Wearable Textile Inverted E Shape Microstrip Patch antenna by using defected ground plane

Priyesh Jaiswal & Dr. Poonam Sinha
priyeshjaiswal01@gmail.com

Department of Electronics Engineering
University Institute Of Technology, Barkatullah University, Bhopal.

Abstract-

The textile antenna is very common due to their tininess for wireless communication devises. The antenna is appropriate due to their different parameters like low dielectric constant, relative permittivity etc. The antenna is premeditated by using textile substrate (wash cotton) with a permittivity of 1.51 and thickness of 3mm. The structure is trouble-free, compact and simple to manufacture by using wash cotton substrate. The predictable antenna is propose by using a slot of length λ/2 open stub on ground plane and exiting patch of 6mm x 23mm with a probe feeding of 0.3mm radius of SMA connector between ground and exiting patch. The antenna is applicable for medical application as well as for 2 to 4GHz band application. The proposed antenna is planned to achieve a band of 63.36%. for VSWR are in between 1 to 2, the directivity and losses for proposed antenna is 5dBi to 7.1dBi and -19.5dB.The designed structure is proposed for 2 to 5 GHz band application. The antenna is designed and computer based software generated by IE3D software.

Keywords Wearable antennas wide band, Integral equation three dimensional electromagnetic simulator (IE3D), wash cotton , slot, defected ground plan .

I. INTRODUCTION

The used of an antenna is fast increasing newly due to different form of wireless communication systems They are used into the different application like 4G mobile and cellular services, marine or land vehicle navigations (GPS), wireless LANs access, sensing devices for monitoring systems, and many tiny devices embedded with WiFi, Ultra Wide Band, Zigbee etc.[1] At the current moment, portable communication devices and human body which is to be wearable communication systems require wide- gain, wideband with packed together sizes which should be an combined part of the wearer clothing [1–6].These are wearable movable phones; Note pad; personal digital assistant (PDA) devices, sports activities, body area networks (BAN); Industrial, scientific, and medical (ISM) band; WLAN so on. The material based wearable radiator be supposed to correspond the voice data, or biotelemetry signals at high data rates. It should have different features like low weight, at ease to used, flexible, need to be undisclosed, and it health aware of user. In perform, human being made or standard cloth materials are used as dielectric substance to produce the textile or cloth-based wearable antennas. These materials are polyester, wet cotton, dry cotton, fleece stuff, Nomex, nylon, foam, copper strip, insulated wire, conducting coat, copper layered material etc .The person responsible work on effect for different parts of human body like hand, stomach, leg etc actions for impedance matching of textile-based antenna is designed [5]. To take away of the metal section of the rectangular microstrip patch antenna by formation the slots within the patch to excite lower resonant frequency. The conductor removing technique helps to reduce the effect due to human body activities on the antenna. It also decrease the Specific absorption rate (SAR). The meta material square split ring resonator (SRR)

is set in within the slot to achieve the enhanced toning in the wireless local area network (WLAN). The author proposed a designed of an antenna which is acting as a most important function involving in wireless and sensor which is attached in on body and other devices. The devise of textile antenna is unlike as of the usual antenna. [1] [2]. The author proposed an antenna in which the substance (textile material) be used it projected the three different design in which blind cotton and polycot as a material are used to create the multiband [3]-[7] A number of research are going on to work on an antenna which is predictable on human body for communication whose signal is along the float up of the individual being and explain about the directed pattern which is proportional to the surface of a human body. In wireless body area network (WBAN) plane antenna face cannot be provided in general [4]. Bending result of the wearable antenna a few is work on electronics band gap (EBG) to get better the input impedance matching and improve bandwith [5-6]. In this requires a potential combination of the wearable antenna device for daily usable clothing.[7]. Here we are move toward the microstip patch antenna design technique for wearable antenna design to achieved the wide band and high gain antenna.

