



UNIVERSITI TEKNIKAL MALAYSIA MELAKA

**IMPLEMENTATION OF ONE WAY COMMUNICATION IN
FIBER OPTIC CABLE FOR DEVELOPMENT OF
MICROPHONE SYSTEM**

This report submitted in accordance with requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor's Degree in Electronic Engineering Technology (Telecommunications) (Hons.)

by

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**TAJUK: Implementation of One Way Communication in Fiber Optic Cable
For Development of Microphone System**

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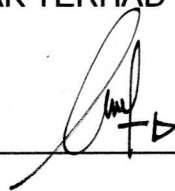
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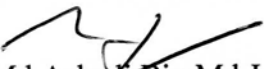
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APPROVAL

This report is submitted to the Faculty of Engineering Technology of UTeM as a partial fulfillment of the requirements for the Bachelor's Degree in Electronics Engineering Technology (Telecommunications) (Hons.). The member of the supervisory is as follow:



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ABSTRAK

Projek ini diperkenalkan kepada masyarakat mengenai konsep komunikasi gentian optic secara meluas dan mendalam dan bagaimana gentian optic dapat di aplikasikan. Projek ini juga diperkenalkan untuk mempertingkatkan sistem audio terutama didalam proses penghantaran data antara alat dan memperjelaskan lagi manfaat kabel gentian optic berbanding kabel tembaga didalam pembangunan penghantaran data. Selain itu, projek ini juga memberikan pendedahan kepada masyarakat mengenai gentian optik. Projek ini dapat dirumuskan mengenai projek media penghantaran yang menggunakan kabel gentian optik sebagai pengantara alat di dalam sistem mikrofon. Seperti yang diketahui, sistem audio atau lebih jelas di dalam iaitu sistem mikrofon mempunyai kos yang sangat tinggi. Skop projek ini adalah untuk menyelidik pembangunan sistem mikrofon. Cabaran projek ini adalah untuk merekabentuk dan membina sambungan penghantaran data satu hala yang boleh menghantar data suara melalui kabel gentian optik di dalam sistem mikrofon. Kebiasaanya, projek ini menggunakan alat optik penghantar, optik penerima dan kabel gentian optik untuk beropersi.

ABSTRACT

This project introduced the concept of fiber optic cable communication in depth and how fiber optic can be applied. It meant to improve audio system especially in the process of transmitting data between devices and to explain the benefit of fiber optic cable compared to cooper cable in the development of data transmission. Through this project, the public would be exposed further on fiber optics. This project concentrated on one way fiber optic communication for the development of microphone system. It is a known fact that the audio system especially the microphone system is costly. The scope of this project is to study the development of the microphone system. The challenges of this project is to design and to develop a one way data transmission circuit that can transmit and receive voice data through fiber optic cable in the microphone system. Usually, this project would require an optical transmitter, optical receiver and fiber optic cable.

DEDICATION

Special dedication to my parents, lecturer, siblings and friends for giving me all their knowledge's and moral support for me to completion the project and report.

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Alhamdulillah, thank to Allah for His divinity and blessing. I have completed my final year project for Bachelor's Degree in Electronic Engineering Technology (Telecommunications) (Hons.) successfully. I would like to thanks my lovely family for their encouragement and support. I also would like to thank my supervisor, Mr. Md Ashadi Bin Md Johari and my co-supervisor Mr. Chairulsyah Wasli that who support, help and guide me on my project with patience. I would also like to thank my friends and all the people that has helped me along he course of finishing this project.

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C	LM386 LOW VOLTAGE AUDIO POWER AMPLIFIER
D	LM358 LOW POWER DUAL OPERATIONAL
A	IF-E96 PLASTIC FIBER OPTIC RED LED EMITTER
B	IF D93 PLASTIC FIBER OPTIC PHOTODARLINGTON AMPLIFIERS

