UNIVERSITI TEKNIKAL MALAYSIA MELAKA

A DEVELOPMENT OF FIBRE OPTIC SENSOR FOR DETECTING ALCOHOL (ETHANOL) LEVEL IN PERFUME

This report is submitted in accordance with the requirement of Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor of Electronic Engineering Technology (Telecommunications) with Honours.

By

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BORANG PENGESAHAN STATUS LAPORAN PROJEK SARJANA MUDA

TAJUK: **A Development of Fiber Optic Sensor For Detecting Alcohol Level In Perfume (Ethanol)**

SESI PENGAJIAN: **2016/17 Semester 1**

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I hereby, declared this report entitled "Fiber Optic Sensor for Sodium Chloride Concentration" is the results of my own research except as cited in references.

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Date : ………………………

APPROVAL

This report is submitted to the Faculty of Engineering Technology of UTeM as a partial fulfillment of the requirements for the degree of Bachelor of Engineering Technology (Telecommunication) with Honours. The member of the supervisory is as follow:

……………………………….

(Md Ashadi bin Md Johari)

ABSTRAK

"*Penghasilan pengesan gentian optik untuk mengesan tahap alkohol (ethanol) dalam minyak wangi*" adalah dicipta untuk mengesan sukatan alkohol di dalam minyak wangi. Projek ini memberi tumpuan kepada beberapa janama minyak wangi yang berada di pasaran. Dengan meletakkan sample minyak wangi pada fiber optik tersebut, keputusan kajian akan diperolehi. Hasil kajian ini akan membandingkan beberapa jenama minyak wangi yang digunakan sebagai bahan kajian. Diharapkan hasil kajian ini dapat membantu pengguna mengenalpasti jenama minyak wangi yang mempunyai sukatan alkohol yang tinggi dan rendah.

ABSTRACT

***"A DEVELOPMENT OF FIBRE OPTIC SENSOR FOR DETECTING ALCOHOL (ETHANOL) LEVEL IN PERFUME*"** was created to measure the alcohol level in perfume. This project focuses on some of the perfume brand that was on the market. By put the sample of perfume at the fiber optic, the result of the experiment will be obtainable. The study will compare several brands of perfume that used as research material. It is hoped that the study will help the user identify the perfume brands that have level of alcohol that are high and low.

DEDICATION

This thesis is dedicated to my father, who taught me that the best kind of knowledge to have is that which is learned for its own sake. It is also dedicated to my mother, who taught me that even the largest task can be accomplished if it is done one step at a time. They also helped me financially and supported throughout finishing this project report

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CHAPTER 1

INTRODUCTION

1.0 Background

A fiber optic sensor is a sensor that uses optical fiber either as the sensing element, or as a means of relaying signals from a remote sensor to the electronics that process the signals. Fibers have many uses in remote sensing. Depending on the application, fiber may be used because of its small size, or because no electrical power is needed at the remote location, or because many sensors can be multiplexed along the length of a fiber by using light wavelength shift for each sensor, or by sensing the time delay as light passes along the fiber through each sensor. Time delay can be determined using a device such as an optical time-domain reflectometer and wavelength shift can be calculated using an instrument implementing optical frequency domain reflectometry.

Fiber optic sensors are also immune to electromagnetic interference, and do not conduct electricity so they can be used in places where there is high voltage electricity or flammable material such as jet fuel. Fiber optic sensors can be designed to withstand high temperatures as well.

1.1 Problem Statement

A various kind of sensors has been developed nowadays for different type of usage. For example, a precise and highly sensitive sensor is preferred when it comes to measurement and analyze a chemical substance. For example, to obtain a blood sample in medical laboratory, an accurate and precise acetone concentration technique was used.

In general, the chemical sensors are classified into three parts which is gas, liquid and solid particle. The design of chemical sensor is required appreciation of the needed degree of quantitative reliability.

An electrochemical has been introduced to determine the chemical concentration. For example the acetone (alcohol) rate in perfume. Many perfume products in marker claim that the their product is free alcohol. So that this fiber optic sensor was developed to detect the concentration of acetone in perfume. A few type of perfume will be used as research material.

1.2 Objective

The objective of this project is:

i. To study fiber optic sensor operation
ii. To develop fiber optic sensors for detecting alcohol from different brand
iii. To analyze the performance of fiber optic

1.3 Limitation

This project would be implemented by optimizing the usage of fiber optic sensor based on beam-through technique. This sensor will be used to detect the concentration of ethanol

1.4 Scope

Although there are various techniques used in fiber optic sensor, but the study will cover only on fiber optic sensor beam-through technique. Neither the ethanol physical properties, nor the chemical properties of ethanol will be studied in this paper. Instead, this study will mainly focus on the application of fiber optic as a sensor for the detection of ethanol concentration.

