

Multiple Fault Detection & Analysis in Transmission Line Using IOT

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ABSTRACT

Transmission-line and cable faults can cause interruption of electrical supply, equipment damage, increased maintenance costs, and safety hazards. This paper presents an IoT-based multiple fault detection and localization system capable of continuously monitoring electrical and environmental parameters and identifying different fault conditions. The proposed system uses an Arduino Uno as the main controller and integrates a voltage sensor, ACS712 current sensor, DHT11 temperature and humidity sensor, GPS module, GSM module, LCD, and dedicated fault-detection circuits. The system identifies low-voltage conditions, high temperature, short circuits, line-to-line faults, line-to-ground faults, and cable faults simulated at 2 km and 4 km locations.

When a fault is detected, the controller determines the fault condition, displays the corresponding information on the LCD, obtains geographical coordinates through the GPS module, and sends an SMS notification using the GSM module. The message contains the fault information and location details for faster identification and maintenance. Experimental testing reported in the project demonstrates successful detection of the considered fault conditions and reliable transmission of location-based alerts.

Keywords— Transmission Line, Fault Detection, IoT, Arduino Uno, GSM, GPS, ACS712, DHT11, Fault Localization, Real-Time Monitoring.

INTRODUCTION

Transmission lines and cable networks are essential elements of modern electrical power systems, as they enable reliable transfer of electrical energy from generating stations to consumers. However, these networks are vulnerable to several abnormal conditions such as low voltage, short circuits, overloads, line-to-ground faults, line-to-line faults, and excessive temperature. Such faults can interrupt power supply, damage electrical equipment, increase maintenance costs, and create serious safety risks.

Therefore, early detection and accurate identification of faults are important for improving the reliability, safety, and operational efficiency of transmission and distribution systems.

The proposed Multiple Fault Detection and Analysis in Transmission Line Using IoT system provides continuous monitoring of important parameters such as voltage, current, temperature, and humidity. An Arduino Uno microcontroller processes the sensor data and compares the measured values with predefined threshold conditions to detect faults. When a fault is identified, the system uses a GSM module to send an SMS alert containing fault information, while the GPS module provides the geographical coordinates of the affected location. An LCD is also incorporated to display real-time parameters and fault status, thereby allowing operators to monitor the condition of the system and respond quickly to abnormal situations.

LITERATURE SURVEY

Several techniques have been investigated for detecting and locating faults in electrical transmission and cable systems. Singh *et al.* [1] proposed voltage- and current-based monitoring for identifying abnormal electrical conditions such as overloads and short circuits. Although the method is comparatively simple and cost-effective, it has limitations in accurately detecting line-to-line and line-to-ground faults and does not provide precise fault localization. Fazel *et al.* [2] investigated temperature-based fault monitoring using thermal sensing to identify overheating and cable degradation; however, this approach mainly addresses thermal abnormalities and may not effectively detect electrical faults. Zhao *et al.* [3] explored wireless sensor networks for continuously monitoring parameters such as voltage, temperature, and humidity at different locations. While this enables distributed real-time monitoring, communication reliability and additional infrastructure remain important challenges.

Mohana *et al.* [4] presented a hybrid fault-detection approach combining voltage, current, and temperature measurements with fuzzy-logic processing to identify multiple cable faults. Although the technique improves fault coverage, increased processing complexity can influence real-time performance. Bolaños *et al.* [5] investigated GPS-based fault localization to provide maintenance personnel with geographical information about detected faults, thereby reducing fault-location time. Kumar *et al.* [6] proposed an integrated real-time monitoring system combining voltage, current, and temperature sensing with automated SMS notifications. Furthermore, Chowdhury *et al.* [7] investigated smart-grid technologies for continuous monitoring, automated fault detection, isolation, and network reconfiguration. These studies demonstrate the importance of integrating multiple sensors, real-time processing, fault localization, and communication technologies for improving the reliability and response time of transmission-line fault detection systems.

PROBLEM STATEMENT

Traditional cable-fault identification techniques can depend on manual inspection and periodic checking, resulting in delayed detection and difficulty in locating faults across long transmission or distribution networks. An automated system is therefore required to continuously detect abnormal operating conditions, determine the fault category, provide local indication, and communicate the fault information and location to maintenance personnel.