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LIST OF ABBREVIATIONS, SYMBOLS AND NOMENCLATURE

APD	-	avalanche photodiode
CD	-	chromatic dispersion
EDFA	-	erbium doped fiber amplifiers
ILD	-	Injection Laser Diode
LAN	-	Local Area Network
LED	-	Light Emitting Diode
LHN	-	Long-Haul Network
MAN	-	Metropolitan Area Network
NA	-	Numerical aperture
PGC	-	Phase Generated-Carrier
PIN	-	p-type intrinsic n-type
PMD	-	polarization mode dispersion
POF	-	Plastic Of Fiber
PTFE	-	Polytetrafluoroethylene
SNR	-	Signal Noise Ratio
SONET	-	synchronous optical network
TIR	-	Total Internal Reflection
WDM	-	wavelength division multiplexing

CHAPTER 1

INTRODUCTION

1.1 Background

In this era of audio communication technology, audio is one of the important systems in our daily life. The systems can be divided into three parts which are optical transmitter, fiber optic cable and optical receiver. Fiber optic cable is the path way to encode a message from transmitter to a receiver by using optical signal. It also can be defined as a medium and a technology that linked light impulses through a plastic or a glass of fiber optic. Furthermore, fiber optic had much less electromagnetic interference compared to conventional cooper and it also carried much more information.

This project is meant to design and built a microphone system with one way communication by using optical cable. Furthermore, it has the ability to improve the audio system especially in process of transmitting data between devices. It also explains the benefit of fiber optic cable compare to cooper cable in development of transmission media. Apart from that, optic-microphone system introduced the concept of fiber optic and explained on methods in which fiber optic works. It is also applicable in the field of communication. It uses light- emitting-diode (LED) as a source through the fiber optic cable. It is part of the fiber optic cable which allows easier connection for transmission and data retrieval. Transmitter circuit functions to amplify and to modulate the light emitted from an LED and convert voice signal to an electrical signal. Light wave that travel through optical fiber cable are not affected by any electric or magnetic fields. On the other hand, receiver

circuits help to amplify and to convert the signal back into a sound wave as a final result.

Microphone and speaker are transducers components which help to transform energy from one type to another. The microphone picks up voices from a few meters of distance and converts the sound into electrical energy. Meanwhile, a speaker turns back electrical currents into sound waves which are suitable with human communication. The frequency and amplitude of the wavelength shift are encoded in the sound system is of higher accuracy than conventional microphone with specific frequency band.

1.2 Problem Statement

To define problem statement, why we are using fiber optic cable is because we want to replace the coaxial cable in the technology of wired-microphone system. Besides that, the point that why fiber optic are choose because of the advantage is the quality of the output itself even we know that fiber optic cable is more expensive than coaxial cable. Another reason, why we choose fiber optic because of the characteristic, optical fiber are thinner and it can be rods tied together into a given-diameter cable compare to copper wires. It also carry higher capacity through the fiber optic cable and operate at the high speed for transmit data.

1.3 Objectives

The objectives of this project are to:

- To study the characteristic of fiber optic cable.
- To develop a microphone system by using fiber optic cable.
- To design one way communication link system that can transmit and receive voices via fiber optic cable.

1.4 Scope

This projects scope shows the development of optic-microphone system, which is included with how the system works. This projects target will be:

- Study on the concept operation of the fiber optic cable transmit and receive data.
- Find the suitable circuit and relevant materials to use for transmitter and receiver that can function and communicate each other.
- Design and construct the hardware of one way communication for microphone system using fiber optic cable that will reduce or remove noise interruptions.

CHAPTER 2

LITERATURE REVIEW

2.1 History of Fiber Optic

We will look into the history of fiber optics and how it has evolved to provide its availability for broadband, high quality communications infrastructure. Right after the demonstration of the first laser in May 1960, it was referred as a “solution in search of a problem.” By this, it comes to the solution to the highly demand for bandwidth in communications, due to increased telephone use, relaying of television signals, and other kinds of electronic data transmission. Prior to 1960s, coaxial cables, transmission lines, and radio frequency wireless had been used to direct the transmission of signals in data communications. All of these technologies had severe limitations.

Transmission of signals together with other system that use metal wire which cause losses that increase markedly with the data rate, and thus require the use of many repeaters for long cables. Transatlantic cables which required operational voltages of thousands of volts with a maximum operational frequency of 1 MHz and with a repeater every 37 km. Before satellite relays became available in the early 1960s wireless transmissions had limited bandwidth. Reflection off the ionosphere is required for long-range terrestrial wireless, which only occurs for relatively low carrier frequencies.

