Design and analysis of single band monopole antenna For WLAN applications

A MINOR PROJECT -II REPORT

Submitted by

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BONAFIDE CERTIFICATE

Certified that this **18ECP104L - Minor Project II** report "**Design and analysis of single band monopole antenna For WLAN applications"** is the bonafide work **of" JEGATHEESWARAN.K(927621BEC070), KARTHICK.C (927621BEC072), KARTHIKRAJA.M(927621BEC076), KISHORE.R (927621BEC096)** who carried out the project work under my supervision in the academic year **2022- 2023 EVEN**.

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This Minor project-II report has been submitted for the **18ECP104L – Minor Project II** Review held at M. Kumarasamy College of Engineering, Karur on ___________________.

PROJECT COORDINATOR

INSTITUTION VISION AND MISSION

Vision

To emerge as a leader among the top institutions in the field of technical education.

Mission

M1: Produce smart technocrats with empirical knowledge who can surmount the global challenges.

M2: Create a diverse, fully -engaged, learner -centric campus environment to provide quality education to the students.

M3: Maintain mutually beneficial partnerships with our alumni, industry and professional associations

DEPARTMENT VISION, MISSION, PEO, PO AND PSO

Vision

To empower the Electronics and Communication Engineering students with emerging technologies, professionalism, innovative research and social responsibility.

Mission

M1: Attain the academic excellence through innovative teaching learning process, research areas & laboratories and Consultancy projects.

M2: Inculcate the students in problem solving and lifelong learning ability.

M3: Provide entrepreneurial skills and leadership qualities.

M4: Render the technical knowledge and skills of faculty members.

Program Educational Objectives

PEO1: **Core Competence:** Graduates will have a successful career in academia or industry associated with Electronics and Communication Engineering

PEO2: **Professionalism:** Graduates will provide feasible solutions for the challenging problems through comprehensive research and innovation in the allied areas of Electronics and Communication Engineering.

PEO3: **Lifelong Learning:** Graduates will contribute to the social needs through lifelong learning, practicing professional ethics and leadership quality

Program Outcomes

PO 1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO 2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO 3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO 4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO 5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO 6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO 7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO 8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO 9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO 10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO 11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO 12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes

PSO1: Applying knowledge in various areas, like Electronics, Communications, Signal processing, VLSI, Embedded systems etc., in the design and implementation of Engineering application.

PSO2: Able to solve complex problems in Electronics and Communication Engineering with analytical and managerial skills either independently or in team using latest hardware and software tools to fulfil the industrial expectations.

Abstract	Matching with POs, PSOs
WLAN applications	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO9, PO10, PO11, PO12, PSO1, PSO2

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ABSTRACT

The objective of the single band patch antenna operating at 5.488GHz (WLAN) Under flat and bend condition of different radius of 40mm, 50mm And 60mm. A 1.5mm Rogers RT5880 is used as a substrate and Copper is used as a conductive material. The relative permittivity And tangent loss of the substrate is 2.2 and 0.0009 respectively. The designed antenna has a compact size (38*48*1.5 mm3). For Optimum bandwidth and better radiation pattern a truncated Ground surface is used. The designed antenna efficiently operates(95.07%), giving sufficient bandwidth, directivity, gain and Return loss of 941.7 MHz, 4.86 dB, 4.64 dB and -28.68 Respectively. The designed antenna is low profile, lighted weight, Compact size, and perfectly matched which result in VSWR is 1.03. The proposed antenna works well for WLAN and wearable Electronics.

Keywords— WLAN applications, wearable antenna, wireless Communication.

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ACRONYM	ABBREVIATION
HIS	High impedance surfaces
EBG	Electromagnetic Band Gap
SRR	Split ring Resonators
SAR	Specific Absorption Rate

