UNIVERSITI TEKNIKAL MALAYSIA MELAKA

FIBER FAULT DETECTION AND FIBER LINE MONITORING USING IOT FOR FTTH

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

by

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960915-10-5547

FACULTY OF ELECTRICAL AND ELECTRONIC ENGINEERING TECHNOLOGY

2018

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

BORANG PENGESAHAN STATUS LAPORAN PROJEK SARJANA MUDA

Tajuk: FIBER FAULT DETECTION AND FIBER LINE MONITORING USING IOT FOR FTTH

Sesi Pengajian: 2018/2019

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APPROVAL

This report is submitted to the Faculty of Electrical and Electronic Engineering Technology of Universiti Teknikal Malaysia Melaka (UTeM) as a partial fulfilment of the requirements for the degree of Bachelor of Mechanical Engineering Technology (Telecommunication) with Honours. The member of the supervisory is as follow:

Signature: ……………………………………………….

Supervisor : PUAN SITI ASMA BINTI CHE AZIZ

ABSTRAK

Komunikasi serat optik digunakan secara meluas untuk menghantar data internet dengan kadar data tertentu untuk negara ini. Kabel serat optik boleh merosakkan dan menjadi rosak kerana terlalu lama di dalam kabel bawah tanah atau kabel diperlukan untuk menukar dengan yang baru untuk mendapatkan sambungan yang baik. Selain itu, terdapat keperluan untuk mengesan kerosakan dan pemantauan keadaan garis komunikasi gentian optik. Projek ini menggunakan sistem pengesanan kesalahan pintar menggunakan Arduino UNO sama seperti komunikasi serat optik. Idea ini adalah kesalahan ini akan mengesan dan memantau bekalan kuasa yang diterima dalam serat optik semasa menerima bekalan voltan untuk Arduino UNO. Projek ini menggunakan Arduino UNO yang terdiri daripada mikrokontroller Atmega 328 dengan unit sensor untuk mengesan dan memantau bekalan voltan. Output sensor direka untuk perkakasan untuk memantau bekalan voltan yang diterima untuk sambungan talian. Unit sensor digunakan untuk perkakasan yang terdiri daripada LDR melalui penguat operasi. Oleh itu, jika terdapat perubahan dalam bekalan voltan untuk sambungan talian, mesej kesalahan akan mengesan dan dipaparkan pada LCD yang dihubungkan dengan Arduino UNO dan pada masa yang sama data dan masa kesalahan akan dipindahkan ke IOT untuk pemantauan.

ABSTRACT

Optical fiber communication is widely used for transmits the internet data with specific data rates for this country. The optical fiber cable can be damage and get faulty due to too long in underground cable or the cable is needed to change with the new for getting good connection. Besides, there is a needed to detect the faulty and monitoring the line condition of optical fiber communication. This project were using an intelligent fault detection system using Arduino UNO same as like optical fiber communication. The idea is this fault will detect and monitor the received power supply in optical fiber while receiving voltage supply for Arduino UNO. This project were using Arduino UNO which consists of Atmega 328 microcontroller with the sensor unit to detect and monitoring the voltage supply. The output of the sensor is designed for the hardware to monitor the received voltage supply for the line connection. The sensor unit is used for the hardware consists of a LDR through with an operational amplifier. Therefore, if there are any changes in voltage supply for the line connection, the fault message will detect and displayed on the LCD which is interfaced with Arduino UNO and at the same the data and time of fault will be transferred to the IOT for the monitoring.

DEDICATION

To my beloved parents and friends

ACKNOWLEDGEMENTS

My final year project will not finish by doing alone. The contributions of many people in different ways to make this possible in meet time taken. Then, highly appreciation to the following.

My highly gratitude to my supervisor, Puan Siti Asma Binti Che Aziz for his patience, motivations and immense knowledge for the continuous support on my final year project. His guidance helped me in all the time and completing this project. I could not have imagined having a better supervisor and guidance in completion of my final year project in Universiti Teknikal Malaysia Melaka.

Besides, I would like to thank to all the lectures that helped me throughout the project and willing to help and gives their best suggestions and guidance. Without their support and guidance, this project will not happen or completed successfully.

