MULTIBAND PRINTED MONOPOLE ANTENNA FOR WI-FI AND SATELLITE COMMUNICATION APPLICATIONS

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Abstract - In this paper, a multiband monopole antenna oper-ating at three different frequencies is presented. The proposed antenna works at 2.2, 5.9, and 8.5 GHz. The size of the proposed antenna is 28*24*0.08 mm^3. The main objective of this paper is to design an antenna which can operate at multiband frequencies. This antenna is designed on FR-4 substrate which has 0.8 mm thickness, its relative permittivity and loss tangent are 4.4 and 0.02 respectivily. The presented antenna is constructed in three steps. Step 1 consists of a square ring feed by simple microstrip line. A stub is inserted between the square ring and the feed line for impedance matching. In step 2, two changes are made. I-shaped strip and a slot are added inside the square ring. In step 3 another I-shaped strip is added. The proposed antenna with simple structure has three bands covering 2.1-2.2, 5.8-5.9 GHz (Wi-Fi) and 8.4-8.5 GHz (Satellite Communications) are achieved with bandwidths of 112.7 MHz, 55.6 MHz and 144 MHz having resonance frequencies 2.2, 5.9 and 8.5 GHz respectively.

I. INTRODUCTION

Now a days, many researchers focus their interest in, how to design an antenna which is compact and multiband for multistandard operations.
Number of such antennas have been developed in the neaar past for various portable and wireless communication systems [1]- [11]. For example a novel compact flexible dielectric resonator antenna for WLAN/WiMAX applications is pre-sented in [1]. In [2] a compact triband asymmetric coplanar antenna with bands of 2.35-2.53, 3.34-3.85, and 5.05-6.28 GHz is proposed. A lot of work have been done on design of dual band monopole antennas. A dual band reconfigurable antennas are presented in [3]- [4], . Size of antenna plays an important role while designing, researchers prefer to design an antenna which is simple and compact. [5], for WLAN and WiMAX applications a small and compact triple-band microstrip-fed printed monopole antenna is proposed. An antenna of multiband operation which is compact and multi resonator-loaded is presented in [6]. Many researches have been done on satellite communication applications [7]- [11]. In this paper, a multiband monopole antenna operating at three different frequencies is presented. The structure of this antenna is consists of a square ring feed by Ishaped strip with a stub between them and also two I shaped strips inside the square ring. A small sized slot is also present inside the square ring.

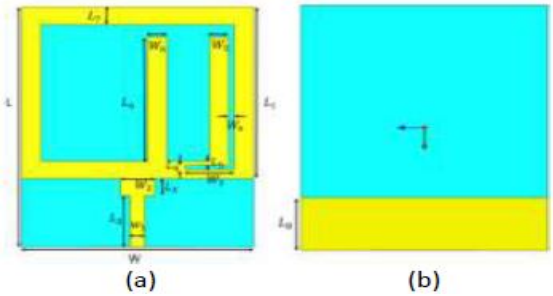


Fig. 1: Structure of the proposed Antenna

II. ANTENNA DESIGN

Figure.1 illustrates the structure of the proposed antenna. This antenna is designed on FR-4 substrate which has 0.8
mm thickness, its relative permittivity is 4.4 and 0.02 is loss tangent. The structure of this antenna is consists of a square ring feed by a simple microstrip line. A stub is inserted between the square ring and the feed line for impedance matching and also two I-shaped strips inside the square ring. The lower line of the square ring has a small slot on the right side. The different parameters of the designed antenna are tabulated in Table 1.
Figure.2 shows the step wise design of the proposed an-tenna. A square ring is designed in step 1 feed by a simple microstrip line. A stub is inserted between the square ring and the feed line for impedance matching shown in Fig.2 (a). The length and the width of the square ring is L1 and W respectively. The I-shaped strip has length L2 and width W1.