Although wireless transmissions moved into the microwave region, the carrier frequency still imposed significant limitations on the availability data rates. The maximum data rates that were generally attainable even at C-band (4–8 GHz)

and Ku-band (12 – 18 GHz) were less than 1 Mb/s. The course to the very high data rates that we have today and the information revolution itself could not have occurred if a new medium for the transmission of a high-frequency carrier had not been developed. (Murphy, 2011)

2.2 Fiber Optic Cable Construction

2.2.1 Fiber optic materials

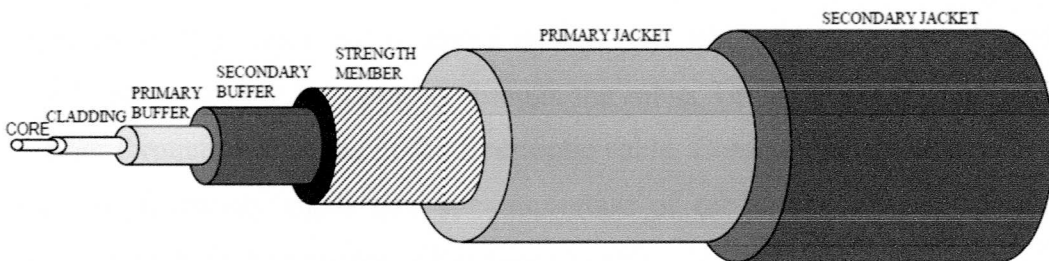


Figure 2.6: Fiber Optic cable construction (Géraldine Trouillard1, 2007)

There are a few materials that using in element in fiber optic cable such as fiber optic cable, Primary Buffer, Secondary Buffer, Mechanical strength reinforcement, Primary jacket and Outer jacket. Every single element in fiber optic cable has its own function. Fiber optic cable using silica for its material which has two types (core and cladding). Polyacrylate 150°C is the material for primary buffer and PTFE material is the secondary buffer element. Different with Mechanical strength reinforcement, this element use material from Aramid/Fiber Glass Woven Braid. Besides that, Primary jacket using PTFE Tape and Outer jacket using Extruded Fluoropolymer as a material. (Géraldine Trouillard1, 2007)

2.2.2 Fiber optic configuration

Depending on the refractive index profile of fiber optic and modes of fiber there exist of optical fiber configurations. These fiber optic configurations are:

- Single mode step index fiber
- Multimode step index fiber
- Multimode graded index fiber
- Plastic optical fiber

2.2.2.1 Single mode step index fiber

In single mode step index has a central core that is really small so that there is potentially only one path for light ray through the cable. The light ray is propagated in the fiber through reflections in the fiber optic cable. Common core sizes are 2 to 15 μm . The extremely small size interconnection of cables and interfacing with source is difficult are the benefits of this type of cable.

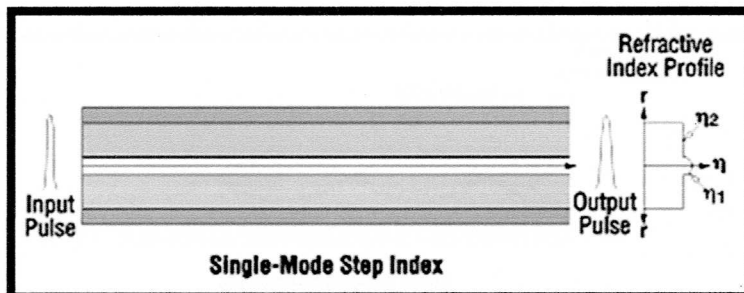


Figure 7.2: Single mode step index fiber (The Glass Story, 2011)

2.2.2.2 Multimode step index fiber.

The most widely used type is multimode step index fiber. It is easy to produce and its core diameter is 50 to 100 μm such as large aperture and allow more light to enter the cable. There are several paths that a light ray may follow during the propagation for example it may be propagated down the core in a zig-zag manner. The principle of total internal reflection (TIR) is used to propagate the light ray. The light enters at less than the critical angle and is guided along the fiber because the core index of refraction is higher than the cladding index of refraction.