1. INTRODUCTION

In the recent decade body centric wireless communication Becomes na essential part of 4G (fourth generation) mobile Communication system. Body centric communication firmly Takes its place in the sphere of both body area network and Personal area network. One of the dominant and ruling Research topics of antenna in body centric is wearable Antennas. Modern communication devices commonly require Wearable antenna with light weight, maintenance free, low Cost and no installation. Flexibility and compactness are the Main features in wearable electronics. Wearable system should Be lighter and whippy as compared to conventional wired System. Monopole antennas are attractive choice and Representative for wearable electronics due to its properties (low profile, compatible to planner and non-planar surfaces). However, it also has some disadvantages such as low gain, Spurious feed radiations and out of phase reflection. Some of These disadvantages as aforementioned can be mitigated by Using metamaterial surfaces .Metamaterial surfaces behave As high impedance surfaces (HIS) within a specific frequency Band and it is called as band gap of the surface. Electromagnetic Band Gap (EBG) structures offers two main Functions. It suppresses the surface wave and as a result Increases radiation efficiency and gain. It provides in-phase Reflection. Moreover metamaterial surfaces also provide Shielding to the human body and strongly reduce Specific Absorption Rate (SAR) value, as well as reduce the effect on The impedance matching, when antenna is in proximity to the Human body .Loading antenna on metamaterial split ring Resonators (SRRs) matches the antenna input impedance at the Required resonance frequency to operate properly.Different shapes of antenna have been proposed and designed By the authors using various techniques. For example E Shaped , 7-shaped , C shaped , double T shaped , L Shaped , B shaped , F shaped , G shaped , U Shaped , and 9-shape antennas. In this paper the Performance of the simple monopole shape antenna and Antenna under three different bend conditions has been Analyzed and discussed in terms of gain, directivity, return Loss, radiation pattern, VSWR, bandwidth and efficiency.

2.LITERATURE SURVEY

For designing multiband antennas, different techniques were used previously to achieve multiband operating frequency standards. The following study, of different multiband antennas covering the microwave band for WLAN applications is concluded. A defected ground structure (DGS) monopole antenna operating at triple frequencies for WLAN applications is presented. The radiating patch and ground of the antenna were etched on both sides of a printed-circuit board (PCB). The ground plane was modified by two equal-shaped slots on the right and left sides. Similarly, a multiband characteristic of the antenna was generated by a rectangular slot on the upper side of the antenna substrate loaded with differently shaped stubs on each side of the slot. A slotted monopole antenna, having a C-shaped patch introduced by a G-shaped parasitic strip and a partial ground plane, is used to obtain a larger bandwidth of 3.5 GHz at (3.92–7.52 GHz). Two elements of a multiple-input–multiple-output (MIMO) antenna etched with a different slot are reported. Similarly, a triple-band antenna for 2.4, 5.2, and 5.8 GHz applications and a dual-band antenna operating at 2.4 GHz and 5.2 GHz in are presented. Meandering slots etched in the patch and a slotted ground DGS is used, respectively, to obtain the triple and dual-band characteristics. A 28-GHz mm-wave antenna of size 30 mm × 20 mm for 5G is reported, which is the combination of a waveguide aperture and several microstrip patches. Further, the study of antennas covering both microwave and mm-wave bands simultaneously were performed. In a multi-layer antenna system having a dual-element MIMO on the top layer operating in the microwave band, and an antenna array at the bottom layer for the 5G band, is presented. A multiband antenna operating in both microwave and mm-wave is introduced which consists of a monopole antenna operating at 2.4/5.5 GHz and a rectangular patch covering the mm-wave 5G band. It was observed from the comparison table that the available designs have large size; complex geometry, multi-ports, and they can only cover the microwave band, or only mm-wave band, but cannot cover both bands with one feeding. Thus, the challenging part of this work is to design an antenna that can cover both the microwave band and mm-wave band with a single feeding and a compact size.

3.EXISTING SYSTEM

3.1.Patch Antenna

presents the detailed dimension and an overview of the Proposed antenna.

