UNIVERSITI TEKNIKAL MALAYSIA MELAKA

GAIN ENHANCEMENT USING MICROSTRIP PATCH ANTENNA USING A REFLECTING LAYER FOR TRAIN TRANSPORTATION APPLICATION

This report is submitted in accordance with the requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor Of Electronics Engineering Technology (Telecommunications) With Honours

by

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FACULTY OF ELECTRICAL AND ELECTRONIC ENGINEERING

TECHNOLOGY

2018

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

BORANG PENGESAHAN STATUS LAPORAN PROJEK SARJANA MUDA

Tajuk: **GAIN ENHANCEMENT USING MICROSTRIP PATCH ANTENNA USING A REFLECTING LAYER FOR TRAIN TRANSPORTATION APPLICATION**

Sesi Pengajian: 2018

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APPROVAL

This report is submitted to the Faculty of Engineering Technology Electric and Electronic of Universiti Teknikal Malaysia Melaka (UTeM) as a partial fulfilment of the requirements for the degree of Bachelor of Electronics Engineering Technology (Telecommunications) With Honours. The member of the supervisory is as follow:

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ABSTRAK

Antena adalah asas bagi setiap sistem komunikasi. Ciri-ciri antena patch Microstrip adalah keuntungan kuasa yang rendah. Salah satu cara untuk meningkatkan prestasi keuntungan adalah dengan menggunakan lapisan yang mencerminkan. Dalam projek ini, antena direka bentuk sebagai penutup yang dikendalikan pada frekuensi 2.45GHz. Ia dibangunkan untuk beroperasi dalam julat frekuensi WiMax 2.5-2.69 GHz. Antena yang direka terdiri daripada patch segi empat tepat pada substrat FR-4 (lossy) di bahagian atas antena, manakala untuk bahagian bawah teruja oleh teknik penyambungan gandingan jarak dekat. Antena direka menggunakan Microwave Studio (CST) dan mengikut proses fabrikasi. Antena direka untuk digunakan untuk aplikasi kereta api. Hasil simulasi dan diukur dibentangkan untuk antena yang dicadangkan. Dengan menggunakan mencerminkan lapisan, keuntungan bertambah baik iaitu 3.615dB. Hasil simulasi dan pengukuran menunjukkan hasil menjanjikan dari segi peningkatan keuntungan, dengan menggunakan lapisan mencerminkan.

ABSTRACT

Antenna is a fundamental a part of every communication system. The characteristics of Microstrip patch antenna is low power gain. One of way to enhance the performance of gain is by using reflecting layer. In this project, the antenna was designed as a cover which is operated at 2.45GHz. It is developed to operate in the WiMax frequency range of 2.5-2.69 GHz. The designed antenna consists of rectangular patch on FR-4 (lossy) substrate on the top the antenna, while for the bottom is excited by the proximity coupling feeding technique. The antenna were designed by using Microwave Studio (CST) and follow by fabricated process. The antenna were designed to use for train application. Simulated and measured results are presented for the proposed antenna. By using reflecting layer the gain improved which is 3.615dB. The simulation and measurement results shows promising results in term of enhancement the gain, by using reflecting layer.

DEDICATION

Dedicated for my parents, Mr Rosnizam Bin Nasrullah and Faezah Binti Mat also my super supportive supervisor, En Adib Bin Othman with love and care.

ACKNOWLEDGEMENTS

Alhamdulillah, I already could done the responsible that have been given to me to do this Projek Saujana Muda (PSM) and its report as well as I can.

Firstly, I would like to give my appreciation to my supervisor, Mr Adib Bin Othman for valuable experience, guidance throughout my project session. Here also, I would like to give a million of appreciation to my beloved parents Rosnizam Bin Nasrullah and Faezah Binti Mat. Also special thanks to all my friend give me support on my way completing the project.

