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A MODIFIED CORN SHAPE PATCH ANTENNA WITH CPW FEED

Vishal Gohane[1], Dr. Arvind Kourav [2] Prof. Nehul Mathur[3]
M.Tech Scholar[1], Professor[2], Assistant Professor[3]
[1,2,3]Department of Electronics and Communication *(ECE)*
[1,2,3]Bhopal Institute of Technology *(BIT), Bhopal, (M.P.), INDIA*
gohanevishal11@gmail.com[1] mathurnehul@gmail.com[2]

Abstract— In this research, an in-depth investigation of antennas utilised in wireless communication systems was undertaken. The reuten loss (S-11), VSWR, and other performance parameters reveal that the suggested cone-shape patch design works well. Cone-shaped antennas with circular slots are shown in this paper. On the basis of antenna characteristics such as VSWR, return loss (S-11), and isolation loss, the suggested design exhibits a better outcome than other prior methods. Wi-Fi frequencies between GHz may be covered by the suggested antenna, which has a limited bandwidth. Wireless fidelity and Wi-Max range are included in the suggested architecture. This shows that (S-11) -32.69dB return loss and (VSWR) 1.08 are also excellent results.
Since it's based on an FR-4 substrate, this design may be readily produced for commercial purposes. Designed for high power, RF efficiency, and OFDM/military use, this radio is also capable of transmitting across the band. For WLAN, WiMAX, and other wireless systems, antennas that are correctly scaled to the allowable frequency ranges may be built. The Microstrip antenna's small size and compatibility with microwave equipment provide the Microstrip antenna the right to be part of a contemporary communication system that is more precise, reliable, and high-performing in the future.

Keywords— Square Patch, Multi- Band ,Wide-Band (WB), Wi-Fi , Wi-Max and Ultra-Wideband (UWB) etc.

1. INTRODUCTION

An overview of UWB antennas for wireless communication applications is presented in this article. A comprehensive assessment of the subject's accomplishments over the preceding decade is provided for the benefit of readers in the field, with a focus on the crucial gaps that remain unfilled and indicate the need for further investigation into new approaches to answering these potential research issues. Researchers have provided insights into how loading may impact and increase the bandwidth of wide-band and UWB antennas, as well as how it can reduce the size of the devices while preserving their antenna properties.

3D, 2D, and planar antennas were the most often utilised for communication purposes. For example, some of these antennas will be used in stationary devices, while others will be used in portable ones. Low-profile transceivers should be employed in various applications, such as antennas for mobile devices and wireless sensors on body networks, in order to save printing board space. To make wireless body networks easier to use, antennas should be able to bend almost 90 degrees [7, 8].

The following is a comprehensive list of the transceiver systems now in use for communication: the elliptical printed monopole and the Meta material (MTM) structure UWB antennas; the wide-band micro strip and the wide-band monopole over a plate UWB antenna, as well as the dielectric resonator UWB antennas (DRAs). Because of the necessity to increase the performance of these antennas, they were replaced.

A. Motivation

One GHz is typically considered to be the upper limit of pure microwave frequencies. High-frequency and broad-band signal repeaters need a new set of skills and methods. Due to the nature of high-frequency designs, it is impossible to handle them in the same manner as reduced electronic circuits, in which all signals must be considered as waves. New standards and tools for electronic design are required to supplement the traditional ones. Second, broad band surgery comes with its own set of difficulties and a bevvy of perplexing issues. The bandwidth of traditional radio systems is just a few percent of the fundamental frequency (CF). It is possible to have a wide range of antenna characteristics with a narrow bandwidth. Although the CF has a very wide bandwidth, emerging technologies like UWB may be able to employ a bandwidth even greater. With so many antenna factors to regulate, it is difficult to create antennas that have acceptable performance fluctuations across such a large bandwidth.

