International Journal of Innovative Research in Engineering
Volume 4, Issue 3(May-June 2023), PP: 412-416.
www.theijire.com **ISSN No: 2582-8746**

Fault Detection System in an Optical Fiber Using NODEMCU

Manikandan V[1], Abilash U[2], Gowtham M[3], Karthik L[4], M.Irshad Ahamed[5]
[1,2,3&4]Department of Electronics and Communication Engineering,E.G.S. Pillay Engineering College, Nagapattinam, Tamilnadu, India.
[5]Associate Professor , Department of Electronics and Communication Engineering,E.G.S. Pillay Engineering College,Nagapattinam, Tamilnadu, India.

How to cite this paper:
Manikandan V[1], Abilash U[2], Gowtham M[3], Karthik L[4], M.Irshad Ahamed[5], "Fault Detection System in an Optical Fiber Using NODEMCU", IJIRE-V4I03-412-416.
.

https://www.doi.org/10.59256/ijire.20230403111

Abstract: *The project aims to develop a cost-effective and efficient solution for detecting fiber optic faults by designing a hardware system that can detect abrupt changes in the power of the optical line. The system will alert network administrators of fault occurrence, reducing downtime and minimizing disruptionto users.The project also seeks to demonstrate the use of ESP8266 boards for data processing and communication, making it suitable for a wide range of industries and use cases. Additionally, the project aims to integrate with Ubidots, a cloud-based IoT platform, to provide a scalable platform for customization and expansion of fault detection and management systems.The overall objective of theproject is to provide a low-cost and easily customizable solution for fiber optic fault detection while showcasing the capabilities of ESP8266 boards for IoT applications.*
Key Word*: NodeMCU; LDR sensor; LCD display; I2C module; Communication*

I.INTRODUCTION

The principle of fiber-optic communication is based on the transport of signals through an optical fiber from one location to another. The signal is transmitted using light, which is a form of electromagnetic carrier wave that is modulated to carry information. Optical fiber is typically used to transmit telephone signals and has many advantages over copper wire, particularly for long-distance and high-demand applications, due to its lower attenuation and interference. While fiber-optic communication systems were initially installed primarily for long-distance applications, they are now an integral part of modern-day communication infrastructure and can be found in roads, buildings, hospitals, and machinery.

The basic structure of an optical fiber consists of a strand of silica-based glass surrounded by transparent cladding. The dimensions of an optical fiber are similar to those of a human hair. Light can be transmitted along the fiber over great distances at very high data technologies play a key role in opening up real broadband access to end users, as they can support higher bandwidthsthan traditional copper wire networks.

Monitoring and identifying fiber faults is essential for continuous service delivery to customers, as any service outage dueto a fiber fault can result in a significant financial loss for service providers. Therefore, it is crucial to detect and locate fiber faults as quickly as possible to minimize downtime and reduce costs.

Fiber optic cables are essential components of modern communication networks. These cables transmit data at high speeds with minimal signal loss over long distances. However, they are vulnerable to various types of faults that can cause severe disruptionsto the network. Therefore, detecting and locating these faults is crucial to ensure the integrity and reliability of the network. In this project, we present a solution for fiber optic fault detection using an ESP8266 board, LCD display, I2C module, and Ubidots.

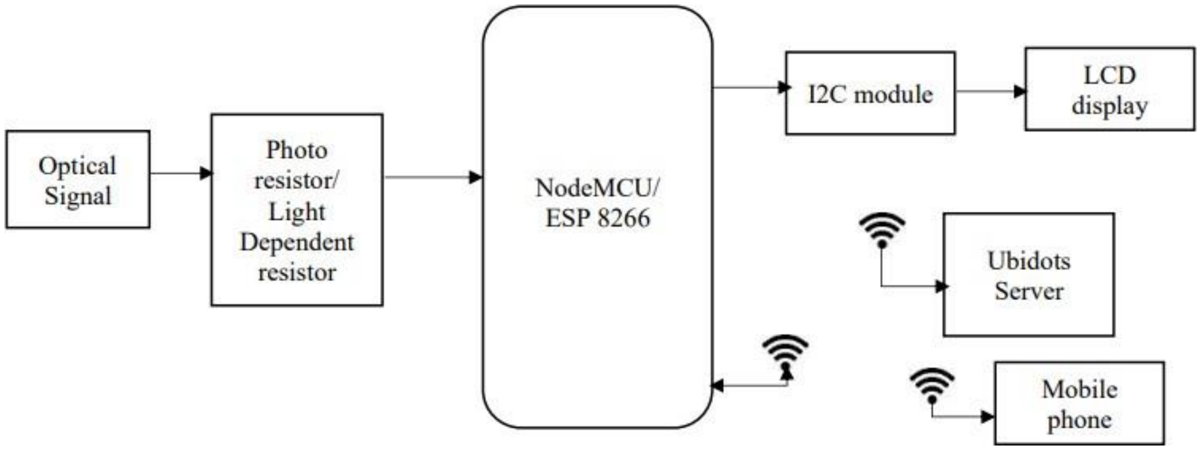
Detecting and locating these faults is crucial to ensure the integrity and reliability of the network. Fault detection can be accomplished using various methods, such as TDR, OTDR, and power loss monitoring. However, these methods can be expensive and require specialized equipment.

