International Research Journal of Engineering and Management Studies (IRJEMS)
Volume: 03 Issue: 03 | March -2019 e-ISSN: 2395-0126

Design of Patch Antennae for WLAN,WIMAX and WI-FI Applications

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Abstract

In recent years, the inventions in communication systems require the design of low cost, minimal weight, compact and low profile antennas which are capable of maintaining high performance. This research covers the study of basics and fundamentals of the microstrip patch antenna. The aim of this work is to design the microstrip patch antenna for Wi-Fi, WLAN AND WIMAX applications which operates at 2-4.45 GHz. The simulation of the proposed antenna was done with the aid of the computer simulation technology (CST) microwave studio student version 2014. The substrate used for the proposed antenna is the flame resistant four (FR-4) with a dielectric constant of 4.3.The proposed antenna may find applications in wireless local area network (Wi-Fi) and Bluetooth technology.. Then, the simulation and measurement results were compared. The designed antenna structure is planar, simple and compact since it can be easily embedded for Wi-Fi applications, cellular phones and wireless communications for low manufacturing cost. The aim of this project is to design a rectangular microstrip patch antenna for global WLAN systems and to study the various performance parameters of antenna such as Directivity, Gain, VSWR, bandwidth, return-loss, far-field and also radiation pattern.

Key Words:— WI-FI, WIMAX, CST, WLAN

INTRODUCTION

Depending on its application, there are different forms of antenna. The Microstrip antenna generally has many features, which depend on its applications. These characteristics include low profile, light weight, compact and structural comfort, easy manufacture and easy installation. These features help to implement Microstrip antennas, such as in the military applications of aircrafts, missiles, space crafts, and commercial sectors such as satellite mobile systems, mobile cellular transmission, satellite broadcasting systems, wireless communication, and the global positioning system. The selection of antenna is based on the application's requirements. For example band frequency, gain, cost, coverage, weight, etc.

In today's wireless communication Wi-Fi is the area that is growing fastest. This enables users to move around and remain connected to the network within a broad coverage area. This offers considerable flexibility and freedom. Due to easy installation and location freedom, wireless is becoming popular for the home user. Together with mobile and cellular technology, portable antenna technologies have grown. The right antenna for a device is important. The correct antenna will enhance transmission and reception, reduce electricity consumption, improve service life and improve communication equipment efficiency. A single Microstrip Patch Antenna is designed and simulated with a high-frequency structure for wireless networking.

DESIGN GEOMETRY OF MICROSTRIP PATCH ANTENNA

A Microstrip patch antenna in its fundamental form consists of the radiating patch built on a dielectric substrate and attached to a substrate on a ground level, as shown in Figure 1. The patch usually is made of materials like copper or gold and can take any form.

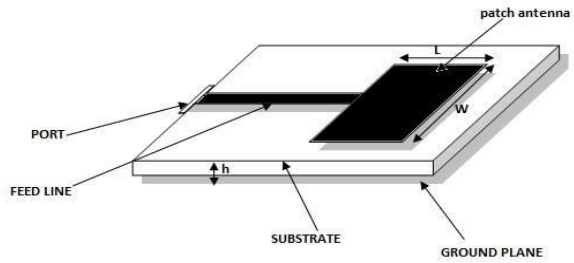


Figure 1: Basic structure of Rectangular Micro strip

Usually radiation patch and feed lines are photoedged on the dielectric substrate. In the calculation of antenna dimensions, the relative permittivity of the dielectric substrate is very important. The patch is usually of a square, rectangular, circular, triangular, elliptic and other

common form in order to facilitate analysis. The rectangular patch is available in this paper. Because of the fringing fields between the patch's edge and ground plane Microstrip patch antennas radiate. A thick dielectric substratum with a low dielectric constant is desirable for good antenna performance, given that this offers greater efficiency, greater bandwidth and better radiation.

The major step and the most important task in image processing is segmentation. Its task is to extract the details from an image. The process of segmentation is used in various and different applications like in medical fields, computer aided operations. There are many types in the process of segmentation. They are boundary approach, edge based approach and region based approach. The above three techniques plays a prominent role in the processing of an image. Initially the given MRI image is processed and converted into gray level image.

Antenna Design

A Resonant Frequency of 5.4 GHz is available for the proposed antenna. The Rogers RT / Duroid 5880(tm) substrate material has the relatively high performance of €r=2.2. The thickness of the substratum is 1.6 mm. the sizes of antenna are caluclated using

i. Width of the Patch:

W = / 2 2 +1

Where,

c =free space velocity of light.

fr = resonating frequency.

= relative permittivity of substrate.

ii.: Effective dielectric Constant

=(+1)/2+(−1)/2[1+12h/] Where,

h = Thickness of the substrate.

