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Dual Band High gain Slotted hexagonal shaped Microstrip patch flexible antenna

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Abstract— This paper presents the novel design of slotted hexagonal shaped microstrip patch flexible antenna. The design was done using high frequency simulation software. This novel design has dual band resonance at 2.5 GHz and 4.1 GHz. The goal of the paper was to see the effect of rectangular slots on the hexagonal patch, the size of each segment of hexagon taken is 19 mm. The dimension of the substrate on which the patch has been designed is taken to be 80 x 40mm.The parametric analysis has been shown by changing the length of the symmetrical rectangular slot. The hexagonal patch and slotted hexagonal patch has been compared based on different performance parameters. The comparative analysis of different antenna parameters such as return loss, VSWR, radiation pattern has been presented.

Keywords— Hexagonal shaped microstrip patch, circular slots, Antenna, flexible antenna, WLAN Antenna

I. INTRODUCTION

Recently the flexible antenna has drawn attention of research community toward it due to the many advantages it has specifically in Body area network application. The fundamental advantages that body area network provide is in medical emergency situations. The single band design for wearable antennas has been proposed in [1-2]. The dual band design for wearable antennas can be found in [3].The multiband antennas design for automative applications is proposed in [4]. A plethora of designs with patch antennas[5] or printed inverted F antennas[6] as base can be found in the literature. It is the area of research which is tremendously growing due to its immense potential applications.The analysis done by varying the properties of the UHF antennas which can be worn is discussed in [7-10] .The major obstacles was obtain the omni-directional radiation pattern and flexibility near the body. These problems are being addressed by changing the material properties and different meandering techniques [11-15]. Various techniques to obtain multiband operation in microstrip antennas with metamaterials have been proposed in [16].The antennas for wideband applications using negative refractive index material is been proposed in [17].

II. PROPOSED MODEL AND DESIGN

The design of the proposed flexible hexagonal shaped microstrip patch antenna with symmetrical rectangular slots is shown in the figure 1.Full wave simulation software was used to simulate the proposed design and to gather the results of analysis. The patch is fed using inset feed method. The feed line length and width were optimized in order to obtain the desired results. Firstly the traditional hexagonal patch antenna was designed by taking jeans as the substrate. The dielectric constant of the jeans was taken as 1.6.Then the rectangular symmetrical slots of 14 mm length.Table 1 show the material used to design the antenna. Copper of thickness 0.035 was assigned to patch while jeans was used as the substrate on which the patch was placed. The reason for choosing the jeans was to create a flexible antenna also known generally as textile antenna. The Thickness of Jeans was taken as 1.6 mm. The copper again of thickness 0.035 thickness was placed at the bottom of the substrate and it is acting as the ground.

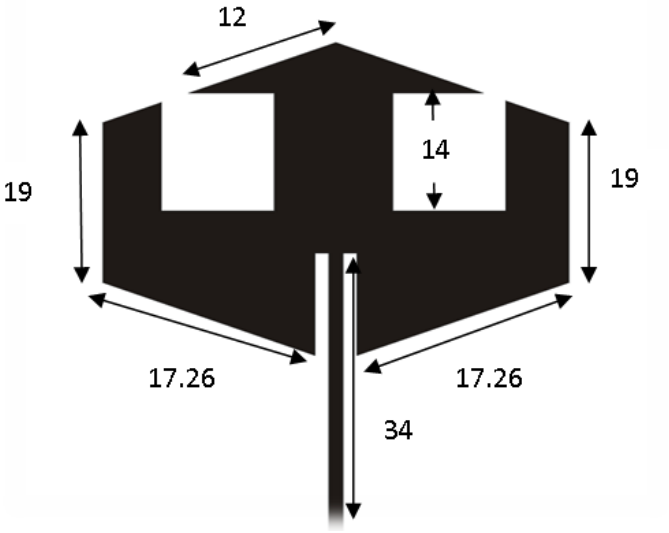

Fig 1: Image of proposed design of patch

TABLE I

MATERIALS CHOSEN FOR THE DESIGN

	Material chosen	**Thickness**
Patch	Copper	0.035 mm
Substrate	Jeans	1.6 mm
Ground	Copper	0.035 mm