II. WIDEBAND ANTENNA TECHNOLOGIES

It has been more than a period since humans first began investigating radio occurrences known as radio waves. Most people have generally been baffled by the connection between electrical circuits and the atmosphere. Antenna development begins with basic ideas and current science, much like all other technologies. In recent years, the data transfer rate used by communication networks has steadily grown. The first implementations used a lot of bandwidth. However, it is only in the present era that antennas are designed to be broad in their purpose. If space is a concern in most mobile phones, planar or integrated antennas on a printed circuit board should be examined. Ultra-wideband Since the impedance-bandwidth performance of antennas has not been a concern prior to 375H [2]–376H [5], antenna polarisation has attracted more attention than bandwidth expansion. Wireless communication systems might get bottlenecked due to today's patch antenna bandwidth requirements.

A. Antenna History

Radio pioneers were forced to use resonant circuits to feed their antennas since they lacked the ability to create continuous waves. Diffused sinusoidal impulses are generated by such resonant circuits. The transmission may be thought of as a series of impulses travelling across space and time. It is only natural that a large frequency band around the impulse centre frequency would be used when such a pulse transmission is conveyed in the frequency domain. It was known to physicists a century ago, however, that electromagnetic waves propagate through media. The relationship between frequency, phase velocity, and wavelength has long been known. When this information was learned, it quickly led to the notion of wavelength or frequency-selective communication channels between 37H [1] and 374H [3,] the path to today's narrowband systems. Since then, a slew of new resonant antenna designs, including the patch antenna, have been unveiled. Directivity, gain, and other similar parameters.

B. Theory and Techniques

Antenna technology is built on Maxwell's well-known equations, which form the basis of all electromagnetic technology. In the beginning, Maxwell's equations described electric and magnetic field behaviour using a total of 20 equations. Electromagnetic fields can be described by using the differential form of the four fundamental equations of electromagnetism, which are shown in Eqs. 2.1-2.4, 37H [1], 378H [2]. Here, t and E are the electric field intensity and total electric charge density in cubic metres, respectively, of an electric field. Free charge density and bound charge density are interdependent, as can be seen in Eq. 2.5, and this is true for total electric charge density as well. 2.6 shows that the bound charge density is directly related to the electric polarisation in P (coulombs per square metre). In magnetic induction in teslas, m J is the current density in matter caused by charge flow, f J is the current density of free charges, dtdP is the magnetic polarisation, M is equivalent to the current density in magnetised matter, and M is the magnetization in amperes per metre. "B is the magnetic induction.

C. Antenna Principles and Printed Circuit Board Integration

In free space, a wavelength originating from a single point source will travel in all directions at the same speed. In the far-field areas of 384H [1], 385H [7], the radiation from the antenna shows plane wave qualities when seen from a distance. 2.8, where 0 is the free-space temperature coefficient and 0 is the free-space conductivity, gives the velocity (c) in free-space. Free-space impedance is defined by the ratio of magnetic and electrical characteristics, which is shown in Equation 2.9. For free-space, the relationship between frequency 0f and wavelength 0 is merely dependent on c (see Esq. 2.10 and 2.11, 386H [1], 387H [7], for instance).

D. Multi- Band and Resonance Antenna Systems

It is possible to combine an unlimited number of antenna components to create an antenna array. This category differs from the preceding parasitic coupling approach in that it uses an arbitrary number of radiating antenna elements or antenna components in multi resonant structures. Electrical interconnects may be used to feed the structure directly, or taper feeding can be used. Switches, power dividers, or T multiplexing methods may be used to match the impedance of electrical feeding systems. I'm 428H [17] and 429H [18]. As a result, numerous antennas may be employed to improve performance (e.g., mitigating 430H interference). Switching chooses the active radiating antenna element by switching the electrical route as indicated in X431HFig. One of the most essential aspects of a switch is how quickly it can be switched on and how noisy it is. The switch settling time must be rapid enough to provide a matched impedance path during transmission. In addition, it is required that the switching arrangement does not significantly increase noise (432H) [17].

