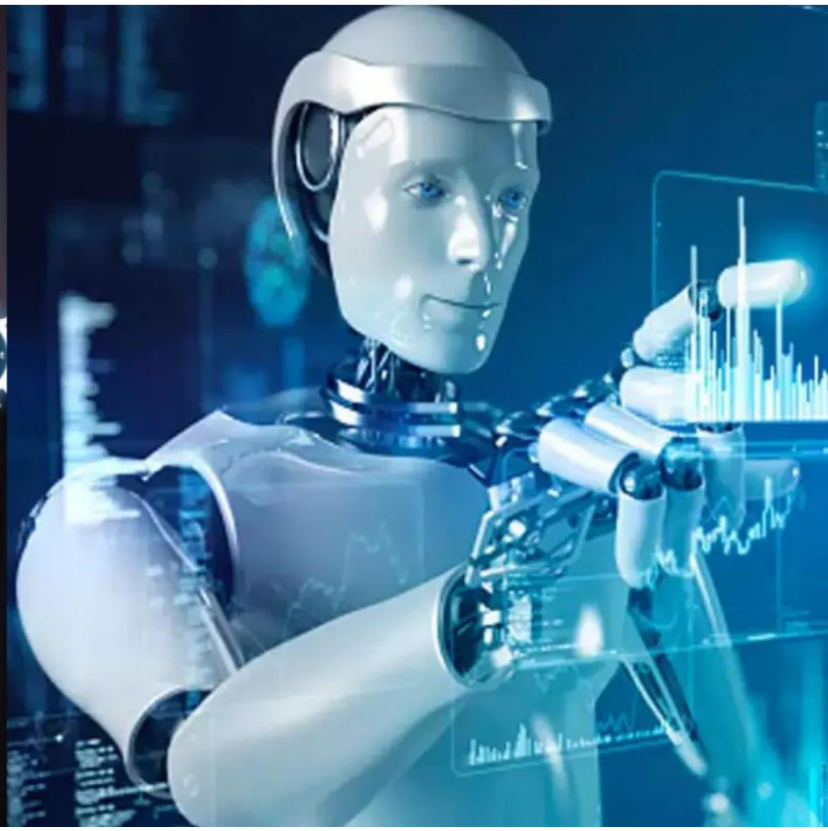
IJIRSET
International Journal of Innovative Research in Science | Engineering | Technology

ISSN(O): 2319-8753
ISSN(P): 2347-6710

International Journal of Innovative Research in Science Engineering and Technology (IJIRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)



Impact Factor: 9.935

Volume 15, Issue 5, May 2026

International Journal of Innovative Research of Science, Engineering and Technology (IJIRSET)

Impact Factor 9.935

|www.ijirset.com |A Monthly, Peer Reviewed & Refereed Journal| e-ISSN: 2319-8753| p-ISSN: 2347-6710|

Volume 15, Issue 5, May 2026

|DOI: 10.15680/IJIRSET.2026.1505111|

IoT-Based Smart Electrical Leakage Detection and Automated Alert System for Power Distribution Safety

Heema Julie Raj . J, Angayarkanni. M, Ms. D. Beaulah Princiba, M.E.,

Dr. J. V. Libija, M.Sc., M.Phil., B.E., Ph.D

Department of ECE, St. Joseph's College of Engineering, Chennai, India

Department of ECE, St. Joseph's College of Engineering, Chennai, India

Assistant Professor, Dept of ECE, St. Joseph's College of Engineering, Chennai, India

Assistant Professor, Dept of Physics, Rani Anna Government College for Women, Tirunelveli, India

ABSTRACT: Power distribution systems can suffer electrical leakage or transmission failures which can cause electric shock, fire, damage to equipment and even power failure. Conventional protections will not continuously monitor in real time and rapidly detect faults. To tackle this, the paper introduces the concept of IoT-based Smart Electrical Leakage Detection and Automated Alert System with voltage sensors and current sensors, ESP32 microcontroller, relay modules and cloud communication. All electrical parameters are checked continuously, and abnormal conditions, such as leakage currents, voltage drops and wire-cut conditions are detected. The results of the experiments showed the ability of the system to detect changes in voltage from 230V to 90V, and leakage currents up to 3.0A with an average relay response time of less than 2 seconds. The fault response efficiency and electrical safety were enhanced thanks to automated siren alerts, relay-based power shutdown and IoT notifications, which made the system suitable for smart grid and industrial monitoring applications.

