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Review IJEPST

IoT Based Automatic Fault Detection in Low Transmission Line

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Abstract

Electric hazards associated to transmission lines are a big worry when negotiating India's complex electrical distribution network. According to estimates from the National Crime Records Bureau, about one lakh individuals have perished from electrocution in only the last ten years. The average yearly death toll increased from approximately 11,000 to 12,500 between 2021 and 2025. According to CEI-Electrical Accident Statistics, it has reached 13,855 by 2023. Transmission line mishaps, especially in the LT Line, are a significant contributing element to these disasters. The conventional safety system does not provide sufficient safety and cannot keep up with new technology developments. Our innovative method seeks to enhance power distribution and avoid accidents by quickly identifying issues on the transmission lines. The dual-post system is made up of Node-MCU controllers and Raspberry Pi (RPI) boards. RPI coordinates data processing, street light regulation and central control. The wireless communication, line break detection and street light activation are all controlled by the Node-MCU. Relay-controlled street lights are efficient in adjusting both human inputs and external circumstances. The Node-MCU's potentiometer-based circuit quickly identifies and logs line breaks. Enhancing theft detection, a current sensor tracks the load on a light that is actuated by a push button. For prompt action, RPI receives real-time data on theft attempts and line breaks. Users are empowered with remote control of street lights and theft notifications; thanks to seamless Android app integration. We can save important human lives and avoid accidents brought on by electrical hazards by putting this technology into practice.

Keywords: IoT, line breakage detection, accident prevention, fault location detection, remote street light control

INTRODUCTION

When navigating the intricate landscape of electricity distribution in India, transmission line-related electric dangers are a major concern. The National Crime Records Bureau (NCRB) estimates that almost 1 lakh people have died from electrocution in the last ten years alone. Between 2021 and 2025, the average annual death toll rose from roughly 11,000 to 12,500. CEI-Electrical Accident Statistics states that by 2023, it had increased to 13,855. A major factor in these incidents is transmission line accidents, particularly in LT Line. The traditional safety system is unable to keep up with new technological advancements and does not guarantee adequate safety [1].

Our most recent system seeks to detect transmission line defects rapidly in order to improve power distribution and prevent accidents. It has two post systems: Node-MCU controllers and

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Raspberry Pi (RPI) boards. Street light regulation, data processing and central control are all handled by RPI. The Node-MCU is in charge of line break detection, wireless communication and turning on street lights. The Node-MCU's potentiometer-based circuit quickly detects and reports line breaks. To improve theft detection, the current sensor monitors the load on a light that is actuated by a push button. Relay-controlled Street lights that are efficient, can adjust to changes in the environment and user input.

For quick action, RPI receives real-time data on theft attempts and line breaks. Users can receive theft notifications and remotely adjust street lighting with the integration of Android apps. We can save important human lives and avoid accidents caused by electrical hazards by putting this technology into practice.

LITERATURE REVIEW

The paper "Health Condition Monitoring System for Distribution Transformer Using Internet of Things (IoT)" was proposed by Dr. S. B. Deosarkar and Rohit R. Pawar in 2017. It outlines the creation of a transportable embedded system for tracking various distribution transformer characteristics, including humidity, oil level, vibration, temperature and current [2]. An 8-channel analog to digital converter is used by the system to capture data and if any anomalies are found, alert messages are sent to mobile devices and monitoring units. Proactive maintenance is made possible by the facilitation of two-way communication between the transformer and operator. Notwithstanding, constraints can encompass certain obstacles in real-time data processing and transmission dependability in isolated or severe settings, requiring additional verification in a variety of operational scenarios. A novel method for identifying low-severity inter-turn faults in dry-type transformers during online operation is presented in the study "Inter-Turn Fault Detection of Dry-Type Transformers Using Core-Leakage Fluxes" by Subash Chandar Athikessavan and Elango Jeyasankar (2019) [3]. It studies the basics of building block of core-leakage fluxes using only two low-cost flux sensors. Theoretical and experimental validation of the approach demonstrates its ability to identify defects as small as a 2-turn bolted flaw in just three cycles. It is comparable to classical approaches, impervious to loading and voltage imbalance, and requires 78% fewer sensors. However, more research may be necessary to determine the technique's scalability, resilience under different circumstances and usefulness outside of experimental setups.

