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A Dual-Band L Slot Patch Antenna for Wearable Applications

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ABSTRACT: In today's world, importance of wearable textile antennas has gained importance for healthcare and pervasive applications. This project studies about the flexible ,lightweight , mechanically robust textile antenna for dual-band operation embedded on jeans substrate. Wearable antenna is mainly used in medical field, mobile communication, navigation and military. Wearable antenna is device which used as man and machine interface device, which is part of smart clothing..In this project L slotted microstrip patch antenna has been designed for applications involving a frequency range of 2.45GHz to 3.09GHz. Microstrip patch antennas are extremely advantageous to design in such a way that they are simple to fabricate and easy to modify and customize. A wearable antenna is meant to be a part of the clothing used for communication purposes, which includes tracking and navigation, mobile computing and public safety. In particular, the microstrip patch antennas are good candidates for body-worn applications, as they mainly radiate perpendicularly to the planar structure and also their ground plane efficiently shields the body tissues.

KEYWORDS*:*dual band, L slot, jean substrate,wearable antenna

I.INTRODUCTION

From the past few years, the rapid progress in the development of wearable computing potentially increased the demand for body-worn devices which could be easily integrated with fabrics. Wearable textile antennas can be one of these devices. Generally, wearable antennas consist of a conducting material (patch/radiating element), printed on a dielectric substrate.Today in the field of communication, antenna plays a vital role in transmission of data. In every part of today world we can see at least an antenna present. Antenna also has important role in wireless communication system. Hence there is an requirement to optimize the efficiency of antenna. In modern wireless communication system, wearable textile antenna has been playing a very important role for wireless service requirements. The current trend in commercial and government communication system has been to develop low cost, minimal weight, low profile antenna that are capable of maintaining high performance over a large spectrum of frequency.

In literature, several topologies have been presented for the development of the wearable textile antennas which include 3D printing technology , Substrate Integrated Waveguide technology (SIW), aperture coupled , microstrip patch , CPW fed, EGB based , meta material based , and cavity based textile antennas. Micro strip patch antennas are a superior selection for wireless communication systems due to their attractive characteristics of small size, low cost and weight, conformability, and ease of manufacturing, so these antennas have been developed in the last decades increasingly.

In this project L slotted microstrip patch antenna has been designed for applications involving a frequency range of 2.45GHz to 3.09GHz. Utilization of wearable textile materials for the development of micro strip antenna segment has been rapid due to the recent miniaturization of wireless devices. The use of wearable textile antennas is increasing rapidly in wireless applications. A wearable antenna is meant to be a part of the clothing used for communication purposes, which includes tracking and navigation, mobile computing and public safety. In particular, the microstrip patch antennas are good candidates for body-worn applications, as they mainly radiate perpendicularly to the planar structure and also their ground plane efficiently shields the body tissues. Specific requirements for the design of wearable antennas are thus, planar structure, flexible conductive materials in the patch and ground plane, and flexible dielectric materials.Textile materials, being universally used and easily available, are possible materials to design wearable antennas for in- and on-Body Area Networks (BAN). The textile material is used because it is wearable, washable, very economical, and flexible & needs less care. Textile antenna consists of textile materials which have a very low dielectric constant, so that it reduces the surface wave losses and improves the impedance bandwidth of the textile antenna.

II. ANTENNA CONFIGURATION

Fig 1 shows the schematic diagram of presented antenna, having two frequency patch elements of L slot works at 2.45and3.09 GHz frequency bands . . The antenna consists of patch element of L slot with a microstrip line feeding. The complete antenna is designed using the software HFSS 15.0 on a jean substrate with a thickness of 2 mm and a relative permittivity of 1.6, and occupying an area of 96mmx101mm for the substrate and an area of 96mmx101mm for the ground plane.

The dimensions of patch elements describe to operate to mobile devices and L-Slots are employed on the main patch elements for excitation of the dual-band and wideband modes. Since cutting the L slot on the patch can change the current distribution and the current path, and hence improve the impedance matching especially at higher frequencies. In these project textile materials , jean material is used ,which have a very low dielectric constant, so that it reduces the surface wave losses and improves the impedance bandwidth of the textile antenna. The miniaturization of antenna is used by the various slot technique.