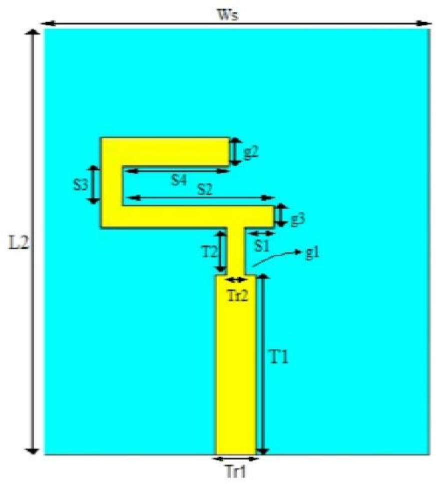

Fig.3.1.Geometerical Model of a simple antenna Front View

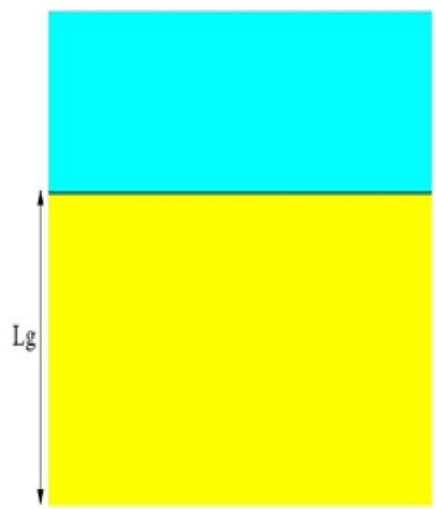

Fig.3.2.Geometerical Model of a simple antenna Back views

The substrate Roger (relative permittivity = 2.2 and tangent Loss =0. 0009) is used, which is 1.5 mm thicker. Table 1Shows the dimension of the simple patch antenna.

Parameters	**Values(mm)**
Ws	40
Ls	38
T1	16
T2	4.2
Tr1	4.3
Tr2	2
g1	1.15
G2	2.5
G3	2
S1	3
S2	15.7
S3	3.5
S4	11
Lg	24

TABLE 3.1. Summary of Antenna Dimensions

4.PROPOSED SYSTEM

A patch antenna is a type of antenna with a low profile, which can be mounted on a surface. An antenna is a specialized transducer that converts radio-frequency (RF) fields into alternating current (AC) or vice-versa. The objective of this work is to design a miniaturized tri-band antenna which is expected to operate at the resonant frequencyof13.12 GHz,26.29GHz,29.24GHz. The dimensions of the substrate are 25mm x 25mm.The material used in the substrate is FR4 with the permittivity of 4.3and thickness of 1.6mm. The material used in the ground and patch is copper. The patch is in the shape of octagon and the given feeding is microstrip feeding. Electromagnetic field solvers for applications across the EM spectrum are contained within a single user interface in . The solvers can be coupled to perform hybrid simulations, giving engineers the flexibility to analyse whole systems made up of multiple components in an efficient and straightforward way. Co-design with other products allows EM simulation to be integrated into the design flow and drives the development process from the earliest stages. Common subjects of EM analysis include the performance and efficiency of antennas and filters, electromagnetic compatibility, and interference (EMC/EMI), exposure of the human body to EM fields, electro-mechanical effects in motors and generators, and thermal effects in high-power devices.

5. SIMULATION AND MODELING

The simulation and modeling of the designed antenna are Performed employing CST MWS 2015. The radiating patch is Supported by finite ground surface having dimension is. The Inset feed mechanism technique is used for impedance Matching. A monopole antenna is a class of radio antenna consisting of a straight rod-shaped conductor, often mounted perpendicularly over some type of conductive surface, called a ground plane. The driving signal from the transmitter is applied, or for receiving antennas the output signal to the receiver is taken, between the lower end of the monopole and the ground plane. One side of the antenna feed line is attached to the lower end of the monopole, and the other side is attached to the ground plane, which is often the Earth. This contrasts with a dipole antenna which consists of two identical rod conductors, with the signal from the transmitter applied between the two halves of the antenna. The monopole is a resonant antenna; the rod functions as an open resonator for radio waves, oscillating with standing waves of voltage and current along its length. Therefore, the length of the antenna is determined by the wavelength of the radio waves it is used with. The most common form is the quarter-wave monopole, in which the antenna is approximately one quarter of the wavelength of the radio waves.

6. ANTENNA UNDER DIFFERENT BEND CONDITIONS

An on-body application, the antenna is to be printed on the Garments. For this goal the compact antenna is bent on Different radius. The bending affects the performance of the Antenna. Therefore, the designed model is analyzed and Investigates under different bending conditions portrayed the front view of the proposed antenna Under different bend conditions

