FIBER OPTIC SENSOR FOR SOIL HUMIDITY/MOISTURE MONITORING

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FAKULTI KEJURUTERAAN ELEKTRONIK DAN KEJURUTERAAN KOMPUTER

BORANG PENGESAHAN STATUS LAPORAN
PROJEK SARJANA MUDA II

Tajuk Projek :**FIBER OPTIC SOIL SENSOR FOR SOIL/HUMIDITY MONITORING**

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Sesi Pengajian : | 1 | 6 | / | 1 | 7 |

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Tarikh : .....

Specially dedicated to my father, mother and my friends for their loving, understanding, care and support for this project

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ABSTRACK

This project is about to monitor moisture in soils using fiber optic as a main component. The reason why fiber optic is used is because, the measurement for reading are immune from interference caused by surrounding electric or magnetic fields. So the measurements are more accurate. The basic concept of a fiber optic sensor is to detect a change in intensity of the light that travels inside the fiber. This changes can be induced either by allowing the light to escape the fiber, or by absorbing the light. The light is normally confined inside the core of the fiber by the cladding coating. So the effect only can happen when the cladding coating is remove. In this project phototransistor is used to detect the light in fiber optic. Other than that, Arduino nano is used to read the output data whereas optical connector is to send the light through the fiber optic. So, this project will be use five different sensor with different length and width which is the function of the sensor is to detect the level of soil moisture. All the sensor are being analyse to know which are the sensor are suitable for this project. If the sensor are suitable with this system, the output that generate by the receiver should be same with the theory.

ABSTRAK

Projek in adalah untuk menguji kelembapan tanah menggunakan gentian optik. Untuk projek inin gentian optik adalah komponen utama. Sebab utama gentian optik ini digunakan adalah bebas daripada ganguan yang disebabkan oleh sekitar medan elektrik atau magnet. Jadi bacaan akan lebih tepat lagi. Konsep asas yang digunakan oleh gentian optik adalah mengesan perubahan cahaya yang melalui dalam gentian optik. Perubahan ini boleh disebabkan sama ada dengan membenarkan cahaya untuk keluar dari gentian optik atau menyerap cahaya ke gentian optik. Cahaya dalam gentian optik ini biasanya terperangkap dalam lapisan pelapis. Kesan perubahan cahaya ini hanya akan berlaku sekiranya lapisan pelapis dibuang. Untuk projek ini, fototransistor akan digunakan untuk mengesan cahaya, arduino nano akan memproses, penyambung optik untuk menghantar cahaya ke gentian optik, Untuk project ini, lima jenis sensor dengan panjang dan lebar yang berbeza iaitu fungsi sensor ini adalah untuk menguji tahap kelembapan tanah. Semua sensor ini dianalysis untuk mengetahui sensor yang mana sesuai untuk projek ini. Jika sensor ini sesuai dengan sistem ini, nilai yang dihasilkan oleh penerima haruslah sama seperi megikut teori.

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ABBREAVIATION

POF	-	Plastic Optical Fiber
GOF	-	Glass Optical Fiber
GI-POF	-	Grand Index Plastic Optical Fiber
SI	-	Step Index Profile Fiber
PCB	-	Printed Circuit Board

CHAPTER 1

INTRODUCTION

1.1 Introduction

There are various type of technologies that are used to to measure soil moisture available in the market. For example, the technologies that are currently use are resistivity or capacitance. Open source moisture sensors that everyone uses with Arduino are based on electrical resistance measurement [1].

This project involves the development of soil moisture sensor based on fiber optic. The reason why fiber optic is used is that the measurement is immune from interference caused by surrounding either electric or magnetic fields. Fiber optic is preferred because soil conductivity is very sensitive to ionic concentrations or amount of salts.

Basically the basic concept of a fiber optic sensor is to detect a change usually in intensity of the light that travels inside the fiber. It change by induced either by allowing the light to escape from the fiber, or by absorbing the light [2].

