DESIGN AND ANALYSIS OF MULTIPLE BANDS RING SHAPED CIRCULAR PATCH ANTENNA FOR IOT APPLICATION

PUTCHA POORNA PRIYA¹, SYED INTHIYAZ², MARNI RISHITHA³, JOSEPH REDDY SAGILI¹, SIRIGIRI CHERISHMA⁵

¹,²Associate Professor, Department of ECE, Koneru Lakshmaiah Education Foundation, Vaddeswaram, Guntur District, A.P, India
³,⁴,⁵Students, Department of ECE, Koneru Lakshmaiah Education Foundation, Vaddeswaram, Guntur District, A.P, India
¹putchapoornapriya@kluniversity.in, ²putchapoornapriya@kluniversity.in, ³rishithamarni2000@gmail.com, ⁴bblaprib@gmail.com, ⁵cherishmachowdary123@gmail.com

ABSTRACT:

We have designed a multiband circular patch antenna at an operating frequency of 1.8 GHz, 5.3 GHz, and 9.0 GHz which belongs to the c band, RFID, and WLAN using Ansoft's HFSS simulator software. The compact size of the proposed antenna is 30 X 30 mm. The antenna is designed with ring resonators and having a circular patch that is connected through the feed. The fractional bandwidth of this proposed antenna corresponding to each frequency is 54.54 %, 15.38%, and 9.94 %. The results are discussed in terms of Antenna gain, fractional bandwidth, and return loss. Since the multiband circular patch antenna is designed for WLAN and C band it is applicable in different satellite communication applications and IoT applications.

Keywords: return loss, stub, IoT, radiation efficiency.

I INTRODUCTION

The internet of things defines the physical object network which is embedded with sensors software and other technology to communicate and share data over the wireless network with other devices and systems. Day by day everything is getting smaller so we are making an antenna with a smaller size. We are using this circular patch antenna for multiple applications in IoT. The antenna has features like less weight, small size, low return loss, etc. it is a wide band antenna from a frequency 1GHz to 10 GHz which belongs to c band, l band, and s band used for IoT applications and satellite application. There are many modules for wireless communication, such as WiMAX, Wi-Fi, Blue Tooth, WLAN, etc. Which are linked to IoT devices and transmit and retrieve data.

Antennas are developed with low cost, less weight, and easy fabrication in current years. due to its circular shape, it can be used for multiple applications with different frequencies. A patch antenna is a kind of low profile radio antenna that can be placed on a flat surface. The shape of the patch antenna can be a rectangular, circle, triangle metal which is mounted on a large metal sheet. Radiation at the edges allows the antenna to behave electrically larger than its actual size, so the antenna to be resonant is used for a microstrip transmission line length slightly shorter than half the wavelength at the frequency. The patch of the antenna is smaller than the ground plane. If the dielectric constant lies in the range of 2.2 to 12 then we can say the antenna can have better performance.

II ANTENNA DESIGN

www.turkjphysiotherrehabil.org
The multiband circular patch antenna is simulated in Ansoft hfss software using Rogers RT/duroid 5880™ as a substrate material. The compact is made of dimensions 30 * 30 mm. we have made a prototype contains feed lines, four ring resonators, and a circular patch in the center of the antenna. The ground is not completely conductive. It has feed parts which are conduction and some are etched as shown in the figure. We have used Copper as the conducting material for the patch and substrate and the ground has a thickness of 30 microns. The substrate has a dielectric loss tangent with 0.0009 and a relative permeability of 2.2.

In figure(2) we have developed a practical antenna with copper material which works for IoT applications.

III RESULTS AND DISCUSSION’S:

The proposed antenna is multiband circular patch antenna designed using Ansoft hfss software. Antenna can be used in the range of 1 to 10GHz frequency. Results can be analysed in terms of return loss, band width, gain and radiation efficiency. And plotting graphs in terms of radiation pattern, 3D polar plot of gain of antenna, and frequency response. The antenna has a dielectric constant of 2.2 and conducting material of the antenna is copper.