II. MATHEMATICAL ANALYSIS

The antenna is to be demonstrate to propose of an antenna with a range of frequency 2.4GHz, here we used the wash cotton substrate with relative permittivity ε_r=1.51, and height (t) = 3mm, Loss tangent loss (tanδ)=0.02. By used of equation, from 1 – 5. We find out the width and length of the ground and exciting patch of the proposed design.[10]

$$W = \frac{c}{2f\sqrt{(\varepsilon_{r+1})/2}} \quad (1)$$

$$\varepsilon_{reff} = \left(\frac{\varepsilon_r + 1}{2}\right) + \left(\frac{\varepsilon_r - 1}{2}\right)\left[1 + 12\frac{h}{W}\right]^{-1/2} \quad (2)$$

$$Le = 0.412h \frac{\varepsilon_{reff} + 0.3\frac{W}{t} + 0.264}{\varepsilon_{reff} - 0.258\frac{W}{t} + 0.8} \quad (3)$$

$$L = \frac{c}{2f\sqrt{\varepsilon_{eff}}} - 2Le \quad (4)$$

$$L_0 = L + 6t \quad (5)$$

$$W_0 = W + 6t \quad (6)$$

where:

f = frequency

ε_r = relative Permittivity

ε_{reff} = Effective permittivity

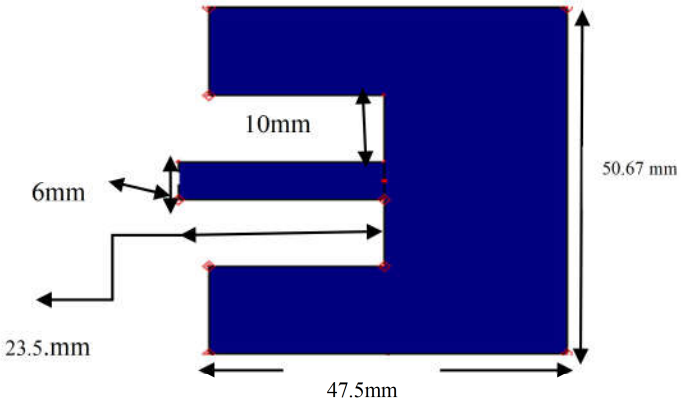
W = Excited Patch's width

L = Excited Patch's length

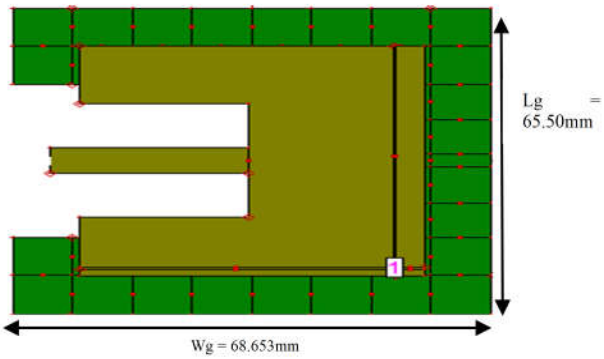
t,h = Thickness of textile substrate

L_0 = Measurement lengthwise of ground

W_0 = measurement widthwise of ground



(a)



(b)

Fig.1 Geometry of an antenna (a) Top of the patches (b) Bottom plane with shorting pin.

The structure of designed antenna with a slot of λ/2 is place on exciting patch and cut ground plane with open slot of 40mm x 40 mm and probe feeding is as shown. It shows fig 1 the pass band of 1.8 to 2.6Ghz and 3.1 to 4.1 Ghz. The antenna is drawing by 68.653mm x 65.50mm x 3mm. As per table 1 special components of a proposed antenna is to be calculated is shown.

Table No-1:- Specification for the design proposed antenna.

Sr. N.	Parameters	Values for proposed antenna
1	Design frequency(f_o)	2.4GHz
2	Dielectric constant(ε_r)	1.51
3	Height of substrate(t)	3
4	Loss tangent for wash cotton	0.02
5	Width of proposed antenna(W)	50.67mm
6	Length proposed antenna (L)	47.5 mm
7	Width of ground plan (W_0)	68.65 mm
8	Length of ground plan(L_0)	65 .50mm
9	Feed location: X_f (along length), Y_f(along width)	-19.41mm 25.32mm

III ANTENNA DESIGN AND RESULT ANLYSIS

A. Antenna Design .

The architecture of proposed designed is consists of two slot of λ/2 at exciting patch look like as a E shape slot .The feeding is probe feeding by using a wash cotton substrate which has a substrate thickness of 3mm and dielectric constant of 1.51 that the return loss of the textile antenna, directivity of the proposed antenna, and the 3D pattern be able to obtain by using the proposed antenna which is done by MOM software Electromagnetic software (IE3D). Based on the IE3D Software and numerical Analysis [10] the parameter as shown in a table 1 of a proposed textile wearable antenna is calculated.

