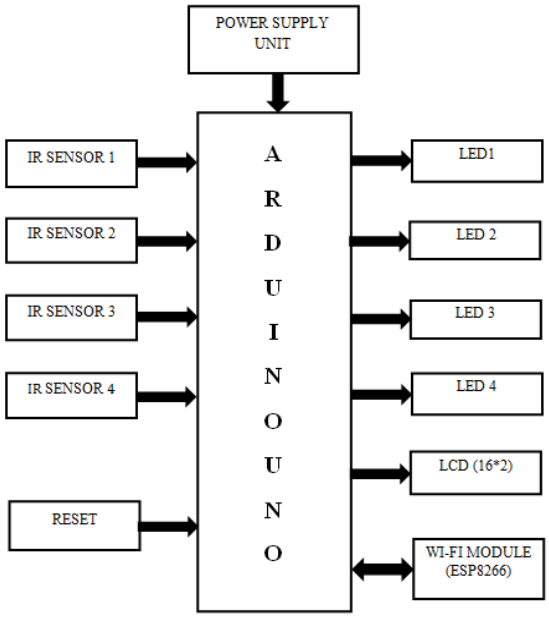


Figure 1: Block diagram.

A. Arduino UNO - A microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started.

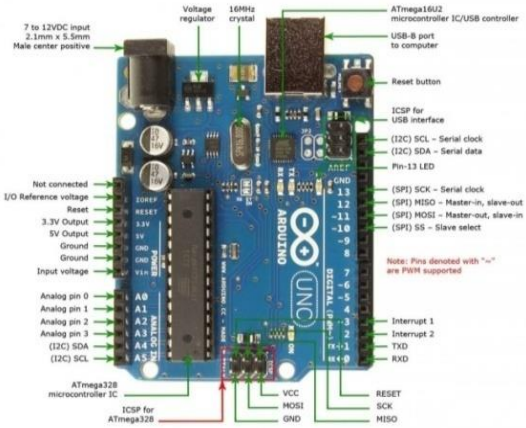


Figure 2: Arduino UNO

B. Sensor - The Infra Red photoelectric reflective module, with a range of 0.02 to 0.4 meters was used. It requires 5Volts and less than 2mA of current the required power is provided by the raspberry pi board. The output goes low in the presence of an obstacle.



Figure 3: IR sensor

C. LCD Display - A Liquid Crystal Display is a thin, flat plate used for electronically displaying information such as text. In the Proposed System LCD shows the condition of parking slot whether the slot is booked or vacant.

D. Wi-Fi Module (ESP8266) - The ESP8266 Wi-Fi Module is a self contained SOC with integrated TCP/IP protocol stack that can give any microcontroller access to your Wi-Fi network. The ESP8266 is capable of either hosting an application or offloading all Wi-Fi networking functions from another application processor.

E. SPRS (Smart Parking Reservation System) Architecture - The system architecture for the smart parking with reservation system has major components:

i). **User App** performs four operations searching, checking availability, reservation and cancelation. User interface of the app is easy to use.

ii). **Parking Slots:** In the parking slots, all sensors are kept in the individual lot were that gives the appropriate data to the Arduino Uno. Arduino uploads the data to the cloud.

IV. IMPLEMENTATION AND WORKING

We here explain the real time working of the system with the help of a flowchart as given in Figure 4.

We had implemented the system using a toy car and android app, but this system could be implemented in malls and multi storied buildings. Below are the steps involved in booking a slot in our parking system

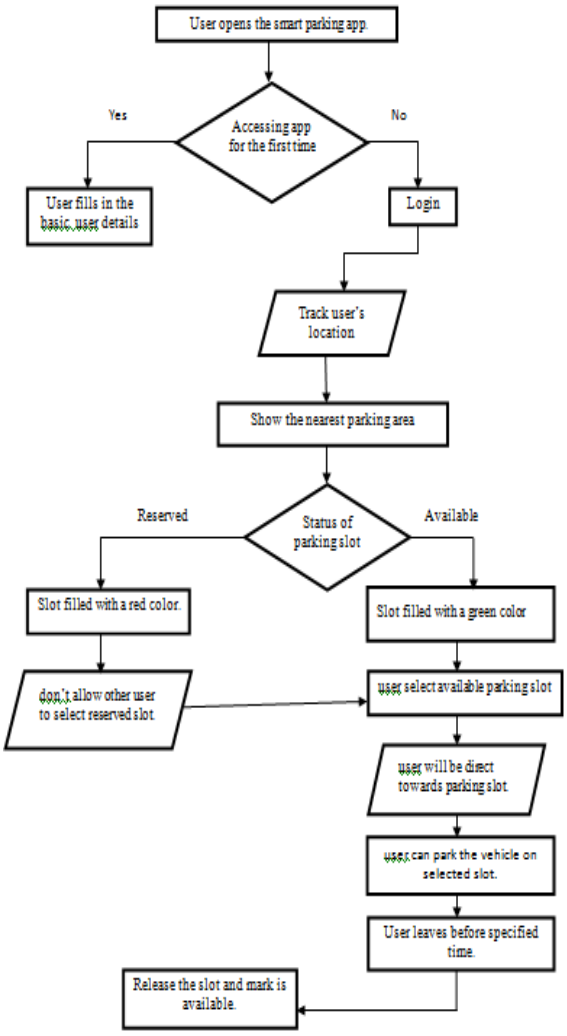


Figure 4: Flow Chart of the System

Step 1: Install the android app in the mobile.

Step 2: Register the app using the credentials.

Step 3: Login to the system.

Step 4: The parking map displays the free slots in the parking area.

Step 5: If the user wishes to reserve a slot in the parking area then click on book option to reserve the parking slot.

Step 6: Status of the reserved area notified via LED lights in parking area.

Step 7: Once the car is parked and then taken off from the parking slot, the parking charges are deducted.

Step 8: If user wants to cancel the reservation, user can just give the cancellation request in the mobile app.

V. RESULT ANALYSIS

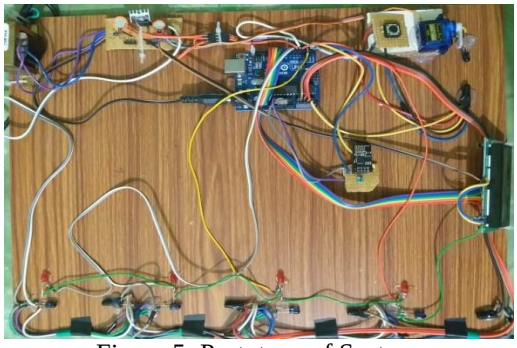


Figure 5: Prototype of System

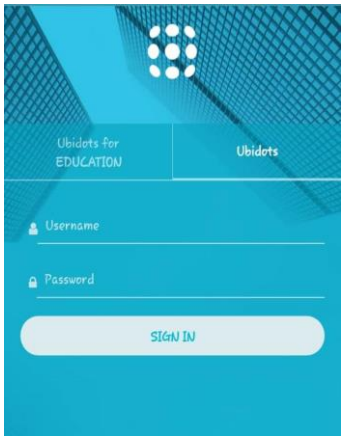


Figure 6: Login of User

User has to login with a specific details as shown in the android app.



Figure 7: To book the slot in Mobile App.

If the slot is booked it indicates the full or it indicates the Vacant in the mobile app.
In the above figure it indicates booking of slot 1 in the parking area.



Figure 8: Identification of the available Parking Slot.

Red color indicates the parking slot is not available.
Green color indicates the parking area is available to Book.



Figure 9: Indication of Parking Slot on the Display

B indicates parking slot is Booked.
Y indicates parking slot is Vacant.

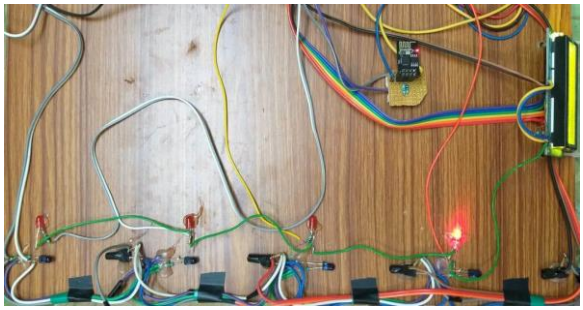


Figure 10: LED at the Parking Area

LED indicates the Status of the parking slot in the parking Area.



Figure 11: Indication of No vacancy on Display.

If all the parking slots are filled, then it indicates the "No Vacancy, All Slots Are Full" on the Display at the Parking Area.

VI. CONCLUSION

An IOT based smart parking solution has been described in this paper. The world moves towards smart cities, such a parking solution is the need of the hour. This work focuses on a parking system with prior reservation to overcome waiting in the queue. This prototype is developed using IR sensor, Arduino, mobile app, thus by using this prototype the average waiting time for vehicle parking becomes minimal. Smart parking with reservation system increases the revenue for service providers, provides service differentiation for users with different needs, eliminates traffic congestion pertaining for parking.

VII. FUTURE SCOPE

The sensors used to detect the vehicle are the essential components. Here, we have employed Arduino which seemed to be cost efficient with easy installation and maintenance. In future we would develop application for OS and also with virtual reality and test its workability in a real time environment. We infer that our future work would facilitate parking issues and decrease traffic congestion and pollution created by the search for parking.

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Design of Rectangular Patch Array Antennas for Future 5G LTE Applications

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Abstract- The main aim of this paper is to design and simulation of rectangular patch antenna arrays with micro strip and coaxial feeding techniques and generate resonant frequency at 28GHz for future 5G applications. Here our objective is to design a four element antenna array i.e. 4*1 and 2*2 array with large bandwidth i.e. higher than 1GHz and with maximum radiation gain and less return losses. These antenna arrays are designed over a Rogers RT/Duroid 5880 substrate with dielectric constant 2.2, thickness of 0.508 and loss tangent of 0.0009.The optimum design parameters of the antenna arrays are chose to get the compact design and also best possible characteristics such as large bandwidth ,high gain, low return losses. The simulation results shows that 2*2 antenna array fed by coaxial line is better than 4*1 antenna array fed by micro strip line. Gain of 2*2 and 4*1 antenna array is 12.56db and 10.81db.bandwidth of 2*2 and 4*1 antenna array is 0.9GHz and 1GHz.Return losses of 2*2 and 4*1 antenna array is -49.56db and -12.52db.

Keywords- patch antenna, micro strip line feed, coaxial feed, 5G.

I. INTRODUCTION

The standardization of 5G is being developed with a first deployment planned for the moment in 2020.4G cannot meet current requirements such as congestion or the reduction of energy consumption. That is why the world is focuses on 5G.
The 5G which will probably still see a large increase in data volumes exchanged .And it uses a millimeter bands. Millimeter band is a band of spectrum from 26GHz to 300GHz.It is also known as extremely high frequency (EHF) or veryhigh frequency(VHF).It is a undeveloped band of spectrum that can be used in a broad range of products services like high speed, point to point WLANS etc. In 5G the allocation of data rate is up to 10Gbps.As it uses low propagation capacity with implementation of small cell radio transmitter. It is used to identify several trends of 5G specifications.
The improvement of data speed and also latency can be increased by using 5G.The specifications of 5G should have to work in real time such as autonomous vehicles, remote surgery and IoT applications like MIMO structures, smart cities, smart grids, telemedicine and machine to machine communication.

Now-a-days the wireless technology is rapidly expanding due to the number of users increased in terms of internet usage. Modern wireless communication system should require low profile, high gain and simple structure antennas. Normally the micro strip patch antenna can combined all these requirements to the simplicity and compatibility with PCB technology .The specification of micro strip patch antenna are the multiband properties.
The antenna achieves nearly omni directional pattern. It has numerous advantages for these reasons many students have been made to improve the performance of antenna patch. By using multiple number of slots in ground plane has enhanced the bandwidth. another way to improve the bandwidth efficiency of patch antenna is to reduce the dielectric constant of the substrate. The return losses can be reduced by decreasing the thickness of the substrate.

II. PATCH ANTENNA THEORY AND DESIGN:

Here we design microstrip patch antenna fed by microstrip line feed and co-axial feed.fig1 shows basic structure of microstrip patch antenna.In this radiating patch,dielectric substrate and ground plane are present.

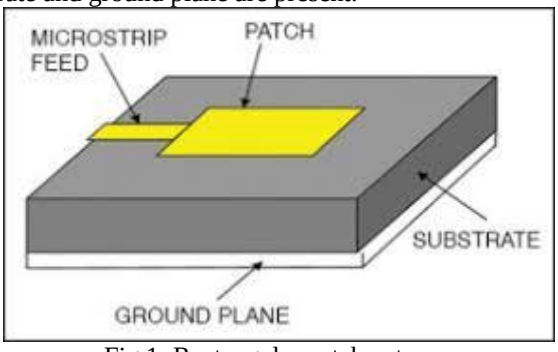


Fig.1: Rectangular patch antenna

DESIGNING EQUATIONS:

W= $\frac{c}{2f_0\sqrt{\frac{\varepsilon_r+1}{2}}}$

$$L = L_{eff} - 2\Delta L$$

$$L_{eff} = \frac{c}{2f_0\sqrt{\varepsilon_{eff}}}$$

$$\varepsilon_{eff} = \frac{\varepsilon_r + 1}{2} + \frac{\varepsilon_r - 1}{2}\left[1 + \frac{12}{W}\right]^{-1/2}$$

$$\Delta L = 0.412\square \frac{(\varepsilon_{eff+}0.3)\left(\frac{W}{\square}+0.264\right)}{(\varepsilon_{eff}-0.258)\left(\frac{W}{\square}+0.8\right)}$$

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$$\Delta L = 0.412\square \frac{(\varepsilon_{eff+}0.3)\left(\frac{W}{\square}+0.264\right)}{(\varepsilon_{eff}-0.258)\left(\frac{W}{\square}+0.8\right)}$$

$$L_{sub} = 6\square + L$$

$$W_{sub} = 6\square + W$$

Where W is the width of the antenna and L is the length of the antenna

f_0 is the resonant frequency of the antenna

ε_r is the dielectric constant of the substrate

ε_{eff} is the effective dielectric constant .We must be calculated effective dielectric constant because the radiation done through the air and dielectric substrate. The dielectric constant of the air and substrate are different

Where 'h' is the substrate thickness.

L_{eff} is the effective length of the patch..We must calculate effective length because the radiation done through the width of the patch.So, the length of the patch changes.

where L_{sub} is the length of the substrate.

W_{sub} is the width of the substrste.

III. DESIGN OF ANTENNA

In the designing of antenna we use Rogers RT/Duroid 5880 as substrate with a dielectric constant 2.2 and a loss of tangent 0.0009.This substrate has low dielectrictic loss tangent.Due tothis we can enhance the antenna gain and maximum radiation can be improved.

TABLE 1: THEORITICAL DIMENSIONS OF RECTANGULAR PATCH ANTENNA.

parameter	value
h(mm)	0.508
W(mm)	4.23
L(mm)	3.28
ΔL	0.26
ε_{eff}	1.98
L_{sub}	6.3
W_{sub}	7.28

In the microstrip line feed to achieve 50 impedance,we should calculate W_f(line width).This parameter depends on the thickness of the substrate,whereas in the co-axial feed we should calculate inner conductor radius(r_{in}) and outer the conductor radius(r_{out}) to achieve the characteristic impedance 50Ω.

TABLE 2:FEEDING PARAMETERS:

parameter	h(mm)	r_{in}	(r_{out}	W_f
value	0.508	0.51	1.173	1.62

IV. SIMULATION RESULTS

Here we will show the simulation results of different rectangular patch antennas by using different feeding techniques using ANSYS HFSS CAD tool(High Frequency Electromagnetic Field Simulation).

A)SINGLE PATCH ANTENNA: The dimensions of the single rectangular patch antenna were optimised for the co-axial feed and microstrip feed to obtain the resonant frequency 28GHZ.When thickness(h) of the substrate is increased then the the band width of the antenna is improved.Here our main aim is to obtain return losses lower than -20db.

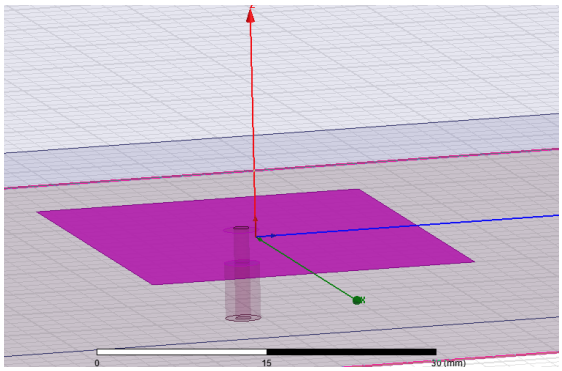


Fig.2: Geometry of rectangular patch antenna with co-axial feed.

For a rectangular patch antenna with microstrip line feed ,the gap parameter y1 was adjusted to obtain minimum return losses at the resonant frequency 28GHZ.For achieving minimum return losses we choose the length of the patch L=3.52mm and y1(gap)=1.1mm.

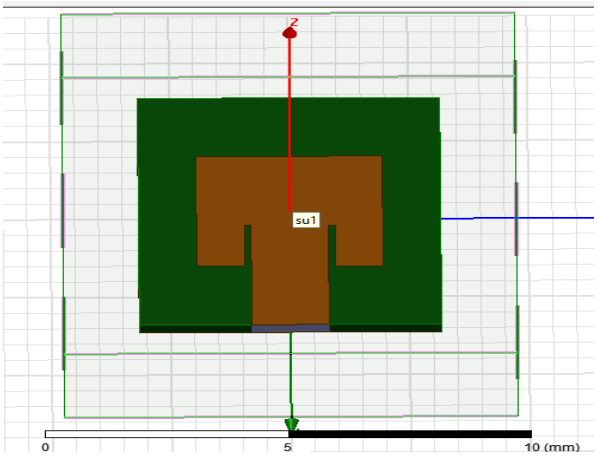


Fig.3:Geometry of rectangular patch antenna with microstrip line feed.

The simulated return losses for the patch antenna with microstrip line feed is shown in the fig4.

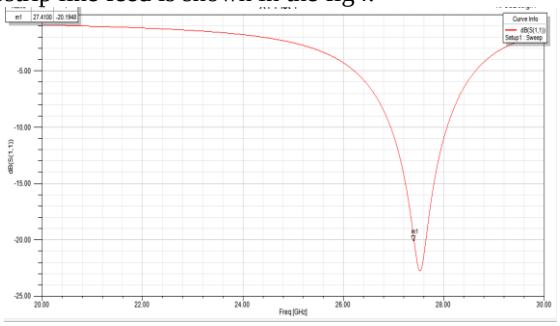


Fig.4:Simulated resurn losses(S11) of rectangular patch antenna with microstrip feed.

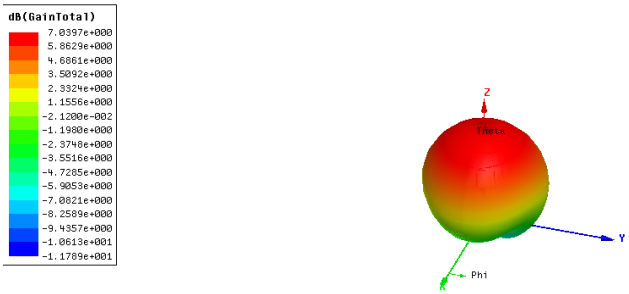


Fig.5: Simulated gain 3D plot of rectangular patch antenna with microstrip line feed.

B)Rectangular patch array antenna:
By using single antenna we cannot achieve high gain.So by using multiple antennas we can achieve high gain and bandwidth and also we can achieve minimum return losses.

1) Two-element antenna array design:
Here up to now we have designed the single patch antenna.So it doesnot exceed more than 7db.For the system of 5g, 7db gain is very small value.For this reason we should extend the single antenna as an array antenna.For the design of array antenna we should use the configuration of T-junction.

The T-junction means the junction which is in T-shaped that in a particular slot at which on eslot joins another at right angles without crossing it.By using this configuration we can design a 2 element antenna array with different calculation methods and we can increase a 3% of gain rather than the single antenna and also it allows good impedance matching over a frequency band.

FIG 6:T-Junction configuration:

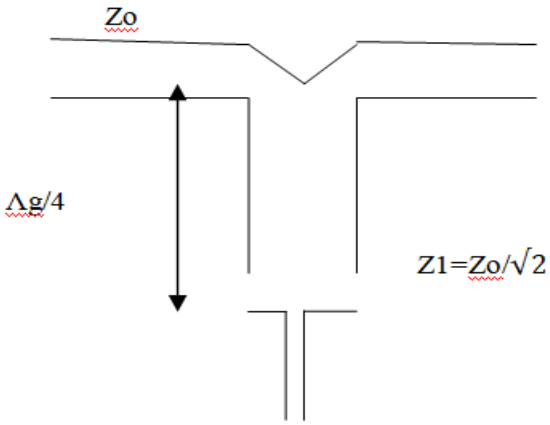


Fig.6:T-Junction configuration.

For designing two element antenna array,the spacing between the antennas with a distance of 7.4mm.The distance d was reduced to achieve the maximum gain.The simulated gain,return losses,gain 2D pattern,fed by microstrip line feed were shown in the below figure.

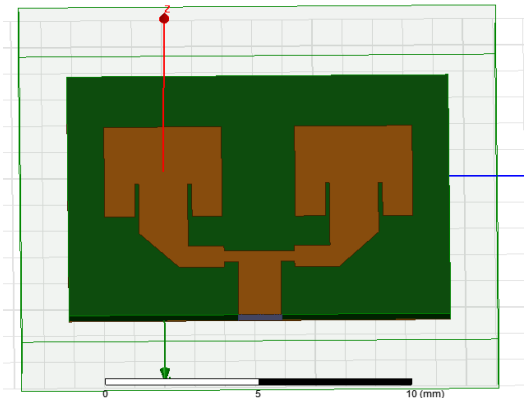


Fig.7:Geometry of the 2*1 rectangular patch array antenna.

