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A Robust Flexible Microstrip Bow Tie Antenna (FMBTA) for Wi-Fi and Wi-Max Communication Applications

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Abstract—In this survey paper- A bow tie antenna is made from bi-triangular sheet of metal. It is used for all UWB applications like Wi-Fi, ground penetrating radar, wireless and microwave imaging applications. But Micro strip patch antenna consists of a radiating patch on one side of a dielectric substrate which has a ground plane. The antennas may be easily mounted on missiles, rockets and satellites without major alterations. The bow tie antenna is resonant at multiple frequencies of 2.4,3.6, 3.9 & 4.9GHz which are unlicensed band and used for wireless applications. Other hand a Micro strip patch antenna having the operational frequency of 1.8 GHz, 3.8 GHz and 5.2 GHz VSWR bandwidth and return loss bandwidth up to - 23.75db has been obtained. So through bow tie antenna get four frequencies at four different levels which are used for wireless applications.Keywords— Microstrip patch antenna (MPA),ultra-wideband (UWB) applications, reduced radar cross section (RCS), octagonal microstrip patch antenna, wireless body area networks (WBAN)

Keywords—Microstrip Circularly polarized antennaMicrostrip antennaSlot antennaSAR and WBANCPW-fed, Bow-tie arm, Tri-band, Gain

I. INTRODUCTION

Antenna is a key device for any wireless communication system. An antenna is a means of radiating or receiving radio waves, this definition is given in IEEE. Or we can say that antenna acts as an interface for electromagnetic energy, propagating between free area and guided medium. Satellite and Wireless communication has been developed quickly within the last few years and it has left a great impact on human life. Recently the trend in commercial and government communication systems has led to developing low value, low profile, minimal weight, and broadband antennas that are able in the maintenance of the high performance over a very huge range of frequencies. The trend in technology has centered a lot of effort in the designing of Microstrip antennas which are referred as patch antenna. With an easy geometry, patch antennas provide several benefits not usually given in different antenna configuration. As an example, they are terribly low profile, simple and low cost, light-weight weight to fabricate exploitation modern computer circuit board technology, compatible with MMIC i.e. the (microwave and millimeter-wave integrated circuits) and have the facility to adapt to platelike and non-planar surfaces. In addition if chosen once the form and operational mode of the patch, designs become very versatile in terms of polarization, pattern, operating frequency, and impedance.The variability in design that's attainable with Microstrip antenna in all probability exceeds that of the other kind of antenna element. Lower Gain of Microstrip antenna is one of the major disadvantages that restrict its widespread use. If the Gain of Microstrip antenna could be higher, it would be very useful for recent trend of wireless communication. Many researchers have successfully overcome the disadvantage of having low gain of Microstrip antenna by modifying their shape, size or introducing additional element making appropriate wire free communication.For the simulation Microstrip antenna with

ground plane by using CST microwave studio2011 and Ansoft HFSS-13, which is based on finite difference time domain method (FDTD) is one in every of the most imperial electromagnetic software that allows to solving for radio and microwave application.

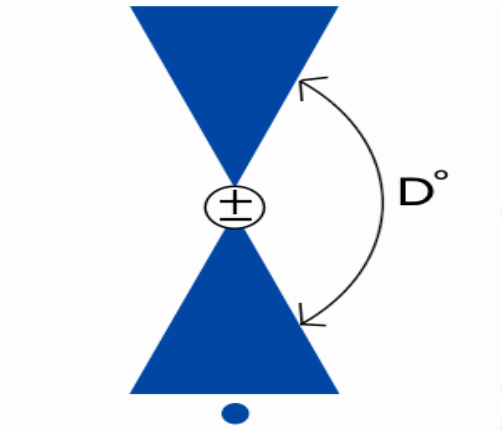


Fig1. Infinitely Long Bow-Tie Antenna.

