Inverted U-Shaped Dielectric Resonator Antenna for WLAN

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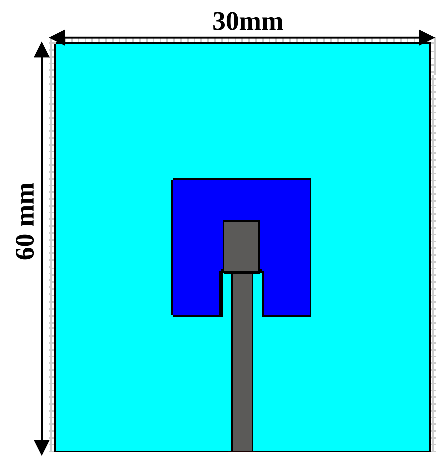
***Abstract*— A Dielectric resonator antenna design is presented for Wireless Local Area Network (WLAN) applications. By using a dielectric resonator with an inverted U-shape cross section and optimized rectangular patch adhered in between the dielectric resonator as a feeding mechanism, an impedance bandwidth of about 15.7% and covering a frequency range of 5.1 to 5.97 GHz is achieved and resonating at 5.5GHz. The proposed antenna is suitable for wireless local area networks (WLAN) applications in 5-6 GHz frequency range. This U Shaped DRA exceeds the bandwidth requirements for the IEEE 802.11a wireless local area network (WLAN) applications (5.15-5.35 GHz and 5.725-5.825 GHz) within a 2:1 VSWR. Parametric studies of the antennas with CST microwave based design data and simulated results are presented here.**

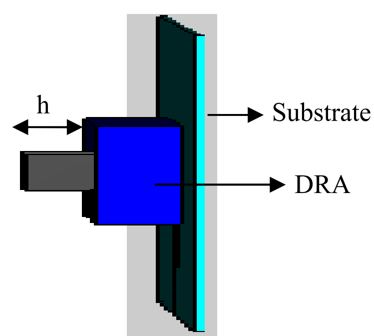
Keywords- Dielectric resonator antenna (DRA), Inverted U-shaped cross section, rectangular patch, WLAN.

I. INTRODUCTION

Rapid progress in wireless communication promises to replace wired communication in the near future in which antenna plays a more important role. The dielectric resonator antennas (DRAs), could be used for such applications due to their advantages including high radiation efficiency, flexible feed arrangement,[1-3], proximity detuning and DRAs are not susceptible to tolerance errors as Microstrip antennas, especially at high frequencies[4]. High –radiation efficiency, bandwidth and polarization flexibility make them by far superior to conventional Microstrip patch antennas. DRAs are intrinsically immune to those surface wave power leakage and conductor loss problems, which effects the Microstrip patch antenna and reduces their efficiency. The resonant frequencies of a DRA are predominantly determined by its size and shape, relative permittivity of the material ε_r, and the selected mode of operation [5, 6]. DRAs can be excited using probe, Microstrip line [7, 8], microstrip slot [9], and coplanar waveguide [10] coupling. Rectangular DRAs offer more design flexibility since two of the three of its dimensions can be varied independently for a fixed resonant frequency and known constant of the material [11].DRA with high permittivity materials were used for W-LAN Applications.



(a)



(b)

Fig. 1. Geometry of proposed DR antenna. (a) Top-view (b) Side-view

In this paper, we introduce an inverted U-shape antenna with Microstrip feed line and studied the performance of the antenna at various heights of rectangular patch at the center of Dielectric resonator. The proposed antenna is suitable for 802.11a WLAN which is resonating at 5.5 GHz.

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II. ANTENNA CONFIGURATION

The area of DR is 20 X 20 mm^2 with a slot of 7 X 6.5 mm^2 at the bottom side. A rectangular patch is placed in between the inverted U-shaped patch with the dimensions 5.2 X 7 X 10mm^3 as a feeding mechanism [12], which is connected with a 50 Ω Microstrip line. The Microstrip line is printed on one side of substrate with dimensions 3 X 30 mm^2 and ground is below substrate. The rectangular patch- feed mechanism gives good coupling between the patch and DR.

III. RESULTS AND DISCUSSION

The commercial 3D full wave electromagnetic (EM) simulation software CST Microwave studio, based on FIT method is used for simulation. The optimized rectangular patch dimensions used for feeding are 5.2 X 7 X 10 mm^3. Fig.2. Shows the simulated return loss which is about -22.7dB at 5.5GHz. The bandwidth of 15.7% or 870 MHz with return loss less than -10 dB. The height of rectangular patch for coupling is varied 2 mm to 10 mm and parametric study is performed which is giving the optimum result of resonating frequency 5.5GHz, return loss of -22.7dB at 10mm. When the height of the rectangular feed is changing the resonant frequency is changing and it is moving from right to left and the return loss is also increasing. The simulated radiation pattern of the antenna at frequency 5.2, 5.8&6GHz are illustrated in Fig.3. A good omnidirectional pattern in the H-plane is obtained. The relative high cross-polarization level in the E-plane patterns mainly caused by the asymmetrical current distribution on the ground plane.

