Faculty of Electrical and Electronic Engineering Technology

DEVELOPMENT OF TRANSPARENT ANTENNA USING WATER AS CONDUCTING MATERIAL

NURUL AIDA SUKMA BINTI AMRAN

Bachelor of Electronics Engineering Technology (Telecommunications) with Honours

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A project report submitted
in partial fulfillment of the requirements for the degree of
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Disahkan oleh:

DR. MUHAMMAD INAM ABBASI
Senior Lecturer
Department of Electronic And Computer Engineering Technology
Faculty Of Electrical and Electronic Engineering Technology
University Teknikal Malaysia Melaka

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I declare that this project report entitled "Development of Transparent Antenna Using Water As Conducting Material" is the result of my own research except as cited in the references. The project report has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

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DEDICATION

Special dedicated to

My beloved family and friends for the help and encouragement throughout my study. Thank you for my supervisor, Dr Muhammad Inam Abbasi and all the lecturers who gave me guidance and advice throughout the process in finish my final year project.

ABSTRACT

This research offers a low-profile transparent microstrip antenna using a substrate of lead glass and a conducting medium of water. The transparent microstrip antenna is made consisting of a thin lead glass substrate and an antenna patch with distilled water as the ground. Water is the principal conducting substance when compared to other transparent materials since it is readily available, inexpensive, and easy to make. According to early modelling data, the antenna operates at 2.45GHz. The return loss is less than -10dB. Because of its low cost and remarkable radiation performance, this revolutionary transparent patch antenna is projected to have a wide range of exciting applications in future transparent electronics and flexible electronics designs.

ABSTRAK

Penyelidikan ini menawarkan antena mikrostrip telus berprofil rendah menggunakan substrat kaca plumbum dan medium air pengalir. Antena mikrostrip telus dibuat terdiri daripada substrat kaca timah nipis dan tambalan antena dengan air suling sebagai tanah. Air adalah bahan pengalir utama jika dibandingkan dengan bahan lutsinar lain kerana mudah didapati, murah, dan mudah dibuat. Menurut data pemodelan awal, antena beroperasi pada 2.45GHz. Kerugian pulangan kurang dari -10dB. Antena tampalan telus yang inovatif ini diharapkan mempunyai pelbagai aplikasi menarik dalam reka bentuk elektronik telus dan elektronik fleksibel di masa depan kerana kos rendah dan prestasi radiasi yang luar biasa.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF SYMBOLS

δ	-	Voltage angle
ΔL	-	Length extension
|S11|	-	S-parameter
W	-	Width of patch
εeff	-	Effective dielectric constant
Wg	-	Width of ground
Wf	-	Transmission line width
$Leff$	-	Effective length
Lg	-	Length of ground

LIST OF ABBREVIATIONS

PCB	-	Printed circuit board
ITO	-	Indium tin oxide
PDMS	-	polydimethylsiloxane
RCS	-	Radar cross-section
CP	-	Circularly polarized
PB	-	Pancharatam-berry
WLAN	-	Wireless local area network
VFH	-	Very high frequency
GHz	-	Giga hertz

LIST OF APPENDICES

CHAPTER 1

INTRODUCTION

1.1 Background

An antenna is a device that connects radio waves to space-based electric currents. It works by absorbing the energy from radio waves and returning it to the transmitter or receiver. A transmitter or receiver is connected to an antenna by a series of cables. They can be designed to receive and transmit radio waves in all directions, or they can only be used in one. Horn, helical, dipole, and parabolic antennas are among the many types of antennas available. The most prevalent are micro strip patch antennas. Its structure is a thick metal sheet with a radiating patch.

A microstrip antenna is a kind of antenna built on a printed circuit board using photolithographic methods (PCB). Patch microstrip antennas are the most popular form of microstrip antenna. Patch antennas can also be combined with other antennas to form a bigger array. The entire system is supported by a ground plane, which is connected to the dielectric substance. Stimulation is also provided by feed wires linked to the antenna through the patch. Since it is one of the most popular designed of the antenna, the microstrip patch antenna will be proposed in this project with water as conducting material.