CHAPTER 2

LITERATURE REVIEW

2.0 Inroduction

This chapter will provide the review of previuos research that is related to this final year project. There are previous researches understanding on the fibre optic sensor, technique used in fibre optic sensor, the role of acetone in the diabetic ketoacidosis, acetone in industrial usage, and the current acetone sensor.

2.1 Fibre Optic

An optical fiber is a flexible, transparent fiber made by drawing glass (silica) or plastic to a diameter slightly thicker than that of a human hair. Optical fibers are used most often as a means to transmit light between the two ends of the fiber and find wide usage in fiber-optic communications, where they permit transmission over longer distances and at higher bandwidths (data rates) than wire cables. Fibers are used instead of metal wires because signals travel along them with lesser amounts of loss; in addition, fibers are also immune to electromagnetic interference, a problem from which metal wires suffer excessively. Fibers are also used for illumination, and are wrapped in bundles so that they may be used to carry images, thus allowing viewing in confined spaces, as in the case of a fiberscope. Specially designed fibers are also used for a variety of other applications, some of them being fiber optic sensors and fiber lasers.

Optical fibers typically include a transparent core surrounded by a transparent cladding material with a lower index of refraction. Light is kept in the core by the phenomenon of total internal reflection which causes the fiber to act as a waveguide. Fibers that support many propagation paths or transverse modes are called multi-mode fibers (MMF), while those that support a single mode are called single-mode fibers (SMF). Multi-mode fibers generally have a wider core diameter and are used for short-distance communication links and for applications where high power must be transmitted.[citation needed] Single-mode fibers are used for most communication links longer than 1,000 meters (3,300 ft).

An important aspect of a fiber optic communication is that of extension of the fiber optic cables such that the losses brought about by joining two different cables is kept to a minimum. Joining lengths of optical fiber often proves to be more complex than joining electrical wire or cable and involves careful cleaving of the fibers, perfect alignment of the fiber cores, and the splicing of these aligned fiber cores. For applications that demand a permanent connection a mechanical splice which holds the ends of the fibers together mechanically could be used or a fusion splice that uses heat to fuse the ends of the fibers together could be used. Temporary or semi-permanent connections are made by means of specialized optical fiber connectors.The field of applied science and engineering concerned with the design and application of optical fibers is known as fiber optics

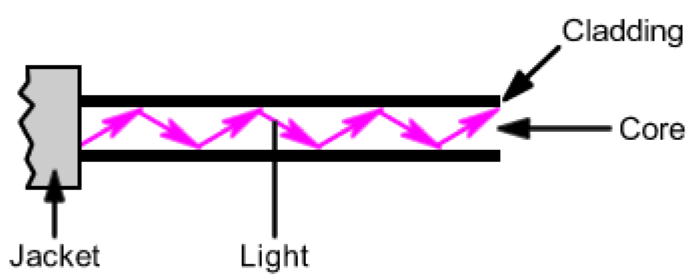

Figure 2.1: Light rays incident on the core-cladding interface at the angle greater than the critical angle and trapped inside the fibre core

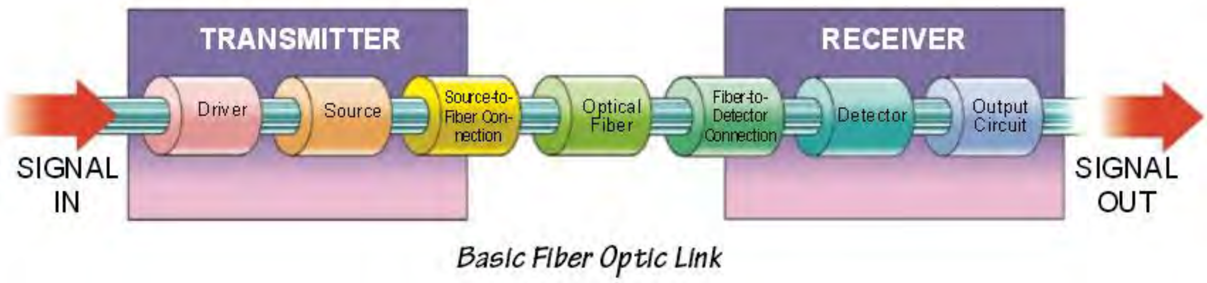

Figure 2.2: Basic fiber optic link

2.1.1 Principle of operation

An optical fiber is a cylindrical dielectric waveguide (nonconducting waveguide) that transmits light along its axis, by the process of total internal reflection. The fiber consists of a *core* surrounded by a cladding layer, both of which are made of dielectric materials. To confine the optical signal in the core, the refractive index of the core must be greater than that of the cladding. The boundary between the core and cladding may either be abrupt, in *step-index fiber*, or gradual, in *graded-index fiber*.