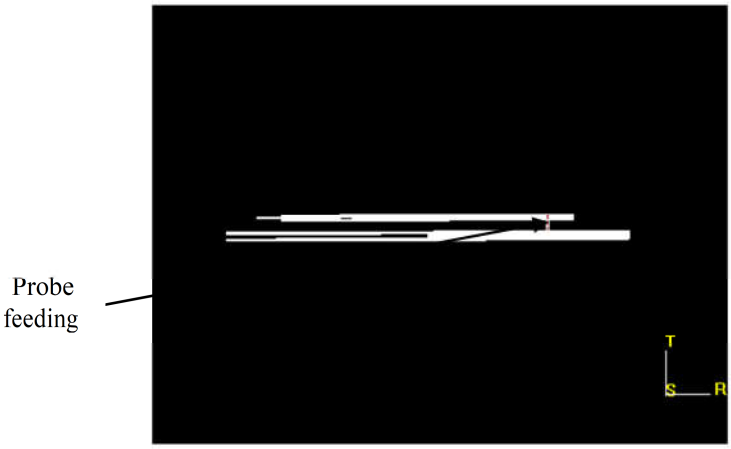


Fig.2 3D view of proposed antenna

Fig 2. Shown the 3 Dimensional view of a proposed an antenna. The top is an radited patch and the bottom plane is an reflector in sandwiched between probe feeding is given.

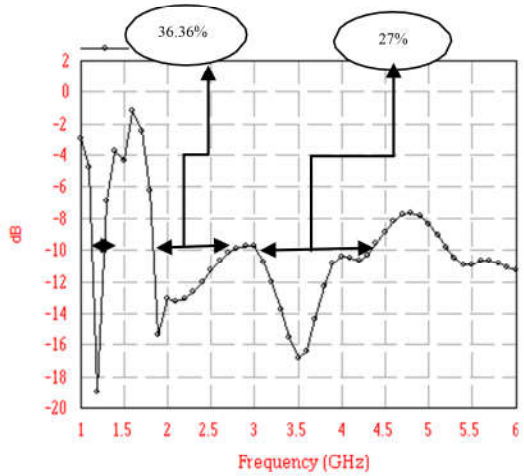


Fig.3 Return loss curve for antenna with E slot shorting pin

From Fig 3. It represented the return losses and bandwidth of an proposed antenna and from fig it is summarized that the return loss of a proposed geometry is approximately -20dB. The design of an antenna contain two group of frequency band form 1.8 Ghz to 2.6 Ghz and 3.1 to 4.1 Ghz, The reflection Loss for band is useful in between 1.8 Ghz to 2.6 Ghz and 3.1 to 4.1 Ghz.

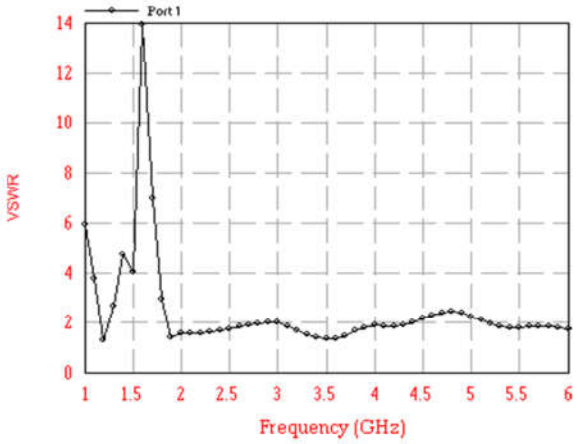


Fig.4 VSWR plot for proposed geometry

The Voltage standing wave ratio is less than 2 among 1.8 to 2.6 Ghz and 3.1 GHz to 4.1 Ghz respectively,