The motivation for this project is to develop a low-cost and efficient solution for fiber optic fault detection that can be easily implemented and customized for various applications. Our solution is based on the power of the optical line. If there are any abrupt changes in the power of the optical line, the fault message is displayed on the LCD, which is interfaced with the ESP8266 board. At the same time, the date and time of fault occurrence messages are transferred to the registered mobile number and email id allowingfor quick identification and resolution of the fault.

II. Material And Methods

The system overview of the above project involves the use of an ESP8266 board, LDR sensor, LCD display, and I2C module to detect and display fiber optic faults. The system detects abrupt changes in the power of the optical line using the LDR sensor, whichis connected to the ESP8266 board. The ESP8266 board processes the data and displays the fault message on the LCD display, whichis interfaced with the board using the I2C module.
Additionally, the system integrates with Ubidots, a cloud-based IoT platform, to provide remote monitoring and management capabilities. The integration with Ubidots enables users to receive notifications of fault occurrences via email and SMS and remotely monitor the system's status using a web-based dashboard.

BLOCK DIAGRAM:



Working principle: The project aims to detect fiber optic cable faults by monitoring the optical signal's power. The basic principle of the project is that a sudden change in the power of the optical signal can be an indication of a fault in the fiber optic cable.

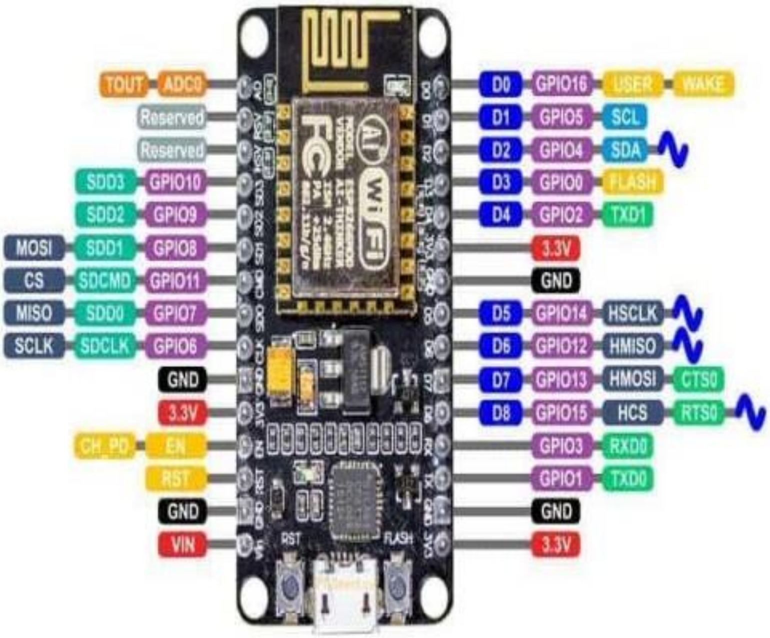
Hardware System: The hardware system consists of an ESP8266 board, an LDR sensor, an LCD display, an I2C module, and a power supply. The LDR sensor is used to detect changes in the power of the optical signal, while the ESP8266 board processes the data and controls the LCD display and I2C module. The LDR sensor is connected to the fiber optic cable, and the amount of light detected by the LDR varies with the optical signal's power. When the optical signal's power changes, the LDR sensor detects the change and sends the data to the ESP8266 board.

Software System: The software system is responsible for processing the data received from the LDR sensor and displaying the results on the LCD display. The software system is implemented using the Arduino IDE and programming language. The software system consists of two main parts: the setup function and the loop function. The setup function is responsible for initializing the system and configuring the ESP8266 board and LCD display. The loop function is responsible for continuously monitoring the LDRsensor's output and displaying the results on the LCD display.

