Transmission Line Multiple Faults Detection And Indication To Electricity Board

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Abstract: Transmission lines play an essential role in the power system network, but their losses are enormous compared to other components of the power system due to the many conditions of transmission lines and the wide range of prone to failure. Because these flaws are difficult to detect, the entire cable must be replaced. As a result, extensive research has been conducted to use cutting-edge technologies to improve consumer energy supply. Identifying the source of a failure is time-consuming; rapid failure detection allows the equipment to be protected before significant damage occurs. Precise fault location can assist maintenance personnel in troubleshooting persistent faults and locating fault-prone areas, reducing fault occurrence and minimizing outage time. This article aims to use an Arduino board to detect a flaw in a transmission line and transmit it to a control center via an IoT device. An IoT-based circuit breaker is a fast-responding system controlled by an interconnected network (the Internet). The IoT blynk Platform monitors transformer temperature and fire detection events in real-time. Through an IoT module connection, line status, such as temperature and ON/OFF status, can be accessed via the BLYNK APP. This is possible with a sophisticated, low-power, low-cost Nodemcu IoT module.

Keywords: Fault detection, Internet of things, Arduino UNO, LM 35

I. INTRODUCTION

The power system is divided into generation, transmission, and distribution. The transmission network is a vital power system component because it connects supply and demand.Electrical transmission and distribution network losses are considered extremely high in comparison to other components of the electrical system. Electrical infrastructure is extremely vulnerable to various malicious and natural physical events. To detect faulty transmission line segments, many transmission companies rely primarily on circuitindicators [1, 2].

Wireless sensor-based transmission line monitoring solves various problems, including faster fault location, real-time structural knowledge, accurate fault diagnosis by identifying and distinguishing electrical and mechanical faults, and profitable maintenance.These applications have stringent requirements, such as delivering highly reliable data on time [3]. Faults must be identified quickly so faulty lines can be immediately isolated from equipment for effective defense [4]. Following that, the fault must be classified and located to restore and expedite system recovery. Fault voltage and current signals are used in transmission networks to discover, detect, and classify faults [5]. After the relay detects an abnormal signal, the circuit breaker disconnects the faulty part of the transmission line from the rest [6].

These faults can be open circuits or short circuits. Worn insulators on power lines and open conductors due to wear are examples of open circuit faults. A short circuit occurs when two or more lines carrying different voltages are unintentionally or intentionally grounded or come into contact with each other due to environmental influences, such as a tree falling on the line or a bird perched on the line. Three-phase faults (three-phase earth or three-phase short-circuit) are symmetrical short-circuit faults, while the rest are asymmetrical. These are the most common and severe types of defects, resulting in abnormally high current flow through a transmission line or facility [7].

If the fault is not resolved quickly, it will cause significant equipment damage in a short period. Locating the fault site protects the environment and power system equipment from damage caused by the fault. Accurate fault location determination has numerous advantages, including lower maintenance costs, shorter restoration times, and less labor for teams locating fault locations in difficult terrain. There are multiple fault location techniques, such as wavelet analysis, traveling wave, impedance, and artificial neural network-based methods.

II. LITERATURE SURVEY

S.Suresh et al. [8]An optimal formulation for a cost-effective wireless connection capable of transmitting time-sensitive sensor data over a network of transmission lines is proposed in the existence of latency and bandwidth constraints. The suggested technique is broad and covers many variables; including tower tilt data generation, radio link reliability, link utilization cost, and uneven cell coverage characteristics. According to evaluation studies, the bandwidth of wireless links is the main bottleneck for cost minimization.

PathirikkatGopakumar et al. [9] The suggested scheme can significantly aid the system protection center (SPC) in locating the fault and quickly restoring the line. A study based on a standard power system network is used to validate the proposed system's effectiveness.This is a distinct advantage over conventional methods designed for specific transmission line configurations such as single-end or double-end transmission lines.

SaurabhVerma et al. [10] the developed system monitors the cable error's 3-wire sequence, i.e., phases R, Y, and B. The system sends a notification to the line if an error is detected. The monitoring channel also provides details on the faulty cable and its location. Line voltage can also be transmitted to monitoring stations via the system. Blynk IoT server-based efficient data transmission for various applications was proposed by Ramalingam et al. [11–13]. Using Blynk and a wireless sensor network, Venkatramanan and Ramalingam created an intelligent Internet of Things (IoT) device for real-time applications. Data collection and transmission into the cloud have both been done using this intelligent IoT device [14, 15].