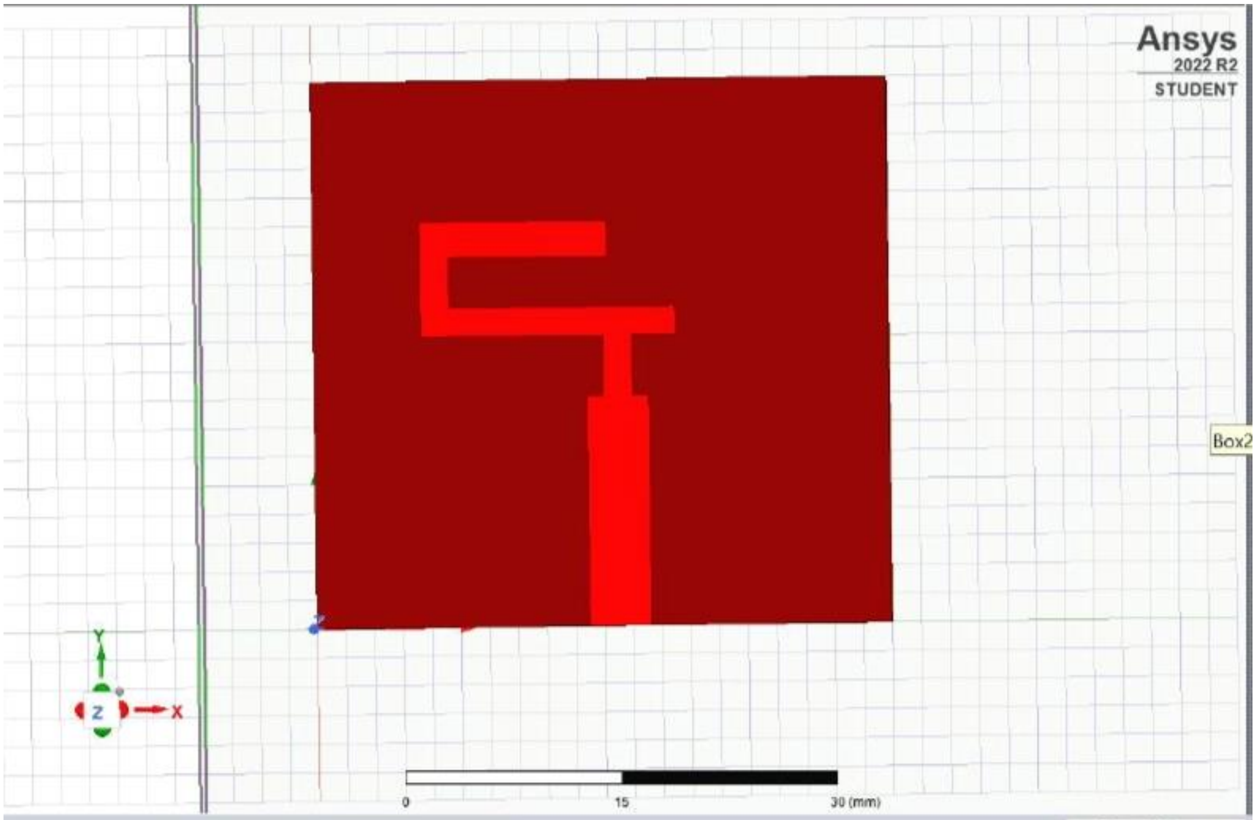

Fig.6.1.Front view of antenna with different radius

Compares the flat and bending antenna return loss. It Has been observed that bending the antenna with a radius of 60mm has minimum effect on return loss, which shows that Bending has no prominent effect on return loss of the proposed Single band antenna.

