DESIGN AND ANALYSIS OF A SLOTTED E-SHAPED MICROSTRIP PATCH ANTENNA FOR INDOOR WIRELESS APPLICATIONS

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***Abstract*—Due to the rapid development in wireless communication, the antennas capable of broad-band operations are very demanding in cellular communication systems. This paper presents the design and analysis of a slotted E-shaped micro strip patch antenna .Our main objective deals with designing an antenna structure such that it can operate over more than one frequency band to increase the antenna usage in multiple applications. To achieve this aim a slotted E-shaped micro strip patch antenna is designed and simulated over ADS simulation software. This Method of Moments (MoM) based full-wave electromagnetic simulator provides the results in terms of S_{11} parameter, gain, directivity, radiation pattern etc. which are quite important to analyze the antenna performance. The proposed antenna is designed and the simulated to show that the designed antenna provides a gain of 7.258 dBi, directivity of 7.259 dbi. This antenna is effective for high speed wireless local area network.**

Keywords—E-shaped, micro strip antenna, ADS (Advanced Design System), patch antenna.

I. INTRODUCTION

The concept of micro strip antennas was first demonstrated in 1886 by Heinrich hertz and its practical application by Guglielmo Marconi in 1901 and it can be newly proposed by Decamps in 1953.Howell and Munson developed the first practical antenna in the early 1970's.Microstrip antennas have been studied extensively because of attractive advantages like low profile, ease of integrating with active devices, low cost, mechanically robust when mounted on rigid surfaces, capability of dual and triple frequency operations. These features lead to the development of micro strip patch antenna which is used in many diversified applications. With the development of communication and integration circuit technologies, size reduction and bandwidth enhancement are becoming important design considerations for practical applications of micro strip antennas. However, micro strip antennas inherently have a narrow bandwidth, for the sake of extending its bandwidth, many approaches have been utilized traditionally, such as using impedance matching network, thick substrates with low dielectrics constant, or parasitic patches stacked on the top of the main patch or close to the main patch in the same plane. Micro strip antenna are also known as "Printed Antennas". The basic configuration of a micro strip antenna is a metallic patch printed on a thin, grounded dielectric substrate. Modifying patch's shape includes designing an E-shaped patch antennas. This proposed systems provide broad bandwidth when compared to the other research system. This proposed system of E-shape only adjust length, width and position of slot. The main objective of this paper is to optimize the base design in to obtain higher bandwidth and gain.

II. RESEARCH METHODOLOGY

E shaped micro strip patch antenna is designed by cutting two notches in rectangular patch antenna. A small patch antenna using a CRLH unit cell is designed and simulates in 3.59 GHz frequency with a gain of -4.7dBi [2]. Optimization of double T- micro strip patch antenna with a return loss of -16dB at 2.4 GHz [3]. Little research has been done to enhance the operation bandwidth and reduce the patch with a thin substrate less than ~1% of working wavelength [4], whereas developing ultralow-profile micro strip antennas with enhanced bandwidth and reduced size is very challenging in future integrated RF communication systems, for example, RF front-end antenna integration and package in microwave and millimeter-wave bands [5], [6]. In the past few years, new designs arising from the Planar Inverted-F Antenna (PIFA), one of the studies [7] focused on the development of wideband planar inverted-f antennas. They used two different studies to obtain the wideband operation. These developed wideband antennas that cover the GPS, DCS, IMT-2000, 2.4 GHz WLAN and 3.5 GHz WIMAX bands applications.

III. ANTENNA DESIGN

The antenna design is shown on fig.1proposed slotted E-shaped micro strip antenna with dimensions length (L), width (W), slots with width W_1,

W_2, W_3, L_1, L_2, L_3. The proposed patch is fed by a probe along the centerline of the patch Table 1shows the optimized design parameters obtained for the proposed patch antenna. A dielectric substrate with dielectric permittivity, □□of 4.2 and thickness h of 1.5mm has been used in research .The presence of slots also restrict the patch currents, as its resonance frequencies that provide lower resonance on the design.