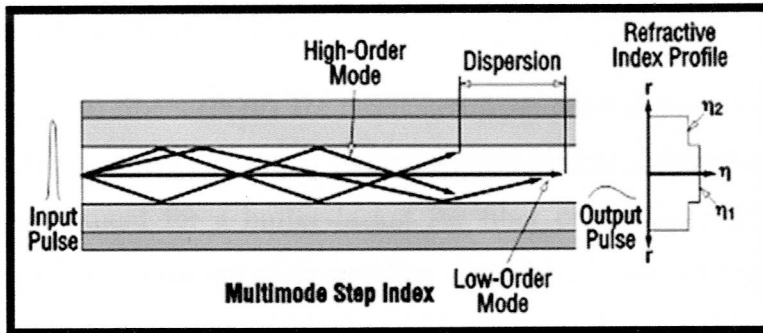


Figure 2.8: TIR in multimode step index fiber (The Glass Story, 2011)

2.2.2.3 Multimode graded index fiber

The 50 to 100 μm range is used for core size of multimode graded index cable. The light ray is propagating through the refraction and it enters the fiber at many different angles. The light ray intersecting a less dense medium as it propagates across the core toward the centre. Thus, the light rays are being continuously being refracted and ray is bending constantly. This cable is highly used for long distance communication.

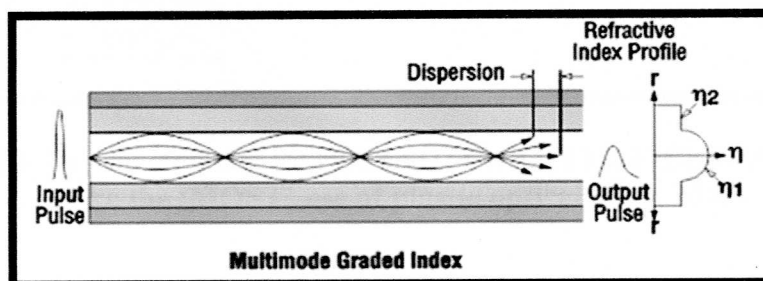


Figure 2.9: Multimode graded index fiber (The Glass Story, 2011)

The light rays follow a serpentine path being gradually bent back towards the centre by the continuously declining refractive index as they no longer follow straight lines; they travel slower than the serpentine modes as the mode traveling in a straight line are in a higher refractive index. All modes arrive at around the same time thus this reduced the arrival time disparity. (Bagad, 2008)

2.2.2.4 Plastic optical fiber (POF)

Plastic or polymeric fibers (POF) are fabricated from organic polymers for both the core and cladding regions exhibiting large core and cladding diameters. Thus, there is reduced requirement for a buffer jacket for fiber protection and strengthening. These fibers are better than the corresponding silica based glass variety because they are usually cheaper to produce and easier to handle than. However, they have limited use in communication applications as their performance especially for optical transmission in the infrared is restricted. POF have large numerical apertures which are multimode with either a step or graded index profile as a consequence of the core cladding refractive index difference which allow easier coupling of light into the fiber from a multimode source.

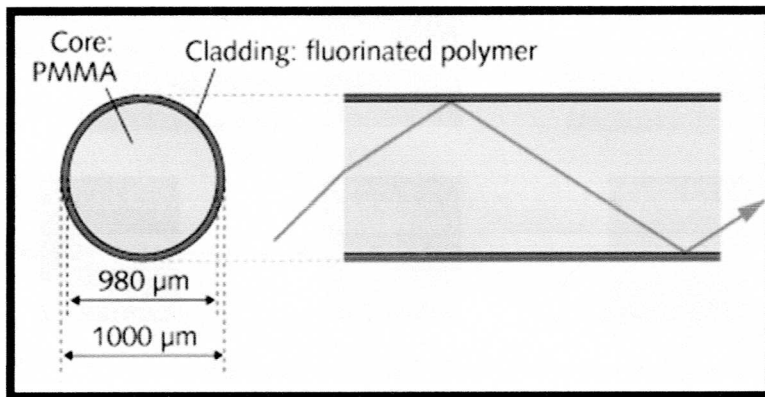


Figure 2.10: Typical structure for POF (AUTOMOTIVE FIBER: Automobiles make the 'MOST' use of plastic optical fiber, 2012)