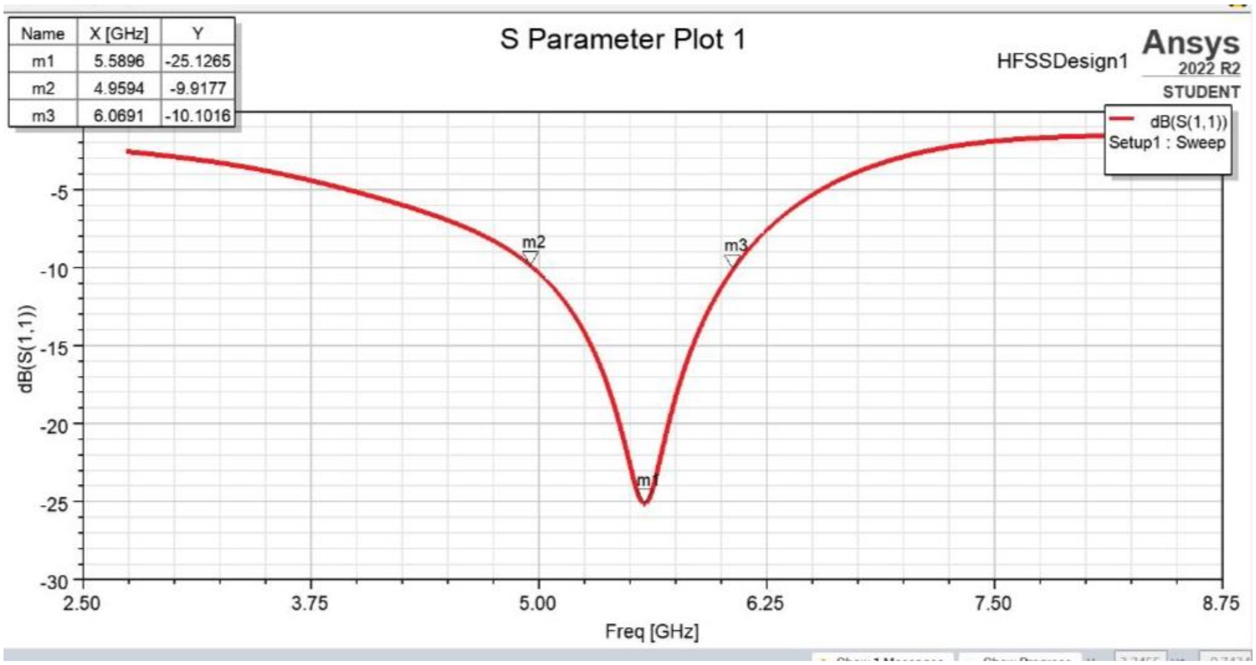

Fig.6.2 Reflection coefficient under different bends conditions

Figure 5.2 shows the effects of bending on directivity and gain Pattern. The radiation pattern of the designed antenna is Shifted from 0 degrees to the left 90 degrees. The proposed Antenna has maximum directivity and gain under flat condition While it has been observed that directivity and gain decreases Gradually as radius decreases.

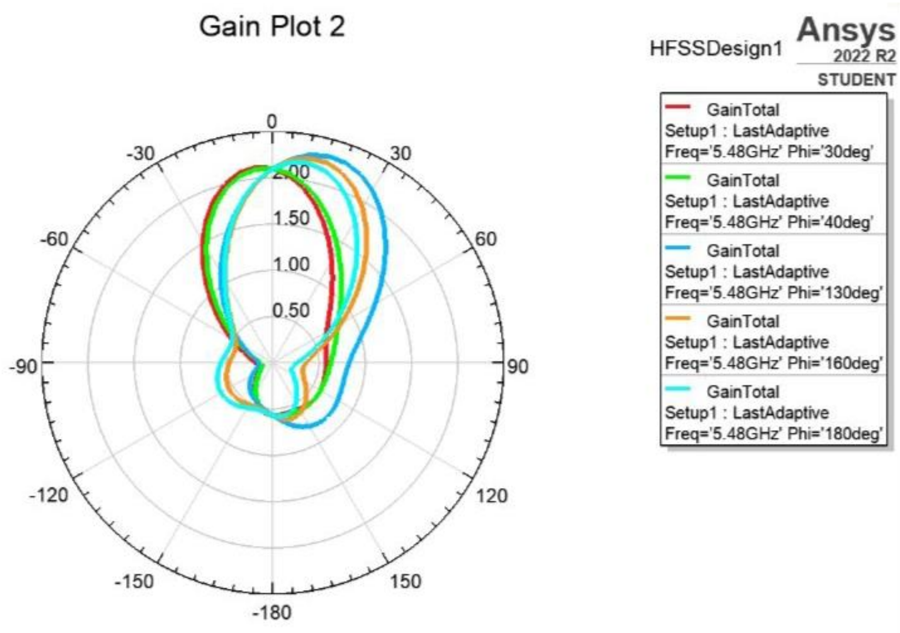

Fig.6.3.Polar plots under different bend conditions

7.RESULT AND DISCUSSION

7.1.Scattering Parameter

The operating frequency range of the proposed antenna is From 4.5 to 6GHz. The designed antenna operates at the Resonance frequency of 5.488 GHz. The proposed antenna has A bandwidth of 941.7 MHz and a return loss of -28.60dB at 5.488 GHz. Fig 3 portrayed the return loss of the designed Antenna.

