SIMULATION OF S-SLOT RECTANGLE MICROSTRIP PATCH ANTENNA FOR WLAN APPLICATION

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ABSTRACT

This abstract gives a study on design and analysis of a '**S Shaped Slot Rectangle Micro-strip patch antenna**' for WLAN applications. Micro-strip antennas have been a standout amongst the most inventive points in reception apparatus hypothesis and outline lately and are progressively discovering application in an extensive variety of current microwave systems. Also, micro strip patch antennas have turned into the most loved of antenna creators on account of its adaptability and preferences of planar profile, simplicity of manufacture, similarity with incorporated circuit innovation, and likeness with a formed surface. This paper presents the simulated results of the proposed antenna. The rectangle patch with S slot design is made on FR-4 Epoxy material used as a dielectric material with its dielectric constant (ε_r) 4.4 and thickness is 1.6mm. The designed antenna has a resonating frequency of 2.4 GHz which is applicable to Wireless Local Area Network (WLAN).

Keywords - *Rectangle patches Micro Strip Antenna, High Frequency Structure Simulator (HFSS), WLAN.*

1. INTRODUCTION

Micro strip antenna was first introduced in the 1950s. However, the technology of Printed Circuit Board (PCB) was later introduced in 1970s.Therefore, from that time MSA had become a very common antenna having wide range of applications due to their advantages light weight, low profile, low cost, planar configuration and many more. MSAs are widely used in Radio-Frequency Identification (RFID), Broadcast radio, mobile systems, Global Positioning System (GPS), satellite communication, television systems, multiple-input multiple output (MIMO) systems, vehicle collision avoidance system, surveillance system, direction founding, radar systems, remote sensing, missile guidance, and so on. Because of micro strip patch antenna's many unique and attractive properties, there seems to be little doubt that it will continue to find many applications in the future. Its properties include, light weight, low profile, easy fabrication, compact and conformability to mounting structure. In this design, we are concentrating on rectangular microstrip patch antenna which consists of rectangular patch of length [L1] and width [W2] of the patch. The proposed antenna works on the wireless local area network (WLAN) frequency of 2.4GHz (2400-2484MHz) for WLAN applications. The Substrate material used is FR-4 Epoxy which has permittivity i.e., its dielectric constant $\varepsilon r = 4.4$ which lies in the specified range of $2 <= \varepsilon r <= 12$.

2. LITERATURE SURVEY

Antenna is one of the important elements in the RF system for receiving transmitting signals from and into the air as medium. Without proper design of the antenna, the signal generated by the RF system will not be transmitted and no information or signal can be received at the receiver. Antenna design is an active field in communication for future development. Many types of antennae have been designed to suit with most devices. One of the types of antennae is the micro-strip patch antenna (MPA). The microstrip antenna has been said to be the most innovative area in the antenna engineering with its low material cost and easy to fabricate which the process can be made inside universities or research institute. The concept of microstrip antenna with conducting patch on a ground plane separated by dielectric substrate was undeveloped until the revolution in electronic circuit miniaturization and large-scale integration in 1970. In this paper asymmetric S- slot on lower patch and a rectangular slot on upper patch is presented. A microstrip S shaped patch antenna has been proposed for wireless application. S slotted rectangular microstrip patch antenna has been proposed for wireless system and RF application.

3. METHODOLOGY

The software part of our project revolved around determination of the radiation pattern, return loss curve and VSWR of simple rectangular patch.

Step:1 Start of HFSS :

Go to "Start" button on the lower left corner of your screen, click on it, then go to "Programs" button and a list of programs will pop up. Go to "Ansoft<< HFSS 12.0<< Electronic shop". A new window will pop up as shown below.

Step 2: Insert an HFSS design :
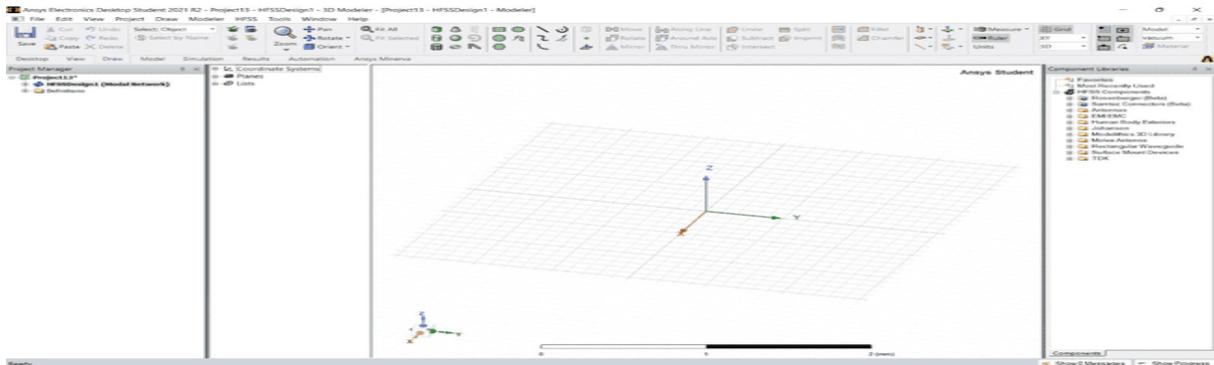
Click on the HFSS ion to view the 3D view with the rectangular coordinate system to design the designed microstrip antenna.

