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DESIGN AND PERFORMANCE ANALYSIS OF RE-CONFIGURABLE MICRO STRIP PATCH ANTENNA FOR HEALTH CARE APPLICATIONS

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Abstract: ***This paper presents wearable re-configurable strip antenna options in health care applications. Designs of re-configurable wearable antennas for personal wireless body area network devices operating in the industrial, scientific, and medical (ISM) band at 2.4GHz.Antenna is able to switch between 1.38 GHz to 3.24 GHz centred at 2.4 GHz.The re-configurability of design is realized by utilizing a different mechanism. The Dielectric substrate material using in the proposed wearable re-configurable strip antenna is FR-4 Epoxy with dielectric constant 4.4.This antenna consists of a circular patch with an S-shaped slot in the substrate.Two PIN diodes are mounted on the S-shaped slot to achieve reconfiguration.The proposed antenna might have potential applications in future health care multifunctional personal wireless systems.***

Keywords: ANSYS HFSS, Gain, Micro strip patch antenna, PIN Diode, Return Loss.

I. INTRODUCTION

Recently, there has been growing research interest and development in personal wireless body area network which is any communication on, within or around the human body utilizing wireless technology. It covers a wide range of newly rising applications such as personal health care, personal entertainments, sportive activities, identification systems, military, and so on. This technology has the potential to user in a new generation of seamless information exchanges between individuals and machines.

The growth in this domain can be attained by improving the performance and quality of antenna. By taking this into consideration, the various needs of upcoming technology can be satisfied by applying antenna that has the capacity to work for multiple systems at particular instant. Thus, re-configurable antennas are introduced. Re-configurable antennas can provide diverse functions in Frequency, Polarization, pattern configuration which gains considerable attention in recent technology. Re-configurable antenna has some smart advantages such as multi-band function, steerable radiation pattern, and polarization diversity which leads to reduced size, less complexity , reduced cost of antenna and improvement in the total performance of entire system. For reconfiguration to be achieved active elements such as PIN diode, RF MEMS, var-actor diode can be used as Switching elements to attain re-configurability.

In this work, antenna with single reconfiguration feature is applied. For reconfiguration to be obtained the diodes are placed in between patches of different shape. The diode is activated through the switching condition. PN junction diode is a semiconductor diode that operates such that when the input current is applied it converts the incoming Alternating Current to Direct Current and it can flow in a particular direction. Two diodes are implemented in this design and under 4 switching conditions such as making the diode to ON and OFF reconfiguration is attained. In ON state the diode is in forward bias and alternately it is in reverse bias under OFF condition. The frequency range obtained ranges from 1.38 GHz to 3.24GHz.

The simulated return loss value obtained is of optimum level. The various gain of antenna is obtained in simulation. The analysis of the antenna is done in ANSYS HFSS software.

II. RECONFIGURABLE ANTENNA

An antenna which has multifunctional characteristics is claimed to be re-configurable antenna .This is usually achieved by functions on the characteristic or parameter of antenna. Application of re-configurable antenna is widely appreciated in present personal wireless body area network field. The achievement of re-configurability is done by using active elements such as PIN diode, Var-actor Diode and RF MEMS. The deigning of this antenna has many advantages like reduced size, multifunctional capabilities.

A. Pin Diode:

Diode can conduct electricity in only one direction. It can act as rectifiers, signal modulators and DE-modulators, switches and oscillators by development of semiconductor switches, re-configurable antennas are fabricated using PIN diode. The benefits of using this element are they have less insertion loss, switching speed is high , small size and low cost. Thus, it can be easily fabricated on the surface of antenna and might be switched to achieve frequency re-configurability. The switching condition can be applied to the diode to attain required reconfiguration.

III. DESIGN OF RECONFIGURABLE MICROSTRIP PATCH ANTENNA

The proposed wearable re-configurable strip antenna is designed with circular patch with an S-shaped slot in the substrate. The design is excited with 2.4GHz of frequency basically. The dimension of the substrate is 36x66mm. The geometry of the patch is adjusted according to the substrate.The material used for substrate is FR4-epoxy.This has 4.4 as dielectric constant.The substrate has thickness of 1.6 mm. The material can be easily available for fabrication and has advantages when compared to other material. Ground is applied less for better performance of antenna. The current flows from the patch to the substrate. The patch and substrate connects through fringing fields. In between the patches PIN diode is placed. Two diodes D1, D2 are placed at different places. Diode dimension is 1.0 x 0.91 mm.