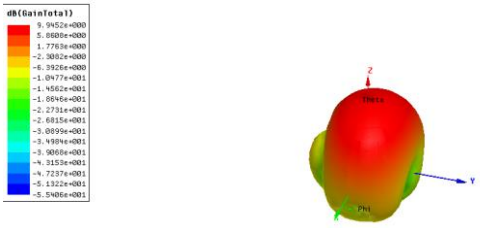


Fig.8:Simulated 3D gain plot of 2*1 patch array antenna.

When the number of antenna elements is doubled then the gain is increased by 3db.The gain of two elements is equal to 9.94db.

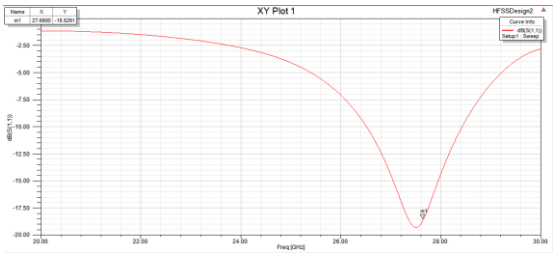


Fig.9:Simulated return losses for the 2*1 patch array antenna .

2)4*1 antenna array with microstrip line feed:

The radiating elements are mounted on the surface of the substrate material with a thickness of 0.508mm and a relative permitivity of 2.22.We should consider the spacing between the elements of the array,because it directly effects the gain and radiation pattern of the antenna.We can achieve the maximum gain when the spacing is between $0.4\lambda o$ and $0.9\ \lambda o$.If the two elements are near to each other,coupling phenomena reduces the gain value and when they are too far apart,side lobes formed and automatically the gain parameter is reduced.

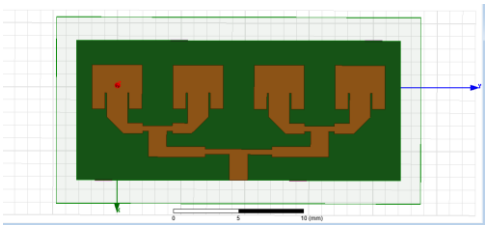


Fig.10:Geometry of the 4*1 rectangular patch array antenna.

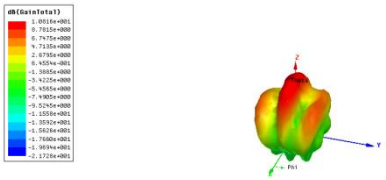


Fig.11: Simulted 3D gain plot of 4*1 rectangular patch array antenna.

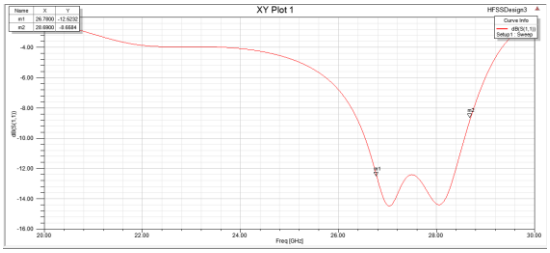


Fig.12: Simulated return losses of 4*1 rectangular patch array antenna.

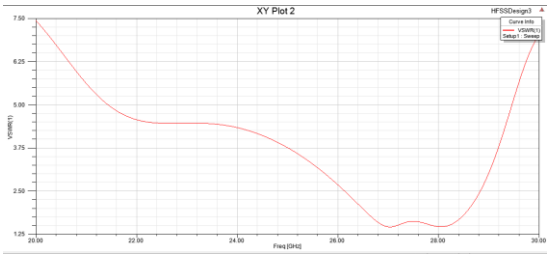


Fig.13:Simulated VSWR of 4*1 rectangular patch array antenna.

3)2*2 antenna array with co-axial feed:

The design of 2*2 rectangular patch array antenna is shown in the fig14.The radiated element are feeding with microstrip line and the antenna array is feeding with co-axial line.The gap between the radiating elements are 7mm and 7.2mm.

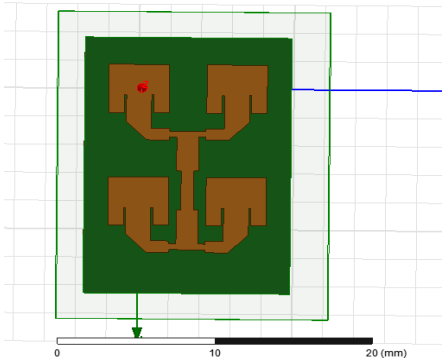


Fig.14: Geometry of 2*2 rectangular patch array antenna fed by coax.



Fig.15: Simulated gain 3D plot of 2*2 rectangular patch array antenna fed by coax

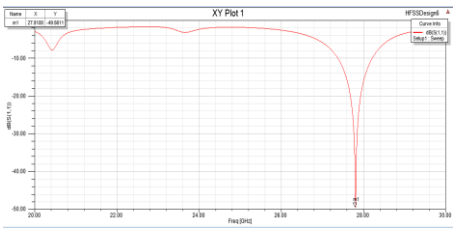


Fig.16: Simulated return losses of 2*2 rectangular patch array antenna fed by coax

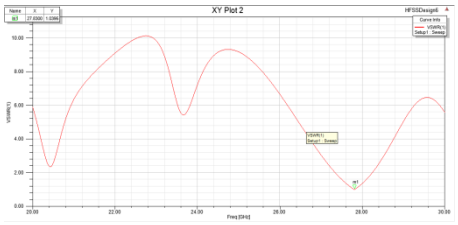


Fig.17: Simulated VSWR OF 2*2 rectangular patch array antenna fed by coax.

When we compare among the 3 structures we conclude that the gain is given by 2*2 rectangular patch array antenna(gain=12.56db)compared with the gain of 2*1 and 4*1 rectangular patch array antenna which is equal to 9.94db and 10.81db.By comparing 3 structures of antenna array we noticed that the bandwidth is given by 4*1 rectangular patch array antenna(bandwidth=1GHZ) more efficient than the bandwidth of 2*1,2*2 rectangular patch array antenna.

TABLE III. 1*1,2*1,2*2 and 4*1 patch antenna array dimensions.

Parameter	Single patch antenna	2*1 patch array antenna	4*1 patch array antenna	2*2 patch array antenna
h(mm)	0.508	0.508	0.508	0.508
W(mm)	4.23	3.7	4.23	3.92
L(mm)	3.28	3.4	3.28	3.26
L_{sub}(mm)	6.3	14	21.6	22.8
W_{sub}(mm)	7.28	10	31.6	19.2
d(mm)	-	7.4	7.4	-
d 2(mm)	-	-	5.5	-
d'(mm)	-	-	-	7
d 1(mm)	-	-	-	7.2

TABLE IV:Comparision between 1*1,2*1,4*1 and 2*2 rectangular patch array antenna simulation performances.

Parameter	1*1 rectangular patch array antenna	2*1 rectangular patch array antenna	4*1 rectangular patch array antenna	2*2 rectangular patch array antenna
Minimum return losses(db)	-20.19	-18.32	-12.52	-49.56
Gain(db)	7.07	9.94	10.81	12.56
VSWR	1.2	1.25	3	1.03

By observing the above results we conclude that 2*2 rectangular patch array antenna with co-axial feed is better than the 4*1 rectangular patch array antenna with microstrip line feed in terms of return losses,gain and VSWR.

FABRICATED 4*1 RECTANGULAR PATCH ARRAY ANTENNA:

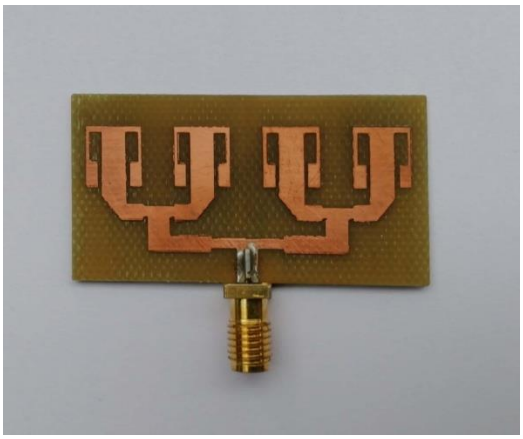


Fig.18: Fabricated 4*1 rectangular patch array antenna.

V. CONCLUSION

The design of 2*1 and 4*1 rectangular patch array antenna fed by micro strip line and coaxial feed were successfully designed and analyzed by using HFSS .The performance parameters for the 4*1 rectangular patch array antenna were optimized with return loss -12.52,gain 10.81db,bandwidth 1 GHz. For 2*2 rectangular patch array antenna return losses -49.56db ,gain 12.56 db and bandwidth 0.9GHz.

In the further work, antenna array of n elements and reconfigurable antenna for the control of the radiation pattern by using the technique of hybrid beam forming will be investigated.

VI. REFERENCES

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Eight Slotted Patch Antenna for 5g Applications with Circular Polarization

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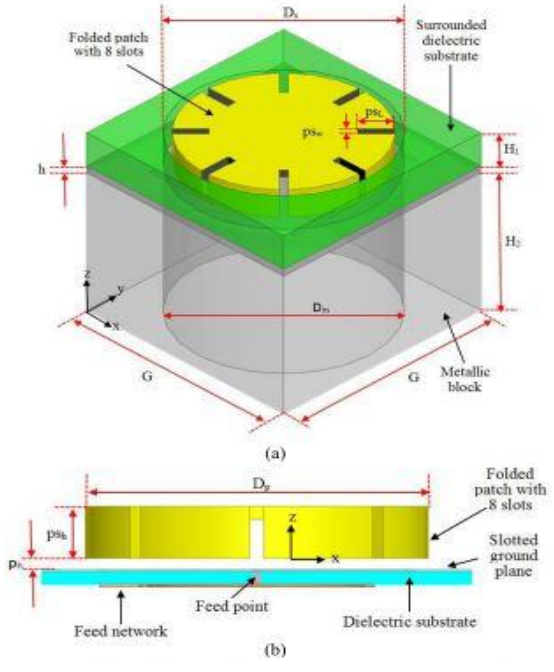
Abstract- A circular polarized patch antenna is presented for future fifth generation mobile phones.The miniaturization and improvement of the beam width of a patch antenna are the two main areas . Folding the edge of the radiant patch with the loading slots, the size of the patch antenna is 44.8% smaller than a conventional half-wavelength patch, which allows it to fit inside the phones easily. The width of the wide beam is obtained by surrounding the patch with a dielectric substrate and supporting the antenna from a block of metal. A beam width of half the measured power of 124◦.The impedance is realized the bandwidth of the antenna is greater than 10% and the bandwidth of the axial ratio of 3 dB is 3.05%. The proposed antenna covers a wide angle of elevation and a full range of azimuth. A parametric study on the effect of metallic block and the surrounding dielectric substrate in the gain at a low elevation angle and the axial ratio of the proposed antennas are presented.

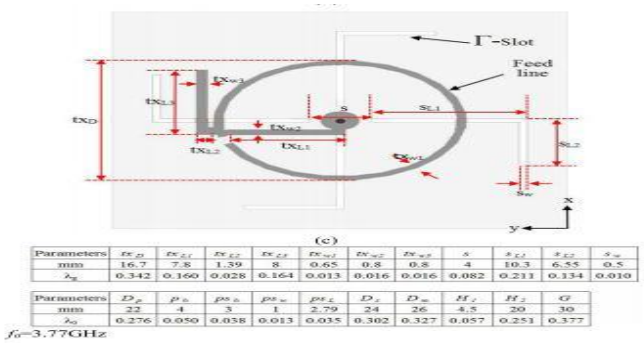
Index Terms- Antenna radiation pattern,amplitude improvement, microstrip patch antennas, satellite antennas, size reduction.

I. INTRODUCTION

Since the 4G has been implemented and becomes mature, many interests are focusing on future 5G communication system. Most research efforts are paying on the ground communication and polarization of the related antennas they are linear However, 5G mobile phones can include the function of satellite communication. Land cell phone system has been well developed in the urban area to provide good coverage and high quality of the telecommunication service. Users can enjoy an instant two-way voice, message and also data communications for sharing photos or watch streaming videos. However, the existing terrestrial the network may not completely cover all the remote areas of the world. In order to achieve ubiquitous wireless coverage on earth, the mobile satellite communication service [1] is the complement.Offersservices that include security communications, accurate global transmission and positioning.It has been mentioned in [2] that the antenna designed for personal satellite communication. The net should be about 10-12 cm thick (mainly described on the helical antenna) and a width is less than 3 cm. Therefore the antenna must be compact to be easy installation. The field of view of the antenna can be done with a directional, omnidirectional or semi-directional model [3]. In general, directional antennas have beam tracking capability [3] - [5] in which a bundle of directives can steer automatically in the direction of the satellite. This document aims to design a CP handheld patch antenna with wide beam width and high gain at low altitude angles of using the phone in the future 5G mobile satellite communication. A sequential feed approach [6] for the the proposed antenna is used, as a broad axial ratio bandwidth.It can be obtained. A normal half-wavelength patch is not small, then some reduction techniques are applied our design. Most of the miniature patch antennas were proposed. Include the use of dielectric substrate [7], [9], patch with slot loading [10] - [12], patch with slot loading [13], [14], folded patch [15], [16], deserted terrain [17], addition of shorted portions [18]. In fact, some beam width techniques have proposed in [7] and [19] - [23], for example three-dimensional ground structure [7], [19] - [21], folding conductive wall [22] and filling the antenna with dielectric [19], [23]. However, parametric study of antenna gain at low elevation angles can to be found in [19] - [23].

ANTENNA CONFIGURATION:





Parameters	tx_{p1}	tx_{p2}	tx_{p3}	tx_{w1}	tx_{w2}	tx_{w3}	s	s_{p1}	s_{p2}	s_w
mm	16.7	7.8	1.39	8	0.65	0.8	0.8	4	10.3	6.55	0.5
λ_g	0.342	0.160	0.028	0.164	0.013	0.016	0.016	0.082	0.211	0.134	0.010

Parameters	D_p	p_{s1}	p_{s2}	p_{s3}	p_{s4}	D_1	D_m	H_1	H_2	G
mm	22	4	3	1	2.79	24	26	4.5	20	30
λ_0	0.276	0.050	0.038	0.013	0.035	0.302	0.327	0.057	0.251	0.377

f_0=3.77GHz

Fig.1: Geometry of the proposed antenna.

Fig. 1 shows the geometry of the proposed CP patchantenna The antenna consists of a slit-hat shapepatch, a double-sided printed circuit board (PCB), a metalblock and a dielectric substrate surround. The patch at the upper part and the double side of the printed circuit board (PCB)they are shown separately for clarity in Fig. 1 (b) and (c).

ANTENNA PERFORMANCE: All proposed antenna simulations are performed by using a commercial EM software, or HFSS (version 15).

VSWR: : Figure 6 shows the VSWR and selected by design. It can be observed that there are two resonances. These are the resonance modes from the patch the cracks on the ground floor and was discussed in [6]. The bandwidth of the measured impedance is 11.08% (VSWR <2), with a bandwidth from 3.58 to 4.00 GHz. The simulated VSWR is less than 2 from 3.53 to 4.01 GHz with an impedance bandwidth 12.73%.

AXIAL RATIO :

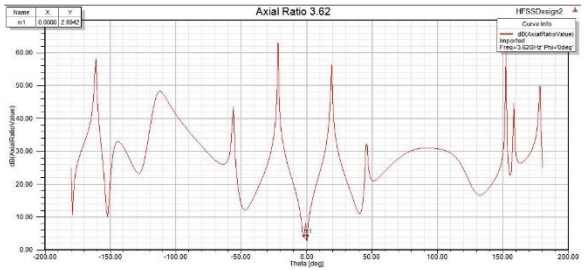


Fig.2: Simulated and measured axial ratio against theta.

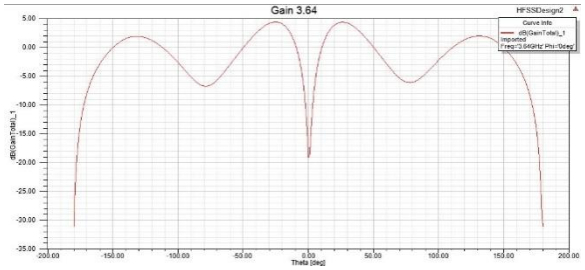
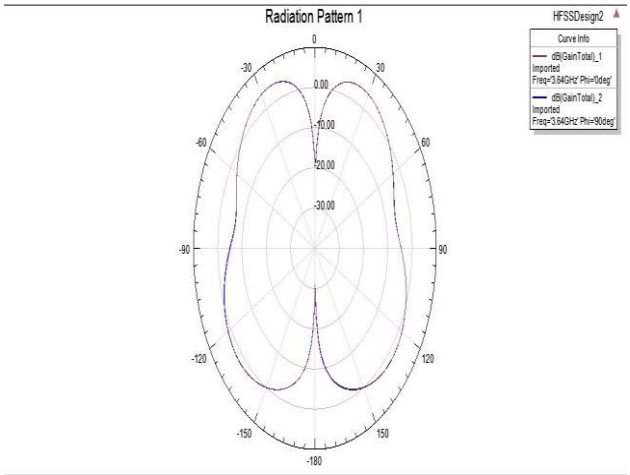
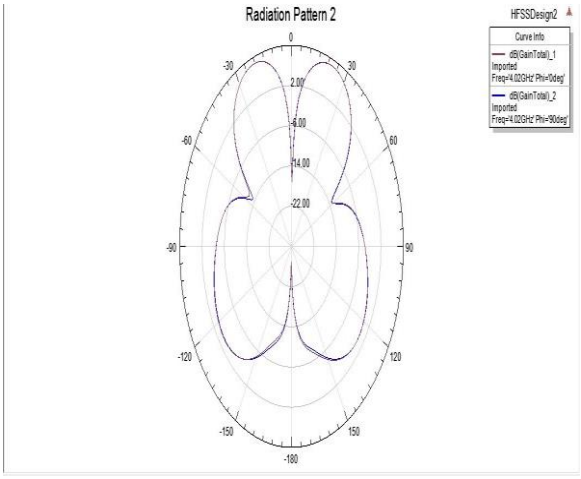


Fig.3: Simulated and measured gain against theta.

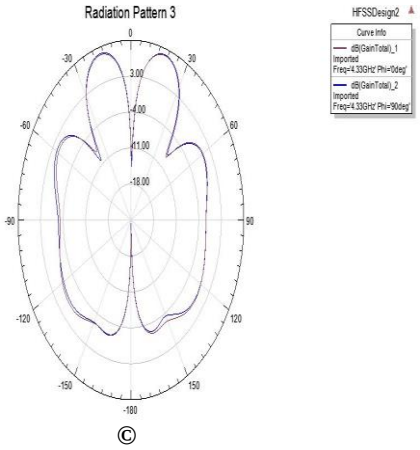
RADIATION CHARACTERISTICS:Fig. 4 shows the verse of the simulated and measured gain frequency of the proposed antenna. Within the frequency bandwidth interval of the axial ratio of 3 dB, the measured gain is 5 dB with a variation of 0.2 dB, which is less than 0.5 dB compared to the simulation The loss of antenna gain may be due to cable and loss of polarization. The simulated and measured radiation models of the antenna in its resonance in the elevation cutting plane (phi = 0◦and phi = 90◦) have been illustrated in Fig. 5. Because the circular polarization of the right hand is less than circular polarization on the left, the proposed antenna works with circular polarization on the left. In the measurement, the half of the power beam width at 3.77 GHz is 124◦ in phi = 0◦ airplane and 123◦ in phi = 90◦ plane. The gain variation is only 0.2 dB at theta = 30◦ , 0.47 dB at theta = 50◦ and 1 dBat theta = 70◦. . So, the proposedPatch antenna possesses both half power and axial ratiobeam width, which can cover much of the upper hemispherearea.



(a)



(b)



©

FIGURE 4.(a) Normalized radiation pattern at 3.64GHz simulated. (b) Normalized radiation pattern at 4.02GHz simulated. (c) Normalized radiation pattern at 4.33GHz simulated.

II. PROCEDURE of ANTENNA DESIGN AND PARAMETRIC STUDIES

MINIMIZATION-The proposed antenna design starts with the simulation ofa simple circular patch fed by a microstrip line couplingthrough four slots in the form of 0. If a half-length circular wavethe patch is used, the antenna size is too large and it is notapplicable to portable devices and therefore to miniature techniquesare required. At the beginning, a circular patch with an initial onea diameter of 24 mm is used, and is shown in Figure 5 (a). Thethe patch is 4 mm above the ground level. Folding the edge ofpatch with 3 mm downwards as shown in Fig. 5 (b) is nextstep. A hat-shaped patch is created. After this, four and eightthe slots are subsequently loaded onto the patch. The structuresthey are shown in Fig.5 (c) and5(d),respectively**.**

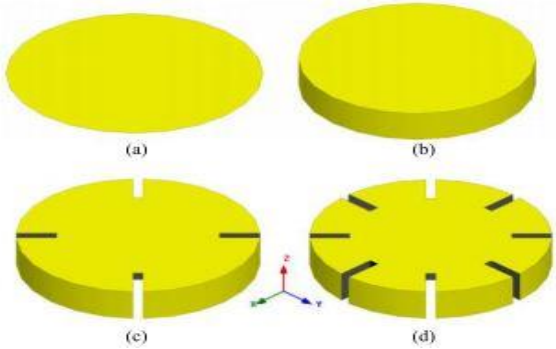


Fig.5: Different patch shape (a) circular patch (b) Folded patch (c) Folded patch with 4 slots and

(d)Folded patch with 8 slots.