III. RESULTS OF SIMULATIONS

This section presents the results obtained by simulating the proposed design using full wave simulation software. Figure 2 presents the return loss analysis of proposed and the results obtained are compared with the traditional antennas return loss. It is clearly visible that the proposed design has dual band also the return loss obtained is better. The traditional hexagonal shaped microstrip antennas resonate at 3.7 GHz and the return loss obtained at this frequency was -11.5 dB. While the proposed design resonated at 2.5 GHz and 4.1 GHz covering the WLAN application frequency range. The return loss obtained at 2.5 GHz and 4.1 GHz is -12.5 dB and -28 dB respectively.

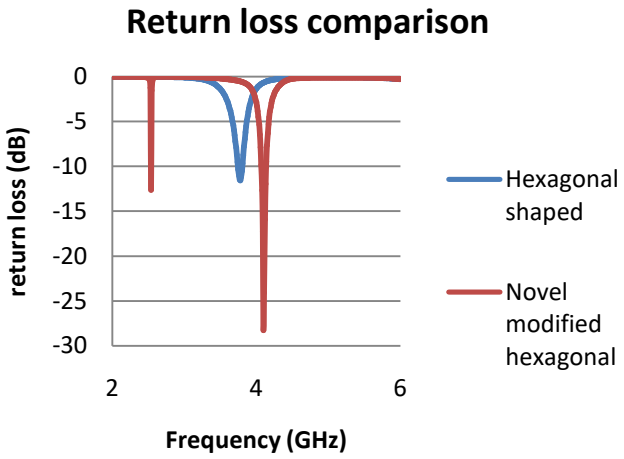

Fig 2: Return loss comparison of hexagonal shaped and novel modified hexagonal slot microstrip patch antenna.

Figure 3 and Figure 4 depicts the current distribution of the tradiational flexible hexagonal shaped microstrip antennas and the proposed antennas. It can be clearly observed from the figure that the current density has increased drastically in the proposed design.

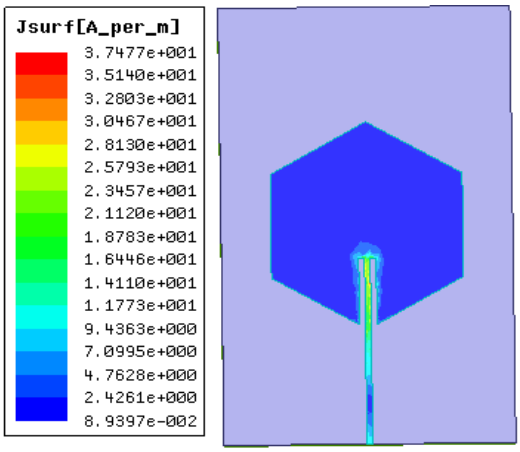

Fig 3. Current distribution of traditional hexagonal patch antenna

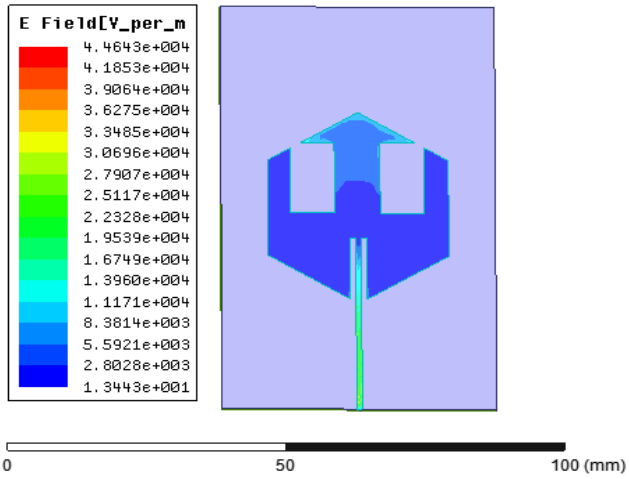

Fig 4.Current distribution of the proposed design at 2.4 GHz.

