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Simulation of Textile Antenna for Wearable Applications at ISM Band

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Abstract:
Utilization of wearable textile materials for the development of microstrip antenna segment has been rapid due to the recent miniaturization of wireless devices. This paper describes a design of textile antenna for wearable applications and simulation is done in CST Microwave Studio software. This antenna is designed by considering the several factors as, Accurate frequency selection, Substrate material and height selection, Patch dimension and Feeding method and the position. In this project, the optimized method is presented to optimize the design of textile wearable antenna. However, geometry of antenna must be adjusted to obtain the greater performance. The designed antenna can be operated at ISM band 2.45 GHz. Finally, the performance of the optimized antenna is compared with the wearable textile antennas that are uses traditional approaches and also examined the performance in terms of return loss, bandwidth, gain and other metrics.

Keywords: Microstrip patch antenna, inset fed, Return Loss, VSWR, Gain, CST Microwave Studio.

I. INTRODUCTION

Wearable devices are becoming more popular today. The development of wearable device technology has spread and finds applications in wireless personal communications, biomedical, entertainment, aviation, emergency rescue, and military warfare systems [3]. In addition, wearable communication devices that can be bent, reconfigured, and con-formable would greatly extend the reach of traditional electronic communication devices. With the development of wearable wristwatches, smart goggles, and electronic textiles, Wireless body area networks (WBAN) gains a lot of attention [3]-[4]. The wearable devices often require built-in antennas that must be compact, conformal, and flexible to operate in the wearable communication devices. In addition, these antennas must show excellent performance.

II. ANTENNA DESIGN

The proposed antenna has been designed with denim material substrate of thickness 2mm having dimension 32 x 30 mm as shown in figure 1. The copper foil is acting as the radiating element with Coplanar feed structure where the two ground planes are positioned parallel with 1.5 mm separation gap. The radiator and ground plane are separated with the optimum gap of 1.5 mm. The prepared prototype is shown in figure 1.

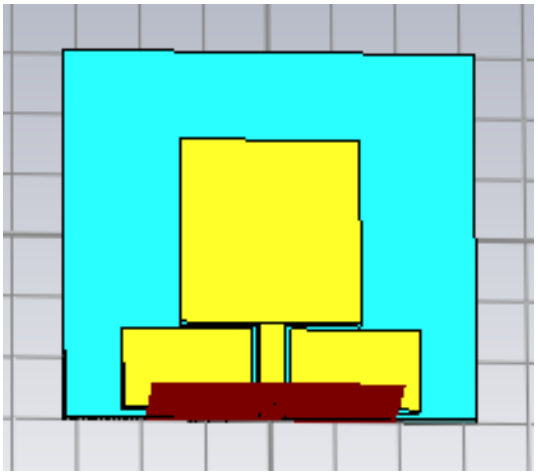

Fig. 1: Antenna structure

The parametric study has been conducted on the various dimensions of the antenna and ground plane to arrive at the optimum dimensions for a better performance. The optimized dimensions have been obtained using trial and error method. The optimized length and width of the antenna is 14 mm and 15 mm respectively. The optimum thickness of the substrate is 2mm. The best dimension of the ground plane is 24 x 11 mm.

III. Proposed Antenna Geometry

The proposed antenna is inset fed on a jeans substrate with dielectric constant of 1.78. resonant at frequency of 2.45 GHz. The proposed antenna geometry (front view and back view) is shown in figure 1a and 1b respectively.

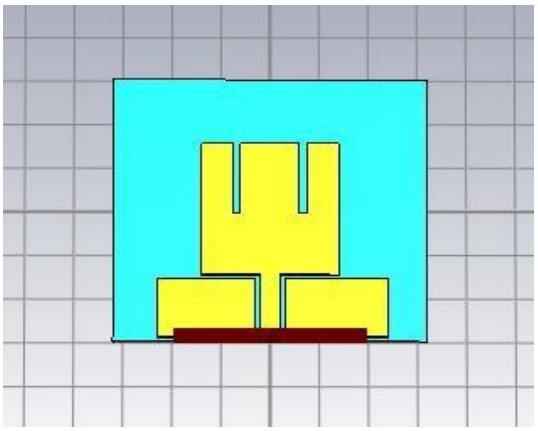

Figure 1a. Front view of proposed antenna

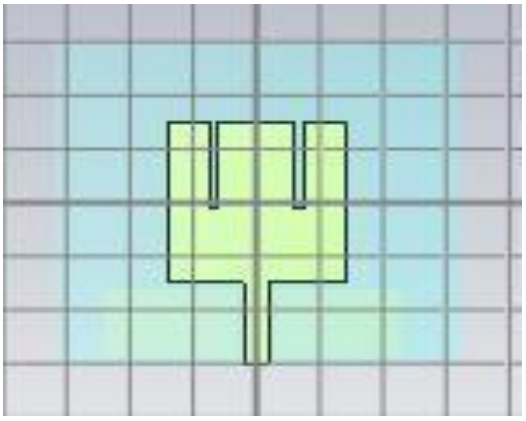

Figure 1b. Back view of proposed antenna

IV. Results:

Figure 2 shows Return Loss graph of proposed antenna. The return loss at 2.53 GHz frequency is -59.06 dB. The bandwidth of designed antenna is 0.67 GHz as shown in figure 3. VSWR is shown on in figure 4. VSWR of 1.04 is obtained for proposed antenna. The radiation patterns (E-field and H-field) are shown in figure 5a and 5b respectively. The gain of proposed antenna is 1.26 dB and it is shown in figure 6.