Bo –Tie Antenna

The two triangular pieces of stiff wire or 2 triangular flat antenna metal plates, organized within the configuration of a bowtie, the triangle'sapexhave the feed point at the gap between them. As a simple (and non-manufacturable) infinitely wideband antenna, let's consider an infinite bow-tie antenna: infinite bow-tie antenna

Wide Band Antenna

When information's are transferred a system is said to be in a **wideband**is when the message bandwidth significantly exceeds the coherence bandwidth of the channel. Many of the communication links have a high data rate that's why they're forced to use a wide bandwidth; other links might have low data rates, and use a wider bandwidth. A band antenna is one with concerning or precisely the same operative characteristics over an extremely wide pass band. It's distinguished from broadband antennas

Flexible Antenna

Wireless technology grow speedy with starting of 4^{th} generation (4G) system. In this way Wi-Max also shows the fast of growth. The study of small strip patch antennas has created a good progress within the recent years, compared with the standard antennas. Subsequent generation networks we have a tendency to need higher data rate and size of devices are abundant smaller. During this evolution two vital standards are Wi-MAX [1] and Wireless local area network [2] antennas are standard for his or her well-known engaging options such as tiny dimension and easy to fit on chip

II. LITERATURE SURVEY

In this Singh, et.al (2021), In this Research work presented a printed compact wideband circularly polarized bowtie slot antenna (WCPBSA) is proposed and presented for wireless body area network (WBAN) applications. The proposed FR4 dielectric based compact antenna has been designed by etching a wide bowtie shaped slot in the ground plane along with a pair of thin slits inserted in the ground plane. The proposed slot antenna is excited by a 50 Ω feedline with dual horizontal stepped stubs, protruding in opposite directions in the slot, which excites dual orthogonal modes to achieve a wide simulated 3-dB axial ratio bandwidth (ARBW) of 48.14% in 4.1 – 6.7 GHz frequency band with approximately identical 10 dB return loss (RL) bandwidth. The proposed WCPBSA is also experimentally verified on human body and observed to be of low specific absorption rate (SAR) value of 0.975 W/kg over 10 g of human tissues and a measured gain of 4.1 dBi at frequency 5.8 GHz. Then proposed WCPBSA of size 20 × 20 × 0.8 mm3 is designed, fabricated and the measured results are verified and validated with simulated results***Bollavathi, et.al. (2020),*** In this Research work presented an extensive study of a wideband slot antenna based on the dumbbell-shaped slot, shorting-vias and SIW cavity is discussed in this research work. The SIW cavity is stimulated by microstrip line feed for planar integration. Due to the loading of shorting-vias in the middle of SIW cavity, the individual bandwidth of the lowest mode is moved upward and coupled with the higher-order resonances, which increases the bandwidth of the antenna. To improve the bandwidth further, a short rectangle slot is appended at each end of the dumbbell-shaped slot. The fabricated sample has been tested to validate the presented design. The measured results show that the fractional bandwidth is 22.4% for the presented antenna. The antenna also consigns with a flat gain in the band of interest and exhibits low cross-polarization level at all the resonant frequencies. Furthermore, shorting-vias approach surpasses the narrow bandwidth of a conventional SIW. Further, the presented design can be readily extended to a higher number of cavities [2] ***Dayo, et.al. (2019***) ,In this Research work presented a planar bow-tie slot antenna for tri-band wireless communication application has been presented and studied in this research work. The tri-band characteristics of the presented antenna have been achieved by setting up the proper dimensions of slots. Moreover, the antenna achieves the substantial fractional impedance bandwidth 25.8%, 13.3%, 9.9% and high gain 6.9dBi at C-band, substantial gain of 3.96dBi at X-band, acceptable gain of 0.49dBi at WIAMX band. The antenna has been designed and simulated through the electromagnetic solver software HFSS 13.0. The simulation results validates the designed antenna is a suitable contender for WIMAX, C-band and X-band wireless communication applications [3] ***Choudhary, et.al.(2018***), The presented antenna shows a wide band and cover Wi-Fi and Wi-Max ranges whose frequencies is between 2 to 6 GHz discussed in the figure 5. The range of presented design covers the Wi-Fi and Wi-Max range. The Gain of proposed design at 2.33 GHz frequency range that is 7.8246 dB in the wide band gain also

