Design and development of wearable patch antenna for GPS applications.

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Abstract: With the growing technology wearable devices have become very popular now-a-days. The wearable device is equipped with antenna is capable to transmit the entire sensor's data to the system for monitoring such as tracking, navigation, mobile computing, medical science and public safety. As a wearable antenna can be a part of the clothing, the design of antenna is very important to ensure comfort to the wearer without affecting the antenna performance. This paper intend to focus on the specification of the truncated square micro strip rectangular patch antenna by using jute as the substrate for the antenna and analysis that to design proper wearable antennas for Global positioning systems (GPS) applications at 1.575 GHz.

Keywords: Wearable device; antenna design; micro strip patch antenna; Global positioning systems (GPS).

I. Introduction

Antenna is a transducer designed to transmit or receive electromagnetic waves. There are many types of antennas such as: linear wire antenna, aperture antenna, horn antenna and microwave antenna. Among all these antennas, microstrip antennas are more popular now a days over conventional other antenna due to their advantages like small size, light weight, low cost and easy to fabricate with planar structures. As a result huge research is going on design of microstrip antenna has made significant progress during the recent years. These microstrip patch antennas can provide dual and circular polarizations and is very well suited for applications such as wireless communications system, GPS, cellular phones, pagers, radar systems, and satellite communications systems [1].Researchers present various designs to improve different antenna parameters at different resonate frequencies.

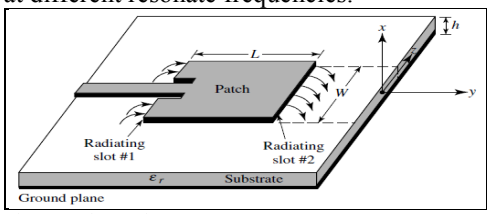

Fig.1. Microstrip Antenna

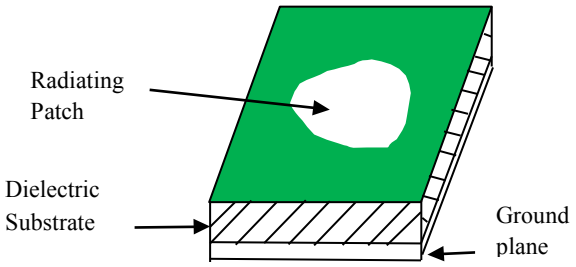

Fig.2. Microstrip antenna configuration

Design of Microstrip Patch Antenna for GPS Applications using EBG Structures: This paper proposes a circularly polarized microstrip patch antenna for Global Positioning System (GPS) and has studied the performance of square shaped microstrip patch antenna in L1 and L2 bands. Operating range of GPS is 1.227 GHz (L2 Band) to 1.575 GHz (L1 Band). Improvement is significant in terms of gain and axial ratio bandwidth when compared to antenna designs without EBG.

Design of Rectangular Microstrip Patch Antenna: This article proposes a rectangular microstrip patch antenna in Advanced Design System Momentum (ADS) [4] with resonant frequency 4.1GHz.This antenna operates at UWB frequencies.

Nowadays Global positioning systems [2] are widely in use today for many scientific applications. GPS is increasingly being used as a standard hardware clock reference GPS is an US military system consisting of an array of 24 satellites equipped with high precision atomic clock arranged such that covers the entire globe and is capable to provide accurate time and positioning information to Earth based systems. The fundamental component of the GPS system is to provide accurate time. Moreover, GPS is a global system, it can be utilised anywhere in the world. Radio timing systems have different frequencies and are localised by national boundaries with the signals varying from location to location.On the other hand GPS signals are the same across the globe.Due to these advantages GPS system is used in antenna now a days. A single GPS antenna can be shared between multiple GPS servers by using a GPS splitter.

In the present days, researchs are focued towards wearable antennas[3] design and analysis. Wearable antennas are being

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applied successfully in various part of life such as health monitoring, physical training, navigation, RFID, medicine, military etc. Considering the easily available flexible textile as a dielectric material, the cost of the antennas becomes very low.
The integration of wireless electronic with textile technology resulting in smart garment in global Positioning System (GPS) application is a solution for several applications, especially for tracking and rescue [3] issues. Hence in this paper the antenna performance is studied towards achieved circular polarization (CP) by truncating two opposite edged of the square patch by using jute as the substrate at 1.575 GHz.

II. FEEDING TECHNIQUES OF MICROSTRIP ANTENNA

A. Feeding Techniques

This feeding technique shown in the figure below has the advantage of the conducting line can be engraved on same substrate of patch antenna resulting in planar shape. Here the edge of the microstrip patch and the conducting strip are connected directly.

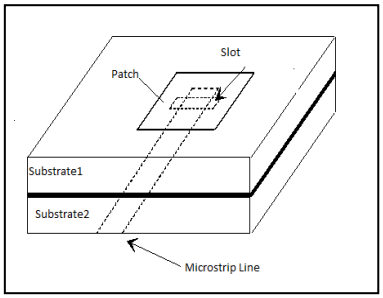

Fig .3.Microstrip line technique

B. Coaxial Probe Feeding Techniques

In this method the outside conductor of a coaxial connector attached at ground plane and the inside across the dielectric. The figure below shows the feeding technique.