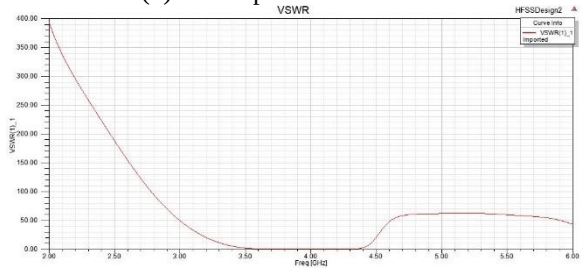


Fig.6: VSWR

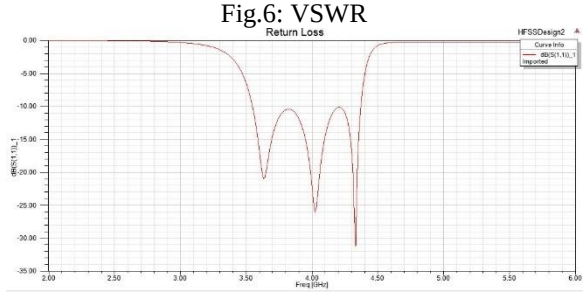


Fig.7:.Return loss

BEAMWIDTH ENHANCEMENT: In our design, two beamwidth enhancement techniques are implemented. One is surrounding the radiating patch with adielectric substrate and the other one is added to metallic blockat the back of the antenna. 1)change the thickness of the surrounded dielectric substrate2) change the height of the metallic block.

TABLE 1. Performance of the proposed antenna and some exiting small-size antenna.

	Gain at (0, 0°)	Frequency	AR Bandwidth	3dB Beamwidth	Patch Length (Ground length)	
	dBic	GHz	%	°	mm	λ_g
Proposed antenna	5	3.77	3.05	124	22 (30)	0.276
Ref [7]	-0.6	1.575	0.76	132	46.5 (150)	0.25
Ref [8]	3.94	2.33	1.61	101	28 (28)	0.218
Ref [9]	6.5	2.33	1.07	<80	23 (30)	0.18
Ref [10]	6	1.525	0.65	83	66.62 (70)	0.34
Ref [11]	*	2.295	1.3	<90	33 (35)	0.25
Ref [12]	*	1.768	0.91	<90	48 (>50)	0.28
Ref [13]	*	2.306	0.41	80	40 (140)	0.31
Ref [14]	4.59	2.492	0.38	90	29 (45)	0.24
Ref [15]	4.7	1.114	1.53	100	30.5 (90)	0.11
Ref [16]	7.5	2.28	3.5	75	30 (90)	0.23
Ref [17]	2.5	1.07	1.6	96.4	19.6 (100)	0.18
Ref [18]	3.8	2.492	0.682	<85	11.35 (21)	0.1

*No information provided in the paper.

III. SUMMARY

In actual application, antenna performance is often in particular, deteriorated from the casing of portable devices metal casings. The study of the metal block on the back of the antenna can not only investigate the influence of the optimization of the beamwidth but also imitates the true wrappingof phones. From the parametric study, it is found that the axial ratio of the proposed antenna is very stable with different ones height (H2) of the metal block. Furthermore, the height of the metal block can help improve half the power beam width and gain at low elevation angles. The result implies this antenna performance can be improved by use of a metal casing in the product design. Even if it seems that the metal block increases the height of the antenna, the improved height can be considered as a portion wrap. In our design, a metal casing has a contribution the antenna performance, in particular the low elevation gain and half width of power beam.

The comparison between the dimensions of the antenna, the width of the beam of 3dB, the gain and the bandwidth of the axial ratio between the proposed antenna and some small CP antennas [7]? [18] are summarized in Table I. Show that the lengths of the antenna patches range from 0.1 to 0.34? 0. Even if the patch the dimensions of the antennas are compact, does not mean this the antenna dimensions are small due to the relatively large terrain the aircraft are used The data in Table I also indicate that 3dB bandwidth of the axial ratio of most small CP patch antennas are less than 2%, except the antenna in [16]. however, the antenna shown in [16] has a large ground plane and the beam width of 3dB is not wide enough. The proposed antenna has a very wide beam width of 3 dB and a high gain in terms of its small size and wide bandwidth of the axial ratio 3dB, which it is comparable to other compact patch antennas.

IV. CONCLUSION

A compact polarized circular patch antenna with widebeam width for handheld devices for future 5G applications has been presented in order to adapt to use in the phone and respecting the requirements of the application model, a care of miniaturization and improvement of the beam width for the proposed CP antenna has been shown in detail. The optimized design was created and tested. The measured results show that the CP antenna is able to cover widely elevation angles and full azimuth range (0 360). Get an average gain of 5 dBic and the measured 3dB. The bandwidth of the axial ratio is 3.05%. Promising results allow the proposed CP patch antenna will be used in the future 5G Mobile phones for satellite communication applications.

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A Novel Low Complexity based PAPR Reduction in OFDM System

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Abstract - In this project the first module, problem of peak-to-average power ratio (PAPR) reduction in orthogonal frequency-division multiplexing (OFDM) based massive multiple-input multiple-output (MIMO) downlink systems. Specifically, given a set of symbol vectors to be transmitted to K users, the problem is to find an OFDM-modulated signal that has a low PAPR and meanwhile enables multiuser interference (MUI) cancelation. Unlike previous works that tackled the problem using convex optimization, we take a Bayesian approach and develop an efficient PAPR reduction method by exploiting the redundant degrees-of-freedom of the transmit array. The sought-after signal is treated as a random vector with a hierarchical truncated Gaussian mixture prior, which has the potential to encourage a low PAPR signal with most of its samples concentrated on the boundaries. A variational expectation-maximization (EM) strategy is developed to obtain estimates of the hyper parameters associated with the prior model, along with the signal. In addition, the generalized approximate message passing (GAMP) is embedded into the variational EM framework, which results in a significant reduction in computational complexity of the proposed algorithm. The draw backs of Module one will be corrected by considering the computationally efficient RCTF method Simulation results show our proposed algorithm achieves a substantial performance improvement over existing method.

Keywords - RCTF, PAPR, BER, OUT-OF-BAND interference.

I. INTRODUCTION

Wireless Communication is the transfer of information over a distance without the use of enhanced electrical conductors or "Wires". The distances involved may be short (a few meters as in television remote control) or long (thousands or millions of kilometres for radio communications). It encompasses various types of fixed, mobile, and portable two-way radios, cellular telephones, Personal Digital Assistants (PDAs), and wireless networking.

One new modulation scheme which has received significant attention over the last few years is a form of multicarrier modulation called Orthogonal Frequency Division Multiplexing (OFDM). OFDM has been used for Digital Audio Broadcasting (DAB) and Digital Video Broadcasting (DVB) in Europe, and for Asymmetric Digital Subscriber Line (ADSL) high data rate wired links.

OFDM has also been standardized as the physical layer for the wireless networking standard 'HIPERLAN2' in Europe as the IEEE 802.11a, standard in the US, promising raw data rates of between 6 and 54Mbps.

Massive multiple-input multiple-output(MIMO), also known as large-scale or very-large MIMO, is a promising technology to meet the ever-growing demands for higher throughput and better quality-of-service of next-generation wireless communication systems [3]. Massive MIMO systems are those that are equipped with a large number of antennas at the base station (BS) simultaneously serving a much smaller number of single-antenna users sharing the same time-frequency bandwidth. In addition to higher throughput, massive MIMO systems also have the potential to improve the energy efficiency and enable the use of inexpensive, low-power components. Hence, it is expected that massive MIMO will bring radical changes to future wireless communication systems.

In this project the first module, problem of peak-to-average power ratio (PAPR) reduction in orthogonal frequency-division multiplexing(OFDM) based massive multiple-input multiple-output(MIMO) downlink systems. Mainly, a set of symbol vectors to be transmitted to K users, the problem is identified an OFDM-modulated signal that has a low PAPR and meanwhile enables multiuser interference (MUI) cancelation. The EM-GAMP algorithm is one of the best solution to overcome this PAPR problem in OFDM signal. The sought-after signal is treated as a random vector with a Gaussian noise mixture, which has the potential to encourage a low PAPR signal with most of its samples concentrated on the boundaries. A variational expectation-maximization (EM) strategy is developed to obtain estimates of the hyper parameters associated with the prior model, along with the signal. In addition, the generalized approximate message passing (GAMP) is embedded into the variational EM framework.

But EM+GAMP which leads to complexity increases. Comparing to in-band distortion, out-band is more critical. It severely interference with the radio communication adjacent channel. So, reducing this problem we are introduce a technique called "RCTF"(Repetitive companding transform function).

International telecom union for radio frequencies (ITU- RF) has approved the bit error rate (BER) as performance evaluation parameter to get desired statistics of the signal. In OFDM, BER is gradually declined due to companding distortion and the sudden declination in BER performance is

due to signal attenuation factor which compresses the original symbols. Minimization of OBI is another prominent factor to be considered and to successfully handle the problem of OBI a frequency-domain filtering is utilized in the latter stage. Finally, the compression of peak signals came into control by performing the companding and filtering approaches for multiple times respectively till to achieve the desired result.

Here OFDM system model is comprises of transmitter and receiver, while RCTF technique is deployed at transmitter end for PAPR reduction. Over- sampled Inverse IFFT operation is used to convert the complex vector in accurate manner. Here two constants K1 and K2 are used to switch the single and multiple operations in respective iteration level.

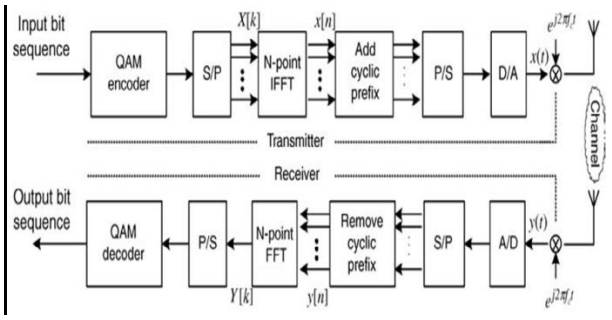


Figure 1: Block Diagram Of OFDM

Peak-to-Average Power Ratio (PAPR) Reduction - The main challenges of OFDM-based systems are the high peak-to-average power ratio (PAPR) of transmitted signals, resulting in signal distortion. OFDM modulation typically a large dynamic range because the phases of the sub-carriers are independent of each other. To avoid out-of-band radiation and signal distortion by using high-resolution DACs and linear power amplifier at the transmitter to accommodate the large peaks of OFDM signals, which leads to more expensive and power-inefficient.

PAPR is defined as the ratio of the peak power of the signal to its average power. Specifically, the PAPR at the m^thtransmit antenna is defined as

$$\text{PAPR}=\frac{max_t|x(t)|^2}{E_t[|x(t)|^2]} \quad \ldots\ldots\ldots\ldots\ldots\ldots(1)$$

LetE[x(t)] · denote the mathematical expectation and the amplitude, $||x||_2$denote the second norm of a vector.

When the number of transmit antennas is larger than the number of users, numerous ZF pre-coding matrices are available. By using this ZF pre-coding process, the MUI is removed and reduce the PAPR also.

In this paper, instead of designing the pre-coding matrix we directly search 'w' signal for reducing the PAPR and MUI cancelation.

II. EXISTING METHOD

A. EM-GAMP Introduction - In this project the first module, problem of peak-to-average power ratio (PAPR) reduction in orthogonal frequency-division multiplexing (OFDM) based massive multiple-input multiple-output (MIMO) downlink systems. Mainly, a set of symbol vectors to be transmitted to K users, the problem is identified an OFDM-modulated signal that has a low PAPR and meanwhile enables multiuser interference (MUI) cancelation. The EM-GAMP algorithm is one of the best solutions to overcome this PAPR problem in OFDM signal.In addition, the generalized approximate message passing (GAMP) is embedded into the variational EM framework, which results in a significant reduction in computational complexity of the proposed algorithm.

To facilitate our algorithm development, we introduce a noise term to model the mismatch between y and Ax, i.e.

$$y = Ax + \epsilon \quad \ldots\ldots. (2)$$

Where ϵ denotes the noise vector and its entries are assumed to be i.i.d. Gaussian random variables with zero-mean and unknown variance β^{-1}. Here we treat β as an unknown parameter because the Bayesian framework allows an automatic determination of its model parameters and usually provides a reasonable balance between the data fitting error and the desired characteristics of the solution.

The graphical model of the proposed hierarchical is presented in Fig. 2(a). In general, Bayesian inference requires computing the logarithm of the prior. In this regard, (24) is an inconvenient form for inference.

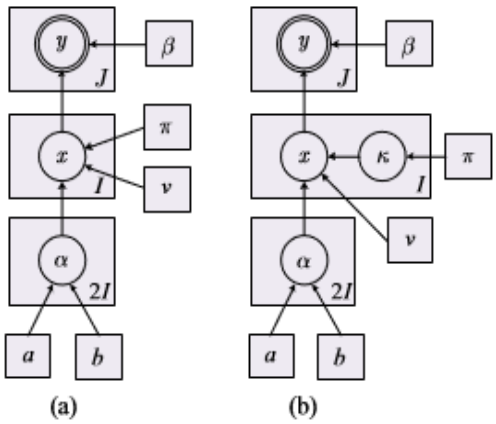


Figure 2: Graphical models for low-PAPR signal priors (a) Original prior, (b) Modified prior

Here circles denoting hidden variables, double circles denoting observed variables and squares representing model parameters.

B. EM-GAMP Algorithm - A variational expectation-maximization (EM) algorithm is developed to obtain estimates of the hyper parameters associated with the prior model, along with the signal. In addition, the generalized approximate message passing (GAMP) technique [22] is employed to facilitate the algorithm development in the expectation step. This GAMP technique also helps significantly reduce the computational complexity of the proposed algorithm. Simulation results show that the proposed method presents a substantial improvement over the PTS algorithm in terms of both PAPR reduction and computational complexity.

i). Likelihood Function Approximation via GAMP -

Let z = {x, α1, α2, κ} denote all hidden variables appearing in our hierarchical model, and θ ≜β, v} denote the unknown deterministic parameters. As discussed in the previous subsection, the posterior of z can be approximated by a factorized form as follows

$p(x,\alpha_1,\alpha_2,\kappa|y;\beta,v)\approx q(x,\alpha_1,\alpha_2,\kappa)=q(x)q(\alpha_1)q(\alpha_2)q(\kappa)$…..(3)

The approximate posteriors can be obtained as

$\ln q(x)=\langle \ln p\ (y,x,,\alpha_1\ ,\alpha_2,\kappa;\beta,v)\rangle_{q(\alpha1)q(\alpha_2)q(\kappa)}$+const,… ……(3.1A)

$\ln q(\alpha_1)=\langle \ln p\ (y,x,\alpha_1,,\alpha_2,\kappa;\beta,v)\rangle_{q(x)q(\alpha_2)q(\kappa)}$+const, …….(3.1B)

$\ln q(\alpha_2)=\langle \ln p\ (y,x,\alpha_1,,\alpha_2,\kappa;\beta,v)\rangle_{q(x)q(\alpha_1)q(\kappa)}$+const ……..(3.1C)

$\ln q(\kappa)=\langle \ln p\ (y,x,\alpha_1,,\alpha_2,\kappa;\beta,v)\rangle_{q(x)q(\alpha_1)q(,\alpha_2)}$+const ……(3.1D)

ii). Generalized approximate message passing (GAMP) -

GAMP is a very-low-complexity Bayesian iterative technique recently developed in [23] for obtaining approximate marginal posteriors and likelihoods. It therefore can be naturally embedded within the EM framework to provide an approximate posterior distribution of x and reduce the computational complexity, as shown in [20]. Specifically, the EM-GAMP framework of [25] proceeds in a double-loop manner: the outer loop (EM) computes the Q-function using the approximate posterior distribution of x, and maximizes the Q-function to update the model parameters (e.g. α1, α2, κ); the inner loop (GAMP) utilizes the newly estimated parameters to obtain a new approximation of the posterior distribution of x.

C. EM-GAMP Procedure -

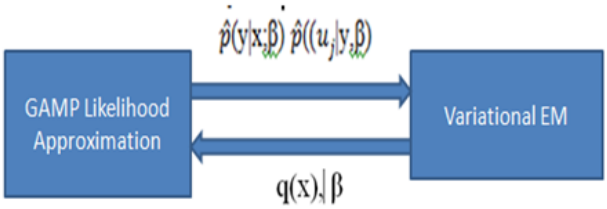


Figure 3: Variational EM-GAMP framework.

GAMP is a simplification of loopy BPand can be used to compute approximate marginal posteriors and likelihoods. Here we approximate the joint likelihood function p(y|x;β) as a product of approximate marginal likelihoods computed via the GAMP, i.e.

$p(y|x;\beta) \approx \hat{p}(y|x;\beta) \propto \prod_{i=1}^{I} N(x_i|\widehat{r_1},\widehat{\tau_i^r})$ …..(3.2)

Where $N(x_i|\widehat{r_1},\widehat{\tau_i^r})$is the approximate marginal likelihood obtained by the GAMP algorithm. To calculate r_i and τ_i^r, an estimate of the posterior q(x) and β is required as inputs to the GAMP algorithm (see the details of the GAMP algorithm provided below). Hence the GAMP algorithm can be embedded in the variational EM framework: given an estimate of q(x) and β, use the GAMP to obtain an approximation of the likelihood function p(y|x;β); with the approximation ˆ p(y|x;β), the variational EM proceeds to yield a new estimate of q(x) and β, along with estimates of other deterministic parameters (e.g. v) and posterior distributions for the other hidden variables (e.g. α1,α2,κ). This iterative procedure is illustrated in Figure 4.

Note that besides the approximation pˆ (y|x_i;β), GAMP also produces approximations for the marginal posteriors of the noiseless output u =

$[u_1,u_2\ldots,\ldots u_j]^T \triangleq$Ax, which are given by

$p(u_j|y,\beta)\approx\hat{p}((u_j|y,\beta)\propto p((y_j|(u_j;\beta)N((u_j|\hat{p}_j,\tau_j^p)$ ……(3.5)

Where $\hat{p}_j$ and τ_j^p are quantities obtained from the GAMP algorithm.

Note that we can also treat {α1, α2, κ} as deterministic parameters.

i). E-Step: Update of Hidden Variables -

Update of q(x): As discussed above, p(y|x;β) is approximated as a factorized form of independent scalar likelihoods, which enables the computation of q(x) (3.1A). Specifically, using (3.1A) (3.5) can be simplified as

$\ln\ q(x)=\langle \ln p\ (y,x,,\alpha_1\ ,\alpha_2,\kappa;\beta,v)\rangle_{q(\alpha1)q(\alpha_2)q(\kappa)}$ +const (3.6)

lnq(x) = −∞ otherwise. It can be seen that lnq(x) has a factorized form, which implies that hidden variables {xi} have independent posterior distributions. Also, it can be readily verified that the posterior q(xi) follows a truncated Gaussian distribution

$$q(x_i)=\begin{cases}\frac{N(x_i|\mu_i,\sigma_i^2)}{\emptyset_i} & \text{if } x_i\in[-v,v],\\ 0 & otherwise\end{cases} \quad \ldots\ldots\ldots\ldots\ldots (3.7)$$

Where σ_i^2= variance

$\mu_{i,}$= Mean

$\emptyset_i$= Normalization constant

Update of q (α_1): Keeping only the terms that depend on α_1,the variational optimization of q (α_1) yields

$\text{Lnq}(\alpha_1)=\langle \ln p\ (x|\alpha_1,\alpha_2,\kappa;v)p(\alpha_1)\rangle_{q(x)q(\alpha_2)q(\kappa)}$ +const

$=\sum_{i=1}^{I}.\langle \ln p\ (x_i|\alpha_{i1},\alpha_{i2},k_i;v)p(\alpha_{i1})\rangle_{q(x)q(\alpha_2)q(\kappa)}$ +const

Therefore $q(\alpha_1)$ follows a Gamma distribution

$q(\alpha_1)$ =Gamma $(\alpha_{i1}|\widehat{a_{i1}},\widehat{b_{i1}})$ … (3.8)

with

$\widehat{a_{i1}} = a+\frac{1}{2}\langle k_i\rangle$

$\widehat{b_{i1}} = b+\frac{1}{2}\langle k_i\rangle\langle(x_i-v)^2\rangle$

Update of q (α_2): Following a procedure similar to the derivation of q (α_1), we have

$q(\alpha_2)$ =Gamma $(\alpha_{i2}|\widehat{a_{i2}},\widehat{b_{i2}})$ ….. (3.9)

with

$\widehat{a_{i2}} = a+\frac{1}{2}(1-\langle k_i\rangle$

$\widehat{b_{i2}} = b+\frac{1}{2}(1-\langle k_i\rangle)\langle(x_i+v)^2\rangle$

ii). M-step: Update of deterministic Parameters:

As indicated earlier, in the variational EM framework, the deterministic parameters $\theta=\{\beta,v\}$ are estimated by maximizing the Q-function, i.e.

$\theta^{NEW}=\max_{\theta} Q\ (\theta,\theta^{old})$ ……. (3.10)

Update of β: We first discuss the update of the parameter β the inverse of the noise variance. Since the GAMP

algorithm provides an approximate posterior distribution for the noise less output u ≙ Ax., we can simply treat u as hidden variables when computing the Q-function, i.e.

$Q(\beta,\beta^{(t)})= \sum_{j=1}^{J}\langle \ln p(y_j|u_j;\beta)\rangle_{p(\widehat{u_j}|y,\beta)}$ +const …….(3.11)

The new estimate of data is obtained by maximizing the Q-function, which can be solved by setting the derivative of $Q(\beta,\beta^{(t)})$ with respect to β to zero.

Update of v: We now discuss how to update the boundary parameter v. The boundary parameter v can be updated by maximizing the Q-function with respect to v. Nevertheless, the optimization is complex since the Q-function involves computing the expectation of the normalization terms η_{il}, i = 1, 2, …..I, l = 1, 2 with respect to the posterior distributions p (α_{il}).The basic idea is to find an appropriate value of v such that the mismatch ‖y−A$\hat{x}$‖2 is minimized, where ˆ x denotes the estimated signal which is chosen as the mean of the posterior distribution q(x).

Note that when the boundary parameter v is small, the mismatch could be large since there may not exist a solution to satisfy the constraint y = Ax. Therefore we can firstly set a small value of v, then gradually increase v by a step-size such that the mismatch keeps decreasing and eventually becomes negligible.

Algorithm 2: EM-GAMP -

EM-TGM-GAMP Initialization: β(0) = 10^3, $v^{(0)}$ = ‖y‖∞/‖A‖∞, initialize the means of q(x), q(α1), q(α2), q(κ) as 0, 1, 1, $\frac{1}{2}$1 respectively, set the variance of q(x) as 1, and set iteration number t = 0.