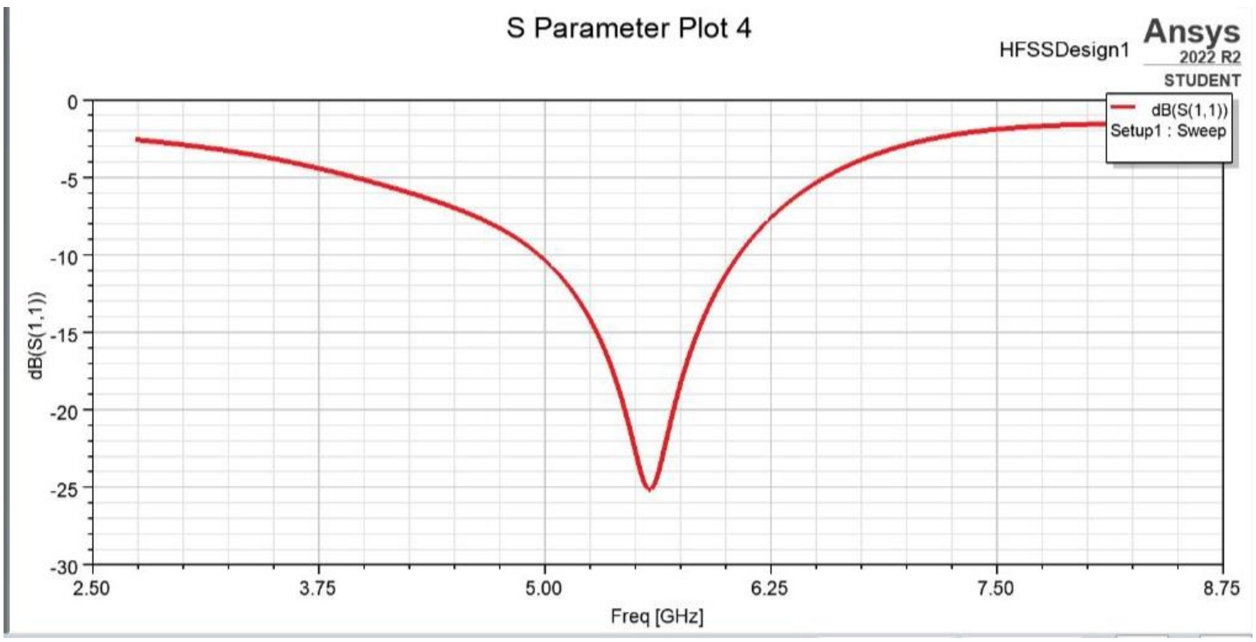

Fig.7.1.Return loss of the proposed antenna

7.2 Polar Plot

The far field 2D radiation pattern of the simple patch antenna In the perpendicular and elevation plane is presented in Figure 4. The designed antenna is excited in its basic mode has a Peak gain in perpendicular direction to the patch. The peak Gain and directivity value of the proposed compact patch Antenna is 4.64 dB and 4.86 dBi respectively.

