

WEARABLE MICROSTRIP PATCH ANTENNA

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**This Report is Submitted in Partial Fulfillment of Requirement for the Bachelor
Degree in Electronic Engineering (Telecommunication Electronic)**

Fakulti Kejuruteraan Elektronik dan Kejuruteraan Komputer

Universiti Teknikal Malaysia Melaka

JUNE 2013



UNIVERSITI TEKNIKAL MALAYSIA MELAKA
FAKULTI KEJURUTERAAN ELEKTRONIK DAN KEJURUTERAAN KOMPUTER

BORANG PENGESAHAN STATUS LAPORAN
PROJEK SARJANA MUDA II

Tajuk Projek : **WEARABLE MICROSTRIP PATCH ANTENNA**

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DEDICATION

I dedicate this report to my beloved parent and supportive supervisor. Without their patient, support, understanding and most of love, the completion of this report may not have been possible.

ACKNOWLEDGEMENT

First and foremost, I would like to thank **ALLAH** for giving me strength to complete the task in the planned period. I want to take this opportunity to thank all those involved directly or indirectly in completing my Final Year Project, especially my supervisor Mr Mohd Sa'ari Bin Mohamad Isa who has guided me along the development of this project. I also want to express my gratitude to my family and my friends because giving me moral support and hope that Allah will reward you guys.

Thank You

ABSTRACT

This paper presents the design of Wearable Microstrip Patch Antenna at the operating frequency of 2.4GHz. This project presents a method of applying the combinational between wearable electronics and antennas. Textile antennas are the most interesting research. In telecommunications, microstrip patch antenna increase in recent years consequently textile antennas are increasingly demanding. Microstrip patch antenna is an ideal choice for integrated into clothes using fabric substrate materials. This project is suitable for the application of the human body. Microstrip patch antennas have more advantages compared than conventional microwave antennas. However, the main disadvantages are narrow bandwidth and low efficiency. Although not possible to eliminate the total limit but there are ways to reduce these disadvantages. At the end, the textile antenna is considered as highly valuable because can use for handy various applications such as for military, medical, emergency services, navigation, and health care.

ABSTRAK

Kertas kerja ini membentangkan reka bentuk Antena Patch mikrostrip boleh pakai pada frekuensi operasi 2.4GHz. Projek ini membentangkan satu kaedah menggunakan gabungan antara elektronik dpt dipakai dan antena. Penyelidikan antenna Tekstil yang paling menarik. Dalam telekomunikasi, mikrostrip patch antena dikembangkan dalam beberapa tahun kebelakangan ini menyebabkan antena tekstil semakin meningkat. Mikrostrip patch antena adalah pilihan yang ideal untuk diintegrasikan ke dalam pakaian menggunakan bahan kain. Projek ini adalah sesuai pada tubuh manusia. Antena patch mikrostrip mempunyai lebih kelebihan berbanding antena gelombang mikro konvensional. Walau bagaimanapun, kelemahan utama ialah jalur lebar sempit dan kecekapan yang rendah. Walaupun tidak mungkin untuk menghapuskan keseluruhan had tetapi terdapat cara-cara untuk mengurangkan kelemahan ini. Pada akhirnya, antena tekstil dianggap sebagai sangat berharga kerana boleh digunakan untuk pelbagai aplikasi yang berguna seperti ketenteraan, perkhidmatan perubatan, kecemasan, navigasi, dan penjagaan kesihatan.