W= Width of the patch.

iii. Effective Length:

= /2

iv. Patch length extension:

=0.412(+0.3)(/h+0.264)/(−0.258)(/h+0.8)

v. Length of the patch:

= −2Δ

vi. Width of the substrate:

=6h+

vii. Length of the substrate:

=6h+

Antenna Modelling

The antenna proposed have the following dimensions from the above relationships. The table 1 below have dimensions of antenna.

Table 1: Antenna dimensions

Parameter	Dimension
Operating Frequency	2.4 GHZ
Relative Permitivity	4.3
Substrate Length	47 mm
Substrate Width	54 mm
Patch Length	28.3 mm
Patch Width	31 mm

Analysis Of Microstrip Patch Antenna

The proposed Rectangular Microstrip patch antenna can be analysed and simulated by using CST antenna simulation software. Figure 2. Shows the design geometry of the proposed Microstrip patch antenna.

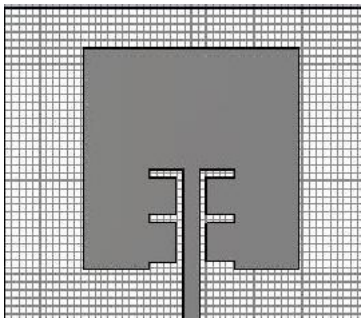


Figure2 . Design of the proposed antenna.

SIMULATED RESULTS

The parameters S11 for the designed antenna were calculated and the simulated return loss results are shown in Figure 3. The resonating frequency 4.8GHz with the corresponding

value of return loss as -26.9590 dB and it can be operated at 4.4125GHz with no reflections.

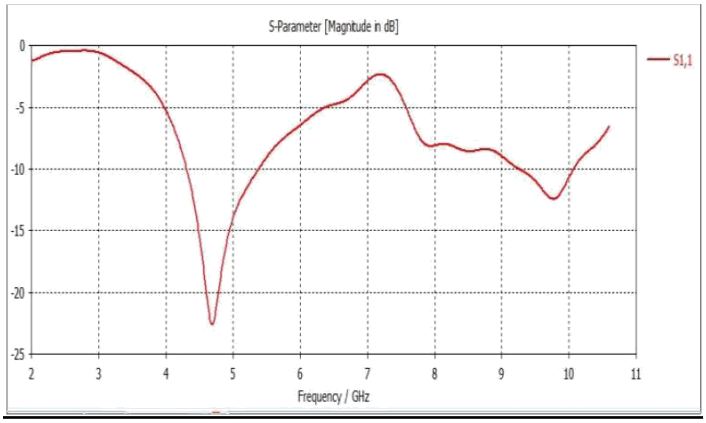


Figure 3. Simulated return loss curve

VOLTAGE STANDING WAVE RATIO (VSWR)

The VSWR is an important specification for allcommunication devices. It measures how well anantenna is matched to the cable impedance where thereflection, |Γ| = 0. This means that all power istransmitted to the antenna and there is no reflection.The simulation result of Voltage Standing WaveRatio, (VSWR) is shown in Fig.4, below.

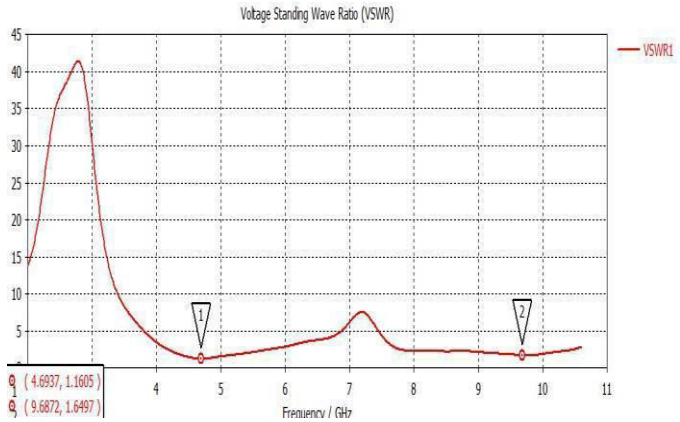
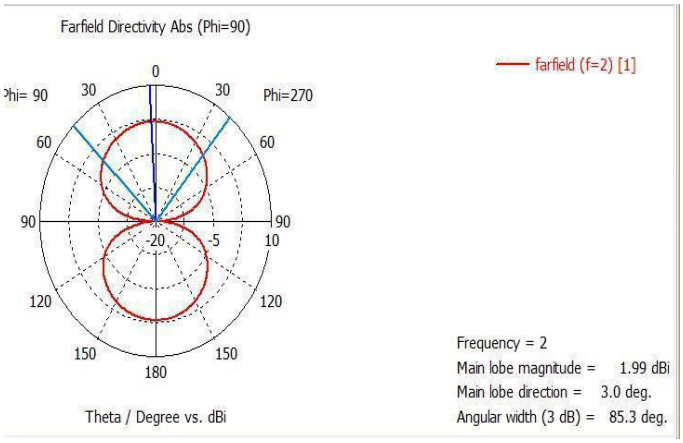