Figure 5 depicts the Gain polar plot in 3 dimension of traditional hexagonal shaped micostrip antenna. It can be clearly observed that the maximum gain obtained is 7.4 dB, which is quite good for microstrip antennas.Figure 6 shows the 3D Gain polar plot of the proposed design at 2.5 GHz and it can clearly be seen that the gain of proposed design has increased to 7.5 dB. Figure 7 presents the 3D gain polar plot of the proposed design at 4.1 GHz and it can be seen that the maximum gain obtained is 9 dB, Hence it can be inferred that the proposed design not only provides the advantage of dual band for wireless application but it also give better gain than the traditional flexible hexagonal patch antenna.

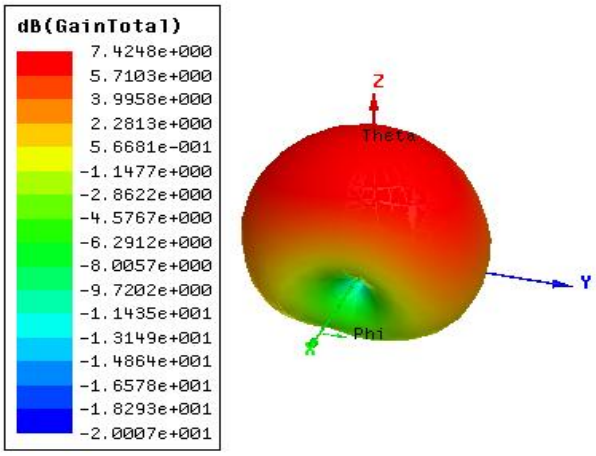

Fig 5 . 3D polar plot for Gain of traditional hexagonal shaped Microstrip antenna.

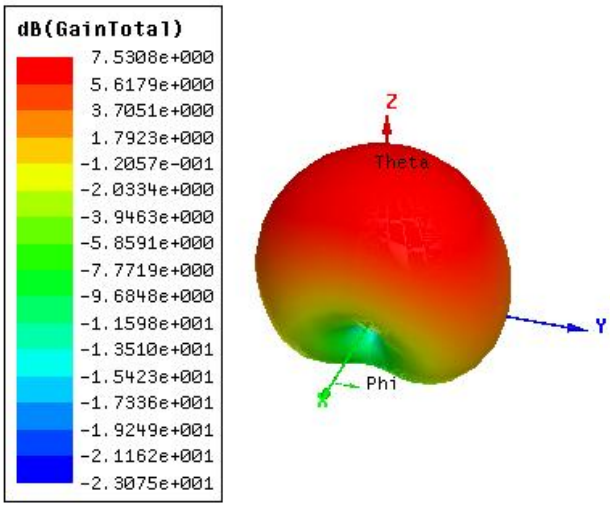

Fig 6. 3D polar plot for gain of the proposed design at 2.4 GHz.

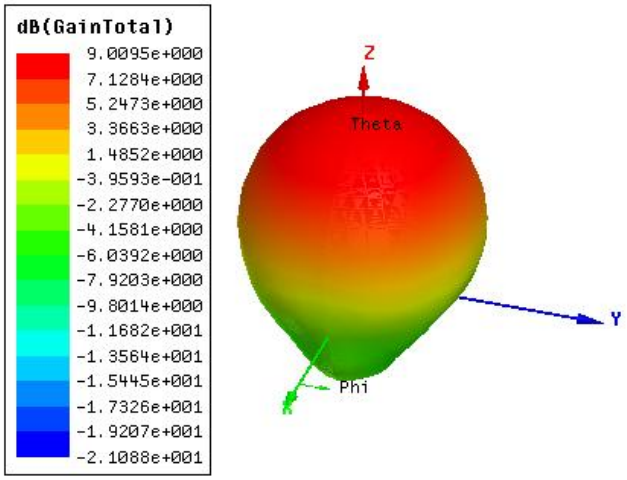

Fig 7. 3D polar plot for gain of the proposed design at 4.1GHz

Figure 8 depicts the 2 D radiation pattern of the proposed design and it can be observed that the design provide the almost omnidirectional radiation pattern which is one of the essential requirements of flexible antennas in body area network. Figure 9 provides the result of the parametric analysis done by varying the length of the slots to be cut from the traditional hexagonal patch antenna. It can be seen that by varying the length of the slot we can achieve the desired frequency of operation.