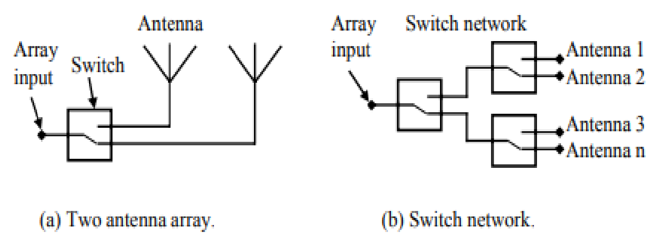
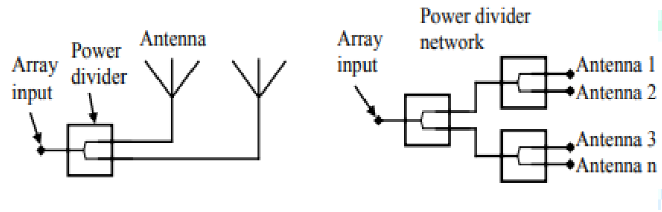


Fig. 2.1. Switched antenna system: (a) a two antenna array, and (b) a four output port switch network.

X43HFig. 5X shows a well-known approach for physically combining different transmitting antenna arrays: energy amplifiers. There are several uses for 43H [17] array architectures, including linear arrays with concentrated radiation, beam steering, and more. A 3 dB loss in power divider loss is added to each signal that is split evenly by two. It's only natural that the signal received by each of the antennas is much diminished when it's dispersed among so many different radiating components. Furthermore, power dividers need no settling time, in contrast to switched antenna systems.



(a) Two antenna array. (b) Switch network.

Sub-arrays produced using energy separators may be used with controls as recommended in Paper I. It is possible to combine any set of subs with a multiplexer 435H [17] by using one or more antenna components in each. There are several ways to integrate multiple narrowband antennas into one wideband antenna system, such as using energy regulators and switches as shown in X436HFig. 6X. 437H [17].

There is no need for the number of switches and power dividers in the system to be symmetrical.

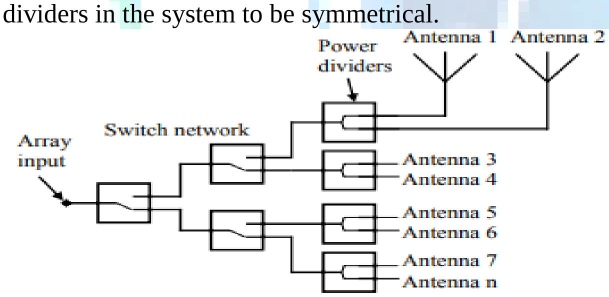


Fig. 2.2. An antenna array consisting of switches and power dividers.

III. PROPSED METHODOLOGY

In this presented work shows the cone shape patch antenna with CPW feed for heath care devices designed. The antenna's bandwidth (B.W.) and gain (G.) are increased by using the quarter ground approach. Due to the simplicity of usage and manufacture in various locations, cone-shaped patch antennas are becoming more common. A cone-shaped patch antenna was developed for this frequency range since wireless local area networks and high-fidelity wireless networks such as 802.11n use frequencies in the gigahertz (2-6 GHz) range. Wireless Local Area networks (WLANs) are increasingly relying on cone patch antennas (WLANs). Other simulated findings include: Return Loss S11 (VSWR), Gain, Radiation Pattern (Vector Diagram of the Electric Field and Mesh Field), and others. Antenna designs and simulated outcomes are discussed in length in this chapter 4, which concludes the series. This thesis presents new microstrip antennas with improved gain and radiation pattern.

A. Proposed Cone shape Patch Antenna With CPW feed for Heath Care Devices

In the research work present a Cone shape patch antenna, Health care technologies will benefit from this move. The suggested design's specifications may be seen in the table below. In this devise explain the flexible multi layer bow tie antenna with quarter ground side. The design specifications of the flexible bow-tie antenna with a quarter ground [10] are now discussed in detail. Five separate layers or sections are included in the suggested design. There are three types of ground: the substrate, the patch, and the sand.

