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The Camouflaged Microstrip Patch Antenna within Hibiscus Flower for Covert Communication

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ABSTRACT: The present scenario in the world of technology and communication demands for increased security and confidentiality of transmission. To cater to the rapid advancements and prevent unauthorized access, in this paper we have simulated a coaxial fed rectangular microstrip patch antenna using hibiscus flower as the substrate material. We have used this trumpet shaped hibiscus flower as it enhances the imperceptibility of an antenna within it, thereby obfuscating the transmission of any information. The task of simulation of this antenna was performed using Zeland IE3D software which is a design and verification platform that has an excellent accuracy in frequency domain applications. This study will provide with a different outlook in the domain of secret transmission in the near future.

KEYWORDS: Microstrip patch antenna, Hibiscus, Secrecy, Dielectric Constant, Future Prospect,

I .INTRODUCTION

Due to advancements in the design and miniaturization in electronics devices, microstrip patch antennas (MPA) find extensive and a wide variety of applications in mobile communications. The intrinsic constructions of such antennas are very simple including easy design, low cost of production, light weight and portability. [1] Microstrip antennas are employed at UHF and higher frequencies because the size of the antenna is directly tied to the wavelength at the resonant frequency. The antenna size and functions of microstrip patch antenna has overcome the constraints on compactness as well as frequency agility. All these salient features has led to their being the topic of large number of research papers inclusive of this too.

In this paper our prime focus is the utilization of Hibiscus, to incorporate this microstrip patch antenna within it thereby concealing the existence of an antenna within it. Hibiscus, also known as rose mallow is a flowering plant and a member of mallow family, Malvaceae.[2] Due to the abundance of this flower we can easily use it as our substrate material for the patch antenna. On one hand our primary goal through this paper is to depict the miniaturized levels of antenna size whereas on the other we have tried to use a peculiar entity i.e. a flower which effectively enhances the secrecy that ultimately can become an advantageous utility in the field of communication.

II. BASIC PATCH ANTENNA GEOMETRY

Microstrip patch antenna has three layers: (a) radiating patch, (b) a dielectric substrate, (c) ground plane. The patch and ground plane are conducting whereas the dielectric substrate is made of a insulating material. Any continuous shape is possible for microstrip antenna, but most common antenna shapes are square, rectangular.[3]

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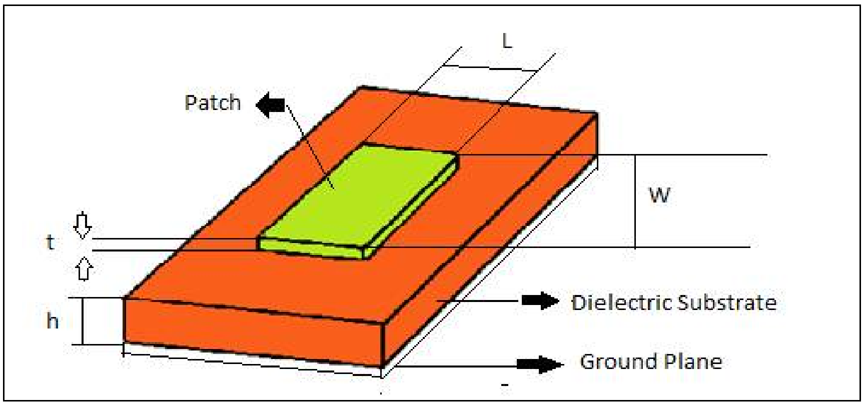

Fig .1 Patch Antenna

Fig.1 shows basic geometry of Microstrip patch antenna.

In Fig 1, the parameters are described as
L= Length of the microstrip patch element.
W=Width of the microstrip patch element.
t=thickness of the patch.
h=height of the dielectric substrate.

III.DESIGN METHODOLOGY

1. Design CRITERIA – Here the job is to simulate rectangular microstrip patch antenna using dielectric medium-Hibiscus (ε_r = 2.8) ,for that we have used Zeland IE3D antenna simulation software and we have simulated mainly the insertion loss of the designed antenna where we have concluded with the discussion of bandwidth of the designed antenna.[4]

1.1 Material Selection- Selection of appropriate dielectric material is an indispensable task for designing a patch antenna. Relative Dielectric Constant, Height of the substrate material and Loss Tangent were considered for the selection of appropriate dielectric material . Based on the above contemplation hibiscus with a dielectric constant of 2.8 and loss tangent 0.01 was selected as a dielectric material

