POLITEKNIK

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IOT UNDERGROUND FIBER OPTIC TYPE CABLE FAULT DETECTOR PROJECT

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JABATAN KEJURUTERAAN ELEKTRIK

SESI 2 2022/2023

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This report submitted to the Electrical Engineering Department in fulfillment of the requirement for a Diploma in Electrical Engineering

JABATAN KEJURUTERAAN ELEKTRIK

SESI 2 2022/2023

CONFIRMATION OF THE PROJECT

The project report titled "IOT Underground Fiber Optic Type Cable Fault Detector Project" has been submitted, reviewed and verified as a fulfills the conditions and requirements of the Project Writing as stipulated

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Signature of Coordinator :

Date :

“I acknowledge this work is my own work except the excerpts I have already explained to our source”

1. Signature :

Name : **WONG GUAN CHENGG**

Registration Number : **08DEP20F2005**

Date : 20/06/2023

DECLARATION OF ORIGINALITY AND OWNERSHIP

TITLE : IOT UNDERGROUND FIBER OPTIC TYPE CABLE FAULT DETECTOR PROJECT

SESSION: SESI 2 2022/2023

1. I, **Wong Guan Chengg** is a final year student of **Diploma in Electrical Engineering, Department of Electrical, Politeknik Sultan Salahuddin Abdul Aziz Shah**, which is located at **Persiaran Usahawan, 40150 Shah Alam, Selangor**. (Hereinafter referred to as 'the Polytechnic').

2. I acknowledge that 'The Project above' and the intellectual property therein is the result of our original creation /creations without taking or impersonating any intellectual property from the other parties.

3. I agree to release the 'Project' intellectual property to 'The Polytechnics' to meet the requirements for awarding the **Diploma in Electrical Engineering** to me.

Made and in truth that is recognized by;
a) **WONG GUAN CHENGG**)
(Identification card No: - 010907140263) ……………………………………
) **WONG GUAN CHENGG**

In front of me, **ZABIDAH BINTI HARON** ……………………………………
(Identification card No: - 780613015804)) **ZABIDAH BINTI HARON**
As a project supervisor, on the date:

ACKNOWLEDGEMENTS

I worked hard on this project. It would not, however, have been feasible without the kind support and assistance of many individuals and organizations. I would like to express my heartfelt gratitude to each and every one of them. I am grateful to Madam Zabidah Binti Haron for her advice and regular supervision, as well as for giving vital information about the project and for their assistance in finishing it.

I would like to show my gratitude to my parents and Politeknik Sultan Salahuddin Abdul Aziz Shah members for their kind cooperation and encouragement in completing this project. I'd like to offer my heartfelt gratitude and appreciation to industry professionals for their time and attention.

My thanks and appreciation also go to my colleague in the project's development and to those who have freely assisted me with their skills.

ABSTRACT

Optical fiber technologies are now crucial in providing end customers with genuine broadband connectivity. Monitoring and identifying fiber failures are crucial for ensuring that clients continue to receive service. As a result, any service disruption caused by a fiber catastrophe could cause telecom carriers to incur large financial losses. An intelligent fault detection system in an optical fiber is proposed in the developed concept to pinpoint the specific location of a problem in the fiber optic cable. The most significant parameter in this project will be monitoring the received light source. Similarly, various factors can be used to monitor the cable's fault. This project proposed developing a system that can assist repairmen in detecting underground cable faults in developing a project that saves money, manpower, and time in fiber-optic fault detector with rapidly locate the fiber-optic cable fault, and only the problematic area needs to be dug up in order to check and repair the fault while also allowing authorities to monitor and test issues via the internet using IOT technology in this project. The system is built with ESP 32 and an IR Brightness Sensor, which is programmed to control all of the circuits. The testing data and outcomes have been included and analyzed in the Blynk Application.

(Keywords : Fiber Optic, ESP 32, IR Brightness Sensor, Fault Detection, IOT, Blynk)

ABSTRAK

Teknologi gentian optik kini penting dalam menyediakan pelanggan akhir dengan sambungan jalur lebar tulen. Memantau dan mengenal pasti kegagalan gentian adalah penting untuk memastikan pelanggan terus menerima perkhidmatan. Akibatnya, sebarang gangguan perkhidmatan yang disebabkan oleh malapetaka gentian boleh menyebabkan pembawa telekom mengalami kerugian kewangan yang besar. Sistem pengesanan kerosakan pintar dalam gentian optik dicadangkan dalam konsep yang dibangunkan untuk menentukan lokasi khusus masalah dalam kabel gentian optik. Parameter yang paling penting dalam projek ini akan memantau sumber cahaya yang diterima. Begitu juga, pelbagai faktor boleh digunakan untuk memantau kerosakan kabel. Projek ini mencadangkan membangunkan sistem yang boleh membantu pembaikan dalam mengesan kerosakan kabel bawah tanah dalam membangunkan projek yang menjimatkan wang, tenaga kerja dan masa dalam pengesan kerosakan gentian optik dengan cepat mengesan kerosakan kabel gentian optik, dan hanya kawasan bermasalah sahaja yang perlu digali untuk menyemak dan membaiki kerosakan sambil membenarkan pihak berkuasa memantau dan menguji isu melalui internet menggunakan teknologi IOT dalam projek ini. Sistem ini dibina dengan ESP 32 dan Sensor Kecerahan IR, yang diprogramkan untuk mengawal semua litar. Data dan hasil ujian telah dimasukkan dan dianalisis dalam Aplikasi Blynk.

(Kata kunci : Gentian Optik, ESP 32, Sensor Kecerahan IR, Pengesanan Kerosakan, IOT, Blynk)

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CHAPTER 1

1 INTRODUCTION

1.1 Introduction

The principle of fiber-optic communication is based on the transmission of a signal from one location to another via an optical fiber. Light is a type of electromagnetic carrier wave that can be manipulated to carry information. Most of the optical fiber is used to transmit telephone signals. Due to substantially lower attenuation and interference, optical fiber has significant advantages over current copper wire in long-distance and high-demand applications. Because infrastructure development within cities was relatively time-consuming and difficult, and fiber-optic systems were expensive and complex to install and operate, fiber-optic communication systems have primarily been installed for long-distance applications; however, fiber is an integral part of modern communications. The optic fiber is a strand of silica-based glass wrapped by transparent cladding with diameters comparable to human hair. Light can be transferred down the fiber over long distances at very high data rates, making it an ideal medium for information transport.

Optical fiber technologies now play a critical role in providing true broadband access to end users. Monitoring and identifying fiber faults are critical for ensuring ongoing service delivery to clients. As a result, any service disruption caused by a fiber accident might result in a significant financial loss for telecom operators. The developed concept proposes an intelligent fault detection system in an optical fiber to pinpoint the precise site of a problem in the fiber optic cable. Monitoring the received light source will be the most important parameter in this project. Similarly, many parameters can be utilised to monitor the defect in that cable.

Fiber is the more environmentally friendly solution, especially in areas prone to natural calamities and severe climate. It is less prone to deterioration because of high wetness, freezing, and electric interference. The wires are expected to survive 25 years or more because to the exterior's robustness. This benefit reduces the continuous need for material upkeep, making it the most environmentally friendly option.

Detecting fault sources is difficult, and complete lines must be excavated to inspect and repair faults, so the proposed fiber optic cable fault detection over IOT that detects the fault over IOT will make the repairing work very simple. This saves a lot of time, money, and effort, and it also allows for speedier underground cable service. IoT technology is deployed, which allows authorities to monitor and inspect issues via the internet. In this project, the results will also be shown on an LCD monitor.

1.2 Background Research

Fiber optic communication is a way of sending data that uses light instead of electricity, as normal lines and cabling do. Fiber optic cables are used in a variety of applications, the most common of which are telephones, the Internet, and television. Every fiber optic system is made up of three major components: Transmitter. Single mode fibers are used to construct polarization maintaining fibers, which are costly. Multimode fibers, which are complex but precise, are also an option. As a result, single-mode fibers are rarely used in optical fiber transmission. Optical fiber technology has advanced communication speeds and offered the quickest digital data transmission system. The primary benefits of optical fibers are that they assist modern communication systems in minimizing signal deterioration and electromagnetic interferences. As a result, optical fiber is critical in modern communication systems.

Fiber technology consumes far less power than the alternative. Because data is carried in the form of light, fiber may use nearly twelve times less energy than copper. Because copper communication systems consume a significant amount of energy, cooling is essential to prevent overheating. The most convenient approach to cool is to use air conditioning, which consumes a lot of electricity. Fiber communication systems naturally stay cooler because they consume less power, reducing the need for energy.

Fiber optic cable is one of the underground cables that is susceptible to a wide range of faults caused by subsurface circumstances, wear and tear, rodents, and so on. It is also difficult to locate the source of the problem, and the entire line must be dug in order to check and repair the faults. So, in this paper, I present a cable fault detection over IOT that identifies the problem over IOT and simplifies repair operations. The repairmen are aware of the problem, and just that region will be excavated in order to locate the source of the problem. This saves a lot of time, money, and effort, and it also allows for speedier underground cable service.

1.3 Problem Statement

Optical transceivers convert data into light to convey data traffic in a fiber optic network. They convert electrical data signals from switches into optical signals that can be delivered across fiber optic cables as wavelength-specific lasers. Fiber optics can transfer more data at quicker speeds and across greater distances than previous technologies. It has formed the foundation of modern data transmission and is increasingly being utilised in telecommunications, internet service provider, and enterprise data centre networks. Fiber optic internet can be delivered in two ways : above ground on poles or underground via conduit. In other circumstances, a hybrid of the two procedures is required. The subsurface cables are susceptible to a wide range of defects due to underground environments, wear and tear, rats, and other factors. It is also difficult to locate the source of the problem, and the entire line must be dug in order to check and repair the faults.

1.4 Research Objectives

The main goal of this project is to create a system that can assist repairmen in detecting underground cable faults. The following are the primary goals of this research : -

i) To develop a project that save money, manpower and time in fiber-optic fault detector.
ii) To quickly locate the fiber-optic cable fault, and just the problematic area needs to be dug up in order to check and repair the fault.
iii) To allows authorities to monitor and test issues via the Blynk Application by IOT technology in this project.

1.5 Scope of Research

The project's scope is geared at fiber-optic cable repairmen, allowing them to easily find the fiber-optic cable fault and just the trouble spot needs to be dug up in order to verify and repair the fault. This project also comprehends the operation and features of fiber-optic cables. The project will be completed in 30 days and will cost RM 173.80 to develop. The project also has the following limitations : -

i) Difficulty in obtaining the greatest and most appropriate sensor, which may cause this project not work perfectly,
ii) In order to obtain accurate results, the IR Brightness Sensor cannot be used in a bright environment.
iii) Need to create a tool comparable to a photo-cell or light detector to ensure that the IR Brightness Sensor can accurately receive the light source from the fiber-optic connection.

1.6 Project Significance

As the globe has become more connected and data consumption has increased exponentially, data transmission technologies have become increasingly important. Fiber optics has been a crucial enabler of these trends from a technological standpoint, setting a new benchmark for data transmission speeds, distances, and bandwidth. Fiber optic networks are currently widely used all over the world. Our lives were made easier by fiber optic connections. Fiber optic patch cords transmit data over long distances in a short period of time and in a secure environment. Furthermore, they are used in a wide range of fields.

My project's main significance is to assist repairmen in the repair of fiber optic cable by reducing time, cost, and personnel during the repair process by utilising the same principle related to Optical Time Domain Reflectometer (OTDR) and Visual Fault Locator. The waste of fiber optic cable could also be reduced. Identifying and resolving cable problems as soon as possible will help ensure that our lives are not cut off from information at any moment. The data that was obtained was also sent to Blynk Application for record and analysis purposes.

1.7 Chapter Summary

In this chapter, I have provided an overview of the upcoming project and detailed the background of the original concept for the beginning of this project, as well as the challenges that are occurring, such as the repairman's difficulty identifying the cable fault. In addition, I presented the project's objectives. The main goal of this project is to assist the repairman in identifying the cable defect at the same time to save time, money, and manpower, and I also remember the project's significance based on the study's objectives. I hope that this project will benefit a large number of people.

