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Hardware Implementation and Optimization of a Dual Band Textile Antenna

Neha Nigam, Vinod Kumar Singh

Abstract: This paper proposed a dual band wearable textile antenna to achieve high gain with partial ground. In this antenna jeans fabric has been used as a substrate whose permittivity is 1.7 and patch has been made by copper adhesive tape. The benefits of jeans are long wearing, cost effective, flexible and needs less care. This anticipated antenna provides gain of 4.260dBi at 4.8265GHz and 5.103 at 7.2997GHz.Simulated and measured reflection coefficient, directivity and radiation characteristics have been studied. The designing and simulation of this antenna is being done by utilizing CST Microwave Studio software.

Key Words: Jeans, Microstrip antenna, Gain, Radiation pattern, CST

I. INTRODUCTION

As of today, antenna has achieved a prominent status and wearable antenna is an incipient technology. This wearable antenna needs a limited ground plane because it works within the sight of the body, a condition which may bring about changing antenna attributes. Wearable textile antenna's applications are one of the fascinating exploration points because of its ease, compact in size, easy fabrication, and user friendly. For designing a wearable antenna,an insulator will be utilized as a substrate for example, leather, flannel, satins, foam or jeans, though for a radiating patch and ground plane copper adhesive material has been utilized. The proposed antenna considers jeans as a substrate because of its low relative permittivity (1.7). Due to low dielectric constant and attenuation are very less as compared to other fabrics. The bandwidth of textile antenna can be enhanced by utilizing substrate which has low dielectric constant.

In this designed antenna jeans material has been utilized as a substrate and there is a radiating patch of copper on one side of the jeans and on other side there is a partial ground surface made up of copper adhesive tape of thickness 0.038mm. The height of jeans fabric is 1mm and its loss tangent is 0.025. Relative permittivity is an important factor which should be taken into consideration, jeans relative permittivity is 1.7. The CST Microwave studio has been utilized for calculating the outcomes like reflection coefficient, gain, and bandwidth.

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* Correspondence Author

Neha Nigam*, Dept of Electronics & Comm. Engineering, SR Group of Institutions, Jhansi, U.P. India

Vinod Kumar Singh,Dept of Electrical Engineering, SR Group of Institutions, Jhansi, UP, India

II. ANTENNA DESIGN PROCEDURE

Theanticipated microstrip textile patch antenna has been simulated by utilizing the Computer Simulation Technology(CST) Microwave Studio software. Figure 1.1 demonstrates the design of the anticipated antenna. The substrate we are using in this project is Jeans whose dielectric constant is 1.7 and thickness is 1mm. Radiating patch and partial ground surface has been made up of copper adhesive tape with thickness 0.038. This antenna provides a dual band. Hence this antenna is best suited for wireless communication.

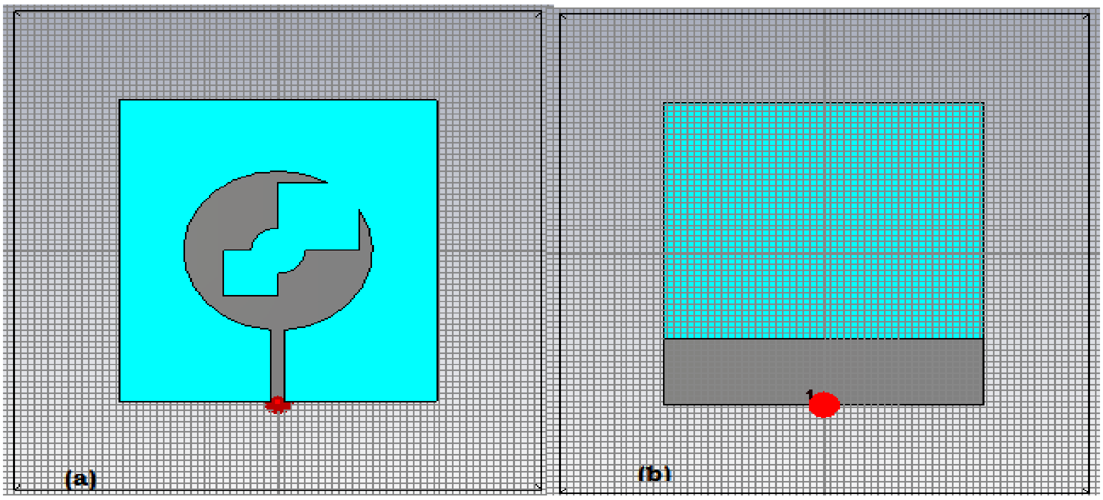

Figure 1.1 (a) Front view of the designed antenna (b)Back view of the designed antenna