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LIST OF ABBREVIATION

PSM	-	Projek Sarjana Muda
CST	-	Computer Simulation Technology
IEEE	-	Institute of Electrical and Electronics Engineers
ISM	-	Industrial, Scientific and Medical
MPA	-	Microstrip Patch Antenna
WLAN	-	Wireless Local Area Network
PDA	-	Printed Dipole Antenna
MSA	-	Microstrip Slot Antenna
TM	-	Transversal Magnetic
RF Analyze	-	Radio Frequency Analyze
DUT	-	Device Under Test
NA	-	Network Analyze
TL	-	Transmission Line
SMA	-	Subminiature Version A

CHAPTER I

INTRODUCTIONS

1.1 Background

Antenna is a wireless communication and are able to access services in variety frequency bands [1]. The growing demand wireless communication makes many researchers are working hard to ensure enhance the performance and applications of antenna [2]. Antenna is the last element in the Radio Frequency (RF) equipment and also critical component. However, the transmitting and receiving antenna are directly involved in achieving the overall performance. There are several examples of wireless communication such as antenna, satellite, mobile, direct broadcast TV, navigation and other.

This paper focus on Wireless Local Area Network (WLAN) applications antenna for intelligent clothes [1, 3]. The WLAN product based on the Institute of Electrical and Electronics Engineers (IEEE 802.11) standards [4, 5, 6]. The old technology using a wire to connected between the transmitter and the receiver while the new technology using wireless to connected between the transmitter and the receiver. The focus of the project is to replace the wireless communication with wearable patch antenna in communication. The operating of weable patch antenna is illustrated at figure 1.1.

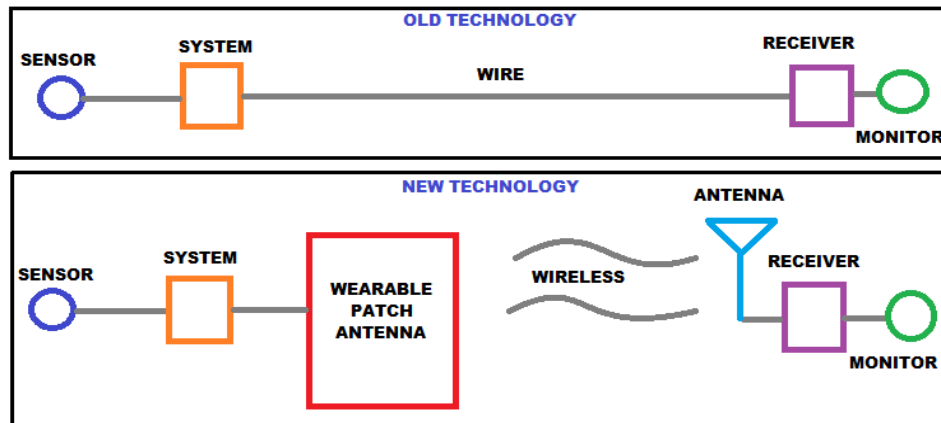


Figure 1.1: Operating of wearable patch antenna [1].

Industrial, Scientific and Medical (ISM) means devices or equipment which uses radio frequency (RF) energy to perform the work [7 - 10]. ISM is a popular frequency band. ISM applications are suitable for short range and low power communication [5, 8]. The characteristics of ISM bands are unlicensed bands operation, open frequency bands and varying by region. One of the example unlicensed band used for worldwide operation is 2.4GHz band. The unlicensed operation often used for standard protocols such as WLAN, Bluetooth, ZigBee and Z-Wave [11].

1.2 Introduction to Project

The proposed project is a Wearable Microstrip Patch Antenna [11, 12]. The main requirement was to design wearable microstrip patch antennas using jeans materials and thus integration into clothing [13]. Wearable antennas can be simple applied into clothing [2, 14]. The concept of textile antenna was introduced in 1990s [14]. Since 1997, the wearable antenna has become a popular topic at research institutions and universities [12, 31]. Textile antenna is considered as highly valuable [14]. Consequently textile antennas are increasingly demanding in recent years [4, 15].