Repeat the following steps until t ≥ tMAX

1. Based on the mean and variance of q(x) and β(t), calculate the approximate distributions ˆ p(y|x;β(t))and ˆ p(uj|y,β(t)), j = 1,...,J,
2. Using the approximate likelihood ˆ p(y|x;β(t)), update the posteriors of hidden variables: q(x), q(α1), q(α2) and q(κ)
3. Compute the new estimate β(t+1) and obtain the v(t+1)
4. Increase t = t + 1 and return to step 1

III. PROPOSED METHOD

International telecom union for radio frequencies (ITU- RF) has approved the bit error rate (BER) as performance evaluation parameter to get desired statistics of the signal. In OFDM, BER is gradually declined due to companding distortion and the sudden declination in BER performance is due to signal attenuation factor which compresses the original symbols. Minimization of OBI is another prominent factor to be considered and to successfully handle the problem of OBI a frequency-domain filtering is utilized in the latter stage.

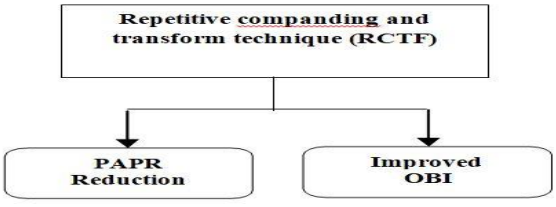


Figure 4: Iterative companding and transform technique and its mechanism

OFDM offers high data rate at one end and on other end its performance is badly impacted by PAPR. The above block diagram design intended to mitigate the peak values in accurate way. Here OFDM system model is comprises of transmitter and receiver, while RCTF technique is deployed at transmitter end for PAPR reduction. Over- sampled Inverse IFFT operation is used to convert the complex vector $X \in C^N$ in accurate manner. Here two constants K_1 and K_2 are used to switch the single and multiple operations in respective iteration level.

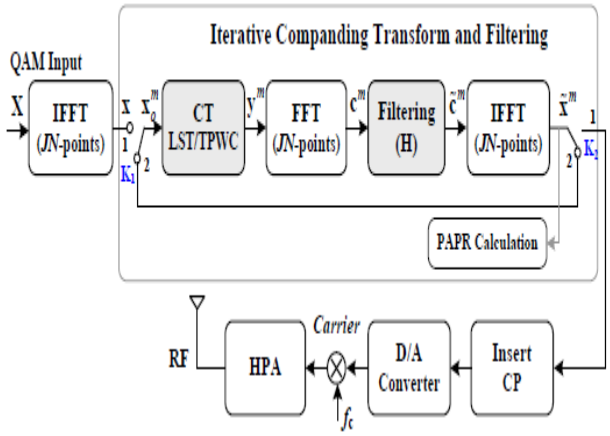


Figure 5: Block diagram of OFDM transmitter using RCTF technique.

If K_1 value is set to 1, then OFDM symbol $X \in C^{JN}$ is given as input to RCTF at the iteration, M=1 and these iterations are processed based on symbol-by-symbol process. In case, if both K_1 and K_2 are set to 2, then in that stage both companding and ICTF are used for the same OFDM symbol. In last iteration both constants values are set to 1 again to get the output as $\tilde{X}^m \in C^{JN}$ reactively. Assume $c^m \in C^{JN}$ and $\tilde{c}^m \in C^{JN}$ represented the frequency-domain OFDM symbol at m^{th} iterative level (before and after filtering process). The proposed figure area as follows The proposed method intends to decrease the PAPR impact and achieves improved OBI performance. The presence companding noise and channel noise results in companding distortion. Finally, BER analysis is carried out using companding distortion. Two companding transform techniques is initialized by linear (LST) companding transform technique and non-linear companding scheme (TPCW).

i). Linear symmetrical transform (LST) - Linear symmetrical transform (LST) is a companding transform profile and its respective companding transform function is as follows

$$f(x)=(k.|x|+b).\mathrm{sgn}(x) \quad (1)$$

The above equation is composed of sign function and two parameters. These parameters are used to specify

companding profile. PAPR reduction and improved BER is achieved by selecting the parameters in linear regions of companding profile. Average power alternation is concerned area in companding transform and by $k^2+\sqrt{\pi}.{kb}/{\sigma}+\frac{b^2}{\sigma^2}$ is used to maintain the average power in unchanged form. The decompanding function is notated as follows

$$f^{-1}(x)=\frac{|x|-b}{k}.\mathrm{sgn}(x) \qquad (2)$$

The PAPR and the transform gain G is defined as the ratio of the PAPR of original symbol to that of the companded symbol are as follows

$$PAPR_{LST}(db)=10\log\frac{\max_{n\in[0,JN-1]}\{|y_n|^2\}}{\frac{1}{JN}\sum_{n=0}^{JN-1}|y_n|^2}$$

$$=20\log\frac{k.v+b}{\sigma} \qquad (3)$$

$$G_{LST}(dB)=10\log\frac{PAPR_{org}}{PAPR_{LST}}=20\log\frac{k.v+b}{\sigma} \qquad (4)$$

Two-Piecewise Companding (TPWC) - There are four classified companding transform profiles in both linear and non-linear way, Linear Nonsymmetrical Transform (LNST) has achieved best results in terms of PAPR reduction and BER performance over remaining companding transform profiles. The companding function is as follows

$$f(x)=\begin{cases}u_1|x|.\mathrm{sgn}(x) & |x|\le v\\ (u_2|x|+s).\mathrm{sgn}(x), & |x|>v^1\end{cases} \qquad (5)$$

$For\ u_1>1,\ 0<u_2<1,\ s=(u_1-u_2)v>0\ \ and\ \ 0\le v\le V$

is the cutoff point with $V=\max_{0\le n\le JN-1}\{|x_n|\}$ with maximum value $V=\max_{0\le n\le JN-1}\{|x_n|\}$

The de-companding function of TPWC is given by

$$f^{-1}(x)=\begin{cases}\frac{1}{u_1}|x|.\mathrm{sgn}(x) & |x|\le u_1v\\ \left(\frac{1}{u_2}|x|-s\right).\mathrm{sgn}(x), & |x|>u_1v\end{cases} \qquad (6)$$

For a single TPWC-CT approach, Its achievable PAPR is given by

$$PAPR_{TPWC}(dB)=20\log\frac{u_2V+s}{\sigma} \qquad (7)$$

The corresponding transform gain G is written by

$$G_{TPWC}(dB)=20\log\frac{V}{u_2V+s} \qquad (8)$$

Companding Distortion Analysis:

i). Companding noise - The BER performance in RCTF procedure is investigated. Based on Buss gang theorem for real and complex Gaussian Signal, the companded signal can be approximately decomposed into two parts the attenuated signal component and companding noise, ρ_n ,i.e $y_n=SAF\times x_n+\rho_n$ Thus, the transmitted symbol with 'm' iterations using ICTF can be approximately decomposed $x_n^m=SAF^m\times x_n+\rho_n$

ii). Channel noise - Improved BER is achieved even in the absence of de-compounding operation at receiver end. The necessary theoretical analysis as follows;

a) RCTF-LST - At receiver end, When de-compounding operation is performed and if m=1 (Iteration 1) the received signal is as follows

$$\tilde{x}_n=f^{-1}\left(f(x_n)+\omega_n\right)=x_n+\frac{\omega_n}{k} \qquad (9)$$

Where ω_n =channel noise

If number of iterations increased then it results in noise,

$$e_n^{(m)}=\left|{\omega_n}/{k^m}\right| \qquad (10)$$ As a result, it is preferable to abandon the decompanding at the receiver. It is noteworthy that this is quite advantageous for practical OFDM systems.

b) RCTF-TPWC - RCTF-TPWC analysis is carried out in same way as RCTF-LST. Assuming that m iterative de-companding operations are performed at the receiver, the recovery error is approximately given by

$$e_n^{(m)}=\begin{cases}\left|{\omega_n}/{u_1^m}\right|, n\in\phi_1(v)\\ \left|{\omega_n}/{u_2^m}\right|, n\in\phi_2(v)\end{cases} \qquad (11)$$

IV. SIMULATION RESULT

To better evaluate the PAPR reduction performance, we plot the CCDF of the PAPR for respective schemes in Fig. 6(a). The number of trials is chosen to be 1000 in our experiments. Note that PAPRs associated with all M antennas are taken in account in calculating the empirical CCDF. it reduces the PAPR by 2dB The SER performance of respective schemes is shown in Fig. 6(b), We observe that the proposed algorithm incursan SNR-performance loss of 2.5 dB and 1.7 dB (at SER = 10−3) compared to the ZF and FITRA schemes, respectively.

Assume that, the number of subcarriers is N=128 using quaternary phase shift keying (QPSK) or 16 Quadrature amplitude modulation (16-QAM). Over sampling j=4 is used in proposed work to accurate PAPR estimation.

BER performance is analyzed in both the AWGN channel and multipath fading channels (RACIAN and SUI) are applied. A CP with length of ¼ symbols is inserted to control ICF. ICTF achieves better PAPR reduction (6.57dB

PAPR reduction is achieved) over traditional CT techniques and ICF. The impact of PAPR reduction technique on OFDM system is observed using BER and OBI.

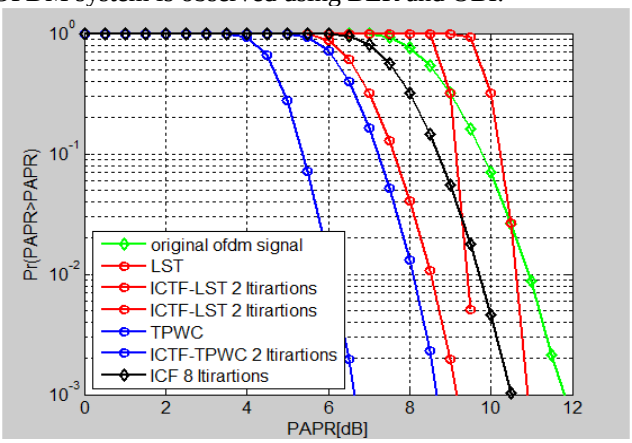
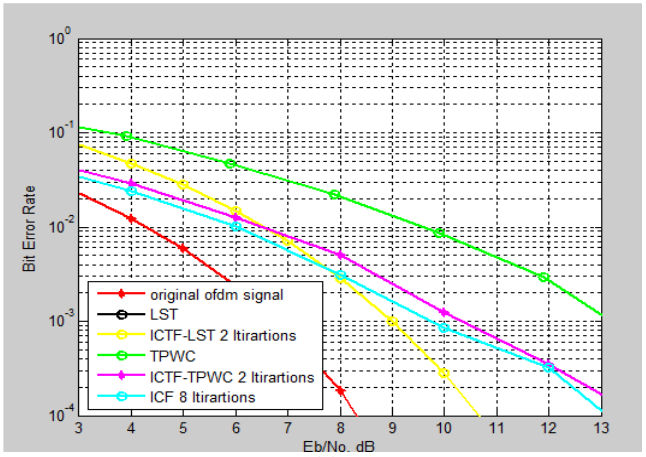
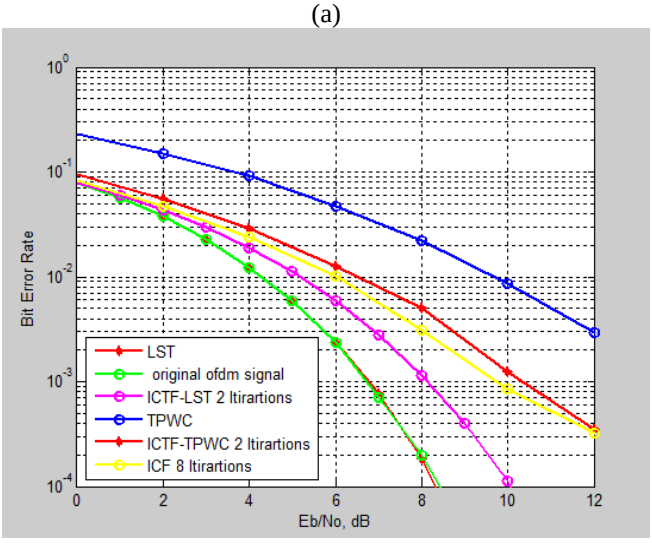


Figure 6: CCDF statistics of OFDM symbol for different PAPR-reduction schemes (N=1024, QPSK, and the over-sampling ratio J=4).



(a)



(b)

Figure 7: BER comparison for different PAPR-reduction schemes through AWGN channel for OFDM system (N=1024, QPSK).

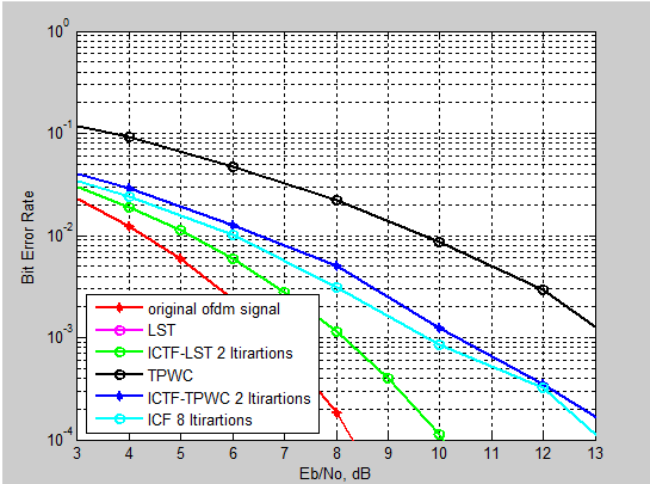


Figure 8: BER comparison for different PAPR-reduction schemes through Rician fading channel for OFDM system (N=1024, QPSK).

V. CONCLUSION

We considered the problem of joint PAPR reduction and multiuser interference (MUI) cancelation in OFDM based massive MIMO downlink systems. ICTF is an equipped approach has ability to reduce PAPR and improved BER performance. Both AWGN channel and SUI channel for reliability and efficiency. ICTF achieves good results over conventional techniques. The proposed ICTF technique not only obtains significant PAPR reduction with improved BER and OBI performance, but also dramatically decreases the iterations number. In addition, ICTF procedure can also be extended to other well-known linear and nonlinear companding profiles. The proposed algorithm also demonstrates a fast convergence rate, which makes it attractive for practical real-time systems.

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Role of Automation in Pisciculture for Better Yield

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Abstract - The proposed system is role of automation in fish farming which is based on Internet of Things (IoT) for real-time monitoring. The system can be monitored remotely and can control from a different locations with the use of an internet and obtain the time to time alerts for the farmer via SMS using GSM. Due to lack of monitoring pond parameters in real time effects the growth of fishes and it leads loss to the farmers. For avoiding such losses, the embedded system is installed in the farm which can monitor the farm and to control the system based on the threshold conditions which can increases the rate of growth of the fish and decreases the death rate. Objective of this manuscript is to provide an automatic fish farm monitoring and thereby saving time, money & power of the farmer. In the fish farming process we use various sensors like pH sensor, Temperature, GSM, Wi-Fi, Turbidity, PIR sensor and level sensors. With the help of these sensors the system is automated.

Keywords - Aquaculture, Fish Farming, Internet of Things (IoT), Temperature sensor, Level sensor, pH sensor, turbidity, PIR sensor, GSM and Wi-Fi.

I. INTRODUCTION

A fish farmer with success inseminated gathered fish eggs and raised the fish that were hatched for food. Fish farming is extremely important to mankind. Fish is high in important nutrients. Fish might lower your risk of heart attacks and strokes. Fish contains nutrients that are crucial during development. Fish might increase gray substance within the brain and shield it from age-related deterioration. Fish might facilitate stop and treat depression, creating you a happier person. Different types of fishes are available every fish is benefit to human beings in form of nutrients and proteins etc., This is the main reason for farming of fishes and to help the farmers making them risk free with the advancement of new range of technologies and automation innovative solutions we are doing this project which supports in monitoring and automatic controlling on real-time. IoT can also play a significant role in precision farming to enhance the productivity of the farm. The rapid development of aqua cultural IoT has an important role in realizing intensive aquaculture, high yield and high quality providing solid foundation for development with in aqua cultural information technologies in this paper we worked on monitoring and automation of fish farming for better yield.

II. LITERATURE SURVEY

In 475 BC, a Chinese man referred to as Fan Lai wrote a book known as The Classic of Fish Culture to show others a way to raise fish for food. In 1733, cultivation in its trendy kind was initial introduced in European country. A fish farmer with success fertile gathered fish eggs and raised the fish that were hatched for food. Fisheries sector play an important role in the socio-economic development of farmers in the country. The sector has been recognized as a powerful income and employment generator as it stimulates growth of a number of subsidiary industries, and is a source of cheap and nutritious food besides being a foreign exchange earner. Most importantly, it is the source of livelihood for a large section of economically backward population of the country. The main challenges facing fisheries development within the country includes correct knowledge on assessment of work resources and their potential in terms of fish production, development of sustainable technologies for fin and shell fish culture, yield optimization, harvest and post-harvest operations, landing and berthing facilities for fishing vessels and welfare of fishermen. And it is useful in many aspects like malnutrition and starvation are the two serious problems being faced by millions of rural poor in most of the developing countries. The downside of deficiency disease is actually additional serious and of an even bigger dimension than the starvation problem and is caused chiefly because of animal protein-deficient diets.Animal macromolecule is important for correct growth, repair and maintenance of body organs and tissues. Fish contain about 16-20% protein compared to about 12% in egg, 3.5% in milk and 6-8% in rice and wheat. Moreover, it is wholesome, tasty, highly nutritive and an excellent source of essential minerals, vitamins and essential amino acids. At present concerning thirty first of the overall animal macromolecule provide within the Asian region is within the sort of fish macromolecule. For the poorest segments of the population, fish isn't solely the foremost vital animal macromolecule supply, however typically the sole one.

III. PROPOSED SYSTEM

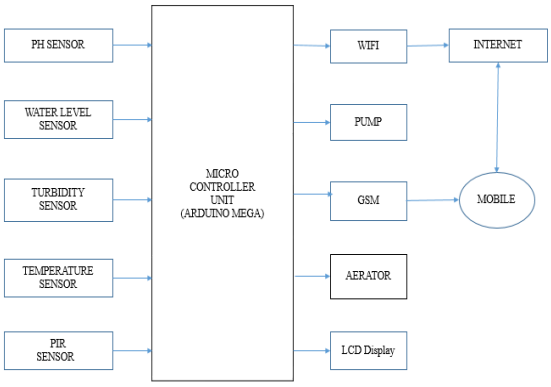


Figure 1: Block diagram of proposed system

The proposed hardware of this system includes Arduino MEGA board, Temperature sensor, pH sensors, Turbidity sensor, Water level sensor, PIR sensor, Wi-Fi, DC motor GSM, Aerator, power supply unit, LCD Display.

IV. HARDWARE COMPONENTS

A. Arduino

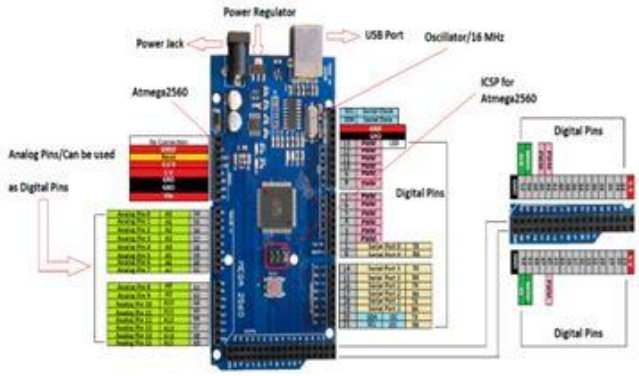


Figure 2: Schematic diagram of Arduino Mega

The Arduino Mega 2560 could be a microcontroller board supported the ATmega2560. It has fifty four digital input/output pins (of that fourteen are often used as PWM outputs), sixteen analog inputs, four UARTs (hardware serial ports), a sixteen megacycle per second quartz oscillator.

B. LCD

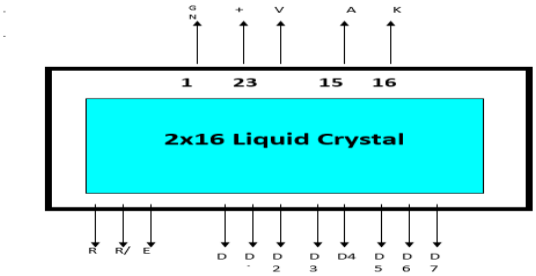


Figure 3: 2x16 LCD display

The LCD display consists of two lines, 20 characters per line that is interfaced with the PIC16F73. The display contains two internal byte-wide registers, one for commands (RS=0) and the second for characters to be displayed (RS=1). It also contains a user-programmed RAM area (the character RAM) that can be programmed to generate any desired character that can be formed using a dot matrix.

C. Temperature Sensor



Figure 4: Temperature sensor with probe

External probe detector for direct dominant and observation of liquid temperature. It consists of three wires - Red connects to 3-5V, Black connects to ground and White is data. DS18B20 Sensor technical specifications are of temperature sensor which has the usable temperature range of 55 to 125°C (-67°F to +257°F). Temperature sensors will share one pin ±0.5°C accuracy from -10°C to +85°C it's temperature-limit alarm system query time is less than 750ms, usable with 3.0V to 5.5V power/data.

D. pH Sensor



Figure 5: pH electrode with probe

A pH meter may be a instrument that measures the hydrogen-ion activity in water-based solutions, indicating its acidity or pH expressed as pH. The pH meter measures the difference in electrical potential between a pH electrode and a reference electrode, and so the pH meter is sometimes referred to as a "potentiometric pH meter".

E. Ultrasonic Sensor



Figure 6: Ultrasonic sensor

Ultrasonic sensor is used to measure the water level of the farm. It is of non-contact type sensor i.e., the sensor doesn't have any direct contact with the water and it analyses the level of the water. It's detection ranges between 2cm to 400cm.

