IN CAMPUS COMMUNICATION SYSTEM USING OPTICAL PRINCIPLE AND TECHNIQUE (TRANSMITTER)

SYAHMI BIN GHAZALI

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DEDICATION

Specially dedicated to my father, mother, brother and my friends for their understanding, concern, care and continuous support.

ACKNOWLEDGEMENT

Firstly, thanks to Allah because with His Blessings, I am able to complete my Bachelor Degree Project and prepare this report.

I wish to express my appreciation to my supervisor, Mr. Tan Kim See for his support, guidance and advice during the completion of this final project.

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ABSTRACT

This new generation network nowadays needs to fulfill the demands of the new information age, which requires improved scalability, flexibility, and dynamic delivery of communication services. An evolution of the network is underway to meet this demand. The evolution introduces new network elements supporting an architecture that is better suited for the dynamic global distribution of broadband based services. As such, the next major step in the progression is the wide scale deployment of intelligent optical switches. The purpose of this study is to investigate the characteristic and the behavior of optical techniques to implement an efficient FOS communication system. For the transmitter side, the laser is used to transmit the beam directly to the receiver. To interface with the computer, the Borland C++ 3.1 programming is used. The framework used for this method is general enough for further investigation by either evaluating other parameters by extending its applications in the communication network. From this research, it is hope that more in-depth knowledge on the transceiver, laser and photo diodes, free space propagation, line of sight and data propagation are acquired.

ABSTRAK

Rangkaian telekomunikasi yang wujud masa kini perlu memenuhi permintaan teknologi maklumat baru yang merangkumi peningkatan terhadap pengukuran, flexibilitinya, dan juga kemudahan dalam penghantaran telekomunikasi. Adalah penting bagi perubahan rangkaian ini supaya ia dapat memenuhi permintaan sejagat. Perubahan ini memperkenalkan satu teknologi baru yang mampu menyokong kemudahan teknologi maklumat luas yang lebih dinamik dalam globalisasi. Oleh itu, langkah penting seterusnya adalah penggunaaan suis optik dalam rangkaian secara meluas. Tujuan kajian ini adalah bagi mengkaji dan menyiasat bagaimana perwatakan dan fungsi komunikasi laser supaya dapat implemantasikan secara efektif ke atas system rangkaian optic. Untuk bahagian pemancar, pancaran laser perlu menembak secara terus kepada fototransistor pada sebelah penerima. Program Borland C++ 3.1 digunakan untuk pengaturcaraan dengan komputer. Rangka pengukuran adalah bersifat umum dan boleh digunakan untuk kajian lanjut samada bagi menguji parameter lain bagi meluaskan penggunaannya dalam rangkaian telekomunikasi optik. Dari penyelidikan ini, adalah diharapkan bahawa pengetahuan yang lebih mendalam dapat diperolehi tentang laser dan diod foto, perambatan ruang bebas, garis pandangan, dan perambatan data.

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P_i	Input power
P_{in}	Incident power
P_T	Transferring power
P_{ref}	Reflected power
P_o	Output power
a	Attenuation
R	Receiver Sensitivity for BER
T	Transmission Power
NT	No. of Transmitters
A	Receiver Aperture Area
NR	No. of Receivers
θ	Beam Divergence
l	Length
L	Loss
d	Path Length
LG	Geometric Loss
LF	Fixed System Losses (dB)
V	Voltage
PD	Photo diode
APD	Avalance Ph

CHAPTER 1

INTRODUCTION

This chapter consists of introduction, scope of works, project objective, problem statement and background.

1.1 Introduction of the project

A fiber optic communication link uses light sources and detectors to send and receive information through a fiber optic cable. Similarly, wireless optical communications uses light sources and detectors to send and receive information, but through the atmosphere instead of a cable. The motivation for free space optical communications is to eliminate the cost, time, and effort of installing fiber optic cable, yet retain the benefit of high data rates for transmission of voice, data, images, and video.

Free space, dynamic, optical wireless communications will require topology control for optimization of network performance. Such networks may need to be

configured for connectivity, reliability and quality of service. Topology control involves the introduction of new links and nodes into the network too achieve such performance objectives through reconfiguration as well as precise pointing, acquisition, tracking and steering of laser beams. The most important consideration in wireless optical communications link planning process is to ensure that there is sufficient optical power received by the transceiver.

