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Tajuk Projek : UWB ANTENNA WITH DUALBAND NOTCH FUNCTION

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UWB PATCH ANTENNA WITH DUAL BAND NOTCH FUNCTION

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KHAIRIAH NAZIRAH BINTI MOSMIN

This Report is Submitted in Partial Fulfillment of the Requirement for the Bachelor Degree in Electronic Engineering (Wireless Communication) With Honours

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ABSTRAK

Beberapa tahun selepas siasatan awal pada jalur lebar ultra (UWB) sistem tanpa wayar, usaha penyelidikan yang agak besar telah dimasukkan ke dalam reka bentuk antena UWB dan sistem komunikasi. Antena UWB menyediakan komunikasi jalur lebar tanpa wayar berdasarkan penggunaan denyutan sangat sempit atas perintah nanosaat yang meliputi jalur lebar yang sangat luas dalam domain frekuensi, dan pada jarak yang sangat pendek pada kepadatan kuasa yang sangat rendah . Pada frekuensi yang diperuntukkan (7.5 GHz) pada sistem UWB, memang wujud beberapa kumpulan kecil untuk standard komunikasi data lain, seperti pada frekuensi 3.69GHz untuk WiMAX (Saling Boleh Kendali Dunia bagi Akses Gelombang Mikro), dan pada frekuensi 5.825 GHz untuk WLAN (rangkaian tanpa wayar tempatan), yang mungkin menyebabkan gangguan elektromagnet dengan sistem UWB itu. Dalam projek ini, antena tampalan UWB telah dicadangkan untuk menyediakan aplikasi UWB. Jalur dwi takuk mempunyai ciri-ciri penolakan pada 3.5 GHz untuk Wi-MAX di 5.5 GHz untuk WLAN. Antena yang dinyatakan di atas direka menggunakan Perisian Gelombang Mikro CST 2014. Antena jenis tampalan digunakan kerana ia lebih kecil dalam dimensi dan mudah untuk difabrikasi. Antena UWB asas dibuat. Antena ini mempunyai tampalan radiasi berbentuk penyodok dan tampalan pembumian di belakang. Penolakkan jalur WiMax dan WLAN dapat dicapai dengan teknik menggores dua slot bentuk C bersarang pada tampalan radiasi.

ABSTRACT

A few years after the early investigation on ultra-wideband (UWB) wireless system, considerable research efforts have been put into the design of UWB antennas and systems for communications. These UWB antennas are providing wireless wideband communications based on the use of very narrow pulses on the order of nanoseconds, covering a very wide bandwidth in the frequency domain, and over very short distances at very low power densities. Over the allocated bandwidth (7.5 GHz) of the UWB system, there exists some narrow bands for other data communication standards, such as at frequency 3.69 GHz for WiMAX (World Interoperability for Microwave Access), and at frequency 5.825 GHz for WLAN (Wireless Local Area Network), which may be cause electromagnetic interference with the UWB system. In this project, a UWB patch antenna is proposed for providing UWB application. The dual band-notched function has rejection characteristics at 3.5 GHz for Wi-MAX at 5.5 GHz for WLAN. The aforementioned antenna is designed using CST Microwave 2014 software. A patch antenna is used because it is smaller in dimension and ease of fabrication and conformity. The basic UWB antenna is taken. The antenna has the shovel shape radiating patch and grounding patch at the back. By etching two nested C-shaped slots in the radiating patch band rejection is achieved for Wi-MAX and WLAN.

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For mum and dad,
I grew up, but I'll always be your little girl.
Smile.

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LIST OF ACRONYMS

UWB	-	Ultra Wide Band
AUT	-	Antenna Under Testing
WiMAX	-	World Interoperability for Microwave Access
WLAN	-	Wireless Local Area Network
CST	-	Computer Simulation Technology

LIST OF APPENDIX

CHAPTER 1

INTRODUCTION

1.1 Ultra Wideband (UWB)

Ultra Wideband (UWB) technology, due to its large bandwidth, is capable of supporting high data rate applications. The Federal Communications Commission (FCC) agreed in February 2002 [1] to allocate 7.5 GHz of spectrum for unlicensed use of UWB devices for communication applications in the 3.1 GHz to 10.6 GHz frequency band.

This technology has given rise to much interest in designing wideband antennas with performances of the broadband impedance matching, Omni-directional radiation pattern, constant group delay, and compact size. The benefits of UWB technology are derived from its unique characteristics that are the reasons why it presents a more eloquent solution to wireless broadband than other technologies. The unique characteristics are UWB has an ultra-wide frequency bandwidth; it can achieve huge capacity as high as hundreds of Mbps or even several Gbps with distances of 1 to 10 meters [2]. This requires a data rate which is much higher than what can be achieved through currently existing wireless technologies. Another that, UWB system is extremely fine time and range solution even through loss, opaque media. UWB also has low probability of detection and interception. UWB provides high secure and high reliable communication solutions. Due to the low energy density, the UWB signal is noise-like, which makes unintended detection quite difficult. Furthermore, the “noise-like" signal has a particular shape; in contrast, real noise has no shape [3]. In the other hand, UWB system has immunity from multipath.

