

# Real-Time Detection and Classification of Three-Phase Transmission Line Faults Using an IoT-Enabled Arduino and ESP32 Embedded System

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**Abstract:** *This paper presents the design and implementation of an embedded system for the detection and classification of faults in a three-phase transmission line. The proposed system uses an Arduino UNO microcontroller and ESP32 IoT module to detect four types of faults: line-to-line (L-L), line-to-ground (L-G), open-circuit, and over/under voltage. The system utilizes sensing circuits to monitor phase voltages and currents, with an LCD display for real-time fault information, a buzzer for audible alerts, and SMS notifications sent to a mobile device using the Twilio API. Additionally, the system incorporates a relay mechanism for phase isolation in case of voltage anomalies. Testing results indicate the system's accuracy in detecting faults, fast response time, and efficient alerting mechanism, making it a reliable and cost-effective solution for improving the safety and reliability of power transmission systems. The integration of IoT-based notifications enables remote monitoring, while the system's modularity allows for scalability in larger networks..*

**Keywords:** embedded system