OBJECTIVES

The major objectives are:

1. To develop a real-time multiple fault detection system capable of monitoring voltage, current, temperature, and cable conditions and detecting faults such as low voltage, short circuit, line-to-line, line-to-ground, and faults at predetermined cable locations.
2. To provide rapid fault localization and notification using GPS and GSM technology so that fault details, geographical coordinates, and location information can be transmitted to maintenance personnel.

PROPOSED SYSTEM

The proposed system is centered on an Arduino Uno microcontroller. The controller receives information from the voltage sensor, ACS712 current sensor, DHT11 temperature and humidity sensor, and dedicated digital inputs representing different cable fault conditions. The monitored fault conditions include faults at 2 km and 4 km, line-to-ground faults, line-to-line faults, short circuits, low voltage, and excessive temperature.

The GPS module provides geographical coordinates, while the GSM module communicates the detected fault information through SMS. An I2C LCD provides local visualization of temperature, humidity, voltage, current, and

fault status. The system is supplied through a step-down transformer and bridge rectifier arrangement that provides the required DC supply to the electronic components.

The block diagram presented on page 15 of the project report illustrates the integration of the Arduino Uno with the current sensor, voltage sensor, DHT11, LCD, GPS, GSM, and individual fault-detection inputs. The corresponding circuit diagram on page 19 provides the electrical interconnection of these modules.

BLOCK DIAGRAM

Fig. 1 shows the block diagram of the proposed multiple fault detection and analysis system, with the Arduino Uno acting as the central controller. It monitors voltage, current, temperature, and various transmission-line faults, while the GPS, GSM, and LCD modules provide fault localization, SMS alerts, and real-time status display.