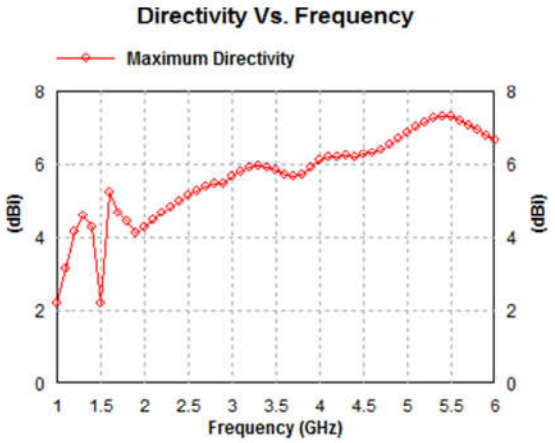


Fig.5 Directivity vs frequency curve for proposed antenna

The directivity of proposed is as shown in Fig 5 the directivity is in between 5 to 7.9dBi at 1.8 to 5.5 Ghz

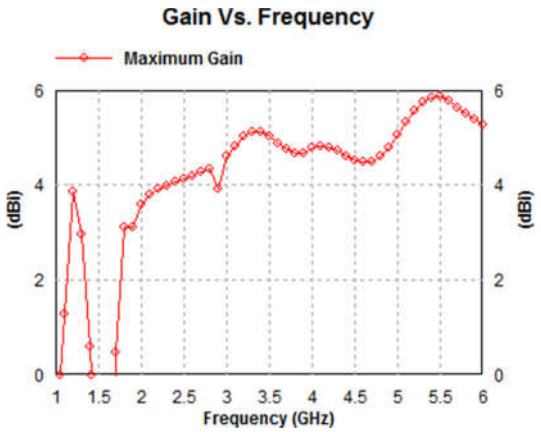


Fig.6 Gain in dBi vs frequency in Ghz response of proposed geometry. The gain of the design is 6dBi.

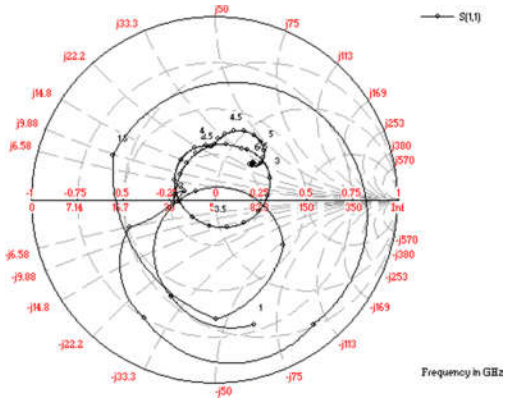


Fig. 7 Smith chart for proposed Design

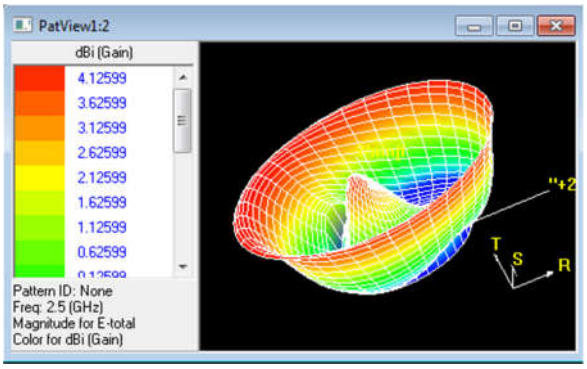


Fig 8: The 3D radiation pattern of the proposed antenna

The 3D radition sample of an antenna at change of cyacle 2.5 Ghz as shown. It capable of empirical from the energy that designed antenna has steady radiation all over the band of operating frequency range which is applicable for ISM band.

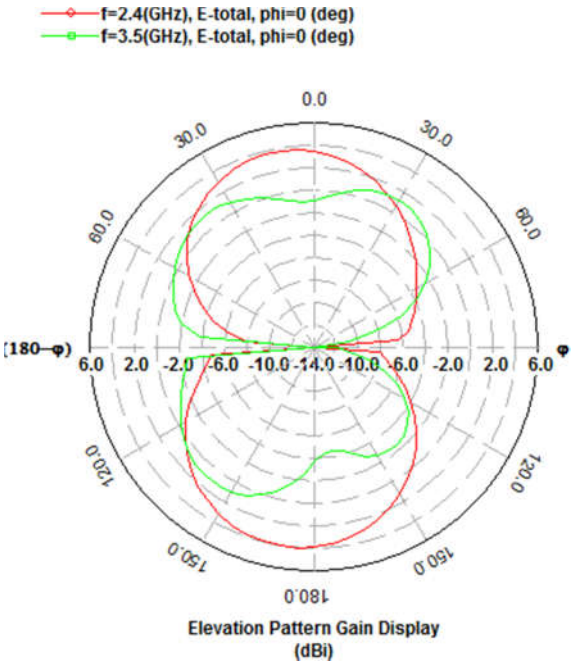


Figure 9 Elevation Pattern at 2.4 and 3.5 GHz

The Etotal of a design antenna radiation pattern for ISM band at 2.4 GHz and for S band at 3.5 GHz.

