Design of Micro Strip Patch Antenna For WiFi Application

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Abstract- *In the world of communication systems, wireless technology is one of the most important areas of research. In this paper we have proposed to design a Microstrip Patch Antenna for WiFi Applications. In this project we have also covered different types of feeding techniques of Micro Strip Patch Antenna and different types of parameters of antenna. Basically Microstrip Patch Antenna have a dielectric substrate with a radiating patch on one side and a ground plane on the other. Moreover different values of substrate can be used for the design purpose of the Microstrip Antennas. Substrate which has lower dielectric constant provides larger bandwidth and better efficiency.*

Keywords- Microstrip Patch Antenna,Feeding Techniques, Rectangular patch,HFSS simulation

I. INTRODUCTION

In today's world, the Wireless Power Transmission systems are broadly used for different kinds of our day to day activities. There is a requirement of high efficiency of power transmission which leads to finding of new methods to implement these systems. The most innovative and impressive ideas for solving these problems is using microwave engineering. The Wireless Power Transmission systems using microwave have proven that they are the new future of power transmission in this new world. In this paper, we have discussed the components and main parts of the Wireless Power Transmission systems which includes the transmitter and receiver. The main aim of this project is to design, simulation and fabrication of microstrip.

Antenna is a device which converts one form of energy to another (electrical current in radio waves at transmitter and radio waves back to electrical current and voltages at the receiver end).

II. MICROSTRIP PATCH ANTENNA

Microstrip Patch Antenna consists of dielectric substrate with radiating patch on one side and ground plane on the other side, as shown in Fig. 1.

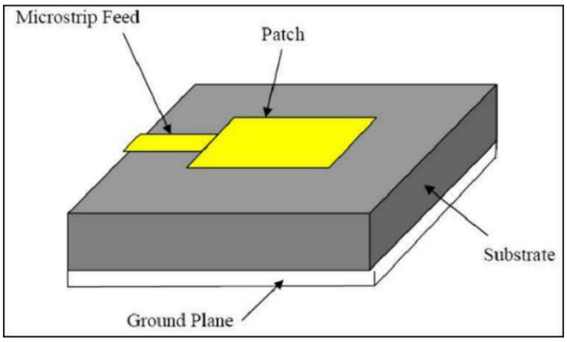

Fig. 1 Microstrip Patch Antenna structure

Microstrip Patch Antennas can easily be implemented using Printed Circuit technology, therefore they are also known as Printed Antennas. Microstrip Patch Antennas come in variety of shapes such as rectangular, triangular, circular. Due to ease of installation rectangular patch is preferred. They are antennas with low height and width also known as Low profile antennas. They can easily be mounted on planar and non-planar surfaces. Microstrip patch antenna are simple inexpensive and simple to manufacture.

Microstrip patch antenna gives large directivity but also leads to increase in size of individual element. Microstrip patch antenna also gives poor efficiency, if we increase the height of substrate efficiency also gets increased but that also leads to increase in Bandwidth. With increase in height of substrate surface waves gets introduced which eventually extract some power from the receiver side and leads to power loss during the transmission. We can eliminate these surface waves by building cavities i.e. byseparating patch and ground by dielectric sheet. For better efficiency we use dielectric substrate with lower values. To overcome these disadvantages we use Array antennas.

III. FEEDING TECHNIQUES OF MICROSTRIP ANTENNA

The patch antennas may be powered with various kind of methods. The feeding process is categorized into thesemethods:

A. Microstrip line Feeding Techniques :

In this feeding process, the edge of the microstrip patch is directly connected to a conducting strip. In this kind of feeding method it gives the benefit that the conducting line haveengraved on same substrate of patch antenna which providesa planar shape. The width of conducting element is much smaller if we compare it with the patch antenna.

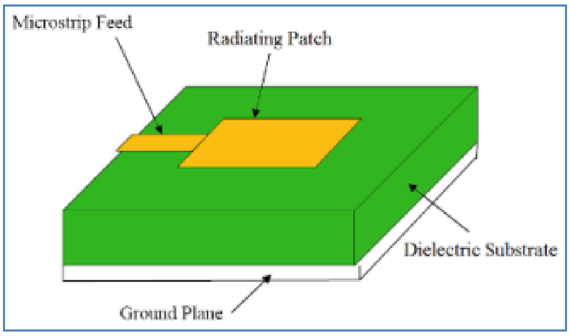

Fig-2 Microstrip line technique

B. Coaxial Probe Feeding Techniques:

In this method the outside conductor of coaxial connector is directly attached to the ground plane, while the inside is extendedacross the dielectric and is welded at the radiating element antenna. The main disadvantage of this technique is that it is a difficult to model and produce a narrow bandwidth as per the requirement.