2.3 Optical Fiber Communication System

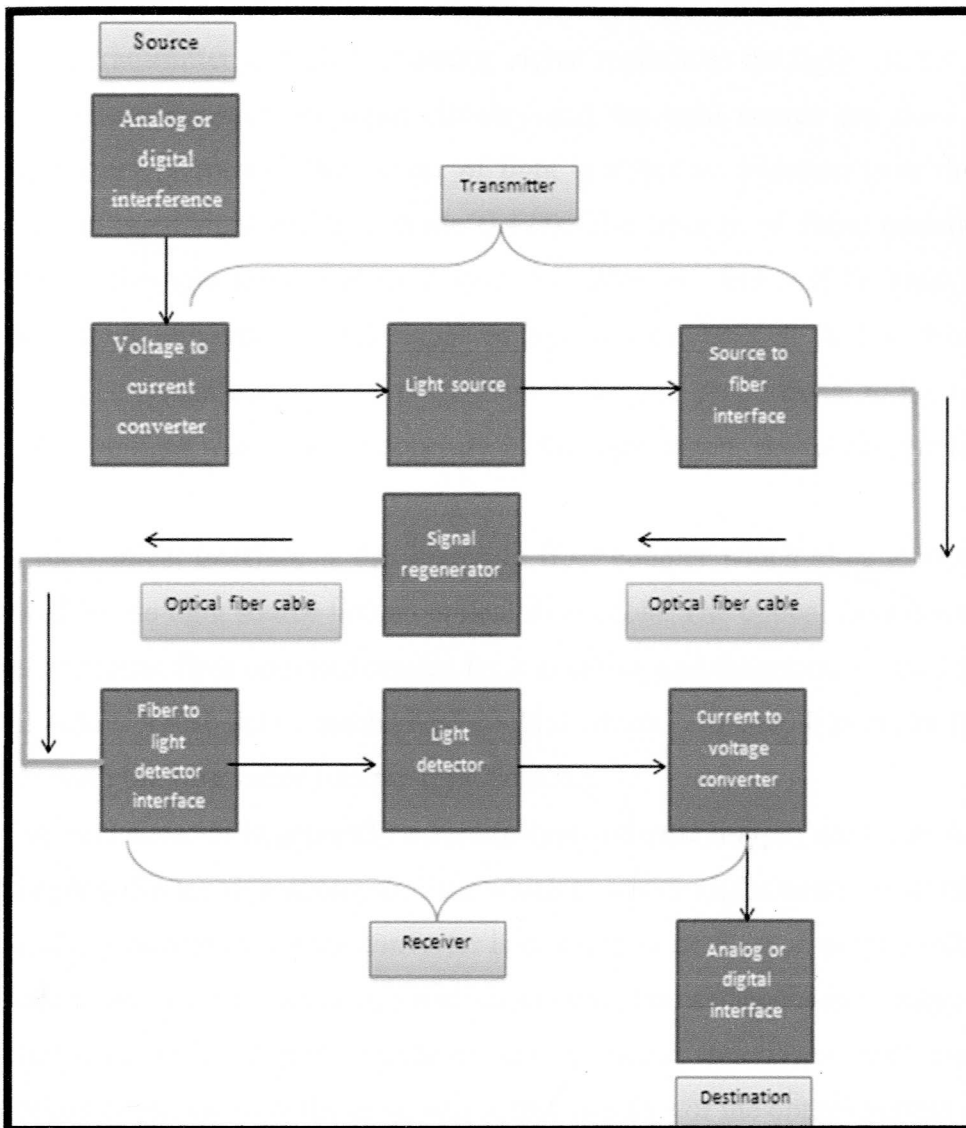


Figure 2.6: Optical fiber communication link

Figure 2.6 shows a simplified an optical fiber communication link block diagram of a one way optical fiber communications link. The three primary building blocks are fiber optic cable, the transmitter and the receiver, and the optical fiber cable. The transmitter is consisting of a source to fiber interface (light coupler), a light source, and voltage to current converter, and the fiber guide is the transmission medium, which is either a plastic cable or an ultrapure glass. It may be necessary to add one or more regenerators to the transmission medium, according on the distance between the transmitter and receiver. Functionally, the regenerator performs light