International Journal of Electrical and Electronics Engineers
Volume 16, Issue No. 01, Jan-June 2024
ISSN (O) 2321-2055
ISSN (P) 2321 -2045

IOT Based Transmission Line Fault Detection

Mr. Vijay R. Patil[1], Mr. Darshan B. Rankhambe[2],
Mr. Aniket N. Pujari[3], Mr. Abhinandan A. Patil[4],
Mrs. S. B. Kumbhar[5]

[1,2,3,4,]*Department of Electrical Engg. Sanjay Bhokare group of Institute, Miraj*
[5]*Assistant Professor, Department of Electrical Engg. Sanjay Bhokare group of Institute, Miraj*

ABSTRACT:

This project focuses on the development of an IoT-based system for real-time fault detection in transmission lines using ESP (ESP32 or ESP8266) microcontrollers and the Adafruit IO server. The primary objective is to create a smart monitoring system capable of detecting various faults such as overvoltage, under voltage, phase cut, phase neutral fault, earth leakage, and displaying these anomalies on an LCD screen while also transmitting the data to Adafruit IO for remote access and analysis.

Future enhancements for the project include refining fault detection algorithms for higher accuracy, implementing advanced machine learning or AI techniques for predictive analysis, exploring remote control capabilities, and developing a user-friendly interface, potentially mobile or web-based, for comprehensive monitoring and control.

The IoT-based Transmission Line Fault Detection System successfully accomplishes the objective of real-time fault detection in transmission lines. It provides an effective means of monitoring and reporting faults, both locally through the LCD display and remotely via the Adafruit IO server, ensuring prompt identification and response to potential issues in the transmission network.

KEY WORDS: *Fault detections, ESP32 Microcontroller, Adafruit server, IOT etc.*

I. INTRODUCTION

A literature review on IoT-based transmission line fault detection would involve examining research articles, conference papers, and academic journals that focus on the use of Internet of Things (IoT) technology for detecting faults in transmission lines

One proposed method for IoT-based transmission line fault detection involves deploying sensors along the transmission lines to monitor parameters such as current, voltage, temperature, and vibration. These sensors collect real-time data, which is transmitted to a central monitoring system via IoT communication protocols. Machine learning algorithms are then employed to analyze the data and detect any abnormalities indicative of faults, such as short circuits or line breakages. The system can alert operators in real-time, enabling prompt maintenance actions to minimize downtime and prevent potential accidents.

The hardware setup involves interfacing ESP microcontrollers with sensors for voltage monitoring, current detection, and phase status assessment. Voltage sensors are deployed to monitor overvoltage and under voltage conditions, while a current sensor is utilized to detect earth leakage. Additionally, a phase detection sensor is incorporated to identify phase cut and phase neutral faults. These sensors are integrated into a unified system connected to an LCD display for on-site fault indication.

Software aspect revolves around programming the ESP microcontrollers using ESP (ESP32 or ESP8266) or Platform IO to continuously monitor data from the sensors. The firmware is designed to analyze incoming data, apply predefined thresholds for fault detection, and trigger alerts when fault conditions are detected. Integration with the Adafruit IO platform enables the transmission of fault statuses to the cloud server, allowing remote access and analysis of transmission line health.

Extensive testing is conducted to validate the system's functionality, accuracy in fault detection, and responsiveness to various fault scenarios. The system is rigorously evaluated to ensure reliability, stability, and consistent performance under different conditions.

FAULTS IN TRANSMISSION LINE:

OPEN CIRCUIT FAULTS:

Failure of one or more conductors causes these faults. Joint failures of cables and overhead lines, failure of one or more phases of a circuit breaker, and melting of a fuse or conductor in one or more phases are among the most common causes of these faults. A series fault is the same as an open circuit fault. Except for three-phase open faults, these are unsymmetrical or unbalanced faults.

SHORT CIRCUIT FAULTS:

A short circuit is an abnormally low-impedance connection between two points of different potential, whether intentionally or accidentally made. These are the most common and dangerous types of faults, which cause abnormally high currents to flow through equipment or transmission lines. If these faults are allowed to persist even for a short time, the equipment will be severely damaged. Shunt faults are another name for short circuit faults. Insulation failure between phase conductors, between earth and phase conductors, or both causes these faults. Three phases to earth, phase to phase, single phase to earth, two phase to earth, and phase to phase are all possible short circuit fault conditions. A fault can occur between any of the three lines and the ground in a single line to ground fault. A fault occurs between any two of the three lines and the ground in a double line to ground fault. A fault can occur between any two lines in a line-to-line fault. A sudden change in voltage occurs when a fault occurs. If not corrected immediately, this voltage change could cause serious system damage.

FAULT DETECTION METHODS:

ONLINE METHOD:

This method utilizes and processes the sampled voltages and current to determine the fault points.

OFFLINE METHOD:

In this method special instrument is used to test out service of cable in the field. Existing system used for offline method. This method can be divided into two methods. They are tracer method and terminal method.