Fig4: simulated

VSWR Radiation pattern

The radiation pattern of microstrip Patch Antenna is the power radiated or received by the antenna. It is the function of angular position and radial distributionfrom the antenna. The radiation pattern for theproposed microstrip patch antenna is show in Figure 5



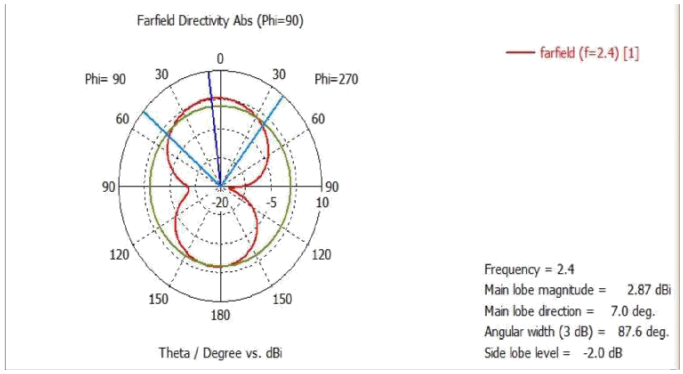
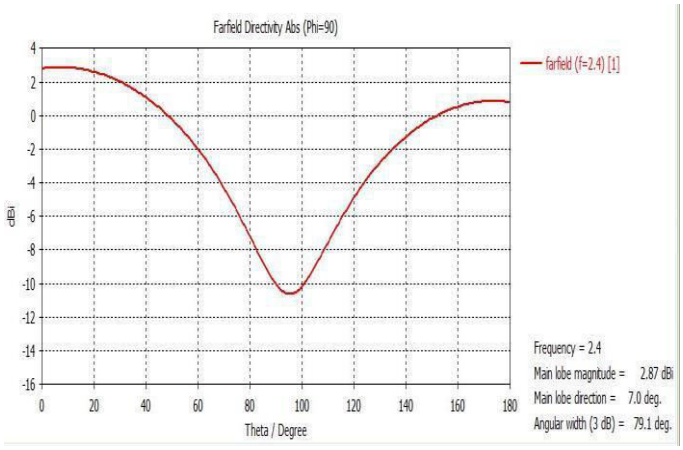


Fig5: Radiation Pattern

DIRECTIVITY

The directivity of a microstrip patch can be found from the cavity models of patches and integrated over the hemisphere to compute directivity. We obtain the same directivity for linearly and circularly polarized patches because a circularly polarized patch is a linear combination of two linearly polarized patterns. Integration over all values of Phi produces the same integral for both cases shown in Fig6



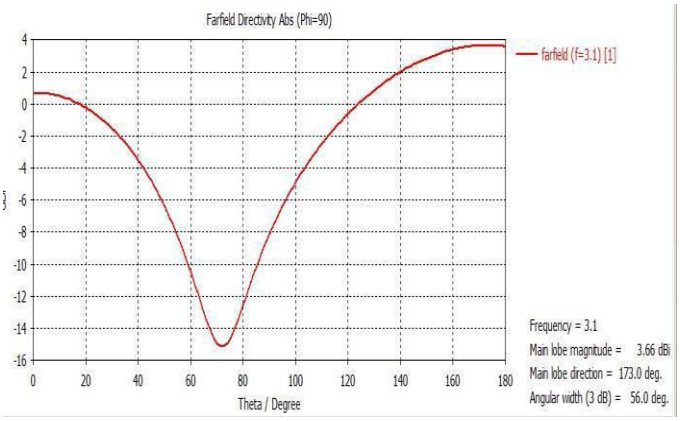


Fig6: Directivity

3. CONCLUSIONS

A Microstrip line fed single frequency Microstrip patch antenna has been designed and simulated using CST Antenna Simulation software. This is operating in the frequency of 2.4-4 GHz Wi-Fi communication in the IEEE 802.11 standard. The simulated corresponding value of return loss as -16.7269dB which is small enough and frequency is closed enough to the specified frequency band feasible for Wi-Fi application. However, the size of the Microstrip antenna, reported here, is not very small. Cutting inclined slots on the patch, the size of the Microstrip antenna may be reduced; also the bandwidth may be enhanced. Work is going on to achieve even better results with good axial ratio over a wide bandwidth.

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