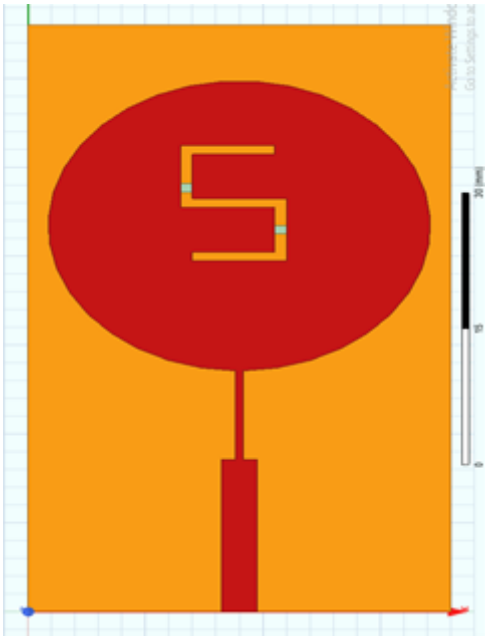

Fig. 1 Top view of antenna.

IV. ANTENNA DESIGNED IN HFSS

The simulated results of re-configurable micro-strip patch antenna created by ANSYS HFSS (High Frequency Structure Simulator software) is shown on Fig. 2

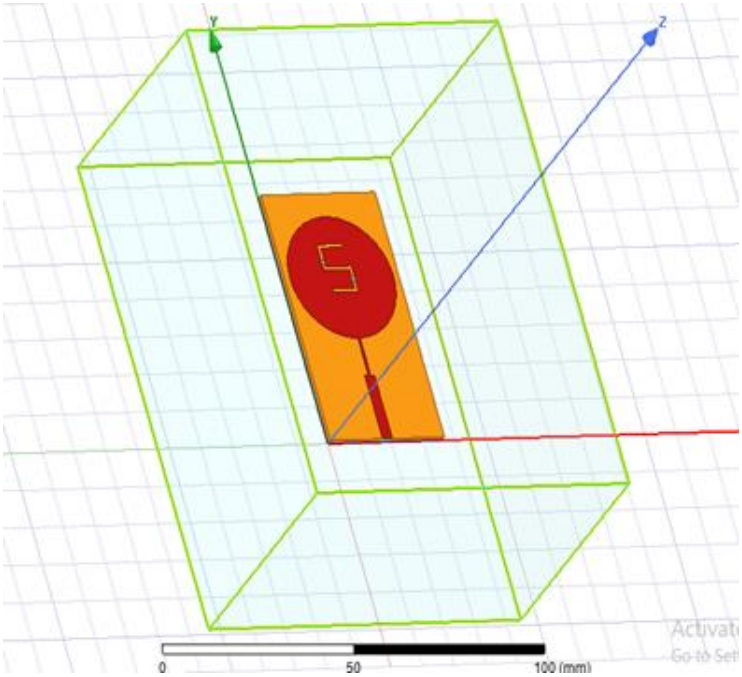

Fig. 2 Overview of antenna.

V. SIMULATED RESULTS IN HFSS

A. S1,S2 are OFF Condition:(F1)

When all the diodes are in OFF condition (i.e) Reverse bias ,the frequency reconfiguration attained is with the range of 2.409 GHZ and the return loss obtained is -25.9151 db. The gain obtained is measured as 1.72 db.

