FIBER OPTIC VOICE COMMUNICATION SYSTEM

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This report is submitted in partial fulfillment of the requirements for the award of Bachelor of Electronic Engineering (Telecommunication Electronics) With Honours

Faculty of Electronic and Computer Engineering
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To my beloved mum and dad

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ABSTRACT

This project basically provides the student the opportunity to have a deeper understanding on optical fibers and optical communication principles by developing a fiber-optic communication link to transmit and receive voices and music via optical fiber. The system comprises of a transmitter converts the electrical signal to light. The receivers will coverts the light back to the voice or music signal to the output. There are a few advantages of fiber optic cables over copper for example fiber optic networks can operate at speeds up to 10 gigabits per second or higher, as opposed to 1.54 megabits per second for copper. Other advantage is has a large carrying capacity which mean It can carry more information. Fiber optics also has a greater capacity for information which means smaller cables can be used. There are 4 phases of methodology in order to achieve the objective of the project. The first phase is project planning, second phase is literature review, third stage is hardware design and final phase is performance test for testing either functioning or not. At the end of this PSM project, one communication system that using the fiber optic as the medium channel to transfer the information is form of light will be designed.

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ABSTRAK

Projek ini pada asasnya adalah untuk memberi peluang kepada pelajar untuk mempunyai pemahaman yang lebih mendalam berkenaan dengan gentian kaca dan prinsip komunikasi optik dengan membangunkan talian komunikasi gentian kaca untuk menghantar dan menerima suara atau muzik dengan menggunakan wayar gentian kaca. Sistem itu mengandungi sebuah alat pemancar yang berfungsi untuk menukar isyarat elektrik kepada cahaya. Alat penerima akan menukar cahaya kepada isyarat suara atau muzik kembali. Terdapat beberapa kelebihan wayar gentian kaca yang mengatasi wayar tembaga contohnya rangkaian gentian kaca boleh beroperasi pada kelajuan sehingga 10gigabit sesaat atau lebih, berbanding 1.54megabit sesaat untuk tembaga. Kelebihan yang lain adalah ia mempunyai kapasiti membawa yang besar, maksudnya ia boleh membawa lebih banyak maklumat. Gentian kaca juga mempunyai kapasiti yang besar untuk maklumat yang bermaksud wayar yang kecil boleh digunakan. Terdapat empat fasa metodologi dalam mencapai objektif projek. Fasa pertama adalah perancangan projek, kedua adalah kajian latar belakang, ketiga adalah reka bentuk perkakasan dan fasa terakhir adalah ujian prestasi untuk menguji samada berfungsi atau tidak. Di penghujung projek PSM ini, satu system komunikasi yang menggunakan gentian kaca sebagai medium untuk menghantar maklumat dalam bentuk cahaya akan dibina.

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LIST OF SYMBOLS

θ	-	angle

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LIST OF SHORTERM

POC	-	Plastic optical cable
NA	-	Numerical Aperture
LAN	-	Local Access Network

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CHAPTER I

INTRODUCTION

1.1 Project Introduction

Our current age of technology is the result of many brilliant inventions and discoveries, but it is our ability to transmit information, and the media we use to do it, perhaps is the most responsible for its evolution. Progressing from the copper wire a century ago to today's fiber optic cable, our increasing ability to transmit more information, more quickly and over longer distances has expanded the boundaries of our technological development in all areas.

Today's low-loss glass optical fiber cable offers almost unlimited bandwidth and unique advantages over all previously developed transmission media. The basic point-to-point fiber optic transmission system consists of three basic elements: the optical transmitter, the fiber optic cable and the optical receiver as shown in Figure 1.1 below.