Step 3: Assigning Ground Plane :

Click on the Draw<Rectangle to create a ground plane with the dimensions calculated using theoretical equations. The position of the ground plane is (0,0,0), with L_g= 70 mm, W_g=70 mm.
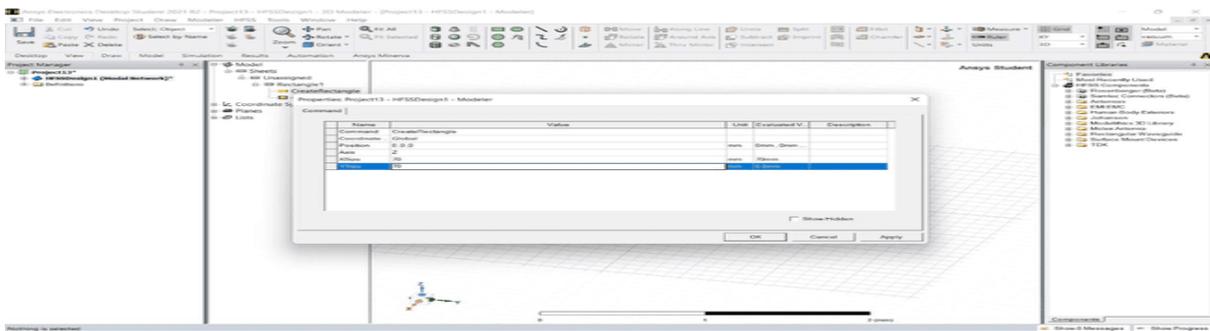
Step 4: Creating A Defective Structure Of FR-4 Epoxy Dielectric Material:
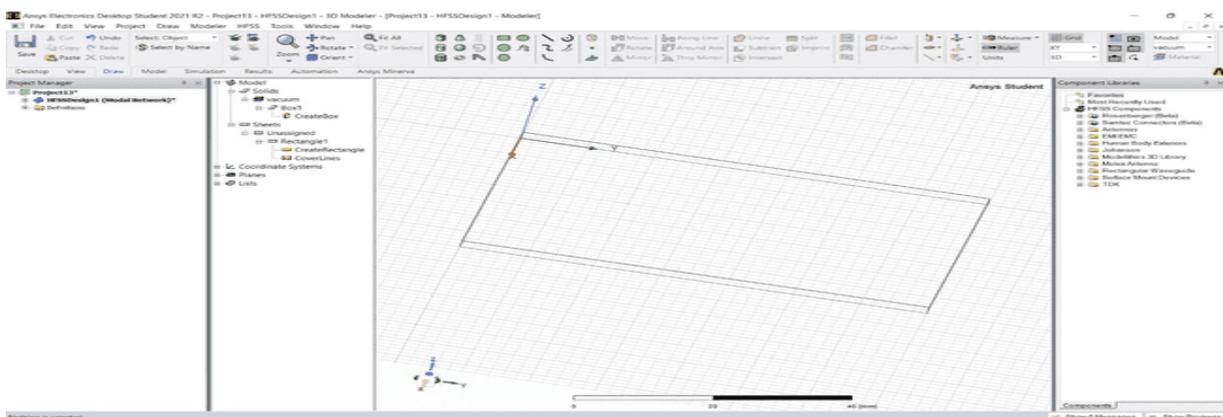
Step 5: Creating a Substrate and Applying Properties:

Click on the Draw<Box to create the substrate and apply properties of the substrate as FR4 and the length and width are given as 70mm and 70mm respectively and the position of the ground plane is (70,70,0).
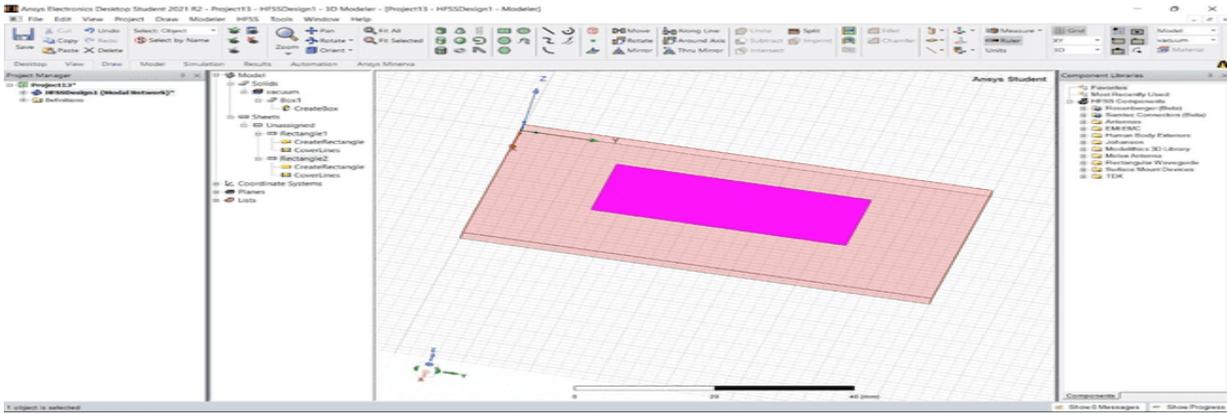
Step 6: Unite and Subtraction operations S shaped slot:

Now the designed S shape should be united and the it should be subtracted from the ground plane to from the defective ground structure.
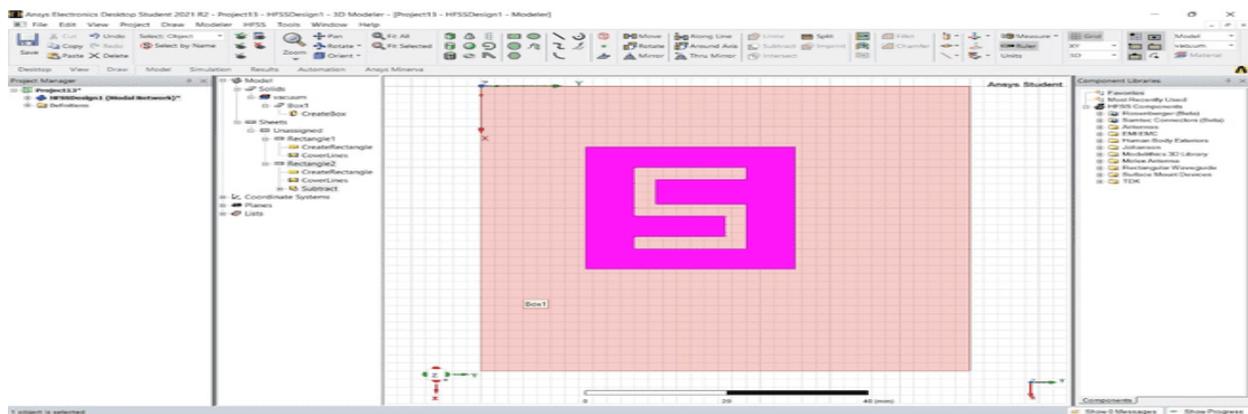
Step 7: Create Feeding line :

The feeding technique used is microstrip line feeding. Draw<rectangle to create the line-feeding. The width of the feed is 3mm because we are using FR-4 epoxy dielectric.
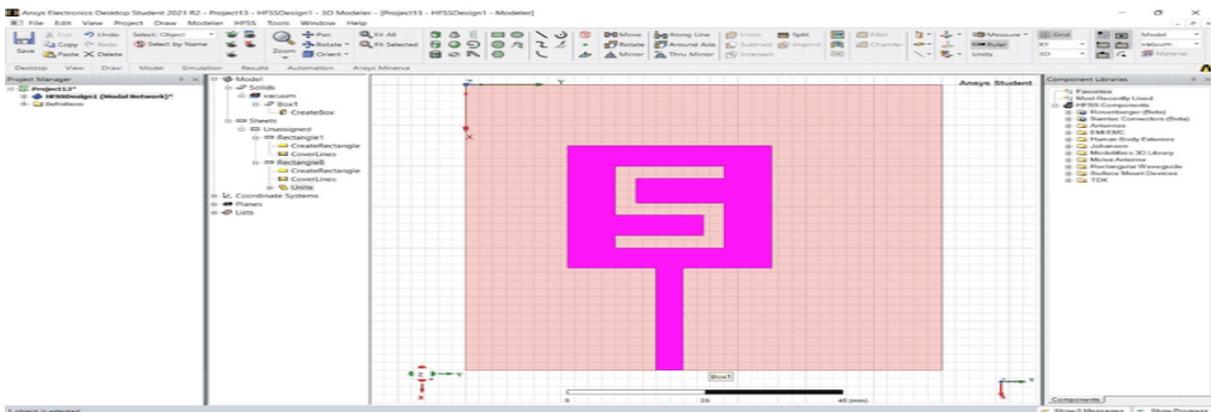
Step 8: Create a port:

