Design of Bat Shaped CPW Fed Antenna for Bluetooth Application

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***Abstract*—In this paper a low profile, small size Bat shaped CPW fed antenna for Bluetooth application is presented. The proposed antenna comprises of simple strip rod radiator and Bat shaped ground plane. It is resonating at 2.4GHz frequency, which covers the operating frequency range of Bluetooth. The proposed antenna is designed with FR4 epoxy substrate having dielectric constant of 4.4 and loss tangent of 0.002 and overall size 19x 20x 1.6 mm^3. The simulated results of the proposed antenna are presented in this paper. The antenna yields -10dB return loss and it has stable and omnidirectional radiation patterns across the band. The antenna is designed using simulation tool Mentor graphics 15.10 version which is based on method of moments (MoM).**

***Keywords*—Coplanar waveguide(CPW), Personal area network(PAN) Industrial, Scientific and Medical(ISM).**

I. INTRODUCTION

In the recent developments in wireless communication the Bluetooth technology is more popular because of its short range connectivity which establishes between the electronic devices like mobile phones, computers for exchanging the data, voice and video[1-2].

Bluetooth plays major role in sharing the data in short range of distance. Bluetooth belong the frequency range of 2400-2438.5 MHz, it is standardized as IEEE 802.15.1(PAN). This standard comes under unlicensed industrial, scientific and medical (ISM) 2.4GHz. Bluetooth uses the terminology of spread spectrum it is frequency hopping spread spectrum. Bluetooth is having designated 79 channels and each channel is having bandwidth of 1MHz, in this terminology firstly the data breaks into packets and then it transmits through the Bluetooth's designated channels in the step of 1MHz.

Coplanar waveguide fed antennas are very important part of modern wireless communication system. They are widely used because they are light weight, compact, cost effective. and integration of active and passive component is easy on the substrate layer and The size of the antenna has great influence on the whole size of wireless systems and there is generally a tradeoff between size and performance of antenna, because the characteristics of the antenna are closely concerned with its size. In this proposed antenna, the major concentration is on size miniaturization[3-8].

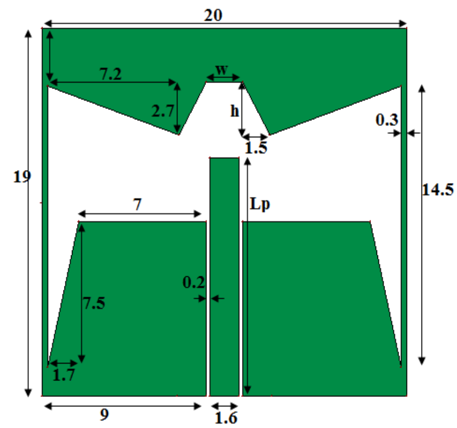


Fig. 1. Proposed antenna Structure.
(all dimensions are in mm)

II. ANTENNA DESIGN PARAMETERS

Fig. 1 shows the structural geometry of proposed antenna. In order to fit the requirement of portable devices, a compact planar geometry is presented, which is fed by CPW feed line and designed on 1.6 mm thick FR4 epoxy substrate with dielectric constant of 4.4 and loss tangent of 0.002.The antenna dimensions are 19 x 20 mm^2. The antenna is consisting of rod type patch and on the same plane, ground plane is located.

For this proposed antenna, the rod length Lp=12.3 mm, width of the feed line is 1.6 mm, gap between patch and ground plane is 0.2 mm and two symmetric finite ground planes are located with 9 mm width and 9.2 mm length.

III. SIMULATION RESULTS

The most important parameter of antenna is return loss characteristics. The return loss characteristics are shown in Fig. 2. It is observed that, proposed antenna has prominent resonance with peak return loss of -38.41dB which occurs at 2.41GHz frequency.

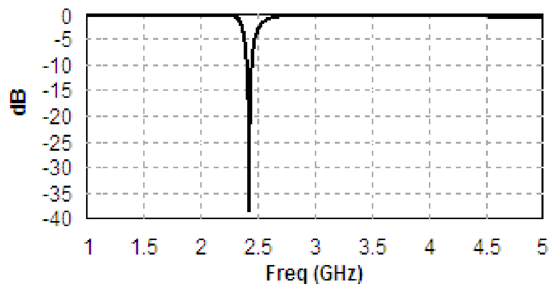


Fig. 2. Return loss characteristic of proposed antenna

Fig. 3 shows the VSWR characteristics of the proposed antenna. The proposed antenna is having VSWR less than 2. It satisfies the 2:1 VSWR bandwidth, which is sufficient for the antenna operation.