1.2 Project Objective

The main objective of this project is to study and provide the wireless connection by using the optical principles and techniques. This project is very similar to the fiber optic communication system except the medium is free space instead of fiber. However, this wireless optical connection offers many advantages when compared to the fiber. Its deployment requires a fraction of the time and cost as compared to conventional fiber networks, allowing carriers to generate revenue quickly while taking advantage of the high capacity of optical transmission.

This project functions depend on the free space optic technologies as the light from the transmitter is directed to the receiver through free space and this is managed in the duplex transmission format. Light travels through air faster than it does through glass, so it is fair to classify this project technology as optical communications at the speed of light. Besides, this technology are been used in many university and company, but some people doesn't know about them because it secure.

1.3 Problem Statement

There are many challenges in undertaking this project. The medium of transmission connection between the transmitter and receiver is the biggest problem of the project. Firstly, the fog is the greatest challenge of this project. The fog is a vapor that is comprised with many tiny drops of water. The drops of water can "modify light characteristics or completely hinder the passage of light through a combination of

absorption, scattering and reflection. Through absorption, the drops of water take away the photons from the laser beam, which reduces the power of the beam.

Secondly, the physical obstructions such as buildings and trees will provide the line of sight for the light beam. As mentioned, this project is a line of sight technology. If something comes in the way of the transmission path, the connection will be cut off. The problem is common because the laser beam is sent through the atmosphere, so the beam can be obstructed easily even if a bird flies by. The third is the swaying building. When a building is swayed, even to a slightest degree, the laser beam may miss the target in transmission.

Many people have the wrong perception that optical laser is dangerous because the beam which is intense and coherent is directed in the open air. However, it is proven otherwise as the beam is not directed into the eyes. Laser is powerful, but its power depends on its wavelength. Infrared radiation at 1550 nm [wavelength] tends not to reach the retina of the eye, being mostly absorbed by the cornea.

1.4 Scope of works

The scopes of work for the project include the following areas:

1. The understanding of the circuit operation transceiver (transmitter) of the project.
2. To study about the transmitter and receiver
   - The completed system consist of two transceiver, each capable of simultaneously transmitting and receiving either analogue or digital information. The user has an option to manually select between either analogue or digital information via means of two switches which control the laser transmitter and receiver.
3. Identification of the parameters and specification about the laser to be considered in this project.
4. To develop of a prototype for the project.

5. To study the interface between computer and the circuit.
6. To study about the executable coding Borland C++ 3.1

1.5 Project's Methodology

Project Planning

- Understanding the concept and theory of the project
- Prepare Gantt Chart for guidelines and progress of the project

Literature Review

- Background reading and references
- Search for suitable and practical circuits
- Identify the equipment and some important component to be added to my project
- Develop the prototype of this project
- Simulate and analysis of the prototype

Finishing

- Test of the prototype in operation, application and result
- Presentation on outcome of this project
- Write the final report

The detail explanations of these phases continue on chapter 3.