CHAPTER 2

2 LITERATURE REVIEW

2.1 Introduction

A literature review serves as the foundation for high-quality medical education research, assisting in the maximization of relevance, originality, generalizability, and impact. A literature review provides context, informs methodology, maximizes innovation, minimizes duplicative research, and guarantees compliance with professional norms. Iterative literature reviews take time and should be conducted throughout the study process. Researchers should make the best use of available resources, such as human resources, search tools, and current literature.

Further examination of previous research and associated information will make significant contributions to the field of study. Fault detection systems utilising Ohm's Law, and light detection systems or closely comparable systems will discuss in this chapter. The benefit of having a cable fault detector is that it requires less maintenance, is more efficient, detects less faults in underground cables, and can detect various sorts of cable faults. There are numerous sources of information about cable failure detection systems published on the internet. The information gathered offers advice on current approaches as well as samples of perspectives. As a result, much prior research supports and justifies the hypothesis. This literature review also identified and analyzed the hardware components employed in the project.

2.2 Fault Detection Challenges in Fiber Optic

Fiber optic cable was formerly thought to be a high-performance technology, but it is now found in a wide range of situations and networks. If you are familiar with copper cable, you'll quickly realize that fiber optic cable is a completely different animal. The installation of fiber optic cable is not only unique, but fault-finding or troubleshooting is an entirely separate beast. Fiber optic cables, unlike copper cable, are extremely brittle. The cable's sensitive nature makes it susceptible to difficulties. The most typical problems that occur with fiber optic connections and how they can be rectified will be discussed. One of the faults occurred during the installation of a new metallic cable along a conduit line in an optical drop cable. There is also a fault instance concerning the suspension of optical telecommunication service due to a fire-damaged aerial optical fiber cable a few years ago.

Troubleshooting a network is not as simple as it appears. When attempting to troubleshoot complex network issues, it is usually helpful to know where to begin. Some of the most typical difficulties that can occur with a fiber optic cable are listed below. Excessive bending and flexing can put physical stress on a fiber optic cable, causing it to break; poor quality fiber optic cables and connectors; excessive signal loss due to a long fiber optic span; "dirty" or contaminated connectors on fiber optic cables can cause extreme signal loss; a faulty splice or connectors can cause significant signal loss; and having too many connectors or splices on fiber optic cable can cause significant signal loss.

2.2.1 Previous Research

The majority of subterranean detectors that have been developed use the concept of Ohm's Law. The change in current and voltage in reaction to the problem detects the specific location of the fault and sends it to the LCD display as well as the IOT related webpage. The key distinction between the previous literature reviews is that the hardware employed was different. For example, a cable fault detector robot can be constructed, with the robot going underground and measuring the cable pressure and temperature.

Another option for constructing this project is to use Arduino and Global System for Mobile Communication (GSM) technologies. When compared to microcontrollers, using Arduino has greater advantages. GSM technology will be combined with Fiber Optic Distributed Temperature (FODT) sensors used in cable line fault detection, where it corresponds with the low resistance grounded system, long distance line, and multi-circuit line properties. A neural network-based fault diagnosis system for underground transmission lines, on the other hand, has a maximum detectable distance of 10 km, an accuracy of 99.99%, and a time requirement of 15 to 30 seconds.

Another possibility for developing the project is to use a system similar to the Optical Time Domain Reflectometer (ODTR) gadget. The OTDR can locate the fiber optic cable and estimate the error. By locating a fault from a distance of 100 km or more with accuracy of 100m, OTDR can also enable the start of service without wasting time searching for the exact side of the issue.

Last but not least, the project can be developed by combining a power sensor with an Arduino. If the power of the optical line changes abruptly, a fault message is displayed on the LCD interfaced with Arduino, and the date and time of the fault occurrence are reported to the web server. Table 2.2.1 illustrates the comparison table for the study we conducted to complete our project.

Articles/ Journals	**IOT Based Underground Cable Fault Detector**	**Under Ground Cable Fault Detection using a robot**	**Arduino based Underground Cable Fault Detection**	**Underground Cable Fault Distance Locator over GSM Technology**	**Fault Detection System in an Optical Fiber Using Arduino**
Sensor	-	-	-	-	LDR
Concept	Ohm's law	Ohm's law	Ohm's law	Ohm's law	Ohm's law
Objective	The goal of the project is to use a PIC16F877A controller to locate a problem in underground cable lines from the base station in kilometres.	Implementing a robot with a camera, temperature sensor, pressure sensor, and other sensors to identify cracks and conditions in order to remedy the existing system problem.	To use an Arduino and used a straightforward understanding of ohm's law in this project to calculate the distance in kilometres from the underground cable fault of the base station.	The project's primary goal is to find and locate the underground cable fault. Instead of using overhead wires, the electrical cable travels underground in metropolitan areas. Every time a fault occurs, correcting it gets challenging.	In optical fiber communication, an intelligent failure detection system based on Arduino was proposed. This fault invigilating module is designed to monitor the received power supply in optical fiber.

Hardware	PIC 16F877A, ESP8266 Wi-Fi and 16X2 LCD	Arduino Uno, LM 35 Temperature Sensor, Gas Sensor, Microcontroller	Arduino Uno, LCD Display	Microcontroller 8051, FODT sensor, LCD Display	Arduino Uno, Atmega 328 microcontroller, LDR, LCD
Method	Depending on how long the cable is, the current will change. The voltage between series resistors changes in response to a problem, and this altered voltage is supplied to an ADC to create exact digital data, which is then fed to a programmable PIC IC that further shows the location of the fault in terms of distance.	The robot detects the temperature, pressure, and other properties of the pipes. The robot's built-in camera captures images of the problem area and sends them over Bluetooth to an Android app for end users.	The current fluctuates depending on where the fault is in the cable when a low voltage at the power supply device is applied across a series resistor. The voltage between the series resistors changes in response to a short circuit (a grounded line), which is then supplied to the ADC on the Arduino board to create precise digital data for the in kilometre.	The Ohm's law serves as the foundation for the system established here. The suggested method is used for identification as well as for sending the authorities detailed information about the defect using GSM and for cutting the power supply at that specific point for public safety. In LCD displays, the type of the issue was also previously displayed. FODT sensor used in fault detection of cable lines.	The sensor unit employed in the simulation is made up of an LDR and an op-amp. If there are any abrupt changes in the power of the optical line, the fault message is shown on the LCD interfaced with Arduino, and the date and time of the fault occurrence are communicated to the web server.

Data/ Result	With the aid of the PIC 16F877A and the work automatically shows the phase, distance, and time of fault incidence on a webpage.	Provide a better test coverage of the pipeline and cable faults, obtain a live video coverage through the camera that is mounted in front of the robot and collect screenshots of the faults and the conditions inside pipe galleries.	The defect can be quickly found and fixed. Use of the Arduino is more beneficial since it has various benefits over the microcontroller. Underground fault detection with an Arduino is preferable to underground fault detection using a microcontroller.	A low resistance grounded system, long distance line, and multi-circuit line are suitable for use with FODT sensors in cable line fault detection. A neural network-based fault diagnosis system for underground transmission systems has a maximum detectable distance of 10 km, an accuracy and a time requirement of 15 to 30 seconds.	The Arduino programming language (C++) is utilised to generate the output and display it on the LCD. At the same time, a JAVA programme is executed to transfer the output from the Arduino to the computer via the serial connection and to the MySQL database, which is designed using the PHP programming language.

Table 2.2.1 : Comparison Table of Previous Research

2.3 Control System

Control actions are classified into two types, such as open loop and closed loop. The controller's control action in an open-loop control system is independent of the process variable. A central heating boiler regulated solely by a timer is an example of this. The control action is the activation or deactivation of the boiler. The temperature of the building is the process variable. This controller keeps the heating system running at a steady rate regardless of the building's temperature. In a closed-loop control system, the controller's control action is determined by the desired and actual process variables. In the boiler analogy, this would involve using a thermostat to monitor the building temperature and feeding back a signal to guarantee that the controller output keeps the building temperature near to the value set on the thermostat.

A feedback loop in a closed-loop controller assures that the controller exerts a control action to control a process variable at the same value as the setpoint. a result, closed-loop controllers are sometimes known as feedback controllers. Diagram 1 shows the block diagrams of the open loop and closed loop systems.

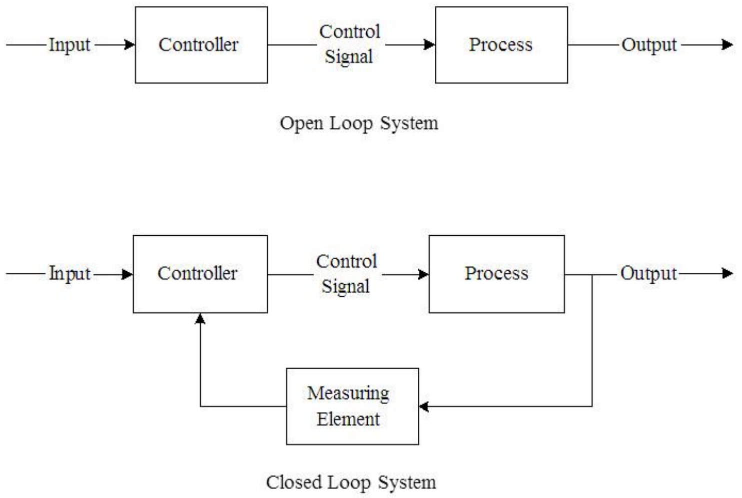


Figure 2.1: Block diagram of open loop and closed loop system

2.3.1 ESP 32

ESP32 is a low-cost, low-power system-on-a-chip microcontroller family featuring built-in Wi-Fi and dual-mode Bluetooth. The ESP32 series is powered by a Tensilica Xtensa LX6 dual-core or single-core microprocessor, a Tensilica Xtensa LX7 dual-core or a single-core RISC-V microprocessor, and includes built-in antenna switches, RF balun, power amplifier, low-noise receive amplifier, filters, and power-management modules. Espressif Systems, a Shanghai-based Chinese firm, conceived and developed the ESP32, which is produced by TSMC using their 40 nm technology. It is the ESP8266 microcontroller's replacement.

2.3.2 IR Brightness Sensor LM 393

A photoelectric sensor module is a sensor module that may be used to determine the distance between barriers, detect changes in the environment, and other purposes. It includes an IR transmitter, an IR receiver, an LM393, and a potentiometer for setting a digital output threshold. When the ambient light brightness is less than the defined threshold, the DO-side output is high; when the ambient light brightness exceeds the threshold, the DO-side output is low. This module may be utilised in obstacle detection in autonomous robots and autos, positioning feedback in control systems, industrial safety systems, wheel encoders, and other applications.

2.3.3 Potentiometer

A potentiometer is a three-terminal resistor with a sliding or revolving contact that serves as a voltage divider that may be adjusted. It functions as a variable resistor or rheostat when just two terminals are employed, one end and the wiper. A potentiometer is a measuring tool that is basically a voltage divider used to measure electric potential (voltage); the component is an application of the same idea.

Potentiometers are often used to regulate electrical devices such as audio volume controls. Potentiometers with a mechanism can be used as position transducers, such as in a joystick. Potentiometers are seldom used to regulate considerable power (greater than a watt) directly because the power dissipated in the potentiometer is equivalent to the power in the controlled load.

2.3.4 Red LED

Red LEDs are utilised to target dermal tissues like adnexa and fibroblasts because they have the deepest tissue penetration of all visible wavelengths. An LED's forward voltage typically ranges from 1.8 to 3.3 volts. The LED's colour affects how it changes. Usually, a red LED loses between 1.7 and 2.0 volts. For red LEDs, the variance is around 200 mV. Forward voltage for forward currents below 10mA is significantly lower than for blue or white LEDs, enabling reasonably priced operation straight from a Li+ cell or a triple NiMH cell.

2.3.5 LCD Display

A flat-panel display or other electronically controlled optical device that makes use of polarizers and the light-modulating capabilities of liquid crystals is known as a liquid-crystal display (LCD). Liquid crystals don't directly emit light; instead, they create colour or monochromatic images via a backlight or reflector.