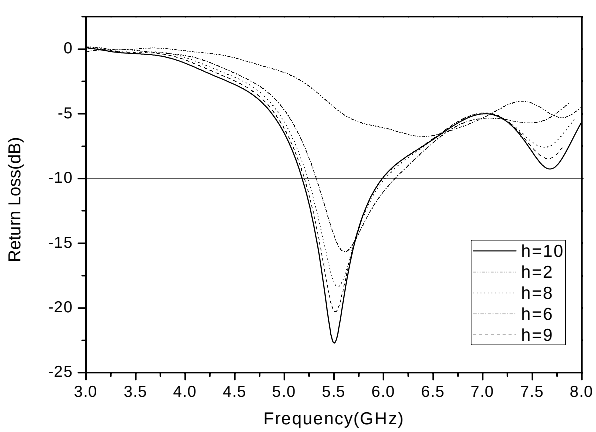

Fig.3. Simulated Return Loss of the Proposed Antenna.

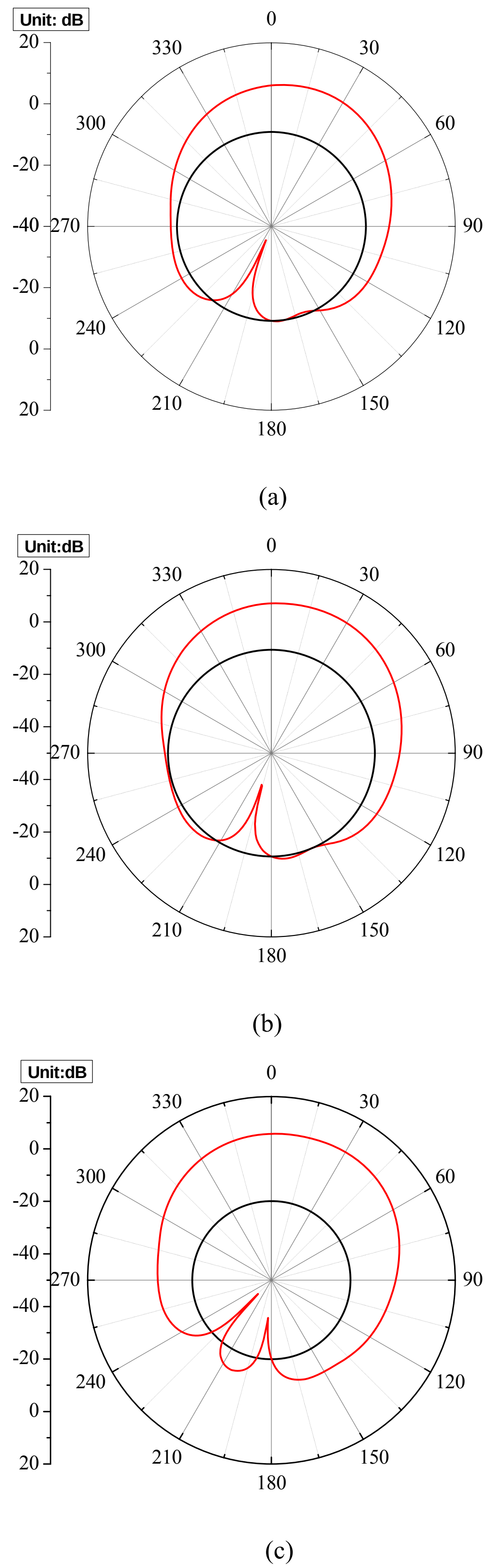

Fig.3. Simulated Radiation Pattern at (a) 5.2GHz (b) 5.8GHz (C) 6GHz.

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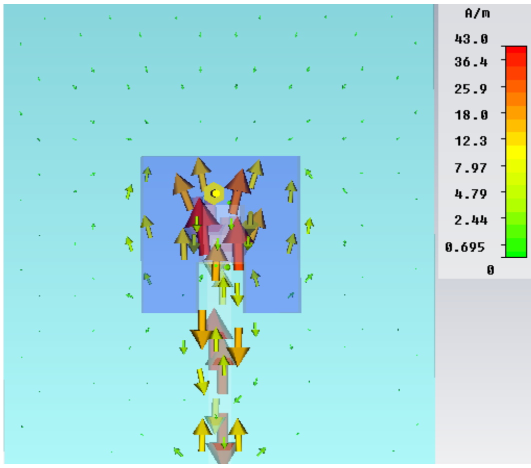

Fig. 4. Surface current distribution at 5.5 GHz

The antenna radiates in the broadside direction. The current distribution is shown in Fig.4.at 5.5 GHz the rectangular patch at the center couples most of the input power from feed line to the DR. The gain of antenna is well above 6dBi in the frequency range.

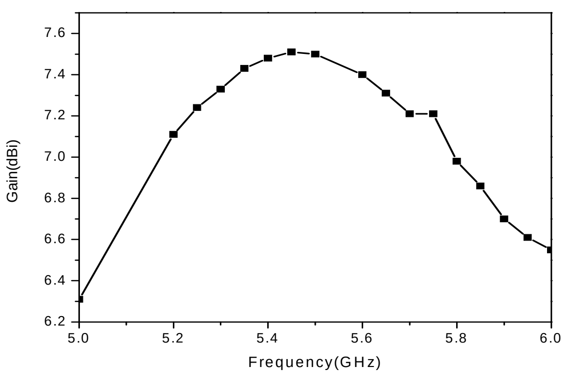

Fig.5. Simulated Gain vs. Frequency curve

IV. Conclusion

A inverted U-shaped DR radiator with a rectangular patch adhered in between the DR as a feeding mechanism has been described and investigated for WLAN applications. Moreover, a parametric study has been carried out to optimize the antenna design. From the simulated results it is clear that antenna works well for WLAN applications resonating frequency at 5.5 GHz and gain of 7.5 dBi and with a stable broad side radiation pattern. Fabrication of proposed antenna will be carried out in future.

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