The proposed wearable antenna is ideal for Wireless Local Area Network (WLAN) at 2.4 GHz [4- 8]. Microstrip patch is an ideal choice for integrated into clothes using fabric substrate materials which suitable for human on body application [3]. The characteristics of the project are fully flexible, robust, small design and are easy to use [14, 16-18]. The important of the project are antenna design on body application, a person can carry some range of sensors and devices and potential of commercialization. There are several factors to consider when designing an antenna such as the characteristics antenna, radiation efficiency, ease of integration and cost effectiveness [4]. This project is to improve the quality of our lives [12].

There are several applications of wearable antenna such as for military, medical, health care, emergency services and navigation [14, 16-17]. In military applications, helps in establishing communications between soldiers including sending images and videos, location tracking soldiers, army protections [14]. In medical applications, is used to keep records of health to monitor their health and can communicate with each other or with the outside world [18]. Wireless sensor network is used to improve the quality of health care and medical services that can continuously monitor patient wirelessly [6]. In health care applications, is used in physiological systems and pulse rate monitoring in doing sports [4, 7, 8, 19]. Wearable antennas also help emergency services such as firefighters, paramedics, police and detective. Finally in navigation applications, support navigation in the cars or while walking.

1.3 Objectives of project

The main objective is to study the theory of microstrip patch antenna [13]. Next, to design and study antenna characteristics such as return loss (RL), resonant frequency (f_r), bandwidth (BW), efficiency, gain, directivity and radiation pattern [1, 6, 9]. The return loss S_{11} (dB) must be lower than -10dB to get the acceptable performance. The resonant frequency (f_r) of this design is 2.4GHz. Meanwhile the bandwidth must greater than 200MHz to capture more signals. The illustrated at figure 1.2. Finally, analyze and compare between simulation and measurement result.

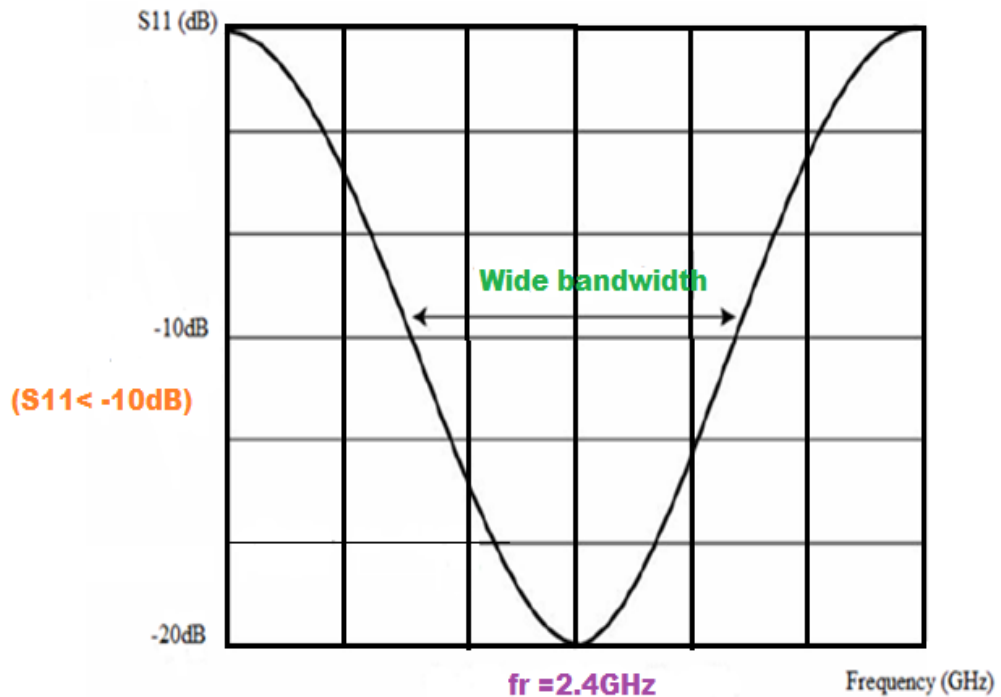


Figure 1.2: The performance of characteristics antenna [1].