B. Part Of Proposed Cone Shape Health Care Patch

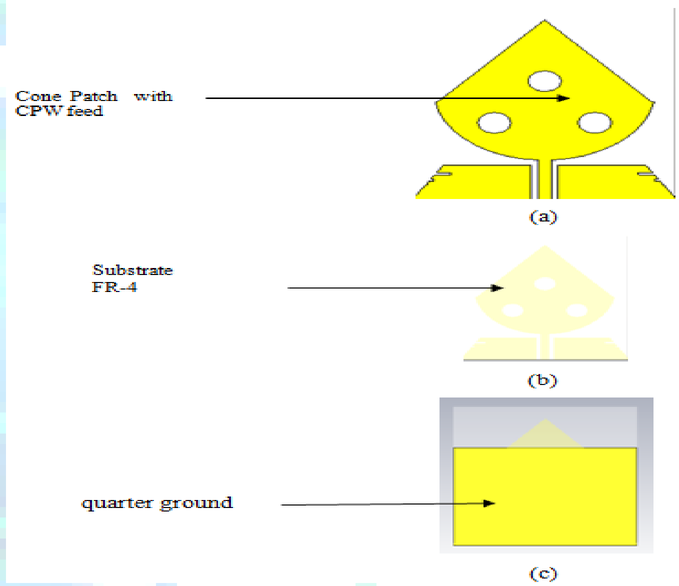


Fig. 3.1 Geometry of proposed Cone shape patch antenna

The above figure 3.1 This demonstrates the suggested design's geometry. Figures (a), (b), (c), and (d) illustrate the ground structure, the substrate of the proposed antenna, the first patch of antenna, and the bow tie patch antenna in the suggested design. On the ground, make a few alterations. First, utilise a quarter-ground layout. Next, optimise the ground width for various sizing options.

Apply a microstrip feed to the patch side. The primary goal of this study is to develop a cone-shaped antenna using CPW and DGS on an FR-4 substrate as the primary support (ε_r= 4.4 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 78X95x1.6035 mm^3 design. There is a mix of micro strip feed in the patch recommended for the new design. Figure 4.2 depicts the suggested design's geometry. Using three circular slots on the patch side and two right-angle cuts on the CPW feed is recommended in the design for the proposed patch side. Use two right-angle triangles (90o) to create a bow tie structure on the patch. When using the wave guide port or the microstrip feed port, apply a 1 mm-diameter microstrip feed.

Waveguide or coaxial ports with 50 input impedance may be used in this case.

Table 3.1 Dimension of Antenna Design

Antenna Parts	Antenna dimension	Dimension in mm^3
Substrate (s)	Substrate (s)	78x97x1.6
Ground (G1)	Ground	78x67.02x0.035
Patch (P)	P1[Half circle] & Triangular exclude	(64.62X0.0635) radius and (39x39.5x0.0635)
Microstrip feed line (f_l)	$feed\ line\ (f_L)$	4x19.56X0.0635

In the table 3.1 shows the all parameter of antenna design specification of proposed antenna. In this antenna substrate dimension are length (L), width (W) and height is 1.6.

C. Antenna for Microstrip Patch Base Design

Microstrip patch antennas were originally used in the construction of cone-shaped antennas. Mathematical calculations are needed to create a basic microstrip patch antenna. It is simple to create, frequently used, and straightforward to evaluate the square patch. The methods outlined below may be used to create a square patch. The traditional way to make rectangular micro-strip patch antennas is to look at three important factors:

Frequency of operation (f_0): The antenna's resonance frequency has to be selected carefully. communication systems that operate at frequencies between 1 and 6 GHz. Resonance frequencies that range from 1 to 6 GHz have been chosen for the design shown.

Di-electric constant of the substrate (εr): In the design of the patch antenna, the dielectric constant of the substrate material is critical. So there is a trade-off between the antenna's size and performance. The dielectric constant of the FR 4 substrate used in this thesis is 4.4..

Height of di-electric substrate (*h*): The dielectric substrate's height must be reduced. Substrate height is assumed in this thesis to be 1.6 mm.

According to factors such as dielectric constant (r), frequency of resonance (fo), and room height (h), a rectangular micro-strip patch antenna may be designed by taking into account the length and breadth of the room.

