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# METAMATERIAL BASED ANTENNA DEVELOPMENT FOR VARIOUS WIRELESS APPLICATIONS

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***Abstract:***
Wireless communication plays a vital role in today’s research. The existing research focus on designing and developing technology driven, efficient and multiple applications-oriented antenna. The metamaterial antennas have proved their potential in research domain for its high efficiency, moderate gain and multiband applications. A triple layered, multiband, metamaterial inspired antenna is designed, developed, analyzed and presented in this paper. The proposed antenna design exhibits resonance at 2.62 GHz, 4.67 GHz, 5.77 GHz and 7.24 GHz frequencies with moderate gain. The FR4 substrate has been utilized as a substrate. The claimed antenna is applicable for various wireless applications.

**Keywords**: Wireless communication, Metamaterial antenna, Split Ring Resonator

## I. INTRODUCTION:

The growth of wireless communication demands a structural change in multiband antenna design to meet the present industry requirement. The requirement needs a smart, compact antenna that covers the application-oriented frequencies for navigation, WiFi, and satellite communication. In order to get the desired response, various feeding techniques could be utilized, viz., microstrip line feed, insert feed, and quarter-wave feed. The presented design utilizes a quarter-wave feeding technique to meet the maximum impedance matching requirement. The left-handed material helps to reduce the size of an antenna significantly and get the desired frequency bands for specific applications. Metamaterials are artificial materials that show negative permittivity and permeability for certain frequency spectrum [1– 4]. Split Ring Resonator (SRR) is considered a fundamental block for metamaterials. The artificial metamaterials make themselves suitable for enhancing the electromagnetic properties of any microwave devices such as antennas. It also enhances filter performance with overall structure compactness and application-oriented frequency resonance [5, 6]. Dual-band microstrip antennas could be used for higher frequency performances [7]. Complementary Split Ring Resonator (CSRR) could also be an effective technique to enhance antenna performance [8]. The literature also exhibits a combination of microstrip slot and SRR which plays a significant role in designing a miniaturized antenna for dual-band performance [9]. The radiation characteristics and miniaturization techniques have been systematically covered in [10]. The researchers have also tested the SRR technique to get an adequate response from reconfigurable antennas [11]. The literature also covers a wide spectrum of miniaturization without the presence of SRR/CSRR; however, optimum size reduction may not be achievable [12, 13]. There are many effective and interesting techniques are available for antennas miniaturization and bandwidth enhancement like negative refractive index materials [14- 18], planar inverted antennas[19-21] and frequency selective surfaces. Dielectric Resonator antennas, however, without major fabrication stress can provide high gain and wide bandwidth. DRAs offer the benefits of high radiation proficiency, simplicity of excitation, little size, and wide data transmission [22-25]. Optimum designing of an antenna plays a major role in its application for wireless communication. Electrically small antenna could be utilised for RFID, GPS and IEEE 802.11 a/b/g/s Applications. In this manner, DRAs could be the appropriate candidate for wireless communication applications. The antenna bandwidth could be enhanced using negative refractive indexed material [26,27].
The figure 1 depicts the flow of antenna design. It gives idea about how the authors have finalized athe specific application oriented antenna.

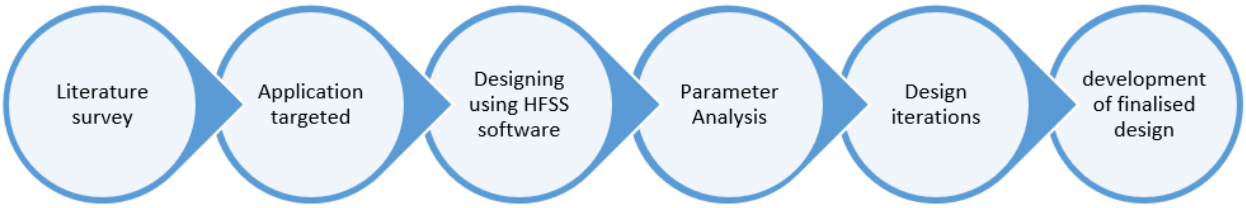
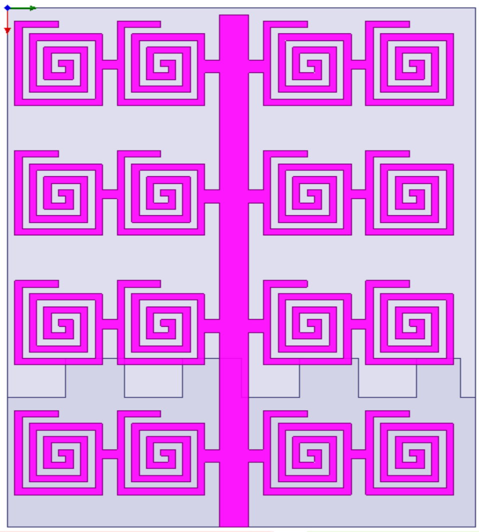


