DESIGN AND ANALYSIS OF A PATCH ANTENNA FOR BLUETOOTH APPLICATION

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Abstract

This paper analyzes the patch antenna for Bluetooth application. After analyzing its various parameters the proposed design is created using simulator software HFSS. The parameters considered for the presented design are the gain, radiation pattern, VSWR, and directivity. Through simulation results it was inferred that the design is optimum and the parameters are calculated.

Keywords: *Patch Antenna, Bluetooth, Gain, Radiation Pattern, VSWR, Directivity.*

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1. INTRODUCTION

Patch antenna is a type of radio antenna; it can be mounted on a flat surface usually rectangular surface. The rectangular sheet can also be referred as patch of metals. To mount this, the large ground surface is required which is called ground plane. The combination is usually placed inside a plastic housing. This protects the antenna from certain damages. The major advantages of patch antenna are its ease in modification, customization and fabrication. In this paper the Bluetooth application has been chosen for the analysis of its various parameters which includes the gain, radiation pattern, VSWR, and directivity; there may be many other parameters for analysis but author is focused some important characteristic of patch antenna. As the frequency of Bluetooth ranges from 2.4 GHz to 2.458 GHz hence the analysis is carried out in the respective frequency range only.

2. DESIGN PROCEDURE

The proposed antenna is designed using FR-4_epoxy material; the substrate with this is drawn by taking the geometry of 12mm x 9mm (Length and Width) with z dimension as 0.32mm. The relative permittivity is 4.4 and permeability is of the order of 1. There are two sheets are used in the presented design viz. lumped port and perfect_E, further the lumped port includes the source terminal with the parameters of 0.495 with y-plane and 0.16 with z-plane. The perfect_E is further divided into three parts which includes feed, ground and the patch terminals. In the feed terminal the orientation is taken as z-axis with 2.5mm. The ground is characterized as 12mm x 9mm with again z-axis orientation. And finally the patch is given dimension as 7mm x 2mm with z-axis. The following figure-1 and 2 shows the basic design of the proposed antenna.

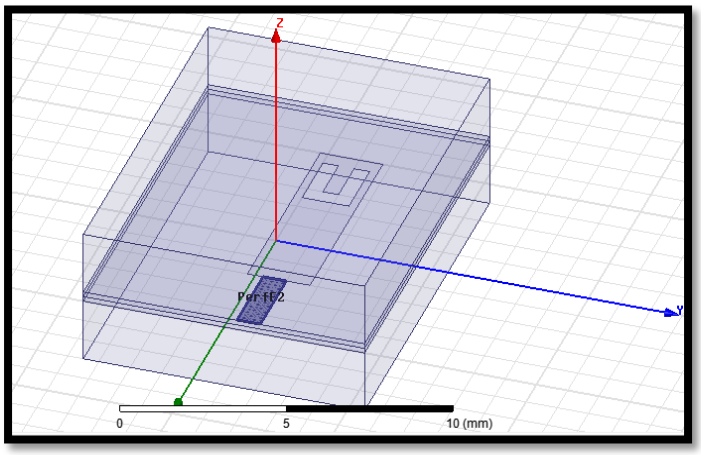


Fig-1 Proposed patch antenna with feed

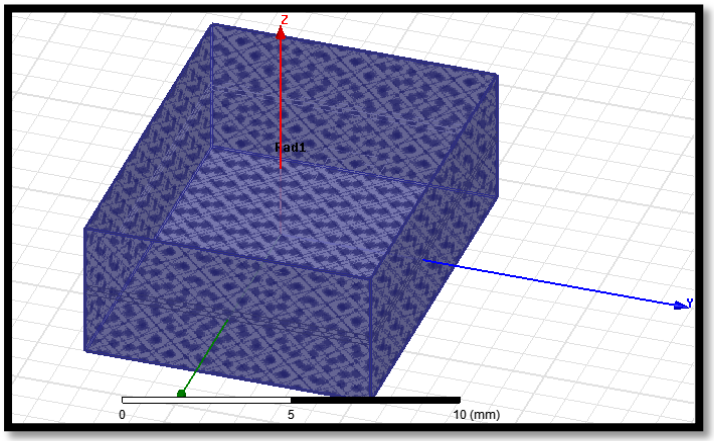


Fig-2 Air boundaries of the antenna

3. SIMULATION RESULTS

The Antenna gain is usually defined as the ratio of the power produced by the antenna from a far-field source on the antenna's beam axis to the power produced by a hypothetical lossless isotropic antenna, which is equally sensitive to signals from all directions. Usually, this ratio is expressed in decibels, and these units are referred to as "decibels-isotropic" (dBi). The following figure-3 shows the antenna gain with setup-1 Last Adaptive parameter and the frequency at Φ = 0 and Φ = 90 degree.