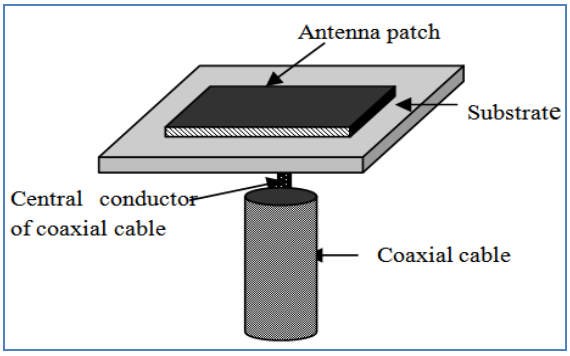

Fig-3 Coaxial Probe Feed

C. Feeding Techniques with Proximity coupled

In this kind of feeding technique or process it uses two dielectric substrates with the aim that the feed line, firstly, is in between two substrates and on the other side the radiating element is on top of the upper substrate.

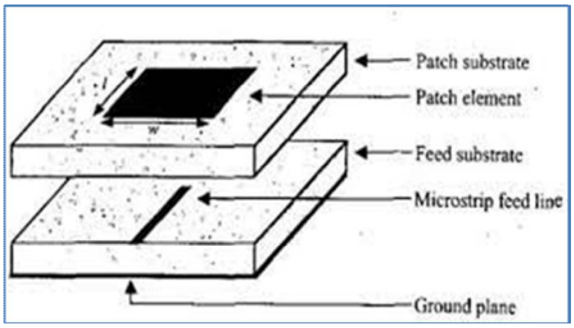

Fig-4 Feeding with Proximity coupled

IV. DESIGN RECTANGULAR PATCH ANTENNA

While designing the rectangular patch antenna we have consider some of the factors before designing the rectangular patch antenna for the best output .The most important steps for the designing of rectangular patch antenna are:

Step 1: A parameter Width of the radiating RPAis compute from this equation:

$$W = \frac{c}{2f_r}\sqrt{\frac{2}{\varepsilon_r+1}} \qquad \ldots\ldots\ldots\ldots\ldots\ldots\text{(1)}$$

Where

C : velocity of light, 3*108m/s,

ε_r: dielectric constant of the substrate.

fr : resonant frequency of antenna

Step 2: Effective Dielectric constant of the rectangular patch antenna is determined as

$$\varepsilon_{eff} = \frac{\varepsilon_r+1}{2} + \frac{\varepsilon_r-1}{2}\left\{\frac{1}{\sqrt{1+\frac{2h}{W}}}\right\} \quad \ldots\text{(2)}$$

Step 3: The effective length is specified at the resonance frequency by.

$$L_{eff} = \frac{c}{2f_r\sqrt{\varepsilon_{eff}}} \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\text{(3)}$$

Step 4: Extension length is computed with the help of this equation:

$$\Delta L = h * 0.412 * \frac{(\epsilon_{eff} + 0.3)(\frac{W}{h} + 0.264)}{(\epsilon_{eff} + 0.)(\frac{W}{h} + 0.264}$$

The length " L" of the PRA is calculates as:

$$L = L_{eff} - 2\Delta L \ldots\ldots\ldots\ldots\ldots\ldots\ldots (5)$$

V. HFSS SIMULATION

The simulation of rectangular patch antenna is done using Ansys High Frequency Structure Simulator (HFSS) software. Ansys HFSS is basically 3D electromagnetic simulation software in which we can design and simulate high-frequency electronic products such as antennas or microwave components, filters, connectors, IC packages and printed circuit boards. Engineers across the world uses Ansys HFSS software to design and simulate high-frequency and high speed electronics found in communications systems. The results of simulation of rectangular patch antenna made by software) is shown in Fig-5

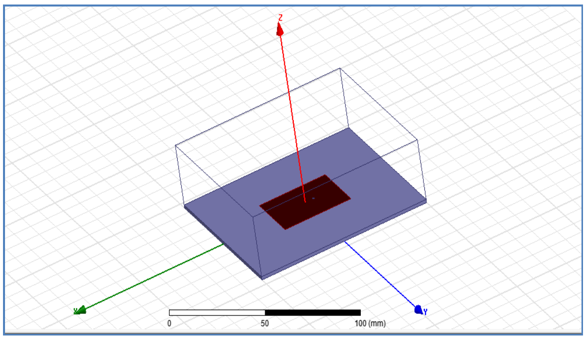

Fig-5HFSS model of microstrip antenna with rectangular patch

Parameters of the antenna for wifi application are:

- Substrate: RT Duroid 5880
- Resonant Frequency:2.4 GHz
- Dielectric constant:2.2
- Height: 1.6 mm
- Feed: coaxial feed
- Length of patch : 40 mm
- Width of patch: 30 mm

The parameter VSWR is the measure that numerically describes how well the antenna is impedance matched to the radio or transmission line it is connected to.