2.4 Chapter Summary

The first section of this chapter focuses on the findings on the problem of identifying the fault of the underground cable, with some summary from the research papers regarding the process of development of the project. The second portion reveals information regarding the technical element, including the choice of controller type. This chapter also summarizes the analysis and explanation of the technologies or approaches employed by previous researchers to answer the problem statement. The main controller in this project will be an ESP 32.

CHAPTER 3

3 RESEARCH METHODOLOGY

3.1 Introduction

The practical "how" of any given piece of research is simply referred to as research methodology. It is primarily about how a researcher designs a study in a systematic manner to produce accurate and trustworthy results that address the research aims and objectives.

A very complete approach is being undertaken to actualize this project as a ready-to-use product with safety characteristics. A step-by-step method is followed to ensure that the project is completed on schedule. This includes gathering data from various types of fiber optic cable, designing the part as a transmitter and receiver of the fiber optic cable from the LED source, and testing and verifying the circuit design.

3.2 Project Design and Overview

As discussed in the previous chapter, the proposed controller is using a closed-loop system with ESP 32 as the main controller. The ESP 32 controller circuit is designed using Proteus software and then converted to a PCB circuit. The controller's results and data from the IR Brightness Sensor LM 393 will be posted to a webpage for recording and analysis.

3.2.1 Block Diagram of the Project

A block diagram is a type of high-level flowchart that is used in engineering. It is used to create new systems, as well as to explain and improve current ones. Its organization gives a high-level perspective of major system components, essential process actors, and critical working relationships. The block diagram for the IOT Underground Fiber Optic Type Cable Fault Detector Project is shown in Diagram 3.2.1. Initially, the system will employ an LED source to generate the fiber optic signal that will be used as the transmitter signal. The receiver at the fiber's end will be connected to an IR Brightness Sensor LM 393, which will detect the signal and alter the light source to the equivalent percentage. The data receiver is then collected by ESP 32 and output to LCD and Webpage via Wi-Fi Module for display to users.

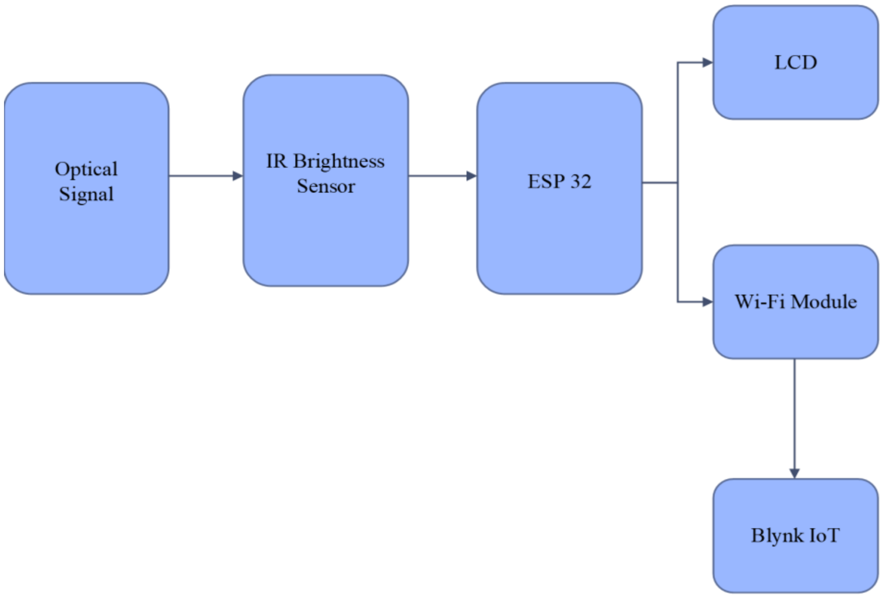


Figure 3.2.1: Block diagram of IOT Underground Fiber Optic Type Cable Fault Detector Project

3.2.2 Project Flowchart

A flowchart is a graphical representation of a process, system, or computer algorithm. They are widely used in a variety of fields to document, examine, plan, enhance, and convey frequently complex processes in clear, simple diagrams. Flowcharts, also known as flow charts, use rectangles, ovals, diamonds, and maybe other forms to indicate the type of step, as well as linking arrows to define flow and sequence. They can range from simple hand-drawn charts to detailed computer-drawn diagrams displaying numerous processes and paths. Considering all of the different types of flowcharts, they are one of the most ubiquitous diagrams on the globe, used by both technical and non-technical people in a wide range of professions.

Figure 3.3.2 depicts the overall system's circuit diagram. It depicts the progress of the IOT-based Fiber Optic Type Underground Cable Fault Detector Project. The system will initially attempt to connect to Wi-Fi; if this is unsuccessful, it will attempt again until a connection is established. Following connection, the system will begin to identify the supplied power source and display the findings on an LCD. The readings of the findings are expressed as percentages and compare the transmit and received powers. The results will periodically upload to the Blynk as well as being displayed on LCD. Along with the notification and email sent to the user informing them of the fault's discovery, the condition associated with it may be shown on Blynk. It is also possible to create and show the viewer a graph based on the data gathered. After the readings are obtained, the user can view the graph of the results for a minimum of 30 minutes and a maximum of 2 months, allowing them to monitor the cable's conditions over an extended period of time.

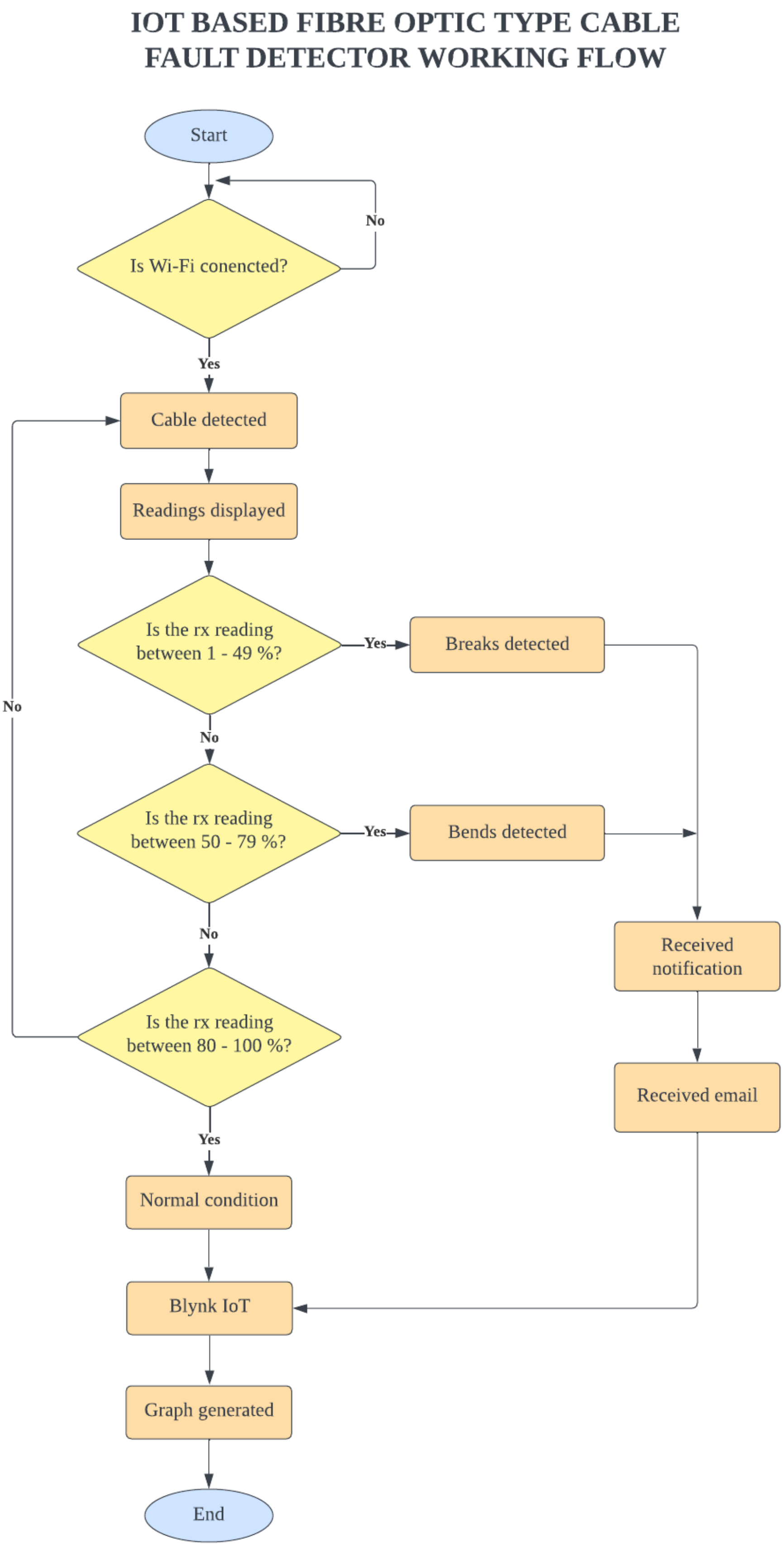


Figure 3.2.2: Flow Chart of IOT Underground Fiber Optic Type Cable Fault Detector Project

3.2.3 Project Description

As stated in sections 3.2.1 and 3.2.3, the LED light source will function as the transmitter signal of a fiber optic cable during the testing process. The other end of the fiber will then be connected to the system that has been developed in order to convey the received light source to the IR Brightness Sensor LM 393. The light source obtained by the IR Brightness Sensor LM 393 is then converted into percentage form to determine whether the cable is faulty or not. The data will then be fed to the ESP 32 and output to the LCD to show whether or not such a cable fault has been discovered. The linked condition may be shown on Blynk in addition to the message and email sent to the user informing them of the finding of the defect. On the basis of the acquired data, a graph can also be produced and displayed to the viewer. The user can keep track of the cable's health over an extended length of time by seeing the graph of the findings for at least 30 minutes and at most two months after the readings are taken. The condition table of this project have been attached in Appendix D.

3.3 Project Hardware

The main controller, as mentioned in the previous chapter, is Arduino. The transmitter and receiver will be used to measure the light signal. The receiving light source of the cable's end will be detected by the IR Infrared Obstacle Avoidance Sensor. The received light source is then converted to voltage or power form, the Arduino processes data from the sensor, and the data is then sent to a Wi-Fi module. It is a Wi-Fi module and one of the major platforms for the Internet of Things. It can send data to the IoT cloud.

3.3.1 Schematic Circuit

The overall circuit design for this project is shown in Figure 3.3.1. The ESP 32 is at the heart of this project. The transmitter and receiver are 2 components that were designed for this project. It has a straightforward connection at the transmitter component, which is built using two LEDs, two resistors, and two potentiometers. The optical source for this project will be made up of LEDs. A buzzer, an LCD display, and two IR Brightness Sensor LM 393 have been attached to the ESP 32 as the receiver part to receive the detected and received optical sources.