I also would like to express my gratitude to all my fellow friends, who always stood by me and cheering up throughout some good and bad times together. I would not achieve at this point to complete my project without their helps and support.

Last but not least, highly appreciation to my parents that always supporting me, encouraging me and gives some advice towards my project. There are no possibilities to do my project without their helps and encouragement.

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LIST OF ABBREVATIONS, SYMBOLS AND NOMENCLATURES

FTTH	-	Fiber to the Home
IOT	-	Internet of Things
ONU	-	Optical Network Unit
WDM	-	Wavelength Division Multiplexing
LDR	-	Light Dependent Resistor
LCD	-	Liquid Crystal Display
LED	-	Light Emitting Diode
Op-Amp	-	Operational Amplifier
IC	-	Integrated Circuit
DC	-	Direct Current
AC	-	Alternating Current
LAN	-	Local Area Network
OLT	-	Optical Line Terminal
ONT	-	Optical Network Terminal
FCC	-	Federal Communication Commission
OS	-	Optical Switch
MAC	-	Medium Access Control
TDM	-	Time Division Multiplexing
TDMA	-	Time Division Multiplexing Admission
PON	-	Passive Optical Network
OTDR	-	Optical Time Domain Reflectometer
ODN	-	Optical Distribution Network
SANTAD	-	Smart Access Network Testing, Analyzing and Database
CO	-	Central Office

FBG	-	Fiber Bragg Granulating
FDH	-	Fiber Distribution Hub
EDFA	-	Erbium-Doped Fiber Amplifier
EPON	-	Ethernet Passive Optical Network
SCPI	-	Standard Commands Programmable Instruments
ACS	-	Access Control System
TCP	-	Transmission Control Protocol
IP	-	Internet Protocol
TX	-	Transmitter
RX	-	Receiver
USB	-	Universal Serial Bus
ACS	-	Access Control System
GUI	-	Graphical User Interface
BER	-	Bit Errors Rate

CHAPTER 1

INTRODUCTION

1.0 Project Background

The principle of optical fiber communication is primarily based at the transportation of the signal via an optical power fiber from one source to some other. The light is a shape of electromagnetic carrier wave that is modulated to perform records. Optical fiber is usually deployed to transmit data. The optical fiber has sufficient benefits over present copper wire in long-distance because of a great deal lower attenuation and interference.

Fiber optic communication systems have commonly been set up over long-distance programs, due to its infrastructure improvement inside towns turned into surprisingly time and hard, and fiber-optic systems had been high price demand and complicated to put in and perform. Besides, fiber is an imperative a part of cutting-edge day communication infrastructure and may be determined alongside roads, in homes, hospitals and machinery.

The optic fiber is a strand of silica primarily based glass surrounded by using transparent cladding and its dimensions is just like the ones of a human hair. Light can be transmitted along the fiber over excellent distances at very excessive records costs, supplying an impeccable medium for the delivery of data. Nowadays, optical fiber technology play a key function in establishing up actual broadband get admission to the stop consumer. Monitoring and identification in opposition to fiber fault is important for non-stop provider transport to clients.

Consequently, any provider outage because of a fiber fault can be translated right into a super economic loss in commercial enterprise for the service carriers. The sensible fault detecting device in an optical fiber to locate the fault inside the fiber optic cable by way of the usage of sensor. Some of the numerous parameters we're going to display the obtained power of fiber optic cable. Although, we will use extraordinary parameters to monitor the fault in that cable.

1.1 Problem Statement

Optical fiber is made from brittle glass. Typically its outside diameter is 125µm. The center diameter of single mode fiber is simplest 7-8µm. For multimode fiber center diameter is 50µm. for the duration of the setup, connector can be damaged, bilging and natural getting old because of purpose of the brutal work, robust outside effect, these types of factors will result in the fault of optical fiber transmission device.

Cable communication failure no longer best offers an immediate financial loss to the operators, however additionally reasons excellent social affect because it brings inconvenience to the human’s lifestyles. Consequently, it's far critical to make sure the well-being of optic fiber cable. Repair and protection of cable communication have a profound importance.