International Journal of Electrical and Electronics Engineers
Volume 16, Issue No. 01, Jan-June 2024
ISSN (O) 2321-2055
ISSN (P) 2321 -2045

II. HARDWARE IMPLEMENTATION

A hardware implementation of IoT-based transmission line fault detection typically involves several components:

Components

- ESP32 MICROCONTROLLER
- SENSORS
- POWER SUPPLY
- CONNECTIONS CABLES
- ADFRUIT SOFTWARE
- DISPLAY
- RELAY

1. Sensors: Various sensors are deployed along the transmission lines to monitor parameters such as current, voltage, temperature, and vibration. These sensors can be current transformers, voltage transformers, temperature sensors, accelerometers, etc.

2. Microcontrollers or Microprocessors: Each sensor node is equipped with a microcontroller or microprocessor to process the sensor data locally and prepare it for transmission. Popular choices include ESP32, Raspberry Pi, or specialized microcontrollers with low-power consumption capabilities.

3. Communication Modules: Each sensor node needs to communicate wirelessly with a central monitoring system. Communication modules such as Wi-Fi are commonly used for this purpose. These modules enable the transmission of sensor data over the internet to the central monitoring system.

4. Power Supply: Sensor nodes require a power source to operate. Depending on the deployment location, power can be supplied through batteries, solar panels, or even harvesting energy from the environment (e.g., vibration-based energy harvesting).

5. Fault Detection Algorithms: Machine learning algorithms or rule-based algorithms are implemented on the central monitoring system to analyze the collected data and detect faults or anomalies. These algorithms may include pattern recognition, statistical analysis, or other techniques to identify abnormal behavior indicative of faults.

By integrating these components, a hardware implementation of IoT-based transmission line fault detection system can effectively monitor and detect faults in real-time, helping to ensure the reliability and safety of the power grid.

Implementation:

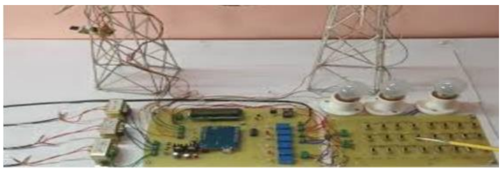

Fig 2.1:

International Journal of Electrical and Electronics Engineers
Volume 16, Issue No. 01, Jan-June 2024
ISSN (O) 2321-2055
ISSN (P) 2321 -2045

Connect each sensor (current, voltage, temperature, vibration) to the corresponding input pins of the microcontroller**.** Connect the microcontroller to the communication module. (ESP32) Connect the power supply to the respective power input pins of the microcontroller and sensors. Connect the storage device to the microcontroller and configure data logging routines in the firmware.

VI .RESULT

The IoT-based Transmission Line Fault Detection System successfully accomplishes the objective of real-time fault detection in transmission lines. It provides an effective means of monitoring and reporting faults, both locally through the LCD display and remotely via the Adafruit IO server, ensuring prompt identification and response to potential issues in the transmission network.

If fault is not present in system, display shows "R-Y-B ok" as shown in figure. It means system is at all right condition

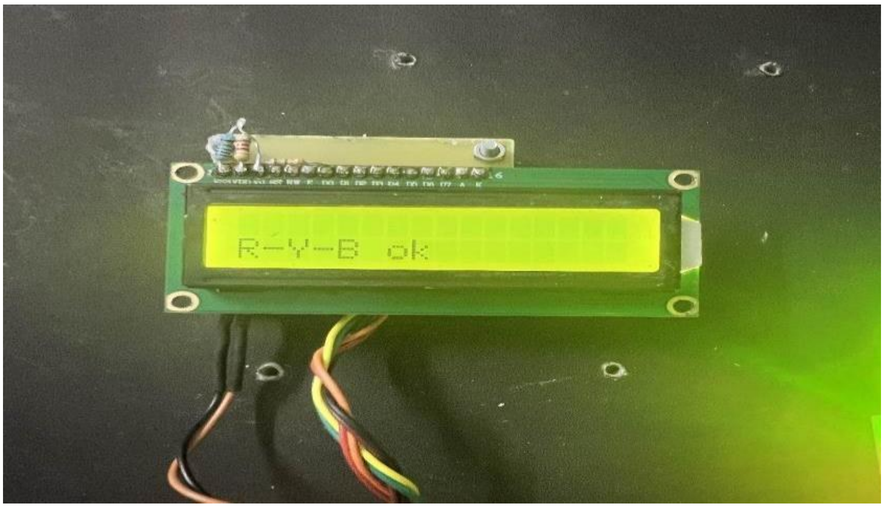

Fig 3.1

Transmission line goes under phase to phase fault which is shown in LCD display as and fault is detect.

