A Wearable Antenna Using Jeans Substrate Operating in Dual-Frequency Band

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Abstract In this paper, the research work has been carried out on designing wearable microstrip patch antenna which resonates at dual-frequency bands, which are 2.6 GHz and 5.8 GHz, respectively. Both the bands are permissible bands for wearable devices as recommended by Federal Communication Commission (FCC). Easily available textile material like Jeans is used as the substrate material and copper is used for the conducting part. The simulation result is satisfactory with respect to gain, bandwidth, return loss, directivity VSWR, and other antenna parameters.

Keywords FCC · Wearable antenna · Textile material · Return loss · Gain

1 Introduction

Nowadays wearable devices are gaining much importance mainly in remote monitoring of environmental conditions and different parameters of human body. With the use of these devices, it becomes easy to monitor the health conditions, especially for elderly people for sudden degradation of their health condition. Due to the rapid advent of the technology called the Internet of Things; the wearable devices are becoming an integral component of each and individual things. Antenna is the inherent integral part of all devices used for remote transfer of data. Wearable

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antennas find much significant application in the area which includes rescue team, defense (where the wearable device can be a part of their clothing), persons who are working in the mines or far remote places where regular vigilance is impossible. One of the important requirements of antenna used in wearable devices which are attached to human body for health monitoring is that they must be flexible, easy to wear and compatible to human body. Jeans is one of such materials which satisfy these requirements. This material is very easily available and can be easily attached to clothing. These kinds of textile materials are also having the advantages like low cost, flexible and easily wearable. The textile materials are having the inherent advantage of low dielectric constant, which helps in improving the impedance bandwidth by reducing the surface wave loss. Antenna bending effect can also be measured and can be taken into account for antennas made up with textile materials.

Wearable antennas can be attached as a part of clothes and all other wearable things like belt, shoe, helmet, bag, tie, cap, etc. The availability of such a variety of textile materials made the rapid growth of wearable devices possible.

2 Antenna Design

The antenna design and simulation is carried out in HFSS13.0. In the first stage of antenna design, simple rectangular structure of patch is used. Copper is used as the conductor. Jeans is used as a substrate having 2 mm thickness. The dielectric constant used here is 1.76 and loss tangent 0.02. Overall dimension of the ground surface is 50 mm × 50 mm and the dimension of the patch is 34 mm × 34 mm. The simulation result shows that the antenna resonates at 2.6 and 5.8 GHz. Further to improve the structure in terms of gain, band width, directivity, and other parameters, a wide slot of 10 mm × 10 mm is inserted at the ground. The simulation result shows a return loss of −15 and −20 dB at respective resonating frequency bands of 2.6 and 5.8 GHz. Figures 1 and 2 show the corresponding antenna structure and simulation result.

3 Result and Discussion

The proposed antenna has been designed and simulated using HFSS software. The antenna designed is planner patch antenna with microstrip feed. The following Fig. 2 shows the S11 display of the designed antenna. The diagram clearly shows that the antenna resonates at 2.6 GHz and 5.8 GHz. The return loss achieved is around −15 dB and −20 dB, respectively.

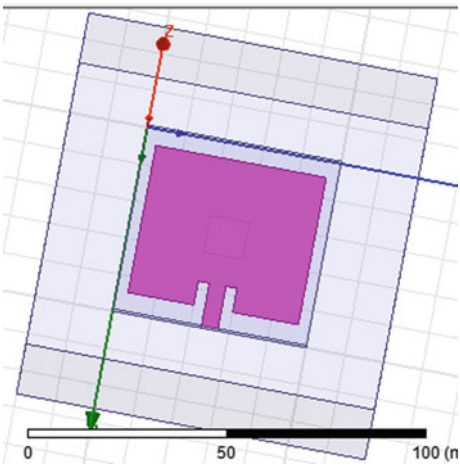

Fig. 1 Antenna structure

The antenna is resonating at 2.6 GHz and a very high gain of around 7.8 dB is achieved at this frequency. The frequency 5.8 GHz is the first harmonic of the resonating frequency. The return loss at this frequency is around −20 dB and gain is around −10 dB. The VSWR achieved is 0.84 which satisfies the acceptable limit for a good antenna performance. In this design, inset feed is used improve the impedance matching (Fig. 3).