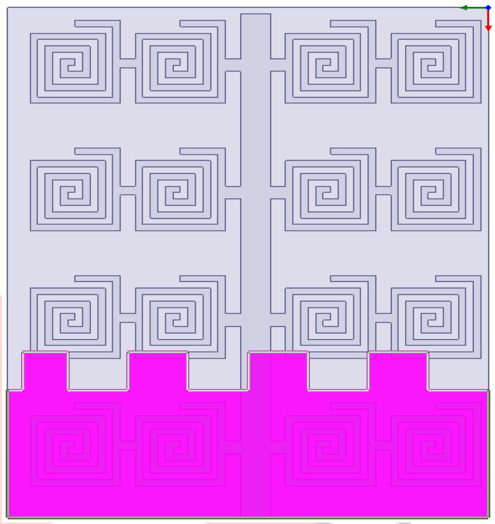

Figure 1: Flow of antenna designing

## II. ANTENNA GEOMETRY:

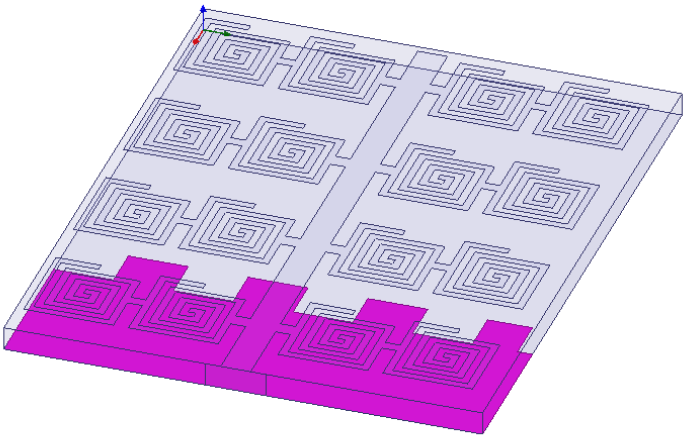
The metamaterial and SRR block-inspired antenna is designed and shown in figure 2. Figure 2 (a), (b), and (c) show the top view, back view, and side view respectively. As shown in the figure, four rows of SRR-based structure is developed at the top surface of an antenna. The feeding line is placed between the four similar structures to maintain symmetry. The bottom layer is having the ground plane which is partial and having the comb shape to improve the bandwidth.



(i) Top View
(j)



(ii) Back View



(iii) Bird eye View

Figure 2: antenna design

## III.RESULT AND DISCUSSION:

Figure 3 illustrates the return loss for a frequency range from 1 GHz to 10 GHz. It could be observed from the figure that four resonating bands could be achieved by the proposed geometry. The appropriate impedance matching is required to improve the return loss graph.

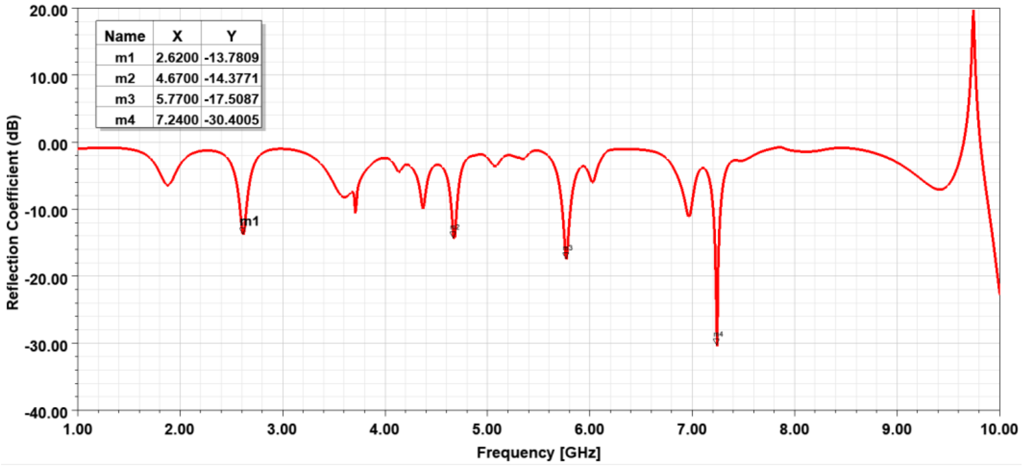



Figure 3: Graph of reflection coefficient vs. frequency

The 2 Dimension radiation pattern is shown by figure 4. The radiation pattern is having omnidirectional and moderate positive gain. Figure 4 (a), (b) , (c), and (d) shows radiation pattern for 2.62 GHz, 4.67 GHz, 5.77 GHz and 7.24 GHz frequencies.

