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Textile Antenna for Microwave Wireless Power Transmission

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Abstract

In this paper the modified and efficient design of the antenna for wireless power transfer has been proposed to gain efficient power. The antenna are capable to use various type of communication like satellite communication and also used for power transfer, military use and various welfare works such as medicine field, natural disaster relief program. The textile material is used because it is wearable, low cost and flexible & needs less care. Simulated results like bandwidth, return loss, radiation pattern, gain and efficiency are presented to validate the importance of the current proposed design.

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Keywords: Ultra wide band, CST studio software, Return loss,gain

1. Introduction

In order to design a lightweight antenna for wireless power transmission we have to keep the efficiency of antenna as high as possible to gain maximum power output. The rapid development of wireless power transmission has increased the demand for compact textile antennas with high gain and broadband characteristics. Microstrip patch antennas are very advantageous because of their effective cost, low profile, low weight and simple realization process.There are a lot of methods to increase the bandwidth of antennas, including increase of the substrate thickness, efficiency of antenna, the use of a low dielectric substrate, the use of various impedance matching and feeding techniques [1-7]. This paper describes simple design of microstrip antenna. The proposed antenna is made of patch and ground is made of copper self adhesive tape. Simulation results such as reflection coefficient, gain and efficiency are presented. The development of wearable computer system technology has been quickly growing to enhance the quality and efficiency

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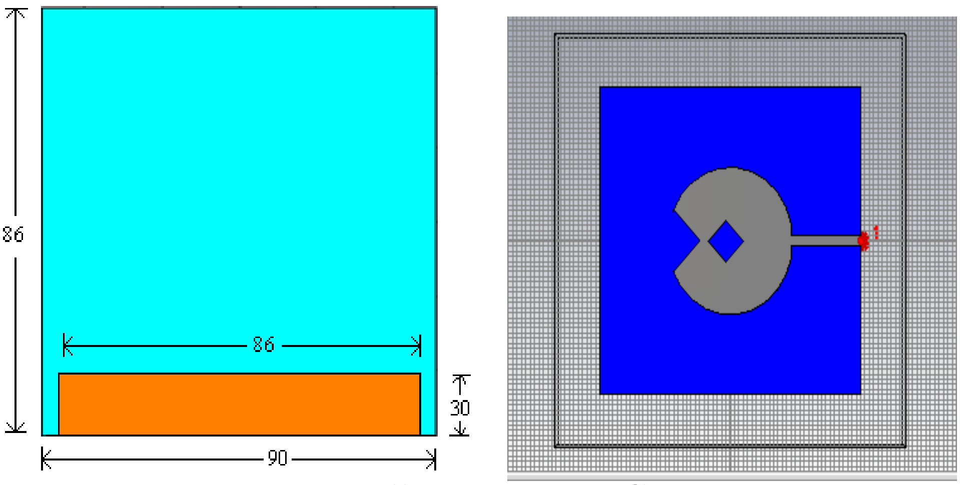
of human life by providing flexible mobile system. Usability, functionality, durability, safety and comfort have become important prerequisites of a wearable system [8-16]. The system known as intelligent clothing, transmission of information and communication has been developed in health monitoring activity in the medical area, surveillance in military units and illness prevention and citizen medicine in healthcare sector [17-23].
The rest of the article is organized as follows: section 2 describes the design of proposed antenna, section 3 denotes simulation results such as S_{11} parameter, 3D & 2D radiation pattern of presented antenna, Finally conclusion is presented in section 4.

2. Design of proposed antenna

In this paper, an improved design of antenna has been proposed and analysed. Figure 1 shows the geometry of proposed antenna with partial ground of dimension 86mm × 30 mm and slit loaded circular patch of 14mm which was calculated by equation (1). The ground plane & patch of designed antenna is made of copper tape with a thickness of 0.03 mm [16-24]. The proposed antenna is made of copper tape of dimension 90mm × 86 mm. The simulations were carried out using CST Microwave Studio software and the antenna characteristics were studied.



