DESIGN OF DIPOLE PLANAR ANTENNA FOR RFID APPLICATION

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For the most beloved and supporting parents,

MUHAMMED NOR BIN YAACOB
FATAHIAH BT YAACOB

Dedicated, in thankful appreciations for the support, encouragement, love and understanding.

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ABSTRAK

Projek ini menerangkan mengenai reka bentuk antena planar dwikutub untuk aplikasi RFID. Frekuensi yang dipilih adalah pada 2.45GHz dimana ia digunakan untuk aplikasi RFID. Pengenalan Frekuensi Radio (RFID) telah berkembang maju dan digunakan dalam kebanyakan aplikasi seperti kilang, gudang, sistem kehadiran dan lain-lain. Antena untuk pembaca yang dicipta akan digunakan di kedai kasut dan diletakkan di rak kasut. Polarisasi merupakan perkara yang penting untuk ditimbang dalam reka bentuk antena dan polarisasi linier digunakan kerana tag yang dilekat pada kasut adalah tetap dan diketahui kedudukannya. Projek ini melibatkan proses penyelidikan, mereka, simulasi, pengukuran, penilaian dan fabrikasi antena untuk aplikasi RFID. Rekaan antenna ini mempunyai susuk rendah yang sesuai dilekatkan pada objek yang dikehendaki dan murah untuk tujuan pasaran. Di dalam rekaan penerima ini, perisian CST telah digunakan untuk menganalisa seluruh struktur litar. Parameter antena yang disimulasi adalah gandaan, bentuk radiasi, frekuensi dan lain- lain. Gandaan yang dibuat pengukuran akan dapat memberikan analisis karakter radiasi. Proses pengukuran menggunakan spektrum penganalisis, rangkaian penganalisis.

ABSTRACT

This project describes a design of dipole planar antenna for RFID applications. The frequency chosen is at 2.45GHz which is particular interest for RFID application. Radio frequency identification (RFID) is rapidly develop and being use in many application such as attendance, animal tracking, warehouse, factory and so on. This reader antenna will be use in warehouse which is shoes store and installed at the rack of shoes. Linear polarization is chosen for design this antenna because the tags from shoes is fixed and known. This work involves the research, design, simulation, performance, measurement and fabrication of a printed antenna for RFID application. This antenna designs almost low profile, small enough to be attached to the required object and cheap for commercial purposes. In this design, CST software is used to simulate the antenna performance and antenna parameter. The antenna parameter that simulated is return loss, bandwidth, gain, radiation pattern and directivity. Gain measurement will carried out to determine the radiation characteristics performance. The measurement process is using the spectrum analyzer and network analyzer.

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LIST OF ABBREVIATIONS

Symbol	Definitions
RFID	Radio Frequency Identification
CST	Computer Simulation Technology
EAS	Electronic Article Surveillance
MCMC	Communications and Multimedia Commission
WiMAX	Worldwide Interoperability for Microwave Access
WLAN	Wireless Local Area Network
HPBW	Half-Power Beam width
FNBW	First-Null Beam width
3D	Three Dimension
FBW	Frequency Bandwidth
EM	Electromagnetic
TEM	Transverse Electromagnetic
CPW	Co-planar waveguide
GPS	Global Positioning System
ADS	Advanced Drainage
PCB	Printed Circuit Board
FR4	Fire Retardant-4
ISM	Industrial Science and Medical
IE3D	Industry Standard for 3D Electromagnetic Design
IC	Integrated Circuit
UV	Ultra Violate
DXF	Drawing Interchange Format

LIST OF SYMBOLS

Symbol	Definitions
dB	Decibel
dBm	Decibel per meter
mm	Milimeter
G	Giga
h	Heigth
Hz	Hertz
F	Frequency
M	Mega
K	Kilo
Ω	ohm
d	Distance
λ	waveguide
cm	centimetre