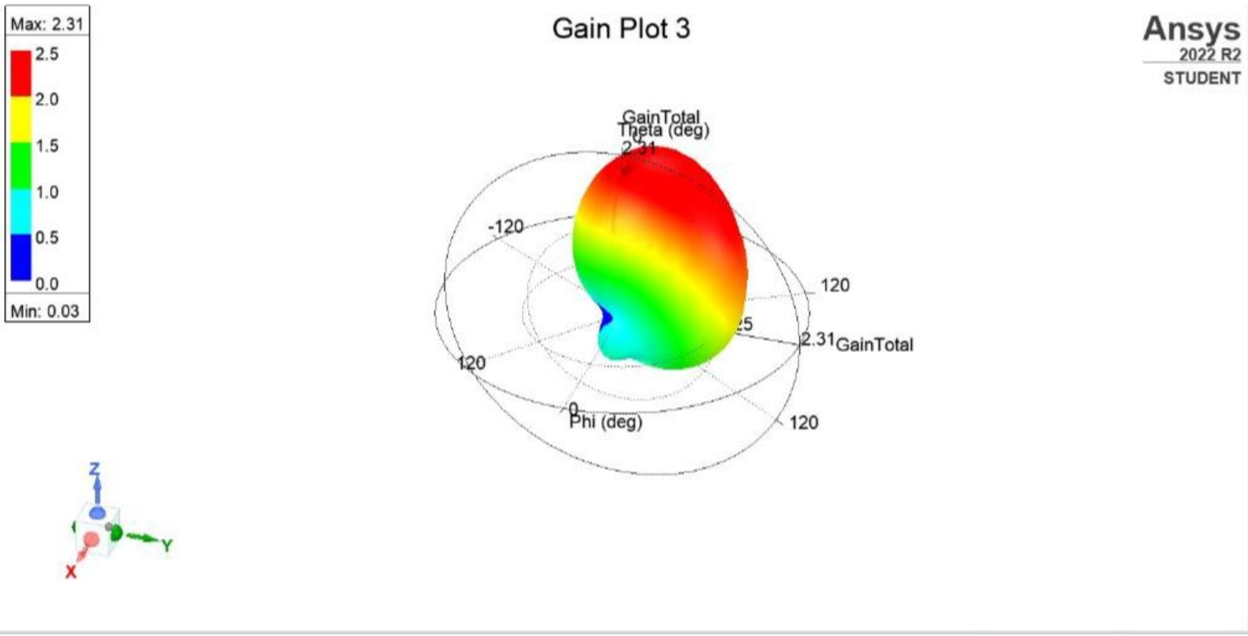

Fig.7.2..Polar plots of antenna under flat condition Gain

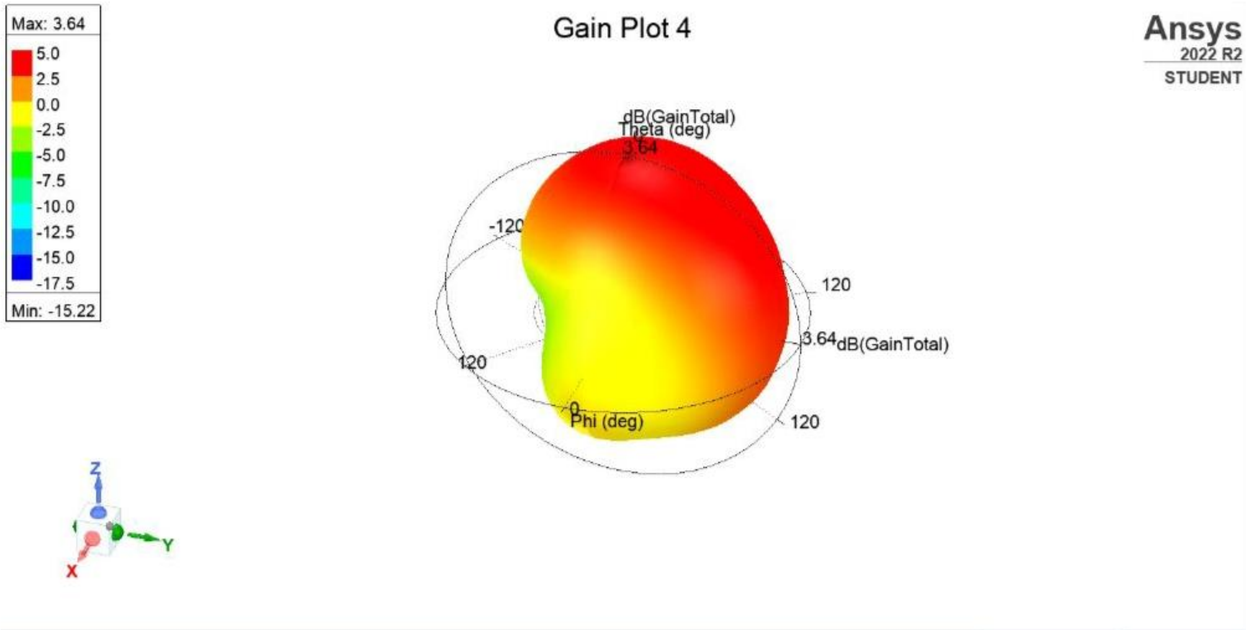

Fig.7.3.Polar plots of antenna under flat condition Directivity

8.CONCLUSION

In this paper a simple and compact antenna is designed Employing low cost wearable material (Roger). The designed Model was analyzed, compared and simulated in term of Bandwidth, VSWR, far field gain and directivity, scattering Parameter and efficiency. It has been observed that the antenna Has minimum return loss under flat condition while the return Loss increases as the radius of antenna decreases due to Bending. The antenna has maximum directivity and gain under A flat condition which gradually decreases with decreasing the Radius. Prototype of the proposed antenna will be fabricated in The near future in order to compare measured and fabricated Result

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