The proposed antenna has

Proposed Patch Length= 14 mm

Proposed Patch Width= 20mm

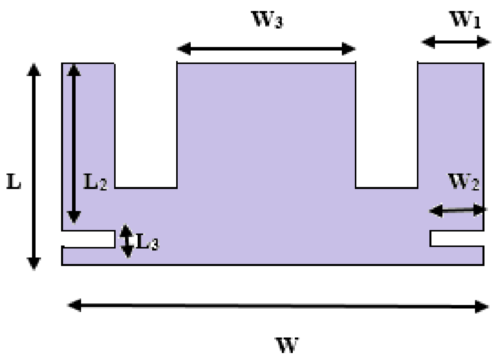


Fig. 1. Proposed slotted E-shaped antenna

Calculation of micro strip patch antenna parameter are as Width of the patch (W) follows

$$W = \frac{C}{2f_0\sqrt{\frac{\varepsilon_r + 2}{2}}}$$

Effective dielectric constant of antenna is

$$\varepsilon_{reff} = \frac{\varepsilon_r + 1}{2} + \frac{\varepsilon_r - 1}{2}\left[1 + 12\frac{h}{W}\right]^{-\frac{1}{2}}$$

Effective dielectric length of antenna is

$$L_{eff} = \frac{c}{2f_0\sqrt{\varepsilon_{reff}}}$$

The extended length (ΔL) of antenna is

$$\Delta L = 0.421h\frac{(\varepsilon_{reff} + 0.3)\left(\frac{W}{h} + 0.264\right)}{(\varepsilon_{reff} - 0.258)\left(\frac{W}{h} + 0.8\right)}$$

The length is

$$L = L_{eff} - 2\Delta L$$

The proposed antenna is operating at the frequency 5.5 GHz which is simulated using ADS software.

TABLE 1 OPTIMIZED ANTENNA PARAMETERS

Antenna parameter		Value
Resonant Frequency		5.5 GHz
Dielectric constant		4.2
Thickness(h)		1.5 mm
Length		14 mm
Width		20 mm
Cut Width	W1	2 mm
	W2	2 mm
	W3	5 mm
	L1	5 mm
	L2	12 mm
	L3	1 mm
	L4	2 mm

IV. MATERIALS AND METHODS

Parametric analysis and optimization were used to find the dimensions to simultaneously maximize factors such as antenna gain, return loss and minimum volume. FR4 was selected as substrate material. Frequency sweep analysis was done and far field reports are recorded for the purpose of analyzing the micro strip antenna.

V. RESULTS AND DISCUSSION

Design of slotted E-shaped micro strip patch antenna using ADS software, simulation results are used to estimate the performance of antenna. The plot of return loss, radiation pattern, gain and directivity have been obtained. Fig 2 shows the return loss value is maximum at the center frequency 5.5 GHz and minimum at 6.3 GHz.

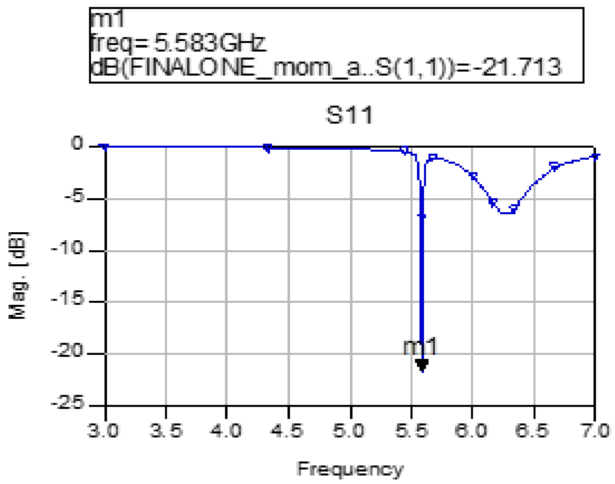


Fig 3 shows distribution of current in the proposed antenna. Current distribution is maximum at the port insertion spot

