PATTERN RECONFIGURABLE ANTENNA FOR RADAR APPLICATIONS

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Specially dedicated to *Abah,*Razak Adam and *Allahyarhamah Mak,* Mariam Zakaria.
Thanks for all of your support.

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ABSTRACT

Reconfigurable antennas change polarization, operating frequency, or far-field pattern in order to cope with the changing of system parameters. Based on pattern reconfigurability, the frequency band remains unchanged while the radiation pattern changes based on system requirements. Using fixed or omnidirectional antenna is wasting the usage power. For fully utilize the power, pattern reconfigurable is proposed. The objective of this project is to design pattern reconfigurable antenna by means of switches. The antenna used in this project is a Vivaldi antenna with operating frequency at 2.4 GHz. The computer simulation package CST Microwave Studio 2014 software is used for the antenna structure design and simulation. The prototype is fabricated on a FR4 substrate. From the simulation and fabricated antenna, the beam peak direction of the patterns can be reconfigured to the right and left side by activating or deactivating the switches.

ABSTRAK

Antena bolehubah berupaya mengubah polarasi, frekuensi dan pola radiasi antena agar beroperasi berdasarkan perubahan parameter pada suatu sistem. Merujuk kepada kebolehubahan terhadap pola radiasi antenna, frekuensi asal antenna adalah tetap tidak berubah manakala pola radiasi berubah berdasarkan keperluan sistem. Penggunaan corak sinaran yang tetap pada satu arah atau tetap pada semua arah mendorong kepada pembaziran penggunaan kuasa. Justeru, bagi menggunakan kuasa secara sepenuhnya, pola radiasi antenna bolehubah dicadangkan. Objektif projek ini adalah untuk mereka bentuk pola radiasi antenna bolehubah melalui penggunaan suis. Antena yang digunakan dalam projek ini adalah antena *Vivaldi* yang beroperasi pada frekuensi 2.4 GHz. Perisian pakej simulasi komputer CST Microwave Studio 2014 digunakan untuk mereka bentuk struktur antena dan simulasi. Prototaip direka pada substrat FR4. Hasil daripada simulasi dan pengukuran mendapati corak pola radiasi antena bolehubah berubah ke kiri dan ke kanan dengan mengaktifkan atau menyahaktifkan suis.

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LIST OF ABBREVIATIONS

CST	-	Computer Simulation Technology
dB	-	Decibel
GaAs FET	-	Gallium Arsenide Field Effect Transistor
IEEE	-	Institute of Electrical and Electronics Engineering
MEMS	-	Micro Electro Mechanical System
PIN DIODE	-	Positive Intrinsic Negative Diode
RF	-	Radio Frequency

CHAPTER 1

INTRODUCTION

1.1 Introduction

Reconfigurable antennas change polarization, operating frequency, or far-field pattern in order to cope with the changing of system parameters [1]. Based on pattern reconfigurability, the frequency band remains unchanged while the radiation pattern changes based on system requirements. The antenna can steer its radiation pattern main beam in different directions. Pattern reconfigurable antennas usually are directional antennas. Directional antennas have advantages in terms of energy consumption, signal sensitivity and long communication range.

Antenna reconfiguration is normally achieved in one of three ways; switching parts of the antenna structure in or out using electronic switches, adjusting the loading or matching of the antenna externally, or changing the antenna geometry by mechanical movement. Among the three ways, switching with external circuit is the most popular ways. The electrical components for switching purpose are included PIN diode, GaAs FETs, varactors or MEMs devices. These devices offer less maintenance of mechanical parts and are smaller in size.

1.2 Problem Statement

The followings are the problem statements for this project:-

i. Using fixed or omnidirectional antenna can be considered as wasting the power. For fully utilize the power, pattern reconfigurable is proposed.
ii. Fixed antennas lack of flexibility to accommodate new services compared with reconfigurable antennas. For make its flexible, pattern reconfigurable is proposed.

1.3 Research Objectives

The objectives of the project are:

i. To design pattern reconfigurable antenna by means of switches.

ii. To simulate, fabricate and obtain patterns reconfigurable antenna.

1.4 Scope of Work

The objectives of this project can be achieved with several outlined scopes. The antenna used in this project is a Vivaldi antenna. Vivaldi antennas are useful for any frequency, as all antennas are scalable in size for use at any frequency. Printed circuit technology makes this type antenna cost effective at microwave frequencies exceeding 1 GHz. The proposed pattern reconfigurable antenna is designed with the help of switches. Reconfigurable antennas using switches offer high reliability, fast switching speed, and cost efficiency. The computer simulation package CST

Microwave Studio is used for the antenna structure design. The prototype is fabricated on a FR4 substrate. Three different reconfigurable beam angle are expected to be achieve in this project.

1.5 Thesis Outline

This thesis is systematized in FIVE (5) chapters. Chapter One gives an overview and the introduction of the project.

Chapter Two discusses review of reconfigurable antenna. The concepts of pattern reconfigurable antenna are discussed and the related work from previous study is also included. Other than that, reviews on reconfigurable antenna technology from the old until the recent technology is explained. Switches method is most cover because this technology is used in this project. Review of Vivaldi antenna focusing on tapered slot Vivaldi antenna is discussed. The last section, all the literature review from the previous study is presented.