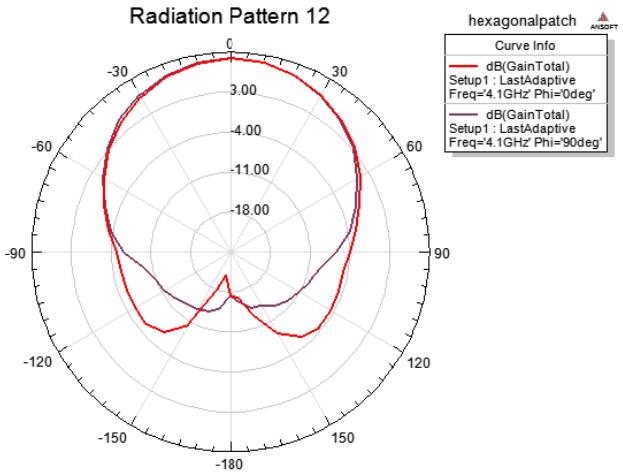

Figure 8. 2D radiation pattern obtained for the proposed design

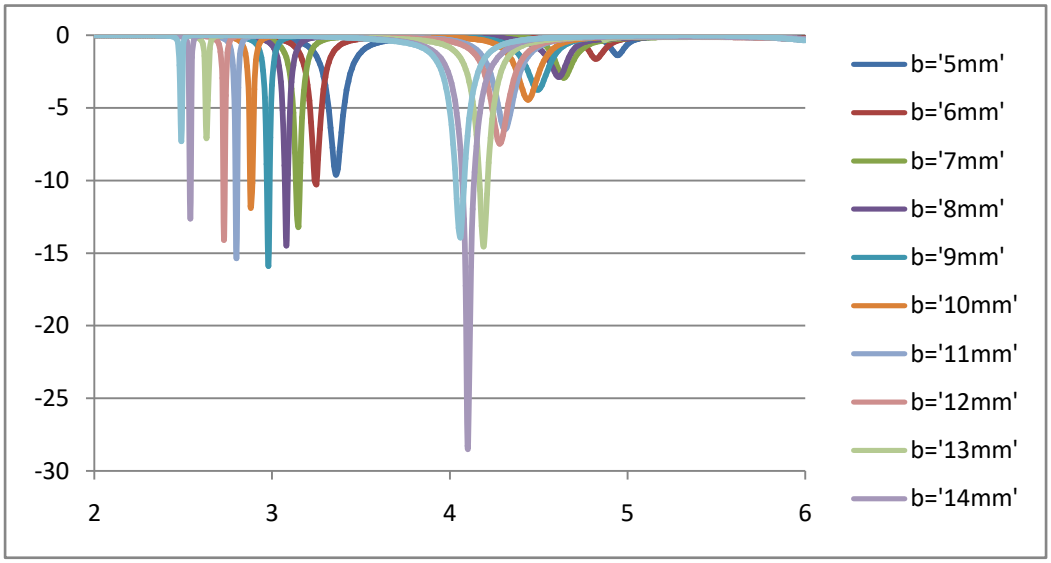

Fig 9: parametric analysis done by varying the length of the slots.

IV. CONCLUSIONS

A novel design of symmetrical rectangular slotted hexagonal microstrip patch antenna with jeans as substrate have been proposed . The proposed antenna has its utilization in Wireless LAN applications. The proposed antenna is resonating at multiple frequencies of 2.5 GHz and 4.1 GHz. The simulation was carried using HFSS 15 and the chosen centre frequency was 2.5 GHz and 4.1 GHz .The proposed design was compared with the traditional flexible hexagonal shaped microstrip patch antenna with jeans as substrate. The return loss, current distribution, 3D Gain polar plot results obtained was presented and compared with the traditional hexagonal microstrip antenna. The gain obtained for the proposed design was 9.0 dB at 4.1 GHz and 7.5 dB at 2.5 GhZ. it can be clearly inferred from the simulation results that by introducing rectangular symmetrical slots in the hexagonal microstrip patch, the performance of the antenna in terms of return loss and gain has drastically improved.

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