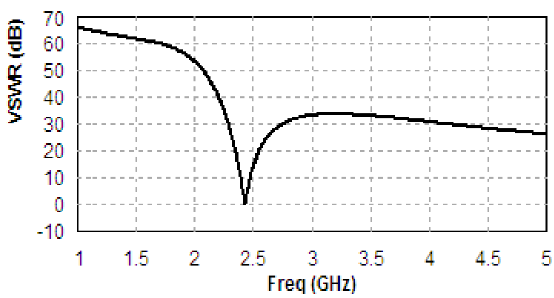


Fig. 3. VSWR characteristics of the proposed antenna

Various results are obtained by varying Lp, w and h. The simulation results are presented in Table I, Table II and Table III. It is clear that, at Lp=12.3 mm, w=2 mm and h=2.7 mm, return loss and gain obtained is better in comparison to other values of Lp, w and h. Optimum results are obtained for these values of Lp, w and h for the proposed antenna.

TABLE I

VARIOUS VALUES OF Lp (in mm)

Lp in mm	**Resonant frequency**	**Return loss in dB**	**Gain in dBi**
12.3	2.43 GHz	-38.40	3.00
12.8	2.41 GHz	-15.54	1.90
13.3	2.37 GHz	-10.07	2.00

TABLE II

VARIOUS VALUES OF w (in mm)

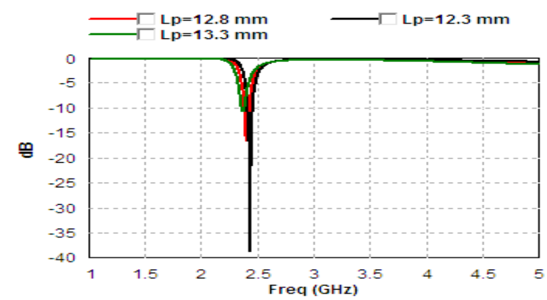
w in mm	**Resonant frequency**	**Return loss in dB**	**Gain in dBi**
0	2.42 GHz	-27.44	2.33
2	2.43 GHz	-38.40	3.00
3	2.40 GHz	-34.20	1.75

TABLE III

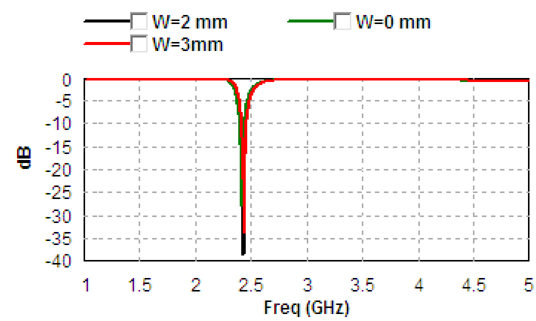
VARIOUS VALUES OF h (in mm)

h in mm	**Resonant frequency**	**Return loss in dB**	**Gain in dBi**
2.2	2.42 GHz	-28.16	2.08
2.7	2.43 GHz	-38.40	3.00
3.2	2.44 GHz	-32.83	1.98

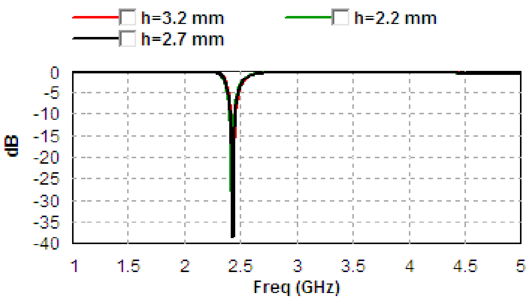
Fig. 4 shows the return loss characteristics with the variation of Lp, w and h. From this graph it is verified that, the resonance frequency is almost same for all variations in Lp, w and h. But the return loss and the gain of the proposed antenna is changing according to the variation in dimensions. Among all the dimensions, Lp=12.3 mm, w= 2mm and h=2.7mm is having the peak return loss of -38.40 dB and gain of 3 dBi.