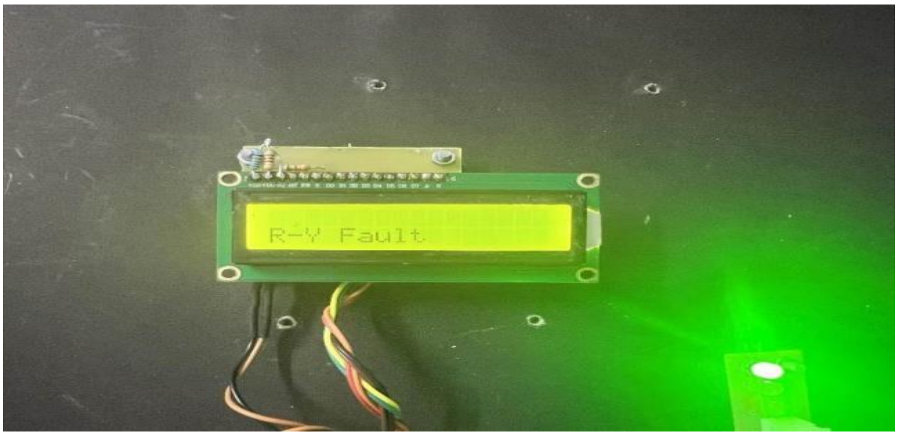

Fig 3.2

International Journal of Electrical and Electronics Engineers
Volume 16, Issue No. 01, Jan-June 2024
ISSN (O) 2321-2055
ISSN (P) 2321 -2045

The transmission line goes under line to ground fault which is as shown in LCD display will give information about LG fault.

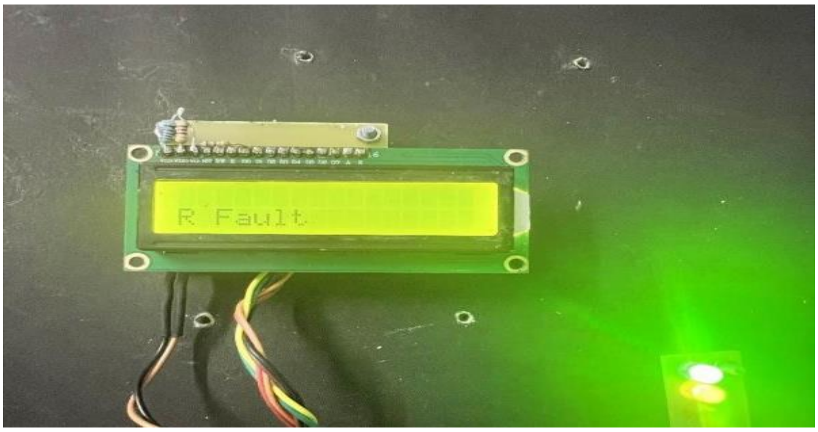

Fig 3.3

VII. CONCLUSION

The short circuit fault is located at a specific distance in the transmission line in order to efficiently rectify the fault. With the help of ESP32 Microcontroller, the work automatically displays the phase, distance, and time of the fault occurrence. Faster repair of the power system, improved system performance, lower operating costs, and shorter time to locate faults in the fields are all advantages of accurate fault location conclusion, IoT-based transmission line fault detection systems represent a proactive and data-driven approach to ensuring the reliability and stability of power transmission infrastructure in the face of evolving challenges and demands.

VIII .REFERANCES

[1] K. K. Densley, “Ageing mechanisms and diagnostics for power cables - an overview,” IEEE Electronic Insulation Mag., vol. 17, no. 1, pp. 14– 22, Jan./Feb 2001.

[2] S.O. Kuan and K. Warwick, “Real-time expert system for fault location on high voltage underground distribution cables”, IEEE Proceedings, Vol. 139,

[3] J. J. Navaneethan and W. H. Soraghan, “An Automatic Fault Detection and Location Technique in Low Voltage Distribution Networks,” Proc. of Energy Management and Power Delivery ’98, pp. 732-736, March 1998.

[4] J.P. Steiner, W.L. Weeks, and H.W, “An Automated Fault Locating System”, IEEE Trans. On Power Delivery, Vol.7, No 2, pp. 967-978, April 1992.

[5] Faruqui, F., Shahnawaz, M., Javaid, N., Khan, Z. A., & Ahmad, A. (2020). IoT-Based Fault Detection and Classification on Transmission Line Using Machine Learning Techniques. IEEE Access, 8, 22574-22587.

[6] Sarker, R., Rahman, M. S., Rahman, M. M., & Gias, M. R. (2020). IoT-Based Fault Detection and Protection System for Transmission Lines. In 2020 International Conference on Electrical, Computer and Communication Engineering (ECCE) (pp. 1-4). IEEE.

[7] Fatlawi, A. F., & Jassim, K. A. (2018). Internet of Things (IoT)-Based Fault Detection and Location in Power Transmission Lines Using Wireless Sensor Networks. Energies, 11(10), 2631

[8] Ansari, M., & Khan, Z. (2018). IoT-based Fault Detection and Classification on Power Transmission Lines Using Artificial Neural Networks. International Journal of Electrical Power & Energy Systems, 99, 290-299

[9] Kumar, A., & Jaiswal, A. K. (2021). A Comprehensive Review on Internet of Things (IoT) Enabled Fault Detection Techniques in Power Transmission Line. In 2021 12th International Conference on Computing, Communication and Networking Technologies (ICCCNT) (pp. 1-5). IEEE.