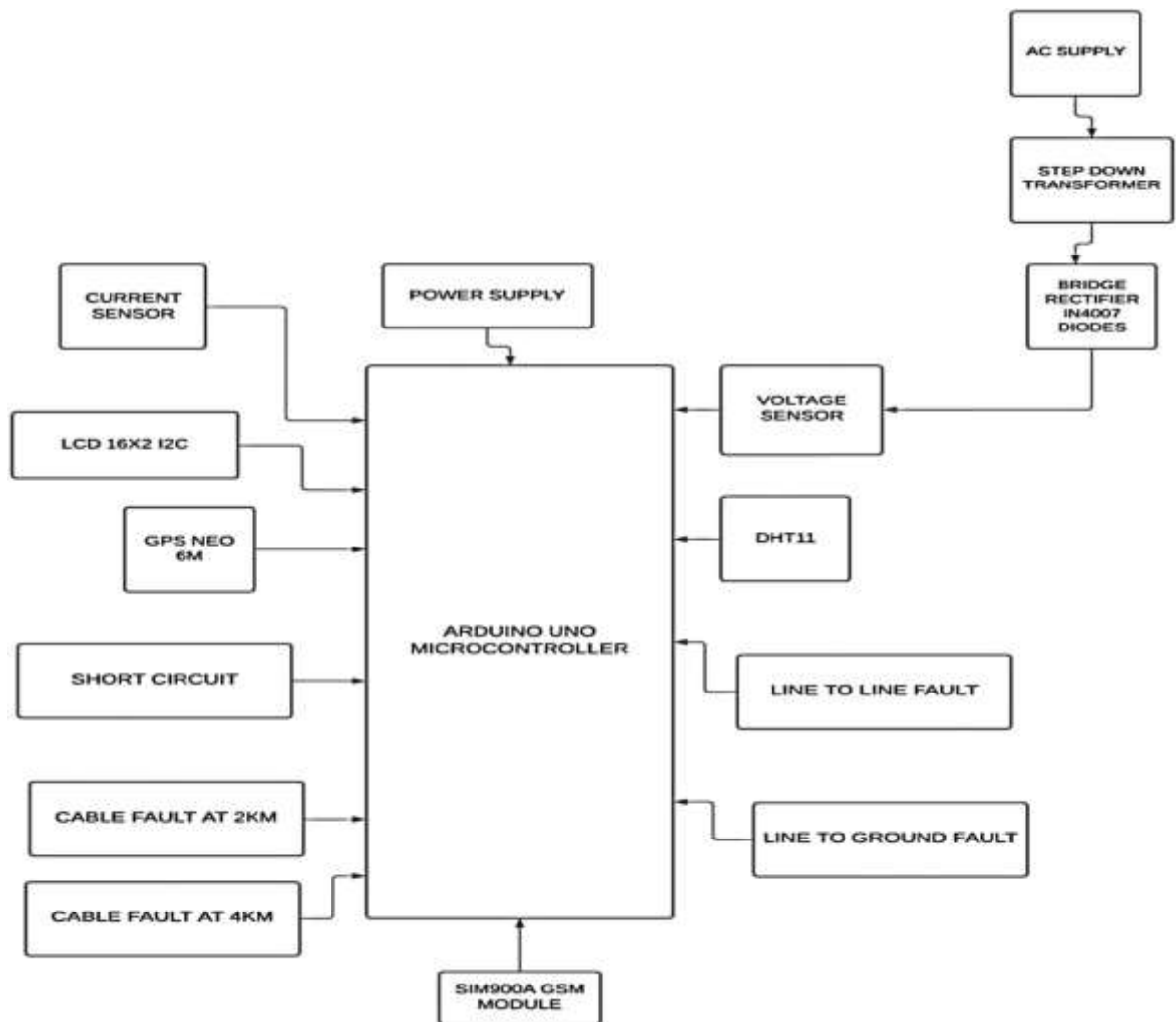


Fig 1 block diagram

CIRCUIT DIAGRAM

Fig. 2 shows the circuit diagram of the multiple fault detection system, where the Arduino Uno interfaces with voltage, current, DHT11, GPS, GSM, and buzzer modules. The circuit continuously monitors transmission-line conditions and generates local and remote alerts when faults are detected.