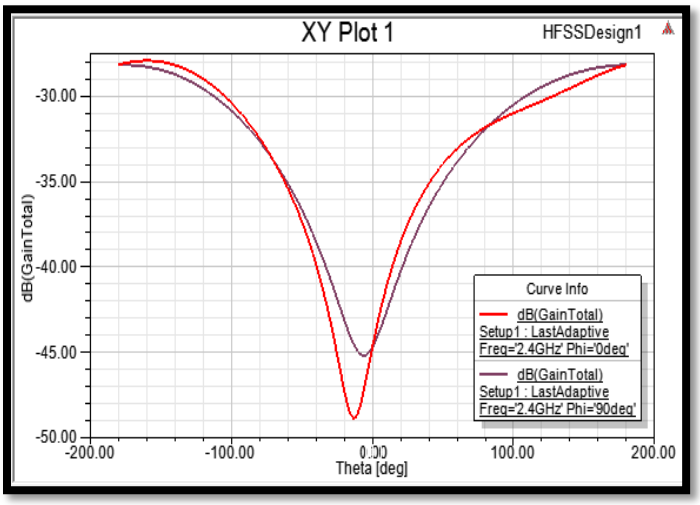


Fig-3 Antenna gain as rectangular plot

The fast sweep type is used and the frequency setup is chosen to be linear count, furthermore the maximum solution is given as 250 with 0.5% of error tolerance. The radiation plot of antenna gain is shown below in figure-4 as 3D-rectangular plot.

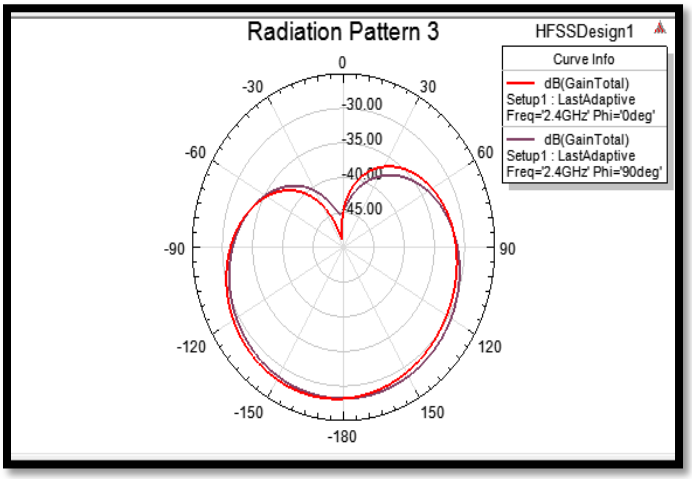


Fig-4 Antenna gain as 3D-Radiation plot

The 3D polar plot of antenna gain is shown in figure-5 and 6 here also the solution setup is last adaptive and the geometry is infinite sphere, the primary sweep is phi and the secondary sweep is theta the magnitude of db (Total Gain) is measured and the real plot report is obtained.

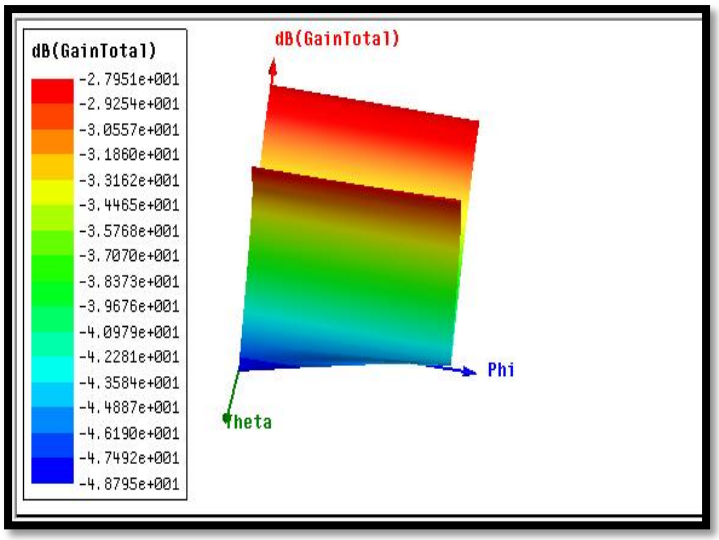


Fig-5 Antenna Gain as 3D polar plot - 1.