Step 1: Calculation of Width (W)

The realistic radiator width that results in excellent radiation efficiency is as follows:

$$W = \frac{c}{2fo\sqrt{\frac{\varepsilon r+1}{2}}} \qquad 3.1$$

Where c is the speed of light in its unconfined free space.

Step 2: Di-electric Coefficient value calculation (ε reff)

Effective permittivity of the dielectric constant (ε reff) is calculated by evaluating the ability of the fringe field, but it is surrounded by a homogeneous dielectric (ε reff) using the same geometry (W h).

$$\varepsilon reff = \frac{\varepsilon r+1}{2} + \frac{\varepsilon r-1}{2}\left[1+12\frac{h}{w}\right]^{-1/2} \qquad 3.2$$

Step 3: Effective Length Design Equation (L eff)

$$Leff = \frac{c}{2fo\sqrt{\varepsilon reff}} \qquad 3.3$$

Step 4: Length Extension (ΔL) Design Equation

$$\frac{\Delta L}{h} = \frac{0.412(\varepsilon reff+0.3)(\frac{w}{h}+0.264)}{(\varepsilon reff-0.258)(\frac{w}{h}+0.8)}$$

Step 5: Actual Length of Patch (L) Equation

The length of the patch is determined by the following equation:

$$L = Leff - 2\Delta L$$

Step 6: Ground Dimensions (Lg, Wg) Equation

To use the broadcast line model, you must have a surface that is limitless. However, a limited base surface is required for practical concerns. Similar outcomes to the limited base surface and eternity may be achieved if a patch's size is six times greater than the substrate's thickness along its edge, according to [6]. Because of this, the size of the bottom surface is determined by

$$L_g = 6h + W$$
$$W_g = 6h + L$$

Step 7: Micro-strip feed line width calculation

The micro-strip line's width is determined by the following formulas.

$$\frac{w}{h} = \left(\frac{exp(H')}{8} - \frac{1}{4\exp(H')}\right)^{-1}$$

$$H' = \frac{Z_0\sqrt{2(\varepsilon_r+1)}}{119.9} + \frac{1}{2}\left(\frac{\varepsilon_r-1}{\varepsilon_r+1}\right)\left(l_n\frac{\pi}{2} + \frac{1}{\varepsilon_r}l_n\frac{4}{\pi}\right)$$

$$\varepsilon_{eff} = \frac{\varepsilon_r+1}{2}\left[1 - \frac{1}{2H'}\left(\frac{\varepsilon_r-1}{\varepsilon_r+1}\right)\left(l_n\frac{\pi}{2} + \frac{1}{\varepsilon_r}l_n\frac{4}{\pi}\right)\right]^{-2}$$

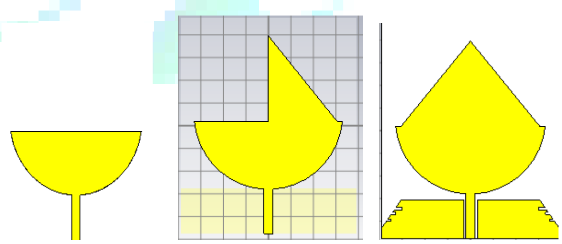
er is the dielectric constant; Zo is 50 ohm; and h is 16 millimeters (mm);.

Step 8 : The length of the micro-strip feed line must be determined.

Free-space wavelength (λo):

λo = c / f

The first step in building a bow tie antenna is to create a basic patch antenna. To create the cone form, use a separate Boolean function. In the following part, we will describe the development of suggested design forms for cone shapes.

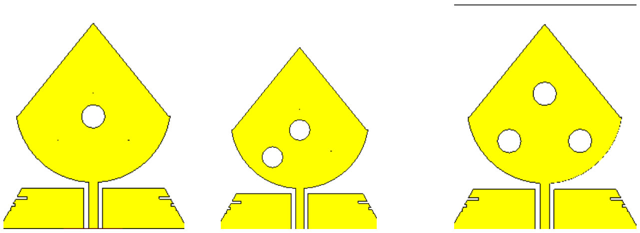


(a) Semi circle, (b) Right angle triangle, (c) CPW apply

Fig. 3.3 Second step patch antenna with a semi-circular form

After that In the next step design right angle triangle on the top of semi circle patch side using exclude function. Similar right angle triangle design on left hand side. Apply boolean addition the semi circle.