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LIST OF ABBREVIATIONS

WiMAX	Worldwide Interoperability for Microwave Access
CST	CST Studio Suite
RF	Radio Frequency
PCB	Printed Circuit Board
UHF	Ultra High Frequency
GSM	Global System for Mobile
VSWR	Voltage Standing Wave Ratio

CHAPTER 1

INTRODUCTION

1.1 Introduction

This chapter provides an overview of the project introduction. The problem background and problem statement are described next. This is followed by research objectives and scope of the study. This part will describe more from the beginning until end of project

1.2 Background

Today, many antennas made are designed to work in empty space. There are antennas designed for adverse environments. A few are designed to have a massive bandwidth with a purpose to make them to work even after detuning. Detuning is the undesirable exchange in operating frequency that takes area because of the environment of the antenna. Others are made in this sort of manner that they'll be very sturdy to changes of their surroundings and may work in hard environments. The aim of those designs is to maintain the fields inside the shape of the antenna and in that way reduce the sensitivity of the antenna to its environment.

1.3 Problem Statement

Antenna is a fundamental a part of every communication system, a thing that is responsible for the actual communication among the various digital structures and entities. In the railway the design of the antenna, because of the tough surroundings,

performs a sizeable role to the overall performance of the services offered. Following the technological shift inside the rail together with the big investments, better and greater efficient antennas are needed. Antenna parameter like directivity, gain, radiation pattern, and efficiency must be optimized. The used of FR4 because the substrate in conventional antenna isn't always appropriate for wearable system because of the limited body movement problem. To triumph over this trouble is with the aid of converting FR4 substrate with textile substrate. This antenna is to be a part of a sensor network placed on trains. The sensor will monitor in a later stage vibrations of the wheel bearings on the train wagons and sent information to antenna. This is done in order to detect faulty and broken wheels. The goal is to enable better planning of wagon maintenance by detecting which wheel will break before it actually does by sensor. Today detection is only possible after the wheel gets so badly damaged that it starts to cut into the rails. When this happens the wheel will damage the rail along the whole way from the point it starts to cut until it gets repaired or replaced. Being able to replace the wheels before this happens would thus reduce the need for rail maintenance.

1.4 Objective of the Study

The objective of the project:

a) To design an antenna that operate at Wimax frequency (Train transportation application)
b) To improve gain by using reflecting layer
c) To validate the measurement of fabricated antenna in term of gain.

1.5 Scope of study

This project will cover the overview antenna like feature and application. Design antenna and examine the simulated result may be carried out by means of the use of software program like CST simulation tools in terms of antenna properties such as return loss in 2.45 GHz frequency range, radiation pattern, gain and bandwidth. Design and simulation, do overall performance and characteristics analysis for the fabric materials and parameter of the antenna. Finally, this project will cover the fabrication and measurement of the antenna and evaluation between simulation and measurement.

1.6 Project Outline

This report is divided into three chapters. Chapter 1 is the introduction part which explain the project background, problem statement, project objectives and project scope. Chapter 2 which is literature review of the project is about references and understandings which are gained from various sources such as books, journals, Internet and previous projects. These materials are used as the main source for this entire project. Project methodology, methodology flowchart, software overview and process flow of the project are described in Chapter 3. The progress of PSM 1 and planning of PSM 2 will been state in Chapter 4 which preliminary result. While in Chapter 5 it will talk about conclusion that consists of discussion, suggestion and the conclusion of the project.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

A literature review is a summary of the previous analysis of a thesis. The purpose of the literature review is to convey what knowledge and ideas have been established on a topic and what are the strengths and weaknesses. The literature review has been conducted prior to undertaking this project to obtain the information on the technology available and the methodologies that used by the other researcher on the same time topic around the world. This chapter provides the summary of literature reviews on key topics related to the Gain Enhancement Using Microstrip Patch Antenna Using a Reflecting Layer for Train Transportation Application.

2.2 Antenna

Constantine A. Balanis [1], antennas are a totally critical component of communication systems. By definition, an antenna is a tool used to convert an RF signal, traveling on a conductor, into an electromagnetic wave in free. This means that an antenna will hold the same character regardless if it's transmitting or receiving. Most antennas are resonant devices, which perform efficiently over a relatively narrow frequency band. While a sign is fed into an antenna, the antenna will emit radiation disbursed in space in a certain way. A graphical representation of the relative distribution of the radiated power in space is known as a radiation pattern.