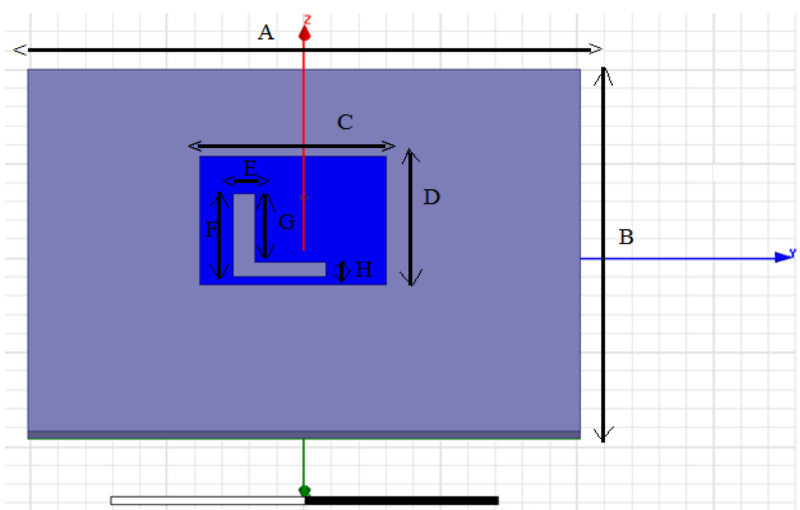

Fig-1Structure of dual band L slot patch antenna

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A	**101mm**	**D**	**34mm**	**G**	**18mm**
B	**96mm**	**E**	**4mm**	**H**	**4mm**
C	**34mm**	**F**	**22mm**	**Total volume=96mmx101mmx2mm**	

DIMENSIONS OF ANTENNA

DESIGNING PROCEDURE:

The microstrip patch antenna design with L slot shape . The ground plane is at the base of the antenna whose size is chosen as (96X101) mm. The substrate, which is a dielectric, is placed above the ground plane. It is made of jean material . A height of2 mm is given to the substrate. The patch is fixed above the substrate whose length is 34mm and width is 34mm with a height of 2mm. since cutting the slot on the patch antenna can change the current distribution and the current path, and hence improve the impedance matching especially at higher frequencies. The radiation pattern and bandwidth can be improved by increasing the return loss of the antenna. The simulation is of the designed transmission antenna using HFSS (High Frequency Structural Simulator)software. The input is fed to the antenna through the port. The port used is lumped port.The current flows through the boundaries of the step shaped aperture. Then the microwave energy radiates from the surface of the patch. This model is simple to design. Power loss is minimum in this design. The low required input power made this compact antenna easier to meet the safety standard. It is lightweight, inexpensive, and easy to integrate.

III.SIMULATION RESULTS

HFSS is a commercial Finite element method solver for electromagnetic structures from ANSYS. The acronym stands for **H**igh-**F**requency **S**tructure **S**imulator. ANSYS HFSS is a 3D electromagnetic (EM) simulation software for designing and simulating high-frequency electronic products such as antennas, antenna arrays, RF or microwave components, high-speed interconnects, filters, connectors, IC packages and printed circuit boards. HFSS software is used to design and simulate the wearable textile antenna.

Figure 2 shows the simulation result for L slot patch antenna, which gives the return loss or reflection coefficient value as -14.9508dB in the frequency range of 2.45GHz,and-15.5596dB in the frequency range of 3.09 GHZ.Return loss is defined as the ratio between input energy to antenna and reflected energy form antenna. Return loss is a measure of the effectiveness of power delivery from a transmission line to a load such as an antenna.

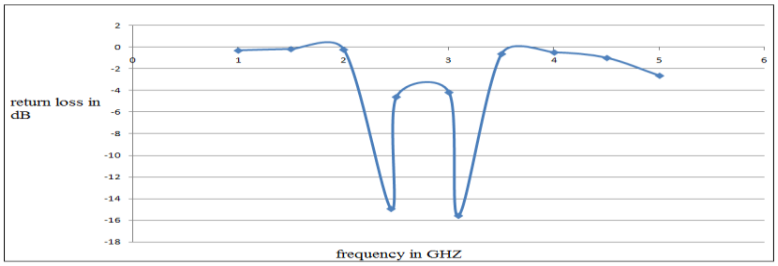

Fig2 Return loss vs frequency characteristics of L slot patch antenna

Fig 3 shows the result of VSWR vs frequency of L slot antenna.The ratio of the maximum to minimum voltage is known as VSWR, or Voltage Standing Wave Ratio. VSWR define as the ratio between maximum voltage and minimum voltage. The most common case for measuring and examining VSWR is when installing and tuning transmitting antenna. VSWR value obtained is s=1.435 for 2.45GHZ and s=1.400 for 3.09GHZ. Ideally, the VSWR must be less than 2(<2) which is achieved in for 2.45GHZ and 3.09GHZ frequency range.