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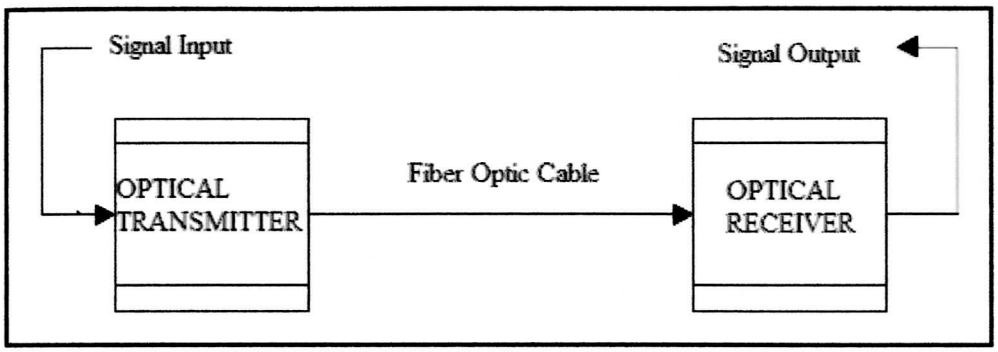

Figure 1.1: Fiber Optic Communication System

As shown in Figure 1.2 above, signal input is usually in the form of sinusoidal generated by the circuit. After that, it is changed into pulse code which contain code '0' and '1' because the optical transmitter and receiver will be operate in that digital form as in Figure 1.2.

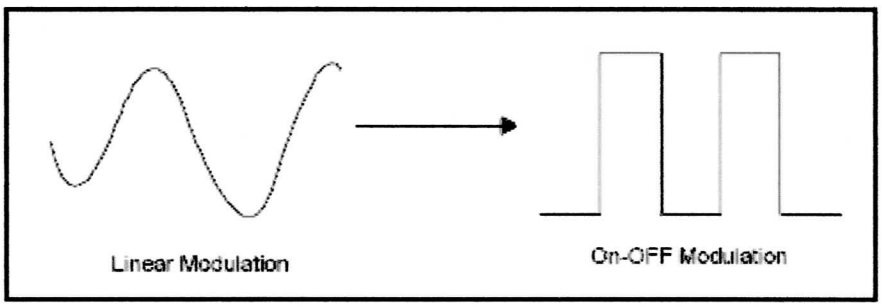

Figure 1.2: Basic Optical Modulation Methods

In the optical transmitter, the transmitter converts an electrical analog or digital signal into a corresponding optical signal. The source of the optical signal can be either a light emitting diode, or laser diode. For this project, light emitter diode will be used because this system only operates in short distance as an example. The most popular wavelengths of operation for optical transmitters are 850, 1300 or 1550 nanometers.

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However, most Fiber link transmission equipment manufactured by Communications Specialists operates at wavelengths of 850 or 1300nm. Fiber optic cable actually plays the role as the medium propagation of light. The cable consists of one or more glass fibers, which are also known as waveguides for the optical signal. Fiber optic cable is different to electrical cable in its construction, as it provides special protection for the optical fiber within. Each type of fiber optic has its own capability in term of loss, efficiency and others. Because this system involves a short distance communication, the plastic optical fiber is used. However, this type of fiber has high loss which means its efficiency is also low.

At the optical receiver, the receiver will converts the optical signal back into a replica of the original electrical signal. The detector of the optical signal is either a PIN type photodiode or avalanche-type photodiode. Lastly, the original input that is `supplied to the transmitter will be reproduced at the output of receiver.

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1.2 Project Objective

The objective of the project is to design simplex fiber optic communication link system than can transmit and receive voices and music via fiber optic cable. The word 'simplex' means this system will operate in one way operation where the transmitter will send the signal in the form of voice or music, and the receiver will receive that signal and can't transfer back that signal to the receiver.

The other objective is to study more about fiber optic cable characteristic as a medium of propagation to couple the light from the transmitter to the receiver. The following characteristics will be analyzed.

a) Types of fiber optic cable

b) Losses

c) Coupler

d) Power budget

Figure 1.3 below shows the various important parameters that will be considered in this project in order to achieve the objective.