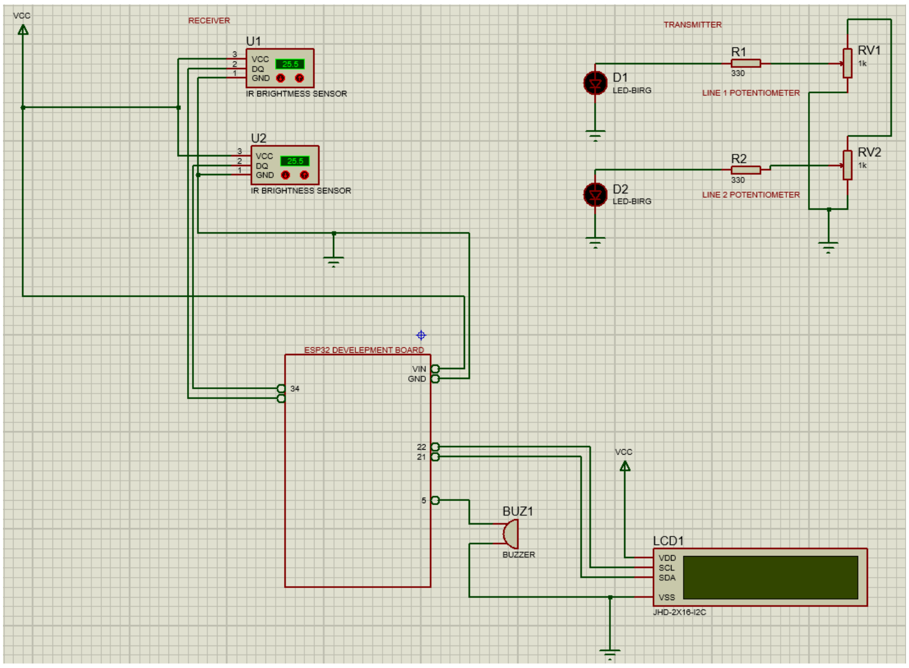


Figure 3.3.1: Circuit Diagram of IOT Underground Fiber Optic Type Cable Fault Detector Project

3.3.2 Description of Main Component

The key components in this project are the ESP 32 as the project's heart, the IR Brightness Sensor LM 393 to operate as a light source from an LED attached end to end of the fiber cable, and the LCD to display the data acquired during cable fault testing.

3.3.2.1 ESP 32

ESP32 can function as a full standalone system or as a slave device to a host MCU, which lessens the burden on the primary application CPU caused by communication stack overhead. Through its SPI/SDIO or I2C/UART interfaces, ESP32 may connect to other systems to provide Wi-Fi and Bluetooth capability. Since the ESP32 dev kit is less expensive than the Arduino Uno, this project may purchase a more potent board for a lesser cost. At the point where can utilize the current Arduino knowledge to work with the ESP32, can think of the ESP32 as a faster, more advanced version of the Arduino Uno.

3.3.2.2 IR Brightness Sensor LM 393

Circuits with a microcontroller platform like Arduino are the perfect fit for this light sensor module. This module enables the implementation of devices like twilight switches, which carry out prescribed actions with corresponding brightness. A radiation-sensitive optoelectronic component having spectral sensitivity in the infrared wavelength range of 780 nm to 50 µm is known as an infrared sensor (IR sensor). In order to turn on lights in buildings or identify unwanted visitors, alarm systems today frequently incorporate IR sensors in their motion detectors. The red, green, blue, clear, and IR light may all be detected by the IR sensors.

3.3.2.3 LCD

A liquid-crystal display (LCD) is a flat-panel display or other electronically controlled optical device that uses liquid crystals' light-modulating characteristics in conjunction with polarizers. Liquid crystals do not emit light directly, but rather need a backlight or reflector to generate color or monochrome images. LCDs can display arbitrary or fixed images with low information content that can be displayed or hidden. Preset words, numerals, and seven-segment displays, such as those seen in digital clocks, are all examples of devices having these displays. They both use the same basic technology, with the exception that arbitrary images are created using a matrix of small pixels, whilst other displays use larger elements.

3.3.3 Circuit Operation

As mentioned before, a fiber optic cable is a type of network cable that is made up of strands of glass fibers enclosed in an insulated casing. They are intended for high-performance, long-distance data networking and telephony. Fiber-optic cables transmit data via fast-traveling pulses of light. Fiber optic lines have a higher bandwidth than conventional cables and can carry data over longer distances. Much of the world's internet, cable television, and telephone networks rely on fiber optic cables.

In this project, the LED will serve as an optical signal that may be transmitted to an IR Brightness Sensor LM 393 and then received by that sensor. The LEDs will be connected to a potentiometer so that the transmitting power can be increased or decreased by adjusting the brightness of the LEDs. After receiving the transmitted signal, the IR Brightness Sensor LM 393 will convert it to an equivalent percentage, display it on the LCD, and send the results to Blynk along with the associated condition, such as normal condition, bends detected, and breaks detected. When a fault is found, users will also receive an email and notification.

3.4 Project Software

In this project, I am simulating this circuit with the Proteus application. The following software that I use to design the coding of our project is the Arduino software. Proteus is capable of creating a circuit design before beginning prototyping. This software can assist us in simulating the circuit and ensuring that current flows into all of the components that I have. This is also to ensure that all of the components work as expected. This program can also help us safeguard our component from overvoltage because it allows us to test it in software before testing it on the prototype. After completing the coding, the Arduino program can check the coding for errors before converting it to a hex file for simulation in the Proteus application. This software may examine whether or not all of the components work properly after the coding has been applied to the Arduino in Proteus. This can save time while troubleshooting the problem, whether it's a coding issue or a circuit issue.

Additionally, the Internet of Things (IoT) component of this project uses the Blynk Application. The users can easily monitor the data in these apps and analyze the received data based on the generated graph. The created graph enables users to easily analyze the data, not just while the device is connected to the internet, but also when the data has been collected for at least 30 minutes and up to two months after the device offline. When a defect is discovered, users will receive both a notification and an email. The users' apps will stay open while the fault is being investigated and cool down for one minute; if the fault is discovered again after that time, a fresh notification and email will be sent to the users.

3.4.1 Simulation Result of the System

Diagram 3.4.1 shows the simulation outcome of IOT Underground Fiber Optic Type Cable Fault Detector Project using the proteus application. Because some of the hardware that I used in this project was not available in Proteus, this project simulation progress are only able to create a similar circuit to run the simulation as below.

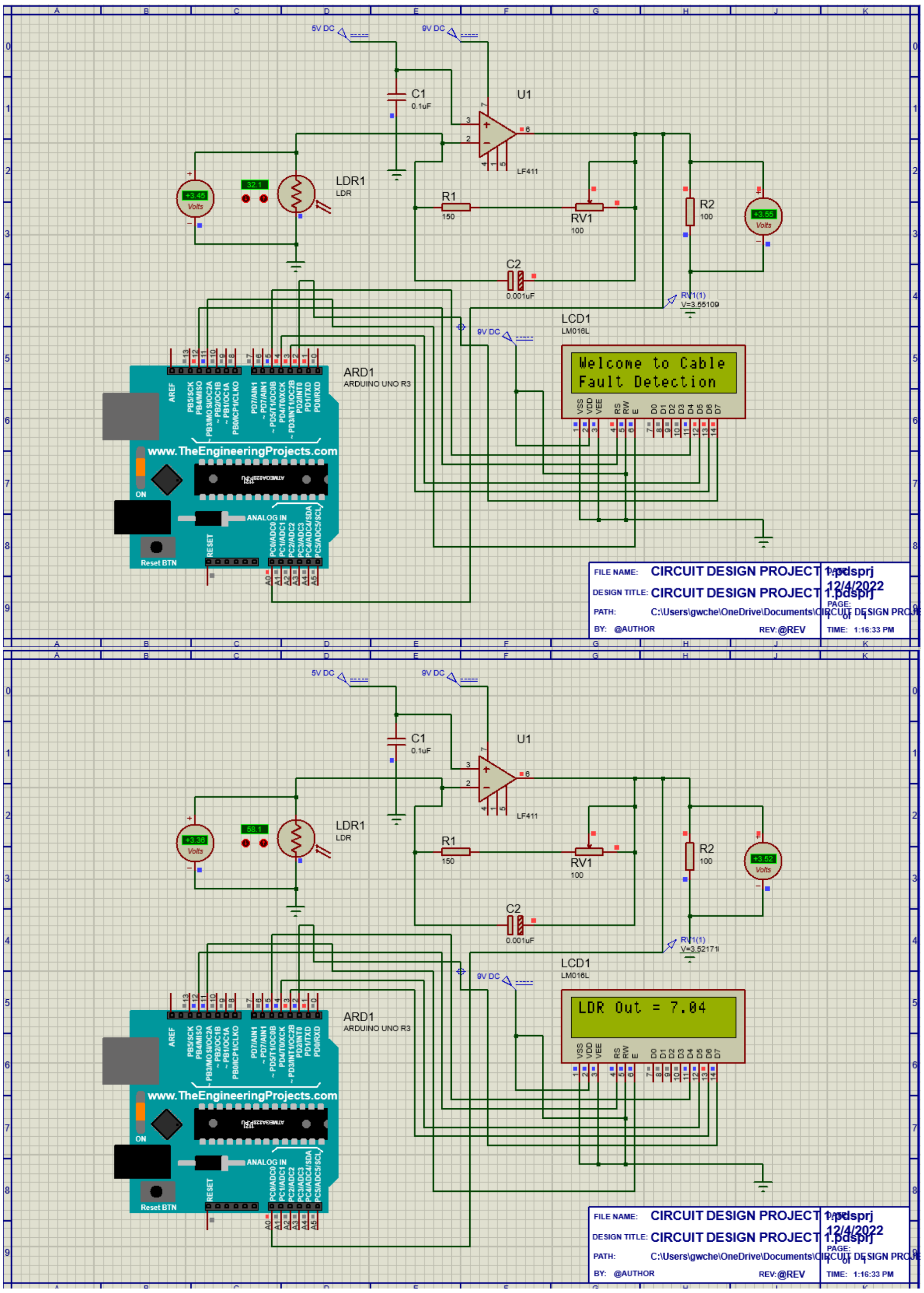


Figure 3.4.1: Simulation Result of IOT Underground Fiber Optic Type Cable Fault Detector Project

3.4.2 Description of Simulation Result

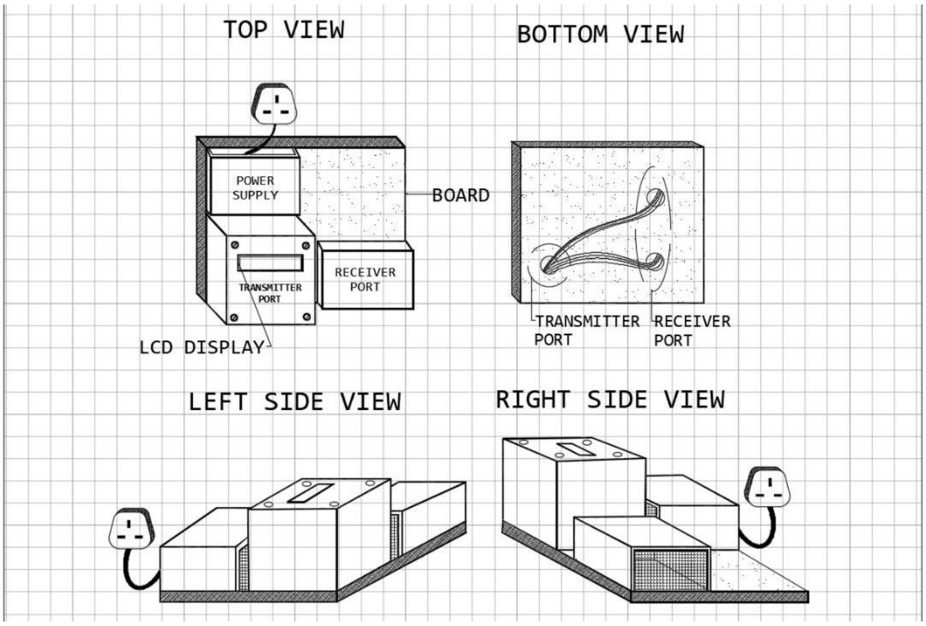
The simulation result using the circuit design employing Arduino Uno, LCD, LDR, and Op-Amp is shown in Diagram 3.4.1. When the system is turned on, the LCD will briefly display "Welcome to cable fault detector." The measurement and data from the LDR will then be sent to Arduino via the Op-Amp circuit, where the process of converting the incoming light source into voltage and power form will also take place. The LCD will then display the data received by Arduino as well as the voltage and cable condition. The result will also be sent to a webpage via the Wi-Fi module.

3.5 Prototype Development

A prototype is a look-alike or a copy of a part that illustrates the product features and explores all possibilities before investing in the full creation of the part. A prototype might range from a detailed pen and paper drawing to a fully functional version of the product. As a result, prototype development is just a collection of steps used by the manufacturer to create the prototype.