UWB system based on impulse radio features low cost and low complexities which arise from the essentially base-band nature of the signal transmission. UWB does not modulate and demodulate a complex carrier waveform, so it does not require components such as mixers, filters, amplifiers and local oscillators, thus make UWB an inherent capability for integration in low cost, low power Integrated Circuit (IC) processes. Instead of using a single antenna at single frequency, UWB antenna can operate at for many applications because of the wide operating band.

UWB is the leading technology for freeing people from wires, enabling wireless connection of multiple devices for transmission of video, audio and other high bandwidth data. Designed for short range, WPAN, it is used to relay data from a host device to other devices in the immediate area. Recent years, rapid developments have been experimented on the technology using UWB signals. UWB technology offer major enhancements in three wireless application areas: communications, radar and positioning or ranging. UWB technology can be delivered also over wire lines and cables such as cable television (CATV) application.

1.2 PROBLEM STATEMENT

Wireless communication is simply the act of transferring information from one place to another without wired connection. UWB or ultra wideband is a communication method used in wireless networking to achieve high bandwidth connections with low power utilization. The UWB signal is a very low power signal and therefore the power of any single UWB device can be compared to that of a noise floor. But when a number of such devices operate simultaneously then the interference level could rise significantly above the level of the noise floor. Over the allocated bandwidth (7.5 GHz) of the UWB system, there exists some narrow bands for other data communication standards, such as 3.4-3.69 GHz for WiMAX (World Interoperability for Microwave Access), 5.15-5.825 GHz for WLAN (Wireless Local Area Network), which may be cause electromagnetic interference with the UWB system. Because of the existence of other wireless standards an additional requirement for UWB antennas is to reject some multi-bands within the UWB pass-band. A wireless local area network (WLAN) is a wireless distribution method for two or more devices that use high-frequency radio waves and often include an access

point to the Internet. A WLAN allows users to move around the coverage area, often a home or small office, while maintaining a network connection.

Interference is any barrier to the communication transaction and it can best be described as the effect of unwanted signals or noise on the reception of a wanted signal. The two most common causes of interference are radio transmitters and electrical equipment. All communication systems that transmit signals (radio transmitters) are capable of generating interference. These systems include e.g. amateur radios, radio and television stations and mobile phones. Electrical interference may be caused by power lines or electrical equipment in your home. Interference may prevent reception altogether, may cause only a temporary loss of a signal, or may affect the quality of the sound or picture produced by the equipment.

Due to telecommunication system, there are many types of interference. Interference will affect the performance of the bandwidth. Such as decrease in the wireless range between devices, decrease in data throughput over Wi-Fi and intermittent or complete loss of the wireless connection. Interferences may be cancelled or mitigated by changing antenna patterns as required. To avoid the interference between the UWB, WLAN and WiMAX systems, a band-notch filter in UWB systems is necessary. However, the use of a band stop filter will increase the complexity of the UWB systems. Therefore, several techniques used to introduce a notched band for rejecting the WLAN and WiMAX interference have been investigated, which include such as inserting a half-wavelength slot structure, slitting on the edges, utilizing fractal feeding structure, and parasitic quarter-wave patch or parasitic open-circuit stub. With the notched band characteristic, the antenna allows to reconfigurable its frequency that only responsive to other frequencies beyond the rejection bands within UWB bandwidth

1.3 OBJECTIVE

The main purpose of this project is to design, fabricate and simulate the UWB antenna with dual band notch characteristics. Which have two narrow frequency that have stop band at 3.38 -3.82 GHz for WiMAX and stop band at 5.3 -5.8 GHz for WLAN system.

1.4 SCOPE OF WORK

The project scope is focused on patch UWB antenna designs that provide an ultra-wideband bandwidth which is operate in 3.1GHz – 10.6GHz. The notch techniques are added to improve bandwidth which is notched at frequency 3.38 - 3.82 GHz for WiMAX and notched at 5.3 -5.8 GHz for WLAN system. The notch techniques are achieved by adding several shapes on the patch on the antenna. Simulate and optimized the performance such as return loss, gain, radiation pattern (S11) of the antenna to achieve stop band at desired frequency using CST Microwave 2014 software. The fabrication of the optimized antenna is using FR-4 substrate. The measurement of the performance is using virtual network analyser and chamber room.

1.5 METHODOLOGY

The methodology of this project started with literature review by doing research on journal related to design of UWB antenna, single band notch design and design to achieve dual band notch characteristic.

The primitive UWB antenna then design which has he frequency range from 3.1GHz to 10.6 GHz. The designed antenna is designed and running simulated for the parameters of return loss, bandwidth, total efficiency, directivity and realized gain using CST Microwave Studio Suite 2014. Parametric study is carried out to achieve the optimized and most wanted design.

The simulation process is kept running until the desired result is obtained before move to fabrication process. Further design process will be discussed in chapter 3.

The measurement process is doing after done fabrication process. The measured result will be compare with simulated result. Analysis is completed based upon the measured result as well as the simulated result Figure 1.1 below shows the flow chart of this project.