Next, transparent antennas operating in wireless frequency bands are useful in glass-mounted applications such as automobiles, homes, and businesses where transmission and reception are desired through or from a window. Transparent antennas were produced using AgHT materials, indium tin oxide (ITO), and fluorine doped tin oxide on glass and polyimide. The use of a transparent conductor can present difficulties in both fabrication and

application. This project are designing a transparent antenna using water as conducting material. Because this antenna will combined a transparent material which is 100% transparency and the water as conducting material. The sample of water will be tested to get the reading of conductivity in order to study the effect of conductivity of different sample of water on the antenna performance.

1.2 Problem Statement

Due to the increasing cost of materials necessary for complex design features and application requirements, antennas have become exceedingly expensive. Transparent antennas are frequently used in a wide range of communication system applications when device space is limited and antenna integration with other components is necessary. In transparent antennas, indium tin oxide (ITO) or a metal mesh are often employed as conducting materials, however this material has low transparency (70 percent). Furthermore, these two elements are expensive, especially the rare-earth Indium component (ITO).

Because water is clear, cheap, and easily available, glass will be used as a substrate and water will be used as a conducting medium for the transparent antenna. When compared to currently use transparent antennas, the proposed antenna is expected to provide a number of advantages and benefits when utilized properly.

1.3 Project Objective

The objectives of this project are as follows:

a) To study the feasibility of optimum antenna design using water as a conducting material.

b) To characterize the properties of different samples of water in order to study the effect of conductivity on antenna performance.

c) To propose an optimum water based microstrip patch antenna.

1.4 Scope of Project

The scope of this project is to study a very transparent antenna that does not interfere with other passive or active modules. In order to obtain the needed antenna radiation performance, the electrical properties of the chosen material must also be carefully addressed. In this project, water will also be used as the conducting medium of the antenna.

The different type of water used will be simulate using CST Studio Suite. The substrate of the antenna will use lead glass material and the patch and ground will use different type of water. This project will simulate four types of antenna with different source water. The water consist of distilled water, sea water, tap water and rain water.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter will discuss about the analysis of the literature review from several related articles or journals. All related articles and journals are discussing based on the theoretical background.

2.2 Antenna

The link between radio waves traveling across space and electric currents flowing through metal conductors is an antenna. Antenna, also known as Aerial, is a mechanism for directing incoming and outgoing radio waves, such as those used in radio, television, and radar. It is an electrically linked array of components that may be configured to transmit and receive radio waves in an omnidirectional manner, radiating energy about evenly in all directions, with energy radiating more in one direction than others. Any radio transmitter or receiver must couple its electrical connection to the electromagnetic field in order to function. Radio waves (electromagnetic waves) are electromagnetic waves that transport signals across the air with nearly negligible transmission loss.

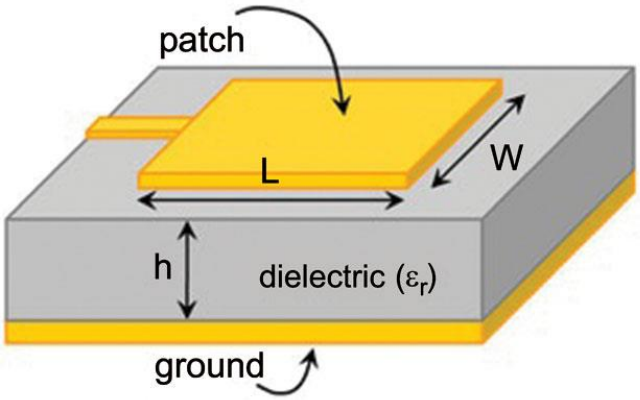

Figure 2. 1 Microstrip Patch Antenna

Table 2.1 compares patch antennas composed of water and copper. A patch antenna with a metallic patch ground has a higher gain than a patch antenna with water as the ground plane. This is because some electromagnetic waves travel through the sea floor and reach the back zones. As a result, the number of electromagnetic waves that reach the main beam is reduced [3].

Table 2. 1 Comparison of patch antennas made of water or copper

	Patch	Ground plane	BW ($\|S_{11}\| \leq -0$ dB)	Max. Gain (dBi)
This work	Water	Water	35% (2.0-2.85 GHz)	4.0
Case 1	Copper	Copper	39% (1.75-2.61 GHz)	7.0
Case 2	Copper	Water	35% (1.95-2.78 GHz)	5.1
Case 3	Water	Copper	38% (1.8-2.65 GHz)	6.7