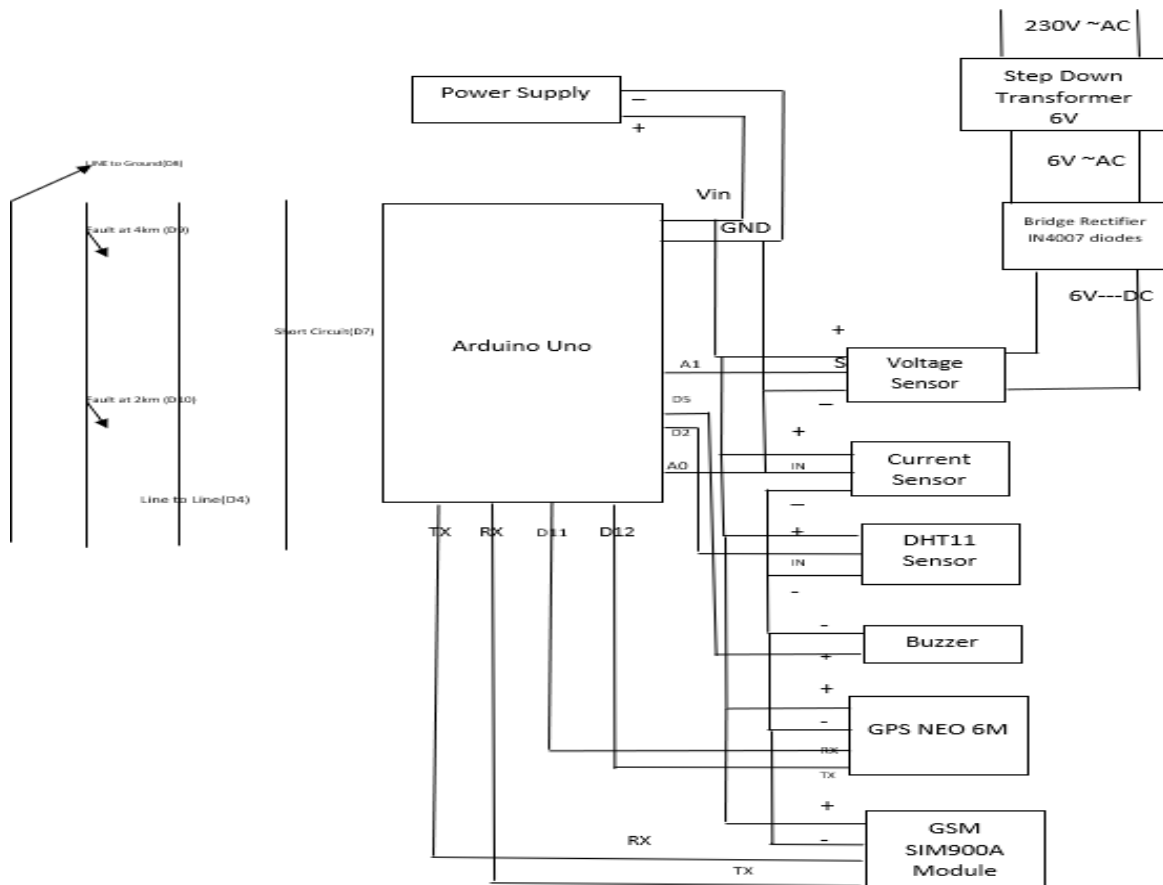


Fig 2 circuit diagram

METHODOLOGY

The system begins by initializing the Arduino Uno, sensors, LCD, GPS, GSM communication, and fault-detection inputs. The voltage sensor continuously monitors cable voltage, while the ACS712 measures current and the DHT11 monitors temperature and humidity. Sensor measurements are processed by the Arduino and compared with predefined thresholds.

The report specifies low-voltage detection below approximately 3.0 V and temperature-based fault indication when the measured temperature exceeds the specified threshold.

Digital fault inputs are continuously examined to identify cable faults at the simulated 2 km and 4 km points, line-to-ground faults, line-to-line faults, and short circuits. Once an abnormal condition is identified, the LCD displays the corresponding fault message. The GPS module obtains latitude and longitude information, after which the GSM module sends an SMS containing the fault type and geographical information. This process enables maintenance personnel to receive fault information remotely while simultaneously providing local fault indication.

RESULTS AND DISCUSSION

The developed prototype was tested by simulating different transmission-line and cable fault conditions. When the input voltage was intentionally reduced below 3.0 V, the system identified the low-voltage condition, displayed “**Low Voltage**” on the LCD, and generated an SMS containing location information. Similarly, faults introduced at the 2 km and 4 km test points produced the corresponding “**Fault at 2KM**” and “**Fault at 4KM**” indications and location-based GSM alerts.

Line-to-ground, line-to-line, and short-circuit conditions were also simulated during testing. The prototype successfully identified these conditions and provided the corresponding LCD and SMS notifications. Testing of the integrated system showed that the GSM and GPS modules could operate concurrently and that multiple fault conditions could be handled by the system. The report further states that SMS alerts were transmitted within approximately **3–4 seconds** after fault detection.

Overall, the experimental results indicate successful detection of low voltage, cable faults at 2 km and 4 km, line-to-ground faults, line-to-line faults, and short circuits. The LCD provided real-time information, while the GPS supplied location data for the GSM alert mechanism. The prototype also demonstrated satisfactory response and stability under the tested operating conditions.