3.5.1 Mechanical Design/Product Layout

Diagram 3.5.1 depicts the project's top and bottom views, as well as its description. The top perspective of the project reveals that it was designed on a board. The transmitter, receiver, and power supply will all be put on the board. As stated, the transmitter part includes a resistor of 330 ohms, a potentiometer of 1k ohms, LEDs, LCD, and ESP 32, where the potentiometer is used to adjust the brightness of the LEDs, LEDs as the optical signal, ESP 32 as the project's heart, and LCD to display the percentage of the received optical signal for line 1 and line 2 fiber. There was also a receiver element of this project that included two IR Brightness Sensor LM 393 to receive the optical signal. The multi-output power supply is used in this project. The connection between the IR Brightness Sensor and the ESP 32 is shown in the bottom image of the project to allow interface between them.



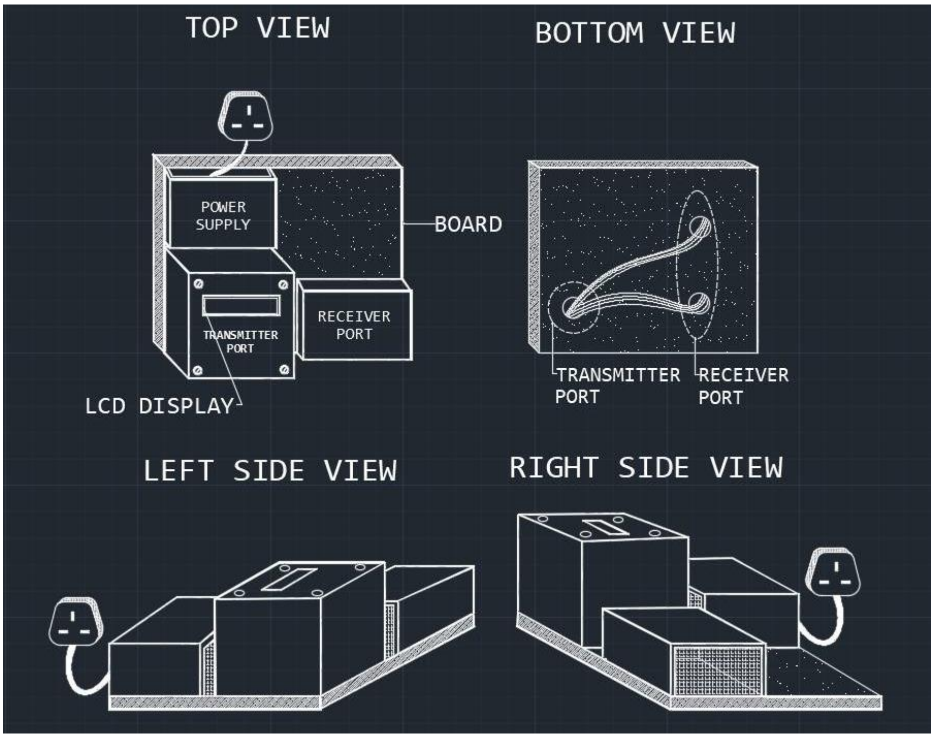


Figure 3.5.1: Top, Bottom, Left Side and Right Side View of IOT Underground Fiber Optic Type Cable Fault Detector Project

3.6 Sustainability Element in The Design Concept

Fiber-optic communication is a way of communicating data from one location to another by delivering infrared light pulses across an optical fiber. Light is a type of carrier wave that can be manipulated to transport data. When high bandwidth, long distance, or immunity to electromagnetic interference are required, fiber is preferable over electrical cabling. Voice, video, and telemetry can be transmitted via local area networks or over vast distances using this mode of communication. Many telecommunications providers employ optical fiber to deliver telephone signals, internet communication signals, and cable television signals.

Fiber technology consumes far less power than the alternative. Because data is carried in the form of light, fiber may use nearly twelve times less energy than copper. Because copper communication systems consume a significant amount of energy, cooling is essential to prevent overheating. The most convenient approach to cool is to use air conditioning, which consumes a lot of electricity. Fiber communication systems naturally stay cooler since they consume less electricity, reducing the need for energy.

The design and production of the IOT Underground Fiber Optic Type Cable Fault Detector Project in this project are low-budget and ecologically friendly. The purpose of this project is to create a fiber-optic fault detector that saves money, manpower, and time by promptly locating the fiber-optic cable fault, and only the problematic area needs to be dug up in order to check and repair the fault. This project does not require a huge area to build because the design is basic and incorporates the complete system into one package, and it will also work well. The design also shows that the component is in a compact box, making it easy to place and carry. This project also highlights the progress made in the IOT Underground Fiber Optic Type Cable Fault Detector Project, with a focus on recent breakthroughs toward the construction of portable, simple, and effective light sensors. The design of this project can be simply customized to meet any model or study objective as needed at a low cost.

3.7 Chapter Summary

This chapter detailed the project design and overview, including a flowchart of the project and a block diagram of the project. Aside from that, this chapter discusses the component used in this project. The system will have a transmitter and receiver component that will be connected end to end of the fiber and will use the IR Brightness Sensor LM 393. All of the components will integrated from the previous circuit into a single circuit. This project's heart will be the ESP 32.

CHAPTER 4

4 RESULTS AND DISCUSSION

4.1 Introduction

Data analysis is the summarization of acquired data. It entails interpreting data acquired using analytical and logical reasoning in order to find patterns, connections, or trends. The outcomes and analysis for this project will be clearly presented and explained in this chapter based on the project's test run progress in 30 minutes. A table detailing the similarities and differences between the light sources used in line 1 and line 2 fiber has also been added. I believe that all of the results and discussions contained in this part have met the project objectives outlined previously mentioned.

4.2 Results and Analysis

Figure 4.2.1 : Final Product of the Project

	Line 1	Line 2
LED Color	Red	Red
Resistor Used	220Ω	1kΩ
Current Flow	22.7mA	5.0mA
Potentiometer Used	1kΩ	1kΩ
Optical Signal Sent	Strong	Fair
Distance (From Receiver)	7.1 cm	7.1 cm

Table 4.2.1 : Transmitted Optical Signal Specification for Line 1 Fiber and Line 2 Fiber

Time	**Collected Results**			
	Line 1 (%)	**Condition**	**Line 2 (%)**	**Condition**
1.51 pm	55.44	Bends Detected	57.32	Bends Detected
1.52 pm	53.13	Bends Detected	55.87	Bends Detected
1.53 pm	51.78	Bends Detected	54.44	Bends Detected
1.54 pm	48.09	Breaks Detected	54.63	Bends Detected
1.55 pm	45.71	Breaks Detected	58.67	Bends Detected
1.56 pm	52.97	Bends Detected	60.22	Bends Detected
1.57 pm	49.06	Breaks Detected	61.98	Bends Detected
1.58 pm	57.33	Bends Detected	58.33	Bends Detected
1.59 pm	60.43	Bends Detected	56.50	Bends Detected
2.00 pm	59.01	Bends Detected	57.88	Bends Detected
2.01 pm	60.17	Bends Detected	60.31	Bends Detected
2.02 pm	49.14	Breaks Detected	66.21	Bends Detected
2.03 pm	46.77	Breaks Detected	60.17	Bends Detected
2.04 pm	53.47	Bends Detected	59.89	Bends Detected
2.05 pm	45.09	Breaks Detected	51.11	Bends Detected
2.06 pm	44.46	Breaks Detected	54.44	Bends Detected
2.07 pm	57.98	Bends Detected	56.46	Bends Detected
2.08 pm	57.76	Bends Detected	56.17	Bends Detected
2.09 pm	50.88	Bends Detected	55.08	Bends Detected
2.10 pm	47.21	Breaks Detected	58.81	Bends Detected
2.11 pm	46.03	Breaks Detected	52.03	Bends Detected
2.12 pm	53.88	Bends Detected	60.01	Bends Detected
2.13 pm	47.89	Breaks Detected	61.98	Bends Detected
2.14 pm	48.03	Breaks Detected	67.65	Bends Detected
2.15 pm	52.41	Bends Detected	61.07	Bends Detected
2.16 pm	50.38	Bends Detected	59.77	Bends Detected
2.17 pm	51.06	Bends Detected	62.76	Bends Detected
2.18 pm	50.77	Bends Detected	66.81	Bends Detected
2.19 pm	50.81	Bends Detected	64.19	Bends Detected
2.20 pm	50.99	Bends Detected	60.34	Bends Detected
2.21 pm	87.17	Normal	37.90	Breaks Detected

Table 4.2.2 : Data Collected 13 May 2023 for Line 1 Fiber and Line 2 Fiber

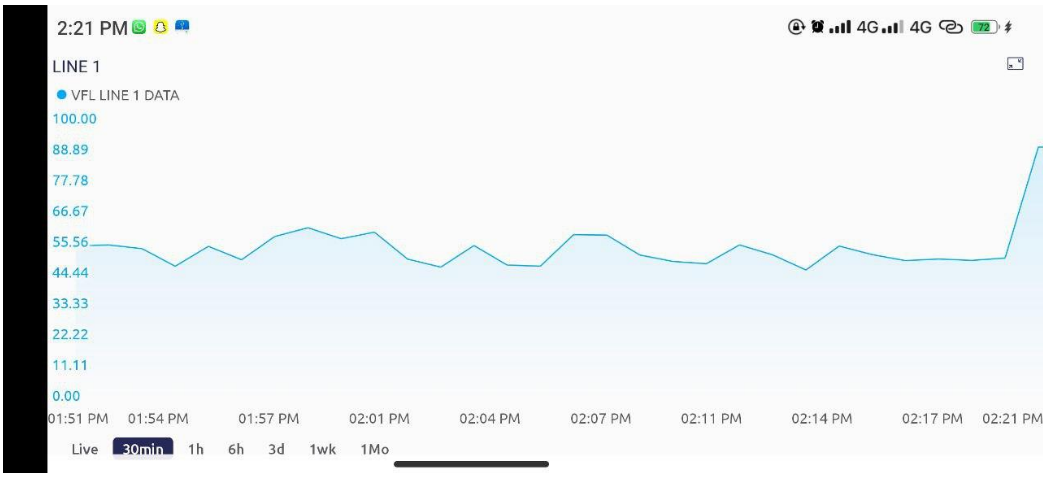


Figure 4.2.2 : Graph for Line 1 Fiber (Data Collected on 13 May 2023)

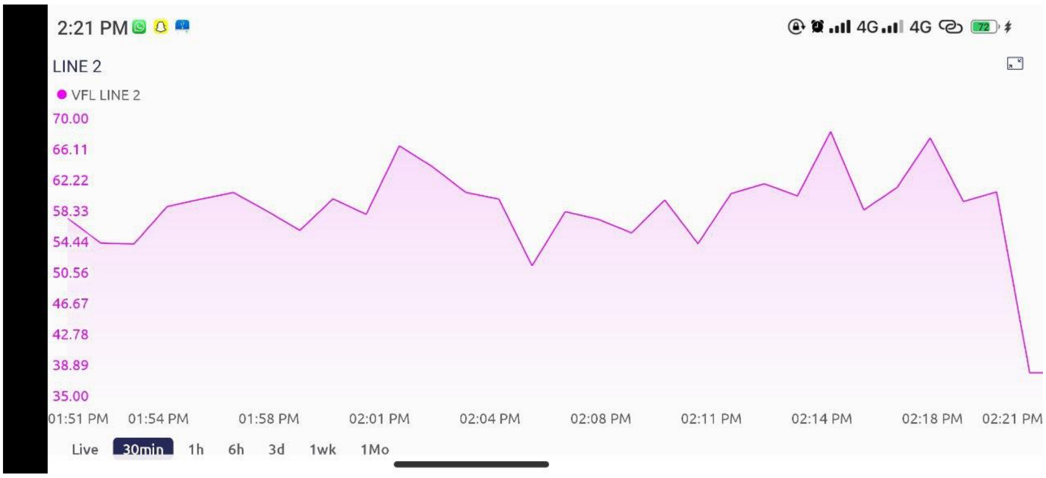


Figure 4.2.3 : Graph for Line 2 Fiber (Data Collected on 13 May 2023)