Besides, with the growth of optic fiber cable fault and optical fiber cable getting older, the frequency of optic fiber line fault will increase, and it is hard to detect fault within the conventional optical fiber management mode. It going to take long term to remove failure issue, and impacts the regular work of the network. Even though these days ring network safety generation can assure the easy and maintain transmission in positive quantity. However the shortcoming of conventional line protection nonetheless exists. So the implementation of the optic fiber cable line real time detection and control, dynamic observations of the transmission properties of the optic fiber cable line degradation, the well timed discovery and save you hidden problem, lessen the occurrence of blocking off turn out to be increasingly more important.

Measured information is analyzed via fiber optic theories and the end result shows that the sensor detection technique by using Arduino UNO works properly in actual conditions. The motive and method of the optic cable line detection is to gather system information, then listing the gathered information and analysis.

1.2 Project Objectives

1) To construct the circuit and simulation through software
2) To implement the coding in hardware through Arduino
3) To detect and monitor the line fault
4) To analyze the simulation result using software and hardware

1.3 Scopes of Work

The scopes of work for the project include the following areas:

1) The study and understanding of the cases of fiber optic faults.
2) Find the a few types of simulation and investigate them.
3) The analysis of the fiber optic faults from the software and hardware.

Other scopes of work include:

i. Maintain good log book record
ii. Prepare the necessary documents
iii. Publishing final report
iv. Project Presentation

CHAPTER 2

LITERATURE REVIEW

2.0 Introduction

This chapter will look into the various aspects and the methods on research methodology on project. This chapter will show the concept of the actual fiber fault and the various related analysis. Furthermore, this chapter will show the necessary enhancement that will make much more efficient for the simulation. Literature Review is important in each project as a base for gathering information necessary to complete the project.

2.1 Fiber Fault Detection

2.1.1 Sensor

It is the most important part of our application which converts the optical source into equivalent voltage. Mostly a LDR is used for the measurement of the power received from an optical fiber from the customer side. The LDR is very much sensitive towards light. The LDR will give a corresponding voltage signal in the range of mV or µV.(Swain, Sahoo, Prasad, & Palai, 2015)

This small voltage is again amplified with the help of an amplifier. In this paper an op-amp of IC model LF411 is used for the same. But due the unavailability of the LDR in the Proteus simulation software a LDR is used for the simulation process. LDR is having a property of showing high resistance in the dark and the resistance goes down in the presence of light. In the simulation, for both dark light and bright light are tested. (Swain et al., 2015)

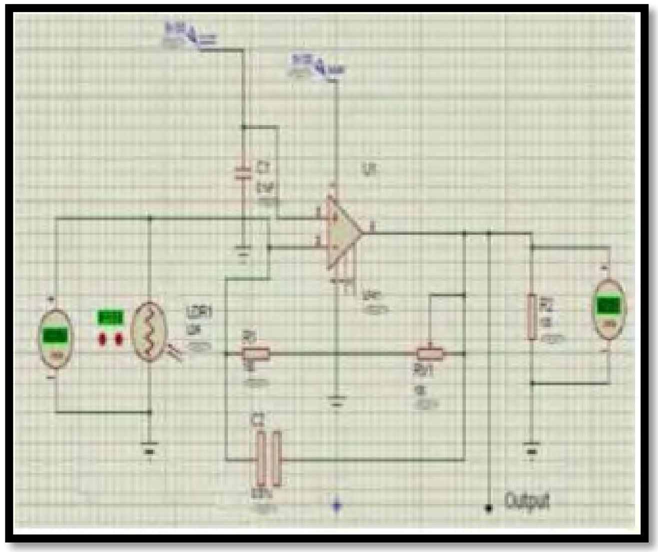

Figure 1: Circuit Diagram of Sensor.

Figure 1 shows an op-amp which is used an integrator with DC gain control is connected to the LDR and used for signal amplification purposes. The feedback network comprises of the parallel combination of resistance and capacitance. It is an AC integrator such as a sinusoidal input waveform will produce another sine wave as its output will be 90o out-of-phase with the input producing cosine wave.