1.4 Problem statement

The main challenge is to design a wearable antenna using fabric for applied into intelligent clothes. Microstrip patch antenna is an ideal choice for integration into clothing. The features of microstrip patch are thin, flat and planar structure [14, 19, 20].

There are two serious lack of the microstrip patch antenna; narrow bandwidth and low efficiency. Narrow bandwidth means have limited bandwidth and more difficult to capture the signals whereas low efficiency means that the antenna design could not operate properly [20-22]. Antenna size and ground partial location relates to the operating bandwidth and antenna efficiency. The larger antenna and ground partial on substrate to improve higher operating bandwidth and higher antenna efficiency [23].

1.5 Scope of work

The scopes of work are research articles about wearable antenna. For the researcher, to know about theory patch antennas, antenna design procedure, simulation, fabrication and measurement of human on body application. The first step is to understanding wearable microstrip patch antenna concept including characteristics and calculation. The characteristic and calculation of an antenna is important so that the simulator will run successfully. Next, to design a microstrip patch antenna that operates at 2.4GHz using CST Microwave Studio software. Fabrication does not require high costs and does not require etching. Meanwhile, antenna is measured in the laboratory using Network Analyzer and RF Analyzer. Network Analyzer is used to obtain the characteristics of the antenna and RF Analyzer is used to obtain the radiation pattern. Finally, comparison between simulation and measurement is observed to analyze the characteristics and radiation pattern of the antenna.

1.6 Methodology

This project will begin by doing the literature review section where to research and study characteristics antenna. After that, the project will be continued by choices the best characteristics of the antenna. Next, calculated all the parameter before the physical layout of the design antenna will be constructing. This thesis will be continued with understand the antenna layout circuit for the antenna design. Then the simulation will be carried out by using the CST software. If the simulator is not achieving at the resonant frequency of 2.4GHz, repeat steps required for antenna design. When all the specification meets the requirement, the fabrication process of the antenna will be carried out. This project uses simple fabrication process. After finished the fabrication, the antenna performance will be measured using a Network Analyzer and RF Analyzer [14]. Next compare between simulated and measured result. If this comparison is not achieved, shall make troubleshoot antenna design to solve antenna problems. All experimental results will be included in the final report. The illustrated at figure 1.3.