(a) (b)

Fig. 1. Geometry of proposed textile antenna (a) Partial ground (b) Slit loaded patch

$$a = \frac{87.94}{fr\sqrt{\varepsilon_r}} \tag{1}$$

Table 1 Proposed Antenna Parameters

Antenna Parameters	Values
SubstrateThickness (h)	1mm
Relative permittivity (ε_r)	1.7
Loss Tangent	0.025
Partial ground dimensions [mm]	86×30
Patch radius[mm]	14.0
Centre square slot [mm]	5×5
Upper square slot [mm]	10×10

3. Results and discussions

The simulation results were obtained by CST Microwave Studio software and the antenna features were studied. Figure 2 shows S_{11}-parameter Vs frequency of proposed textile antenna having the tripple band at resonant frequencies 3.4286 GHz, 9.7311GHz, and 11.176 GHz respectively. Figure 3 presents 3D Radiation pattern at 3.4286 GHz, 9.7311GHz, and 11.176 GHz. At resonant frequency 3.4286 GHz directivity is about 3.353 dBi having the efficiency 87.2%, at resonant frequency 9.7311 GHz the directivity is 4.237 dBi which is quite imposing and with S_{11} of -38.10731dB and at resonant frequency 11.176 GHz directivity is maximum about 5.193 dBi having the highest efficiency of 89.6%. Figure 4 describes the 2D Radiation pattern at 3.4286 GHz, 9.7311 GHz, and 11.176 GHz respectively.

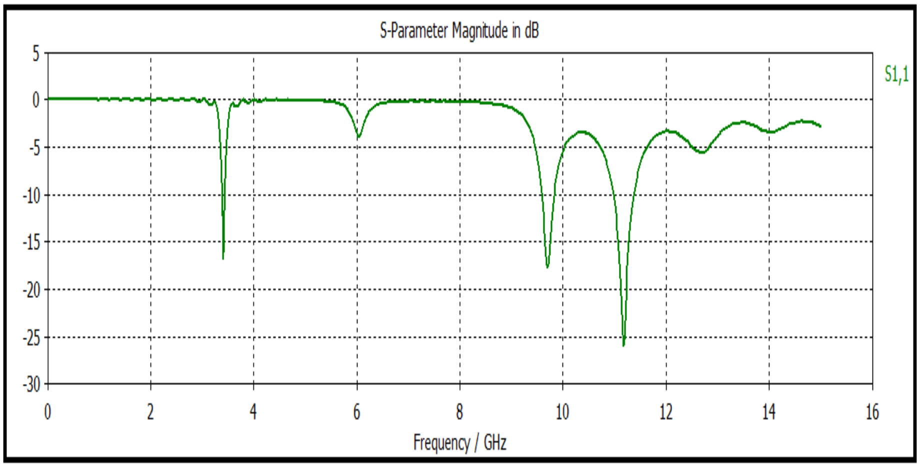
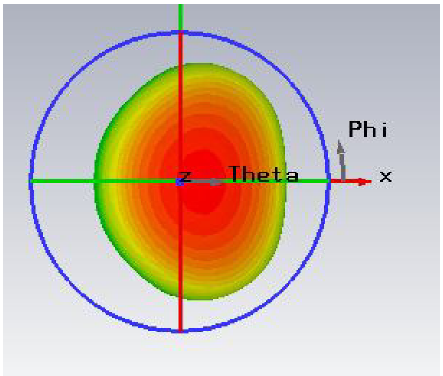


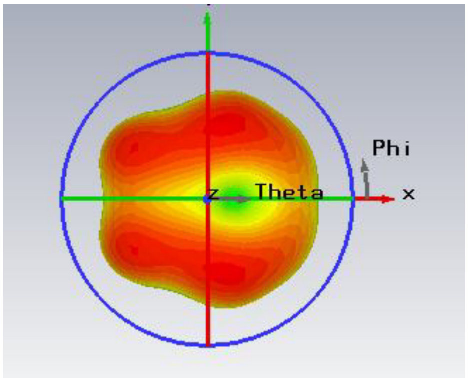
Fig.2. S_{11}-parameter Vs frequency of proposed textile antenna

Table 2 Simulated Gain & Efficiency of Proposed Antenna

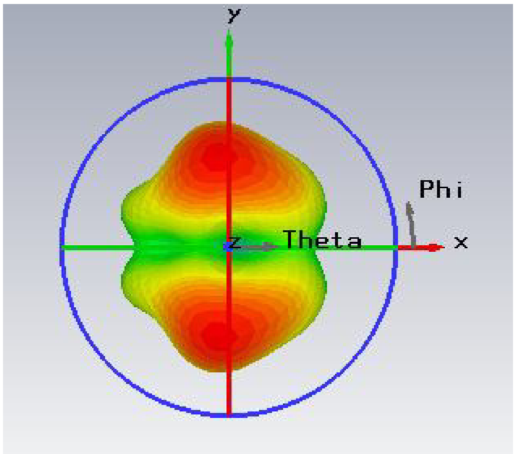
Frequency	Directivity	S_{11}	Efficiency
3.4286 GHz	3.353 dBi	-22.23231 dB	87.2%
9.7311 GHz	4.237 dBi	-38.10731 dB	87.4%
11.176 GHz	5.193 dBi	-20.79123 dB	89.6%