Now change the plane to YZ to create the port to feed the signal.
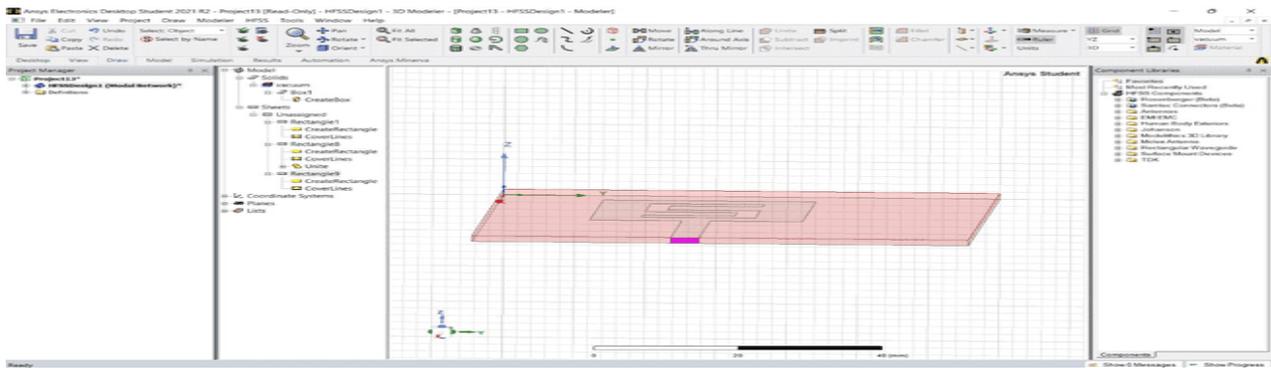
Step 9: Giving Excitation of 50ohms from ground to patch :

Select the port<assign boundaries<lumped port to the port crated. Also select the ground plane<assign exaction< perfect E. click on finish.
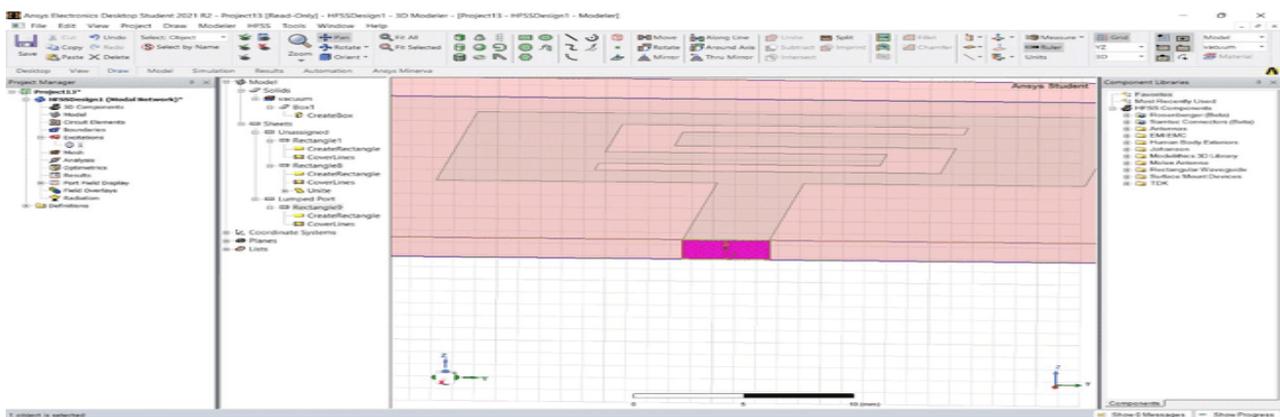
Step 10: Creating A Radiation Box:

After completion of excitation of radiation box to create the radiation environment

The dimensions of radiation box are:

POSITION: (-40, -45, -20)

X: 140 mm

Y: 140 mm

Z: 40 mm

Step 11: Analysis Setup :

To create an analysis setup, select the menu item HFSS > Analysis Setup > Add>Solution Setup. In the Solution Setup window, click the general tab, Solution frequency is 2.4 GHz. Click the Advanced tab, make sure that Lambda Refinement is checked. Click OK button.

Step 12: Add Frequency Sweep:

To add a frequency sweep, select the menu item HFSS > Analysis Setup > Add Sweep. Select Solution Setup: Setup1. Click OK button. Then Edit Sweep Window. Sweep Type: Fast, Frequency Setup Type: Linear Count, Start: 1 GHz, Stop: 3 GHz, Count: 20. Click OK button.
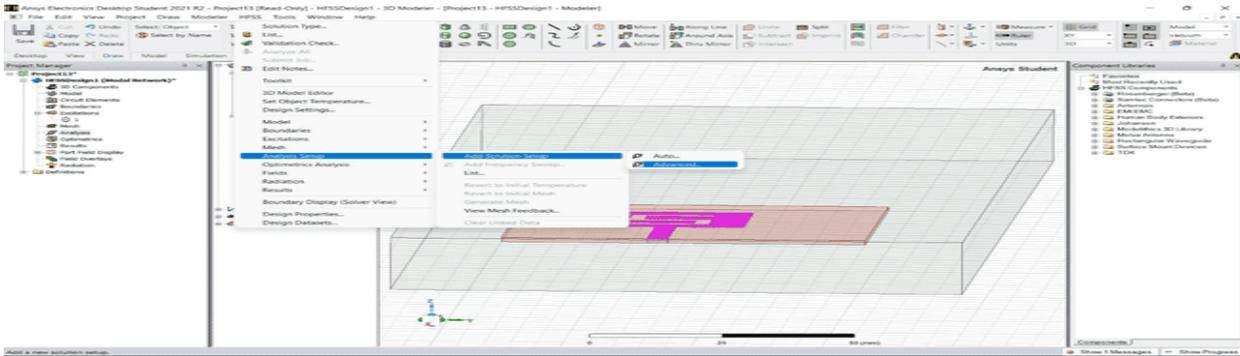
Step 13: Model Validation :

To validate the model, select the menu HFSS > Validation Check. Click the Close button. To view any errors or warnings messages, use the Message Manager. To Zoom Out to fit, click CTRL+D.

Step 14: Save The Project :
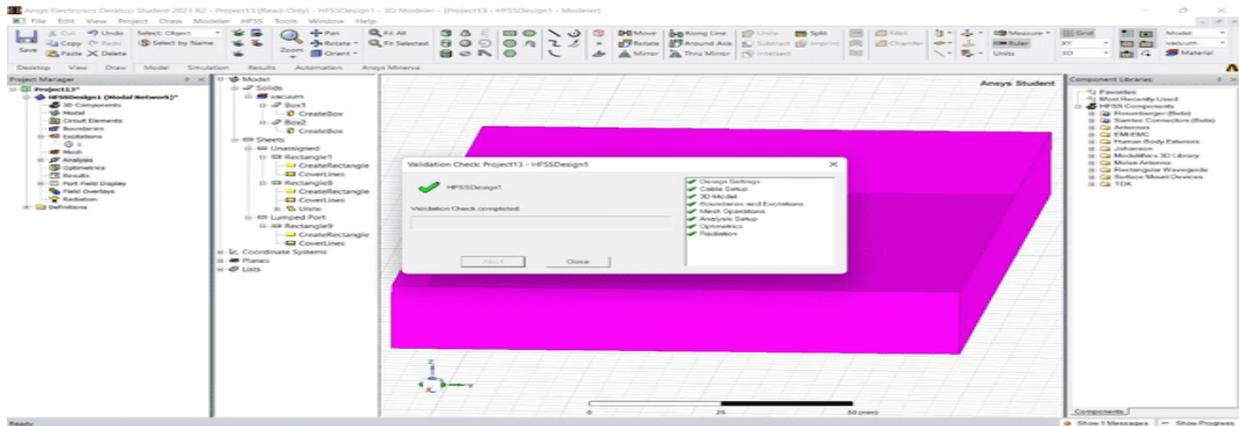
To save the project, in the soft HFSS window, select the menu item File > Save As. From the Save As window, type the file name you want. Click Save button.

Step 15: Analyze :

To start the solution process, select the menu item HFSS > Analyze.

Step 16: Solution Data :

To view the Profile/Convergence/Matrix Data, select the menu item HFSS > Results >Solution Data Note: The Solution Data window can be also displayed by right-click on the Setup1 under analysis on the HFSS design tree. Note also that the default view is Profile. Select the Convergence tab first, and then Plot radio button to view a graphical representation of the convergence data. Click Close button.

Step 17: Viewing the results:

The window which is shown below represents how to see the results.
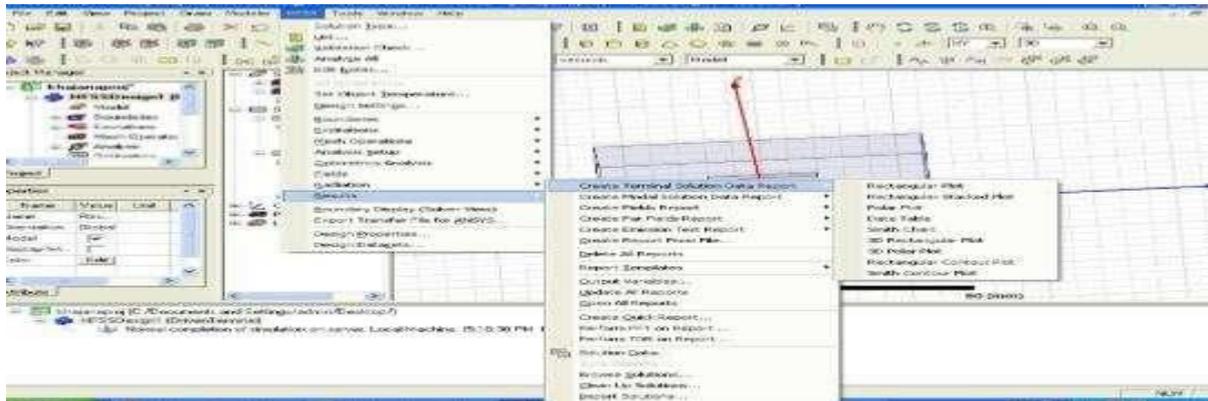
Create Modal S-Parameter Plot versus Frequency :