A decentralized protection system for identifying high impedance faults in low voltage distribution systems is presented in the paper "High Impedance Fault detection in Low Voltage Distribution Systems Using Wavelet and Harmonic Fault Indices" by Vineeth N. and P. Sreejaya (2020) [4]. It uses discrete wavelet transformation to break down transformer neutral current in order to find anomalies that point to problems. To create an accurate fault index, multi-resolution wavelet analysis and harmonic analysis are used. The methods are tested with different loads and load switching scenarios on a test system. Nevertheless, more real-world validation and discussion of the difficulties of actual application are required.

The study of "On-line Condition Monitoring of Power Transformer Health Status Enforced by Temperature and Electrical Signatures," which was proposed by Ehnaish Aburaghiega and Mohamed Emad Farrag in 2019, focuses on creating online tools for tracking the health of power transformers by examining transformer signatures, such as voltage, current, winding and core temperature [5]. The efficacy of circulating current magnitude-based severity classification and real-time defect identification and localization has been verified through experimental investigations. Additionally, the study finds that the temperature of the transformer may be able to reveal defective windings and certain disc areas that are impacted by short circuits. Nevertheless, additional testing under various operating environments and scaling to bigger transformer networks would be required.

A new hybrid method for identifying and locating transmission line faults in interconnected networks using phasor measurement unit (PMU) measurements was presented in the paper "Transmission Line

Fault Detection and Identification in an Interconnected Power Network using Phasor Measurement Units" by Abdul Qayyum Khan and Muhammad Sarwar (2018) [6]. Positive Sequence Current Angle Differences (PSCADs) are used to identify the location of faults, while Positive Sequence Voltage Magnitude (PSVM) is used for fault detection. Positive Sequence Current Magnitude (PSCM) is used, if these conditions are not met. The efficacy of the suggested fault detection and identification algorithm is validated by simulations in MATLAB/SIMULINK, tested on a five-area interconnected transmission network using PMUs.

The paper "A New IoT Application for Dynamic Wi-Fi based Wireless Sensor Network" by Fatih Ertam and Ilhan Firat Kilincer (2020) describes a wireless sensor network-based approach for the Internet of Things (IoT) that allows for remote data exchange and control through wireless communication technology [7]. It makes use of ESP8266 devices to provide a wide-ranging sensor network for temperature and humidity monitoring that is connected to wireless access devices in campus networks. A server receives the data gathered by ESP8266 modules in order to provide real-time reporting and monitoring. The technique has the benefits of being inexpensive, dynamic and simple to use in already-existing Wi-Fi networks. Notwithstanding, such constraints may encompass issues related to the wireless sensor network's scalability, dependability and security, necessitating additional research for feasible execution.

In order to address flaws in the current distribution automation systems, HUA Guanghui and CHEN Mingjia (2018) proposed the paper "Research and Application of Monitoring Method of Small Current Grounding Fault in Distribution Line Based on Cloud Computing," which offers a novel distribution line monitoring method [8]. It presents a compact current ground fault monitoring system for distribution lines that make use of wireless connectivity, cloud computing and smart grid sensors. The goal of this integration is to improve the distribution system's visibility and transparency, which will increase its operational and financial stability. However, restrictions can include problems with data security, scalability and compatibility with current infrastructure, requiring more investigation and verification before a feasible implementation can be made.

In order to address problems with manual operation, high maintenance costs and subpar usability, Andi Adriansyah and Akhmad Wahyu Dani (2017) proposed the paper "Automation Control and Monitoring of Public Street Lighting System based on Internet of Things" which describes an IoT-based automation control and monitoring system for public street lighting [9]. Actuators, microprocessors, sensors and graphical user interface softwares are all used in the system. The findings of the experiment point to more accuracy, less maintenance and better pleasure. Limitations, however, can include difficulties with scalability, compatibility with current infrastructure and possible dependability problems in extreme weather, requiring more testing and improvement before broad adoption.

In their 2020 paper, "Development of Electricity Theft Detector with GSM Module and Alarm System," by Jennica Astronomo and Mariel Dane Dayrit, suggests developing an Arduino-based device that combines an alarm system with a GSM module to prevent energy theft [10]. The Arduino Uno, GSM module, LCD and current sensors that make up the system monitor the current discrepancies between sensors that are positioned at the drop-wire section and electrical service cap in order to identify pilferage. The technology notifies the utility company via SMS and sounds an alarm when a threshold is crossed. The prototype exhibits functioning; however, there are certain limits that may arise, such as difficulties with scalability, dependability and adaptability to various electrical systems and surroundings. More testing and improvements are required before wider adoption.