F.PIR Sensor



Figure 7: PIR sensor

Objects with a temperature higher than temperature emit energy within the variety of radiation. Usually this radiation isn't visible to human eye as a result of it radiates infrared wavelength however it may be detected by device designed for such a purpose. The term "passive" means that sensor is not using any energy for detecting purposes, they work entirely by detecting the infrared radiation (radiated heat) emitted by or reflected from object.

G. Turbidity Sensor

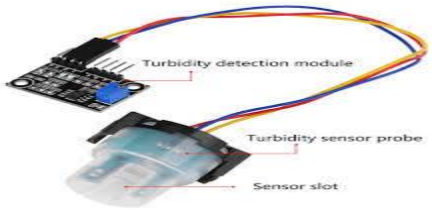


Figure 8: Turbidity sensor

Turbidity sensor is used to monitor the quality of the water based on solid particles present in the water. It works on the principle of emitting of light and the scattering of light. Water flows between the 2 projectionsof the clear plastic wall. The phototransistor emits lightweight rays that square measure alleged to reach the photodiode. These lightweight rays come upon the water flow and lose their path once they meet any suspended particle within the water. The amount of light sent and received is conveyed to the micro controller operating the sensor and decisions are taken in accordance to that.

H. Wi-Fi Module

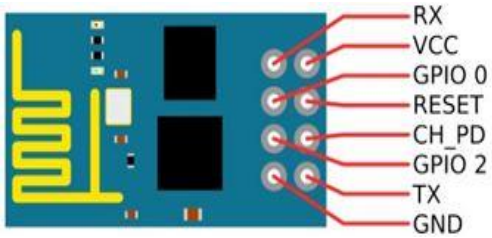


Figure 9: Wi-Fi module

The ESP8266 WI-FI module is basically, a complete solution to access the internet from the long distance, which have self-contained operating system and integrated TCP/IP protocol stack that can be easily connect to the microcontroller for gaining the access to any Wi-Fi network

I. GSM Module

GSM is combination of TDMA (time division multiple access), FDMA (frequency division multiple access) and frequency hopping. Initially, GSM use 2 bands of twenty five MHz dimension : 890 to 915 MHz frequency band for up-link and 935 to 960 MHz frequency for down-link. Later on, two 75 MHz band were added. 1710 to 1785 MHz for up-link and 1805 to 1880 MHz for down-link.



Figure 10: GSM Module

V. CIRCUIT DIAGRAM

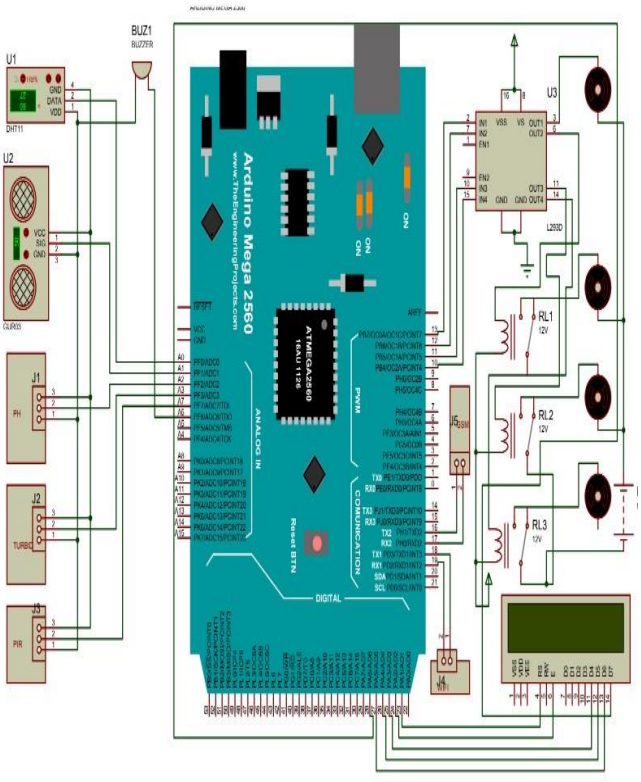


Figure 11: Interfacing diagram of proposed model

VI. RESULTS

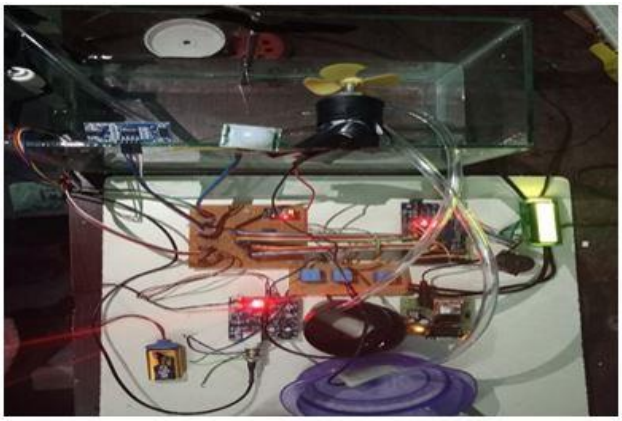


Figure 12: Electronic setup for Pisciculture Monitoring



Figure 13: Output values in LCD



Figure 14: Messages from the kit to mobile

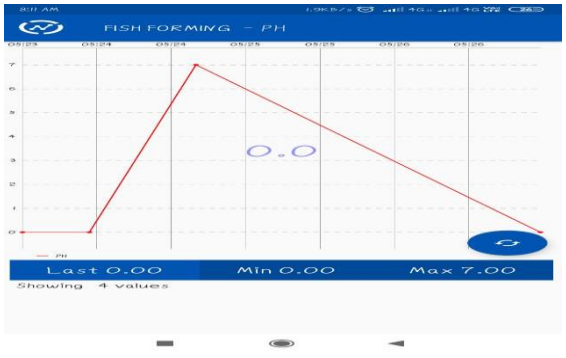


Figure 15: Monitoring pH in ThingView

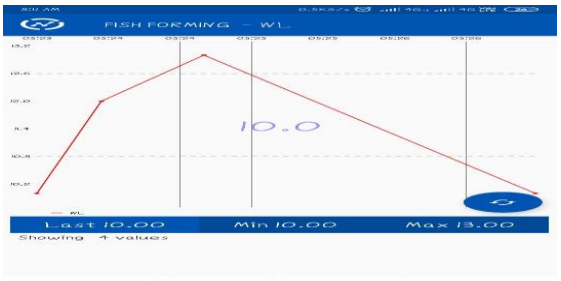


Figure 16: Monitoring Water Level in ThingView



Figure 17: Monitoring Temperature in ThingView



Figure 18: Monitoring PIR in ThingView

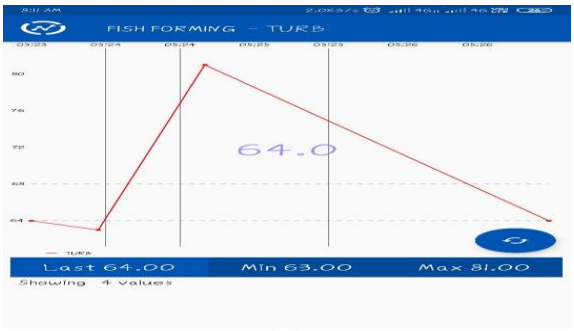


Figure 19: Monitoring Turbidity in ThingView

VII. CONCLUSION

Technological development in Pisciculture can produce more accurate control and higher economic efficiency of the system.The demand from aqua-farming folks for maintaining water quality is satisfactory because of the introduction of the watching technology. This article discussed some physical measures such as level,

temperature, turbidity, pH value and they are analyzed using Arduino mega. The resulted values are updated to the server via Wi-Fi and the time to time alerts are given to the farmer via GSM.

VIII. FUTURE SCOPE

The scope for the future techniques are detailed as follows:
By considering the various parameters like dissolved oxygen, alkalinity, hardness, ammonia, nitrites we can monitor the farm very effectively. It's very difficult to measure the growth in fishes. With the addition of camera and using the Raspberry pi controller the system can upgraded by means of security.

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Wireless Data Transmission using Visible Light Communication

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Abstract- [1]VLC (visible light communication) is an interesting background for the communication and the technology becoming more easily available due to advancement.[1] It sounds very interesting to send data through light has already approved by many researchers. Light may be connected in different topologies to increase the distance of communication. [1]Existing infrastructure may also used for VLC which is further plays an vital aspect for its popularity. VLC could replace the RF communication. [1]Transmission of data using visible light by sending data through the light bulb that varies in intensity faster than the human eye and Receiving through photo-detector. If the LED is on state, the photo detector registers a binary one; otherwise it's a binary zero. This paper deals with the wireless data transmission using visible light communication technology.
While the LI-FI based system are used to transfer the data from one computer to another. The main components of this communication system are high brightness LASER which acts as a communication source and silicon photo diode serving as the receiving element of the device. [2]The data from the sender is converted into the intermediate data representation, i.e. byte format and is then converted into light signals which are emitted by the transmitter. The light signals which is received by photo diode at the receiver side. The reverse process takes place at the destination computer to retrieve the data back from the received light.

Keywords- Li-If, High-Brightness LASER, photo diode ,Visible light communication(VLC)

I. INTRODUCTION

[1]Now a day's interested for this kind of communication is increasing and technology becoming more popular due to its advancement. Li-If stands for 'light-fidelity'.
Li-IF is a new way of wireless communication that uses LASER lights to transmit data activities in the fast world.[3] The main technological development that made VLC possibly cheaper, high power lights of high quality, capability of switching at the high frequencies which is undetectable to human eye. Hence have high security than RF communication schemes. [3]Since light can be used to produce data rights higher than 10 megabits per second which is faster than our broad band connection. VLC system employ visible light for communication that occupy the Line of sight(LOS).
[1]spectrum ranges from 380 nm to 750 nm corresponding to a frequency spectrum of 430 THz to 790 THz which are higher in compression to radio based system.[1] Visible light utilized to transmit data which can be utilized to enhanced version of WI-FI. Laser used should be highly efficient to manage data at high frequencies rates. The goal of the project is to create a system for transmitting high speed data through LASER which can be detected by a photo-diode embedded in an integrated circuit (IC) due to its impact size and high sensitivity. In the next section, the system design and the experiment setup is been described.

II. PROPOSED SYSTEM

This proposes a Li-IF based system to transfer data from one device to another device using visible light spectrum. The proposed system consists of Li-IF transmitter and receiver circuits with LASERS, photo-detector, battery, connecting wires and USB or COMM port.[3] Hence,the sending device will select some data to the transmitter circuit by the sender's device. The LASER'S in transmitting circuit will transmit this data and the photo detector of the receiver circuit will receive this data from the light source and will send it to the receiving units of the devices which in interpret and obtain the final data that was send by the sender.[4]In this pro-type the audio is also send by the transmitter by using microphone and received by the audio speaker which equipped in receiver section. So that visible light can also be used audio purpose instead of using text transmission. So this proposed system will converges, the transmission of both text and audio which are provided in the system design.

BLOCK DIAGRAM :

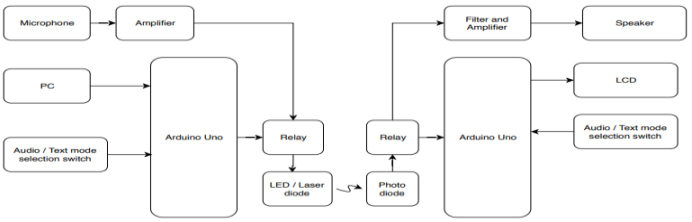


Fig.1:Block diagram.

III. SYSTEM DESIGN

The experimental set up and practical block diagram of VLC communication has been designed .[4] In the present prototype, an optical which a photodiode of dimensions and responsively of 0.45 A/W is used. Photo diode generates a voltage according to the intensity of light fallen on the photo diode. Hence Photo diodes are widely used to generate electric solar power and now it can be utilized for data communication also.

[1]In the developed system, a digital square waveform is been transmitted with the help of LASER and received by the optical receiver. The transmitted signal is received at the receiver is obtain with some noise which further may be passed through a filter to get the accurate signal.

VLC can be used both for data transmission and illumination. It uses visible light spectrum range from 380nm to 780nm. Since, Air is used as a transmission medium. [1]It has many advantages in compression of the present RF communication system like high band width, low power consumption, can use existing infrastructure, high security and many others.

A. Transmitter:

LASER: LIGHT AMPLIFICATION BY STIMULATED EMISSION OF RADIATION.

[5]While LASER, will emits the light as a result of striking the atoms and complex them to release the similar photon. The light emitted by the LASER consist of various colors. while the layout beam produced by the LASER consist of a single color.

B. LIGHT SOURCE:

The most important requirement that a light has to the meet in order to serve communication purposes is the ability to be switched on and off repeatedly in very short intervals. Hence LED and LASER illumination exist everywhere, it is expected that the LED illumination device will act as a lighting device and a communication transmitter simultaneously everywhere in a near future.

Typically, red, green, and blue LASER's will emit a bond of spectrum, depending on the material system. The white LASER's drawn much attention for the illumination devices. Comparing the LASER illumination has many advantages such as best utilization, high efficiency, environment –friendly manufacturing, design flexibility, long life-time, and better spectrum performance.

Laser works on the principal of stimulated emission and LED works on the principle of Electro-luminance. While laser emits light as a result of striking the atoms and complex them to release the similar photon.

C. Receiver:

[1]Optical received used, is manufactured by Texas Instruments and Receiver can be different types like optical receiver IC, photo diode, solar panel etc depending on the type of use.

Due to above stated and many other advantages we can employ this system at many places to transmit and receive data which is also cheaper and durable than the existing RF technology. The receiver consists of an optical receiver which senses the transmitted signal and further we can use a filter to the unwanted noises.

IV. EXPRIMENTAL SETUP OF WIRELESS DATA TRANSMISSION

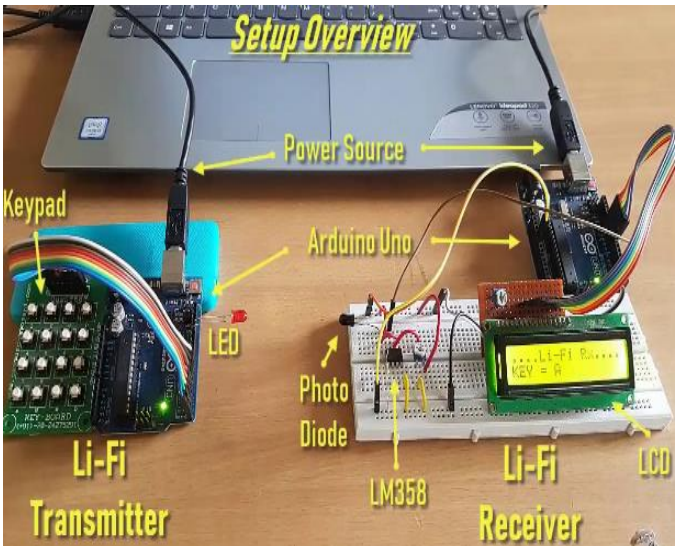


Fig.2:Text data transmission.

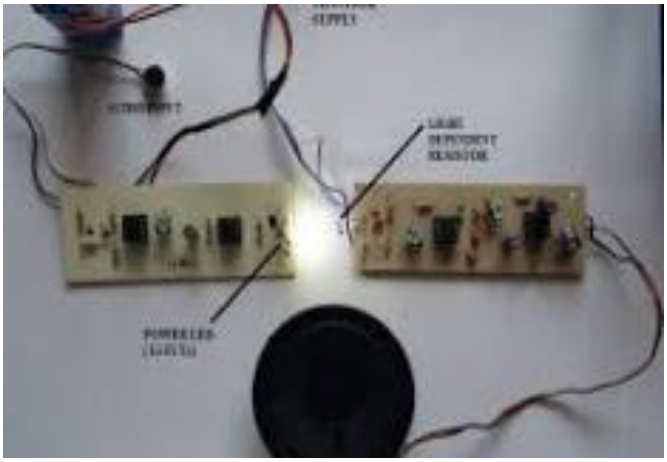


Fig.3:Audio data transmission

SOFTWARE DETAILS:

[5]Optical receiver that is mentioned the highly sensitive receiver and has a less effect of ambient light and noise source. The data reading module, data interpretation module and data display (GUI) are implemented in this software module.

The software that performs the task of selection of data to be sent, reading the data to be sent the data conversion at the sender's side.[6] First, the user selects the COMM port to

which the circuit is connected and the other required settings for communication. [7]Then the user interface appears which allows to communicate with the receiver and send text, audio. The data to be send is sent is selected by the user and the software reads this data. Then, this data is to be converted into byte format so that it can be send to the transmitter circuit.
[3]The Encryption can also be performed on this recited data. Finally, this data is send in the form of light through LASER. At the receiver side, the receiver circuit captures the light signals, converts them into bit sequence and sends this bytes of data to the software. This plain of text is the received data. The received data is then displayed on the receiver's device as output.Fig3.2 shows the transmitted data and received data, this verifies that the optical data can be transferred via LASER efficiently at a medium distance with line of sight (LOS) transmission of data. In addition, to the data transmission rate could be enhanced by using fast switching LASER's.[5] The test were carried out indoor under ambient light conditions .Large coverage of area for transmission can be obtained by using LASER light.

V. APPLICATION

- Intelligent street light system.
- Special road system to pass priority vehicles fatly.
- Providing data in flight
- Industrial and school/college.
- Household application and many other can achieved using VLC.

VI. ADVANTAGES

[3]LI-FI works on visible light technology. Since homes and offices have already have light bulbs for lighting proposes, the same source of light can be used to transmit data. [1]Hence, it is very efficient in term of costs as well as energy, light must be ON to transmit data, so when there is no need for light, it can be reduced to a point where it appears OFF to human eye, but is actually still on and working.

- Visible light's large frequency spectrum bandwidth
- There is no EMI.
- Visible light communication requires much less power compared to RF communication
- Visible light cannot penetrate through the walls, so Indoor Visible light communication is comparatively secure.
- Visible light usually poses no health hazards to human body and eyes

VII. CONCLUSION

[3]In this paper, a real time audio broadcast prototype off the self LASER are used, it is envisaged that using commercial LASER lamps would results in higher distance of transmission. It is shown that transmission of high quality audio with the medium distance can be achieved.
The improvement can be made by using adding focusing lens between the transmitter and receiver. In the data transmission prototype, the encoding and decoding can be used in transmitter and receiver part to reduce the error in

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Design and Implementation of IoT Based Smart Shopping Cart using RFID Technology

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Abstract- Electronic Commerce has become extremely popular with the rise in wireless technologies and other communication techniques [4]. In this paper we are discussing about the "Smart Shopping Cart using IoT" for the real time applications. The entire system is designed using the single board processor with the 1GHz processing speed i.e., raspberry-pi. The single board processor is different from the normal computers that is having the on board memory, wifi module, onboard processor etc. In this we are using the RFID (Radio Frequency and Identification) technology a term that sums up all the technologies that use radio frequencies to identify the objects. In this RFID technology both the RFID reader and tags are used for reading the information from the tags. The tags consist of the respective product information and it gets read by the reader. The RFID reader will read the tag data and the amount and it will be sent to the server using the wifi module with operating frequency (2.4GHZ) with IEEE 802.11b/g standard used for communication. The wifi module can transmit and receive the data with 115200 baud rate. Here we are using the python language for programming the kit. The SQL (structured query language) is used for communication with the database, personnel home page which is an open source and popular language for web development which is an HTML embedded. Hypertext transfer protocol is used to serve the files in the form of web pages to users with respect in their requests, which are forward by HTTP clients. It is used to establish the channels between the IOT system and database in the client.

Key Words- RFID technology, decentralized billing unit, IOT, cloud computing.

I. INTRODUCTION

In the present days with the increase in the technology the food items are available at our door steps without any human effort. But going to the mall and the things what we need is more advantageous and useful for us. At the same time it is having disadvantages also like mainly the important reason is waste of time by standing in the long queues for the payment of the bill. While coming to advantages we can judge the product quality and quantity by seeing the product structure and verifying that the product is not having any damages. So in order to overcome all these problems we are introducing the smart shopping cart has additional features which will be helpful for the customer and the shopkeeper. In this the stock level will be updated whenever the products are sold out. The main technologies that play an intense role in this project are as follows: 1) A single board computer which is used to connect to the server wirelessly. 2) RFID tags and reader for the product information and details. 3) Infrared sensors which are used to know the product count. 4) Creation of the web application for the display of the total amount of the customer and the remaining product count to the shopkeeper.

RFID technology is the latest and fast growing technology in the present. RFID means Radio Frequency and Identification in which the small tags are present which are added to the tags. In this systems RFID readers are used which will wirelessly read the information of the RFID tags based on the inductive coupling technique. The rfid reader will collect the information about the products that are stored predefined in the database. Thus it identifies the object automatically and collects the information regardingly. The small tags used are a passive tag which consists of a small chip inside it.

II. EXISTING METHOD

In the existing model the mainly used technology is the barcode scanner in most of the shopping malls. The barcode represents a series of thick black lines which are of different widths and separation between those lines. These lines can be coded into the data or information. Each product is equipped with the barcode and it is scanned by the barcode scanner. The data stored in the PC of respective barcode will be displayed and the total amount will be added and the total bill will be generated**.**

Barcode scanners are mainly made up of light source, photo diode, camera based scanners or simple decoders. In this the barcode scanner scans the black and white elements of the barcode by illuminating the code with a red light, which is then converted into the matching language.

III. PROPOSED METHOD

In the proposed system we are using the latest RFID (radio frequency and identification) technology. In this it is having mainly 2 components such as the RFID tags and the RFID reader.

These tags are attached or incorporated to the products for the purpose of the identification using the radio waves. The tags used are the passive tags or battery less tags or chip based tag which consists of the chip and antenna. In this paper we have developed a smart shopping cart that allows the user to manage their list while shopping and easily pays the bill at the exit door. The cart is equipped with the kit that displays the total amount of bill for all the products which are placed inside the trolley. By this process it is easier for the customer in knowing of how much bill they should pay. By this way time will be saved and customer gets the faster service. This will be helpful for the shopkeeper in reducing the cash counters.

