

COMMUNICATION SYSTEM USING OPTICAL FIBRE

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For my lovely parents, Abu Hassan Md Yasin and Zaiton Jurimi.

For my sweet sister and tough brothers.

And all my friends.

Thanks for the encouragement and support

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ABSTRACT

This project presents a simple communication system using fibre optic as communication media. This communication system provides sending an audio signal with bandwidth of 300Hz to 4 kHz from transmitter to a receiver. Using the optical fibre medium, the communication distance of 10m to 20m has been carried out. The transmitter for this communication system incorporates 660nm red LED for easy visibility with the spectral bandwidth of 20nm.

ABSTRAK

Projek ini membentangkan satu sistem komunikasi ringkas dengan menggunakan gentian optik. Komunikasi ini menyediakan penghantaran isyarat suara dengan had lebar 300Hz sehingga 4kHz dipancarkan dari suatu pemancar kepada penerima. Dengan menggunakan media gentian optik, komunikasi ini boleh dilakukan di antara jarak antara 10m hingga 20m. Pemancar untuk sistem komunikasi ini menggunakan 660nm LED merah supaya mudah dilihat dengan had lebar 20nm.

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LIST OF ABBREVIATION

| | | |
|--------|---|---------------------------------|
| AC | - | Alternating Current |
| ATC | - | Automatic Threshold Control |
| Bd | - | Baud |
| Bps | - | Bit Per Second |
| CAT | - | Category |
| COTS | - | Commercial Off The Shelf |
| EMI | - | Electromagnetic Interference |
| FO | - | Fibre Optic |
| GaAlAs | - | Gallium Aluminium Arsenide |
| Hz | - | Hertz |
| IC | - | Integrated Circuit |
| IM | - | Intensity Modulation |
| LAN | - | Local Area Network |
| LED | - | Light Emitting Diode |
| MM | - | Multimode |
| NPN | - | Transistor type |
| PC | - | Polycarbonate |
| PCB | - | Printed Circuit Board |
| PFM | - | Pulse-Frequency Modulation |
| PIN | - | Photodiode type |
| PM | - | Power Margin |
| PMMA | - | Poly Methylmethacrylate Acrylic |
| POF | - | Plastic Optical Fibre |
| PSM | - | Projek Sarjana Muda |
| RF | - | Radio Frequency |

| | | |
|-----|---|---------------------------------|
| Rx | - | Receiver |
| Si | - | Silicon |
| SMF | - | Single Mode Fibre |
| Tx | - | Transmitter |
| UHF | - | Ultra High Frequency |
| UV | - | Ultra Violet |
| VHF | - | Very High Frequency |
| WAN | - | Wide Area Network |
| WDM | - | Wavelength Division Multiplexer |

CHAPTER I

INTRODUCTION

1.1 Introduction of Communication Using Optical Fibre

Communication is defined as the transfer of information from one point to another. When the information is to be conveyed over any distance, a communication system is usually required. To exchange information between any two devices in communication system, some type of electric or optical signal which carries this information has to be transmitted from one device to the other via a communication channel.

Two wire lines is one of the oldest transmission channels that are currently in use today. This system is basically used for voice transmission system. The first attempt to reduce wire was from Paul Cordua, president of HIT Products, Inc., with a 4-wire system. It consisted of two wires to carry the power and two wires to carry the signal. This was in 1966 for agricultural installations [1]. This two wire line easy to install, cheap to acquire and affordable compared to more recent transmission. This affordability is the major reason why most developing country of the world uses copper wire for telecommunication transmission.

Despite this affordability, copper wire has numerous disadvantages where the maintenance cost is high while it facing with corrosion, rain and theft. In May 2001, 3298 customers of the major telecommunications service company (Telkom) were affected by cable theft for period up to seven days [2]. The reason is, these wire has been associated to use in manufacturing metal art and craft objects which have a booming tourist market.