Step - 3 Circular Slot - In this step apply circular slot on patch shown in the below figure 3.4.



(a) Single circular slot (b) Double circular slot
(c)triple circular slot

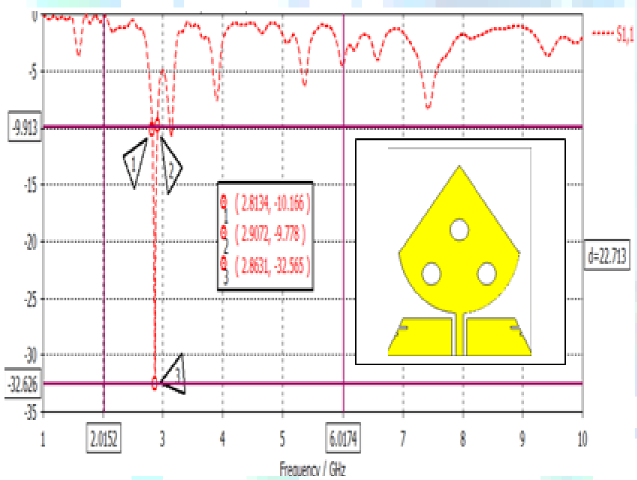
Fig. 3.4 Third step design Cone shape apply circular slot antenna

IV. SIMULATION RESULTS

A. Return Loss (S -11)

The signal's power loss is reflected as a result of the transmission line's discontinuity.

In the above figure 4.3, 4.4 and 4.5 shows different return loss of different proposed design. First design leaf shape in the figure 4.3 shows the basic leaf shape return loss (S-11). In the figure 4.4 shows the proposed design with single circular slot and its return loss (S-11). Similar that figure 4.5 (b) shows the return loss (S-11) loss of this design.



X axis the frequency range of the proposed work

Fig. 4.2 Return loss (S-11) of proposed antenna combined two bands

In the above figure 4.2 shows the complete result with all three bands. In the figure 4.2 shows the three different return loss (S-11) that is obtain in between range 1 to 6 GHz, it is the heart of RF and microwave. The S- parameter shows that RF energy propagate in multi-port network. In the above figure 4.2 shows that the resultant S- parameter of proposed antenna. In the proposed result figure X- axis shows the frequency range and Y axis shows the return loss in dB. The result shows there are three different bands in between 1 to 6 GHz. The S-11 of proposed antenna is obtain narrow band obtain resonate frequency, at 2.8 GHz obtain return loss is -32.565 dB.

Simple Leaf Shape

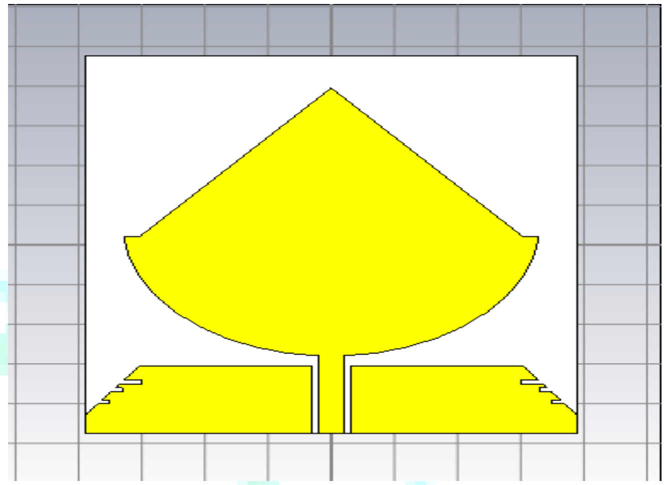
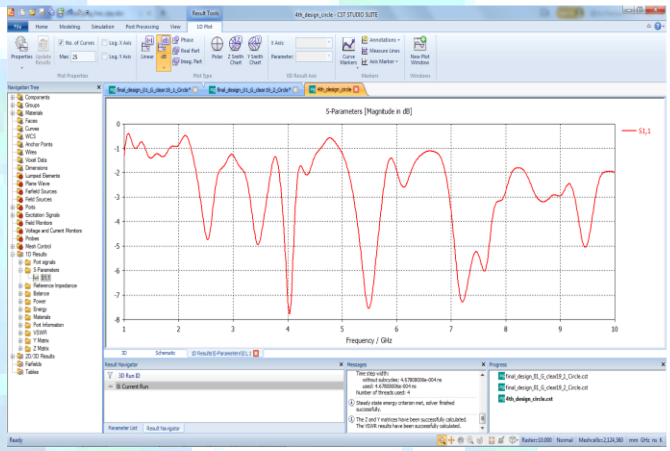