A. BLOCK DIAGRAM

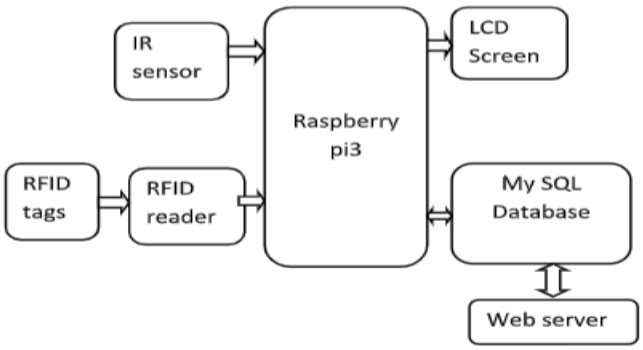


Fig.1: Proposed block diagram

B. FLOW CHARTs

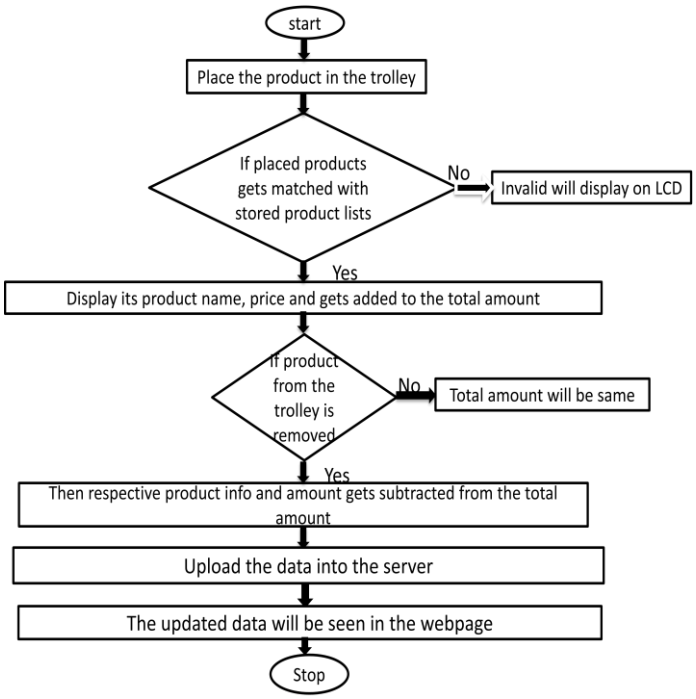


Fig.2: Proposed flow chart

C. Raspberry pi3:

It is the third generation raspberry pi. This is faster than the previous models such as Raspberry pi model B+ and Raspberry pi2 model B. it is the single board computer can be used for various applications and implementations. The processor used is Broadcom BCM2387 chipset with 1.2GHz Quad-Core ARM Cortex-A53 (64bit). The wireless LAN is IEEE 802.11 b/g/n with the Wi-fi protocol as WEP<WPA WPA2, algorithms such as AES-CCMP (maximum key length of 256 bits), the maximum range of 100 meters. The Bluetooth is IEEE 802.15 which uses symmetric encryption algorithm, advanced encryption standard (AES) with 128 bit key and the maximum range of 50 meters. This is operated with 5.1V micro USB supply. Generally it uses 700-1000mA depending on what peripherals are connected to it. This power requirement will increase depending on different interfaces attached to it. The graphical user interface is the 400MHz video core. The RAM size is 1GB RAM and 64 bit CPU. The network connectivity is the 1x10/100 Ethernet. There are total 4 USB ports. There are total 40 pins out of which there are 28 GPIO pins and each pin uses16mA. The HDMI port uses 50mA and the camera uses the 250mA and the key board and the mouse uses 100mA. It is having micro SD port for loading your system and storing the data.

D. IR Obstacle Sensor:

On the basis of the simple idea the IR sensor is easy to built, easy to calibrate and provides a detection range up to 10-30cm. the frequency of the IR sensor is more than the microwave and less than the visible light. This is mostly used in the indoor applications where there ambient light is present. In this the basic idea is to transmit the infrared light through the IR-LED'S, which are reflected back when it hits an obstacle. The object can be anything which has certain shape and the size. The infrared technology is used widely in wireless applications. Here the IR-LED will transmit the signal and when these are hit by an obstacle they get reflected back and are received by the IR-receiver which may be either the photo diode or photo transistor which is used to decode the signal. In the electromagnetic spectrum the infrared area is mainly divided into the 3 regions such as near, mid and far field regions. These are divided based upon the wavelengths and their applications [3].

Region	Wavelength	Application
1) Near field region	700 nm to 1400 nm	Fiber optics
2)Mid field region	1400 nm to 3000 nm	Heart sensing
3)Far field region	3000 nm to 1 mm	Thermal imaging

The ir sensor is having mainly 3 pins such as: 1) active high output, 2) power supply ground, 3) power supply input. The

operating voltage is +5v DC regulated and when any obstacle is detected it is indicated by active high output.

E. RFID System:

An RFID system consists of RFID reader, RFID tag, information managing host computer. The reader consists of RF transceiver (transmitter and receiver), a signal processor, a control unit, a coupling element and a serial data interface to the host system. The tag used is the passive tag which acts as a programmable data-carrying device. The passive tags which no battery on it has called as battery less tags. The absence of the power supply makes them cheaper and reliable. The RFID systems in the market are divided into two categories: near field systems and far field systems. There is a distance commonly known as the "radial sphere" inside which one is said to be near field and the field outside is the far field region. The near field systems are used for the systems operating in the LF and HF bands which are relatively short reading distances. In this the coupling technique used is inductive coupling. The tag properties are as follows:

Tag Type	Passive
Technology	Inductive Coupling
Frequency	125 KHz / 134 KHz
Read Rage	Short (few cm to Inches)
Read Speed	Slow
Works with Metal	Yes
Works with Liquids	Yes
Cost	Low

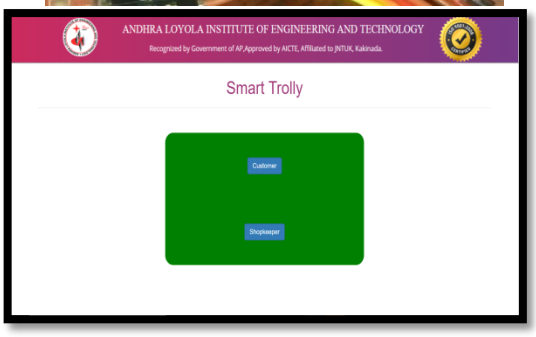
F. LCD Display:

LCD (Liquid Crystal Display) is an electronic display module and finds the wide range of applications in today's world. There are varieties of LCD's in the market. Here we are using the 16x2 LCD which is the very basic module and commonly used in the various devices and circuits. 16x2 means it can display 16 characters per line and there are 2 such lines.

IV. RESULTS AND DISCUSSION

The system has been implemented with the above mentioned features and put into the use. With the help of this system the user can know the information of the shopping and the manager knows the stock information. This system can be easily arranged in the cart and it is feasible.





V. FUTURE SCOPE

In future we can pay the bill at the cart itself after shopping and we can predict the products that are needed excess in the future based on the sales in the present. By placing a screen on the cart we can select the list of products we want to purchase and we can also know where the product is located in the market (by placing a location sensor mapping can be made possible). By inserting the load cell we can know the weight of the products. By implementing this if any object is not read by the reader it will give an error by checking the weight of products in the cart.

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Automated Fire Detection and Fighting Robot using IoT

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Abstract - In the development of robotics, the human involvement is becoming less and robots are being used widely for the safety purpose. Now-a-days fire accidents are becoming common and it sometimes lead to accident that makes it hard for fireman to protect the human life. Our proposed system is used in these situations where it is difficult to protect. We designed a robot which is operated in two modes- Automatic mode & Manual mode. In Automatic mode, the robot is operated by itself based on the command defined by the user. In Manual mode, PHP webpage is used to control the robot in remote locations using IoT. The switching from Automatic mode to Manual mode can be done by using PHP webpage.

Keywords - Raspberry Pi 3, IR sensor, DC motor, fire detection, L293D Driver IC, IoT.

I. INTRODUCTION

As the robotic technology have becoming improved and plays an important role in our day to day life. The protection of human life from the fire accidents is also plays a crucial role for fireman. This system is developed to find an alternate solution for human work and efforts with the improvement in technology of embedded system particularly when fire hazards occurred. The fire sensors are positioned by estimating the range of fire detected and placed in various directions. The Ultrasonic sensor is connected with Raspberry Pi 3 for obstacle avoidance. Whenever the fire is detected water pump is turned ON to extinguish the fire. To sprinkle water in various directions the water pump is connected with servo motor to rotate in various directions.

II. LITERATURE SURVEY

A. Existing System - Automatic systems that are developed in the stream of robotics can't be controlled manually when needed. Manually controlled robot can be operated by the human in the vicinity of fire which can be harmful.

Drawbacks of Existing System

- In some situations the robot may get lost from the field of fire.
- Operation of manually controlled robot is limited in the existing system.

B. Proposed System - In this system, we have implemented both Automatic and Manual mode of operation to overcome the drawback of the existing system. Manually controlled robot can be operated from anywhere by using the PHP webpage. The fireman work can be minimized by operating the robot in Automatic mode.

The advantage in this system is we can switch from Automatic to Manual mode whenever we need.

D. Proposed system Modules -

- The manual mode can be operated by using controls on PHP web page that contains Left, Right, Front and Back.
- To avoid obstacles, we are using Ultrasonic sensors.
- There is a possible to switch between Automatic and Manual modes.
- We can detect the fire in various directions of front, back, left and right by placing various sensors in different sides of robot.

III. HARDWARE REQUIRED

The movement of the robot can be done by using four-wheeler motor with L293D Driver IC which is used to control 100RPM motor. Raspberry Pi 3 is used as a controller to read the values from the sensors and sends the signals to control the robot movement. The Ultrasonic sensor is used for avoiding the obstacles when the robot is in moving condition. In order to sprinkle the water we are using water pump connected with servomotor in what direction the sprinkling is needed.

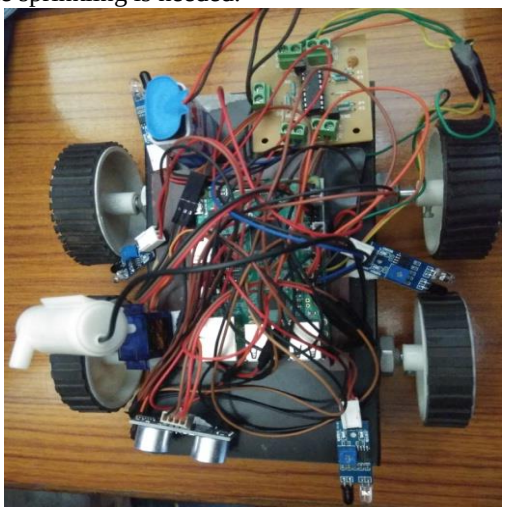


Figure 1: Top view

The IR sensors are placed in various directions for the detection of fire in what direction the fire is occurred. The Ultrasonic sensor is not only used for obstacle avoidance but also used to maintain a safe distance from fire source to robot.

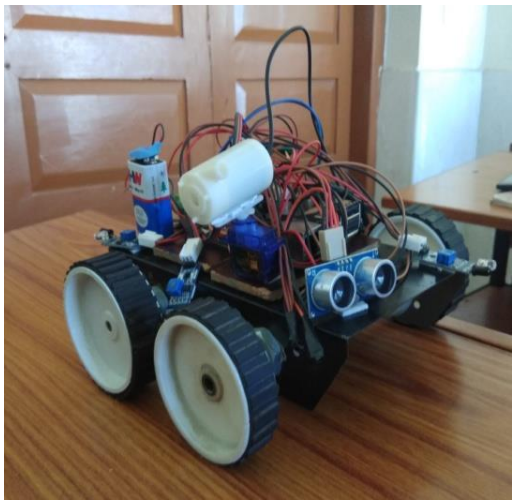


Figure 2: Front view

The movement of the motors can be achieved by providing the power supply of 9V DC. In that case we are using a battery connected to Driver IC L293D.

IV. SOFTWARE IMPLEMENTATION

The controller used in this system is Raspberry Pi3 microcontroller which is programmed using Python language. When it is powered ON, the Raspberry Pi 3 initializes the GPIO pins as outputs, in order to send the controlling signals to Ultrasonic sensor.

If the fire is detected, the servo motor rotates in that direction and sprinkles the water. This can be achieved by the predefined commands given to the microcontroller.

In manual mode, the robot is controlled from the PHP webpage from the different location. This can be done through IoT.

V. WORKING

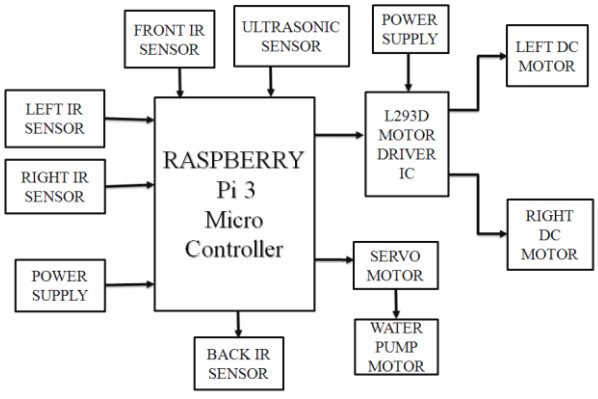


Figure 3: Block Diagram

Initially the robot is in moving condition in forward direction, the ultrasonic sensor reads the data whether the obstacle is presented or not. When the fire is detected in left side of the robot, it will rotate in left direction, stop the action and the servo motor is rotated in that direction and the water pump is turned ON to extinguish the fire.

This action can be done in automatic mode in what direction the fire is detected the motor will rotate in that direction and stops the movement and the servo motor has to rotate in that direction with sprinkling of water. In manual mode, the mode is switched from the automatic to manual mode on PHP webpage. If it is switched, the robot controls can be available on that page to operate the robot in remote locations.

A. Manual mode - In this mode, the controlling action can be done by using PHP webpage where we can send commands to motor driver through GPIO pins of Raspberry Pi 3 to move in required direction.

The PHP webpage contains the following commands:

1. Forward
2. Back
3. Turn left
4. Turn right
5. Stop
6. Motor ON
7. Motor OFF
8. Back right
9. Back left

There is also a control to switch between automatic and manual modes.

B. Automatic mode - In this mode, the robot initially in forward direction when the obstacle is detected the robot stops and moves in another direction. When the fire is detected, the robot will do its operation based on the predefined commands provided in the program. Only one thing to do is, we have to select the automatic mode in PHP webpage.

VI. FLOW CHART

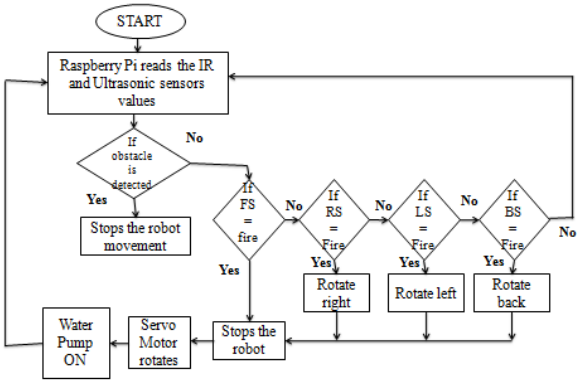
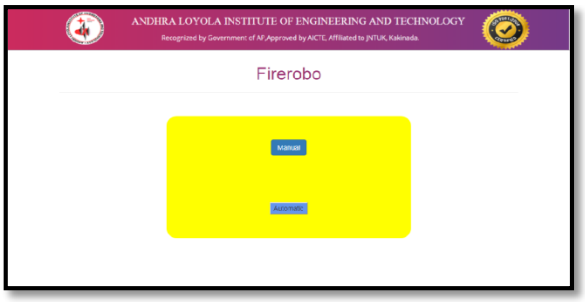


Figure 4: Flow chart for proposed system

VII. RESULTS

This system is capable of detecting fire and extinguishes the fire successfully. The robot is in continuous rotation whenever the fire is detected; the robot will rotate in that direction and extinguishes the fire.



VIII. CONCLUSION

In order to reduce the manual work we are introducing the "Fire Fighting Robot" with the above mentioned features. This robot can work automatically or manually based on our requirement. It is easy to control and feasible.

IX. FUTURE SCOPE

- Implementation of this robot with addition to the camera can be monitored and controlled from anywhere using PHP webpage.
- By inserting the camera we can visualize to what extent the damage has been occurred.

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Design and Simulation of Loop and Dipole Antenna over Polarized AMC Surface

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Abstract **-** In this project, we are implementing dipole and loop antennas over Artificial Magnetic Conductor (AMC) surface. The AMC surface is well known to achieve low-profile and low return losses. It is also known as Electromagnetic Band Gap (EBG) surface. AnAMC surface with a rectangular unit cell was adopted for two orthogonal polarizations with two different frequencies to achieve high output power. Dipole antenna and loop antenna are placed over polarized dependent AMC surface in order to reduce ground losses. . In existing method there will be more return losses due to normal surface. So we proposed this method. Finally, the performance characteristics of both loop and dipole antennas will be observed and compare the return losses of both antennas by using with and without AMC surface .At last the loop Antenna with dipole Antenna are compared.

Keywords **-** *AMC surface, EBG surface, polarization*

I. INTRODUCTION

RF sources which are, broadly available and stable are digital TV broad casting and Mobile phone services. As power flux density of those ambient radio waves is very low, it is preferable to capture both frequencies so as to obtain as much RF energy as possible. In UHF band, loop and dipole antennas for digital TV's and cellular bands were designed. For the 500MHZ and 875MHZ bands, loop antennas and dipole antennas may be considered appropriate because these antennas are used for transmitting and which have high input impudence. These antennas with AMC (Artificial Magnetic Conductor) surface is mainly used for RF energy harvesting in dual band. To achieve efficient reception, a reflector is used which is AMC surface is used which is similar to EBG (Electromagnetic Band Gap) in order to achieve low return losses and low profile structure. The AMC surface is two-dimensional artificial ground plane that comprises of a metal ground plan and periodically arranged metal patches on top as shown in the Figure 1.1.Each patch is connected to the ground plane with a metal post ,and is so called a mushroom structure .The surface has been researched in many ways .

Due to the periodic nature, surface waves on the structure are forbidden to propagate at
frequencies with the electromagnetic band gap .Another important feature is the property that radio waves incident on the surface are reflected without any phase change, at a frequency with the band gap, as if the surface were a magnetic conduction .Therefore it is also called an Artificial Magnetic Conductor (AMC). AMC surfaces can be much closer to antennas because the phase of the reflected waves do not change .Therefore a low profile of the antenna structure can be achieved while retaining high radiation efficiency .from the view point of fabrication simplicity ,it is important to note that the AMC property can be exist without a metal post via the printed circuit board architecture .However ,the EBG property which forbids surface waves and prevents degradation of the radiation pattern, is known to move away from the exhibiting the AMC property when the metal posts are removed. From the view point of designing an antenna over an AMC surface, driving-point impedance of the antenna is a very important parameter for impedance matching with the load or source

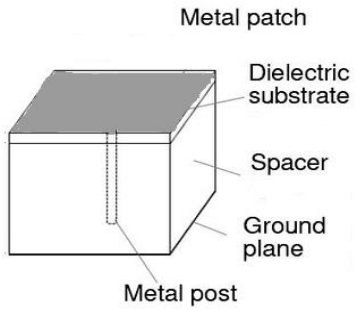


Figure 1.1 AMC unit cell

II. EXISTING SYSTEM

In this loop antenna and dipole antenna is designed without any surface due to this there are many losses for instance return losses are more in the case of loop antenna and dipole antenna without AMC surface due to more return losses the Voltage Standing Wave Ratio (VSWR) is greater than unity. Due this there are more ground losses. Due to this an antenna has the same radiation pattern over perfect ground in free

space with the twice the voltage An image antenna is an electrical mirror image of an antenna element formed by the reflecting from a conductive surface called a ground plane , such as the surface of the earth .It is used as geometrical technique in calculating the radiation pattern of the antenna .

III. PROPOSED SYSTEM AND IMPLEMENTATION

Here we placed the loop and dipole antenna over polarized AMC surface , by placing an AMC surface the waves incident on this surface reflect without any phase changes as shown in the below Figure 3.1 and Figure 3.2. Hence reflections will be less, therefore there will be less return losses as shown in the Figure 4.1 and Figure 4.2.

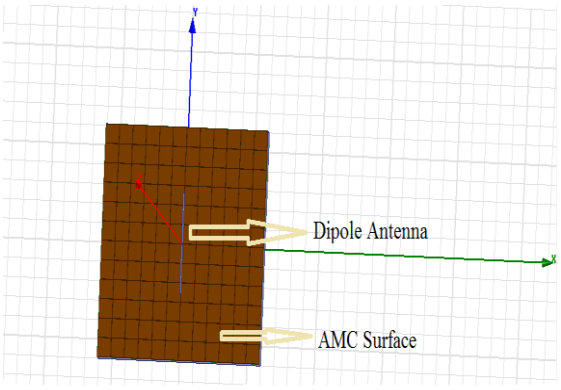


Figure 3.1.Dipole antenna over AMC surface

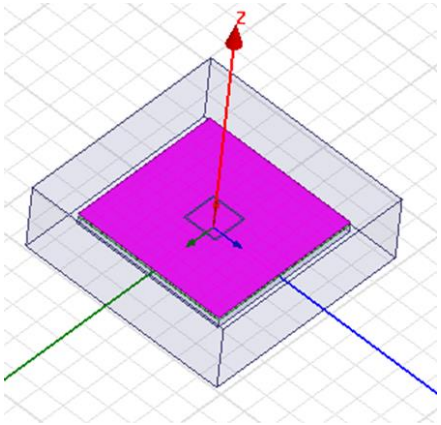


Figure 3.2 Loop antenna over AMC surface

IV. PERFORMANCE & DIFFERENCE BETWEEN EXISTING AND PROPOSED SYSTEM

In existing method, the reflections will be more. Due to more reflections, the return losses will be more. It is one of the main disadvantage. The another disadvantage was that the value of VSWR ranges greater than 1. So we placed an AMC surface instead of normal surface. The main advantage of the AMC surfaces is there will be less reflection. Hence there will be low return losses.