Create a report, select the menu item HFSS > Results > Create Report. Set Report Type to Modal S Parameters, Display Type to Rectangular then click OK button. In the Traces Window, set Solution to Setup1: Adaptive1. In the Y tab, set Category to S Parameter, Quantity to S (wave port), and Function to dB and click Add Trace button. Click done button. Note that you can create any type of report it all depends on what you want to analyse specifically.

Step 18: Create report for VSWR :

Create a report, select the menu item HFSS > Results > Create Report. Set Report Type to VSWR Display Type to Rectangular then click OK button. In the Traces Window, set Solution to Setup1: Adaptive1. In the Y tab, set Category to S Parameter, Quantity to S (wave port), and Function to dB and click Add Trace button. Click done button. Note that you can create any type of report it all depends on what you want to analyse specifically.

Step 19: Radiation Pattern

Create infinite sphere. Then go to HFSS< Results< Create Report. When the new window pops up change the Report Type to Far Field and Display type to 3D Polar Plot. Click Add Trace then Ok.

4.   RESULTS

Stimulated Results: Stimulated results of S shape microstrip antenna. The proposed S shape antenna is simulated in Ansoft HFSS v12 software and the results obtained are shown below.

1. The below Figure shows the return loss characteristics of S shape antenna using HFSS software. In these above characteristics the frequency of operating is 2.4000 GHZ and the return loss is -19.3837.
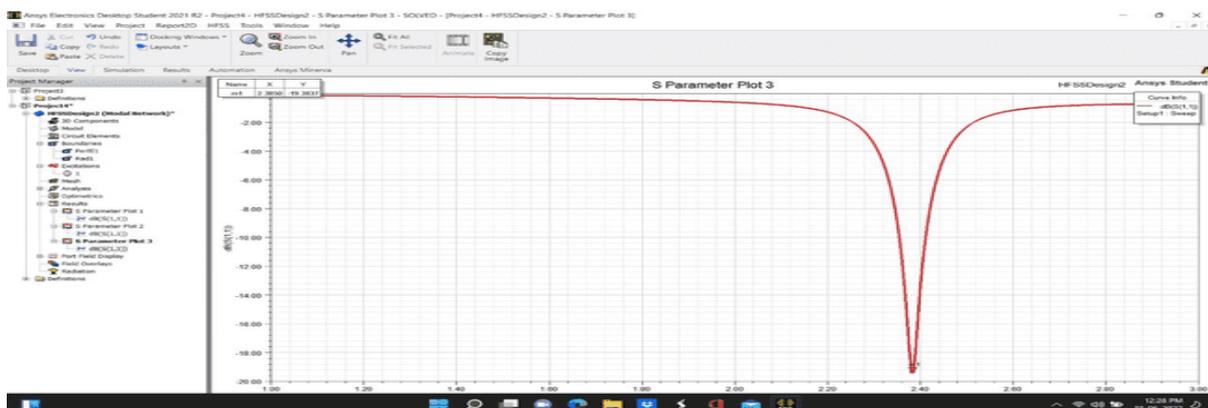
Fig 4.1: Simulated Return loss characteristics (in Ansoft HFSSv12)

2. The below figure shows the Frequency vs Gain with S- slot using HFSS software. The Gain of S shape antenna is 4.6866 at 2.4000 GHz.
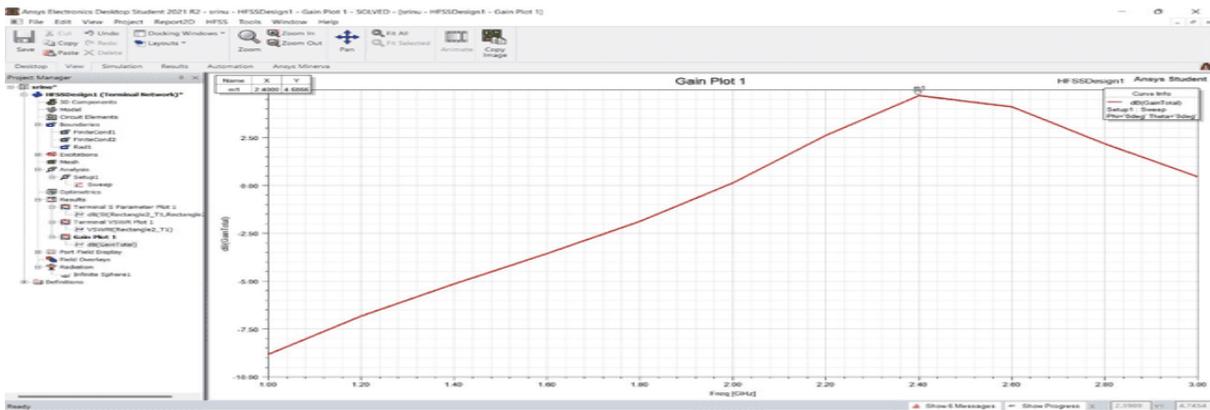
Fig 4.2: Frequency vs Gain Curve (in Ansoft HFSSv12)