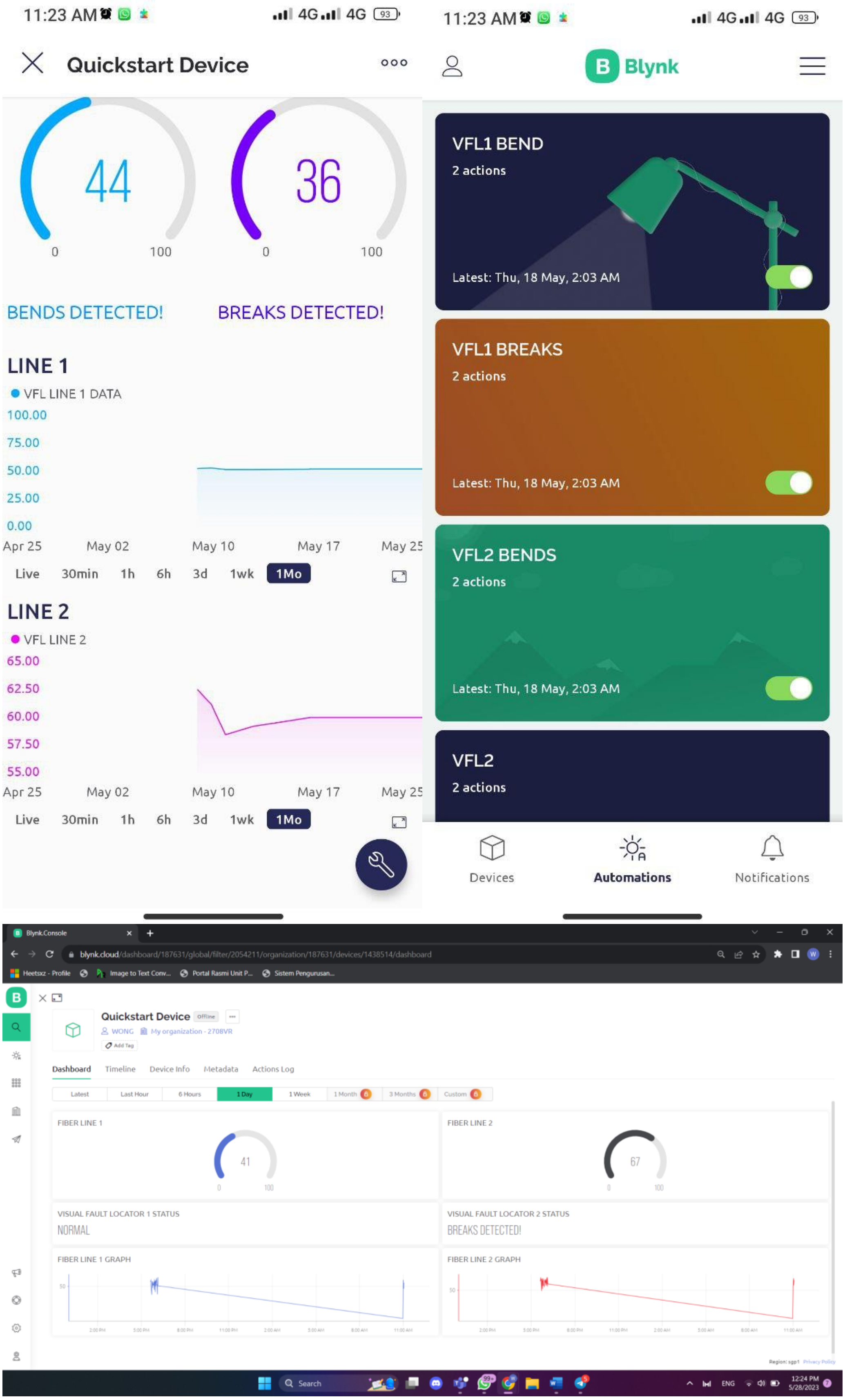


Figure 4.2.4 : User View in Blynk Application by using Mobile Phone and Laptop

4.3 Discussion

As indicated in the findings section above, Figure 4.2.1 depicts the project's end product, which consists of three major system components: a power supply, a transmitter, and a receiver. The transmitter component includes the ESP 32 as the main operating system, a resistor, a 1k potentiometer to regulate the brightness of the optical signal, an LCD to display the readings of line 1 and line 2 fibers, and two red LEDs that act as the sent signal. The receiver section comprised two IR Brightness Sensor LM 393 to receive the optical signal and transfer it to the ESP 32, which compared the transmitted signal and displayed the relevant percentage readings in the LCD and Blynk Application. This project's power supply is a multioutput power supply that can convert an alternating current power source to 5V, 6V, 9V, and 12V direct current power sources.

The specification of the optical signal that will be sent to the receiver portion is shown in Table 4.2.1. The optical signal for line 1 and line 2 fiber will utilize the same color LED as the optical source, such as a red LED. There are two resistors used for line 1 and line 2 fiber, such as 220Ω and 1kΩ, to limit or regulate the flow of electrical current in this system. As a result, there will be a strong signal at line 1 and a fair optical signal at line 2. In this setup, the potentiometer is utilized to alter the brightness of the optical signal. Both reception sensors are situated 7.1 cm apart from the transmission light source. Furthermore, because the cost of developing this project is less than RM 150, I have achieved the initial goal of developing a project that saves money, labor, and time in fiber optic defect detector.

Table 4.2.2, Figure 4.2.2, and Figure 4.2.3 illustrate the results of a 30-minute test on May 13, 2023. The results that have been measured and recorded as shown above are the results of taking the average of the data in 1 minute (an average of 60 points of data is taken) to reduce the mistake that occurs. Based on the observations above, the measurements that I have collected range from 44% to 60%, and I discovered that the line 1 fiber has detected bends and breaks. This is because the bends and breaks have exceeded the limitations and may have caused the fiber to break.

For line 2 fiber, the results that have been obtained range from 51% to 66%, indicating that there are bends in the fiber cable. Because only an average of 5 data points were collected due to the device being offline, the above-mentioned values for 2.21 pm may be considered inaccurate. This is one of the project's constraints. Based on the results that have been recorded and observed, I can simply state that the second purpose of this project, which was to swiftly locate the fiber optic cable defect, was met, and only the problematic area needs to be dug up in order to verify and repair the fault.

The user view of the Blynk application that I am using in this project is depicted in Diagram 4.2.4. The user can access the data not only by mobile phone, but I have also created a monitoring portal in the Blynk Application website that allows the user to view the data via laptop or PC. The readings displayed on the LCD of this project, as well as their accompanying conditions, will be displayed in the Blynk Application, as seen above. To avoid reading errors, the graph was created every one minute. This demonstrates that the third purpose of this project, which is to allow authorities to monitor and test issues using the Blynk Application and IoT technology, has been met.

Some limitations exist in this final output. The fundamental constraint of this project is that the power supply used is in poor condition, and the integrated circuit utilized gets too hot after a lengthy period of operation. I have included a cardboard as indicated in Figure 4.2.1 as a safety measure to avoid the user directly touching the body of the power supply, especially when the system is working. Another option for resolving this issue is to utilize a different type of power source that is available on the market or has been approved by SIRIM.

Not only that, but I discovered that several environmental conditions led the reading of the IR Brightness Sensor LM 393 to generate incorrect readings. To avoid the problem, a cardboard was put to the sensor area, with the inside of the cardboard likewise painted black to reduce the environmental issue that causes the error.

4.4 Chapter Summary

The outcomes of this project have been linked to this chapter to illustrate that the aims of the project that were previously set have been effectively attained. The discussion has also been provided based on the project results, such as the description and development of the final project, the specification of the optical source for two different lines of fiber, the results that have been collected and recorded for 30 minutes, the user view of the Blynk Application, and the limitations of this project and its solution. This project's distance between transmitter and receiver has been measured and demonstrated, as indicated in the results section.

CHAPTER 5

5 CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

The conclusion in this chapter is based on the results and discussion from the previous chapter. To see the benefits of the project and to improve it to its maximum potential, the conclusion must be produced to summarize the overall results. This section will also include and discuss suggestions for future work to improve the project's working and operation for another researcher based on the project that has been created and specific in this report. The conclusion also includes the approaches learned throughout the length to create the final product within the time frame given in the Gantt Chart in Chapter 6.

5.2 Conclusion

In summary, based on the results that were attached in the previous section, I discovered that this project fully achieved the three main goals that were mentioned previously, such as being able to develop a project that saves money, manpower, and time in fiber-optic fault detector, being able to quickly locate the fiber-optic cable fault, and only the problematic area needs to be drug up in order to check and repair the fault, and allowing authorities to monitor and test issues via Blynk Application.

According to the results and discussion that have been discussed, fiber optic type underground cable fault detection would make repair work easier and provide the user with accurate results. Because fiber optic cable is now widely used, in this project, the users can save money, people, and time in maintaining it. Furthermore, using IOT technology, the collected data will be displayed and logged onto the webpage via a Wi-Fi module to accelerate reporting and documentation. On the benefits side, this research can save organizations time, energy, and money by detecting difficult-to-detect underground fiber optic cable damage. When there is a disconnection or cable breakage, the fiber optic connection can prevent dissociation between them. For the nation, this project tool will help to improve the country's image by showcasing the advancement of knowledge and progress in fiber optics in our country. Finally, repairmen will be able to detect fiber optic cable damage quickly by analyzing the data acquired by this project tool.

A lot of techniques have been learned and practiced in the time frame to complete this project, such as how to draw and design the project's schematic diagram, flowchart, and block diagram by using appropriate application or website, allow to create the source code based on the needs, identify and buy the correct and suitable components and sensor for the project, soldering technique, project testing as well as identifying the damage when the system is not working as expected, documentation, and also the presentation. The presenter certificate for ICOESS 2023 and EEEiC for this project is shown in Appendix E and F. A user manual have also been designed.

5.3 Suggestion for Future Work

Future research should focus on electromagnetic interference, bandwidth, and the length of data transmission to the fiber optic cable, which may help users obtain more accurate data during fault detection testing. Furthermore, the design of the light collector that will be used in the project should be modified in order to collect the light signal more easily and accurately. Consider how the different types and modes of fiber optic cable may affect the project's data accuracy.

Based on the findings of this project, we observed that the condition exhibited in this Blynk Application corresponds to the readings received and that there is a delay after the initial data displayed, which could be due to the coding settings that I performed. To avoid delays in receiving the most accurate results in the future, the coding settings and parameters should be examined.

As previously stated, the power source used may cause the system to be in less-than-optimal condition and performance. The researchers must assess the most appropriate power supply to be used and obtain verification from any organization, such as SIRIM. There are many light sensors on the market today, but according to my research, there is no perfect light sensor that can be used in fiber optic measurement. The researcher must devise a new sensor that will be produced on a regular basis in the market.

5.4 Chapter Summary

The conclusion was reached based on the previous outcomes and discussions, as well as an examination of the project goals, benefits, and strategies learned during the process of developing this product. The constraints, as well as ideas for future research, have been given, mostly focusing on fiber optic type, characteristics, and metrics that can be examined.

CHAPTER 6

6 PROJECT MANAGEMENT AND COSTING

6.1 Introduction

In the implementation of hardware costs, this endeavor comprises the cost of procuring parts and supplies and receive most of the hardware components through online sources. Some surveys were conducted at multiple online shops to compare pricing, such as on Shopee, before purchasing some elements. This strategy will also make things easier because it will save time and money. The overall gross expenditure estimate for this project's implementation is RM 173.80, with additional expenses coming in at RM 62.20.

6.2 Gant Chart and Activities of the Project

The Gantt Chart is used in this project to show the start and end dates of a project's terminal items and summary elements. A Gantt chart is used for project management; it is one of the most popular and useful methods of displaying activities, tasks, or events against time. This Gantt chart depicts the tasks that must be accomplished by the deadline. Every task must provide the number of weeks it will take to complete. Diagrams 6.2.1 and Diagram 6.2.2 depict a Gantt Chart for Project 1 and Project 2. It displays the activities that must be completed each week. This Gantt chart encourages everyone to be more punctual in their work.