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CHAPTER I

INTRODUCTION

1.0 Project background

This project is describes a design dipole planar antenna for RFID application for 2.45GHz. RFID (Radio Frequency Identification) is a term that is used to describe a system that transmits the identity of an object, goods or person wirelessly or using radio waves. This new technology is used in some application like electronic toll collection, asset identification, retail item management, access control, animal tracking and vehicle security. The label tags that used before is generally cannot operate as well on the surface of conducting materials due to the degradation of the tag performance. Technology of radio communication was rapidly growth in last 10 years and improves their performance in order to make it smaller, cheaper and reliable. A basic component of RFID is RFID tags, readers or antenna and transceiver.

Planar antenna is the one of type antenna that used in designing the antenna for RFID application and it is the latest type that develops. This type is very popular because of ease fabrication and many advantages. This antenna is also low cost and inexpensive because of the simple 2-dimensional physical geometry. Planar antenna is low profile and has the capability to be fabricated using the printed circuit technology.

1.2 Problem Statement

Nowadays, the RFID is the better choice compared with barcode in the manufacturing industries or warehouse, service industries, distribution logistics to identify goods. Barcode label is used before this is seems to have disadvantages of limited storage capacity and cannot be reprogrammed. The tags sometimes cannot be detect in certain distance, so the reader antenna is design to provide good performance of tag identifications. In the store of shoes shop the outgoing stock sometimes did not written in the book or system that use barcode label, so there might cause problem to the shop owner in checking the update stock. So, to overcome this problem, reader antenna is introduced and the RFID system is replacing the barcode. Reader antenna will be installed in the store of shoes shop to detect the tags from goods and carry on the information of incoming and outgoing stock in their store.

1.3 Scope

The scopes of this project are to study the dipole planar antenna for RFID reader application on several published papers, journal, and books. Literature review about the planar antenna had been done for in detail understanding the concept, theoretical and characteristic of planar antenna itself. Besides that, Radio Frequency Identification (RFID) had been studies and understand first before proceed with the project. Planar antenna that has linear polarization is designing for the operating at 2.45GHz frequency.

The design of antenna is simulate using Computer Simulation Technology (CST) Microwave Studio simulator. The parameter of antenna will be simulating to show the performance of antenna. The design is fabricated by using photolithography as well as etching process on FR4 substrate after the simulation is done and satisfy.

Network Analyzer was used to measure the designs. Then, the results were analyzed based on several parameters, such as return loss, gain, radiation pattern and so on. Both simulated and measured data are analyze and compared. Lastly, report writing has to write regarding to the project.

1.4 Objective

The objectives of this project are to design, simulate and fabricate the dipole planar antenna for RFID reader at operating frequency of 2.45GHz. The design will be analyze and performance of antenna between simulation and measurement.

1.5 Outline of Thesis

This thesis consists six chapters. The first chapter gives a brief introduction of antenna, RFID and advantages of planar antenna. It also discussed the problem statement, scope and objective of the project.

Chapter two introduces the history of RFID and antenna description. It also discusses the antenna parameter and literature review from other researcher.

Methodology of this project is discussed in chapter three. It is consisting of flow chart project, Gantt-chart, K-chart and fabrication flow chart. Besides that, the measurement process also being discussed in this chapter.

Meanwhile, in Chapter four is result analysis and discussion of project. It is contains of result simulation and measurement. The comparison of both results has been made and a brief discussion regarding to this project were state in this chapter.

Chapter five is about future work or recommendation to the project. There is also conclusion on overall project and reference books and journal that used in completed this project.

1.6 Summary

This chapter introduced the RFID, antenna and advantages of planar antenna. The problem statement, scope and objective of this project also consist in this chapter. In the following chapter, literature review is reported.