The light is normally confined inside the core of the fiber by the cladding coating. When the cladding coating is removed, the light can escape through leak out. It is when some compound substance or material that is use to wrap the fiber comes in contact with the fiber where the cladding layer has been removed. Then, when the refractive index of the compound is equal or greater than the refractive index of the fiber core the effect is significant.

The light can be absorbed by this compound whenever the compound is in contact with the core of the fiber even if it's refractive index is less than the fiber core. This effect is will happen when there are water comes contact with the fiber optic which changing light in the fiber optic.

1.2 Project Objective

The main objective of the project is to design and develop fiber optic sensor for humidity/moisture monitoring. Once the fiber optic sensor is ready, Arduino nano is combine with the sensor to allow the display of data transmitted from transmitter to the receiver. After that, the data obtained is monitored and analysed. The data shows the soil moisture/humidity sense using fiber optic sensor.

1.3 Problem Statement

Soil moisture sensors are used to measure the volumetric water content in the soil. Since the direct gravimetric measurement of free soil moisture requires some of condition such as removing, drying, and weighting of a sample, soil moisture sensors measure the volumetric water content indirectly by using some other property of the soil. For example electrical resistance, dielectric constant, or interaction with neutrons, as a proxy for the moisture content.

So, current moisture sensor are lack of accuracy. This is due to sensor must be in direct contact with undisturbed soil in order to provide accurate readings. During installation, damage to roots and soil structure should be minimized and air voids, large roots, rocks, and other obstructions should be avoided. So the reading will not be accurate.

1.4 Scope of Work

To implement the project, a few consideration have been taken in term of limitation or condition to assure that the project will be successful. There are several main area that are needed to consider in order to realize the project.

Firstly the light source that is used for this project is 530nm. This is because LED 530nm are cheaper. Second, is the type of fiber that will use are PMMA 1mm diameter optical fiber. The characteristics of PMMA fiber is large core size at lower cost than glass equivalent and it is suitable for application as a sensor.

CHAPTER II

LITERATURE REVIEW

2.1 PLASTIC OPTICAL FIBER

Optical communications systems have a long history. Before this they are using signal with smoke and fire. Often relaying messages from mountain top to mountain top. However, this type of communication had limited transmission capacity.[3] An optical fiber or optical fiber are thicker than that of a human hair that are flexible, transparent fiber that are made by glass or plastic to a diameter slightly. Fibers optic are used instead of using metal wires because immune to electromagnetic interference and signals travel along them with lesser amounts of loss, a problem from which metal wires suffer excessively. Optical fibers are used most often which is means to transmit light through fiber and find wide usage in fiber-optic communications. Fiber optic can transmit over longer distances and at higher bandwidths than wire cables which is are currently use now. Fibers are also used for illumination, and wrapped in bundles. So it can carry images, thus allowing viewing in confined spaces, as in the case of a fiberscope. Some of fiber optic are specially designed that are used for a variety of other applications.[4]

Fiber optic are refers to the the technology that are associated with the transmission of information as light pulses along a glass or plastic strand or fiber. Optical fiber can carries much more information than conventional copper wire. Copper wire will effect to electromagnetic interference and it need to retransmit signals again. But Fiber optic are will not be effect by interference of electromagnetic. Majority of the telephone company that use long-distance lines are use optical fiber because of it. Transmission by using fiber optic cable will requires repeater at distance intervals. In terms of protection of fiber, the glass fiber requires more protection within an outer cable than copper because the installation of any new cabling is labor-intensive. A few communities have installed optical fiber cables from the phone company's branch office to local customers known as local loops. A type of fiber known as multimode for short distance and single mode for longer distances.[5]

Most of Computer networking now use fiber optics. This is because an fiber optic have ability that are transmit data and will provide high bandwidth. Fiber optics is frequently used in broadcasting and electronics to provide better connections and performance. Military and space industries also use of fiber optic which means of communication and signal transfer and its ability to provide temperature sensing. Fiber optic cables can be beneficial because of the weight and smaller size which is will easy to use.[6]