1.2 Design Steps:

Step 1 - Calculation of Width (W):

$$W= \frac{c}{2f_r}\sqrt{\frac{2}{\varepsilon_r+1}}$$

Step 2 – Calculation of effective dielectric constant:

$$\varepsilon_{reff} = \frac{\varepsilon_r+1}{2} + \frac{\varepsilon_r-1}{2}\sqrt{[1 + 12\frac{h}{W}]}$$

Step 3 – Calculation of Effective Length (L_{eff})

$$L_{eff} = \frac{c}{2f_r\sqrt{\varepsilon_{reff}}}$$

Step 4 – Calculation of length extension (ΔL)

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

Step 5 – Calculation of actual length of patch (L)

$$L= L_{eff} - 2(\Delta L)$$

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Dimensions	Value
Width of the substrate(W)	21 mm
Length of the substrate(L)	9.7 mm
Thickness of substrate(h)	0.01
Relative dielectric constant(ε_r)	2.8
Resonant Frequency (f_r)	5 GHz
Loss Tangent	0.01

Table.1 Antenna parameters

Fig .2(a)

Fig.2(b)

Fig .2(a) and 2(b) describes practical view of our proposed job. It is clear from the the figures that similarly it can be implemented using any other flowers which enhances the future prospect of our proposed work.

IV.SIMULATION AND RESULT

<u>Result</u>

The proposed antenna design was simulated using Zeland IE3D software and the return loss was obtained.

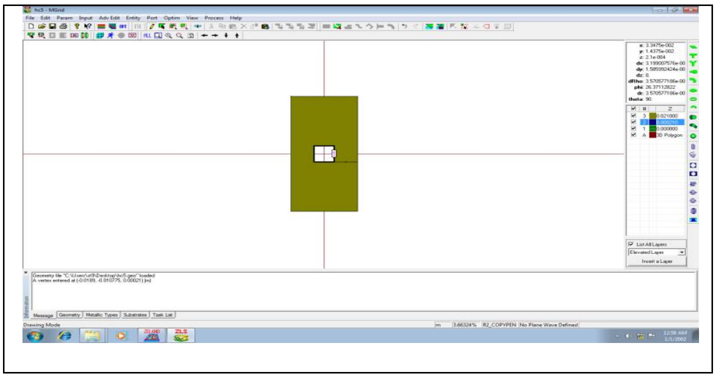

Fig .3(a) Patch design in IE3D Simulator

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Fig.3 (a) shows the design of the patch in Zeland IE3D software.

The above patch was simulated using the software to get optimized results and the return loss plot.

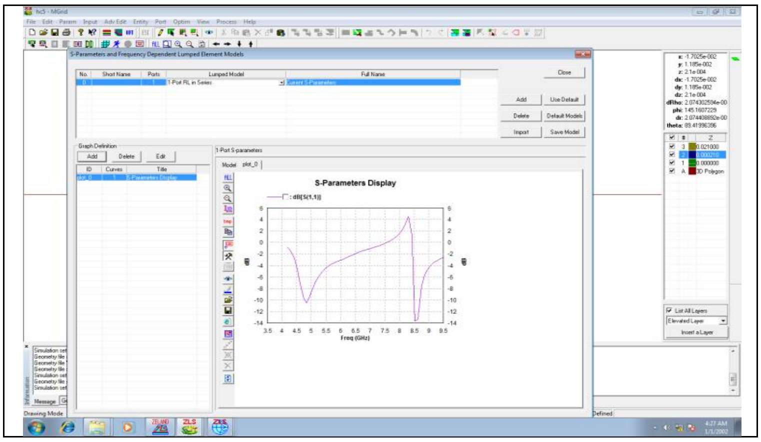

Fig .3(b) Return Loss Plot

Fig.3 (b) describes the return loss plot of simulated antenna.

From the above simulation we obtained two useful peaks at 4.7GHz and 8.5GHz which creates two bandwidth of approximately 0.4GHz and 0.25GHz with gain -11dB and -14dB respectively. It is advantageous to get two peaks which helps to operate on two different frequency range using single antenna. [5]

V.CONCLUSION

Our paper comprises of the entire overview of a microstrip patch antenna. Due to conformal and planar structure , high transmission efficiency, low cost and ease of integration, its application are diverse in portable communication equipments. Extensive research works has been performed to enhance the bandwidth, gain and reduced antenna size since the invention of antenna theory. Although antenna parameters such as substrate nature, resonance frequencies influences antenna radiation patterns , the main aim of our paper remains the hibiscus flower which augments the efficacy of secret communication. Novelty of this paper lies in the use of flowers as a medium for the objective of concealment of the transmitter. Furthermore, this can lead to new dimensions in the era of covert and secured communication in future.

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