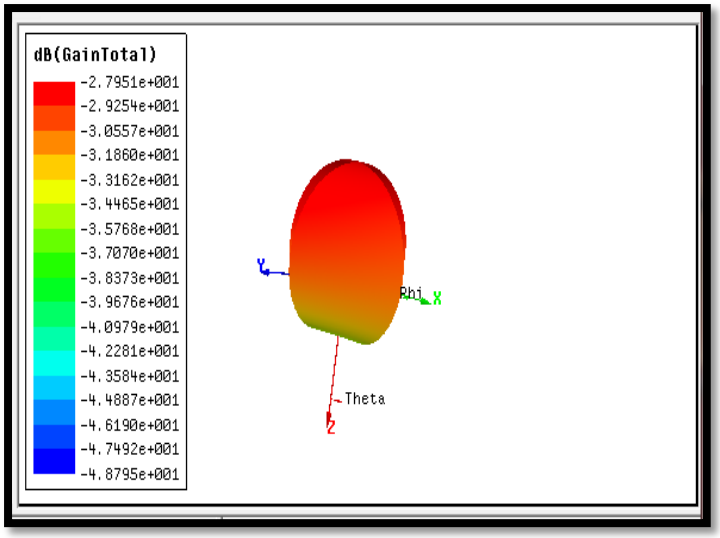


Fig-6 Antenna Gain as 3D polar plot – 2.

Now the parameter considered for the simulation is directivity. Directivity is a figure of merit for an antenna. It measures the power density the antenna radiates in the direction of its strongest emission, versus the power density radiated by an ideal isotropic radiator (which emits uniformly in all directions) radiating the same total power. The following figures- 7 and 8 show the various simulated representation of directivity.

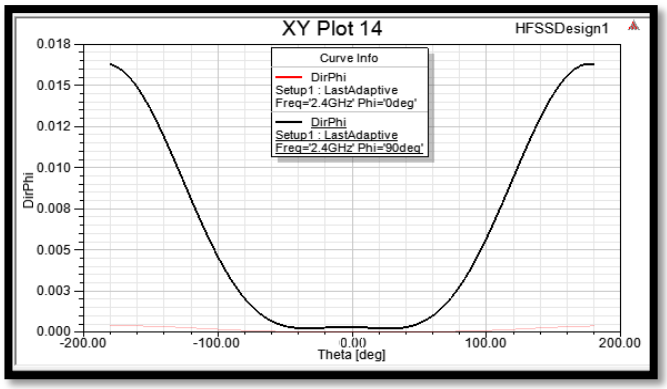


Fig-7 Antenna directivity in rectangular plot

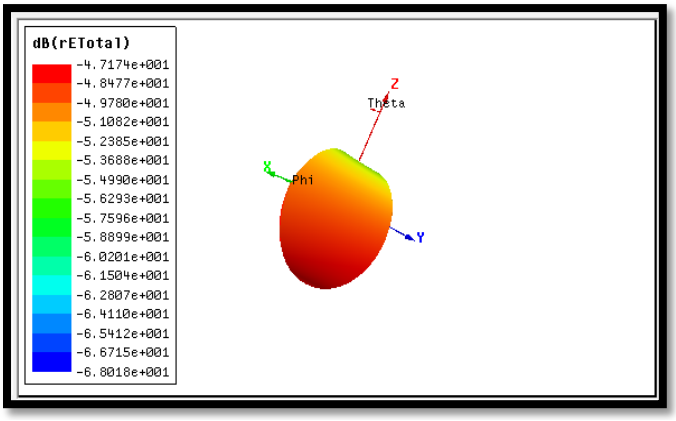


Fig-8 Antenna directivity in 3D-polar plane

The next parameter for consideration is the VSWR. Voltage Standing wave ratio (VSWR) is the ratio of the amplitude of a partial standing wave at an antinode (maximum) to the amplitude at an adjacent node(minimum), in an electrical transmission line. The figure-9 shown below is for VSWR measurement.

