INVESTIGATION OF HIGH GAIN ANTENNA FOR OFF-GRID COMMUNICATION AT 915MHZ

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Signature :

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Date : 1 Jun 2018

APPROVAL

I hereby declare that I have read this thesis and in my opinion this thesis is sufficient in terms of scope and quality for the award of Bachelor of Electronic Engineering with Honours.

Signature	:
Supervisor Name	: PROF DR ZahrilAdha bin Zakaria
Date	: 1 Jun 2018

DEDICATION

Special dedication to:

My beloved and supportive parents

My Supervisor

Utem staff

And to all of my friends

For their encouragement, and best wishes

ABSTRACT

Recently, wireless coverage for outdoor communication system leans on base tower station to operate adequately. After all, most of the remote regions such as forests, hills or secluded place are not entirely covered by any telecommunications coverage. Thus, it is complex to reach out to people outside that particular region. Similarly, occur during the natural disaster. Communication process cannot be accomplished if the base tower station breaks down during landslide or earthquake. Hence, to overcome this issue, Malaysia Communication and Multimedia Commission (MCMC) has suggested a specific frequency spectrum for Short Range Device (SRD). Proceeding to this, a prototype of a planar antenna which supports the wide range of spectrum specifically for outdoor appliances is the main goal of this project. An antenna with a frequency of 915 MHz is designed by using Computer Simulation Technology (CST) software. This investigation also introduces a planar antenna that comes with a compact in size with a gain of 4.347dB and return loss of 12.761dB. This research is important for the off-grid wireless communication system to restore connection in deserted regions and during an emergency.

ABSTRAK

Baru-baru ini, liputan wayarles untuk sistem komunikasi luar bersandar pada stesen menara asas untuk beroperasi secukupnya. Bagaimanapun, kebanyakan kawasan terpencil seperti hutan, bukit atau tempat terpencil tidak sepenuhnya dilindungi oleh sebarang liputan telekomunikasi. Oleh itu, ia adalah kompleks untuk menjangkau orang-orang di luar kawasan tersebut. Begitu juga berlaku semasa bencana alam. Proses komunikasi tidak dapat dicapai jika stesen menara pangkalan terputus semasa tanah runtuh atau gempa bumi. Oleh itu, untuk mengatasi masalah ini, Suruhanjaya Komunikasi dan Multimedia Malaysia (SKMM) mencadangkan spektrum frekuensi tertentu untuk Peranti Pendek (SRD). Prosiding ini, prototaip antena planar yang menyokong pelbagai spektrum khusus untuk peralatan luaran adalah matlamat utama projek ini. Antena dengan kekerapan 915 MHz direka bentuk dengan menggunakan perisian Teknologi Simulasi Komputer (CST). Penyiasatan ini juga memperkenalkan antena planar yang bersaiz padat dengan keuntungan 4.347dB dan kehilangan kembali 12.761dB. Penyelidikan ini adalah penting untuk sistem komunikasi wayarles grid untuk memulihkan sambungan di kawasan-kawasan yang terpencil dan semasa kecemasan

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ABBREVIATION

SRD	Short Range Device
CST	Computer Simulation Technology
dB	Decibels
RL	Return Loss
VSWR	Voltage Standing Wave Ratio
MCMC	Malaysia Communication and Multimedia Commissions
M	Meter
Km	Kilometre
BW	Bandwidth
VNA	Vector Network Analyzer
MHz	Megahertz

CHAPTER 1

INTRODUCTION

This chapter discusses public overview and shortly justify the project by explaining the objective, problem statement and the scope of the project.

1.1. Project Briefing

Planar antenna is an antenna which all of the elements of active and parasitic are in one plane. It provides large aperture and uses the concept of directional beam. This project is concentrating on the advancement of the planar antenna for the off-grid wireless communication system. The basic concept of communication is to depend fully on base tower station, thus Malaysia Communications and Multimedia Commission (MCMC) has suggested a frequency spectrum for Short Range Device (SRD).

The design of this high gain planar antenna is using microstrip patch approach. Which this antenna is expected to reimburse the narrow bandwidth attribute possessed by the dipole antenna or conventional monopole antenna. It also supposed to be a different method to communicate, if the base tower station breaks down due to the natural disaster. The main goal of this project is a prototype of high gain planar antenna that can sustain the wide range of the spectrum, especially for outdoor appliances. Briefly, this project will apply the approach of microstrip patch antenna. The design of stacked patch antenna will be concluded by using Computer Simulation Technology. After that, the antenna will be connected to Short Range Device (SRD) at the frequency of 915 MHz to generate off-grid wireless communication system in the range of 2km. this device is assumed to restore the coverage between the isolated area with the metropolitan cities.