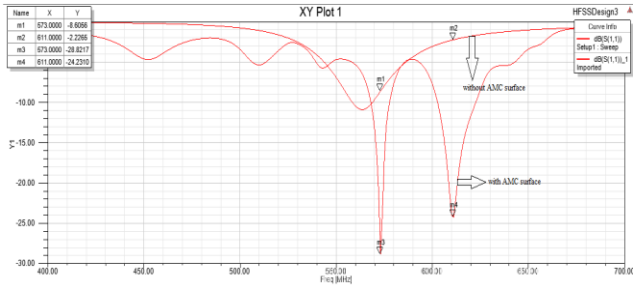


Figure 4.1 Return losses for loop antenna with and without AMC surface

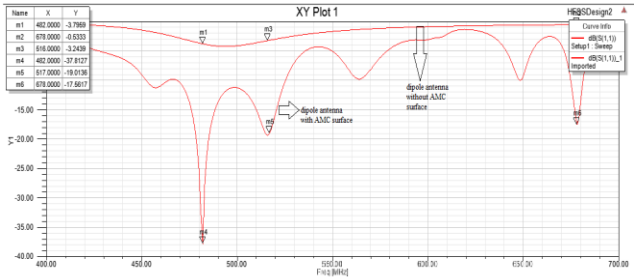


Figure 4.2 Return losses for dipole antenna with and without AMC surface

V. RESULTS

Finally, the return losses have reduced by using an AMC surface. Hence loop antenna is used for narrow band applications and dipole antenna is used for broad band applications is as shown in the Table 5.1 and Table 5.2. The main application of this design is dual band RF energy harvesting which is used to retrieve more power and store the energy for long time.

Table: 5.1 comparison of dipole antenna with and without AMC surface

PARAMETER	DIPOLE ANTENNA WITHOUT AMC SURFACE		DIPOLE ANTENNA WITH AMC SURFACE	
	482MHz	678MHz	482MHz	678MHz
RETURN LOSSES(dB)	-3.79	-0.53	-37.81	-17.56
VSWR	4.64	5.41	1.02	1.24
REFLECTION COFFICIENT	0.645	0.68	0.009	0.107

Table 5.2 comparison of loop antenna with and without AMC surface

PARAMETER	LOOP ANTENNA WITHOUT AMC SURFACE		LOOP ANTENNA WITH AMC SURFACE	
	573 MHZ	611 MHZ	573MHZ	611MHZ
RETURN LOSSES (dB)	-8.60	-2.22	-28.82	-24.23
VSWR	2.18	7.84	1.07	1.13
Reflection Coefficient	0.37	0.77	0.03	0.06

VI. CONCLUSION

Finally, with a view to applying the loop antenna and dipole antenna over an AMC surface for dual-band RF energy harvesting applications, a polarization dependent AMC surface (rectangular unit cell) was studied. The experimental results proved the dual-band operation of the polarization dependent AMC surface with loop and dipole antennas and also the validity of the simulations. Therefore the performance characteristics of both loop and dipole antennas will be observed and compare the return losses of both antennas by using with and without AMC surface. Hence we can conclude that loop antenna is used for only narrow band whereas dipole antenna is used for broad band.

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Optimization of Shell and Tube Heat Exchanger Design in Organic Rankine Cycle System Using Kinetic Gas Molecule Optimization

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Abstract: Among various types of heat exchanger, Shell and Tube Heat Exchanger (STHX) is highly used in the industrial application. The thermal efficiency of the heat exchanger is considered as a major factor for many applications. A considerable amount of heat is present in the low-temperature geothermal heat source, which is not sufficient to generate the electricity due to its low temperature. Many researches have been made to increase the thermal efficiency of the exchanger by the using of Organic Rankine Cycles (ORC). In this research, the Kinetic Gas Molecule Optimization (KMGO) is used to find the optimized parameter settings for the power plant. The geothermal ORC system is developed in the simulation and other various factors are considered to optimize the performance. The TEMA NFN STHX with a double-segmented baffle is analyzed for single-phase flow model. The different aspects such as baffle cut, baffle leakage, etc., are given as input to the heat exchanger. The proposed technique is evaluated with two different fluids such as R245fa and R134a. The KMGO technique is based on the swarm behavior of gas molecules, which is used to provide the optimized performance. The simulated results are measured and compared it with the existing methods for validation of the performance. The outlet temperature is achieved as 64.52°C and the enhancement factor is achieved as 1.88 for the R245fa fluid in STHX. This is achieved due to the KMGO technique identifies the global minima effectively due to the kinetic gas molecules theory, which shows the high efficiency compared to the existing method.

Keywords: Double-segmented baffle, Geothermal heat source, Kinetic gas molecule optimization, Organic rankine cycles, Shell and tube heat exchanger, TEMA.

1. Introduction

A heat exchanger is a device which is used to recover the thermal energy between fluids, present at different temperature [1]. Heat exchangers are highly used in industrial applications and there are a number of heat exchangers available. The design of heat exchanger consists of many geometric and operational parameters to provide heat transfer while meeting the set of constraints [2]. The STHX is highly used heat exchanger due to its reliability, robustness and versatility. The segmental baffle is a common baffle in the STHX that is highly used in petrochemical industries, waste heat recovery, power generation, air-conditioning and so on [3]. The segmental baffles in heat exchanger provide an improvement in heat transfer of the exchanger [4]. Geothermal power generation showed strong growth in the past decades and the electrical capacity are increased 15.9% in between the 2010 and 2015 [5]. The global energy crisis and the environmental awareness, create the demand for the renewable energy and these energies are promoted by the developed countries.

The environmental awareness causes to an exploitation of technology of power generation from low-medium temperature heat sources [6]. Much research has been carried out to improve the heat efficiency of the exchanger by using ORC. There are only few studies available for the detailed optimization of the heat exchanger, in terms of efficiency and economic [7]. Artificial Bee Colony (ABC) method has been presented to the optimization of the STHX and their result showed that the ABC provided higher efficiency compared to the

traditional trial and error method, and conventional Genetic Algorithm [8]. NSGA-II algorithm is applied to the heat recovery in the power system of hybrid PV-diesel [9]. A lot of methods have been followed in the recovery of waste heat or to reduce environmental pollution and energy shortage problem [10]. In this paper, an optimization technique is used to identify the parameters for an effective system of heat transfer. A number of parameters of the heat transfer considered for the KGMO method and outcome of that is analyzed. The fluid used in this method are R245fa and R134a, based on the consideration of the operation conditions cycle and its environmental-friendly characteristics. Different kinds of parameters are given as input to KGMO technique to achieve optimization. The various outcomes have been measured and compared with an existing method for the analysis of efficiency. The simulation result showed that the proposed optimization in STHX has higher performance compared to a state-of-art method.

The paper has been organized as, section 2 contains literature survey, section 3 presents problem definition, Modelling of STHX is in section 4 and Simulation results is provided in section 5.

2. Literature survey

The latest research related to STHX with different aspects are analyzed in this section. Various method in different parameter settings of exchanger were analyzed in this section.

I. Milcheva, F. Heberle, and D. Brüggemann [11] proposed the Taborek version of the Bell-Delaware method for the specific heat exchanger design and the calculation method was applied to the main geometrical parameters like cross flow area, effective number of tubes in the overlapping regions and leakage areas. The simulation was carried out in DYMOLA 2015 FD01 and the achieved outcome was validated by the data of real power plant and the deviation were measured up to 1.14 %. The enhancement factor J_x was developed and the heat accuracy was attained due to the application to other STHXs with double-segmental baffles. The Taborek version of the Bell-Delaware method was validated by CFD simulated in the ANSYS FLUENT 15.0. The experimental result showed that this method has a higher efficiency in simulation. The function of different fluid is required to test on the simulation for effective performance.

D. Walraven, B. Laenen, and W. D'haeseleer [12] presented a first step toward the optimization of ORCs by optimizing the cycle parameters together with the configuration of STHX. Every heat exchanger has the optimal allocation of a few parameters like heat exchanger surface, pressure drop and pinch-point-temperature difference in the boundary conditions. The different tube configuration was evaluated in this research and concluded that the 30°-tube configuration was used for the single-phase heat exchangers and the 60°-tube configuration was used for the two-phase heat exchangers. The subcritical cycle performance can be increased by adding a second pressure level in the device. More component in the device should be evaluated for better economic optimization.

D. Walraven, B. Laenen, and W. D'haeseleer [13], optimized the plate heat exchanger or STHX together with the cycle configuration. This technique can be applied to the heat exchanger for optimal allocation of some parameters for the given boundary conditions. ORCs with the plate heat exchanger performs better than the ORCs with STHX. The plate heat exchanger has the same geometry on both sides, which can cause the inefficiency. This research showed the influence of the cooling fluid inlet temperature and mass flow on the efficiency of the power plant. This work didn't consider Coolant and additionally effectiveness of the system is needed to measure along with coolant.

F. Calise, C. Capuozzo, A. Carotenuto, and L. Vanoli [14] simulated the model and the model is based on the zero-dimensional energy and mass balances for all the components of the system. This method is also related to the geometrical and design parameters of its components, especially in the case of heat exchanger. This method evaluated the energy and economic performance of STHX in different conditions and design criteria. This allowed to set the geometrical parameters of heat exchanger and evaluated the off-design performance of the system. Hence, this is a useful tool in the preliminary design of the plant. The effectiveness of the ORC is decreased due to increase of the condensing pressure.

S. Cao, J. Xu, Y. Li, and Y. Yan [15] analyzed the condensation of R245fa fluid in a shell-tube condenser. This research suggested that the condenser to operate at weakly inclined flow to reach better thermal performance. Flow patterns and liquid height signals explored the condensation heat transfer mechanisms. The flow is stable in the inclined down-flow and unstable for inclined up-flow, which was caused by the vapor-liquid interface wave. Non-dimensional parameter analysis identifies the competitions between inertia force and gravity force. The vapor-liquid interface wave is the process to improve the condensation heat transfer for inclined up-flow, and it processed while the decreased liquid

film thickness on the tube bottom. That also enhances heat transfer for inclined down-flow. A correlation based on the Froude number of vapor phase successfully matched the experimental data. This method is useful for the condenser design and operation of ORC. This method needs to be investigated for the various fluids to analysis the performance.

3. Problem Statement

The heat exchanger used in the industries are mainly focused on the maximum efficiency of the heat transfer in long period. There are many problems in using the STHX and some of them are listed below.

- STHX system requires high cost of manufacture and minimizing the manufacturing cost of the heat exchanger with high efficiency helps the manufacturer to cope with the competitor. Most of the previous research mainly focused on the heat efficiency of the system without considering the cost and cost efficiency.
- The coolant temperature in the cooling system is one of the important parameters for analysis. This is well known that the inlet temperature and mass flow have more influence on the performance of STHX.
- The pressure drop gradually increases with increase in cooling water flow rate in heat exchanger. This may increase pumping power, but it decreases the efficiency of the model power plant. However, the rate of increase in pressure drop is very small compared to rate of increase in heat transfer. Hence the rate of increase in pump work has to be reasonably minimal.

To improve the effectiveness of the heat exchanger, the important parameters are needed to consider. The proposed method is used to solve the above-mentioned issues in the heat exchanger.

4. Modelling of shell and tube heat exchanger

The ORC preheater of zone model considered in the simulation based on the research [11]. The heat exchanger is divided into several zones and each zone describes the interaction of the cold fluid, the hot fluid, the tubes and the separator. Applying the finite volume method to the developed system from the ordinary differential equations with time derivatives for each zone. This model is the simplification of the distributed models and the parameters change related to the most practical purposes. The partial differential equations used in this work to describe the distributed models. The entire heat exchanger model is implemented based on the methods followed in the research [11]. The exchanger model is designed using the cell models, these are adjusted by changing the parameters like geometry parameters, pressure drop and heat transfer information. These cells suitably modified to process the specific heat exchanger problem. Each cell model represents the control volumes or wall sections and contains the discretized equations for material and energy balance [11].

For considering simulation of the preheater, three cell types are used:

- Refrigerant cells in the shell fluid represent phase change, vapor and liquid phase present,
- Liquid cells from the geothermal fluid led into the tube, which represents the liquid phase present
- Wall cells are used for the thermal conduction of the separator and the tube walls

Shell side design consists of the Heat Transfer Coefficient (HTC) is set as same for the separator wall and at the tube wall. Simulation can support the bidirectional heat flow, i.e., from and to the walls and bidirectional mass flow, i.e., forward and backward. The specific heat exchanger conditions and temperature distributions, respectively determines the actual heat transfer and mass flow direction. Effects of flow regime and heat transfer at the front and at the rear end neglected in the simulation. The pressure drop and the heat transfer area assigned for the each and every refrigerant and liquid cell. In this context, the Gnielinski correlation implemented for the tube-side HTCs. The shell-side HTC for each refrigerant cell (R245fa) measured by using the KMGO algorithm. Pressure drop of cold fluid and hot fluid cells assigned as input parameters from the measured data. This method helps to measure the accuracy of the heat transfer correlation for the shell side.

4.1 Tube side heat transfer coefficient

To provide a fully developed turbulent flow occurs in the tube, the Reynolds numbers $R_{eD}$is set higher than 10^4 for considered load conditions. This flow regime the tube-side heat transfer correlation, Gnielinski is used in the Eq. (1).

$$Nu_t = \left\{ \frac{\left(\frac{f}{8}\right) Re_D Pr}{1+12.7\left(\frac{f}{8}\right)^{\frac{1}{2}}\left(\Pr^{\frac{2}{3}}-1\right)} \right\} \left\{ 1 + \left(\frac{d_{in}}{L}\right)^{\frac{2}{3}} \right\} \left(\frac{pr_t}{pr_{tw}}\right)^{0.11} \times Re_D \geq 10^4 \quad (1)$$

Where Reynolds number is denoted as Re and Prandtl number is denoted as pr, diameter is denoted as D. The friction factor f in Eq. (2) is obtained from the correlation of Konakov:

$$f = (1.8 \log_{10} Re_D - 1.5)^{-2} 10^4 \leq Re_D \leq 10^6 \quad (2)$$

4.2 Shell side heat transfer coefficient

For calculating the average shell-side HTC h_s, KGMO optimization technique is used. Which is shown in the Eq. (3).

$$h_s = J_c J_l J_r J_b J_s h_i \quad (3)$$

4.2.1. Kinetic gas molecule optimization

Kinetic Gas Molecule Optimization (KGMO) is a swarm-based algorithm for solving nonlinear problems, which works based on gas molecule theory [17]. The gas molecules are the agents in the search space. Kinetic energy is used for performance measurement and control [18, 19]. Considering a system with agents (gas molecules), the position of the i^{th} agent is defined in the Eq. (4).

$$X_i = (x_i^1, \dots, x_i^d, \dots v_i^n) \text{ for } i = 1,2, \dots, N \quad (4)$$

Where v_i^d represents the velocity of the i^{th} agent in the d^{th} dimension and the velocity of the i^{th} agent is presented in the Eq. (5).

$$V_i = (v_i^1, \dots v_i^d, \dots, v_i^n), \text{ for } (i = 1,2, \dots, N) \quad (5)$$

Where v_i^d represents the velocity of the i^{th} agent in the d^{th} dimension. Fundamental equations in KMGO are as below. The kinetic energy, which is defined in the Eq. (6).

$$k_i^d(t) = \frac{3}{2} N b T_i^d(t),\ K_i\left(k_i^1, \dots k_i^d, \dots, k_i^n\right), \text{ for } (i = 1,2,.., N) \quad (6)$$

Where N is the number of gas molecules, b is the Boltzmann constant and $T_i^d(t)$ is the temperature of i^{th} agent in the d^{th} dimension at time t. The velocity of the molecule is updated by:

$$v_i^d(t+1) = T_i^d(t) w v_i^d(t) + C_1 rand_i(t)\left(gbest^d - x_i^d(t)\right) + C_2 rand_i(t)(pbest_i^d(t) - x_i^d(t)) \quad (7)$$

Where $T_i^d(t)$ for converging molecules reduces exponentially over time, calculated in the Eq. (8).

$$T_i^d(t) = 0.95 \times T_i^d(t-1) \quad (8)$$

The vector $pbest_i = (pbest_i^1, pbest_i^2, \dots, pbest_i^n)$ provides the best previous position of the i^{th} gas molecule and the $gbest = (gbest^1, gbest^2, \dots, gbest^n)$ is the best previous position among all the molecules in the container. The random particles are applied to initialize the velocity and the position of each particle, which are present in the corresponding ranges. $[-v_{min}, v_{max}]$ is the limits of the gas molecules velocity. If $|v_i| > v_{max}$, then $|v_i| = v_{max}$. w is the inertia weight that shows the gas molecules resistance to slow its movement. The $rand_i(t)$ is a uniform random variable in the interval [0,1] at time t, used to provide a randomized characteristic to the search algorithm, where C_1, C_2 are acceleration constants. The mass m of each gas molecule is a random number is in the range of $0 < m \leq 1$, which remains constant throughout the execution of the algorithm as the container is consider to have only one type of gas at any one time. The random number is used to simulate different types of gases in different execution of the algorithm.

According to [18], the position is updated for each unit of time interval by:

$$x_{t+1}^i = \frac{\sqrt{2(\Delta k_i^d)}}{m}(t+1) + v_i^d(t+1) x_i^d(t) \quad (9)$$

The minimum fitness function is found using:

$$pbest_i = f(x_i) \text{ if } f(x_i) < f(pbest_i) \quad (10)$$

$$gbest_i = f(x_i) \text{ if } f(x_i) < f(gbest_i) \quad (11)$$

Each gas molecule tries to change its position (x_i^d) using the distance between the current position and $pbest_i^d$, and the distance between the current position and $gbest_i$. This method considers different effects to reduce the ideal HTC h_i on a tube bank in cross flow. A deviation from the ideal cross flow

Table 1. Correction factors considered in KMGO

Correction factor (CF)	Influences/effects taken into account
J_c: baffle cut CF	Effect of window respectively of baffle cut
J_l: baffle leakage CF	Effect of leakages between shell and baffles and between tubes and baffles
J_r: laminar flow CF	Effect of flow between inner shell wall and the tube bundle and the influence of pass partition lanes
J_b	Effect of the flow between inner shell wall and the tube bundle and the influence of pass partition lanes
J_s : unequal baffle spacing CF	Effect of unequal inlet or outlet baffle spacing different from central baffle spacing

Table 2. Heat transfer coefficient and Reynolds's number of shell and tube heat exchanger

	$\alpha_{ss,min}$	$\alpha_{ss,max}$	$Re_{s,min}$	$Re_{s,max}$	$\alpha_{ts,min}$	$\alpha_{ts,max}$	$Re_{t,min}$	$Re_{t,max}$	$\frac{\alpha_{ts,max}}{\alpha_{ss,max}}$
Unit	(W/m2 K)	(W/m2 K)	–	–	(W/m2 K)	(W/m2 K)	–	–	–
Design	1204	1219	63743	73544	14058	14245	113728	118501	11.68

regime is consider in form of several correction factors(J_c,J_l,J_r,J_b,J_s). In Table 1 the corresponding effects and correction factors are listed. The ideal HTC h_i is determined by the HTC for flow across the ideal tube bank [20].

$$h_i = \left\{ \frac{\left(j_i C_{ps} G_s (\Phi_s)\right)^n}{Pr_s^{\frac{2}{3}}} \right\} \tag{12}$$

Where C_{ps} is the shell side specific Heat capacity, G_s is the shell side mass flow rate and Φ_s is Shell side viscosity correlation factor.

5. Design and simulation result

The STHX was simulated in the MATLAB with the system specification of 8GB RAM, and Intel i3 processor. The Heat Transfer Coefficient and Reynolds's number of the STHX is shown in Table 2. For the considered load conditions, the tubes Reynolds number R_{eD} is higher than 10^4, i.e. a fully turbulent flow occurs. The Heat transfer coefficient is denoted as α and Reynolds number as Re, and subscripts like s denotes shell, ss denotes shell side, min and max denotes minimum and maximum, and time is denoted as t.

STHX is simulated in the MATLAB software and optimized parameter for effective performance. The cell model implemented and performed optimization technique in the developed model of STHX. The geothermal ORC power plant [21] was used to analyze the performance. The data presented in the research doesn't reflect the maximum performance that can be obtained by the ORC plant. As a number of adverse factors like heat exchangers fouling,

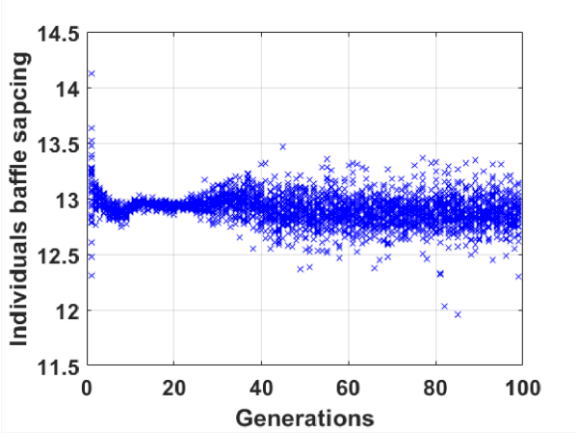


Figure.1 Individual baffle spacing for various generations

presence of non-condensable gases, etc., present in the power plant may cause to decrease the performance, which are not considered in the research. A detailed description and thermodynamic analysis of the entire geothermal power plant is provided in the research [21].

5.1 Design of shell and tube heat exchanger

The shell side cross flow area and the effective tube row number are used as input parameter for calculating baffle leakage $CF\ (J_l)$ and laminar flow $CF\ (J_r)$. The wing baffles and central baffles are in build-in in the simulation. The wing baffles are symmetric and have equal dimension at the same baffle section. The central baffle in the STHX will vary based on the size, window tube number and form.

