

**WEARABLE ANTENNA FOR 2.4GHz FREQUENCY FOR WLAN  
APPLICATION**

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**BORANG PENGESAHAN STATUS LAPORAN**

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**Tajuk Projek** : Wearable Antenna for 2.4GHz Frequency for WLAN  
 Application .....

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For my dearest father and mother  
( Mr. Satar bin Abu Bakar, Mrs. Rafeah binti Abdul Kadir )

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## ABSTRACT

Nowadays, wearable antenna becomes a quite popular study in technology field. The idea of this project is to develop an antenna which can be patched on the human's cloth. This project is built for the Wireless Local Area Network, (WLAN) that operate at 2.4GHz. Since the existing antenna provides low coverage with small gain, thus the new antenna is develop in order to give higher gain to extend the coverage. The aims of this project are to design a wearable antenna with high gain and to reduce the radiation to the user by apply Electromagnetic Band Gap, (EBG). The detail design for this kind of project is doing by using formula and parameter study using CST Microwave Studio 2011 software. The output of this project is the wearable antenna with 2.4GHz center frequency and return loss less than -10dB. Besides, the gain of the antenna must be greater than 3dB. Not only that, the antenna produce must have minimum back radiation to prevent radiation effect to user.

## ABSTRAK

Pada masa kini, antena yang dipakai pada pakaian menjadi satu kajian yang agak popular dalam bidang teknologi. Idea projek ini adalah untuk mereka cipta sebuah antena yang boleh ditampal pada pakaian. Projek ini dibina sesuai untuk Wireless Local Area Network, (WLAN) yang beroperasi pada frekuensi 2.4GHz. Antena sedia ada memberi luas liputan yang rendah dengan menyediakan pulangan yang agak rendah. Tujuan projek ini adalah untuk mereka bentuk antena yang dapat dipakai dengan pulangan yang tinggi dan mengurangkan radiasi kepada pengguna dengan megaplikasikan „Elektromagnetic Band Gap“, (EBG). Reka bentuk terperinci untuk projek ini adalah dengan menggunakan formula dan kajian parameter dengan menggunakan perisian CST Microwave Studio 2011. Output projek ini adalah antena yang boleh dipakai dan dapat berfungsi pada frekuensi 2.4GHz dan pulangan balik kurang daripada -10dB. Selain itu, pulangan antena hendaklah lebih besar daripada 3dB. Bukan itu sahaja, hasil antena mesti mempunyai radiasi yang minimum untuk mencegah kesan radiasi kepada pengguna.



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## CHAPTER 1

### INTRODUCTION

Nowadays, telecommunication is an important thing in our daily life. Every single time people will communicate to each other either to find out the latest news or to strengthen the relationship. Antenna is the main element in communication system since it is a device that used to radiate and receive radio waves. Without antenna, the world will have its own boundary since everyone cannot communicate with each other.

The antenna is being developed due to the need in a wireless communication system and device. Antenna is applied on the traditional radio, television and wireless devices. Antenna is a metallic device used to radiate or receive radio waves and otherwise. There are various type of antenna such as horn antenna, lens antenna, aperture antenna and others. Patch antenna is a type of antenna which can be mounted on a flat surface or grounded surface [1]. Patch antenna is a quite popular because it is easy to fabricate, simple and also inexpensive to fabricate by using modern printed-circuit technology. Even it is a simple antenna, however it can be mounted on the surface of the high performance aircraft, satellites, cars and

spacecraft [1]. Patch antenna is always subjected to rough and harsh use since it is will be bend, twisted and turned [3].

Nowadays, there is variety of shapes of the patch antenna produced. The produce antenna is focus on the specification that needs to be upgraded based on their operating frequency. There is various type of antenna that operates at variant frequencies for different applications. The operating of the antenna depends on the frequency band which it is represent such as 2.4GHz for Local Area Network, (LAN) and 3.3GHz for Worldwide Interoperability for Microwave Access, (Wimax) application.

As explained before, the patch antenna is an antenna that can be mounted on a flat surface such as FR4 board. Here, the project is focus on the antenna that can be implemented on a piece of cloth or fabric. The wearable antenna is a patch antenna that is stick on a piece of fabric such as jeans, cotton or polyester. Here, the jeans is used as the main element because it has a good strength and easy to handle [13].