(a)



(b)



(c)

Fig. 4. Return loss characteristics for different values of (a) Lp (b) w (c) h (in mm)

Fig. 5 shows the current distribution of the proposed antenna at resonance frequency of 2.41 GHz.

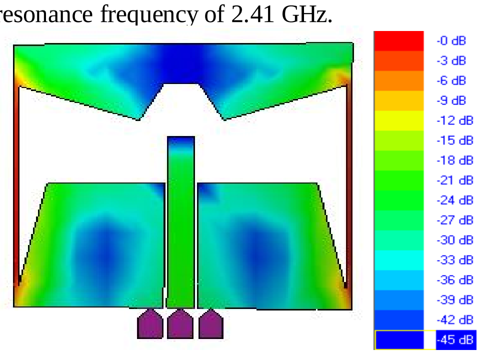
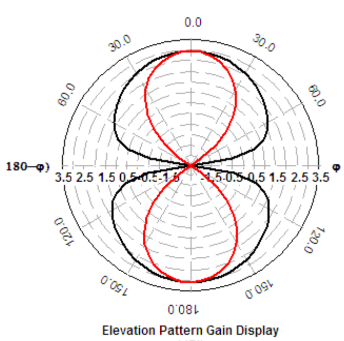


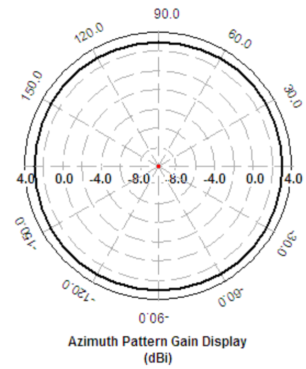
Figure 5.Current distribution at 2.41 GHz

From Fig. 5 it is observed that, the distribution of current is more on the ground plane and current is uniform at the patch at different operating frequencies.

Another important parameter to understand the antenna characteristic is 2D radiation pattern which is shown in Fig. 6(a) and (b) for the proposed antenna. The elevation pattern and azimuthal pattern gain display is presented. For better performance of any antenna, the radiation pattern should be in the shape of eight. For the proposed antenna, the radiation pattern is almost symmetrical and in the shape of eight.



(a)



(b)

Fig.6. 2D Radiation pattern at 2.41 GHz (a)Elevation pattern (E-plane) (b) Azimuth pattern (H-plane)

Fig. 7 shows the antenna efficiency. The optimum value of efficiency for any antenna should be greater than 65 %. For this proposed antenna, the efficiency is almost near to 99.60 %.

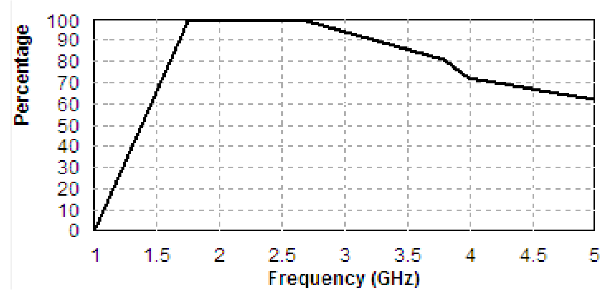


Fig. 7 Antenna efficiency of the proposed antenna.

Fig. 8 shows the gain of the proposed antenna. The gain is 3.00 dBi at the resonance frequency of 2.41GHz, which is sufficient for the proposed antenna, for Bluetooth applications.

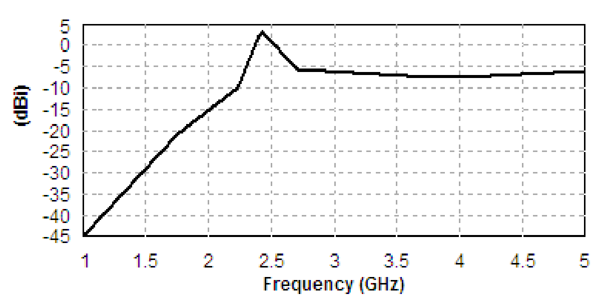


Fig. 8 Gain of the proposed antenna.

IV. CONCLUSION

A Bat shaped CPW fed antenna for Bluetooth application is presented, which is having optimum values of the antenna parameters. The return loss is less than -10 dB and VSWR is less than 2. Radiation pattern and antenna efficiency is quite well. The proposed antenna is small in size and is having optimum gain, which is suitable for Bluetooth application.

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