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Design of a compact Microstrip Patch Antenna for WLAN Application

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Abstract- The increase in demands of high data rate transfer through wireless link, small size antennas used in various purposes. In this paper, a CPW fed novel shaped compact antenna prototyped at FR-4 epoxy substrate with relative dielectric constant 4.4 at the height of 1.6mm is proposed and simulated at the resonant frequency 2.4 GHz that's used for WLAN applications. Simulated results are obtained by using Ansoft HFSS 11 software. The maximum gain have been achieved by the proposed microstrip patch antenna is 2 dB at 2.4 GHz band.

Keywords*: CPW, FR-4, gain, Ansoft HFSS, Microstrip antenna*

I. INTRODUCTION

Every wireless device uses an antenna to send and receive information. Therefore an antenna plays an important role in wireless communication system. Microstrip patch antennas are versatile in terms of their geometrical shapes and implementations. These antennas are very useful in wireless application due to their low profile, low weight, and low power handling capacity, simple and inexpensive to manufacture using modern printed–circuit technology [1]. Microstrip antennas are suitable for various other applications such as aircraft, spacecraft, satellite, missile application due to their attractive characteristic.

Surface wave excitation and narrow bandwidth are the major problems for microstrip patch antenna designing. Various methods have been used to overcome these problems i.e. cutting slot, increasing the substrate height.

One of the important techniques that are used in Antenna designing is CPW-fed technique. The coplanar waveguide, as compared with the microstrip line, can provide a compact low weight and low loss transmission. The coplanar waveguide was introduced by C.P. Wen in 1969 [2] [3]. Figure (1) shows the geometry of CPW microstrip patch antenna.

As shows in above figure that all conductors are placed on the same plane which neglects the need of via holes that makes the structure easy to connect shunt or series lumped elements.

So, that this technique is less costly than other. The line impedance and phase velocity of the coplanar waveguide are less dependent on the substrate height than on the aspect ratios that are slot width / center conductor width [4][5]. The geometry of our proposed antenna is presented in section II. Section III presents the simulation results and the last section IV presents the conclusions of this paper.

II. ANTENNA DESIGN

We have designed CPW-feed microstrip patch antenna for WLAN application There are three essential parameters for designing of CPW fed antenna such as the resonant frequency , the dielectric material of the substrate and substrate thickness (t) .In general, the thickness of substrate not only reduces the size of antenna but also minimize the spurious radiation as surface wave, and low dielectric constant so that antenna can have greater bandwidth, better efficiency and low power loss, for that reason we are using low-cost FR-4 epoxy as a substrate with the height of h=1.6 mm, dielectrics Constant = 4.4 and tangent loss $\tan\delta$=.002.

The essential parameters for the design of microstrip patch antenna can be calculated using the transmission line method. The width of the feed line is selected such that their impedance is near to 50Ω. The results of the designed antenna show that antenna is covering the WLAN frequency band of 2.4 GHz.

Simulated results are obtained by using Ansoft HFSS 11 software .

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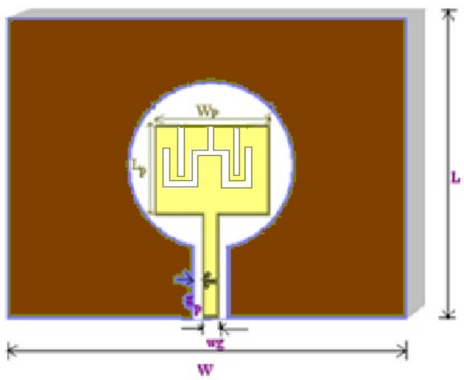

Figure-1 3D Structure of proposed Antenna

Table 1 presents the dimension of proposed antenna In this paper, we are using the ground plane which is placed on substrate having the dimension of 40 mm x. 48.74 mm and patch of dimension 38 mm×29mm is designed on FR4 substrate of height 1.6mm. The structure of CPW-fed consists of a strip width of about 3.05 mm and 34.24 mm long with gap of 0.8 mm between the strip and ground plane.