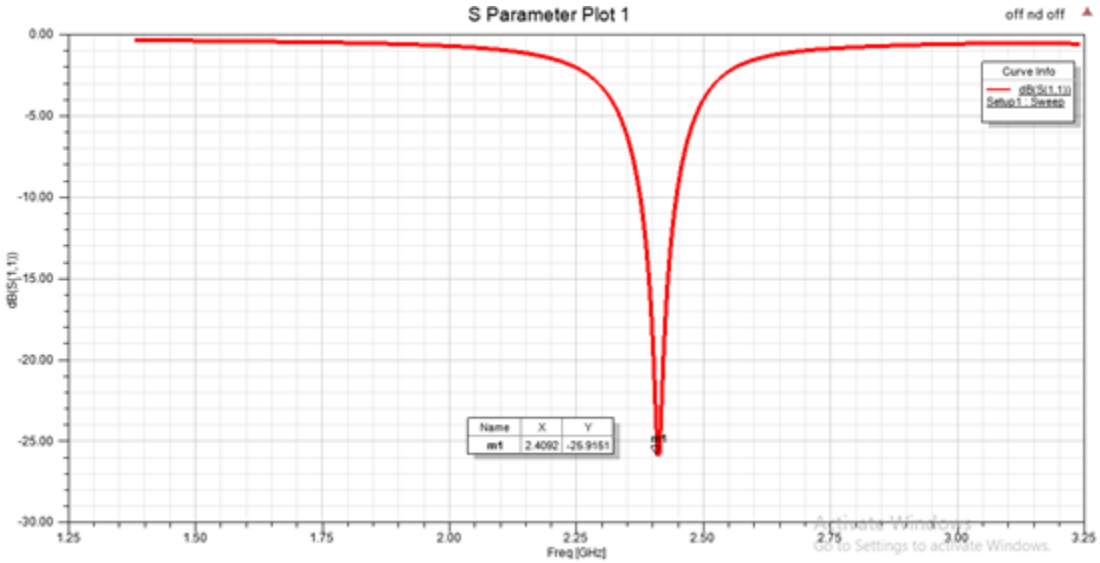

Fig. 3 The simulated S-parameter for 1st condition of the proposed antenna.

B. S1 is OFF and S2 is ON Condition:(F2)

When the diode S1 is OFF condition (i.e) Reverse bias and S2 is in ON condition (i.e) Forward bias ,the frequency reconfiguration attained is with the range of 2.409 GHZ and the return loss obtained is -33.0871 db. The gain obtained is measured as 1.38 db.

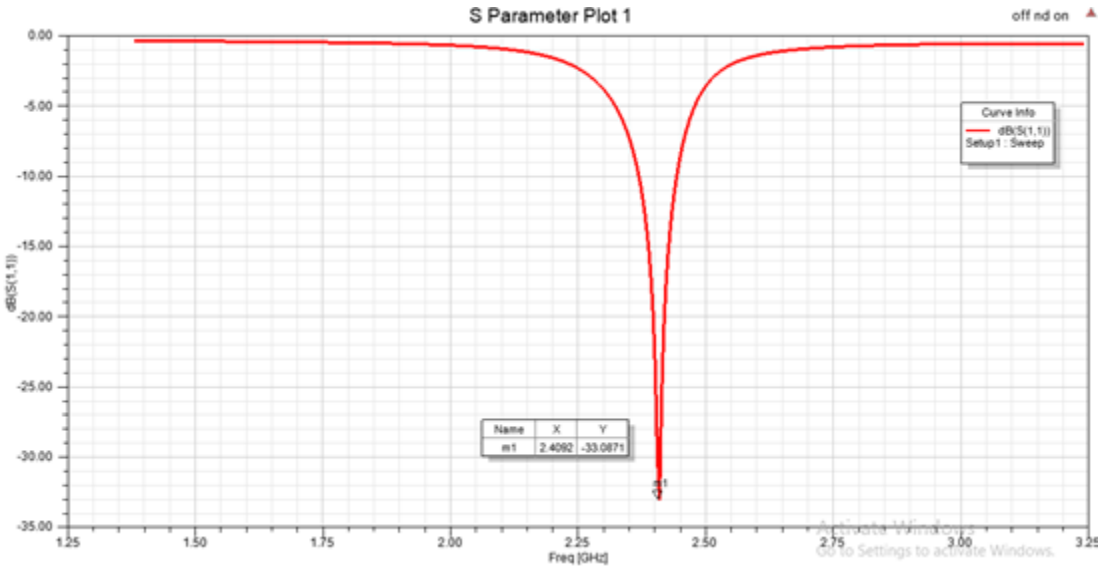

Fig. 4 The simulated S-parameter for 2nd condition of the proposed antenna.