The paper "A Diagnosis of Fault Location System for Electrical Transmission and Distribution Network," written in 2015 by Velhal Geeta Vilas and Dr. V. Muralidhara, addresses fault location techniques in electrical transmission networks by using both offline fault location kits like TAURAUS ACCUMAX-3 and online numeric relays [11]. The data highlights how crucial speed and accuracy are, to fault clearance in contemporary grids. Nevertheless, there can be restrictions with regard to real-time data analysis, fault location technique accuracy and network state adaptability. To overcome these constraints and improve electrical network fault location capabilities, more investigation and verification are required.

In order to overcome the dangers created by external causes, Hengyu Yang (2022) proposed a fault detection system for transmission lines utilizing intelligent algorithms in his article "Transmission Line Fault Detection Based on Multi-layer Perceptron" [12]. In order to improve defect detection accuracy, it focuses on machine learning technology, specifically a multi-layer perceptron method. The multi-layer perceptron outperforms existing machine learning algorithms in terms of accuracy, as demonstrated by experimental verification on a dataset containing three-phase current and voltage inputs. Limitations could, however, include difficulties with practical use, scalability to other transmission line configurations and applicability to different environmental circumstances. To ensure that the system works in a variety of settings and scenarios, more investigation and testing are required.

METHODOLOGY

Establishing the necessary conditions for the RPI, Node-MCU relays, potentiometer, current sensor and Android app to function. Creates a thorough integration strategy to guarantee that hardware components communicate and interact with each other. Configure the RPIRPI to facilitate connection with the wireless Node-MCU device, manage street light schedules, and provide central control. Relays can be set up to function as effective street light switching devices and to disconnect the line as soon as a break is detected. Create a circuit using a potentiometer inside the Node-MCU to quickly and accurately detect line breaks and send data in real time to the RPI. To improve the ability to detect theft, incorporate a current sensor to track the load on the light, that is actuated by a push button. Create an easy-to-use Android application that allows users to adjust street lights remotely and receive real-time event notifications. To find and fix possible hardware or software problems, do thorough testing on both components and the entire system.

BLOCK DIAGRAM

Block diagram of flow of information is shown in Figure 1.

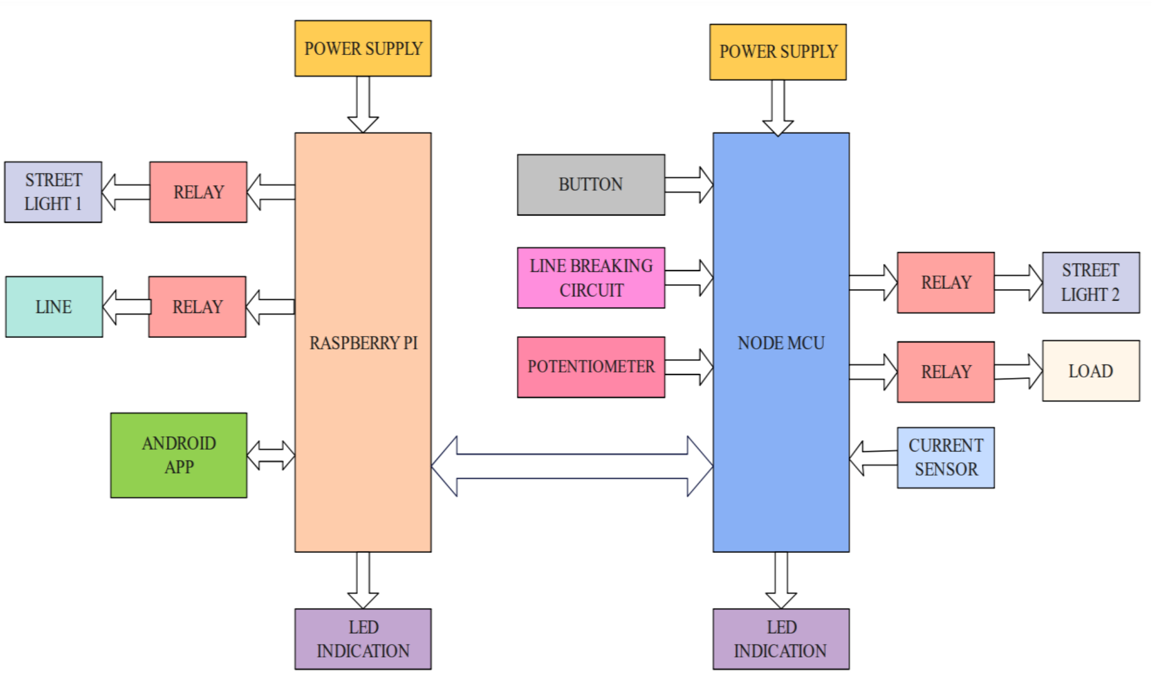

Figure 1. Block diagram of flow of information.