2.3 The Basic Structure of Microstrip of Antenna

Constantine A. Balanis [1], in high-performance aircraft, spacecraft, train, satellite and missile application, where diameter, mass, value, basic installation, aerodynamic profile are constraining, a low-profile antenna may be required. Basically, microstrip element includes an area of metallization assist above the ground plane, named as microstrip patch. The supporting element is referred to as substrate material that's positioned among the patch and the ground plane. The microstrip antenna can be fabricated with the low-cost lithographic method or through monolithically integrated circuit method. The usage of monolithic included circuit approach we can fabricate segment shifters, amplifiers and different devices, all on the identical substrate by the automated system. In the microstrip antenna, the upper surface of the dielectric substrate supports the revealed carrying outstrip that's definitely contoured whilst the lower surface of the substrate is sponsored via a conducting ground plane. So many advantages and applications can be noted for microstrip patch antennas over conventional antennas. There are numerous undesirable features we encountered with conventional antennas like they're bulky, conformability issues and tough to carry out multiband operations soon. Designed for twin and multiband frequencies is the advantages encompass planar surface, possible integration with circuit elements, small surface, generate with printed circuit technology. Another advantage is lightweight, low volume and low profile planar configuration which can be easily made conformal to host surface. Microstrip patch antenna also low fabrication cost, hence can be manufactured in large quantities. Besides, microstrip patch antenna can be easily integrated circuit and useful in aircraft, satellite and missile application. Disadvantages include narrow bandwidth, low RF power handling capability, larger ohmic losses and low efficiency because of surface waves etc.

Low power handling capacity and lower gain can be overcome through an array configuration. Some factors are involved in the selection of feeding procedure. Particular microstrip patch antenna can be designed for each application and different merits are compared with the conventional microwave antenna. Printed Circuit Board (PCB) is used in fabricating this type of microstrip patch antennae such as Flame Retardant 4 (FR4), Rogers RT and Droid 6010. A basic structure of microstrip patch antenna is shown in Figure 2.1. Figure 2.2 shows the different shapes, which the radiating patch element may take the form.

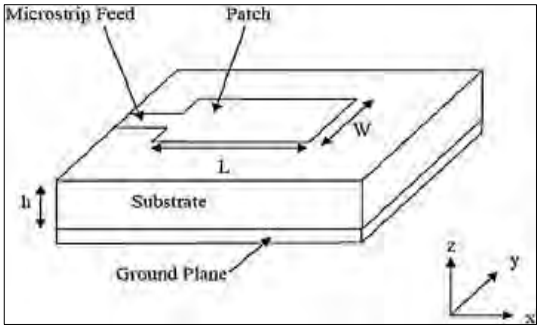

Figure 2.1: Basic structure of microstrip patch antenna

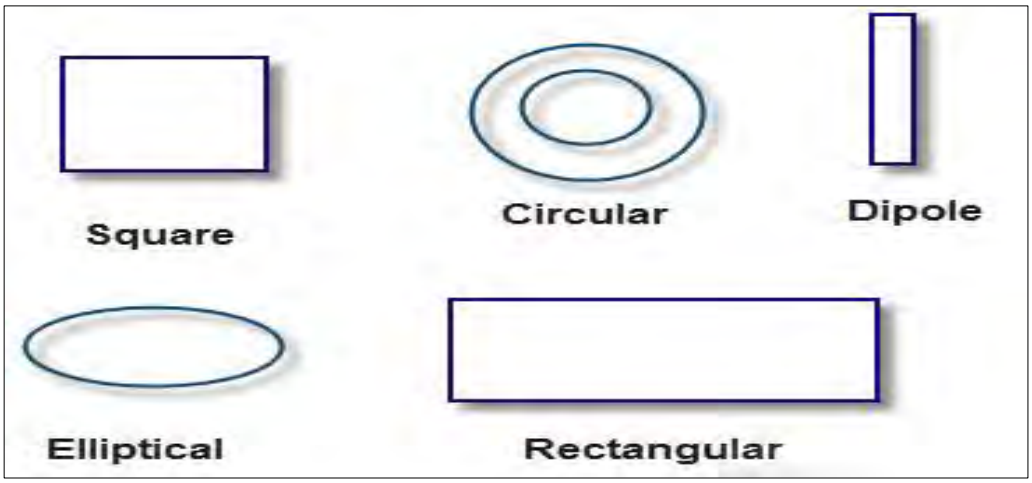

Figure 2.2: Different shapes may represent the patch