3. The below figure shows the VSWR characteristics with S - slot using HFSS software at 2.4000 GHz
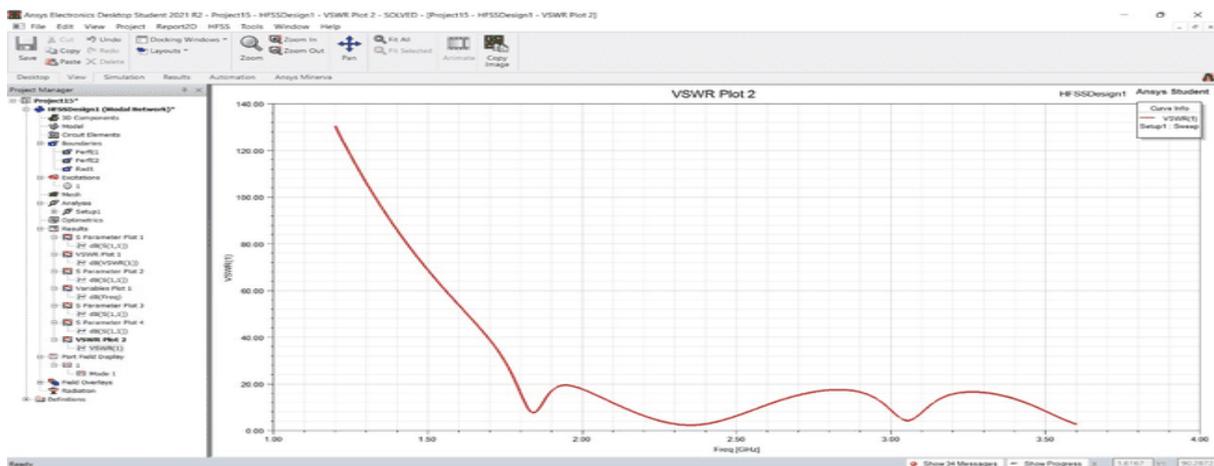
Fig 4.3: Simulated VSWR characteristics (in Ansoft HFSSv12)

4. The below figure shows the radiation pattern with S - slot using HFSS software.
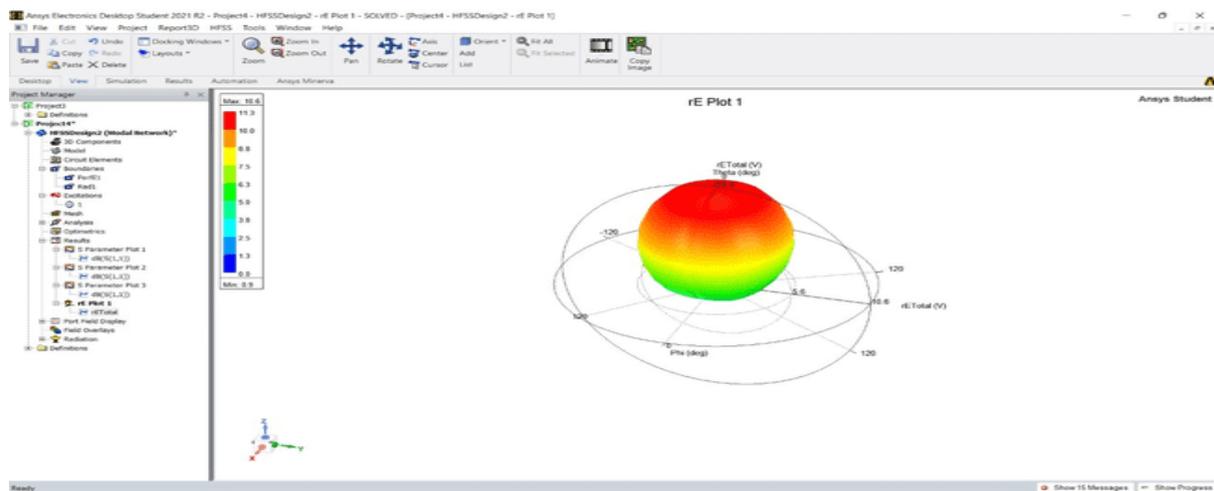
Fig 4.4: Simulated Radiation Pattern (in Ansoft HFSSv12)