Fiber optic communication. There are tools that can give a permanent connection which is using splicer that will holds the ends of the fibers together a fusion splice that uses heat to fuse the ends of the fibers together. Joining lengths of optical fiber 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. Temporary or semi-permanent connections only can made by specialized optical fiber connectors.The figure show that an example of fiber optic. Figure 2.1 show an example of fiber optic

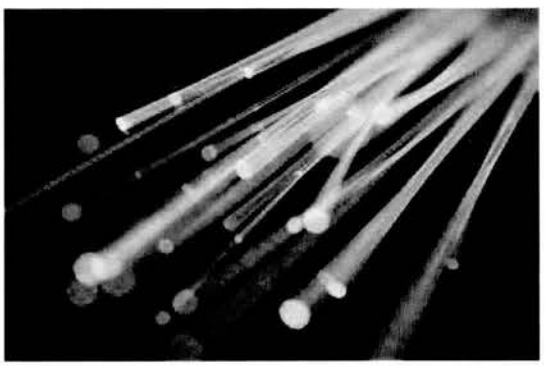

Figure 2.1 : Fiber Optic

2.2 Basic Structure of Fiber Optic

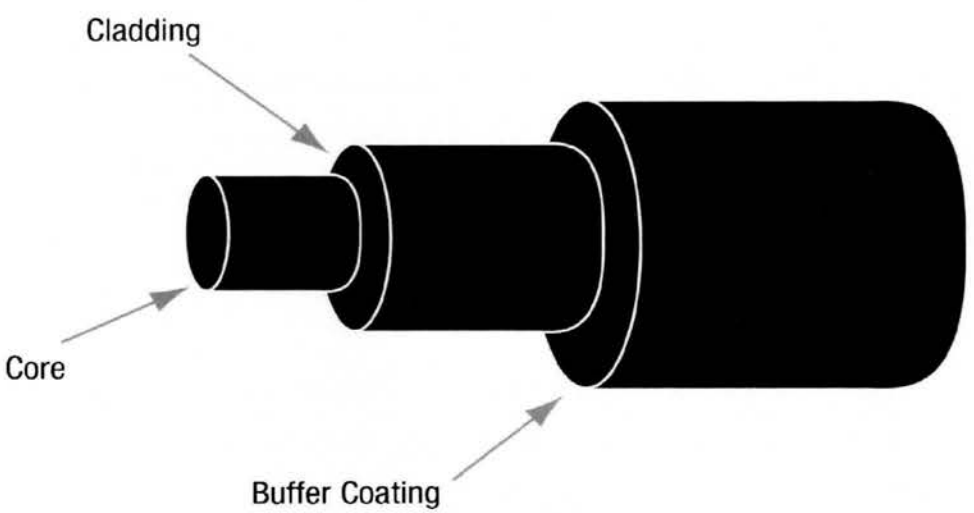

Figure 2.2 : Structure of Fiber Optic

Fiber optic communication system are include of optical transmitter and receive at the other side. So it are very important to start from the beginning of fiber optic.[7]. The figure 2.2 show basic structure of an optical fiber consists of three parts: the core,the cladding, and the coating or buffer.[8]

The core of fiber is a cylindrical rod of dielectric material. Dielectric material do not conduct electricity. The core is generally made of glass that are surrounded by a layer of material called cladding. Light propagates mainly along the core of the fiber. The cladding does perform several functions even though light will propagate along the fiber core without the layer of cladding material.[9]

The cladding layer is made of a dielectric material. The function of cladding layer is to reduces loss of light from the core into the surrounding air cladding is generally are made form glass or plastics. To protects the fiber from absorbing surface contaminants scattering loss at the surface of the core are used .

The coating or buffer is a layer of material used to protect an optical fiber from physical damage.T he buffer also will prevents the optical fiber from scattering losses caused by microbends. Microbends that occur during an optical fiber is placed on a rough place..[10]

2.3 Plastic Fiber Optic (POF)

Plastic optical fiber (POF) has always been lurking in the background in fiber optics a specialty fiber useful for illumination and low speed short data links.