(i) Reflection Coefficient: Reflection Coefficient is measured in terms of impedance bandwidth and return loss. The frequencies are 1.8GHz, 5.3GHz and 9.0 GHz.
Figure 3: frequency response of antenna

Result for proposed multiband antenna:

<table>
<thead>
<tr>
<th>Central frequency (fc)</th>
<th>Return loss</th>
<th>Fractional bandwidth</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.8 GHz</td>
<td>-34.24443</td>
<td>50.0</td>
</tr>
<tr>
<td>5.3 GHz</td>
<td>-26.7244</td>
<td>24.52</td>
</tr>
<tr>
<td>9.0 GHz</td>
<td>-25.6596</td>
<td>10.0</td>
</tr>
</tbody>
</table>

Fractional bandwidth can be calculated through formula:

\[ F_{bw} = \left( \frac{\text{high frequency} - \text{low frequency}}{\text{central frequency}} \right) \times 100. \]

Practical SWR response tested for developed antenna:

(ii) Radiation pattern: The term radiation pattern refers to the directional dependence of the strength of the radio waves from the antenna. The radiation patterns of the designed antenna at resonating frequencies of 1.8 GHz, 5.3 GHz, and 9 GHz and plotted results for 0 and 90 degree.
Radiation pattern of frequency 9 GHz at 0,90 degree:

Radiation pattern of frequency 5.3 GHz at 0, 90 degree

Radiation pattern of frequency 1.8GHz at 0 and 90 degree:

www.turkjphysiotherrehabil.org
(iii) **Current Distributions:** Current distributions are represented in Figures on the radiating patch at resonant Frequencies.

Current distribution at frequency 1.8GHz:

Current distribution at frequency 5.3GHz:

Current distribution at frequency 9 GHz:

(iv) **3D – Gain Measurement:**

Antenna gain is associated with the ability of the antenna or antenna system to direct the radiated power in a specific direction or conversely, absorb the power efficiently coming from a particular direction.
Gain measurement at 1.8GHz:

Gain measurement at 5.3GHz:

Gain measurement at 9GHz:

Results in terms of peak gain, peak realised gain, radiation efficiency:

<table>
<thead>
<tr>
<th>Centre frequency (fc)</th>
<th>Peak gain</th>
<th>Peak released gain</th>
<th>Radiation efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.8 GHz</td>
<td>22.19</td>
<td>4.5589</td>
<td>2.3155</td>
</tr>
<tr>
<td>5.3 GHz</td>
<td>31.18</td>
<td>1.8149</td>
<td>2.701</td>
</tr>
<tr>
<td>9.0 GHz</td>
<td>26.26</td>
<td>0.1663</td>
<td>1.96007</td>
</tr>
</tbody>
</table>
CONCLUSION:
From the above discussion, we can say that the prototype antenna is capable of producing radiation patterns for the multiband spectrum. The antenna is operating at a multiple frequency 1.8GHz, 5.3GHz and 9 GHz used c band, WLAN, RFID, etc so these frequencies can be used for IoT applications. Due to high return loss, the antenna gives perfect impedance matching between patch and feed. The results are analysed and discussed in terms of return loss, fractional bandwidth, and gain. The antenna is made up of small size and high bandwidth it used for IoT applications.

REFERENCES
1. P. Poorna Priya, Dr.Habilitulla Khan, Dr.B.T.P.MadHAV "Defected ground structure Circularly polarized wideband antennas for Wireless Communication Applications: Journal of Advanced research in Dynamical and Control Systems Volume 9 SP-18/2017
12. Intihiyaz, S., Madhav, B.T.P., Kishore, P.V.V., Flower image segmentation with PCA fused colored covariance and gabor texture features based level sets, Am Shams Engineering Journal 9(4), pp. 3277-3291
27. Murali Krishna, B., Siva Kumar, M., Rajesh, J., Intihiyaz, S., Mounica, J., Bhavani, M., Adidela, C.N., “FPGA implementation by using XBee transceiver” Indian Journal of Science and Technology 9(17)