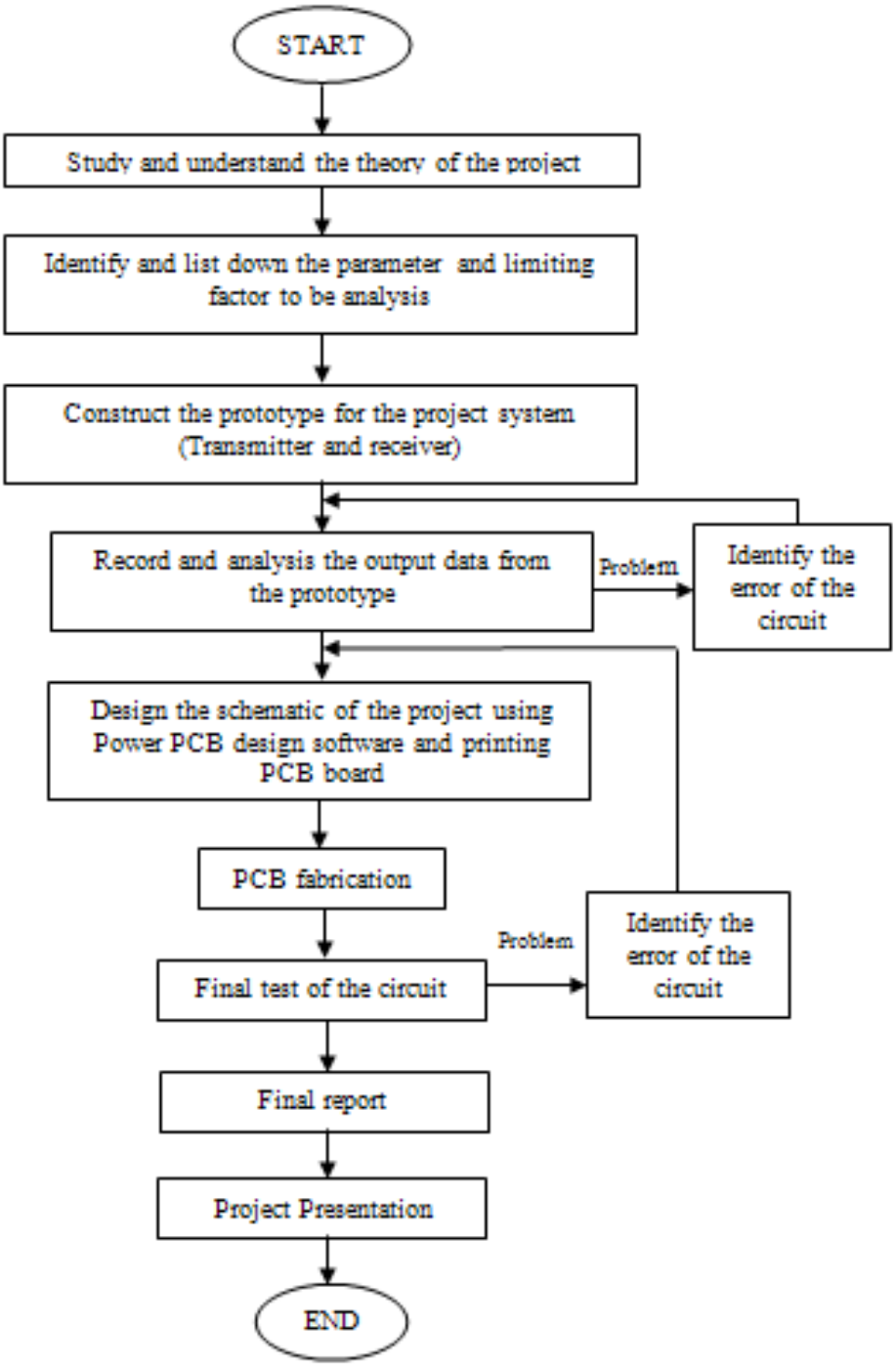

Fig. 1.1 Flow chart of the methodology

CHAPTER 2

LITERATURE REVIEW

This chapter will discuss precisely about the project, including the factors that should be considered before chosing a transceiver and the laser circuit that needs fully attention for this research.

2.1 Introduction

In this chapter, we will focus on the research about the methodology on the proposed project. Past projects, thesis and every journal about the wireless optical communication will be included in this chapter. This will covered the whole of the project progressing and the related analysis. Every data and idea for this project will be analysis to bring the better outcome. An initial hurdle faced by early means of laser communication was the enormous heat generated by pumped laser action.

2.2 History about the Free space Optical Communication Technologies

The idea of Free-Space Optics (FSO) has been around for more than three decades. In fact, many scientists had already developed FSO at that time, but the

technology was not adequate to make FSO practical in real life, so the research was stopped. Sending optical signals through the air is not a new idea. Alexander Graham Bell demonstrated it using reflected sunlight with his Photophone in 1880.

Nearly a century later, Bell Labs hoisted an early laser to the top of a microwave tower at its Murray Hill, NJ, headquarters to send pulses 40 km to its Holmdel site. When FSO was first developed, it was used in many aircraft's operations for data transmission. Now, FSO is becoming more popular, and it is in the trend of replacing other transmission methods.