CHAPTER II

LITERATURE REVIEW

2.1 Introduction

2.1.1 History of RFID

Radio frequency Identification (RFID) is a new technology that comes after bar coding. The concept of both is similar which is enhancing data processes. This technology has been use at 1970s and earliest papers exploring RFID by Harry Stockman. "Communication by Means of Reflected Power" publishes in 1948. IFF (Identification Friend or Foe) systems for aircraft are a technology that related to the RFID and it is long range transponder systems.

The development of integrated circuit, the microprocessor and changing business practices thirty years before technology caught up with the theory. In the 1950's there was a theoretical exploration of RFID techniques with a number of pioneering research and scientific papers being published [2].

Several inventors and researchers developed prototype systems in 1960s. Sensormatic and Checkpoint are some of the example of commercial system that launches with electronic article surveillance (EAS) equipment used as an antitheft

device. These systems used 1 bit tags detecting absence of a tag, were used in retail stores attached to high value items and clothing.

Los Alamos Scientific Laboratory and the Swedish Microwave Institute Foundation are from researchers, developers and academic institutions that have a good interest in RFID at 1970s [2]. Development work is become much well in this time and some of application RFID such as animal tagging became commercially viable. In the 1990s the widespread adoption of electronic toll collection was important in the United States. In 1991 an electronic tolling system opened in Oklahoma where vehicle could pass toll collection points at highway speeds, no toll booths. In Europe there was also considerable interest in RFID applications including toll collections, and rail applications [2].

2.1.2 RFID

RFID (Radio Frequency Identification) is a term for technologies that use radio waves to automatically identify people or objects. RFID systems have three components which is RFID tag, a reader with an antenna and transceiver and a host system or connection to an enterprise system.

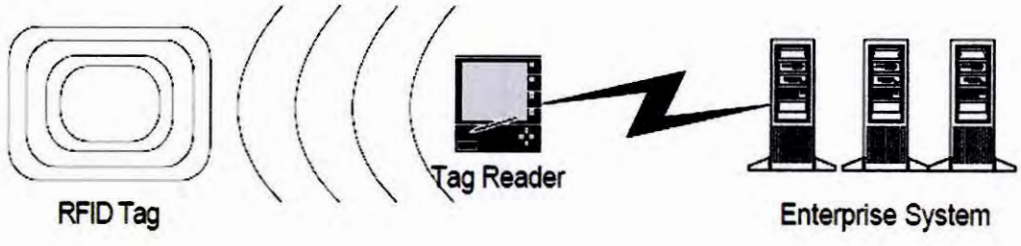

Figure 2.1: Component of RFID [7]

Tags are also known as transponder transponders which is "active tags" and as "passive tags" which is unpowered devices. The characteristic of active tags are larger and more expensive than passive tags. While, the characteristic of passive tags have an unlimited life, lighter, smaller and cheaper. Reader is able to detect the tag at a long range.

RFID Readers sometimes referred as interrogators and it is electronic devices that transmit and receive radio waves that uses an antenna attach at the reader. Readers not only interrogate tags for information, but they can also be used to program information to tags.

2.1.3 Frequency allocation of RFID

Several frequency have been assigned to RFID applications, there are 125-135 KHz, 13.56 MHz, 866-869 MHz, 902-928 MHz, 2.45 (2.400-2.4835) GHz and 5.8 (5.725-5.875) GHz. Each country has its own frequency allocation for RFID and the table 2.1 shows the frequency allocation for each country. Communications and Multimedia Commission (MCMC) is the main bodies governing frequency allocation for RFID in Malaysia.

Table2.1: Frequency allocation for RFID

State	Frequency
Europe	865.6 - 867.6 MHz
North and South America	902 - 928 MHz
Japan	950 - 956 MHz
Malaysia	919 – 923 MHz
India	865 – 867 MHz
Korea	908.5 – 910 MHz
South Africa	865.6 - 867.6 MHz
New Zealand	864 - 868 MHz
Taiwan	922 - 928 MHz
China	920.5 - 924.5 MHz
Australia	920 - 926 MHz