### **1.1 Project Background**

With the growing of technology, many products are developed in order to make life easy. The product produced not only gives an advantage to the user but the most important is it is easy to handle. In this new era, the communication becomes vital in our daily life. However, the communication will become quite complex due to few problems such there is a very limited coverage of the internet access.

This project is focused on the wearable antenna developed for the Wireless Local Area Network, (WLAN) medium that specialised for the frequency of 2.4GHz. Nowadays, internet has played an important role in human life. That is why the wearable antenna is determined to be built in order to make life easy.

To get a quite strong of signal, an antenna is used since it functions to receive the radio waves or signal. The main idea of this project is to implement a type of patch antenna on a piece of cloth. Before, it can be seen that the antenna is implemented at the car, in telephone and other devices to get the efficient signal. Here, the question is can an antenna be embedded on the user's cloth so that the

communication network can be improved? Thus, this project is basically designed for all people and focused on WLAN application.

Jeans is used as the main material of this project. Jeans is chose because, nowadays many types of cloths used jeans as the fabric. This is due to the good strength provided by this fabric. Besides, it is easy to sew and manage. Thus, this project is predicted to be developed.

## **1.2 Problem Statement:**

Most users use Wi-Fi as their main medium of communication to link with others. Thus, the antenna with centre frequency of 2.4GHz is a demanding antenna nowadays. Microstrip patch antenna has been widely used because of its advantages and most of them are produced for the WLAN application. However the existing microstrip antenna provides low coverage area with low gain. The use of wearable antenna is widely been studied for the use of WLAN application. Since it is the antenna that patched on the cloth, thus it will provide back radiation to the users.

## **1.3 Objectives**

The objectives of this project are:

- 1) To produce wearable antenna that can cover 2.4GHz WLAN application
- 2) To increase the coverage of the antenna by provide higher gain
- 3) To design an antenna and simulate by using CST Microwave Studio 2011 software
- 4) To increase gain of antenna by using electromagnetic gap, EBG
- 5) To reduce back radiation by using electromagnetic gap, EBG

## 1.4 Scope

This final year project begin with the literature study of the regarding topic. It focuses on the development of the wearable antenna by using jeans fabric that can be used in 2.4GHz.

The scope of this project is to build a wearable antenna that can operate in a frequency which is 2.4GHz. The antenna design should be used in Local Area Network, (LAN) application. The return loss of the designed antenna should be less than -10dB. The wearable antenna is a patch antenna that is stick on a piece of fabric such as jeans, cotton or polyester. Here, the jeans is used as the main element because it has a good strength and easy to handle and sew.

The antenna that had been chosen as the design is an inverted F-shaped patch antenna. Patch antenna is selected to be used in this project due to a few of advantages such low cost, easy to fabricate and light in weight. The size of the antenna will be reduced to a small size in order to make it more compact. The compact size of the antenna will make the coverage greater since it will improve the bandwidth and gain.

The chosen antenna then will be designed and simulate by using CST Microwave Studio 2011 software.

## 1.5 Outline of Thesis

This thesis consists of five chapters. Chapter 1 will give brief introduction on the antenna, the lists of objectives of the project including scope on the design. Not only that, this chapter also summarized what is the project is all about.

Chapter 2 contain the literature review on the antenna. This section gives some outline on the research that has been done before that brought to the existing antenna. The overview of the existing antenna also indicates the features provided including the disadvantages of the antenna produced.

Move to chapter 3 that shows the methodology used in this project. To be more simple and straight to the point, the flow chart of the design process is also

provided. The flow chart shows the steps or sequences taking while doing this project.

Chapter 4 is about the result including the discussion of this project. It involves the result of simulation and measurement of the antenna.

The last chapter which is chapter 5 conclude the finding including the suggestion for the future study.

## CHAPTER 2

### LITERATURE REVIEW

#### 2.1 Overview

This chapter will contain brief overview of the antenna. Besides, the antenna family also being explain here. In addition, the review on the antenna design also will be representing in this chapter.

#### 2.2 Introduction on the Antenna

Antenna is a root of telecommunication system. Without antenna, there will be no signal transmitted and received. Antenna is also known as the transitional structure between free space and a guiding device. This antenna is used to transport electromagnetic energy from the transmitting source to the receiver. That is how an antenna works.

Antenna can be defined as a device that used for receiving or radiating radio waves [10]. According to Webster's Dictionary, antenna can be described as "a