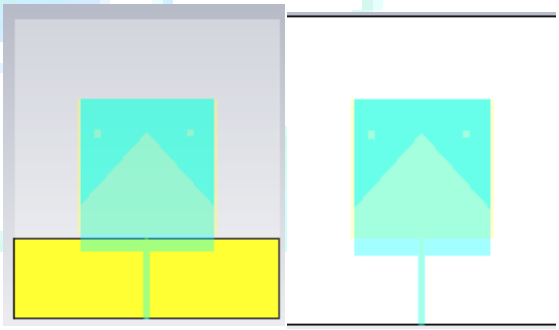
above 6dB. Also shows the good result in terms of return loss that is (S-11) -35dB as well as VSWR that is 1.08. In future try to improve the gain as well as directivity of the design. In future apply soft computing to enhance the present result with the help of neural network and other machine learning techniques [4]. ***Sallam, Mai O. et.al, (2017***), In this research article researchers focus on wideband antenna with fixable property. From 2 slotted right-angle triangles fed by a coplanar wave guide transmission line, the antenna is made. Here a model is being characterized, designed and fabricated through an experiment. The measurements are revealing good agreement with simulations. WLAN is in 2.4 and 3.65 GHz and WiMax is in 2.3, 2.5, and 3.5 GHz spectra, when taken as a whole impedance bandwidth of 1.79 GHz (57.7%) and 1.46 GHz (49.7%), respectively. The radiation of the antenna is bidirectional with gains of 6.30 and 5.09 dB for the free space and brick wall versions, respectively [5] **. *N. et. al. (2016)***, In this Research work presented a multiband Bow Tie antenna with circular arm and fractal geometry has been studied. The multiband operation is achieved by Apollonian Gasket of Fractals which are the combination of mutually tangent circles. The antenna is designed up to 3rd iteration in which best result is obtained for second iteration. UWB band is obtained by cutting two circular slots in the ground. Four resonating frequencies are obtained with very low reflection co efficient. The antenna is fabricated using etching process and tested using VNA. This presented antenna shows a good omnidirectional radiation pattern. Radiation efficiency is more than 40% in each case. It is simulated by in ZELAND IE3D 15.3 software and validates the purpose of this antenna to be used in satellite, cellular mobile and radar applications.[***6] Shao, et. al. (2015)***, In this Research work presented a textile-based broadband elastic RFID tag antenna was been fabricated, designed, and tested. It was demonstrated that the designed antenna achieves a bandwidth of 263MHz in free space, and more importantly, it maintains its tuned behavior when placed on dielectrics with varying permittivity. Different versions of the designed tag antenna were fabricated and tested. [7] ***T. L. Chuan (2014***),]In this Research work presented a novel dual-band configuration of a CPW-fed slot antenna using a signal strip, 2 conducting strips and bow-tie-shaped slots has been projected and enforced. Here the effect of 2 geometrical parameters on the antenna is been studied. For 2.4/5.2/5.8 GHz antenna which is suitable for wireless local area network operation bands with simple tuning parameters. The measured result are showing a positive agreement here with simulated results. [8]

III.PROPOSED DESIGN

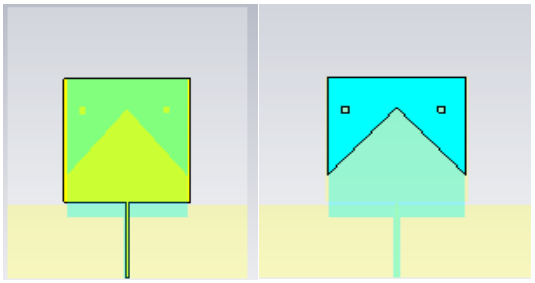
In this presented work shows the flexible bow-tie patch antenna designed. In this antenna apply quarter ground technique to enhance bandwidth (B.W.) and gain (G) of the antenna. Flexible patch antenna has become popular day by day the reason behind this is ease of flexibility and fabrications in cloths. Flexible patch antenna is designed for Giga hertz frequency range 2 to 6 GHz where this frequency range accommodate in the various band in the wireless fidelity range 3.92 GHz and wireless local LAN all are in GHz range frequency. Flexible patch antennas have Gaining importance in the applications of Wireless Local Area networks (WLAN). The simulated results such as Return Loss S11, VSWR, Gain, and Radiation Pattern, Vector diagram of electric field and Mesh field is made. So the details of the antenna designs and simulated results are presented in this chapter 4. New micro strip antennas have enhanced gain and radiation pattern is presented in this thesis.