Parameter	**value**
Length of Patch	30mm
Width of patch	40mm
Length of feed line	36.24mm
Width of feed line	3.05mm
Dielectric constant	4.4
Operating frequency	2.4 GHz
Height of substrate	1.6mm
Radius of circle	28mm

Table1: Dimension of patch antenna

III. SIMULATION AND MEASUREMENT RESULTS

Simulated results can be obtained by using Ansoft HFSS 11 software.The Results achieved after the simulation of proposed antenna are discussed in this section. In short we discuss the important parameters of proposed antenna such as return loss, bandwidth, VSWR, radiation patterns, gain.

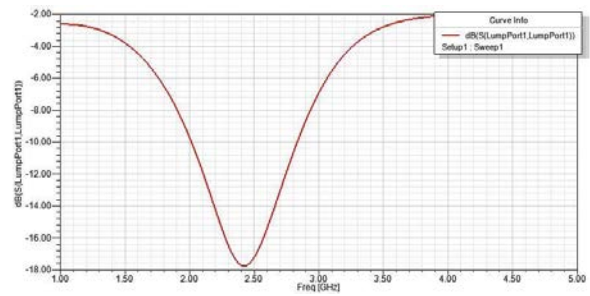

Figure-3 S-Parameter plot of the Microstrip Patch Antenna

I. Return loss

The requirement for any antenna therefore it can be radiate effectively, the return loss should be less than−10 ㏈. Figure 3 shows the return loss plot of the of design antenna. At the operating frequency of proposed antenna provides the return loss is- 17dB.

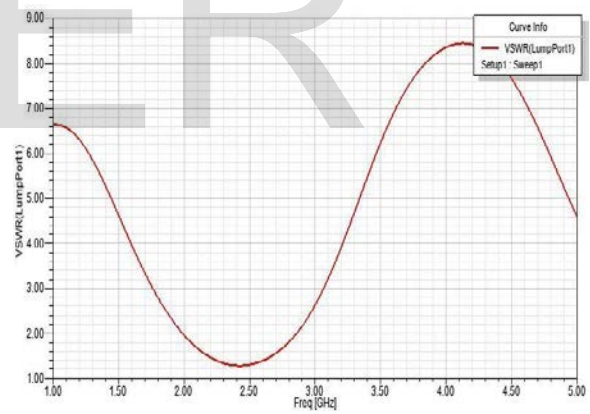

Figure-4 VSWR vs. Frequency plot

II. VSWR

Figure 4 shows the VSWR versus frequency plot for the designed antenna. Theoretically, VSWR is important parameter for antenna designing so an antenna is considered to be perfectly matched. For that requirement the value of VSWR should be lies between 1 and 2. According to the Plot shows in figure 4 the value of VSWR is 1.25 at 2.4 GHz. In fact the value of VSWR is between 1 and 2 in the frequency range from 1.8 GHz to 2.7 GHz. Therefore we can say that design antenna is perfectly matched.

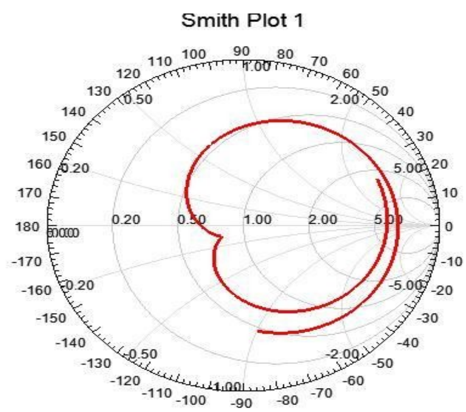

Figure-5 Smith chart

C. Input Impedance

The impedance bandwidth for the proposed antenna is 35.84% in the operating range 2.4 GHz.
The input impedance smith chart is shown in fig 5.