Parameter	Dimension(mm)	Parameter	Dimension(mm)
L	28	L_8	6
L_1	16	W	24
L_2	6	W_1	1.5
L_3	2	W_2	3.5
L_4	0.6	W_3	5
L_5	0.4	W_4	0.6
L_6	14.5	W_5	2
L_7	2	W_6	2

TABLE I: Parameters used in the antenna and its values

A stub for impedance matching with length L3 and width is W2. I-shaped strip is placed inside the square ring in step 2 shown in Fig.2 (b), which has length L6 and has width W5. A small slot cut is also added inside at the right side of the square ring below the I-shaped strip. Another I-shaped strip having same length that of in step 2 is placed inside the square ring in step3 shown in Fig.2 (c). Fig.3 shows simulated S11 results Fig. 3: Simulated S11 against varied

Frequencies of the proposed antenna. This graph shows the results of three steps performed during the design of proposed antenna. The band of step 1 has the resonant frequency of 2.2 GHz with frequency ranges (1.6064-2.8644) GHz and bandwidth 1603.5 MHz. Step 2 gives the band of resonant frequency 5.6 GHz with frequency ranges (5.5676-5.6230) GHz and bandwidth 55.4 MHz. The band of step 3 has the resonant frequency of 8.5 GHz with frequency ranges (8.441-8.5852) GHz and the bandwidth of this band is 143.5 MHz. The proposed antenna is further examined by plotting surface current distribution. Fig.4 shows the surface current distribution of the proposed antenna. Figure.4(a) shows the surface current distribution at 2.2 GHz. Fig.4 (b) and Fig.4 (c) show the surface current distribution at 5.9 GHz and 8.5 GHz respectively.

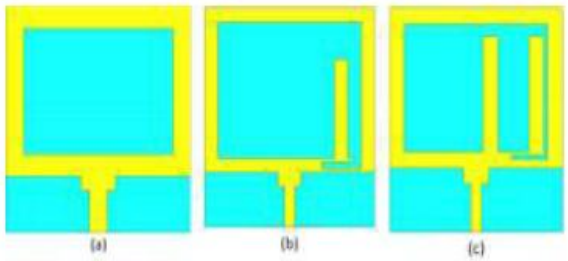


Fig. 2: Steps for the design of proposed antenna. (a) Step 1. (b) Step 2. (c) Step 3.

III. RESULTS AND DISCUSSION

The complete dimensions of the proposed antenna are given in section 2. Based on those dimensions a prototype for the proposed antenna was fabricated and tested. The simulated results are shown in Fig.5.

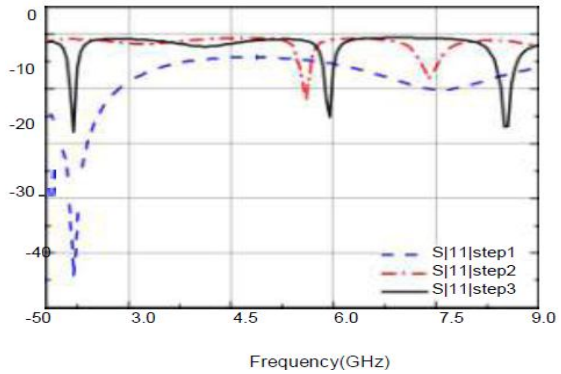


Fig. 3: Simulated S11 Against Varied Frequencies

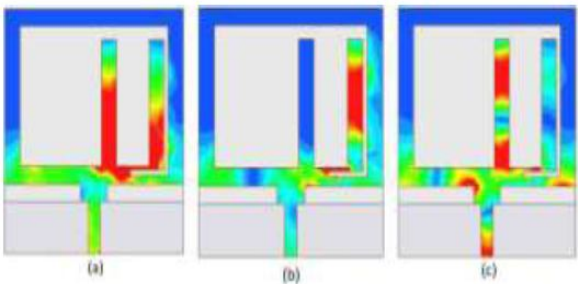


Fig. 4: Simulated surface current distribution of the proposed antenna (a) 2.2 GHz, (b) 5.9 GHz, (c) 8.5 GHz