COMPONENTS:

- Node MCU
- LDR sensor
- LCD display
- I2C module
- breadboard

Node MCU: The ESP8266 is a low-cost, Wi-Fi-enabled microcontroller that is widely used in IoT projects. It is a highly versatile microcontroller that can be used for a range of applications, including home automation, smart lighting, and industrial control. In this comment, we will provide a detailed overview of the ESP8266 microcontroller, including its features, specifications, and applications



Node MCU pin configuration

LDR: Majority of street lights, outdoor lights, and a number of indoor home appliances are typically operated and maintained manually in many occasions. This is not only risky, uncommon circumstances in controlling these electrical appliances ON and OFF. Hence, we can utilize the light sensor circuit for automatic switch OFF the loads based on daylight's intensity by employing a lightsensor. This article discusses in brief about what is a light dependent resistor, how to make a light dependent resistor circuit and its applications.

An LDR or light dependent resistor is also known as photo resistor, photocell, photoconductor. It is a one type of resistor whose resistance varies depending on the amount of light falling on its surface. When the light falls on the resistor, then the resistance changes. These resistors are often used in many circuits where it is required to sense the presence of light. These resistors have a variety of functions and resistance. For instance, when the LDR is in darkness, then it can be used to turn ON a light or to turn OFFa light when it is in the light.

LCD display: We always use devices made up of Liquid Crystal Displays (LCDs) like computers, digital watches and also DVD and CD players. They have become very common and have taken a giant leap in the screen industry by clearly replacing the use of Cathode Ray Tubes (CRT). CRT draws more power than LCD and are also bigger and heavier. LCD's have made displays thinner than CRT's. Even while comparing the LCD screen to an LED screen, the power consumption is lesser as it works on the basic principle of blocking light rather than dissipating. All of us have seen an LCD, but no one knows the exact working of it. Let us takea look at the working of an LCD.

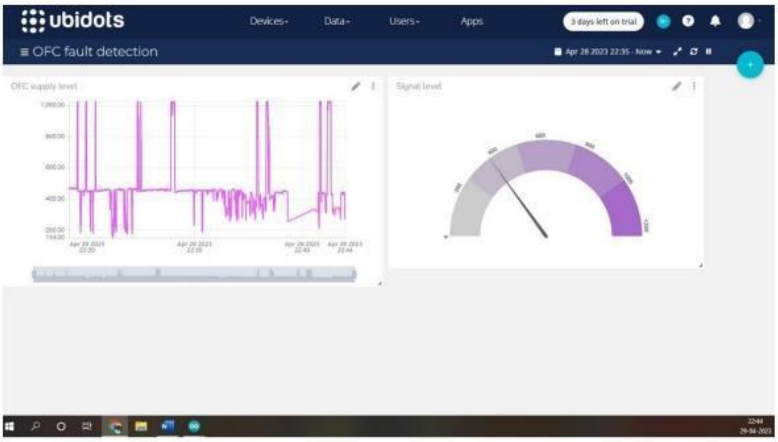
I2C module: The I2C (Inter-Integrated Circuit) protocol is a two-wire communication protocol used to connect low-speed devices in a system-on-chip or microcontroller. The I2C module is commonly used to interface various sensors and devices with a microcontroller or processor, such as an LCD display.When an LCD display is connected to an I2C module, it simplifies the process of interfacing the display with the microcontroller. This is because the I2C module acts as a bridge between the microcontroller and the LCD display, allowing the microcontroller to send data and commands to the display using the I2C protocol. The I2C module with LCD display provides a convenient and cost-effective solution for displaying data in various applications. It allows for easy customization of the display and is suitable for use in a wide range of industries, including automation, robotics, and consumer electronics.

III. Result

But now we want to Visualize the signal waveform remotely from any part of the world. So for that, I won't need to sendthe signal generated to any IoT platform. Using Ubidots you can send data to the cloud from any Internet-enabled device.
The source code for fiber optic fault detection system is given below. Copy this code and change the followingParameters.

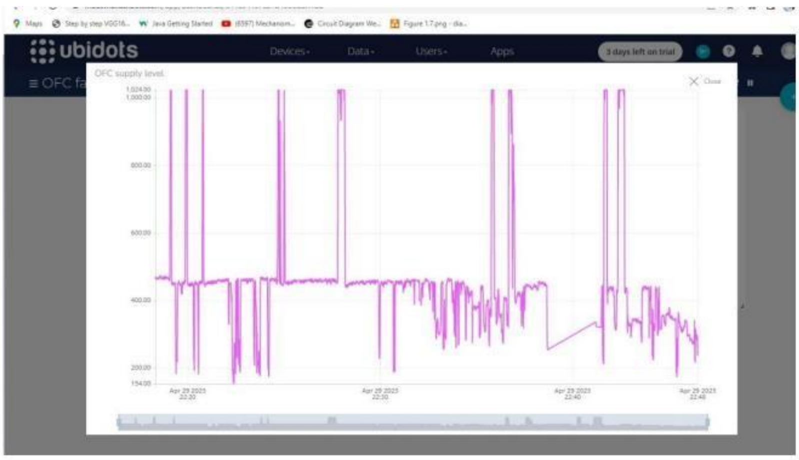
1. **WIFI SSID:** Your WiFi SSID
2. **PASSWORD:** Your WiFi password
3. **TOKEN:** Your Ubidots TOKEN
4. **MQTT_CLIENT_NAME:** Your own 8-12 alphanumeric character ASCII string.