Table1.1Design parameters of the anticipated antenna

S.No.	Design Parameters	Values
1	Relative permittivity (ε_r)	1.7
2	Substrate thickness(mm)	1
3	Partial ground dimension (mm)	47X11.5
4	Dimension of substrate	47x 53
5	Patch radius (mm)	14
6	2 square slots (mm)	4x4, 6x6
7	Inner circle slot(mm)	4
8	Width of microstrip line (mm)	2

III. RESULTS AND DISCUSSIONS

S11 parameter, 3-D radiation pattern, 2-D radiation pattern and Smith chart has been presented and studied. The Return loss versus frequency graph has been shown in Fig 1.2 with a band at resonant frequency 5,27GHz. The 3-D pattern is plotted in Fig1.3 and it shows the measured gain of 4.260dBi at 4.8265GHz and 5.103 at 7.2997GHz. Fig 1.4 shows the 2-D radiation pattern and Fig 1.5 shows the polar characteristics of Smith chart.

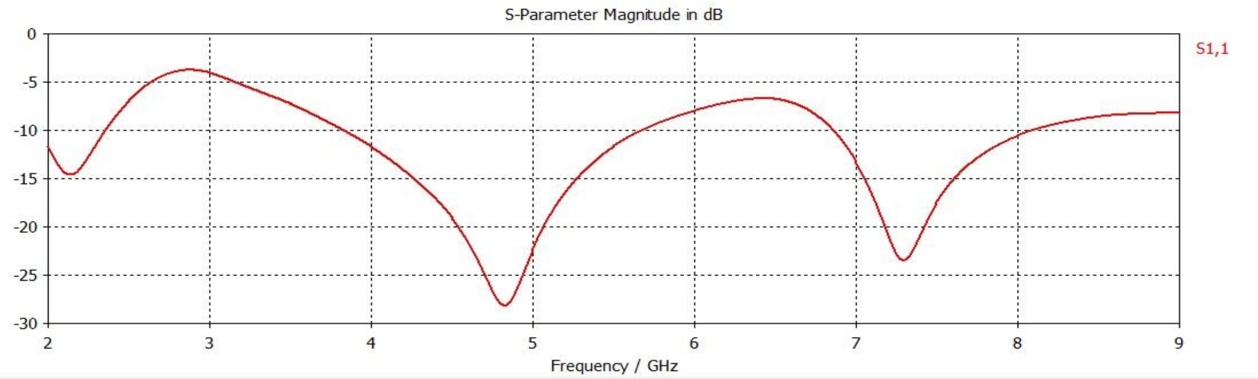

Figure 1.2 S11 parameter (return loss) of proposed textile antenna

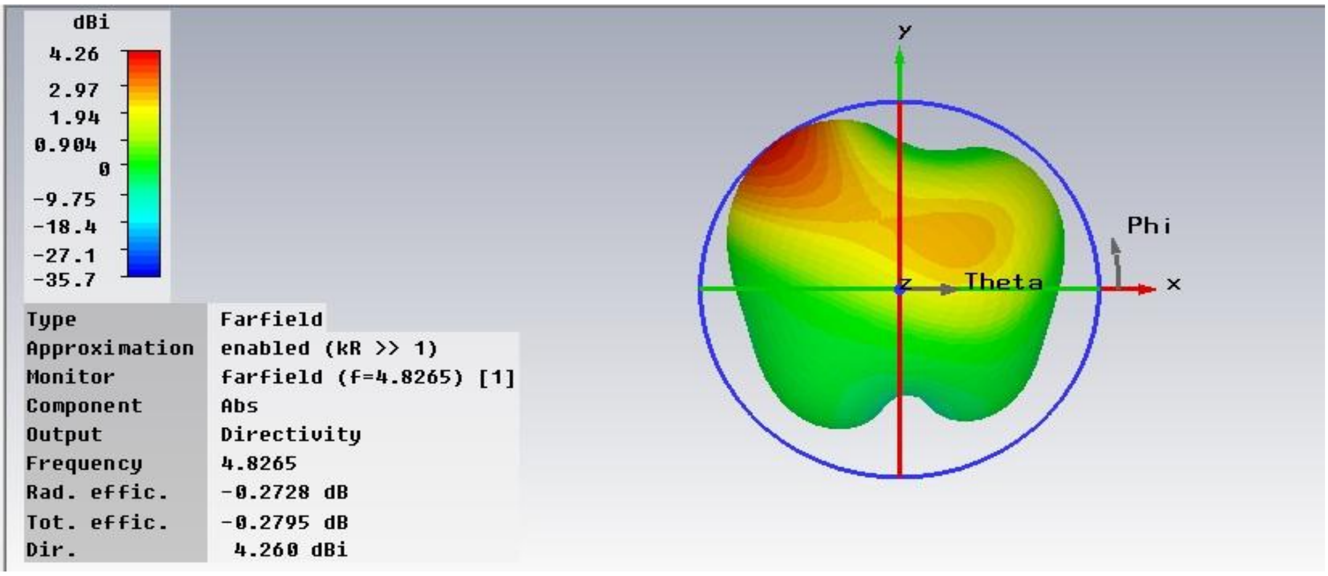

Figure1.33D Radiation pattern of Antenna at resonant frequency 4.8265GHz

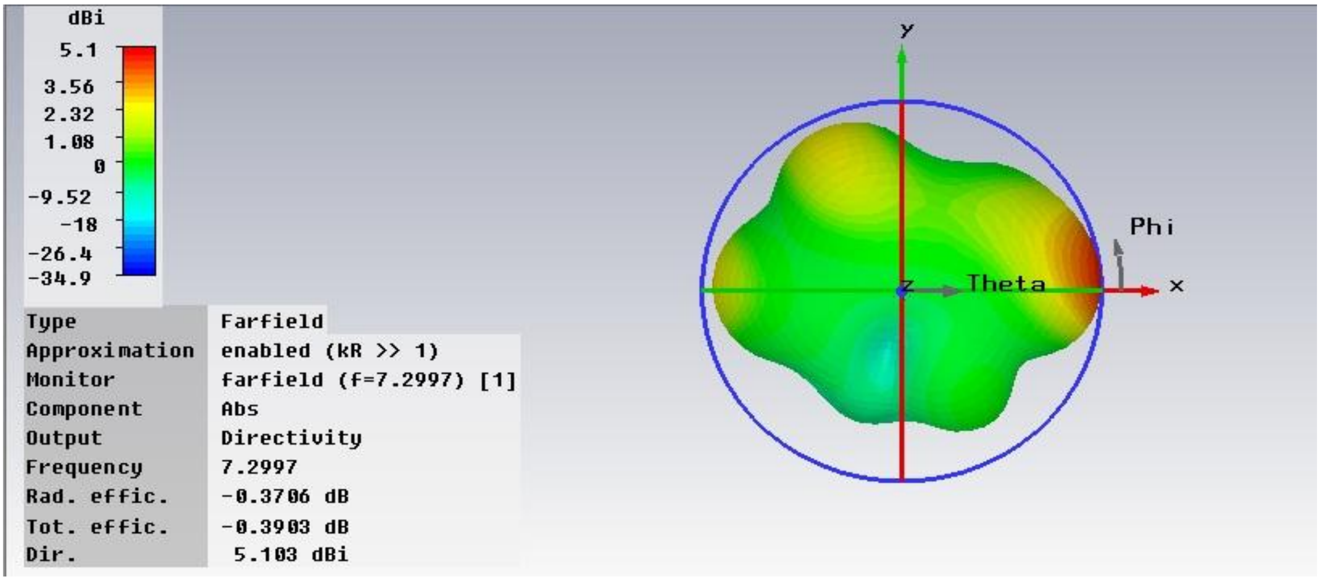

Figure1.43D Radiation pattern of Antenna at resonant frequency 7.2997GHz

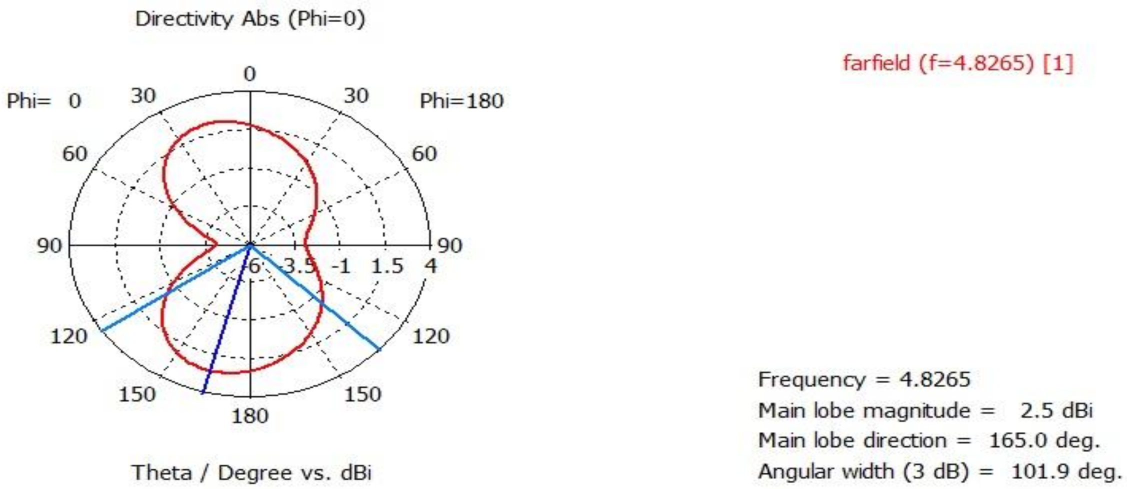

Figure 1.52D Radiation pattern of Antenna at 4.8265GHz

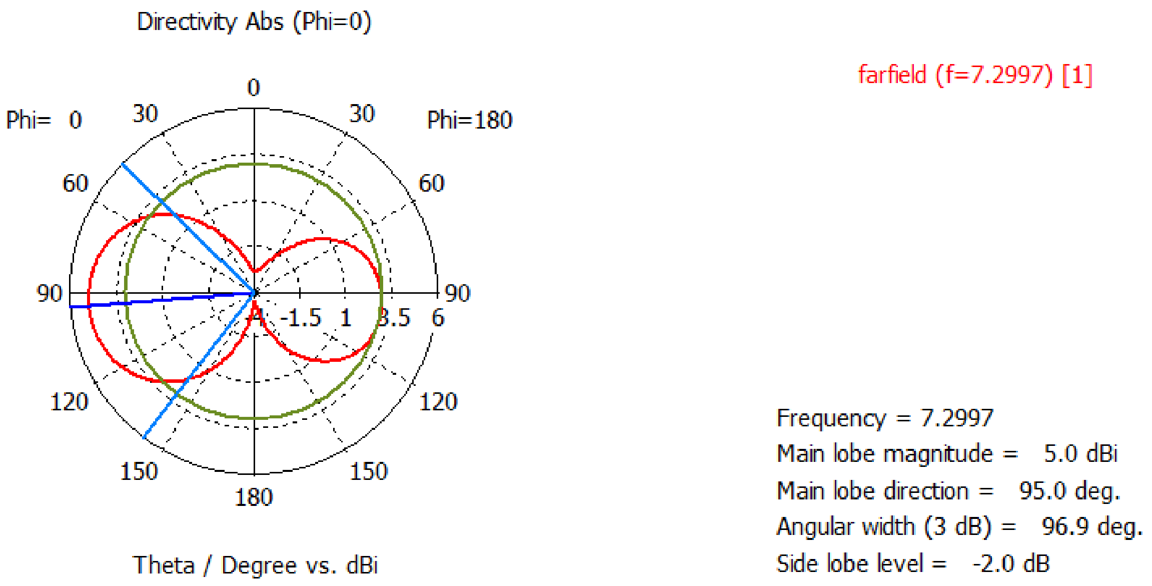

Figure1.62DRadiation pattern of Antenna at 7.2997GHz

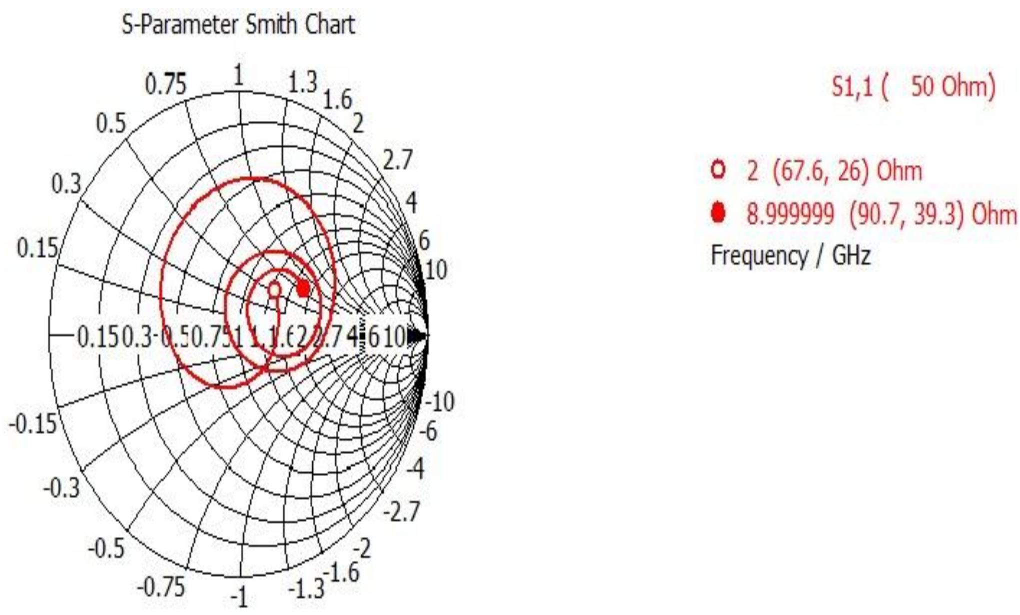

Figure 1.7Smith chart of the proposed textile antenna