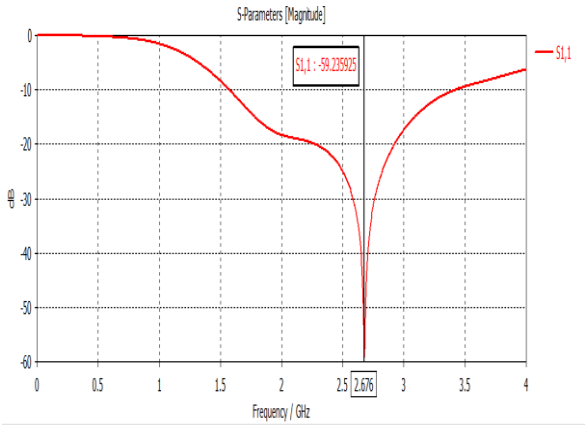

Figure 2: Return Loss graph of proposed antenna

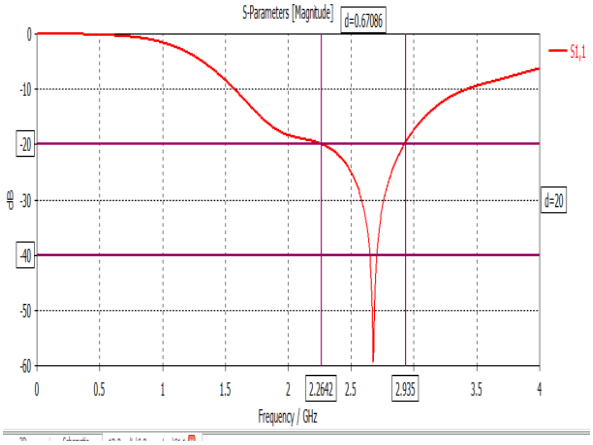

Figure 3: Bandwidth of designed antenna

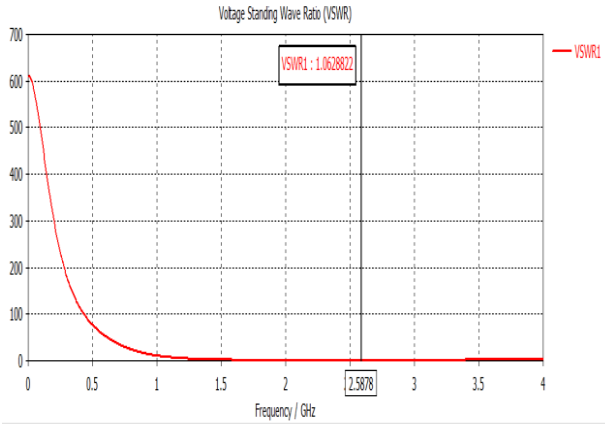

Figure 4: VSWR of proposed antenna

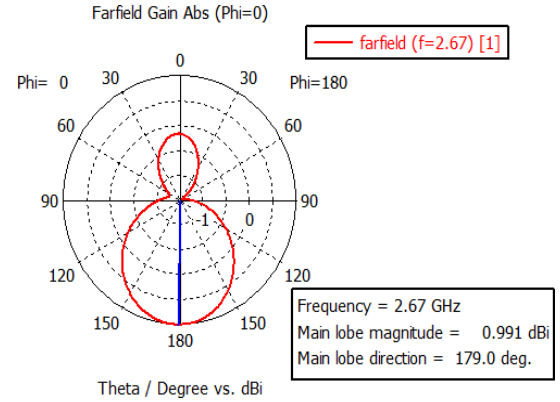

Figure 5a: E-field radiation pattern

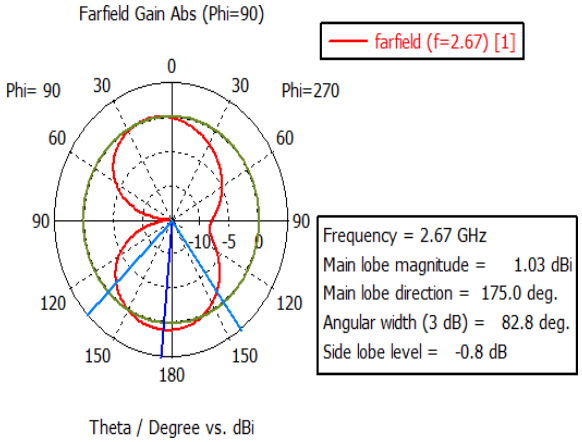

Figure 5b: H-field radiation pattern

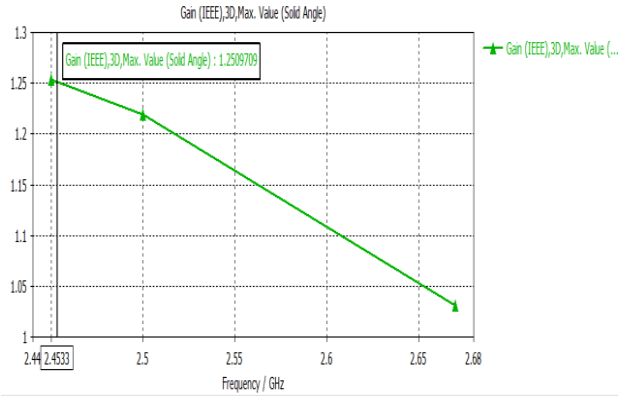

Figure 6: Gain of the proposed antenna

V. Conclusion:

This paper gives the details about the development of E-shaped textile antenna at 2.45 GHz with denim jeans as substrate material. Among all other materials denim jeans is the reliable material with low cost, easy availability and feasibility in all manufacturing steps. The proposed antenna yields better bandwidth, Gain and directivity characteristics for the requirement of the biomedical application in the ISM band.

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