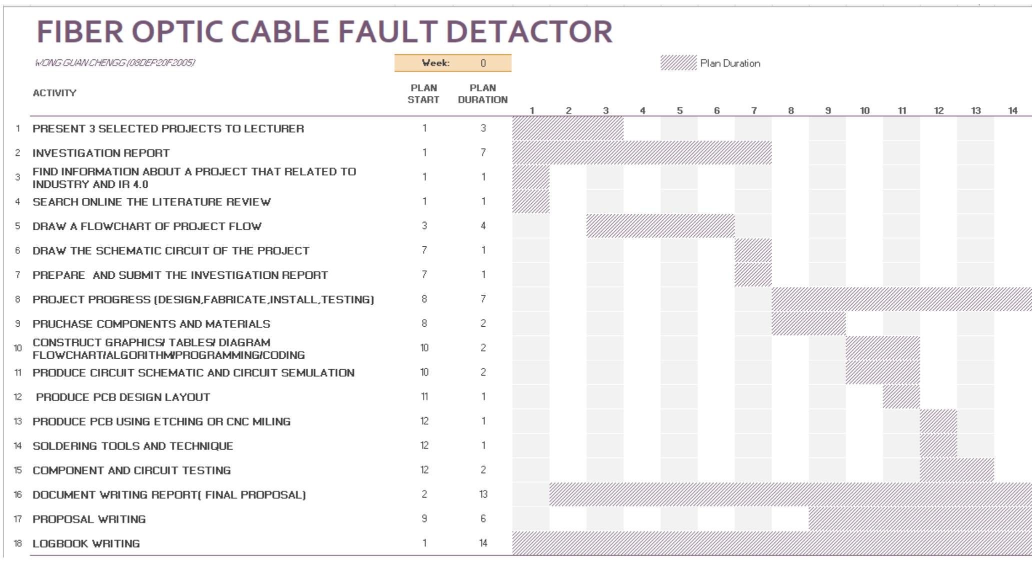


Diagram 6.2.1 : Gantt Chart for Project 1

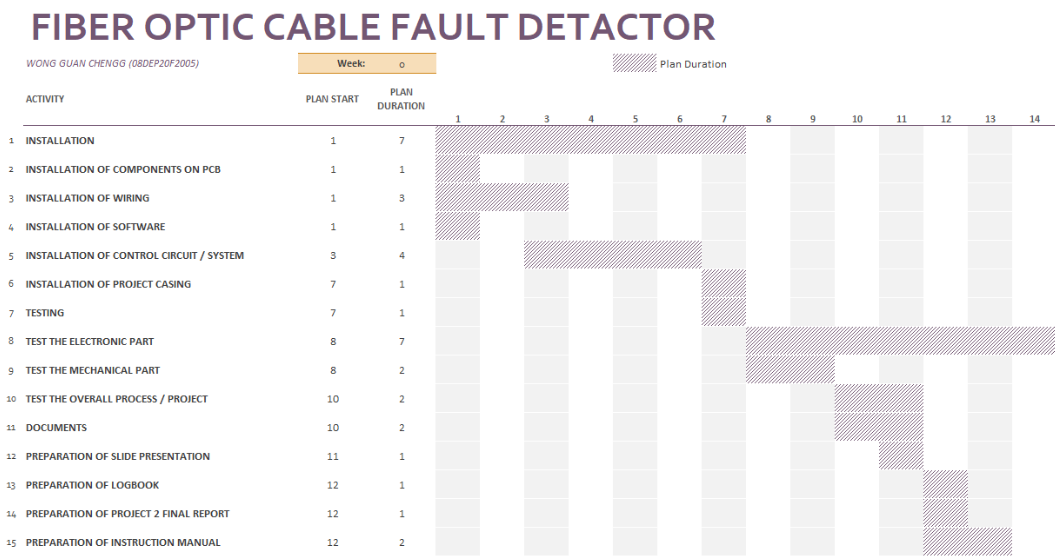


Diagram 6.2.2 : Gantt Chart for Project 2

6.3 Milestone

A milestone is a defined moment in a project's life cycle that is used to track progress toward the end goal. Milestones in project management are used to mark the start or end date of a project, external evaluations or input, budget checks, submission of a major deliverable, and so on. A milestone is a reference point inside a project that denotes an important event or a branching decision point. Table 6.3 shows the milestone of IOT Underground Fiber Optic Type Cable Fault Detector Project.

Description	Date	Cumulative project completion percentage
Completion of project planning	08.09.2022	15%
Completion of model system	20.10.2022	20%
Completion of project implementation	03.11.2022	35%
Completion of project management and finance	10.11.2022	40%
Completion final proposal report and mini project presentation	01.12.2022	55%
Completion of project programming design	30.03.2023	80%
Completion of project wiring and casing installation	20.04.2023	90%
Completion final report and project presentation	18.05.2023	100%

Table 6.3 : Milestone of IOT Underground Fiber Optic Type Cable Fault Detector Project

6.4 Cost and Budgeting

Throughout the project's implementation, the cost of procuring components and materials will be incurred. Hardware ESP 32, IR Brightness Sensor, resistor, variable resistor, micro-USB cable, pin header, buzzer, 16x2 LCD display, LED and jumper wire is among the cost-involved components. These components are obtained through both online and offline ways, depending on which is the most convenient and cost-effective.

The project's financial resources are self-funded, and some of the fundamental components and materials are sourced within the project laboratory. It is anticipated to cost RM 173.80 based on cost projections. The development cost is manageable over a 7-month period at RM 24.83 per month. Based on the investigation, it is realistic and practicable.

As stated in Table 6.4, the entire gross budget estimate for the project's implementation is RM 111.60, with other expenses at RM 62.20. According to this budget cost, this project is less expensive than other projects that can cost more than a thousand ringgit. The project's cost is also consistent with one of the major characteristics of a competent project developer: cheap cost but excellent quality.

No.	Component and materials	The unit price	Quantity	Total
1	ESP 32 Module	RM 35.00	1	RM 35.00
2	IR Brightness Sensor	RM 8.00	2	RM 16.00
3	Resistor 330 Ohm	RM 0.10	5	RM 0.50
4	Variable Resistor 1k Ohm	RM 2.00	2	RM 4.00
5	Micro USB Cable	RM 8.00	1	RM 8.00
6	Pin Header	RM 2.00	1	RM 2.00
7	Buzzer	RM 2.00	1	RM 2.00
8	16x2 LCD Display	RM 23.00	1	RM 23.00
9	LED Red	RM 0.30	2	RM 0.60
10	Product Casing	RM 8.50	1	RM 8.50
11	Jumper Wire	RM 4.00	3	RM 12.00
	Total :			**RM 111.60**
	List of other costing			
1	Transportation	RM 5.00	-	RM 13.00
2	Printing (Brochure)	RM 3.00	5	RM 15.00
3	Printing (A4 Black & White)	RM 0.10	22	RM 2.20
4	Poster / Banner	RM 22.00	1	RM 22.00
5.	Internet and Application	RM 10.00	-	RM 10.00
	Total :			**RM 62.20**
	Overall total :			**RM 173.80**

Table 6.4 : List of Components and Materials of IOT Underground Fiber Optic Type Cable Fault Detector Project

6.5 Chapter Summary

The table above already shows all detail in this chapter about the cost of creating this product. Nowadays, every client is still concerned with cost when purchasing something, so we must create a comparable table to ensure that each of the costs that must be employed does not overburden the project's development. As a result, the goal of this product is to build a profitable, low-cost, high-quality project. The product is quite affordable, costing less than RM 1,000. Last but not least, the concept for this product was created using the most recent design.

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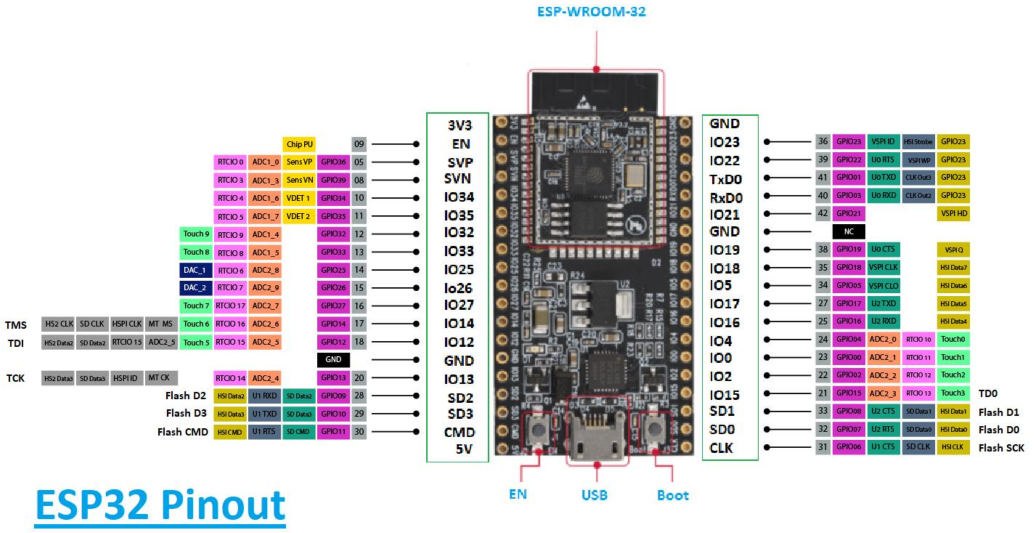
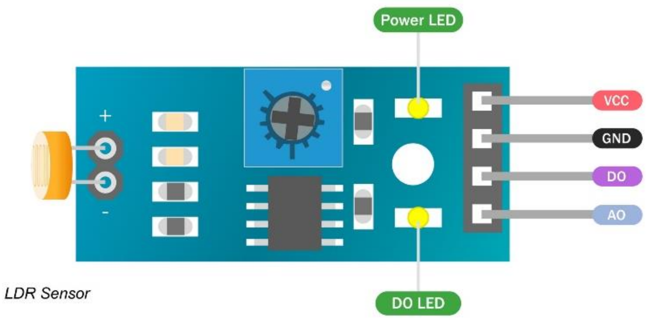
7 APPENDICES