2.1 EXISTING SYSTEM

Previously, the fault had to be located using this method, which involved running through the cable circuit. Acoustic or electromagnetic signals are used to identify the defective segment and are then transmitted to the affected members. This technique can locate faults on the transmission line from one or both ends without monitoring. Bridge technology is the most widely commonly used technique of termination.

Problem Statement

- The main drawbacks of transmission cables are their high initial cost and issues with high-voltage insulation. Another significant disadvantage is that if a problem does arise, it cannot be detected, making it challenging to locate and resolve.
- Arduino, like other components, requires 5V DC power. The relay requires 12V DC.
- There is some delay because reading the angle value takes time.

III. PROPOSED METHODOLOGY

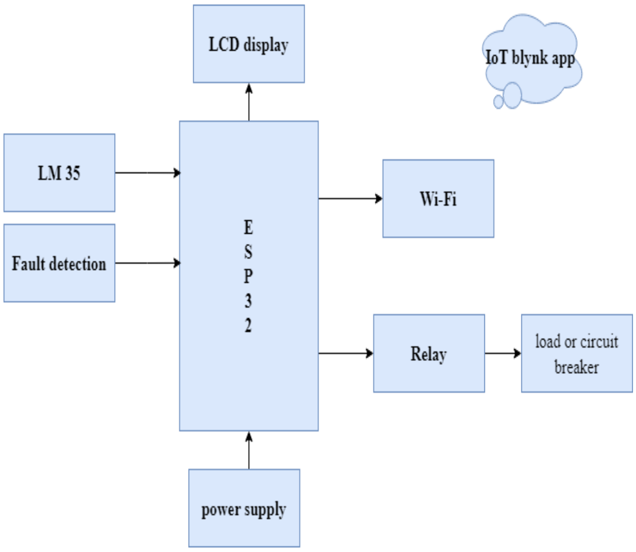

Fig 1. Block Diagram

The designed methodology is an IoT-enabled transmission line fault detection system. When a cable fails, the voltage changes and is used to estimate the distance to the fault. The system comprises a Wi-Fi module, a microcontroller, a step-down transformer, a rectifier, and a voltage regulator. The cable current detection circuit provides the microcontroller with the magnitude of the voltage drop across the resistor and calculates the distance to fault based on the voltage. Figure 1 shows the block diagram of the proposed method.

3.1 Working principle

To detect the voltage level, we use a 3-phase AC voltage detection circuit, i.e., arduino, IoT module, 3-phase sequencer, and temperature sensor in this project. The main idea behind this project is to detect voltage changes and faults in any line and send a message to the distribution authority using an IoT system, which will aid in determining the fault in the line. The primary function of this circuit is carried out by a detection circuit, which detects any change in the three-phase cable, such as a voltage change or a cable fault, and sends a signal to the detection circuit. In the following stage, a detection unit consisting of a resistor network will provide the required output to the micro controller, and changes in the transmission line will be transmitted to the IoT system, from which the faulty power line will be obtained by the power distribution board controller or operator.Figure 2 depicts an interfacing circuit diagram.

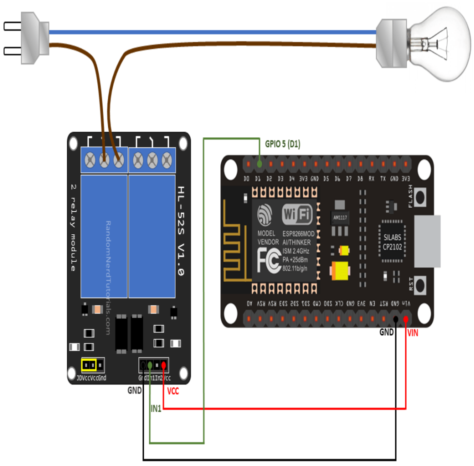

*Fig.2*Interfacing circuit diagram

The operators communicate using an Android application. This project's application will provide information on voltage variations, faulty lines in the transmission network, and real-time notification of power line faults to alert operators. If the line is continuously monitored and the dataset is available on the web, the utility company can take the necessary precautions ahead of time to avoid severe damage. In our project, we show how to use IoT to monitor line parameters and upload data to the network. The voltage and current values are displayed on the LCD screen and are regularly updated. When the maintenance work is finished, enter the password and compare it to the preset password to restart the line. If it matches, the line can be activated individually, similar to deactivation. The system is connected to an IoT module, which sends data and status to BLYNK APP, which can be accessed by substation personnel.