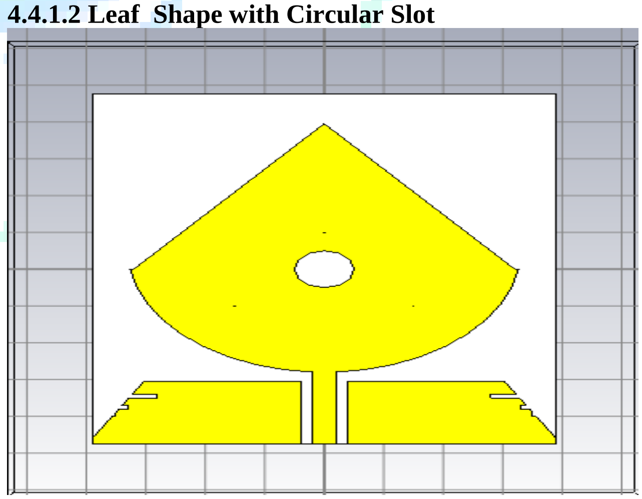
Fig. (a) Shows the basic Leaf shape design



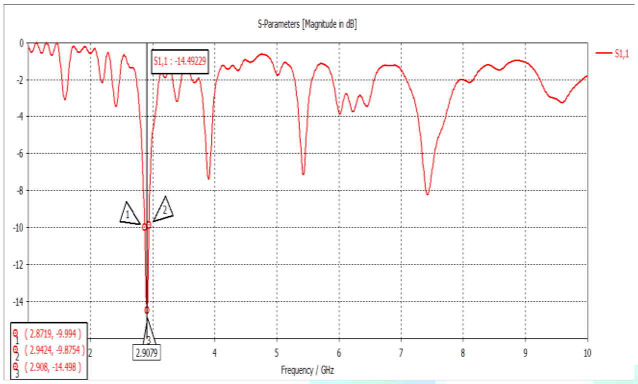
(b) Return loss (S-11) basic leaf shape design

Fig. 4.3 Basic Leaf Shape design and return Loss (S-11)

4.4.1.2 Leaf Shape with Circular Slot



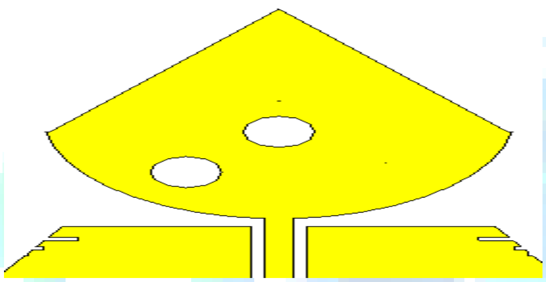
(a) Shows the Leaf shape with single circular slot geometry



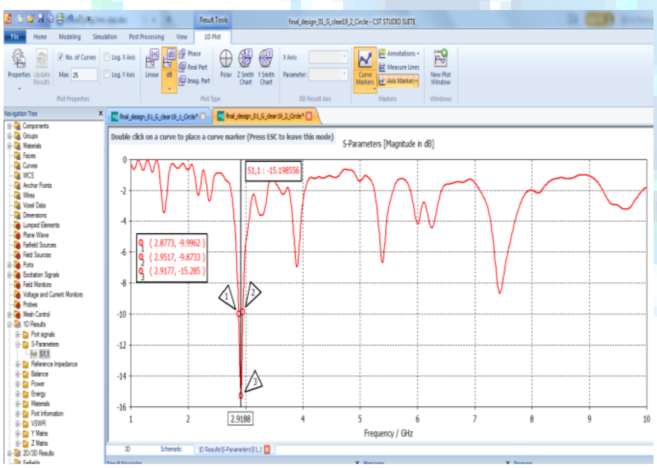
(b) Return loss (S-11) leaf shape with single circular slot