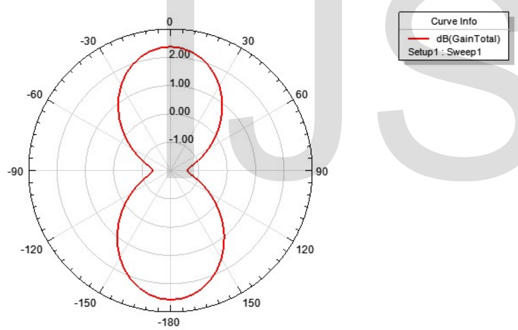

Figure-6 H-plane Radiation Pattern plot of proposed antenna

III. *Radiation Patterns*

The other important parameter for antenna is radiation pattern antenna radiation pattern which is the measurement of antenna's power or radiation distribution with respect to a particular type of coordinates. The total radiation patterns for the proposed antenna is shown in figure 6 at resonant frequency of 2.4 GHz for Phi= -180 degree

I. *Bandwidth*

The S-parameter plot of the proposed microstrip patch antenna as shows in figure 3, with the help of this plot we can easily calculate the impedance bandwidth using the following formula. The proposed antenna provides impedance bandwidth of 35.84% at the resonant frequency of 2.4 GHz.

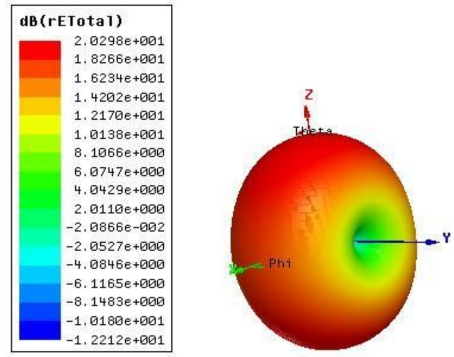

Figure-8 Polar plot of Gain at 2.4 GHz

II. *Gain*

Figure 8 shows the polar plot of Gain. Gain is the important parameter of an antenna that shows how much power is transmitted in the direction of maximum radiation to that of an isotropic source. In fact the gain should not be less than 0dBi for any antenna. It can be as high as 40-50 dBi for very large dish antennas and can be as low as 1.8 dBi for real antennas. The maximum gain of the proposed antenna is 2 dB at 2.4 GHz.

III. **CONCLUSION**

Thus the simulation & design of wide band microstrip patch antenna on substrate of dielectric constant 4.4 at resonant frequency 2.4 GHz have been successfully done using Ansoft HFSS. This design of microstrip patch antenna with CPW- fed is proposed for the WLAN application to operate in the frequency range of 2.4 GHz. and also the return loss characteristics, radiation patterns and other results show that the designed antenna can be effectively used for WLAN communication.

REFERENCES

[1] C. A. Balanis, Antenna Theory: Analysis & Design, John Willey & Sons, Inc., 1997

[2] Leena Varshney, Vibha Rani Gupta, Harish Kumar, Priyadarshi Suraj CPW-Fed Broadband Microstrip Patch Antenna, International Journal of Advanced Engineering & Application, Jan 2011 Issue-1

[3] AK Gupta, RK Prasad, DDK Srivastava "Design and analysis of Quad-Band rectangular microstrip patch antenna", Journal of Electronics and Communication Engineering, July-Aug 2012 Issue- 6

[4] John Wiley & Sons "Compact and Broadband Microstrip Antennas". Kin-Lu Wong, Inc., 2002.

[5] Raj Kumar, P. Malathi "On the Design of CPW- Fed Ultra Wideband Triangular Wheel Shape Fractal Antenna", International journal of microwave and optical technology, Vol.5 NO.2March 2010.

[6] D. Parkash, R. Khanna "Design and development of CPW-fed microstrip antenna for WLAM/WIMAX applications", Progress In Electromagnetics Research C, Vol. 17, 17-27, 2010

[7] Ansoft High Frequency Structure Simulator v11 User's Guide. Pittsburgh, PA: Ansoft Corp., 2005. Computer Software.

[8] J. William and R. Nakkeeran, CPW-Fed UWB Slot Antenna with Triangular Tuning Stub; International Journal of Computer and Electrical Engineering, Vol. 2, No. 4, August, 2010 1793-8163

[9] P. Tunti-A-Longkarn and J. Chuangchai, "Study of Various Shapes of the Coupling Slots in CPW-fed Slot Antennas," *The Journal of Industrial Technology*, vol. 4, no.1, pp. 7-12, January-June 2008

[10]Jeerasak Chuangchai1 and Prakasit Tunti-A- Longkarn2*Dual-band CPW-fed Slot Antennas Using Coupling Slots**;** *the Journal of KMUTNB. Vol. 20, No. 1, Jan. - Apr. 2010*