2.1.2 Benefits of Fiber Optics

Fiber optic communication systems have many advantages over copper wire-based communication systems. These advantages include:

1. Long-distance signal transmission

The low attenuation and superior signal quality of fiber optic communication systems allow communications signals to be transmitted over much longer distances than metallic-based systems without signal regeneration. In 1970, Kapron, Keck, and Maurer (at Corning Glass in USA) were successful in producing silica fibers with a loss of about 17 dB/km at a wavelength of 633 nm.

Since then, the technology has advanced with tremendous rapidity. By 1985 glass fibers were routinely produced with extremely low losses (< 0.2 dB/km). Voice-grade copper systems require in-line signal regeneration every one to two kilometers. In contrast, it is not unusual for communications signals in fiber optic systems to travel over 100 kilometers (km), or about 62 miles, without signal amplification of regeneration.

2. Large bandwidth, light weight, and small diameter

Today's applications require an ever-increasing amount of bandwidth. Consequently, it is important to consider the space constraints of many end users. It is commonplace to install new cabling within existing duct systems or conduit. The relatively small diameter and light weight of optical cable make such installations easy and practical, saving valuable conduit space in these environments.

3. Nonconductive

Another advantage of optical fibers is their dielectric nature. Since optical fiber has no metallic components, it can be installed in areas with electromagnetic interference (EMI), including radio frequency interference (RFI). Areas with high EMI include utility lines, power-carrying lines, and railroad tracks. All-dielectric cables are also ideal for areas of high lightning-strike incidence.

4. Immunity to Electromagnetic Interference

Although fiber optics can solve data communications problems, they are not needed everywhere. Most computer data go over ordinary wires. Most data are sent over short distances at low speed. In ordinary environments, it is not practical to use fiber optics to transmit data between personal computers and printers as it's too costly. Electromagnetic Interference is a common type of noise that originates with one of the basic properties of electromagnetism. Magnetic field lines generate an electrical current as they cut across conductors. The flow of electrons in a conductor generates a magnetic field that changes with the current flow. Electromagnetic Interference does occur in coaxial cables, since current does cut across the conductor. Fiber optics are immune to this EMI since signals are transmitted as light instead of current. Thus, they can carry signals through places where EMI would block transmission.

5. Data Security

Magnetic fields and current induction work in two ways. They don't just generate noise in signal carrying conductors; they also let the information on the conductor to be leaked out. Fluctuations in the induced magnetic field outside a conductor carry the same information as the current passing through the conductor. Shielding the wire, as in coaxial cables can reduce the problem, but sometimes shielding can allow enough signal leak to allow tapping, which is exactly what we wouldn't want.

There are no radiated magnetic fields around optical fibers; the electromagnetic fields are confined within the fiber. That makes it impossible to tap the signal being transmitted through a fiber without cutting into the fiber. Since fiber optics do not radiate electromagnetic energy, emissions cannot be intercepted and physically tapping the fiber takes great skill to do undetected. Thus, the fiber is the most secure medium available for carrying sensitive data.

6. Non Conductive Cables

Metal cables can encounter other signal transmission problems because of subtle variations in electrical potential. Electronic designers assume that ground is a uniform potential. That is reasonable if ground is a single metal chassis, and it's not too bad if ground is a good conductor that extends through a small building. However, the nominal ground potential can differ by several volts if cables run between different buildings or sometimes even different parts of the same building.

Signal levels in semiconductor circuits are just a few volts, creating a problem known as ground loop. When the difference in ground potential at two ends of a wire gets comparable to the signal level, stray currents begin to cause noise. If the differences grow large enough, they can even damage components.

Electric utilities have the biggest problems because their switching stations and power plants may have large potential differences.

A serious concern with outdoor cables in certain computer networks is that they can be hit by lightning, causing destruction to wires and other cables that are involved in the network. Certain computer companies are aware of this problem and trying to solve it by having protective devices for wire circuits to block current and voltage surges.

Any conductive cables can carry power surges or ground loops. Fiber optic cables can be made non-conductive by avoiding metal in their design. These kinds of cables are economical and standard for many indoor applications. Outdoor versions are more expensive since they require special strength members, but they can still be valuable in eliminating ground loops and protecting electronic equipment from surge damage.

7. Eliminating Spark Hazards

In some cases, transmitting signals electrically can be extremely dangerous. Most electric potentials create small sparks. The sparks ordinarily pose no danger, but can be really bad in a chemical plant or oil refinery where the air is contaminated with potentially explosive vapors. One tiny spark can create a big explosion. potential spark hazards seriously hinder data and communication in such facilities. Fiber optic cables do not produce sparks since they do not carry current.

8. Ease of Installation

Increasing transmission capacity of wire cables generally makes them thicker and more rigid. Such thick cables can be difficult to install in existing buildings where they must go through walls and cable ducts. Fiber cables are easier to install since they are smaller and more flexible. They can also run along the same routes as electric cables without picking up excessive noise.