5.2 Shell tube cross flow area

The symmetry settings are used and assumed that the flow in the window right and window left are

same. Then, the shell side cross flow area $S_{m,l}$ and $S_{m,r}$ are equal. So Shell side cross flow area is calculated using the Eq. (13) and N_{tcf} denotes tube number in one row that is same as in overlapping region.

$$S_m = S_{m,l} + S_{m,r} = L_{bc}\left(b_x - N_{tcf}d\right).2 \quad (13)$$

5.3 Effective tube row number

The effective number of rows in overlapping regions is $N_{tcc,l}$ and $N_{tcc,r}$ are added to measure tube row number in cross flow N_{tcc}, as shown in Eq. (14).

$$N_{tcc} = N_{tcc,l} + N_{tcc,r} \quad (14)$$

To calculate the wing-window tube number $N_{tw,w}$, the left and right wing windows $N_{tw,l}$ and $N_{tw,r}$ are added, given in Eq. (15).

$$N_{tw,l} = N_{tw,l} + N_{tw,r} \quad (15)$$

5.4 Wing baffle and central baffle

The wing baffle and central baffle have different settings like number of tubes in the baffle window. The average window tube number in the left and in the right wing windows are used. Then, the baffle tube fraction F_w is measured by dividing the average window tube number by the total tube Number N_t in the Eqs. (16) and (17).

$$N_{tw}^{aver} = 0.5(N_{tw,w} + N_{tw,C}) \quad (16)$$

$$F_w = \frac{N_{tw}^{aver}}{N_t} \quad (17)$$

The same is followed to the shell-to-baffle and tube-to-baffle leakage area.

6. Simulation results

Several parameters selected using the KMGO technique and the optimized values are chosen for efficient performance. The individual baffle spacing is chosen for the various generations in KMGO method. The individual baffle spacing is selected in various generations represented in the Fig. 1. The proposed method is evaluated on the different aspects like enhancement factor, Geothermal water outlet temperature, etc. The proposed method evaluated in the same environment followed in the research [11] and results is compared with Bell-Delaware method. The bell-Delaware method was used in the research [11] and the proposed technique is compared with the simulated results from [11].

Taborek version of the Bell-Delaware method for the specific heat exchanger design and the calculation method was applied to the main geometrical parameters like cross flow area, effective number of tubes in the overlapping regions and leakage areas [11]. This research considered the preheaters of an ORC system from the TEMA NFN type with double segmental baffles and this configuration is a two pass shell with a longitudinal baffle in the middle is called separator. The fluid R245fa is used into the shell and warmed up to the boiling point. The hot medium is the geothermal fluid that led into the tubes. The Taborek version of the Bell-Delaware method provide the considerable performance using the geometrical aspects like effective number of tubes in the overlapping region, leakage area, and cross flow area to specific heat exchanger design by adjusting calculation method.

Table 3. Simulation result for the LT preheater using R245fa fluid

Operating point	Unit	Bell-Delaware method [11]	KGMO technique
Enhancement factor J_x	–	1.51	1.8864
R245fa inlet temperature	°C	19.9	19.9000
R245fa outlet temperature	°C	59.34	64.5239
R245fa inlet pressure	bar	5.48	5.4800
R245fa outlet pressure	bar	5.18	4.3800
R245fa mass flow	kg/s	85.55	88.3333
Geothermal water inlet temperature	°C	66.64	66.6400
Geothermal water outlet temperature	°C	47.77	52.1439
Geothermal water inlet pressure	bar	15	15
Geothermal water outlet pressure	bar	15	4.3800
Thermal water mass flow	kg/s	58.1	61.1839
Relative deviation R245fa outlet temperature	%	0.38	0.3214
Relative deviation geothermal fluid outlet temperature	%	-0.19	-0.1400

Table 4. Simulation result for the LT preheater using R134a fluid

Operating point	Unit	KGMO technique
Enhancement factor J_x	–	1.2329
R134a inlet temperature	°C	19.9000
R134a outlet temperature	°C	42.1741
R134a inlet pressure	bar	5.4800
R134a outlet pressure	bar	6.5800
R134a mass flow	kg/s	67.0000
Geothermal water inlet temperature	°C	66.6400
Geothermal water outlet temperature	°C	27.5941
Geothermal water inlet pressure	bar	15.0000
Geothermal water outlet pressure	bar	17.3000
Thermal water mass flow	kg/s	38.3141
Relative deviation R134a outlet temperature	%	0.4032
Relative deviation geothermal fluid outlet temperature	%	-0.2600

Table 3 presents the simulated results. The proposed method is also evaluated based on the fluid R134a and results are shown in Table 4.

The simulated result is provided in the Table 3, J_x is developed using linearly on the shell fluid mass flow rate M_s as follows

$$J_x = 0.0058.M_s + 1.0102 \quad (18)$$

In this research, the LT preheater of the ORC is considered for simulation and compared it with Bell-Delaware method followed by research [16]. The different aspect was chosen for the simulation, as shown in Table 3, and correlation for the enhancement factor J_x is chosen.

Simulation results having the little deviation in the range of 0.52% for the shell fluid and lower than 0.26% for the tube side. Temperature of the geothermal fluid inlet is also smaller and the rate of mass flow is 88.33. Hence, this method can be used to optimize the performance of the heat exchanger. This optimization technique has been analyzed in the fluid of R134a and results are shown in Table 4. The simulated result of the R134a is low compared to the R245fa in terms of heat transfer. The mass flow is provided as 67 kg/s and the J_x is calculated as 1.2329.

The KMGO technique identifies the global minima effectively due to the kinetic gas molecules theory, which shows the high efficiency compared to the existing method.

7. Conclusion

The STHX is simulated based on the TEMA NFN with double segmental baffles. The optimization technique is applied to the heat exchanger to attain the design parameters for effective performance. The tube side heat transfer coefficient is calculated and in the shell side, KMGO optimization technique is applied. The parameters considered in the optimization are HTC h_i and correction factors J_c,J_l,J_r,J_b andJ_s. Using the optimization of KMGO technique, the outlet temperature increased. The correlation factor J_x is measured and this represents the effect of increased turbulence. The KMGO technique increases the performance of the heat exchanger. The proposed technique is evaluated on the two types of fluid such as R245fa and R134a. Higher performance achieved in the fluid of R245fa with the outlet temperature value of 64.52°C and enhancement factor of 1.88. In the future work, the different parameter settings can be measured for increasing efficiency of the heat exchanger.

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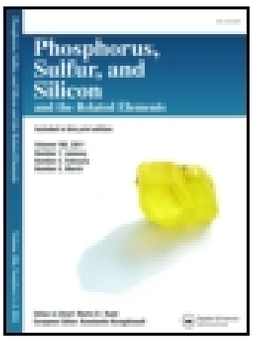
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Polyethylene glycol (PEG-400): An efficient one-pot green synthesis and anti-viral activity of novel α-diaminophosphonates

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Polyethylene glycol (PEG-400): An efficient one-pot green synthesis and anti-viral activity of novel α-diaminophosphonates

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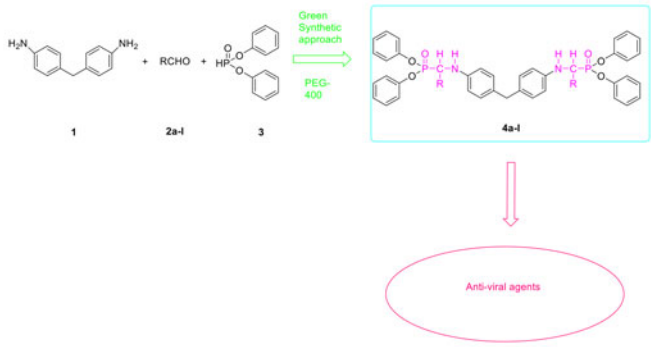
ABSTRACT

An efficient and eco-friendly protocol has been accomplished for a series of novel α-diaminophosphonates by a one-pot, three-component system *via* Kabachnik-Fields reaction of 4,4′-methylenedianiline, a variety of aryl/heteroaryl aldehydes and diphenylphosphite employing polyethylene glycol (PEG-400) as a green solvent at 80 °C. All products were obtained in good to excellent yields (80–95%). The identity of the new synthesized compounds was confirmed by IR, ^{1}H, 13C, and 31P NMR, LC-MS and elemental analysis. *In vivo* anti-viral activity was evaluated against tobacco mosaic virus (TMV). Compounds **4b**, **4c**, **4j** and **4k** exhibited the highest anti-viral activities against tobacco mosaic virus (TMV) when compared with the standard drug ningnanmycin.

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Green synthesis; α-diaminophosphonates; anti-viral activity; Kabachnik-Fields reaction

GRAPHICAL ABSTRACT



Introduction

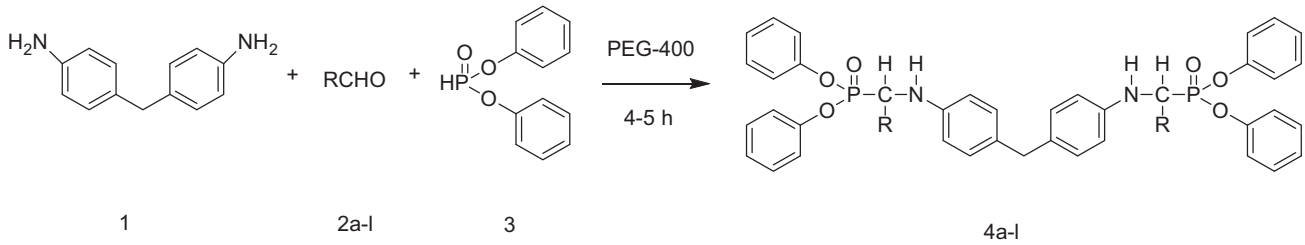
Viral plant diseases can be found worldwide and are a serious hazard to modern agriculture. Although plant viruses are genetically rather simple, they are difficult to prevent or control and have devastating impact on crop growth. Thus plant virus is a type of plant disease, known as 'plant cancer'. During recent years, the influence of climate anomalies and the areas of crops affected by plant virus disease are increasing, resulting in tremendous economic losses in the world. The tobacco mosaic virus (TMV), one of the most important classes of common viral diseases occurring in plants, is a rod-shaped virus composed of single-stranded RNA encapsulated in a coat protein capsid. This virus seriously affects the quality, quantity, yield of tobacco and causes large economic losses. A few anti-viral agents are currently available in reality, and almost no treatment can control TMV effectively. As a consequence, development of novel, highly efficient, environmental benign new anti-viral agents through chemical synthesis has become the vital area of research for elimination and/or prevention of attack by TMV. Ningnanmycin can inhibit virus replication effectively and suppress virus symptoms.

Organophosphorus compounds are biologically active molecules and are widely applied in the areas of industrial, agricultural, organic, bioorganic and medicinal chemistry as well as in nanotechnology, owing to their unique physicochemical and biological properties.[1] Their utility as reagents and potential synthons in organic synthesis is also gaining increased attention.[2] The α-aminophosphonate moiety is a versatile and novel pharmacophore due to the

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Scheme 1. Synthesis of α-Diaminophosphonates (**4a**-**l**).

broad spectrum of biological activities exhibited by compounds bearing this structural unit. α-Aminophosphonates are an important class of compounds, which have a reduced level of toxicity and great ability to substitute naturally occurring α-amino acids (mimetics). Therefore they show great potential applications in living organisms. As a result, they are effective aminopeptidase inhibitors[3] or anti-viral agents. α-Aminophosphonates and their derivatives are interesting synthetic targets because of their significant applications in agriculture as plant growth regulators,[4] herbicides,[5] pesticides,[6] fungicides,[4] in medicine as anti-cancer agents,[7] enzyme inhibitors,[8] peptide mimics,[9] peptidases and proteinases,[10] and antibiotics.[11] They can also suppress the growth of various tumors and viruses.[12]

An large number of synthetic methods for the synthesis of α-aminophosphonates have been reported *via* Pudovik reaction, Mannich type and Kabachnik-Fields reaction. A one-pot, three-component reaction of amines, aldehydes or ketones, and dialkyl, or diaryl phosphonates *via* Kabachnik-Fields (phospha-Mannich) reaction[13] is a straight forward and widely applied methods for the construction of carbon-phosphorus bonds. In a few previous reports, this reaction was accomplished in straight-forward, one-pot procedures without any catalysts.[14] Kabachnik-Fields reaction can be performed by acidic or basic catalysts, microwave irradiation, or by heating.[15] A variety of Lewis acid catalysts, such as $FeCl_3$,[16] $LaCl_3$,[17] $CeCl_3{\cdot}7H_2O$,[18] $BiCl_3$,[19] $InCl_3$,[20] $LiClO_4$,[21] $In(OTf)_3$,[22] $Al(H_2PO_4)_3$,[23] $TaCl_5$–SiO_2[24] and solid acids (montmorillonite KSF, silica sulfuric acid, Amberlyst-15, and Amberlite-IR 120)[25] have been used. Base catalysts were also used such as potassium fluoride on alumina,[26] lithium diisoppropylamide (LDA)[27] and 1,8-diazabicycloundec-7-ene (DBU).[28] However, these methodologies endure from certain disadvantages such as use of prolonged reaction times, unsatisfactory product yields, lack of generality, toxic organic solvents, stoichiometric amounts of catalysts, harsh reaction conditions, expensive and moisture sensitive catalysts. Consequently, the development of a more efficient, eco-friendly synthetic protocol which is simple and cost-effective remains an ever-challenging objective both in academia and industrial research. The most significant principles of green chemistry are atom economy, less usage or no wastage of solvents, and usage of green solvents. The usage of a noticeably benign and inexpensive solvent like polyethylene glycol (PEG) could consequently yield noteworthy "green" chemistry benefits. PEG has been explored as a novel, powerful, eco-friendly reaction medium for several organic transformations due to its interesting properties such as nontoxicity, inexpensive, readily recyclable, safe, natural, non-flammable, biocompatibility, and biodegradable. This background encouraged us to employ PEG as reaction medium and surprisingly, it worked successfully without use of any organic solvent and catalyst.

Entry	R
4a	3-pyridinyl
4b	3-thiophenyl
4c	2-furanyl
4d	4-NO_2-C_6H_4
4e	3-pyrrolyl
4f	4-F-C_6H_4
4g	4-pyridinyl
4h	3-furanyl
4i	4-Cl-C_6H_4
4j	2-thiophenyl
4k	3-indolyl
4l	3-Br-C_6H_4

In this involvement and in continuation of our ongoing research efforts for environmentally benign protocol for various organic transformations,[29] we herein report the use of 4,4′-methylenedianiline and PEG in an efficient one-pot, three-component green synthesis and *in vivo* anti-viral activity of α-diaminophosphonates (Scheme 1). To the best of our knowledge, this is the first report on *in vivo* anti-viral activity and on the synthesis of α-diaminophosphonates employing 4,4′-methylenedianiline and PEG-400.

Results and discussion

In the current investigation, α-diaminophosphonates (**4a**-**l**) were synthesized by a one-pot, three-component protocol *via* Kabachnik-Fields reaction of 4,4′-dimethyleneaniline (**1**), a variety of substituted aryl/heteroaryl aldehydes (**2a**-**l**) and diphenylphosphite (**3**) using PEG-400 as a solvent at 80 °C during 4–5 h (Scheme 1) in good to excellent yields (80–95%).

To optimize the reaction conditions, the reaction of 4,4′-dimethyleneaniline (**1a**), 3-pyridine aldehyde (**2a**) and diphenylphosphite (**3**) were considered. The effect of various solvents on the reaction was examined and the results are outlined in Table S1. Among all the solvents screened, the best results were found when the reaction was carried out using PEG-400, which gave excellent yield (93%) of **4a** (Table S2, entry 5; Supplementary Material). In case of the reactions with other solvents such as ethanol, tetrahydrofuran (THF), toluene, and acetonitrile (MeCN), the times of reaction increased and comparatively poor yields were obtained (Table S2, entries 1–4; Supplementary Materials).

Inspired by the above accomplishments, we further explored the reaction with several aldehydes and diphenylphosphite in PEG-400 to afford α-diaminophosphonates. The results are summarized in Table S1 (Supplementary Materials).

All the chemical structures of the newly synthesized compounds (**4a**-**l**) were confirmed by spectral and elemental analysis data. The characteristic IR spectra showed typical stretching absorptions in the region 3472–3239 cm^{-1} for NH, 1289–1210 cm^{-1} for P = O, and 765–740 cm^{-1} for P–$C_{(aliphatic)}$, which confirms the functional groups for the title compounds.[30] ^{1}H NMR spectra displayed for the aromatic protons a complex pattern in the chemical shift range δ 6.30–8.56. The ^{1}H NMR signal of the methine proton (PCH) was observed as a doublet in the range δ 5.76–5.85 (J = 11.0–16.2 Hz) owing to its coupling with phosphorus. The NHCH proton exhibited a doublet[31] in the range δ 4.30–5.45 (J = 4.2–9.0 Hz) due to its coupling with the neighboring proton. The 31P NMR chemical shifts appeared in the region δ 20.4–27.3 confirming the presence of a phosphonate group[32] in the synthesized compounds. Furthermore, the 13C NMR spectra of the title compounds show signals in the predicted regions.[33] The mass spectral data confirm the identity of the new compounds in accordance with their respective molecular formulae.

Anti-viral activity

In vivo anti-viral activity of all the compounds (**4a**-**l**) were screened against TMV, and ningnanmycin was used as a standard. Table S3 (Supplementary Materials) represents the result of *in vivo* inactivation rate, protective effect, and curative effects of α-diaminophosphonates (**4a**-**l**) against TMV. Compounds **4b**, **4c**, **4j** and **4k** showed the highest inactivation of infection (inhibition rate) at 84.2 ± 0.9, 83.6 ± 0.7, 82.8 ± 0.5, and 84.5 ± 1.4, respectively. The infection protective effects of **4b**, **4c**, **4j** and **4k** were determined at 58.2 ± 0.7, 58.4 ± 0.4, 58.1 ± 0.4, and 58.6 ± 0.7, and the infection curative effects of **4b**, **4c**, **4j** and **4k** were observed at 57.7 ± 0.7, 56.1 ± 0.5, 56.5 ± 1.4 and 56.8 ± 0.7, respectively (Table S3). Chlorophyll is the photosynthetic component of plants which is responsible for photosynthesis, which is the most basic life process of green plants. The extent of viral infection in plants leads to proliferation, expansion and destruction of the chloroplast, and these factors are retarding the production of chlorophyll, which consequently leads to leaf chlorosis and mosaic. It reduces the photosynthetic pigment in TMV infected leaves. The host's resistance of TMV infected leaves is enhanced when these leaves are treated with anti-viral agents. Moreover, the efficacy of the potent title compounds **4b**, **4c**, **4j** and **4k** on the chlorophyll content in tobacco mosaic leaves was examined and the results are given in Table S4 (Supplementary Material). The results obtained show that, after treating the TMV inoculated leaves with compounds **4**b, **4c**, **4j** and **4k**, the chlorophyll content in virus gradually increased during 1–5 days and reached the highest value on the 5th day. Among them, compounds **4b** and **4k** exhibited better effectiveness, when compared with compounds **4c** and **4j**. It is evident that **4b**, **4c**, **4j** and **4k** destroy the virus of the tobacco, increasing hosts resistance toward diseases and significantly enhance the chlorophyll content.

Experimental

All chemicals and solvents were purchased from Sigma-Aldrich and used without further purification. Melting points were determined in open capillaries with Guna digital melting point apparatus expressed in °C and are uncorrected. All products were purified by column chromatography on silica gel of 60–120 mesh. The infrared (IR) spectra were recorded as KBr pellets on a Perkin-Elmer FT-IR 1000 spectrophotometer. ^{1}H, 13C and 31P NMR spectra were recorded as solutions in $CDCl_3$ with a Varian 400 MHz spectrometer operating at 400 MHz for ^{1}H, 100 MHz for 13C, and 300 MHz for 31P. The ^{1}H and 13C chemical shifts are given in ppm using tetramethylsilane (TMS) as an internal standard and 31P NMR chemical shifts are referred to 85% H_3PO_4. Chemical shifts (δ) are given in parts per million (ppm) and coupling constants (J) in Hertz (Hz). ESI mass spectra were recorded with an LCMS-2010A Shimadzu spectrometer and elemental analysis was performed with a Thermo Finnigan instrument. Abbreviations used for ^{1}H NMR signals are: s = singlet, d = doublet, t = triplet and m = multiplet. The Supplementary Materials contains sample ^{1}H, 13C 31P NMR and mass spectra for products **4d** and **4i** (Figures S1–S8).

General procedure for the synthesis of α-diaminophosphonates (4a-l)

A mixture of 4,4′-methylenedianiline **1** (0.001 mol), the aryl/heteroaryl aldehyde **2a-l** (0.002 mol), diphenylphosphite **3** (0.002 mol) and PEG-400 (10 mL) was allowed to react in a 50 mL round-bottomed flask for 4–5 h at 80 °C (Scheme 1). The progress of the reaction was monitored by TLC (hexane:ethyl acetate, 7:3). After completion of the reaction, the crude mixture was worked up in ice-cold water. The product, that separated out, was filtered and the filtrate was evaporated to remove water, leaving PEG behind. This crude product was further purified by column chromatography on silica gel (60–120 mesh) using hexane: ethyl acetate (7:3) as a mobile phase to afford the analytically pure α-diaminophosphonates (**4a**-**l**) in good to excellent yields.

Conclusion

In conclusion, a green, mild, and efficient one-pot protocol for the synthesis of novel α-diaminophosphonates in good to excellent yields (80–95%) has been established. The compounds **4b**, **4c**, **4j** and **4k** showed most potent *in vivo* anti-viral activity against tobacco mosaic virus (TMV) as compared with the standard drug ningnanmycin. The notable advantages of this current method are shorter reaction times, excellent yields of the products, mild experimental conditions, inexpensive solvent, simple work-up procedure, biodegradable nontoxic solvent, reusable green solvent and

potentially valuable new anti-viral organophosphorus compounds.

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Disclosure statement

There are no potential conflict of interest disclosed by the authors.

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