DEVELOPMENT HIGH GAIN ANTENNA FOR OFF GRID WIRELESS COMMUNICATION SYSTEM

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Date : 2/6/2017

Special dedicated to,

My beloved and supportive parents,

My Supervisor,

My family,

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ABSTRACT

In these current years, an extraordinary progression and development has been accomplished in the wireless communication. Other than that, the market likewise requests for portable and multi-useful gadgets. So, a antenna which assumes an imperative part in transmitting and receiving radio recurrence motions in wireless communication, should be conservative and in addition to have the capacity to work in different applications. However, most of the remote and disaster area are not fully covered by any telecommunication coverage. Hence, it difficulties to communicate with a local call, texting, or surf internetin any off grid area. Therefore, The MCMC have introduced frequency spectrum for short range device to solve the problem. To realize this, the frequency 915MHz are design as recommended for SRD by using CST software. Therefore, this study to design a new compact of antenna for SRD that produce higher gain antenna by using CST software. So,the antenna has covered the frequency 915MHz with return loss and gain are -13.06 and 7.01. This study is important for off grid wireless communication to cater remote area and emergency situation.

ABSTRAK

Dalam tahun semasa, perkembangan dan pembangunan yang luar biasa telah dicapai dalam komunikasi tanpa wayar. Selain daripada itu, pasaran juga permintaan untuk alat mudah alih dan pelbagai berguna. Jadi, antena yang menganggap satu bahagian penting dalam menghantar dan menerima usul berulang radio dalam komunikasi tanpa wayar, harus konservatif dan di samping mempunyai keupayaan untuk bekerja dalam aplikasi yang berbeza. Walau bagaimanapun, sebahagian besar daripada kawasan pedalaman dan bencana tidak dilindungi sepenuhnya oleh mana-mana liputan telekomunikasi. Oleh itu, kesukaran untuk berkomunikasi dengan panggilan tempatan, SMS, atau melayari internetin mana-mana kawasan grid off. Oleh itu, SKMM telah memperkenalkan spektrum frekuensi untuk peranti jarak dekat untuk menyelesaikan masalah ini. Bagi merealisasikan ini, 915MHz kekerapan adalah reka bentuk seperti yang disyorkan untuk SRD dengan menggunakan perisian CST. Oleh itu, kajian ini juga tujuan reka bentuk yang kompak baru antena untuk SRD yang menghasilkan keuntungan antena yang lebih tinggi dengan menggunakan perisian CST. Jadi, antena telah dilindungi 915MHz kekerapan kehilangan pulangan dan keuntungan adalah -13,06 dan 7.01. Kajian ini penting untuk komunikasi wayarles dengan grid untuk menampung kawasan terpencil dan keadaan kecemasan.

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ABBREVIATION

CST	-	Computer simulation technology
dB	-	Decibel
MHz	-	Megahertz
VSWR	-	Voltage standing wave ratio
RL	-	Return loss
SRD	-	Short Range Device

CHAPTER 1

INTRODCUTION

1.0 Project Briefing

For basic wireless communication system, it consists of a transfer medium, transmitter and receiver. The demand for small size, light weight and low cost antenna has increased with the widespread development of wireless communication like satellite communication. This project is about development high gain antenna for off grid wireless communication system. This project focus on high gain antenna to cover off grid wireless communication if the antenna cannot be used. It is the alternative wayto communicate to cover isolated area. The designing stacked antenna with frequency lass than 1GHz is design by using CST suite. Then the antenna will connected to short range device.

1.1 Problem Statement

Mobile telephone base station are important. Most of the remote areas are not covered by any telecommunication, so it difficult to communicate with basic text or GPS location in any off-grid areas.If disaster occur such as flood and earthquake, the communication system will not function [1]. So, mobile phone cannot communicate. This case also happen in outdoor activities like camping in the jungle where no telecommunication signal (such as celcom, digi, maxis)[2]. To solve problem, the off-grid communication without using normal communication which utilizes radio frequency technology to send data even in the absance of telecommunication coverage. To solve the problem, the Malaysia communication and Multimedia

Commission(MCMC) have presented recurrence range for Short Range Device (SRD) [3]. This useful when communication using a normal mobile phone without normal communication.

So, the antenna can be considered as the backbone to wireless system. Narrow band antenna are not suitable due to their limited bandwidth [4]. Microstrip antenna are extremely suitable for these application because they are compact and low profile while offering good performance. Compact microstrip antenna have recently received much attention due to the increasing demand of small antenna for personal communication equipment.

1.2 Objective

The main objective of this project is to develop high gain antenna for off grid wireless communication system. The objectives have been declared and must be achieved in completing this project. The objectives is a guideline of any project, thus the objectives of the project are :

i) To design high gain antenna for off grid wireless communication system

ii) To design and simulate high gain antenna that suitable for SRD application (915MHz)

iii) To simulate and analyze the proposed design through the simulation of high gain antenna using electromagnetic(EM) simulator such as CST.

Iv) To evaluate and verify the design in laboratory and field test environment.

1.3 Scope

The scope of this project is to design a high gain antenna with resonance frequencies which are 915MHz covering wireless application. Along with this project, all antenna design work will be done by using CST software. The simulation of the

antenna design includes finding on the basic parameter such as resonant frequency, return loss, gain, directivity, and efficiency. The fabrication process is done by using chemical etching. This is because chemical etching technique is simple to be implemented and found in the faculty. The material used for designing the antenna is FR-4 board which has the specification such as dielectric constant of substrate, tangent loss of substrate, thickness of substrate and thickness of copper. The measurement will only be done after fabrication process. Antenna parameter such as resonance frequency, return loss, gain and directivity will be measured. After that, the field test was done with connected to the srd device to determine the distance that antenna can be transmit signal.