You need one library called Pubsubclient library. So go to the library manager and install the library as shown in theimage below.



The Ubidots line chart output for this project will display the data collected by the ESP8266 board and sent to Ubidots via the internet. The line chart will show the variation in the optical power levels over time, which indicates the performance of the fiberoptic cable.
In addition to the power level, the line chart can also display other variables such as temperature, humidity, or any other data that the ESP8266 board is programmed to collect. The line chart can be customized to show different time periods, such as the past hour, day, week, or month.

The Ubidots line chart output is a powerful tool for monitoring the performance of the fiber optic cable and detecting any abnormalities or faults that may occur. Network administrators can use this data to identify trends or patterns that may indicate potential issues and take proactive measures to prevent downtime or service interruptions.



Ubidots line chart output is an essential component of this project, providing real-time visibility into the performance of the fiber optic cable and allowing network administrators to make informed decisions to ensure optimal network performance.
The Ubidots gauge output of this project provides a clear visualization of the current power status of the fiber optic cable. The gauge display shows the power level in real-time, allowing for quick identification of any anomalies or fluctuations in the power level that may indicate a fault in the fiber optic cable. The gauge display is also customizable, allowing users to set custom administrators to receive notifications when the power level exceeds or falls below a certain threshold, allowing for timely intervention and fault resolution.

IV. Conclusion

In conclusion, this project demonstrated a low-cost and efficient solution for fiber optic fault detection using the power of the optical line. The system was designed to detect abrupt changes in the power of the optical line, which may indicate the occurrenceof a fault in the fiber optic cable. The system also provided a mechanism for alerting network administrators of the fault occurrence,allowing them to quickly identify and resolve faults, minimizing downtime and reducing disruption to users.
The system was developed using the ESP8266 board, LCD, I2C module, and Ubidots cloud-based IoT platform.

The integration with Ubidots enabled users to monitor and manage the system remotely, providing a scalable platform for customizationand expansion.

Future scope for this project includes the development of more advanced fault detection and management systems, such as the integration of machine learning algorithms for fault prediction and prevention. The system can also be improved by incorporatingadditional sensors to detect other types of faults, such as temperature or humidity changes.

Additionally, the system can be further customized and expanded to suit the specific needs of different industries and applications, such as in the telecommunications, energy, or transportation sectors. Overall, this project demonstrated the capabilities of ESP8266 boards for data processing and communication in IoT applications and provided a low-cost and efficient solution for fiber optic fault detection. With further development and customization, this system has the potential to significantly improve the reliability and efficiency of fiber optic networks.

References

[1]. "Node MCUbased fault detection in optical fiber communication" by A. G. Raza et al., published in the Journal of Optical Communications in 2019.

[2]. "An Intelligent Fault Detecting System in an Optical Fiber using Arduino" by G. Baskaran and R. Seethalakshmi, published in the Journal of Theoretical and Applied Information Technology in 2012.

[3]. "Real-Time Monitoring of Optical Fiber Network using Node MCU" by V. M. Shah and S. S. Sharma, published in the International Journal of Computer Applications in 2017.

[4]. "Fiber-Optic Fault Detection in WDM Networks using Machine Learning Techniques" by P. Maity, et al. in the Journal of Lightwave Technology (2019).

[5]. "Automatic Optical Fiber Fault Detection and Localization in Passive Optical Networks" by A. Hadiyan, et al. in the Journal of Optical Communications and Networking (2019).

[6]. "A Comparative Study of Fault Detection Techniques for Fiber-Optic Communication Networks" by H. Liu, et al. in the Journal of Lightwave Technology (2017).

[7]. "A Review of Fiber Optic Fault Monitoring Techniques and Systems" by R. Ahmad and S. Tahir in the Journal of Optical Communications (2019).

[8]. "Fault Detection and Localization Techniques for Fiber-Optic Communication Networks: A Review" by M. N. Sahito, et al. in the Journal of Optical Fiber Technology (2018).

[9]. "An Improved Fiber Optic Fault Detection and Localization Method based on a Single OTDR" by X. Jin, et al. in the Journal of Sensors (2017).