A. Proposed Flexible Microstrip Bow Tie Antenna (FMBTA)

In the research work present a flexible bow tie antenna, it is good step for flexible technology. During this evolution two vital standards are Wi-MAX [1] and Wireless local area network [2] antennas are standard for its well-known engaging options, like a small size, easy to fabricate and easy to use. The demand of flexible antenna is increasing rapidly due to its good properties such an easy to fabricate, easy to fit any communication device and also use in different places where require flexible technology structure. For the flexible technology in antenna use different type of substrates such as Graphene [5], copper indium gallium [6]. [03].The next generation of technology is based on flexible electronics, for the growth of this technology, proposed flexible antenna shows a vital role. [7]. In the below shows the design specification of the proposed design. In this design explain the flexible multi layer bow tie antenna with quarter ground side. Now discuss the design parameters of proposed design that is flexible bow–tie antenna with and quarter ground [10]. The proposed design contain five different layer or parts. There are ground, substrate and patch.



(a) Design of ground view (b) Design of substrate



(c) First Patch(d) Design of bow Tie patch

Fig. 1 Multi Layer Flexible Bow Tie antenna

The above figure 4.1 shows the geometry of proposed design. In the proposed design first desirable the geometry of ground structure in figure (a), in figure (b)shows the substrate of the proposed antenna, (c) shows the first patch of antenna and figure (d) shows the bow tie patch antenna . In the ground side apply different changes, first use quarter ground plan and also apply the optimization of ground width at different size.

On the patch side apply microstrip feed. The main motive of this research work is to design a flexible antenna for this use a flexible Rogers RT5880 substrate (εr= 2.2 and tan δ = 0.0027).The length(L), width (W) and height (H) of the proposed design is shown in figure 4.2, that is $(40 \times 45 \times 0.497)$m. m^3design. Now discuss the last but very important of flexible antenna that is patch of proposed antenna. The patch of the proposed design contain combination of micro strip feed. The geometry of proposed design is shown in the figure 4.2. The length (L) and width (W) are same as the

substrate but height (H) is changed. Due to patch side use a Copper metal that is type lossy. Therefor the dimension of patch is started with $20 \times 25 \times 0.035$. Now apply multi layer bow tie patch with right angle slots are used in the proposed design. On the patch apply bow tie structure with the help of two right angle triangle (θ=90o). The angle of the bow–tie structure $\text{Cos}(\alpha = 41.49^0)$. Also apply tiny microstrip feed of 1mm that is connect by waveguide port or coaxial port. In the waveguide port or coaxial port using 50 Ω impedance value.

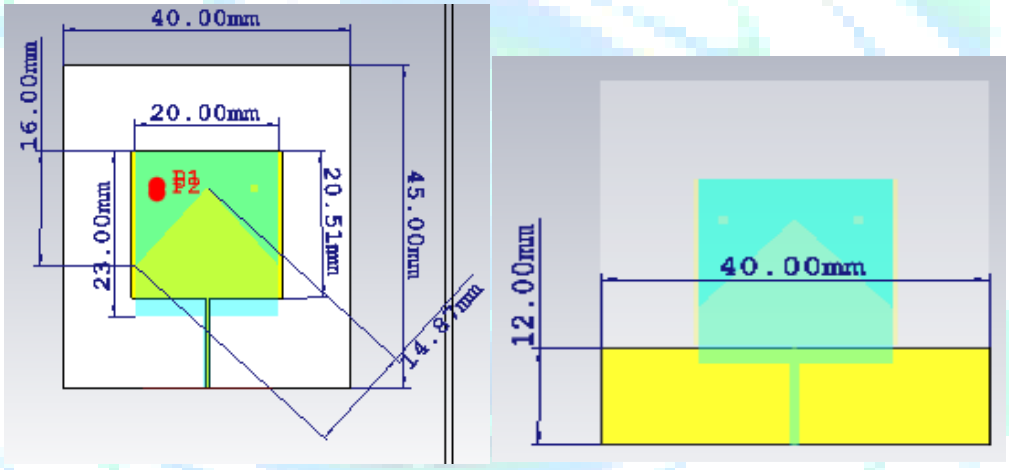


Fig. 2 (a) Dimension of proposed patch antennaFig. 2 (b) Dimension of ground

Table .1 Dimension of Antenna Design

Antenna Parts	Antenna dimension	Dimension Length(L) × Width (W) × height(h)mm^3
Substrate (s)	Substrate (s)	40 × 45 × 0.125
Ground (G1)	Ground (G1)	40 × 12 × 0.0635
Patch (P)	P1[Rectangular (brick B1)]	20 × 20.51 × 0.035
	P2[Bow Tie Patch]	16 × 20.50 × 0.0635
Microstrip feed line (f_l)	$feed\ line\ (f_L)$	12.5 × 1 × 0.0635