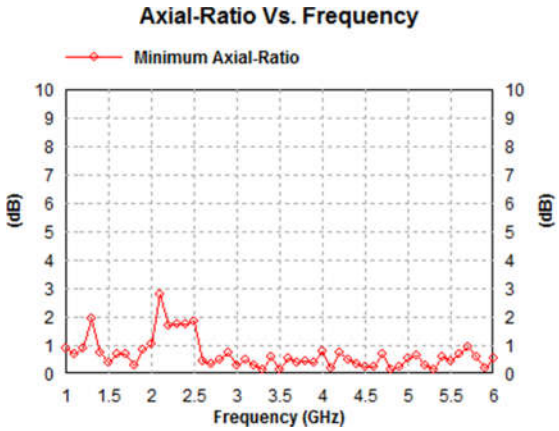


Figure 10 Axial ratio of simulated proposed antenna

The axial ratio for an antenna is shown in fig 10 as shown. It is explain that the antenna is operated in below 3db value of an axial value because of this it is operated in circular polarization. The value is less than 3dB at a frequency range from 1,8 GHz to 2.6 GHz and 3.1 GHz to 4.1 GHz.

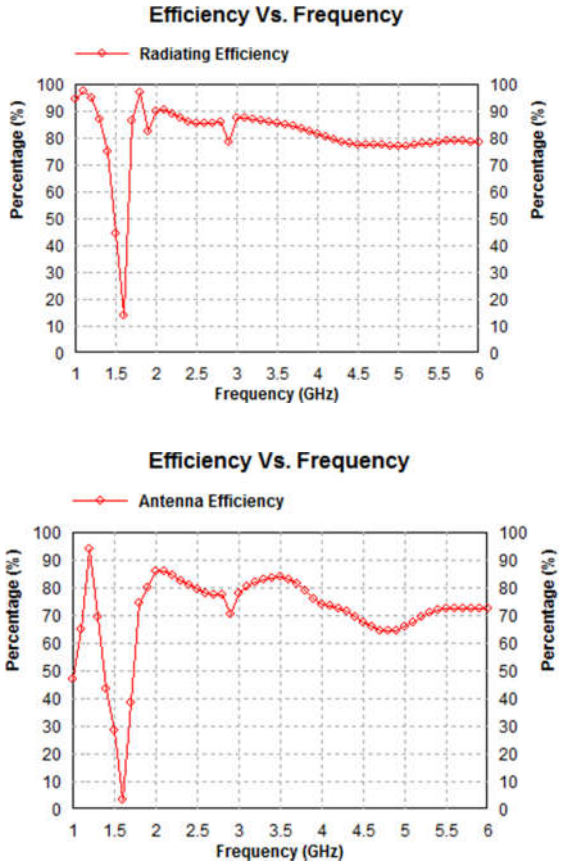


Figure 11 Radiation and antenna efficiency of simulated proposed antenna

The proposed antenna is designed for ISM and S band application that's efficiently used for same is validated by a simulated radiation and antenna efficiency as shown in figure 11. The antenna efficiency is approximately 80% and radiation efficiency is 90%.

IV. CONCLUSION

The wearable antenna is proposed by using wash cotton with a copper conducting outside layer on both sides of ground and existing patch with a probe feeding technique for medical and wireless application are based on software method of movement (MOM) and validated through a software IE3D by using 2.4 GHz. The geometry of an antenna is proposed by using open and closed stub slot. This is used for achieving appropriate bandwidth in a proposed antenna. All the antenna specification are analyzed by frequency 2.4 Ghz frequency. The proposed geometry is stable for a band of just about 63% through a unvarying pattern inside the frequency. By using wash cotton substrate the antenna can be easily manufactured and the substrate thickness is in between 0.5mm to 1mm. The consideration of a proposed geometry is within satisfactory bound so as to it is appropriate for wearable application. In this paper we use trouble-free coaxial feed method is used for the design of this geometry.

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