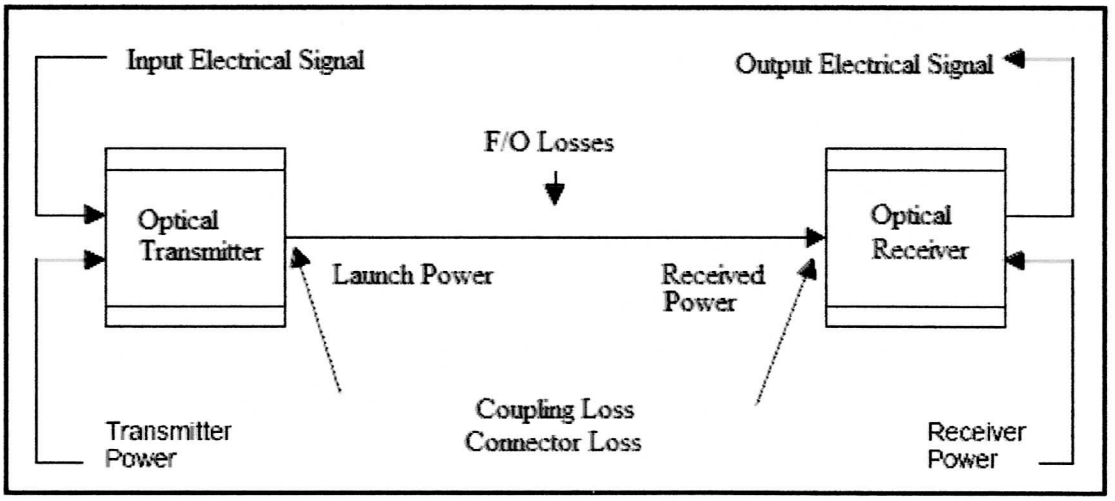

Figure 1.3: Important Parameter to Consider

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1.3 Problem Statement

There are a few reasons why fiber optic cable is used to replace coaxial cable. In terms of the price of the cable, fiber optic cable is more expensive as compared to the coaxial cable, but what is more important is the quality of the output. So, it is important to understand why fiber optic cable is used which is a new technology as a replacement for coaxial cable.

Coaxial cable has small bandwidth. Usually, the communication system needs a wide bandwidth to transfer more information. The characteristic of fiber optic which has a wide bandwidth is another reason it is preferred.

The electrical cable also can be easily influenced by electromagnetic field but not for fiber optic cable. In term of operation, fiber optic cable can operate at high speed up to 10 gigabytes per second, meanwhile the electric cable can operate in speed of 1.54 megabytes per second. Because of this advantage, the data can be transmitted faster by using fiber optic as compared to the electric cable.

Besides that, electric cable have a smaller capacity for information compared with the fiber optics that has a greater capacity for information which means smaller cables can be used.

Since the only carrier in the fiber is light, there is no possibility of a spark from a broken fiber. Even in the most explosive of atmospheres, there is no fire hazard and no danger of electrical shock to personnel repairing broken fibers. The other one is Fiber optic cables are virtually unaffected by outdoor atmospheric conditions, allowing them to be lashed directly to telephone poles or existing electrical cables without concern for extraneous signal pickup.

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1.4 Project Scope

1) Design and construct fiber optic voice communication system via fiber optic cable system.
2) Use Proteus Software to design the circuit.
3) Use the suitable fiber types for the system.
4) Study about looses in the system for example fiber loss, connector loss, coupling loss and others.
5) Use the suitable connector.

1.5 Methodology

There are 4 major stages to look into in order to achieve the objectives of the project. The initial stage is to study the feasibility of the project and the planning to ensure the progress and identify the milestone. The second phase is literature review on every aspects related to the project such as the principles of operation and the applications. The third stage will involve hardware design and final phase is performance test, analysis, diagnosis and verification.

1.6 Report Structure

In this report structure, the short explanation for each chapter in this report will be discussed.

1. Chapter I. In this chapter, the topic discussed is about introduction for fiber optic voice communication system, project objectives, problem statements for other project that has been analyzed, involved project scope, and project methodology that has been used to complete the project.

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2. Chapter II. Literature review about project. All results from analysis of literature review discussed in this chapter. Analysis that has been conducted is analysis method, project theory explanation, how the operation of signal and circuit and circuit design.

3. Chapter III, chapter that involved project methodology explanation. The methods that has been used to complete the project overall. Contents of methodology is, project initial planning, searching of resource material and for the final part, project test, seminar, and report writing is involved.

4. Chapter IV. Discussion for produced results after the fiber optic voice communication system completed.

5. Chapter V. Conclusion and suggestion to improve the project in the future. Summary for all results found after completed the whole project.

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