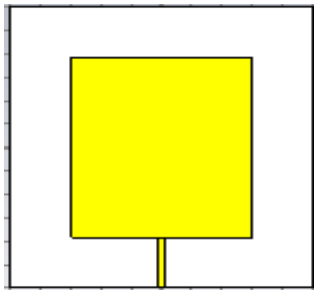
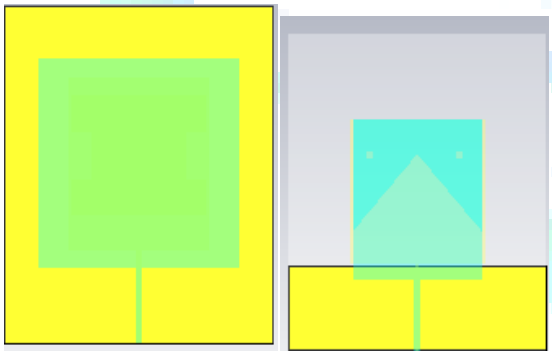


Fig . 3 shows the basic Patch antenna design

Table . 2 Design Parameters of Simple Patch Anten

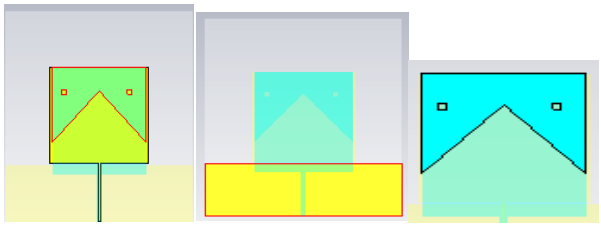
S. No.	Parameter	Dimension (mm)
1	Substrate	40X45X1
2	Ground	40X45X0.0635
3	Patch	29.8X38.4X0.0635
4	Feed type - Microstrip	1X10.8X0.0635



(a) Front end of flexible Patch antenna

(b) Back end of Flexible Patch antenna

Fig .4 shows the basic printed dipole antenna



(a)Patch side (b)Ground side (c) Patch 2

Fig. 5 Shows design 2

Table. 3 Simple Printed Dipole Antenna Dimensions

Antenna Parts	DimensionLength(L) × Width (W) × height(h)mm^3
Substrate (s)	40 × 45 × 0.125
Ground (G1)	40 × 12 × 0.0635
Patch (P)	20 × 20.51 × 0.035
	16 × 20.50 × 0.0635
Microstrip feed line (f_l)	35

Table . 4 Fractal Patch Dimension

Parameter	W 1	L1	L2	W2
Value (m.m.)	20	16	6.5	3.0

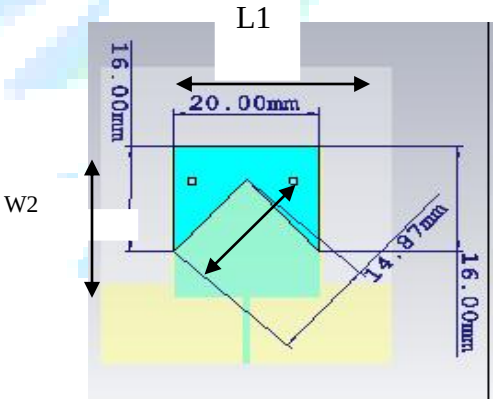


Fig. 6 Geometry of proposed modified fractal design

IV. SIMULATION AND RESULT

In this chapter discuss the simulation and result of the proposed antenna. In this proposed antenna flexible substrate technique as well as multi-layer substrate are used for enhance the bandwidth, return loss (S-11) and

other properties of antenna. The proposed multi layer bow tie patch antenna is design for Giga hertz (GHz) frequency range up to 6 GHz. The proposed frequency where this frequency range accommodate in the various band in between 1 GHz to 6 GHz in between the Wi-FI and Wi-Max range.

CST Design environment

The proposed design in the CST 2016 version. The system for designing used is core i-5 4thG processor. The main part of proposed design is substrate (S), patch (P), ground (G) and feeding system (Wave guide feed). In this design using a wave guide wave port for feeding system. In general there are two type of feeding systems first one is wave guide port and second one is the wave guide port.