A centralized post and a subsidiary post make up the system. A Node-MCU is used in the subsidiary post, and a RPI powers the centralized post. A line-breaking circuit is triggered in the case of a line break, signaling the centralized post from the subsidiary post. Relay switching is then used to cut off the power supply to the central post.

In addition, the post name is sent as a message from the subordinate post to the parent post, and then the RPI relays this message to the Android application. An extra load is incorporated to detect theft; it is triggered by a push button that sends a message to the Android application.

A potentiometer is used to track voltage differences, and then data is transmitted as messages. The RPI and Node-MCU are both powered on, and their power status is shown by LED indicators. A current sensor also keeps an eye on the load. These posts allow you to use an Android application to control streetlights

CONCLUSION

For applications like power distribution and safety, the suggested fault detection system–that is based on RPI and Node-MCU controllers–shows excellent feasibility and resilient promise. Relay-controlled Street lights prioritize energy saving, and the smart distribution of responsibilities between RPI and Node-MCU provides effective control and wireless communication. Reliability and theft detection are improved by the combination of a current sensor and a potentiometer-based circuit. Quick reactions to line breaks and theft attempts are made possible via real-time data transfer to RPI, which is backed by an Android app for notifications and remote control. The versatility of the system includes energy management, smart cities, industrial automation, environmental monitoring, residential automation and agricultural. Its future-proofing and versatility are highlighted by its scalability and potential integration with machine learning algorithms and IoT devices, making it a versatile and dynamic solution with a wide range of applications.

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REFERENCES

1. Wu J, Du W, Wang J, Yang G, Zhao Y. Application of power internet of things in online monitoring of transmission lines. IEEE SCOUT. 2023; 19–5p.
2. Pawar RR., Deosarkar SB. Health condition monitoring system for distribution transformer using internet of things. IEEE ICCMC. 2017; 117–6p.
3. Athikessavan SC, Jeyasankar E, Manohar SS, Panda SK. Inter-turn fault detection of dry-type transformers using core-leakage fluxes. IEEE Transactions on Power Delivery. 2019;34(4):1230–11p.
4. Vineeth N, Sreejaya P. High impedance fault detection in low voltage distribution systems using wavelet and harmonic fault indices. IEEE PESGRE2020. 2020; 6p.
5. Aburaghiega E, Farrag ME, Gouda MM. On-line condition monitoring of power transformer health status enforced by temperature and electrical signatures. IEEE MEPCON. 2019; 521–6p.
6. Khan AQ, Sarwar M, Ullah Q, Tabassum S, Iqbal GN. IFAC-PapersOnLine. 2018;51(24), 1356–8p.
7. Ertam F, Kilincer IF, Yaman O, Sengur A. A New IoT application for dynamic Wi-Fi based wireless sensor network. IEEE ICEE. 2020; 4p.
8. Guanghui HUA, Mingjia C, Haixuan LIU, Rongbo YE. Research and application of monitoring method of small current grounding fault in distribution line based on cloud computing. IEEE CICED. 2018; 7p.

9. Adriansyah A, Dani AW, Nugraha GI. Automation control and monitoring of public street lighting system based on Internet of Things. IEEE ICECOS. 2017; 231–6p.
10. Astronomo Jennica, Dayrit Mariel Dane, Jr. Edjic Cristopher, Regidor Engr. Richard T. Development of electricity theft detector with GSM module and alarm system. IEEE HNICEM. 2020; 5p.
11. Vilas VG, Muralidhara V, Pujara A, Bakre SM. A diagnosis of fault location system for electrical transmission and distribution network. IEEE ICESA. 2015; 163–4p.
12. Yang H. Transmission line fault detection based on multi-layer perceptron. IEEE BDICN. 2022; 5p.