3.2. Module 1: Hardware development

3.2.1 Arduino UNO

Figure 3 depicts an arduino UNO diagram.There are many microcontrollers than the few that run on a "flavour" of the "Arduino board family," but the Arduino board family.

- has a very user-friendly common IDE
- has a lot of peripheral support - including third-party support
- has a lot of sample applications to get started with

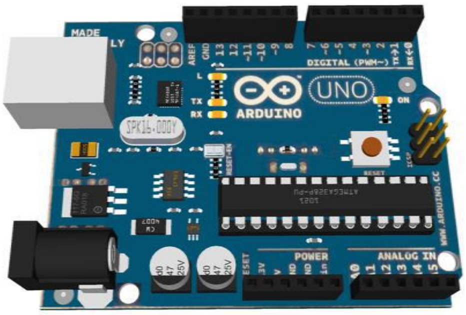

*Fig 3.*Arduino UNO

3.2.2 Nodemcu board

The ESP32 is a single chip with 2.4 GHz Wi-Fi and Bluetooth that was designed using TSMC's 40nm ultra-low power technology. It is designed to provide optimal power and RF performance while demonstrating robustness, flexibility, and dependability in a variety of power situations and applications. The ESP32 is a Wi-Fi and Bluetooth IoT application solution with about 20 external components. The ESP32 includes an RFbalun, low noise receiver amplifier, antenna switch, power amplifier, filter, and power management module.Figure 4 depicts Nodemcu board diagram.

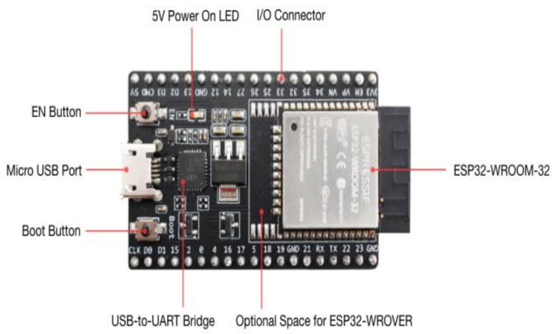

Fig 4. Nodemcu Board

3.2.3 Relay:

***Fig5.*Relay**

A relay is an electromagnetic switch that can open and close a circuit with a small power signal or control multiple circuits with a single signal.Figure 5 depicts relay circuit diagram.

3.2.416*2 Liquid crystal display(LCD)

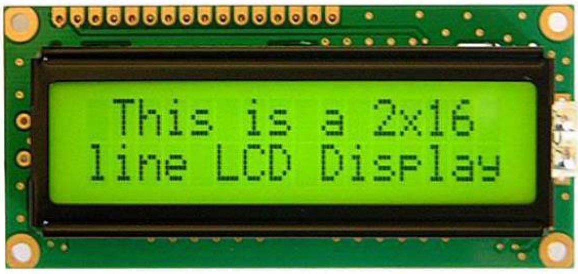

***Fig6.*Relay**

A LCD is an electronic display module that produces visible images by using liquid crystals. The16x2 LCD isa simple module that can be found in many DIY projects and circuits. 16x2 represents a two-line display of 16 characters each. Each character is displayed as a 5x7 pixel matrix on this LCD screen.Figure 6 depicts a 16*2 LCD diagram.

3.3. Module 2: IoT BASED INTERFACE

Application Programming Interfaces (APIs) are used for IoT integration, and applications communicate with each device via logical contacts. The API information allows these devices to function as a data interface and pass data to applications. The app can also control the device and serve as the user interface. Data can be tracked using mobile or web-based applications. These programs act as the user interface, displaying the sensor data. These programs run on portable devices with LCD (liquid crystal display) screens like mobile phones. IoT is constantly evolving, and when used for asset tracking, it provides a variety of benefits such as:

- Asset tracking in real-time.
- Extensive Data Insights
- Fewer supply chain interruptions
- Improved time management and fewer errors

3.4 BLYNK IoT PLATFORM

We created an IoT-based Android application for detecting cable faults. The proposed hardware components connect to the Internet of Things via WiFi gadgets. The Blynk IoT application server monitors hardware output behavior and events in real-time. As notifications, the Blynk Android app can monitor fault location. Figure 7 depicts the Blynk IoT platform.