(a)

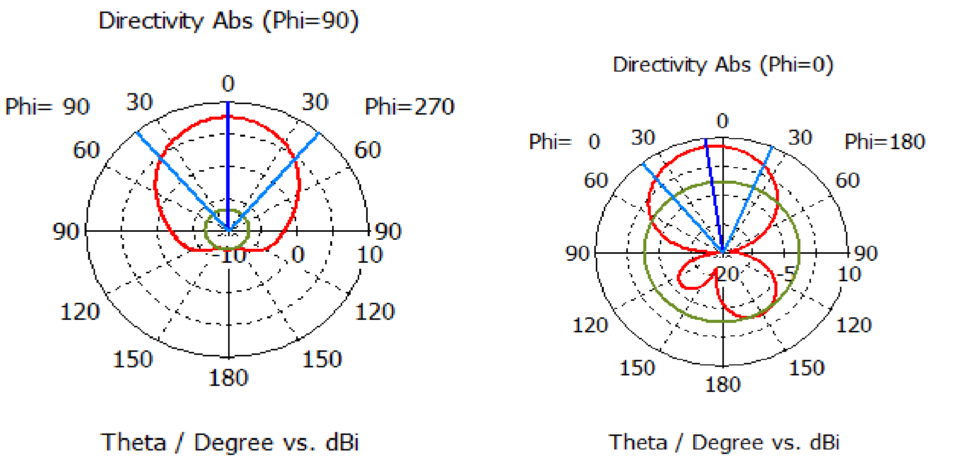


(b)

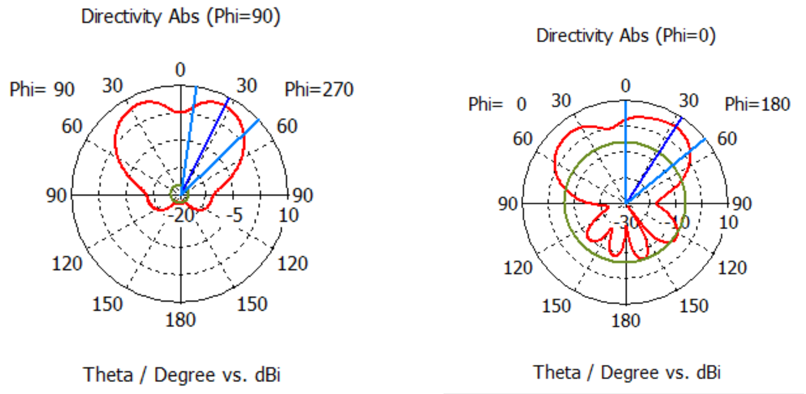


(c)

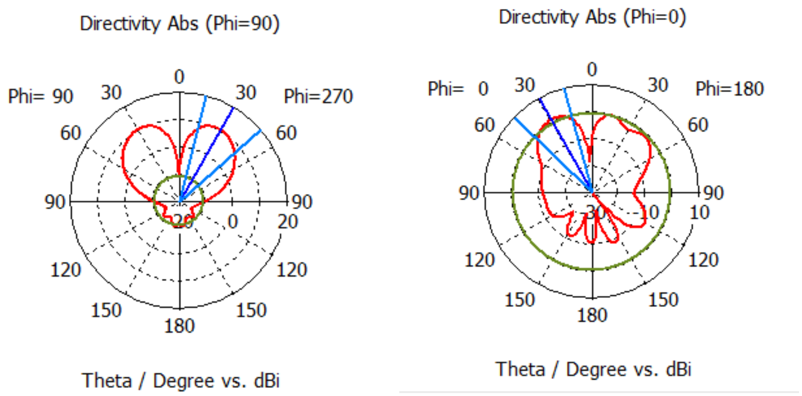
Fig.3. 3D Radiation pattern at (a) 3.4286 GHz, (b) 9.7311 GHz and (c) 11.176 GHz



(a)



(b)



(c)

Fig.4. 2D Radiation pattern at (a) 3.4286 GHz, (b) 9.7311GHz, and (c) 11.176 GHz

4. Conclusion

In this manuscript it has been concluded that the textile wearable antenna with major applications of monitoring a human body is achieved by using a jeans substrate. The textile antenna using jeans with tripple band features is presented and studied. The proposed textile antenna covers a wide impedance bandwidth and operates in three different bands. The proposed antenna gives three different wide bands with the gain of 3.353 dBi, 4.237 dBi, and 5.193 dBi which are best suitable for different wireless communication systems.

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