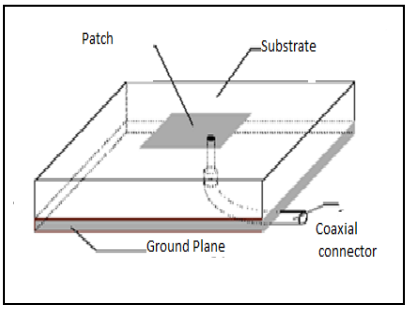

Fig.4. Coaxial Probe Feed

C. Feeding Techniques With Proximity coupled

This feeding technique shown in figure below uses two dielectric substrates first between two substrates and on the other on top of the upper substrate.

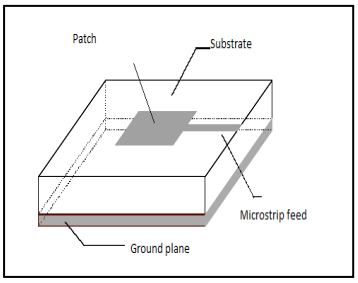

Fig.5.Proximity coupled Feed

D. Aperture coupled feed

In this type of feed technique a microstrip feed line is separated by the ground plane to the radiating patch. The structure is shown below.

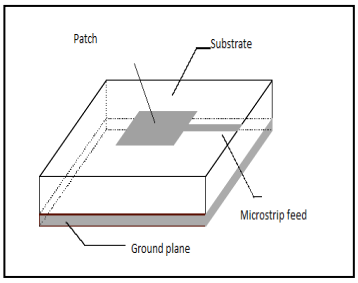

Fig.6.Aperture coupled feed

III. DESIGN RECTANGULAR PATCH ANTENNA

The proposed patch antenna has been designed using jute as the substrate with dielectric constant $\varepsilon_r = 1.74$ and height of substrate (h) = 1 mm and working at a frequency 1.575GHz

Width of the patch is calculated as

$$W = \frac{V0}{2fr}\sqrt{\frac{2}{\in r + 1}}$$

The length of the patch

$$\Delta L = (\,0.412\times h)\frac{(\in r+0.3)(\frac{w}{h}+0.264)}{(\in r-0.258)(\frac{w}{h}+0.8)}$$

$$L=\frac{\lambda}{2} - 2\Delta L$$

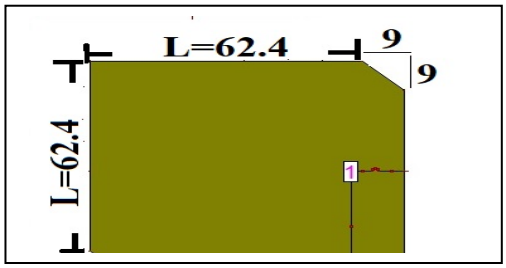

Fig.7.Designed Square patch

IV. RESULTS

The study was done by using IE3D software. Different parameters like real and imaginary S and Z parameters to find the impedance at the edge. Gain and Axial ratio was also studied at the frequency 1.575GHz. The figures below show the simulation results.

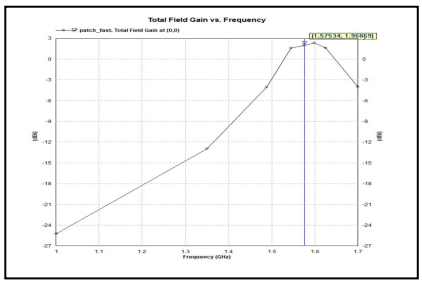

Fig.8.dBvsfrequency

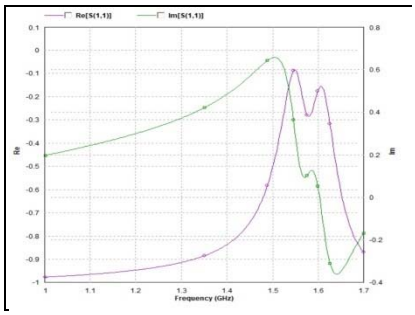

Fig.9.Real&Imaginary-Sparameter

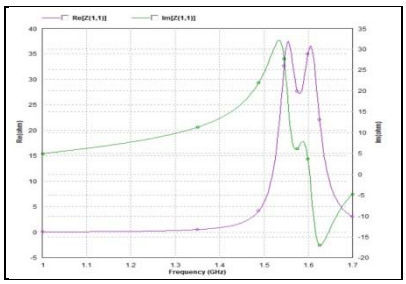

Fig.10.Real&Imaginary-Zparameter

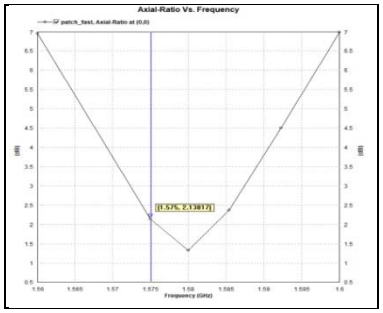

Fig.11.Axial ratio Vs Frequency

CONCLUSION

A wearable patch antenna developed for different types of GPS application has been presented. This research paper gives emphasis on particular wearable patch antenna for GPS application at 1.575 GHz using Jute as the substrate for the antenna.

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