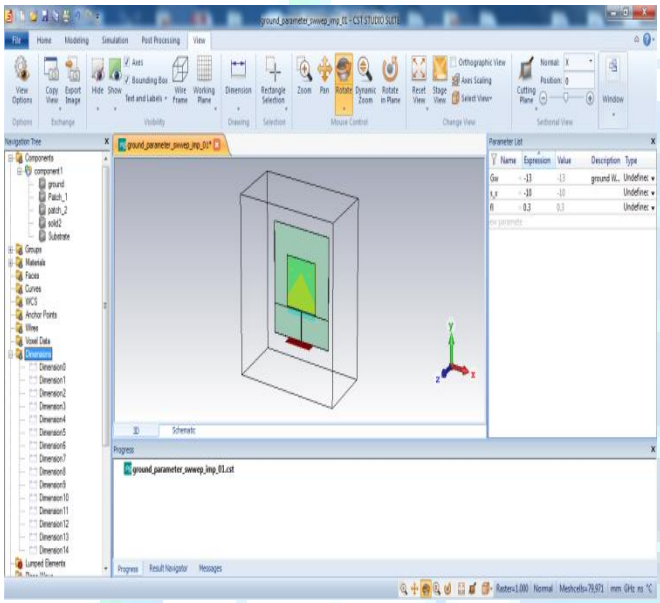


Fig . 7 Shows the front view of proposed design

Return Loss:
Return loss (S-11) is an important parameter for performance measurement of antenna that is measure is DB. It is the Return loss measure in Db.

$$\mathbf{S11(dB) = 10log\frac{P_r}{P_i}(1)}$$

Voltage Standing Wave Ratio (VSWR):
The VSWR is also an important parameter for analysis of antenna design. Ideal value of VSWR 1 to 2. For particle system is near to 2. In ideal case VSWR is 1.

$$\mathbf{VSWR = \frac{1+\tau}{1-\tau}(2)}$$

Gain is representing as a ratio of radiation intensity in particular direction to total input power transmitted by antenna.

$$\mathbf{Gain\ (G) = 4\pi\frac{radiation\ intensity}{P\ total}} \quad \mathbf{(3)}$$

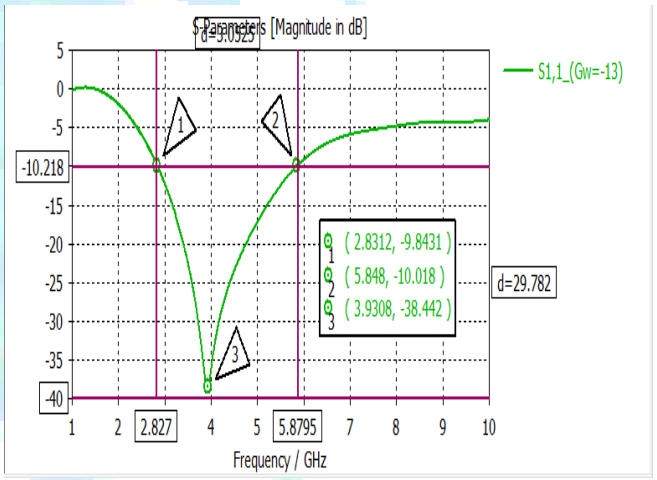
$$\mathbf{G_{dBi} = 10.log_{10}(G)}$$
$$\mathbf{G_{dBd} = G_{dBi} - 2.5\ dB}$$

Bandwidth (B.W)
Bandwidth of the antenna is an important parameter for result measurement. In the below equation shows the bandwidth of antenna.

$$\mathbf{B.W.} = \frac{f_H - f_L}{f_c} \times 100 \quad f_c = \frac{f_H + f_L}{2} \qquad \mathbf{(4)}$$

f_H = Higher frequency
f_L = Lower frequency
f_C = Centre off frequency

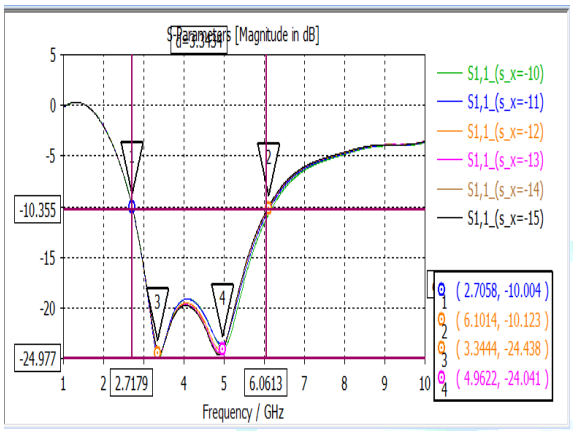
Number of bands
The total number of bands of any antenna is shows that the working of any antenna in the different rang