Fig. 4.4 Basic Leaf Shape design and return Loss (S-11)

Leaf Shape with double Circular Slot



(a) leaf shape with double circular slot



(b) . Return loss (S-11) leaf shape with double circular slot

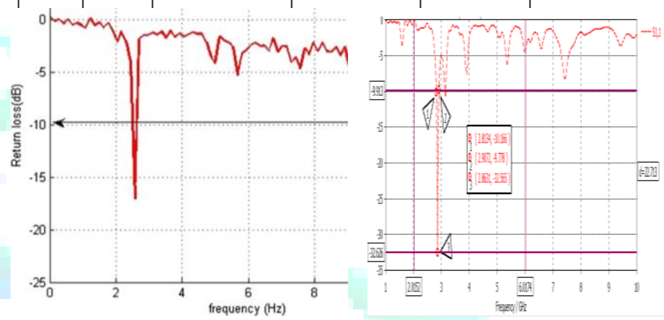
Fig. 4.5 Leaf Shape design with double circular slot design's return Loss (S-11)

C. Result Comparison

At the last compare our calculated results with other methods. That is shown in table 5.1. This table shows the compression on the basic parameters of antenna that is frequency range return losses and number of bands. Our proposed design shows better result as compare to other antenna.

Table 4.1 Comparison on Return Loss (S -11)

S. No Ref.	Year	Size of the antenna	Feed Technique	Range	S - Parameter
0	2022	78x95	CPW feed	1 to 6 GHz	**2.8 GHz return loss (S-11) -32.69**
[1]	2021	78x95	CPW feed	1 to 6 GHz	2.6 GHz return loss (S-11) - 17db



(a) Base Paper result [Springer -2021] (b) Proposed design S-11 result

Fig. 4.5 S-11 Compare of proposed antenna and springer 2021

In the above table 4.1 and figure 4.5 shows the comparison of proposed design with previous design on the basis of return loss (S-11).

V. CONCLUSION AND FUTURE WORK

In this research, an in-depth investigation of antennas utilised in wireless communication systems was undertaken. The reuten loss (S-11), VSWR, and other performance parameters reveal that the suggested cone-shape patch design works well. Cone-shaped antennas with circular slots are shown in this paper. On the basis of antenna characteristics such as VSWR, return loss (S-11), and isolation loss, the suggested design exhibits a better outcome than other prior methods. Wi-Fi frequencies between GHz may be covered by the suggested antenna, which has a limited bandwidth. Wireless fidelity and Wi-Max range are included in the suggested architecture. This shows that (S-11) -32.69dB return loss and (VSWR) 1.08 are also excellent results.

Since it's based on an FR-4 substrate, this design may be readily produced for commercial purposes. Designed for high power, RF efficiency, and OFDM/military use, this radio is also capable of transmitting across the band. For WLAN, WiMAX, and other wireless systems, antennas that are correctly scaled to the allowable frequency ranges may be built. The Microstrip antenna's small size and compatibility with microwave equipment provide the Microstrip antenna the right to be part of a contemporary communication system that is more precise, reliable, and high-performing in the future..

Future Work

Try to increase the design's gain and directivity in the future. In the future, we will use neural networks and other machine learning approaches to improve the current outcome. Long-distance wireless communication has been opened up by the proposed bow tie antenna.

This information was gleaned from antenna designs and is useful for future inquiry.

- In the future, construction and testing of four components will be conducted. Bow–tie MSA and MDA arrays will be tested.
- While designing MSAs with conformal patch feeding, an MDA array with dielectric image guide feeding may reduce metallic losses even more.

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