C. S1 is ON and S2 is OFF Condition:(F3)

When the diode S1 is in ON condition (i.e) Forward bias and S2 is in OFF condition (i.e) Reverse bias , the frequency reconfiguration attained is with the range of 2.405 GHZ and the return loss obtained is -18.5768 db. The gain obtained is measured as 1.98 db.

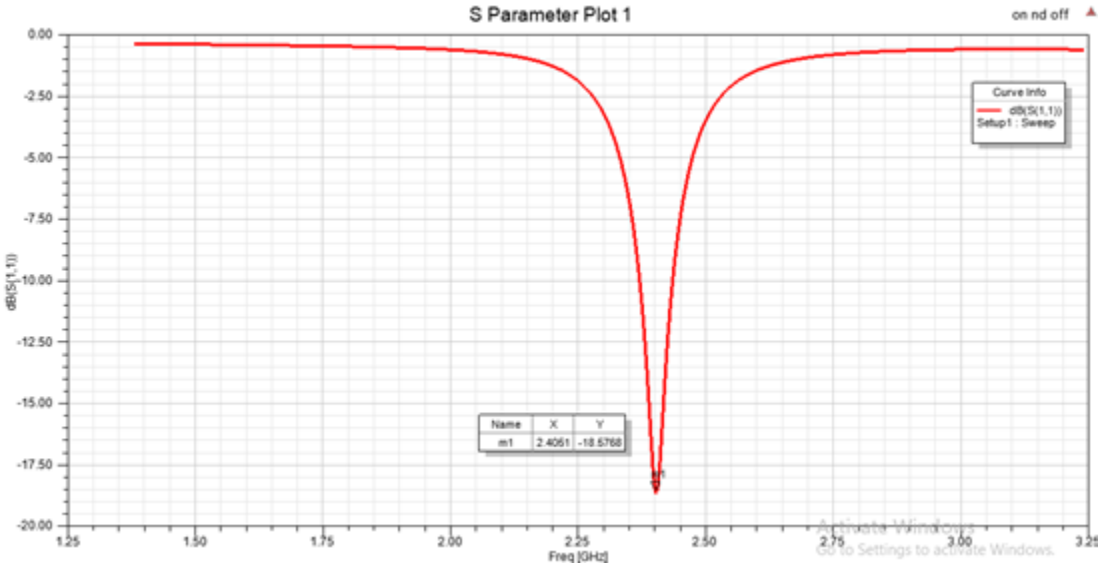

Fig. 5 The simulated S-parameter for 3rd condition of the proposed antenna.

D. S1,S2 are ON Condition:(F4)

When all the diodes are in ON condition (i.e) Forward bias ,the frequency reconfiguration attained is with the range of 2.405 GHZ and the return loss obtained is -20.3867 db. The gain obtained is measured as 1.90 db.