Chapter Three contains the design methodology of the project. In this chapter, the detail discussion of methodology for the project design is elaborated. The complete description of the projects is first clarified. Flow chart is created to provide a clear plan along the way to accomplish this project. The simulation software is introduced in this chapter. Other than that, the design parameters and structure for the proposed antenna is shows in this chapter. In the last part of this chapter, the step by step fabrication procedure is explained and the measurement equipment is displayed.

In Chapter Four, the result and analysis of the simulation and measured for return loss and radiation pattern will be elaborated.

Finally, Chapter 5 explains about the conclusion and the problem which is happening when completing this project. Other than that, the summarization of this project will also be stated and the future work that can be continued by others will also be elaborated.

1.6 Summary of Work

The project flow is outlined as illustrated in Figure 1.1. The project begins with the literature review to gets knowledge and more information on the previous works that related to this research, followed by designed the structure of the proposed antenna and do the simulation using CST. Next, the prototype of the proposed antenna is fabricated on a FR4 substrate. Then the measurement of the return loss and radiation pattern is obtained. The final step is project presentation and thesis writing.

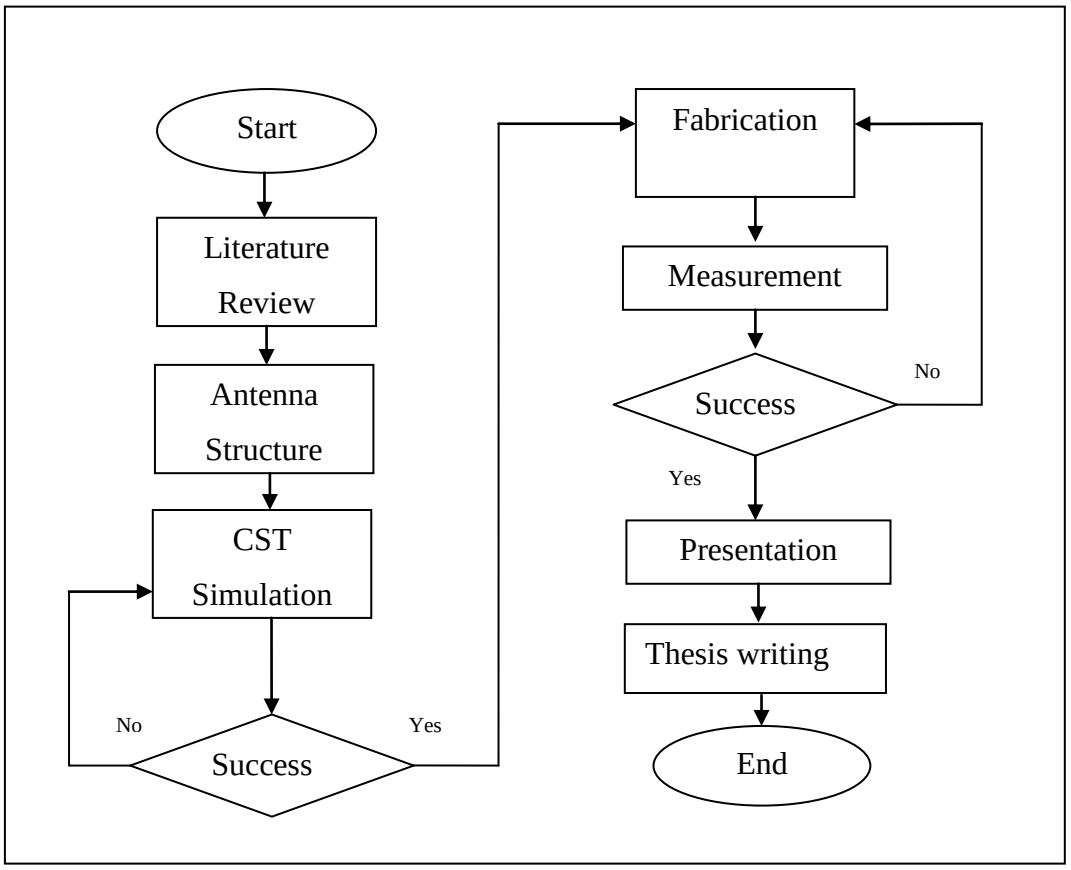

Figure 1.1 Project Overview

Figure 1.2 shows the Gantt chart of the project schedules for phase one and two. The implementation of phase one was in semester one which covers studying and understanding of literature review and also the determination of project specification. Previous research that is related to this project and various types of technology that use for doing reconfigurable antenna are studied, including mechanically, electrical and material changes.

For phase two, the fabrication of Vivaldi antenna with switches are made for three different situations. The differences are the active switch only once a time. Then, the measurement of return loss for three different active switch is accomplished. After the return loss measured at 2.4 GHz is accomplished, the radiation pattern is measured to obtain the direction of the radiation pattern when different switch is activated. Finally, presentation and thesis writing are made after the simulation and measurement results of purposed antenna were successful.

PHASE ONE															
MONTH	SEPTEMBER			OCTOBER					NOVEMBER				DISEMBER		
WEEK	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Research on related topic															
Literature review															
Methodology study															
Presentation															
Report writing															

PHASE TWO																
MONTH	FEBRUARY	MARCH				APRIL				MEI				JUNE			
WEEK	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Fabrication of Vivaldi antenna																	
Measurement																	
Presentation																	
Thesis writing																	

Figure 1.2 Project Schedule.

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