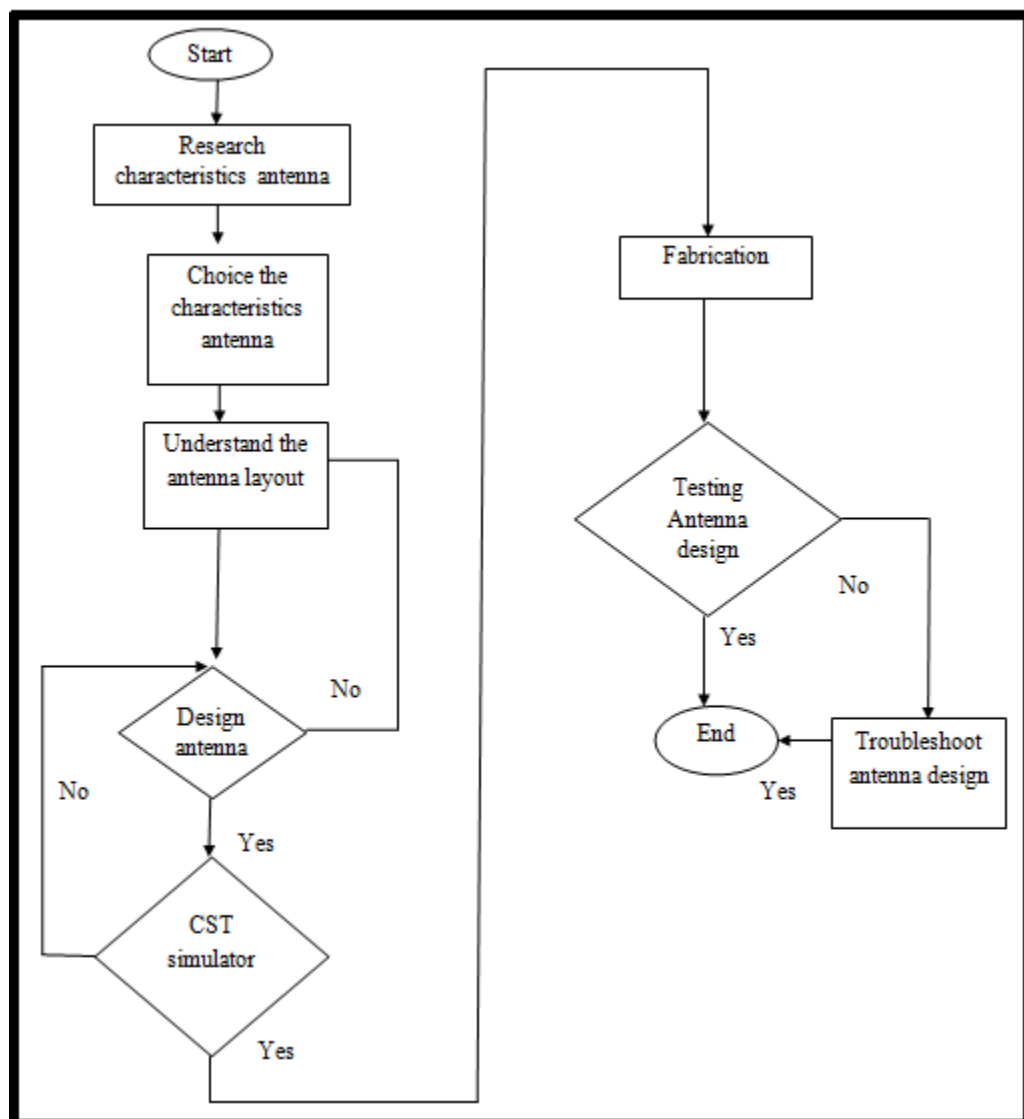


Figure 1.3: Methodology of project

1.7 Report Structure

Chapter 1 describes the introduction of this project. This chapter presents the background, introduction to project, objectives, problem statement, scope of work, methodology and review of all chapters of this project.

Chapter 2 explains the theory and concept about the patch antenna. Then, explain the introduction and the design parameter of the antenna.

Chapter 3 presents the methodology used or the design process in this project. The methodology involves the procedure of getting important data regarding to the antenna design. This result also involves the calculation and parametric study of antenna using CST software. Then, explain the synthesis technique of antenna design and produced the design antenna.

Chapter 4 presents the results achieved from this project. The comparison the characteristics antenna between simulated and measured result are shown in this chapter.

Chapter 5 will present the conclusion of this project. After all the theoretical, simulated and measured result is achieved, the conclusion comes to conclude the overall project achievement and also the future work involved.

CHAPTER II

LITERATURE REVIEW

2.1 Introduction

This chapter will explain the theory and concept about the patch antenna. Then, explain the introduction and the design parameter of the antenna.

2.2 Introduction of antenna

Antennas are essential parts in communication systems. Defines the antenna as transducer is created for sending or receiving electromagnetic waves [24]. The antenna is an electrical device that converts the radio waves into electric power and vice versa [20]. The antenna is also known as conductive elements which transfer an electromagnetic field into electrical field in the receiver, or vice versa in the receiver [23].

The function of antenna are can operate and handle the frequency range for single band and multi-band frequency [1]. Each antenna has designed a specific frequency band. Antenna will reject signal when having other than a band operation. The microstrip antenna design including any continuous shape such as square, rectangular, circular, ring, equilateral triangular, elliptical and etc. Representative shapes of microstrip patch antenna are illustrated at figure 2.1. This project, choose a