2.1.2 Optical Time Domain Reflector (OTDR) Trace and localization

Numerous advanced check gears are invented to find a fiber fault in an optical fiber, consisting of fault locator and optical time area reflectometer OTDR (Bakar et al., 2007). OTDR changed into first said in 1976 (Barnoki & Jensen, 1976) as a telecommunications software and have become a longtime technique for attenuation monitoring and fault localization in FTTH in the telecommunications enterprise (King et al., 2004). OTDR is a method of trying out an optical fiber cable meeting in optical networks. The OTDR launches a totally narrow pulse into the fiber after which data the response of the cable/connector assembly to this pulse. Each reflections and absorption may be found in the cable, imparting the troubleshooter with the facts had to diagnose cable troubles (Harres, 2006).

The OTDR measurements can without difficulty be transmitted into computer for advanced OTDR studying thru RS-232 (serial port) connection, excessive-velocity USB interface, ActiveX, Ethernet TCP/IP connection, and extended memory alternative (manually switch through floppy disk or USB memory) in a proprietary encoding format such as trace. The users can convert the OTDR strains into text record or format for next use by spreadsheet software program such as Microsoft Excel or Lotus 1-2-three.

Conventionally, OTDR is used to pick out a fiber fault in FTTH upwardly from ONUs at special client residential locations toward optical line terminal OLT at CO (in upstream path). Each time a fault happens, OTDR is plugged manually to the defective fiber through the technician to stumble on in which the failure is located. A technician launches an OTDR take a look at from the out-of-provider ONU. By OTDR, you can actually get the space from the fault website online to the dimension website alongside the optical fiber housed within the optical cable (Lu et al., 2006).

According to Chomycz (1996), OTDR testing is the exceptional method for determining the precise location of damaged optical fiber in a hooked up optical fiber cable when the cable jacket isn't visibly broken. It determines the loss due to individual splice, connector or other unmarried factor anomalies hooked up in a machine. It also offers the satisfactory representation of standard fiber integrity. However, this technique could require plenty effort and time. Furthermore, OTDR can most effective show a dimension result of a line in a time. Therefore, it will become a challenge to hit upon a defective fiber with a huge wide variety of subscribers and large coverage vicinity in the fiber plant by the usage of an OTDR.

Moreover, the optical splitters in FTTH will make the identity of a fiber fault past the splitter very difficult. The OTDR checking out sign from all the splitter ports is delivered into one trace in downstream route as summarized in Figure 2. Therefore it is able to end up very complex to localize the failure in an appropriate break up branch of FTTH-PON with tree topology (NIC, 2007).

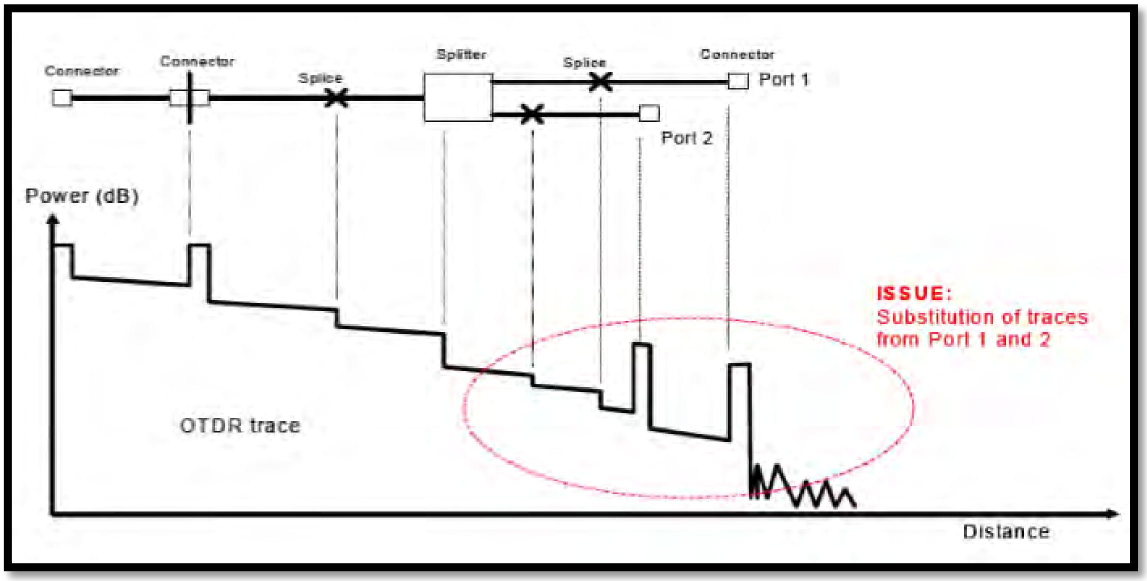

Figure 2: Shows monitoring issue with using OTDR in the downstream direction.