APPENDIX A- DATA SHEET

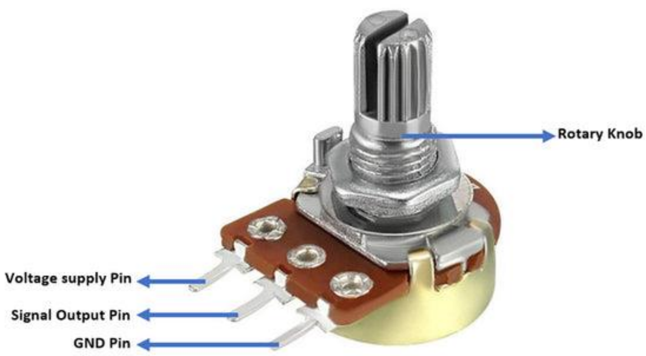
1) ESP 32



2) LDR Module / IR Brightness Sensor LM 393



3) Potentiometer



APPENDIX B- PROGRAMMING

```
#include <LiquidCrystal_I2C.h>
#include <Wire.h>

#define BLYNK_TEMPLATE_ID           "TMPL6IuATJ6d6"
#define BLYNK_TEMPLATE_NAME         "Quickstart Template"
#define
BLYNK_AUTH_TOKEN            "jL2I9pxuSONRf4a8FWvmi68IaV_QGWbS"

// Comment this out to disable prints and save space
#define BLYNK_PRINT Serial

#include <WiFi.h>
#include <WiFiClient.h>
#include <BlynkSimpleEsp32.h>
LiquidCrystal_I2C lcd(0x27, 16, 2);

#define Buzz 5
int TMMRR=0;
int TMM=0;
float BPMx=0;

#define vCalibration 83.3
#define currCalibration 0.50

int mode=0;
int SECURITY=0;

// Potentiometer is connected to GPIO 34 (Analog ADC1_CH6)
const int potPin = 34;
const int potPin2 = 35;
const int potPin3 = 32;
const int potPin4 = 33;
const int potPin5 = 25;

float ADC1,ADC2,ADC3,ADC4;
// variable for storing the potentiometer value
```

```
int potValue = 0;
long irValue = 0;

int PIRSTAT=0;
int BIT=0;
int ALM1=0,ALM2=0,ALM3=0,ALM4=0;
int Ready=0;
int Ml=0;
String MinS="00";
String HourS="00";
String SecS="00";
int DataIn=0;
String DATA="";
String Temp1x="";
String PHx="";
String Temp2x="";
String Temp1y="";
String PHy="";
String Temp2y="";
String Temp3y="";
String Temp3x="";
String Temp4y="";
String Temp4x="";
String currentTime;
String currentDate;
String TimerGet="00:00:00";
int xx=0;
int yy=0;
int zz=0;
int MODE=0;
int Hour=0;
int Min=0;
float Tempx=0;
int Spo2=0;
int Sec=0;

float LEVEL=0;
```

```
int ALM=0;
int Val=100;
int Index=0;
float CV=0;
int CKN=0;

int TDIS=0;
int Rly1=0;
int wait=0;
int Rly2=0;
int Rly3=0;
int Rly4=0;
int Rly5=0;
int CB=0;
float OldZ=0;
int BITR=0;
float BRX=0;
int ALARM1=0;
int ALARM2=0;
float FB1,FB2;

int Tcount=0;

long previousMillis = 0;
long interval = 3000;
long previousMillis1 = 0;
long interval1 = 10000;
//----------------------------------------------
  long UpperThreshold = 518;
    long LowerThreshold = 490;
    long reading = 0;
    float Pulse = 0.0;
    bool IgnoreReading = false;
    bool FirstPulseDetected = false;
    unsigned long FirstPulseTime = 0;
    unsigned long SecondPulseTime = 0;
    unsigned long PulseInterval = 0;
```

```
    int MyTimer=0;
//------------------------------------------------

char auth[] = BLYNK_AUTH_TOKEN;
// Your WiFi credentials.
// Set password to "" for open networks.
char ssid[] = "FIBER";
char pass[] = "12345678";

BlynkTimer timer;

// This function is called every time the Virtual Pin 0 state
changes

BLYNK_WRITE(V10)
{
  int pinValue = param.asInt(); // assigning incoming value
from pin V1 to a variable
  Rly1=pinValue;
   if (Rly1==1){
 ALARM1=1;

  }

  }

BLYNK_WRITE(V11)
{
  int pin2Value = param.asInt(); // assigning incoming value
from pin V1 to a variable
  Rly2=pin2Value;
 if (Rly2==1){
 ALARM2=1;

  }
  // process received value
}
```

```
BLYNK_WRITE(V12)
{
  int pin3Value = param.asInt(); // assigning incoming value
from pin V1 to a variable
  Rly3=pin3Value;
   if (Rly3==1){
 ALARM1=0; ALARM2=0;

  }

}

BLYNK_WRITE(V13)
{
  int pin4Value = param.asInt(); // assigning incoming value
from pin V1 to a variable
  Rly4=pin4Value;
   if (Rly4==1){
  }

}

BLYNK_WRITE(V14)
{
  int pin5Value = param.asInt(); // assigning incoming value
from pin V1 to a variable
  Rly5=pin5Value;

  // process received value
}
//--------------------------------------------------------------
----------------

// This function is called every time the device is connected
to the Blynk.Cloud
BLYNK_CONNECTED()
{
```

```
}
void myTimerEvent()
{
   //--------------------------------------------------------------
----------
static unsigned long timepoint = millis();

  if (millis() - timepoint > 1000U) //time interval: 1s
  {

  lcd.clear();
  lcd.setCursor(0, 0);
  lcd.print("FIBER L1: ");
  lcd.print(FB1);
  lcd.setCursor(0, 1);
  lcd.print("FIBER L2:");
  lcd.print(FB2);

if (ALARM1==1){

  lcd.setCursor(0, 0);
  lcd.print("FIBER L1: ");
  lcd.print(FB1);
  lcd.print(" FAULT!");

  digitalWrite(Buzz,HIGH);
  delay(100);
   digitalWrite(Buzz,LOW);
  delay(100);
  digitalWrite(Buzz,HIGH);
  delay(100);
   digitalWrite(Buzz,LOW);
  delay(100);
}

if (ALARM2==1){
```

```
  lcd.setCursor(0, 1);
  lcd.print("FIBER L2: ");
  lcd.print(FB2);
  lcd.print(" FAULT!");
  digitalWrite(Buzz,HIGH);
  delay(100);
   digitalWrite(Buzz,LOW);
  delay(100);
  digitalWrite(Buzz,HIGH);
  delay(100);
   digitalWrite(Buzz,LOW);
  delay(100);
}

  //------------------------------------------------------------
---

      //  Serial.print(beatAvg);
      // Serial.print("\t");
      //Serial.print(tx);
      // Serial.print("\t");
      //  Serial.println(hx);

delay(100);
Blynk.virtualWrite(V0,FB1);
Blynk.virtualWrite(V1,FB2);
Blynk.virtualWrite(V2,ALARM1);
Blynk.virtualWrite(V3,ALARM2);

  }
}

void setup()
{
    pinMode(Buzz,OUTPUT);
  int i,k;
  lcd.begin();
```

```
  lcd.clear();
  lcd.setCursor(0, 0);
  lcd.print("Connect to WIFI..");
  delay(3000);
  delay(1500);
  Serial.begin(9600);
  Blynk.begin(auth, ssid, pass);
  // Setup a function to be called every second
  timer.setInterval(1500L, myTimerEvent);
   lcd.clear();
  lcd.setCursor(0, 0);
  lcd.print("  CONNECTED!");
   delay(2000);
 }

void loop()
{
  Blynk.run();
  timer.run();
}
```

APPENDIX C – USER MANUAL

USER MANUAL

1 Turn on the suis. The device will attempt a Wi-Fi connection automatically.

2 Configure your mobile hotspot with the SSID and password shown. Ensure that 2.4GHz is the selected network.

3 The "connected" message will be shown on LCD once the device has successfully connected to your mobile hotspot.

4 The LCD display will show the percentage of light that line 1 and line fiber detectors have received.

5 The Blynk application will also display the outcomes that appear on the LCD, as well as condition and produce a graph for simple analysis.

UNDERGROUND FIBER OPTIC TYPE CABLE FAULT DETECTOR	
CONDITION TABLE	
Rx Signal Range	Condition
80% - 100%	Normal
50% - 79%	Bends Detected
1% - 49%	Breaks Detected
0%	N/A

APPENDIX D – CONDITIONAL TABLE

UNDERGROUND FIBER OPTIC TYPE CABLE FAULT DETECTOR	
CONDITION TABLE	
Rx Signal Range	**Condition**
80% - 100%	Normal
60% - 79%	Bends Detected
1% - 49%	Breaks Detected
0%	N/A

APPENDIX E – ICOESS 2023 PRESENTER CERTIFICATE

7th INTERNATIONAL CONGRESS OF EURASIAN SOCIAL SCIENCES

27-30 April 2023 Bodrum, Mugla, TURKEY (Online)

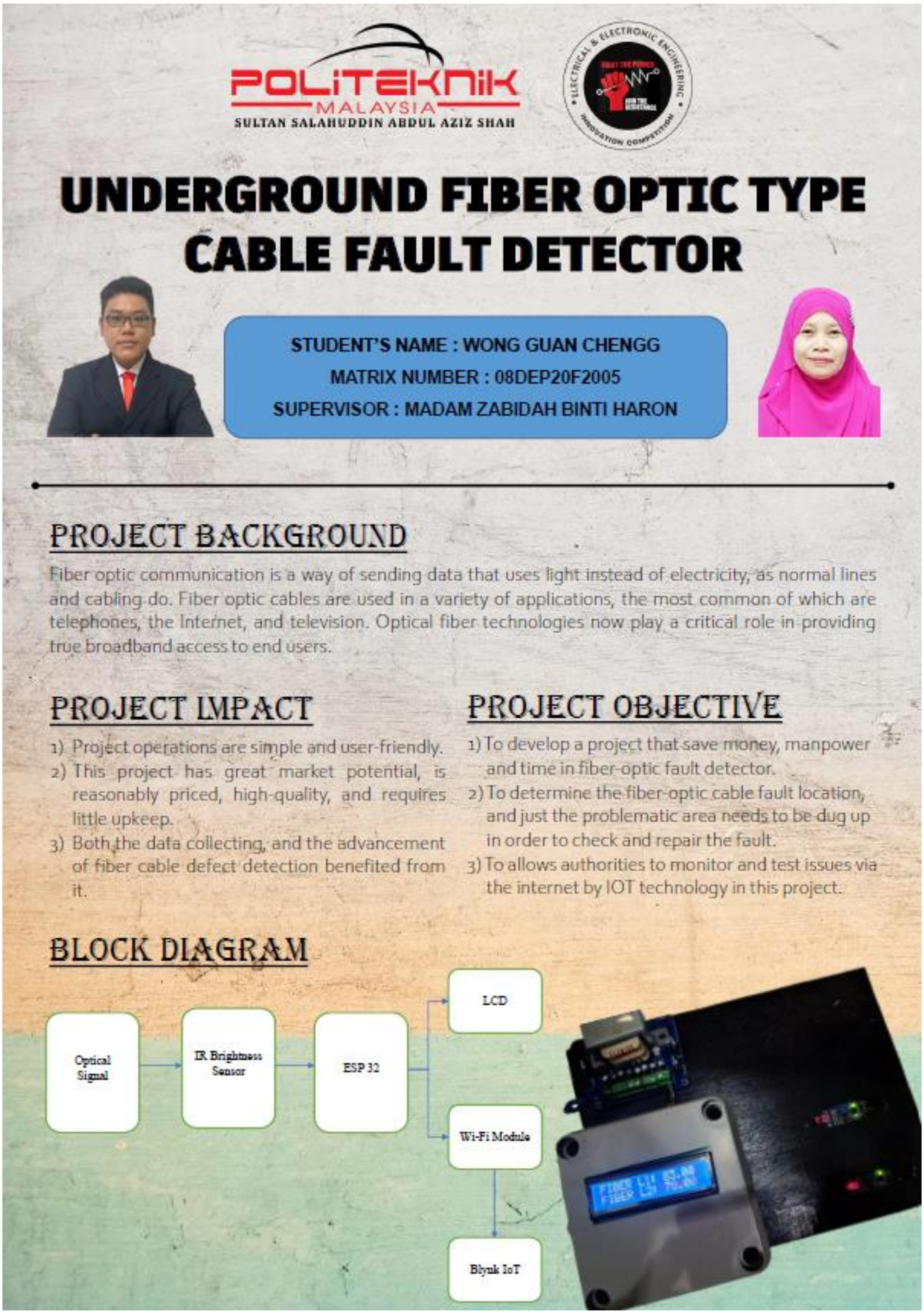
PRESENTER CERTIFICATE

Dear WONG GUAN CHENGG

Hosted by International Vision University; with the contributions of the Korint Publishing, International Journal of Eurasia Social Sciences, International Journal of Education Technology and Scientific Researches and the International Journal of Eurasian Education and Culture, in the 7th International Congress of Eurasian Social Sciences which was held on 27-30 April 2023, participated with a paper titled "**IOT UNDERGROUND FIBER OPTIC TYPE CABLE FAULT DETECTOR PROJECT**".

Prof. Dr. Kubilay YAZICI
Head of the Organizing Committee

APPENDIX F – EEEiC POSTER AND PARTICIPATION CERTIFICATE



POLITEKNIK MALAYSIA
SULTAN SALAHUDDIN ABDUL AZIZ SHAH

SIJIL PENYERTAAN

DIBERIKAN KEPADA

WONG GUAN CHENGG

telah menyertai pameran projek akhir pelajar

ELECTRICAL & ELECTRONIC ENGINEERING INNOVATION COMPETITION

anjuran

JABATAN KEJURUTERAAN ELEKTRIK

11 MEI 2023

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JOIN THE RESISTANCE