1.2 Problem Statement

Naturally, we know, remote and busy areas, such as forest, countryside, concerts, hills, and others are not covered with cellular signal coverage. Thus the communication proses between this affected areas with other areas cannot be attained. Hence, this will be a difficulty to communicate even with basic texts, calls or GPS location to that off-grid regions. Other than that, nature disaster also can contribute to this matter as it can bring efficiency to the base tower station condition. Regarding this condition the transceiver tower will break-down and caused an interruption in the communication system, users at the affected areas can utilize their phones because of congested coverage and priority need to be given to public

facilities such as clinics and hospitals. A new invention has been suggested by expanding a wireless off-grid communication system. This can be a replacement method to interact in the absence of normal communication. Malaysia Communications and Multimedia Commission (MCMC) has suggested unequivocal frequency spectrum for Short Range Device (SRD).SRD technology can be utilized to generate an off-grid communication to recover the normal communication in the absence of transceiver tower or base station. SRD that work in the frequency of 915MHz, are capable to cover the communication problem in remote areas. [1] However there are still limitations on conventional patch antenna. When it comes to higher frequencies, these conventional patch antenna designs confront severe limitations. For example, narrow bandwidth and low gain there are various techniques to achieve a wide bandwidth and high directivities, such as a large ground plane, thick substrate [1], coupling aperture and air gap [2] are introduced. Hence my study will enhance the SRD range, with using one of the techniques and the expected gain value is 5-6 dB So that the antenna can be designed and fabricate with greater gain in compact size and can cover up to 2km.

Figure 1.1: Rooftop view of flood incident happen in Penang

Figure 1.2: Landslide occur in Tanjung Bungah

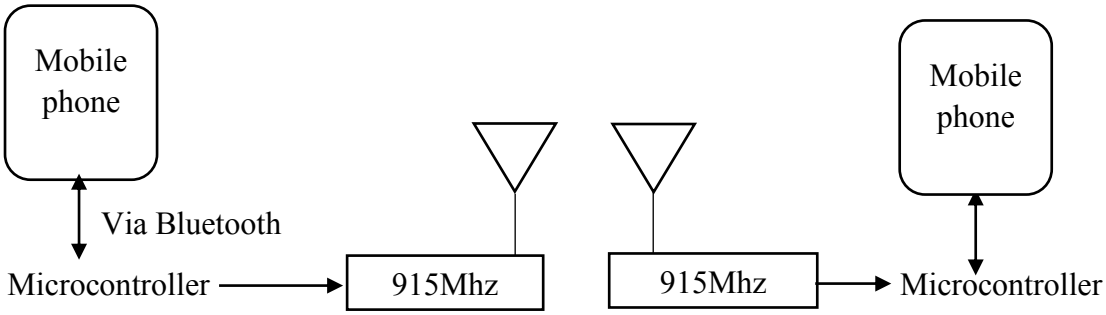

Figure 1.3: Communication Concept of Short Range Device

1.3 Objective

The main purpose of this project is to develop planar antenna for the off-grid wireless communication system. Some objectives have been listed down:

i. To design a high gain planar antenna for off-grid wireless communication by using 915MHz frequency.

ii. To analyze the vital elements in antenna such as frequency, bandwidth, antenna parameters, gain, and return loss.

iii. To validate and evaluate the design in the laboratory.

1.4 Scope of Project

In this project, a high gain planar antenna will be designed for Short Range Device (SRD) by using a free license frequency of 915MHz and expected gain to achieve is 5-6 dB. Computer Simulation Technology (CST) software will be used to design the antenna. Substrate use is FR-4 and copper plate. The antenna will be validated in the laboratory. Vector Network Analyzer (VNA) and the anechoic chamber will be used to validate the parameters of the antenna. Two devices will be used in a field test and each is connected with radio module and used in separate distance to justify that this antenna can achieve the expected range of communication.

1.5 Organisation of Thesis

In chapter 1, a short analysis has been done. It covers the problem statement which has been a catalyst to aid the project, and few goals have been concluded and achieved at the end of the project. The scope of work to has been interpreted to find out the software and process of the study.

For chapter 2, 20 references from journals and websites have been a source to get the information. The information that comes from websites is focused more on technique to overcome the problem whereas the information from journals stressed more on the designs of the antenna. Next, the antenna is investigated regarding of its parameter such as bandwidth, frequency, gain, return loss, and its size to get the optimum antenna design.

Next, in chapter 3, a flow chart showed the development of the project, divided into 6 phases, starting from literature review until report writing. This project use hardware devices such as Vector Network Analyzer (VNA) and software which is Computer Simulation Technology (CST). The design and simulation process of the antenna is interpreted specially in designing the patch and the slot of the antenna. After the simulation process of the antenna, both simulation and measurement outcome has been documented and compared.

In chapter 4, the design of the antenna is explained. The outcome simulation from CST and result from lab measurement has been compared regarding its return loss, gain, frequency, bandwidth, and radiation pattern. The differences between these two results have been distinguished and the reason has been analysed. Also, the tuning

process, which includes the changing path dimension and differing the u-slot dimensions. Based on the results, the patch act to shift to lower the frequency but u-slot change the return loss of the antenna.

Lastly, in chapter 5, a conclusion about the product of this project is made. Thus the antenna design can be enhanced in future studies to get better results and more optimum.

CHAPTER 2

LITERATURE REVIEW

This chapter discusses on some of the sources such as previous journals, websites, and papers as the reference in this project. All references have been cited.

2.1 Introduction

Telecommunication technology is changing promptly and thus new communication approach and practical devices are suggested [7]. The upsurging of telecommunication technology gives a lot of benefit to human, exclusively by generating an advance community and authorize the exchange of information. Unluckily the secluded areas such as villages, forest, hills are not fully covered by the coverage. Hence, make it hard to interact even with basic texts, calls, or GPS location to that particular off-grid regions. Service operators of the telecommunication companies essentially covered metropolitan areas and not fully