IV. HARDWARE OF DESIGNED ANTENNA WITH EXPERIMENTAL OUTCOMES

In the proposed design copper tape is utilized as a radiating patch and for partial ground which is displayed in Fig.1.8. The proposed textile antenna has been designed utilizing jeans fabric as a substrate. After fabrication process this antenna has been tested in Microwave laboratory at BIET, Jhansi and the outcomes are saved. Comparison of reflection coefficient of calculated and experimental outcomes has been done and which is demonstrated in Fig.1.9.

Figure1. 8: Proposed Antenna after fabrication process (i) Front View (ii) Back View.

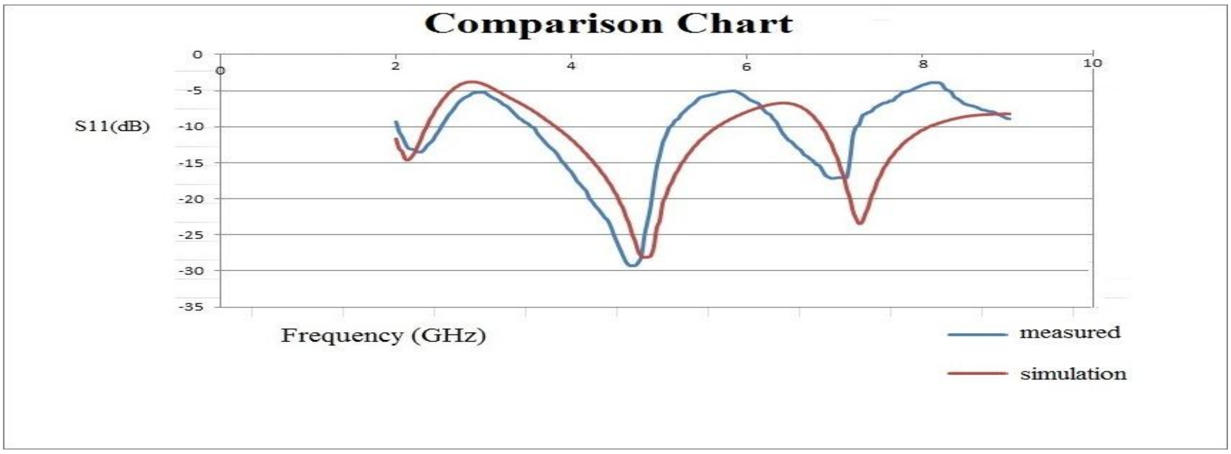

Figure1.9: Comparison between Reflection Coefficient of Measured and Simulated outcomes of the Designed Antenna.

V. CONCLUSION

In this paper a wearable textile antenna is structured which works at 2.44 GHz. This anticipated antenna provides gain of 4.260dBi at 4.8265GHz and 5.103dBi at 7.2997GHz. The presented antenna covers simulated bandwidth 37.47% and15.94% & experimental bandwidth 35.4% and 12.76%.The proposed design is flexible, light weight, cost effective, thin, and easy to fabricate; therefore it is best suitable for wearable applications. Along these lines, the proposed antenna can be utilized in brilliant attire as a piece of a remote correspondence framework.

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