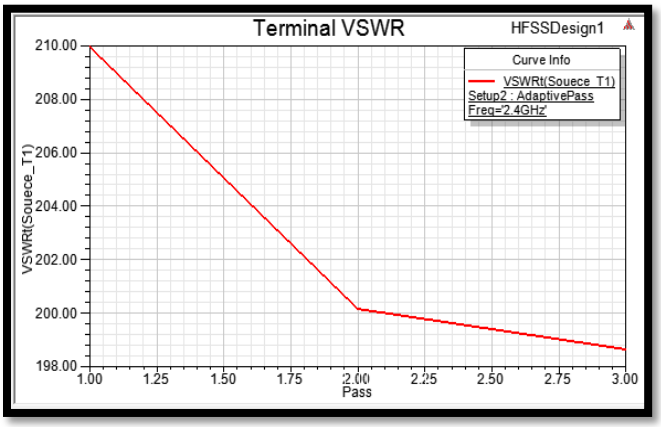


Fig- 9 Terminal VSWR of proposed antenna

The terminal S-parameter and the smith chart of the proposed antenna are shown in figure-10, 11, and 12 respectively.

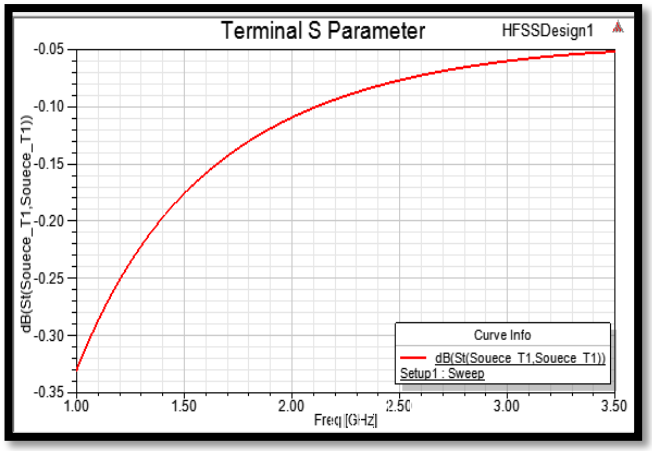


Fig-10 Terminal S-parameter with sweep type

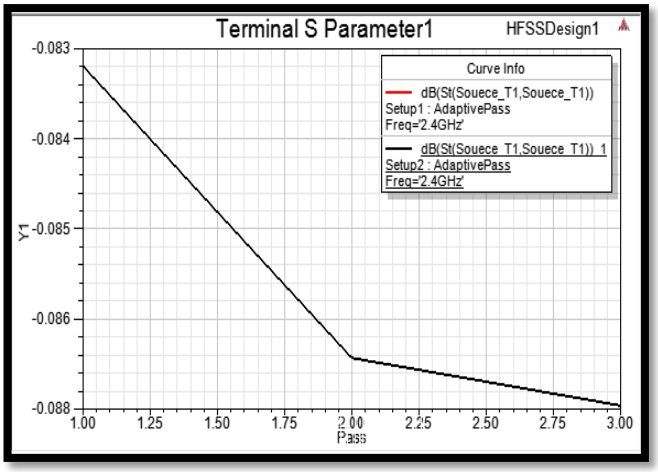
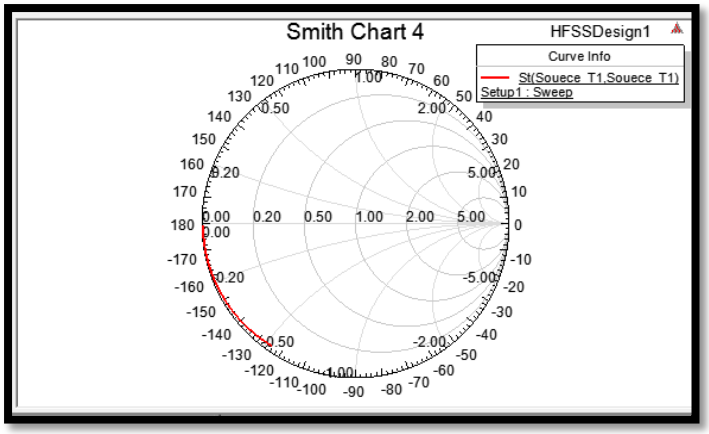


Fig-11 Terminal S-parameters with adaptive type



Fig– 12 Smith chart of proposed antenna

The convergence of the proposed antenna by solving the interpolating type sweep-1 with fast adaptive setup as port P1 is represented in figure-13 as shown below. After analyzing the plot it is clear that the proposed antenna converged appropriately for the specified values and parameters.