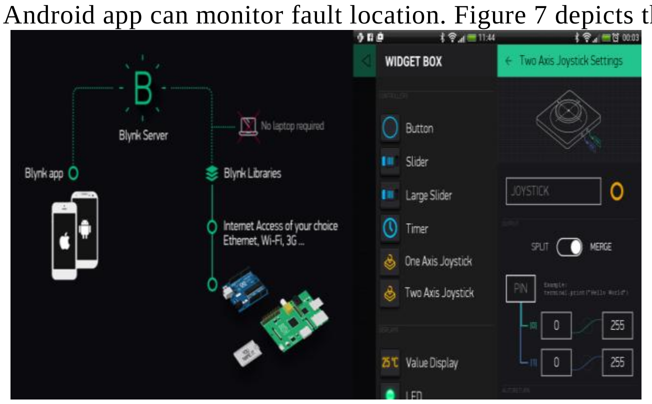

***Fig 7.*Blynk IoT platform**

IV. RESULTS AND DISCUSSION

According to the results, if a fault occurs in the transmission line, the Arduino programmer detects it, GPS locates it, and the type of fault is displayed on the LCD, as shown in the figure below. When a fault occurs, the relay detects and shuts down the load on the associated line.The entire load is disconnected if a ground fault occurs in the system. And once the fault is resolved, the system resumes regular operation. The project is in the early implementation stage, and the theoretical design has formed a working system. Therefore, it can be seen as the most critical stage in ensuring the new system's success and convincing consumers that it is efficient and effective. The implementation phase involves careful planning, consideration of existing system constraints and implementation, and switching system design and evaluation.

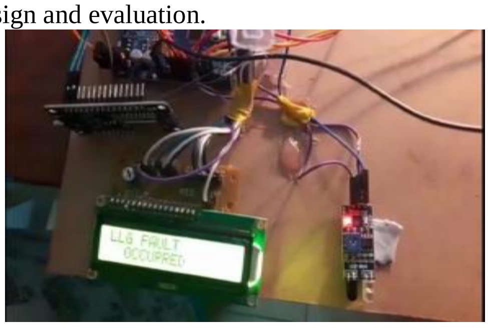

***Fig 8.*Implementation Hardware**

Figure 8 depicts the proposed hardware development model for locating faults. The system comprises an Arduino, a Relay, GPS, a GSM module, an ESP32, an LM 35 sensor, an LCD, and an emergency button. The results of the Android application using the BLYNK IoT platform are shown in Figure 9.

Advantages

- Detects accurate fault sub location
- Time saving and faster maintenance
- Reduce human effort
- Cost effective
- Less software requirements
- Less complexity

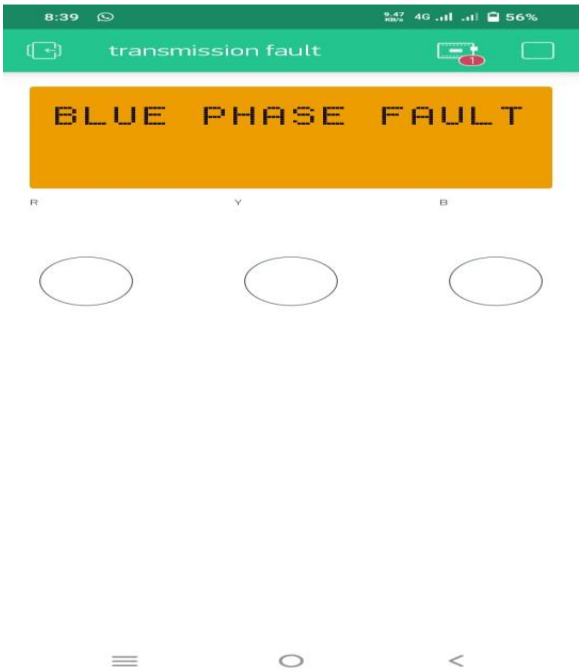

Fig 9.**BLYNK App Result**

V. CONCLUSION

The system was designed, and the results were validated, with the model designed to address consumer problems. We can easily detect and repair transmission line faults using this method. The three-phase transmission line's fault location is dependable, and the data is stable. It operates in real-time, allowing us to maintain data sheets and avoid future line problems. Locating short-circuits faults on transmission lines at specific distances to effectively eliminate defects. When a fault occurs, this work displays the phase, distance, and time automatically using Arduino.The advantages of accurate fault location include quick fixes to get the power system back up and running, improved system performance, lower operating expenses, and reduced on-site fault location time.

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