OTDR is the meter to decide the localization of fault, the most variety is as much as 250 to 400km. relying upon the splitting ratio the quantity of clients can be decided .If the splitting ratio within the method is accelerated then the quantity of clients may be reduced in addition to the Bandwidth required for every client also can be reduced. The losses within the optical network are because of the splitting devices, relying upon the splitting ratio the gap can be modified. Relying upon the gap of the client stop the fiber duration be differ so every parameter are rely on every different. The reflective and non-reflective losses within the fiber defer the damage loss, splice loss, connector loss, and cable loss. The damage and connector loss within the fiber is called reflective loss and the reflective losses can be decided through the Fresnel equation.(Sivakami, Ramprabu, Hemamalini, Veronica, & Thirupoorani, 2015)

The splice loss and cable loss are known as non-reflective losses this could be decided via using Rayleigh event. The default losses that may be present at precise circumstance fiber is the default splice loss in each fiber is 0.1db/splice, the default cable loss be 0.25db/km and the default connector loss be 0.5db/join. For the 1:32 splitter the overall/cumulative loss may be decided via the use of the ratio of distance to the attenuation within the fiber. The cable that is used among the get entry to factor/access nodes to the splitting tool is feeder cable is used due to the fact feeder cable is powerful in nature and additionally it can't have an effect on through any environmental dangers. For the 2.5km fiber the reflective and no reflective event may be precisely determined via the OTDR. On this tool the list of event that can be seem are shown as in Figure 3 below,

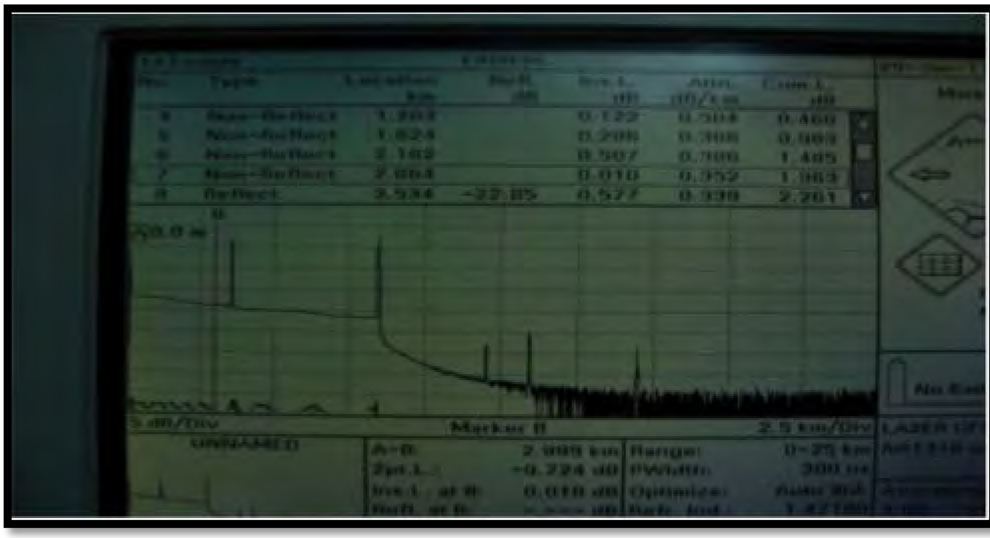

Figure 3: Shows OTDR Trace.

The event includes the event type, location/km, reflection loss/db, insertion loss/db, attenuation db/km. Attenuation within the fiber is happened because of the gap as well as because of the insertion loss within the splitting device. The settings that may be constant inside the device be variety, pulse width, reference indication, optimization, distance and additionally for each 2km repeaters are used the important function of the repeaters is to provide the unique signal or accelerate the weakest signal into most powerful signal. On this method for the upstream and downstream transmission the two types of wavelength that has been used are 1390/1410 nm wavelength.(Sivakami et al., 2015)