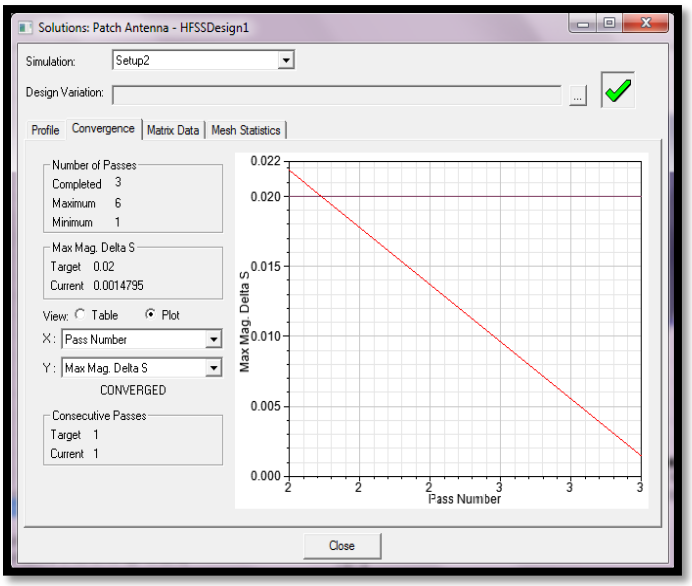


Fig-13 Convergence of proposed antenna

The antenna and its other far field quantities viz. radiation patterns are analyzed and the obtained simulation results are shown below in figure-14 and 15.

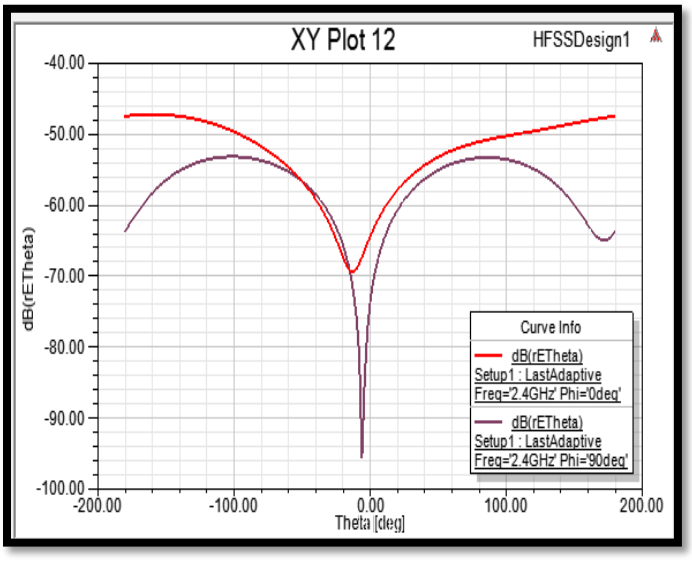


Fig-14 Antenna rE(theta) in rectangular plot

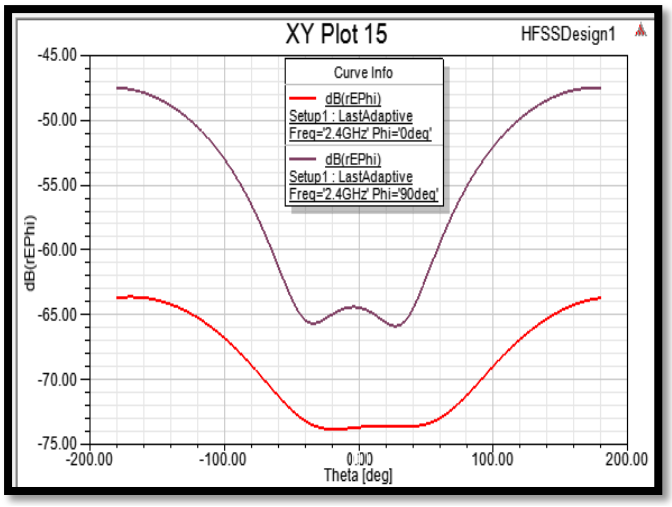


Fig-15 Antenna rE(phi) in rectangular plot.

4. CONCLUSIONS

In this paper the novel design of microstrip antenna is proposed. The parameters of analysis were the gain, VSWR, directivity, and the radiation pattern. The values can be easily seen from the respective plot. After analyzing the simulation results it was concluded that the optimized and improved results were obtained. And since the frequency chosen in this design was 2.4 GHz hence this design is appropriate for the Bluetooth application.

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BIOGRAPHIES

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