Fibre optics is one of the communication media, at least as far as the wiring is concerned. Briefly stated, fibre optics cable is a media which passing light through a plastic or glass fibre between transmitter and receiver [3]. The first person known to have demonstrated image transmission through a bundle of optical fibres was Heinrich Lamm, a medical student in Munich with his paper in 1930 of transmitting the image of a light bulb filament through a short bundle. The multi mode fibre with a refractive index gradient between core and cladding, and core diameters of 50 or 62.5 micrometers is concentrated to develop after the single mode fibre had develop in early 1970s [4].

Since the invention in the early 1970s, the use and demand of optical fibre has grown tremendously. The uses of optical today are quite numerous. The most common are telecommunications, medicine, military, automotive and industrial. Telecommunications applications for example are widespread, ranging from global networks to local telephone exchanges to subscriber's homes to desktop computers. These involved the transmission of voice, data or video over a distance less than a meter to hundred of kilometres using a fibre design [5].

The high bandwidth capability of the fibre optic data link is that it can handle a tremendous amount of electronically transmitted information simultaneously. Depend on the used of fibre optic, the 'Communication System Using Optical Fibre' will be implemented as a part of telecommunication system. This is for preparations of optical system that will meet growth needs for a 15 to 20 year span [5].

1.2 Objective

The objective of this project is to set up a communication system through fibre optic cable. A voice signal with bandwidth from 0.3-4kHz will be used to communicate from a transmitter to receiver via fibre optic cable.

1.3 Scope of Work

This project is focusing on the development of transmitter and receiver circuit and performance of optical fibre cable in order to carry the voice signal from a transmitter to receiver. The transmitting circuit will generate light signal that will propagate through optical fibre cable. Thus, to convert the signal to a light source, the HFBR 1524Z red LED with 660nm is used. The Light Emitting Diode (LED) light source can be transmitted through air for at most 20m distance. The transmitting circuit then connected to a receiver through fibre optic cable which need photo detector HFBR 2524Z as light detector. The detector will capture the propagated light from optical fibre and converted back to electric signal.

1.4 Project Methodology

This project starts with literature review, identifying circuit diagram and appropriate technique used for this project. This project includes designing circuits that will be simulated using Multisim Electronic Workbench and identifying the suitable component for the circuit. Then, the circuit is developed and fabricated using the identified component. The fabricated circuit then will be tested and analyzed to determine its performance. Detail of the research methodology will be explained in Chapter 3.

1.5 Expected Result

At the end of this project, a transmitter and receiver which communication through fibre optic cable will be developed with a voice signal from 0.3- 4 kHz bandwidth.

CHAPTER II

LITERATURE REVIEW

The basic communication system consists of a transmitter, a receiver and a communication channel. At the transmitter, the message is processed and converted into a suitable waveform for transfer over the communication channel. The communication channel can be divided into two categories: unguided channel and guided channel.

One of the unguided channels is atmospheric channel which waves can propagate. This atmospheric channel includes some system such as commercial radio and television broadcasts (satellite) and microwave relay link [6]. While the guided channels include a variety conducting transmission structures such as two-wire line, coaxial cable, rectangular waveguide and optical fibre link.

Two-wire line is the oldest guided channel that still used until today. There are few categories or classes of two-wire line which have different limitation of bandwidth. The ability to carry with a frequency range through 600MHz of CAT 7 and Class F cable make two-wire line can be used for audio and video transmission. Gigabit Ethernet can be run over two-wire line, provided that it is state of the art CAT 5 wiring [7] of local area network (LAN). The CAT 5 can operate up to 10Gbps of data rate with fewer than 100 meters in length [8].

There are limitations to run Gigabit Ethernet over two-wire line, including distance. The quality of image that will be received is not smooth as by using two-wire line, the data tend to have losses and the losses are proportional to the distance of the line. The speed of transmission will also affect the quality of image as low speed transmission will make the image freeze for a couple of times. These are why copper is good solution for corporate LANs, but not a good solution for the corporate campus or corporate WANS [7].

From that, by using fibre optic as a communication channel, the quality of image will be improved as fibre optic cable have less data loss than two wire line.