FSO is a new technology, and it needs time to be adopted by others. The idea of FSO had been introduced already. Now, it is being used by smaller companies that are willing to explore new alternatives. When FSO is proven to be cost-effective, larger companies would also adopt FSO, and all other companies would be pressured into adopting FSO due to competitions in the market. When majority of the companies have adopted FSO, FSO will become the mainstream technology, and all other technologies will become obsolete.

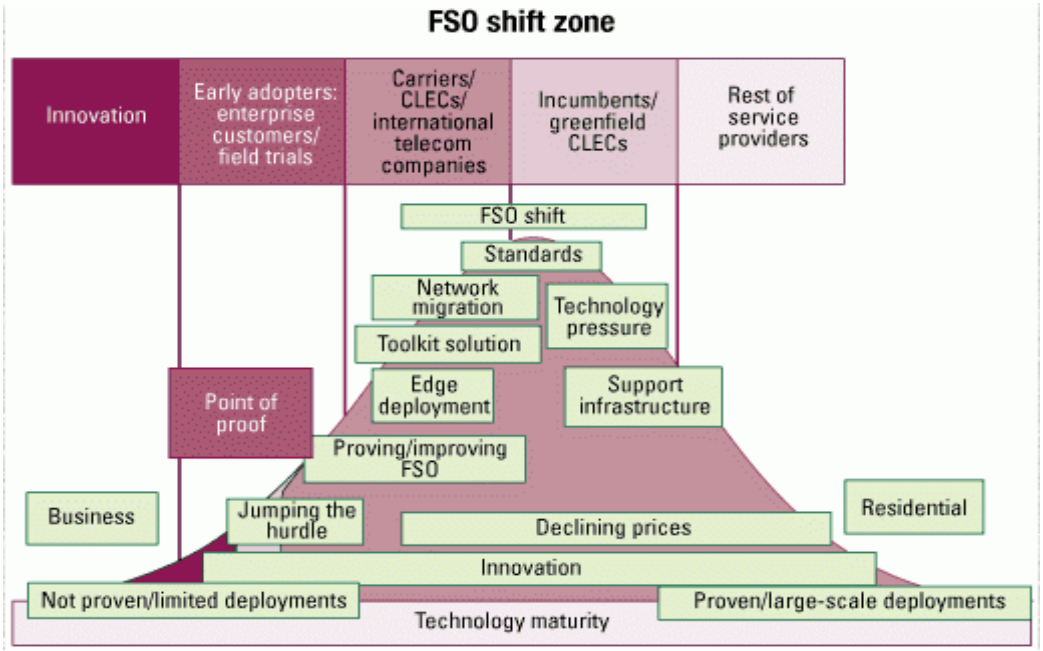

Figure 2.1 the growing process of FSO.

2.3 Free Space Optic technologies

Free-Space Optics (FSO) is capable of transmitting information from one place to another. It is a line-of-sight technology that needs a clear transmission path, without any obstacle, between a sender and a receiver to enable the transmission to function correctly. FSO uses laser beam to transmit information through air. This line-of-sight technology approach uses invisible beams of light to provide optical bandwidth connections.

It's capable of sending up to 1.25 Gbps of data, voice, and video communications simultaneously through the air enabling fiber-optic connectivity without requiring physical fiber-optic cable. It enables optical communications at the speed of light. And it forms the basis of a new category of products optical wireless products from FSO Technologies', the recognized leader in outdoor wireless bridging communications.

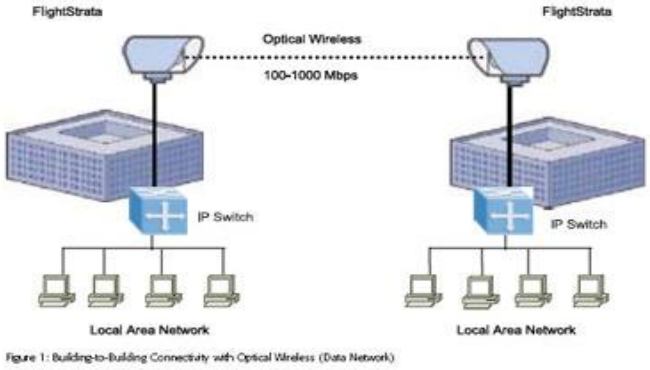

Figure 2.2 The point to point connection between building