The result of simulation of the designed antenna shows that it satisfies the circumstances of the antennas used in wearable devices. Jeans is used as substrate here which is easily available and can be easily attached or stitched to clothing.

4 Conclusion

This paper is the outcome of an effort given in the design of wearable antenna using textile material like jeans. This can be easily attached to clothing, washable, and also fashionable. The proposed antenna is resonating at dual-frequency bands of 2.6 and 5.8 GHz. Both the frequency bands are acceptable for wearable devices. This work can be further improved to get better impedance matching, better efficiency.

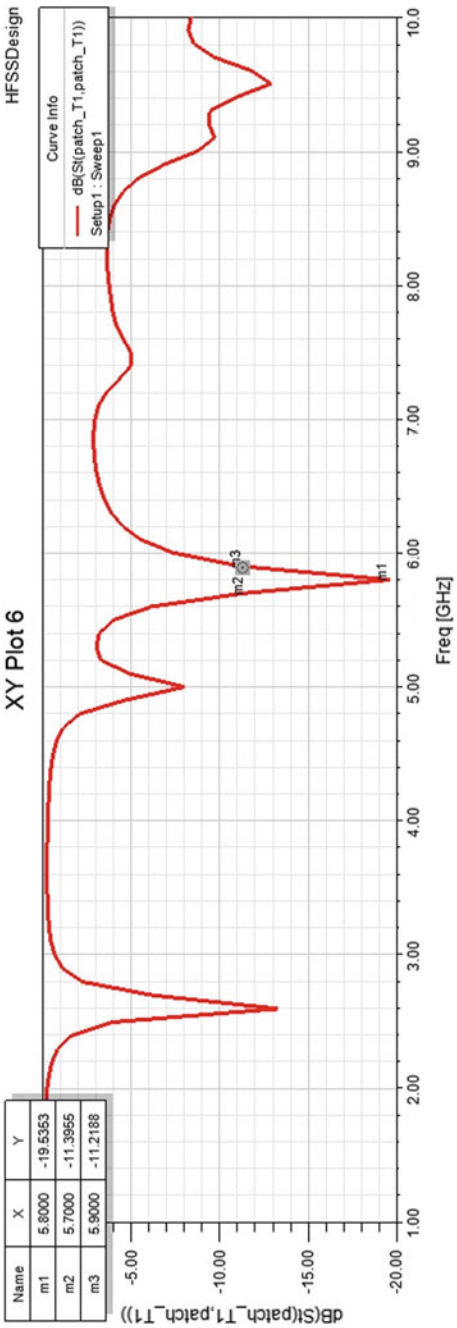

Fig. 2 S11 display of simulated antenna

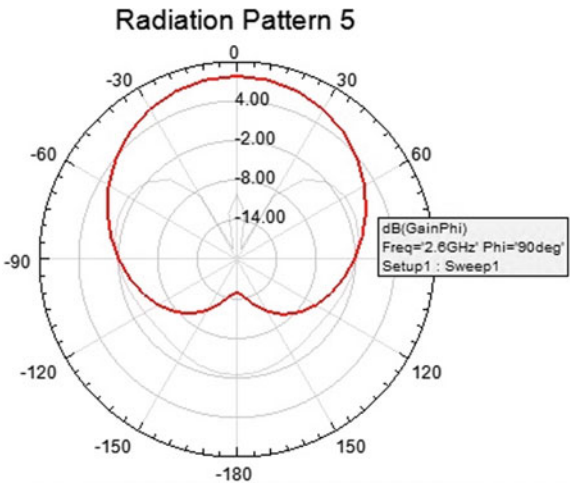

Fig. 3 Radiation Pattern display of simulated antenna

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