X axis the frequency range of the proposed work

Fig. 8 Return loss (S-11) of proposed antenna combined two bands

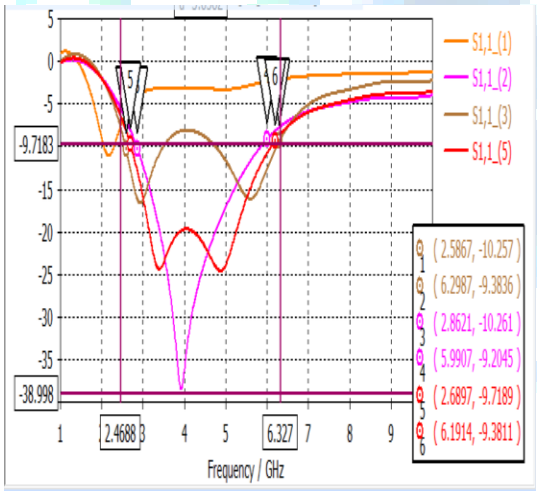
Parametric Study on Ground Width



X axis the frequency range of the proposed work

Fig. 9 Return loss (S-11) of proposed antenna combined two bands

Parametric Study on feed line (f_L) with Ground



Width (G_w)

VSWR of Proposed design

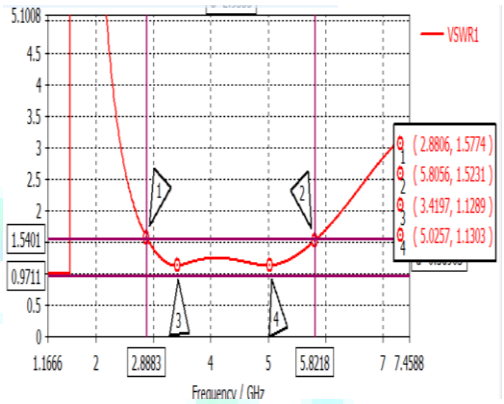


Fig . 10 VSWR of proposed design

VSWR of Proposed design

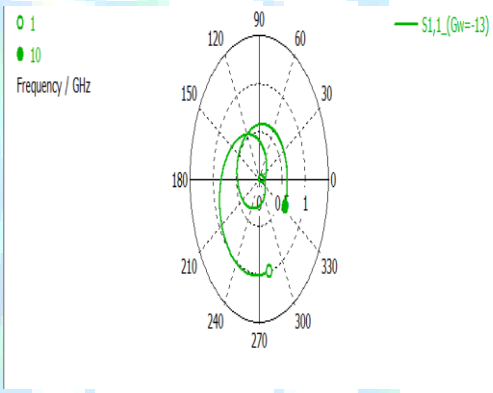


Fig. 11 Shows Polar plot of proposed antenna

Table. 5Compares ion on the basis on S -11 and number of bands

S. No Ref.	Year	Size of the antenna	Feed Technique	Range	S - Parameter	Flexibility
0	2018	40X45	Microstrip Feed	1 to 6 GHz	**3.004 GHz (69.79%)**	Yes
[1]	2017	80x60	CPW feed	1 to 6 GHz	-35 dB (Wide band bandwidth 1.79 GHz) **57.7%**	Yes
[7]	2011	35X35	Microstrip feed	1 to 6	1.405GHz (46.56%)	Yes
[3]	2014	60X45	Microstrip feed	1 to 6	1.94GHz (32.33 %)	No

V. Conclusion

The slotted bow tie patch antenna is resonant at multiple frequencies of 2.4, 3.6, 3.9, 4.9 GHz. Which are unlicensed band and used for wireless applications. So designed antenna can be applied effectively to all wireless applications. But a Micro strip patch antenna having the operational frequency of 1.8 GHz, 3.8 GHz and 5.2 GHz VSWR bandwidth and return loss bandwidth up to 23.75db has been obtained shown in figure 3.1. There are the two different S parameters of bow tie antenna and micro strip antenna which are taken through HFSS software. .

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