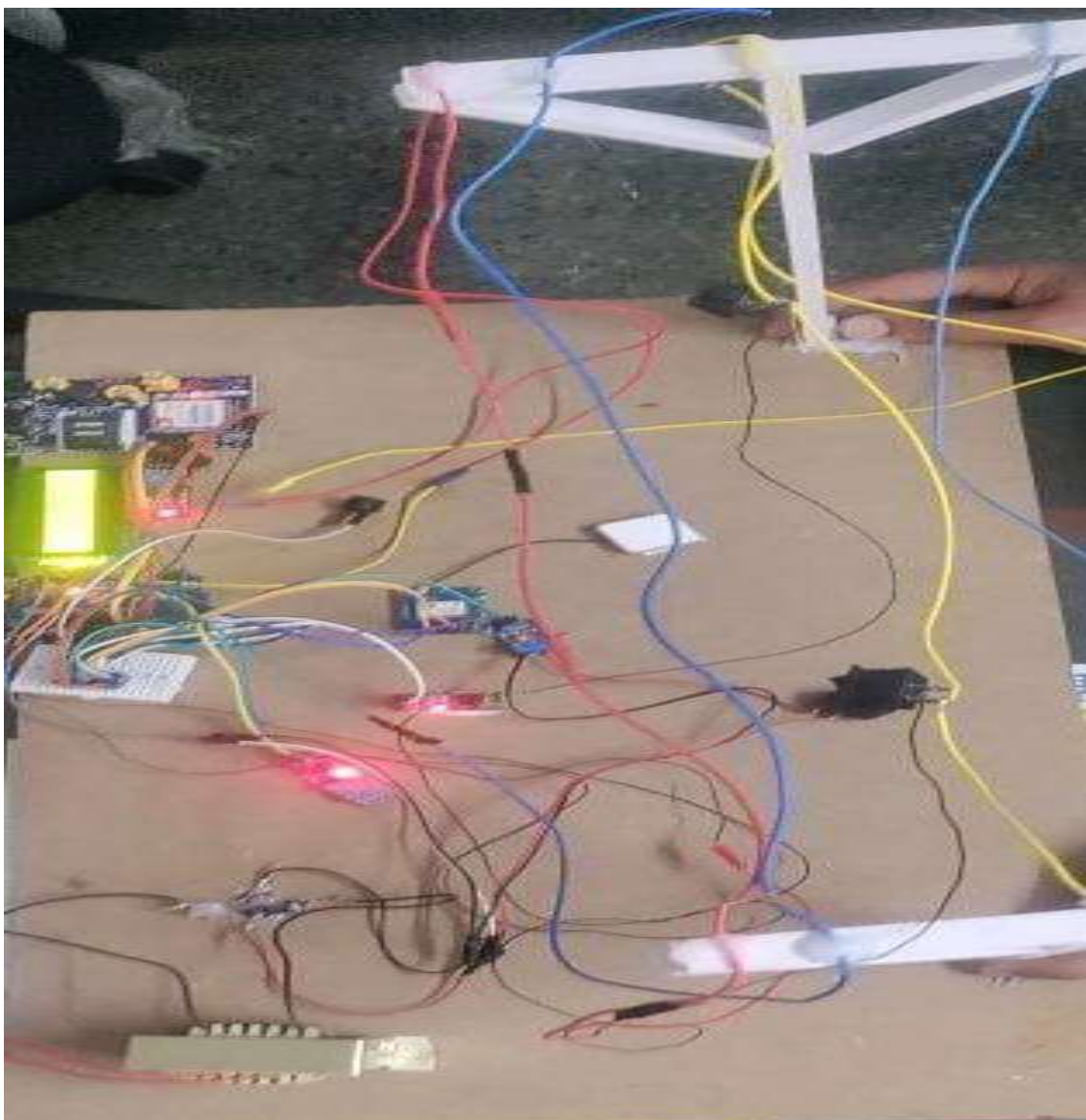


Fig 3 hardware setup

CONCLUSION

An IoT-based multiple fault detection and localization system has been developed using an Arduino Uno and multiple sensing and communication modules. The system continuously monitors voltage, current, temperature, humidity, and dedicated cable fault inputs to identify low-voltage conditions, temperature abnormalities, short circuits, line-to-line faults, line-to-ground faults, and faults at predefined cable distances. GPS and GSM integration enables fault information and location details to be communicated to maintenance personnel, while the LCD provides real-time local monitoring.

The developed prototype demonstrates a practical and cost-effective approach for improving fault identification and reducing the time required to locate abnormalities in electrical cable networks. According to the project results, the system successfully detected the tested fault conditions and provided corresponding alerts. Future development can incorporate mobile-based remote monitoring and more advanced fault-detection algorithms to improve scalability and reliability.

REFERENCES

- [1] A. Bhatti and M. A. Abide, "Fault Detection in Three-Phase Systems Using Wavelet Transform and Neural Networks," *IEEE Transactions on Power Delivery*, 2007.
- [2] V. Govindarajan, "Arduino Based Three-Phase Fault Detection and Protection System," *IEEE International Conference on Electrical, Electronics, and Optimization Techniques (ICEEOT)*, 2016.
- [3] M. H. Osman, "Fault Detection in Three-Phase Induction Motors Using Arduino and Sensors," *Journal of Telecommunication, Electronic and Computer Engineering (JTEC)*, Nov. 2018.
- [4] J. M. Santiago-Perez et al., "A Low-Cost Arduino-Based Three-Phase Multi-Fault Detection System Using Blynk," *Sensors*, 201