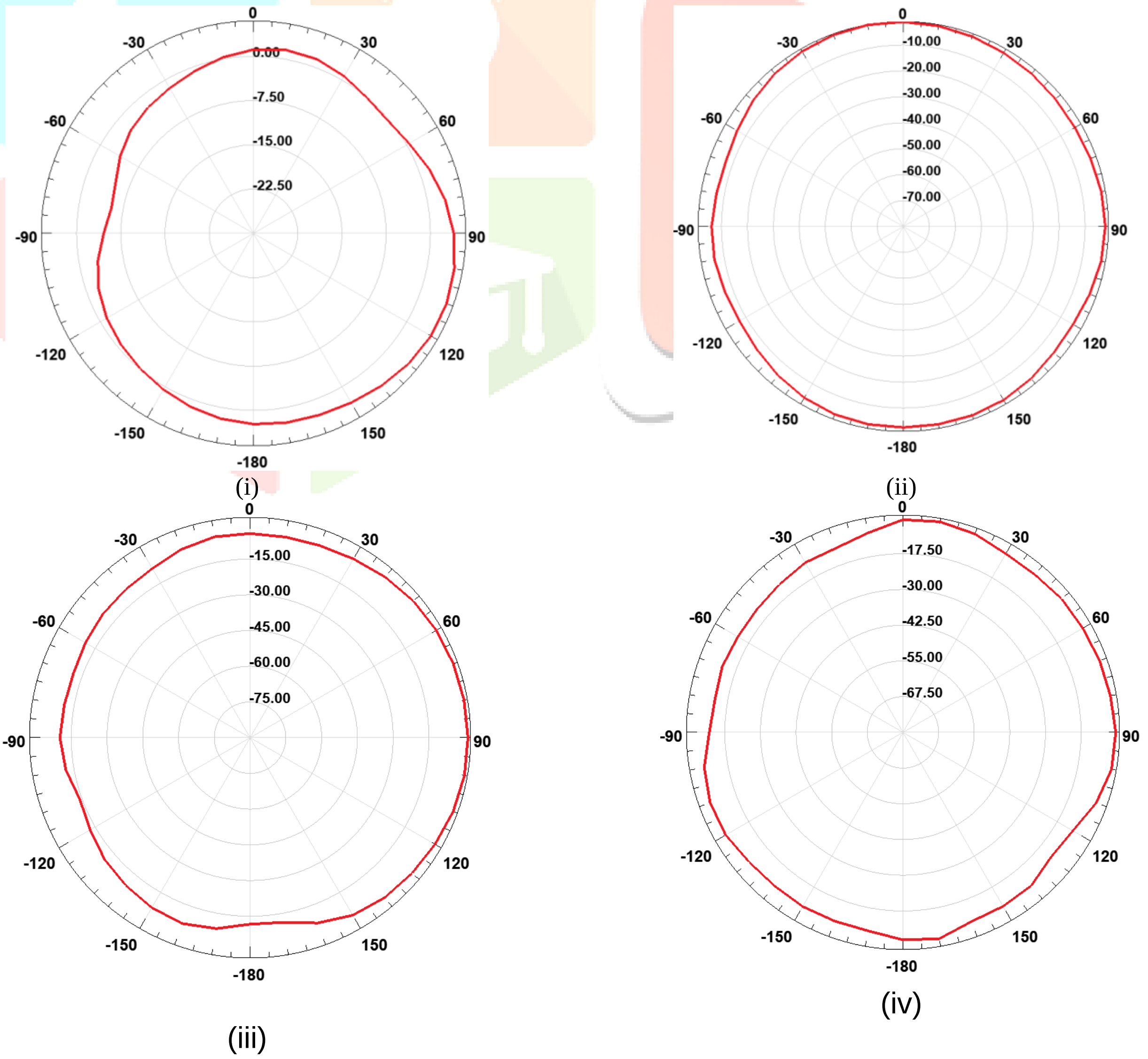



Fig 4: 2D radiation pattern at 2.62 GHz, 4.67 GHz, 5.77 GHz and 7.24 GHz frequencies

## IV.CONCLUSION:

The Split Ring Resonator inspired metamaterial antenna is developed for 2.62 GHz, 4.67 GHz, 5.77 GHz and 7.24 GHz frequencies. The presented antenna could be projected for bulf production as it uses FR4 material as a substrate. The developed structure also gives other antenna parameters such as radiation pattern and gain. The bandwidth and gain could be further increased by using the laminates which are having minimum losses.

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