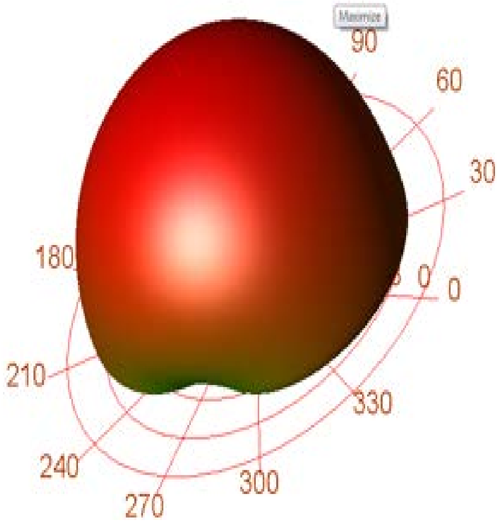


Fig. 4. 3D View of Radiation Pattern

Fig.4 shows the 3D view of Radiation pattern. Fringing fields at the open ends causes radiation. Radiation pattern is important to determine how well the antenna radiates. It is graphical representation of the antenna and measures the radiated power in a desired direction. It is usually drawn as a plot between the radiated power and antenna's position. **Fig. 2. Return loss Vs Frequency**

As it can be seen from the above curve, we get best results at 5.5 GHz, since the power reflected is minimum.

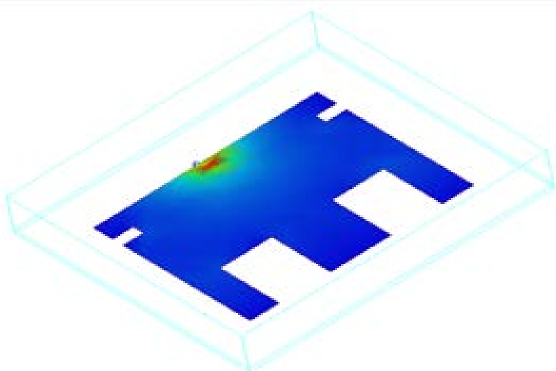
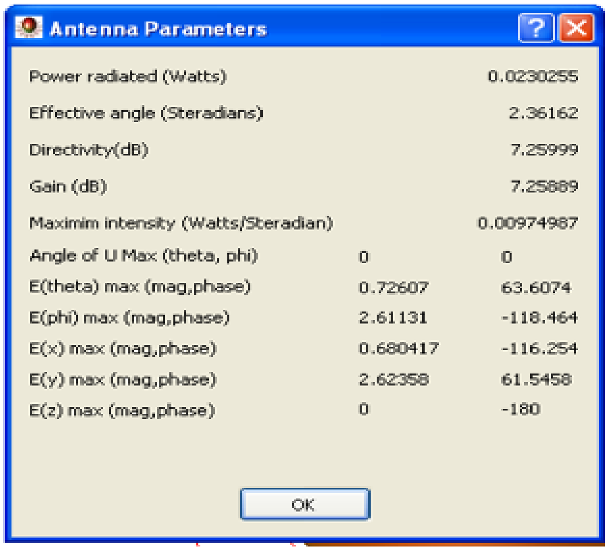


Fig.3. Current distribution



Antenna Parameters

Power radiated (Watts)		0.0230255
Effective angle (Steradians)		2.36162
Directivity(dB)		7.25999
Gain (dB)		7.25889
Maximim intensity (Watts/Steradian)		0.00974987
Angle of U Max (theta, phi)	0	0
E(theta) max (mag,phase)	0.72607	63.6074
E(phi) max (mag,phase)	2.61131	-118.464
E(x) max (mag,phase)	0.680417	-116.254
E(y) max (mag,phase)	2.62358	61.5458
E(z) max (mag,phase)	0	-180

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Fig. 5. Gain, Directivity Measure

Fig 5 shows the measure of gain and directivity of proposed slotted E-shaped micro strip patch antenna. Gain and Directivity are important parameters to determine whether the antenna is efficient or not. Gain of 7.258 is achieved.

VI. CONCLUSION

Upon the conclusion of our project we made the following assessment of our work. The overall working of antennas was understood. The major parameters (such as Return Loss curves, Radiation Patterns, Gain and Directivity) that affect design and applications were studied and their implications understood. The various aspects associated with the design of a E-Shaped Micro strip patch antenna with ADS simulation procedures are explained .With the help of simulation results; it is proved that the minimum return loss of about -22 dB is achieved**.** There were some areas we did not address. They are the experimental radiation patterns of the constructed antennas could be obtained and compared with the theoretical patterns. We are able to simulate several feeding methods, we were able to fabricate one and compare the practical and simulated results.

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