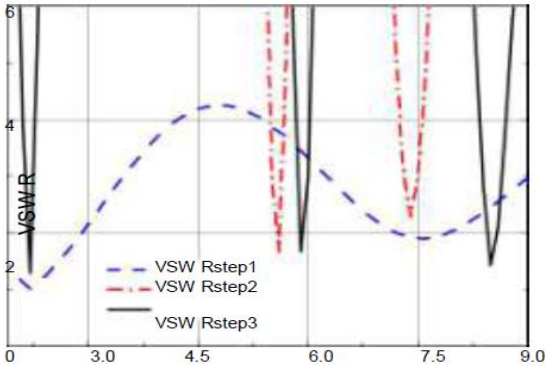
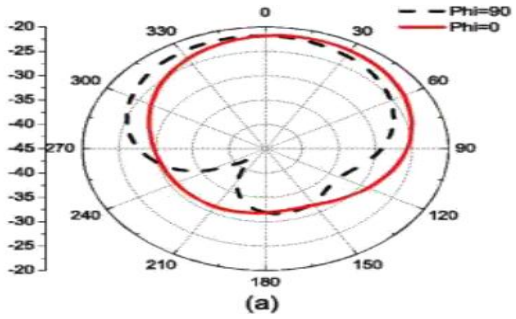
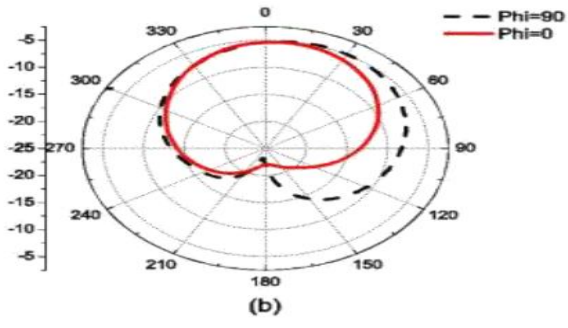


Fig. 5: Simulated VSWR against frequency results of the proposed antenna.

From the graph it can be seen that three bands covering 2.1-2.2, 5.8-5.9 and 8.4-8.5 GHz are achieved with bandwidths of 80.7MHz, 112.7MHz and 55.6MHz having resonance fre-quencies 2.2GHz, 5.9GHz and 8.5GHz respectively. Which can cover the bands of Wi-Fi and satellite communication. Compared to the antennas mentioned above [1]- [11], the Proposed antenna has a much simpler structure. Meanwhile, the antenna configuration is more compact. The gain of this antenna is also higher than the one proposed in [11]. Fig.6 shows the simulated far field radiation patterns in E-plane and H-plane for frequencies at (a) 2.2, (b) 5.9, and (c) 8.5 GHz respectively. In graph red line shows the E-plane radiation pat-tern at phi=0 and black line shows H-plane radiation pattern at phi=90.The corresponding radiation front-to-back ratio (FBR) is 10dB (both in E and H plane), 16.62dB (E plane) 17.62dB (H plane), and 11dB (both in E and H plane) respectively at 2.2GHz,5.9GHz and 8.5GHz. From simulated results it is clear that the proposed antenna has good omnidirectional radiation characteristics and reasonable gains at each resonant frequency.





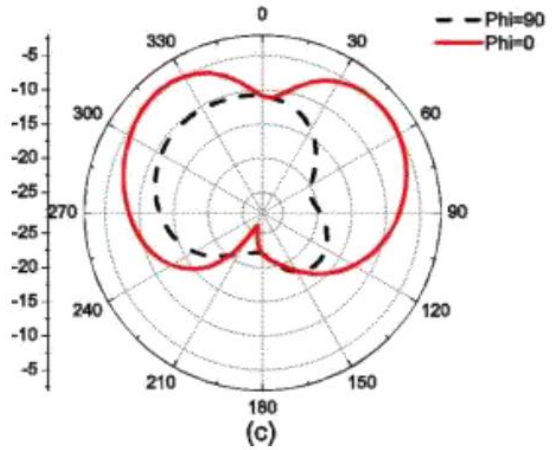


Fig. 6: Simulated radiation pattern (a) 2.2 GHz, (b) 5.9 GHz, (c) 8.5 GHz

CONCLUSION

A Multi-Band Monopole Antenna with size 28*24*0.8 mm^3 for Wi-Fi and satellite communication Applications is presented. The proposed antenna has a simple structure and also small in size. Due to small and simple size and good multi band performance the proposed antenna is best for practical Wi-Fi and satellite communication applications.

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