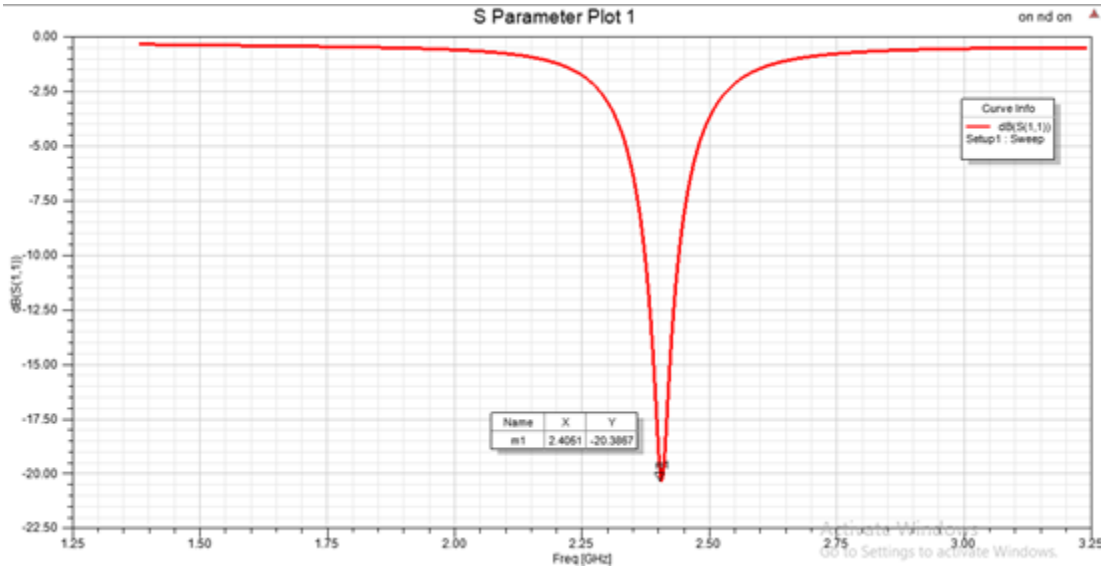

Fig.6 The simulated S-parameter for 4th condition of the proposed antenna.

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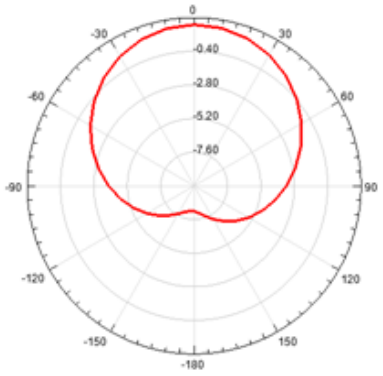
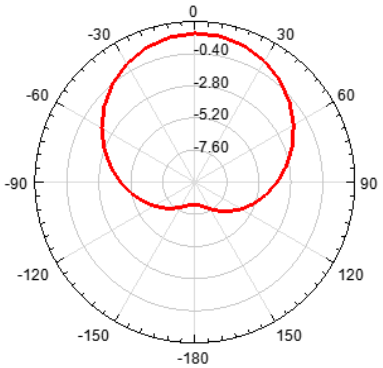
TABLE I: SWITCH CONFIGURATION:

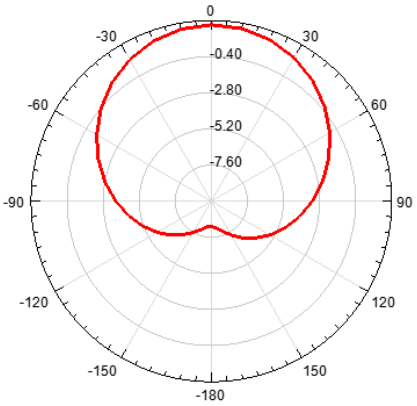
Switch states	Resonant Frequency			
	F1	**F2**	**F3**	**F4**
S1	0	0	1	1
S2	0	1	0	1



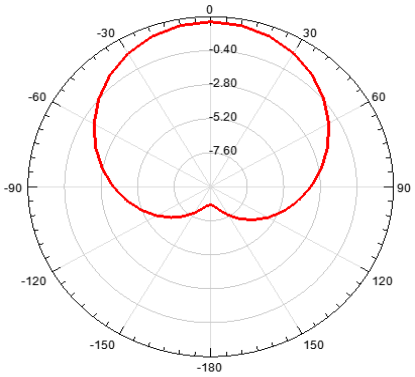
a) F1;



b) F2;



c) F3;



d) F4.

Fig. 7 Simulated radiation patterns for all 4 conditions.

VI.CONCLUSION

The re-configurable strip antenna is designed, analyzed and simulated. The antenna designed is analyzed with 2.4GHz. The substrate used is FR4 epoxy with thickness of 1.6mm. The reconfiguration is attained using four switching conditions. The ON and OFF condition applied to the diode go well with the designed antenna. The obtained results show that the frequency reconfiguration is attained within the range of 1.38GHZ to 3.24GHZ with return loss, VSWR and Gain. The software tool used is ANSYS HFSS. At present COVID 19 situations without visiting the hospital, doctors can able to trace the medical record of the patients by connecting with wearable devices such as pulse oximeter,temperature sensor,heartbeat sensor.

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