AUTOMATIC POWER LINE FAULT DETECTION AND REPORTING SYSTEM USING IOT

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Introduction:

The integrity and safety of electrical power distribution networks are crucial for modern society, as uninterrupted power is essential for homes, industries, and services. Distribution lines are vulnerable to faults caused by environmental factors like rain, wind, and lightning, leading to power outages, equipment damage, and safety risks. Traditional fault detection methods are slow and rely on manual inspection, while advanced systems like SCADA are often costly and complex for smaller networks. To address this, the proposed project introduces a cost-effective IoT-based system using ESP32, sensors, relay modules, LCD, and GSM/GPS. It enables real-time monitoring of voltage, instant fault detection, automatic isolation of faulty lines, and sends location-based SMS alerts. A fire detection feature further enhances safety. This system improves reliability, reduces downtime, and offers an efficient solution for modern power distribution.

Objectives:

1. To detect power line faults such as line breakage, short circuits, and power loss in real time.
2. To automatically isolate faulty lines using relays to prevent accidents and equipment damage.
3. To display the exact faulty pole number on an LCD for quick identification.
4. To detect fire incidents using sensors and activate a siren alert.
5. To send instant SMS alerts with fault details and GPS location to authorities.

Methodology:

The system begins with the initialization of the ESP32 microcontroller, where all hardware components such as input lines from the poles, fire sensor, relay outputs, I2C LCD display, siren, GPS module, and GSM module are properly configured. The ESP32 continuously monitors the status of multiple power line inputs connected from different poles and identifies abnormal conditions such as line breakage, short circuits, or power loss based on the received signals. When a fault is detected, the system immediately identifies the corresponding pole and activates the respective relay to isolate the faulty line, preventing further damage and ensuring safety. At the same time, the LCD display shows real-time system status and fault messages, including the exact pole number for easy identification at the transformer site. The GPS module continuously updates the geographical coordinates of the system, which are used for fault reporting, while the GSM module sends instant SMS alerts to the concerned authorities with details such as fault type, pole number, and location coordinates. In addition to fault detection, a fire sensor monitors high-temperature or fire conditions near the power line or transformer, and when triggered, the ESP32 activates a siren through a transistor-based circuit to alert nearby people. All these operations, including line monitoring, fire detection, relay control, LCD updates, GPS tracking, and SMS transmission, run continuously in a loop, enabling real-time monitoring, quick response, efficient communication, and improved safety in power distribution systems.

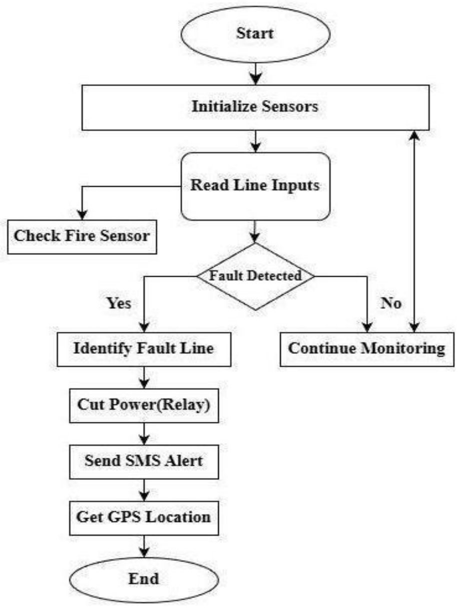

Fig 1: Flowchart of the Proposed Method

Result and Conclusion:

The developed system was tested under various fault conditions such as line breakage, short circuits, and power loss, and performed effectively. The ESP32 accurately detected faults, while the relay quickly isolated the affected line to ensure safety. The LCD displayed real-time fault details, including pole number, and the GSM module sent instant alerts with location information. The GPS provided accurate tracking, and the fire sensor successfully detected high temperatures and triggered alerts. Overall, the system demonstrated reliable, real-time performance and is suitable for both rural and urban power networks.

Fig 1: Implementation of the Proposed System

Project Outcome & Industry Relevance:
The proposed system offers an efficient and reliable solution for enhancing the safety of electrical distribution networks. It detects faults like line breakage, short circuits, and fire incidents in real time and isolates the faulty section automatically. The system provides accurate fault location through pole number display and sends instant alerts using GSM and GPS. It reduces downtime, minimizes manual effort, and improves safety. Its low-cost and scalable design makes it suitable for both rural and urban power distribution systems.

Working Model vs. Simulation/Study:
The project involves the development of a physical working model rather than a simulation or theoretical study. A hardware prototype was built using ESP32, relay modules, LCD display, GSM, GPS modules, and a fire sensor to demonstrate real-time power line fault detection and reporting. The system was tested under different fault conditions such as line breakage, short circuits, and fire detection to verify its performance. This practical implementation ensures real-time monitoring, automatic fault response, and effective communication, making the project a fully functional working model suitable for real-world applications.

Project Outcomes and Learnings:
The project successfully developed a system capable of identifying faults such as line breakage, short circuits, power loss, and fire incidents in real time. The system effectively isolates faulty lines using relays, displays the exact fault location on an LCD, and sends instant SMS alerts with GPS coordinates to the concerned authorities, thereby improving safety, reducing response time, and minimizing manual effort. Through the design and implementation of this project, valuable learning outcomes were achieved, including hands-on experience in embedded systems and ESP32 microcontroller programming, sensor integration, real-time data processing, and hardware-software interfacing. Knowledge of GSM and GPS communication technologies was gained, along with improved problem-solving skills, circuit design understanding, and the ability to troubleshoot and optimize system performance, contributing to both technical and practical learning.

References:

1. A. P. Shetty, A. K. N. S., A. S., A. S. M., and R. Sri, “Smart fault detection and real-time alert system with cloud integration for power distribution networks,” *International Research Journal*, vol. 12, 2025.
2. S. Shoukathali, A. M., M. Vasil, A. Ashok, and F. K., “IoT Based Automatic Fault Detection in Low Transmission Line,” *International Journal of Electrical Power System and Technology*, vol. 10, no. 1, pp. 8–13, Jun. 2024.
3. L. I. Barange, A. C. Ghode, S. A. Kalsarpe, S. B. Gaurkhede, and S. S. Madke, “IoT Based Transmission Line Fault Monitoring System,” *International Journal of Engineering and Creative Science*, vol. 7, no. 4, 2024, ISSN: 2581-6667.
4. A. S. Patil, K. D. Patil, A. S. Kamble, and A. M. Shelake, “Three phase transmission line fault detection over IoT,” *International Journal for Multidisciplinary Research*, vol. 6, 2024.

5. P. S. S. T. Pardhavi et al. “IoT-Driven Fault Detection System for Efficient Transmission Line Monitoring,” International Journal of Novel Research and Development (IJNRD), vol. 9, no. 5, pp. e100–e104, May 2024, ISSN: 2456-4184.

Future Scope:

1. Integration of lightning detection sensors for surge and thunder monitoring
2. Development of a mobile application for real-time alerts and remote control
3. Extension to support renewable energy sources like solar and wind
4. Cloud integration for data storage, analysis, and remote access
5. Use of machine learning for fault prediction and preventive maintenance
6. Scalability for large power grids and smart city applications
7. Upgradation of wireless communication for faster data transmission
8. Addition of sensors for temperature, humidity, and load monitoring
9. Implementation of automated dashboards for better visualization and decision-making