The core material of optical fibert are uses polymethylmethacrylate (PMMA) . It will allows the transmission of light is a one of type plastics fiber. POF also is often called consumer optical fiber because of low-cost optical fiber. Plastic fiber optic are alternative of glass fiber because it are more easier to use. The transfer data for speed is 1 GB/s, which is much better or faster than traditional copper wire that are currently use.

POF are quick, easy and inexpensive for installations. It can developed by home builder using basic tools only such as splicer. POF also can reduce the cost of truck rolls for broadband services provider.POF is much larger in diameter which results in lower data rates making it most suitable for high bandwidth signal transmission over short distances. Majority of POF products are used in medical, automotive, home networks, as well as digital audio and video interfaces. Unlike glass fiber , plastic fiber can easily be cut and bent to fit in hard-to-reach places and the larger core also allows for slightly damaged fiber to work.[11]

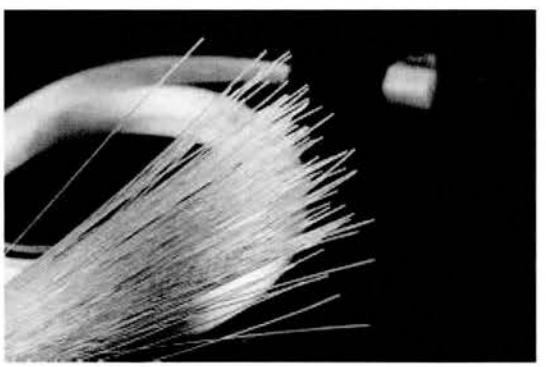

Figure 2.3 : Plastic Optical Fiber

There are many type of glass Optical Fibers (GOF). It that can be divided into several categories depending on the type of applications that are they are use such as lasing,communications, sensing. Optical fibers are not only glass-based a wide

variety of Polymer-based Optical Fibers (POF), it can be mainly classified based on the specific material and the index profile, exists, for several applications as shown in figure 2.4

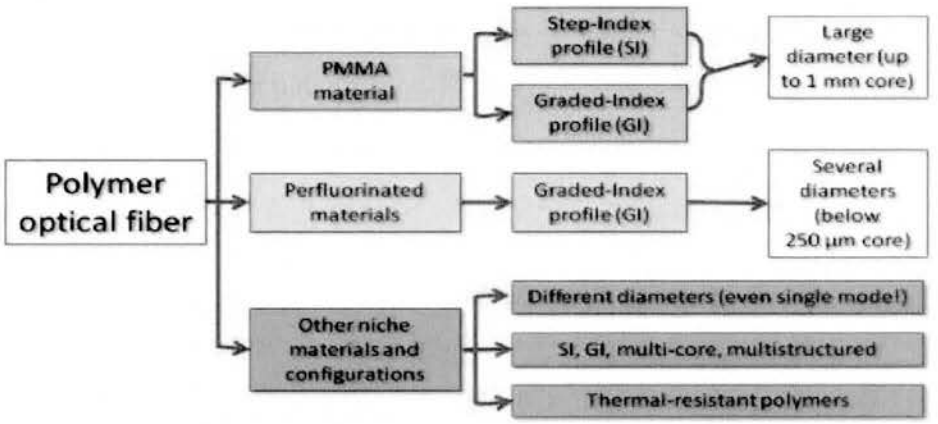

Figure 2.4 : Type of Plastic Optical Fiber

There are two major classes of POF that can be identified.First is Step-Index POF with large core and GradedIndex POF. The second one is PF-POF. Its made of GI-POF or perfluorinated material. Majority of PMMA-SI-POF will be used to address large core step index fibers made of PMMA material.

The use of polymers instead of glass gives certain advantages in terms of mechanical robustness and installation in hostile environments such as in presence of water or high humidity, so many studies are still in progress to reduce the transmission performance penalty that POF pay with respect to GOF. Since the behavior of the best performing GIPOF are getting very similar to multi-mode GOF.[12]