VSWR stands for **Voltage Standing Wave Ratio**, and is also referred to as Standing Wave Ratio (SWR). VSWR is a function of the reflection coefficient, which describes the power reflected from the antenna. If the reflection coefficient is given by Γ .

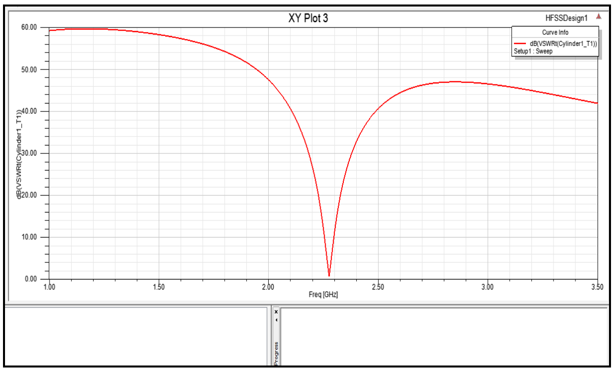

Fig. 6 VSWR

Return loss, S11 is a measure of how much power is reflected back at the antenna port due to mismatch from the transmission line. When connected to a network analyzer, S_{11} measures the amount of energy returning to the analyzer – not what's delivered to the antenna. The amount of energy that returns to the analyzer is directly affected by how well the antenna is matched to the transmission line. A small S_{11}indicates a significant amount of energy has been delivered to the antenna. S_{11} values are measured in dB and are negative, ex: -10 dB. S_{11} is also sometimes referred to as return loss. Fig. 7 shows the return loss of the designed antenna.

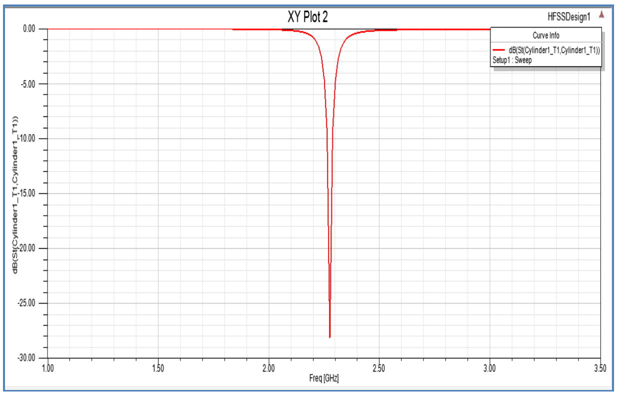

Fig-7Return Loss

The energy radiated by an antenna is represented by its Radiation pattern of the antenna. Radiation Patterns are diagrammatical representations of the distribution of radiated energy into space, as a function of direction. Fig. 6 shows the radiation pattern of the designed antenna.

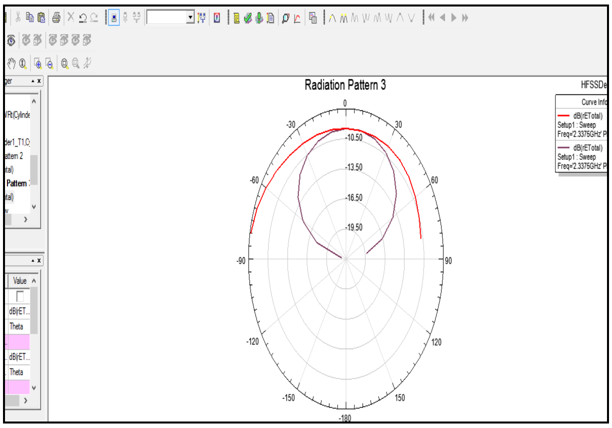
Fig-6 Radiation pattern

VI. CONCLUSION

In this paper, we have discussed different types of feeding technique in microstrip antenna. The paper discusses the design and simulation results of the rectangular patch antenna using High Frequency Structure Simulator (HFSS) according the required parameters. Based on the simulation we have discussed and studied Voltage Standing Wave Ratio, return loss and radiation pattern. These designs will be used for the fabrication of the antenna prototype.

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