

Design and Analysis of High Gain Slotted Circular Patch Antenna

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Abstract— The rapid advancement of wireless communication systems has created a strong demand for compact, efficient, and high-performance antennas, especially for high-frequency applications. In this project, the design and analysis of a slotted circular microstrip patch antenna operating at 10 GHz is presented. Microstrip patch antennas are widely preferred due to their advantages such as low profile, light weight, ease of fabrication, and compatibility with integrated circuits. However, conventional microstrip antennas suffer from limitations such as narrow bandwidth and low gain, which restrict their performance in modern communication systems.

INTRODUCTION

In modern democracies, the integrity, security, and efficiency of the voting process are critical to upholding free and fair elections. Traditional paper-based voting methods are prone to issues such as ballot tampering, long counting times, and voter impersonation. To address these challenges, electronic voting machines (EVMs) have been introduced in many parts of the world. However, even EVMs face vulnerabilities related to identity verification and fraud. This project proposes the development of an Electronic Voting Machine based on Fingerprint Scanner Technology to enhance the security and reliability of the voting process. By integrating biometric authentication, specifically fingerprint recognition, the system ensures that only eligible and registered voters can cast their vote, and that each voter does so only once.

Software Required

The design and simulation of the slotted circular microstrip patch antenna are carried out using specialized electromagnetic simulation software.

- Primary Software Used Ansys HFSS

HFSS (High Frequency Structure Simulator) is a 3D electromagnetic simulation tool used for designing and analyzing high-frequency components such as antennas, RF circuits, and microwave devices. It uses the Finite Element Method (FEM) to provide accurate simulation results.

Circular Microstrip Patch Antenna

A circular microstrip patch antenna consists of a circular conducting patch placed on a dielectric substrate with a ground plane beneath it. It operates based on the dominant TM_{11} mode, which produces symmetrical radiation.

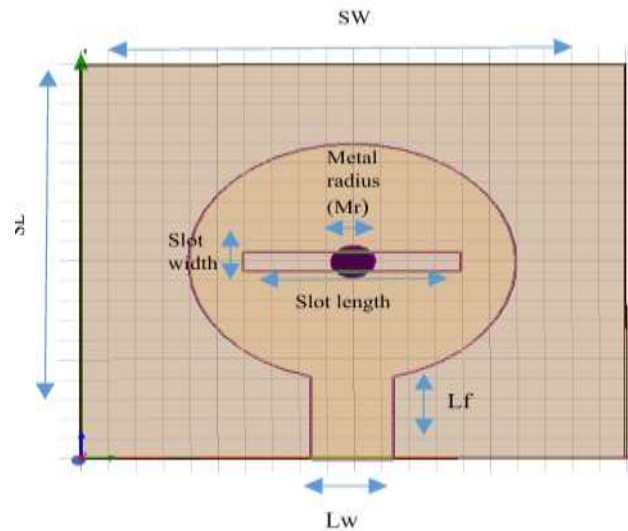


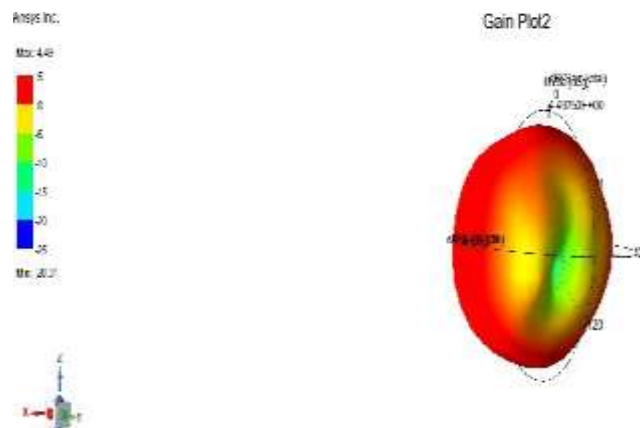
Fig. 1. Front view of Circular MSA with Rectangular slot

RESULT

The slotted circular microstrip patch antenna was successfully designed and simulated using Ansys HFSS at an operating frequency of 10 GHz .

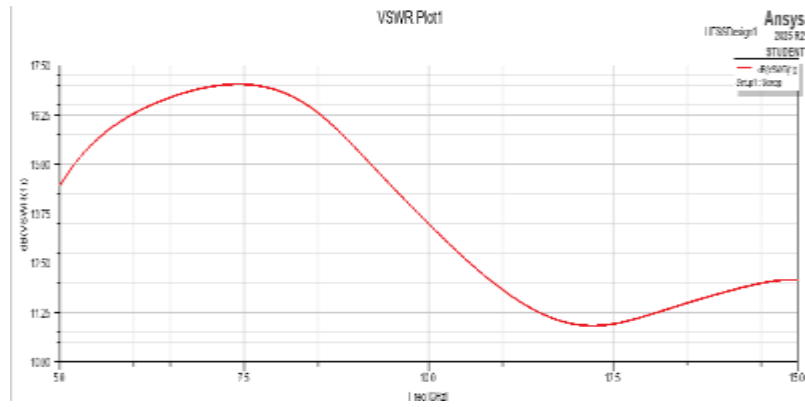
1. GAIN:

Gain measures the ability of the antenna to radiate power in a specific direction .It is expressed in dBi (decibels over isotropic radiator).Higher gain indicates better performance and stronger signal transmission.



2. Voltage Standing Wave Ratio (VSWR)

VSWR represents the impedance matching between the transmission line and the antenna.



CONCLUSION

The present work focuses on the design and analysis of a slotted circular microstrip patch antenna operating at 10 GHz, which lies in the X-band frequency range. The increasing demand for high-frequency wireless communication systems, including radar, satellite, and advanced communication technologies, necessitates the development of compact, efficient, and high-performance antennas. In this project, a microstrip patch antenna with a circular geometry has been selected due to its inherent advantages such as simple structure, ease of fabrication, and stable radiation characteristics.