5. The below figure shows radiation pattern at Pi = 0 degrees with S - slot using HFSS software.
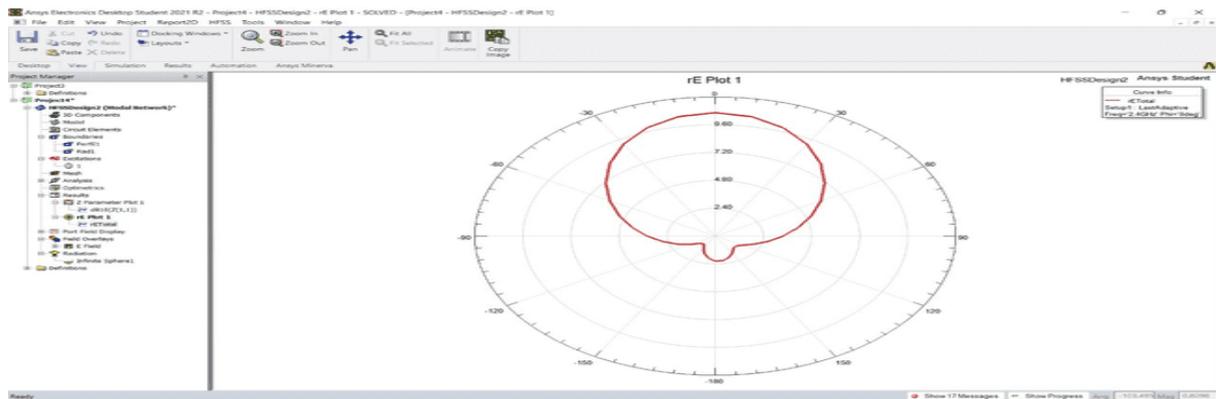
Fig 4.5: Radiation Pattern at $\emptyset = 0^0$ (0 Degrees)

6. The below figure shows radiation pattern at Pi = 90 degrees with S - slot using HFSS software.
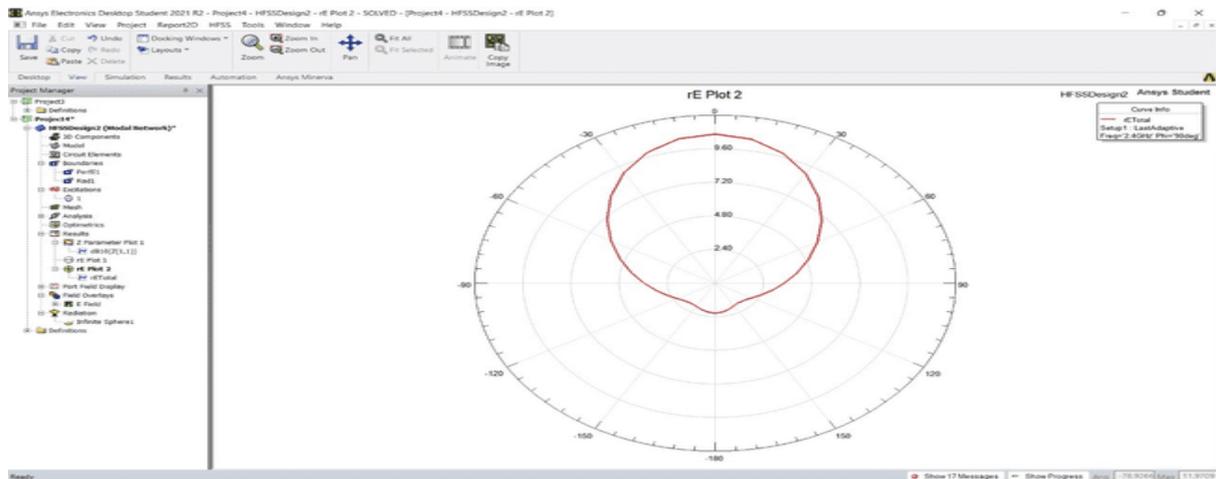
Fig 4.6: Radiation Pattern at $\emptyset = 90^0$ (90 Degrees)

5.   CONCLUSION

It is understood that many efforts are going on to overcome some of the limitations of conventional microstrip antenna characteristics. A theoretical survey on microstrip patch antenna is presented in this project. After study of various research papers, it concluded that Lower gain and low power handling capacity can be overcome through an array configuration and slotted patch. Some characteristics of feeding technique and various antenna parameters are discussed. Particular microstrip patch antenna can be designed for each application and different merits are compared with conventional microwave antenna. Here, A Finite Ground plane monopole antenna covering WLAN bands is proposed. The various parameters of the proposed antenna are optimized through simulation. Prototype of the proposed antenna has been designed, simulated in Ansoft HFSSv12 software. Antenna is tested return loss bandwidths observed in Software is resonating at 2.4 GHZ GHz with the improvement of return loss.

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