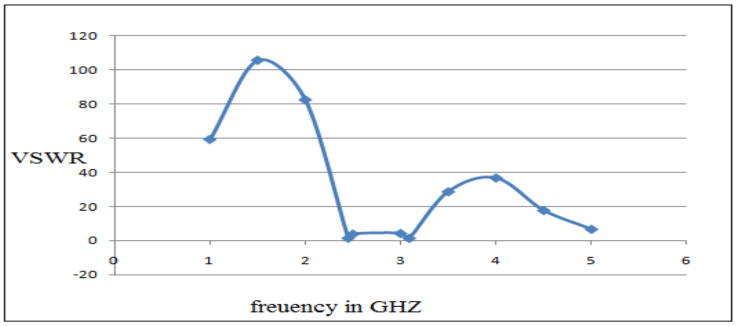

Fig3 VSWR vs frequency characteristics of L slot patch antenna

Fig 4 shows the radiation pattern of L slot patch antenna The antenna pattern is graphical representation in three dimensional of the radiation of the antenna as the function of direction. The radiation pattern is the locus of points with the same electrical field. The radiation pattern is a graphical depiction of the relative field strength transmitted from or received by the antenna. Antenna radiation patterns are taken at one frequency, one polarization, and one plane cut. The patterns are usually presented in polar or rectilinear form with a dB strength scale.

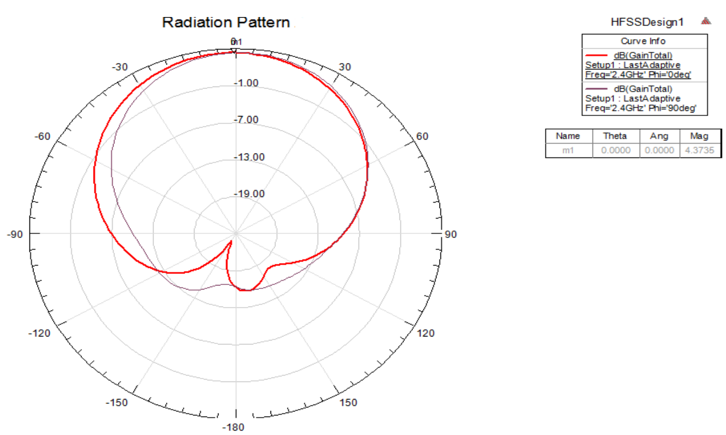

Fig:4. Radiation pattern of L slot patch antenna

Fig5 shows the gain radiation pattern . **gain** is a measure of the ability of a two port circuit to increase the power or amplitude of a signal from the input to the output port by adding energy converted from some power supply to the signal. It is usually defined as the mean ratio of the signal amplitude or power at the output port to the amplitude or power at the input port. It is often expressed using the logarithmic decibel units. A gain greater

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than one , that is amplification, is the defining property of an active component or circuit, while a passive circuit will have a gain of less than one.

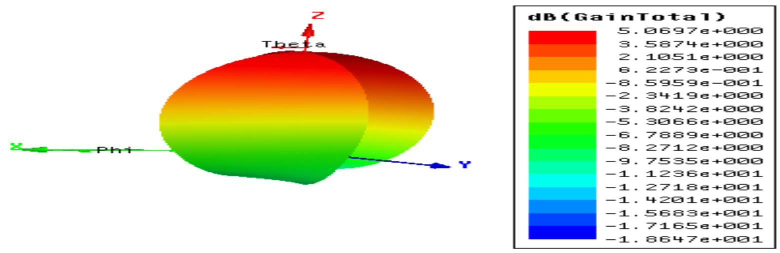

Fig:5 Gain Toal Radiation Pattern

IV. CONCLUSION

The purpose of this thesis is successfully completed as the study and design has been made with the micro strip L slot patch antenna.An experimental micro strip patch antenna system is developed in this Paper. The use of IF processing to control the radiation pattern characteristics proved to be an approach providing stability and easy control of the radiation patterns as verified by the measurements and comparison with theoretical results, which shows good agreement. The radiation pattern is unidirectional and omni directional pattern for operation bandwidth with an excellent VSWR and return loss.

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