1.4 Organization of thesis

Chapter 1 will briefly discuss on the overview of the project carried out. The overview including the background of the project, problem statement, project motivation, project objective, scopes and limitations and outline will be presented in this chapter. This chapter will also explain the reason to design this antenna.

Chapter 2,this chapter has undertaken other projects to gain knowledge and information needed to complete this project. To make this project successful, information from primary sources for this project from a previous project and related thesis project are collected. Other sources such as book, journals, and articles obtained from internet. So this chapter discusses the project which related to the project.

Chapter 3 will explains the methodology of project in detail. Methodology is one of the important parts to the project. It is important to determine the methodology used to ensure the success of this project. Beside that to ensure that project meets the scope and reach goals of the objective

Chapter 4 presents the simulated of the design antenna. The software used to model and simulate the antenna design is CST Microwave Studio. Theoretically, calculations and parametric studies were performed to develop c microstrip patch antenna that could operate in the microwave frequency. All the calculation of EM field is done using

„transient solver" with default setting. Initially, simulation is performed using analytically computed antenna parameters.

Chapter 5 discuss about the conclusion of the project, which is the whole of the project that have be done after all the development of antenna design from the beginning with the literature study until the result and analysis is implemented of the project. There is also recommendation for the future works to improvise the system and to make this system usefully and move efficiently rather than previous design

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This task has undertaken other projects after gain competencies or statistics wished in conformity with whole this project. To perform the project successful, information from previous project and related thesis project are collected. Other sources such as like book, journal, then article from internet. So, this chapter discusses the project which is related to the project.

2.2 Literature survey

Literature survey was performed on a journal to collect related information and facts that can be used in the design process. It was carried out by performing a review of the literature in several journal related to the research. Table 1 summarise the sample of reviewed journal.

At the table, for reference microstrip patch antenna with the U-shaped Slot Loaded probe fed was presented[5]. U-slot patch antenna not only for wideband application, but it also can do for dual-band and triple band application. With the lower frequencies, the antenna acceptable gain that suitable for unidirectional and omnidirectional antenna application.

Beside that, the high gain patch antenna for CubeSat is presented[6]. The design of patch antenna is deemed to be compact with the 10x10x10 to 30x30x30 cm cubic unit. The

cubeSat depands on VHF/UHF with monopole and dipole antenna[6]. The return loss was around -10db at 2.46 and it was ideal. But it produce maximum gain of 9.6 dB at 2.4GHz. For tempered line, 50Ω coaxial feed is proposed as antenna input and placed at center to divide power equally.

The antenna designed is patch antenna for S-Band Application, such as WiMAX. [7] This antenna is circle in shape and also E-shaped. The circular patch gives larger gain and higher bandwidth whereas the E-shaped patch antenna is used to provide minimum return loss. It operates at 3.51 GHz with return loss at -19.6 dB, 9.13dB gain with 1.2 VSWR. Substrate used is FR-4, permittivity is 4.4.

On the other hand, the high gain filtering antenna was presented[8]. The high gain filtering antenna with 13.6% impedance bandwidth covering LTE band (2.3-2.7GHz). However, to shift from LTE band(2.3-2.7GHz) to WCDMA band(1.92-2.17GHz), the stacked patch and driven patch should to increase. The impedance bandwidth for 12.8% can make the gain bandwidth is narrower compare to the 20.7% of the impedance bandwidth. But, in filtering performance, it was same[8].

Table 1 Comparison of article

Reference	Title	Frequency	Remarks
[1]	Quad Bands U-shaped slot Loaded Probe Fed Microstrip Patch Antenna	3GHz	1. Microstrip antenna was narrow bandwidth and low gain. 2.The radiating patch and feed strip line are photo etched on dielectric substrate. 3. The return loss is around -13.61dB. Less than -10dB. The higher band the radiated show directional property.

[2]	High Gain Patch Antenna for CubeSat	2.46 GHz	1. Design array cubeSat - increase gain and good impedance matching 2. Give gain 9.6dB. 3. provide low bit rate to provide high bit rate
[7]	Design and simulation of Patch Antenna for 3.51GHz S-Band and WiMAX Apps	3.51 GHz	1. By circular patch - provide high gain and bandwidth 2. Add E-shape - provide minimum return loss 3. Gain achieve 9.13 dB - combination of circular and E-shape
[8]	High Gain Filtering Antenna for WCDMA Apps	2.3 GHz - 2.7 GHz	1. Add 3 radiation null - improve boresight high gain 2. Tune radiation null - effect the impedance bandwidth 3. Longer and wider U-slot - shift lower frequency 4. The gain achieve is 9.7 dBi

[9]	High Gain 2.45GHz 2x2 Patch Array Stacked Antenna	2.45 GHz	1. Add air gap between radiating element and reflector - increase bandwidth,gain 2. array element with chamfer edges - improve the polarization capability 3. Achieve 19.29 dBi
[10]	High Gain Stacked Antenna Array for 60GHz Communication System	60GHz	1. aperture coupler technique - high gain and wide impedance bandwidth 2. Add array - reduce mutual coupling 3. Achieve gain 18.09dB
[11]	Design of Stacked Segmented Ultra Wide Band Antenna	10GHz-19GHz	1. Increase the height of the stacked - perform better frequency bandwidth 2. Position of the stck center - will shift toward high