KEYWORDS: ESP32, Electrical Leakage Detection, Smart Grid, Fault Monitoring, Automated Alert System, IoT.

I. INTRODUCTION

Power distribution systems are getting more complicated due to the rapid growth of urbanization and industrialization [1]. These shortcomings can contribute to electric shock, fire, equipment damage and power outages. Thus, ensuring safety and reliability of electrical networks is important and a challenge in a modern power system. The issue of electrical leakage in power distribution systems is one of the most pressing safety concerns as it can go undiscovered until major accidents can occur [2]. Traditional protection methods like fuses and circuit breakers, only offer partial fault protection and cannot detect low-level leakage currents in real-time. Also, manual inspection takes time and is ineffective for large-scale transmission networks. The delay in fault detection drives up maintenance expenses and poses hazards to the public [3]. Due to the recent development of embedded systems and the Internet of Things (IoT) technologies, intelligent monitoring systems have been developed. With IoT systems, voltage and current levels can be measured continuously, data can be analyzed in real time, and information can be transmitted remotely via wireless communications [4]. The use of these technologies increases the efficiency, reliability and responsiveness of electrical monitoring systems, while decreasing human intervention. The current research introduces an IOT based smart electrical leakage detection and automated alert system to monitor electrical parameters in the transformer node [5]. It is a system that detects abnormal conditions like leakage currents, voltage drops and wire cut conditions using voltage and current sensors and an ESP32 microcontroller. Once the fault is identified, the system will trigger the sirens to warn people, automatically shut down the power via a relay module, and inform the maintenance party with IoT communication [6].

The objective of the proposed system is to increase the electrical safety, reduce response time and facilitate future smart grid applications by enabling an intelligent and scalable monitoring system [7]. This capability of the system to watch, detect fault automatically and communication from remote location makes it a strong solution which will help in reducing electrical hazards and help to increase the efficiency of the power distribution system [8].

International Journal of Innovative Research of Science, Engineering and Technology (IJIRSET)

Impact Factor 9.935

|www.ijirset.com |A Monthly, Peer Reviewed & Refereed Journal| e-ISSN: 2319-8753| p-ISSN: 2347-6710|

Volume 15, Issue 5, May 2026

|DOI: 10.15680/IJIRSET.2026.1505111|

A. Key Contributions

- Designed an electrical leakage and fault detection system using IoT for real-time detection.
- Wrote code to connect sensors to ESP32 and monitor the voltage and current continuously.
- Implemented automated safety systems, such as siren alarms and power off relays.
- Allow remote notification and monitoring of faults for quick service action.

The rest of this paper is organized as follows: In Section II, the literature survey is provided related to electrical leakage detection system, IoT based monitoring and automatic safety mechanism. In Section III, the proposed methodology, system architecture, sensing modules, processing unit and fault detection process will be explained. The implementation details, experimental setup and performance analysis of the proposed system is discussed in Section IV. Section V brings the paper to a close and suggests further possible enhancements to the system to make it more efficient and scalable.

II. LITERATURE REVIEW

The paper focused on the problem of late detection of gas leakage in the conventional gas detection system. The authors suggested an IoT based monitoring system which alerts users with mobile SMS, email and phone call with sensor data. The system enabled better monitoring and forecasting of hazards at a distance. But, it was applicable only for Gas leakages and not usable for electrical fault detection [9].

This study was aimed at hazards associated with leakage of industrial gases and absence of automation of safety systems. The solution proposed in the IoT was to have ultrasonic sensor, GSM module, and cloud communication to detect leakage and send alerts. Automatic gas shutdown was also put in place. One problem with the work was it was focussed on monitoring of gases and not electrical distribution systems [10].

The authors talked about limitations in the existing ELCB systems for leakage current detection. They suggested the leakage detection system based on ESP8266 Wi-Fi module and CT which detects the leakage in electrical wiring and provides the alarm for leakage over the internet. System gave warnings and automatic power off at fault. This system, however, was unable to support fault localization or large scale network monitoring [11].

This paper concentrated on the current leakage from electric poles as it may lead to electric shocks in public places. The IoT based system proposed in this work was designed to detect the leakage and human presence around the poles by using voltage sensors, current sensors and ultrasonic sensors. In the event of a fault, warning systems were triggered, such as buzzers and visual displays. One limitation was the system was only designed for electric pole monitoring [12].

This study focused on the issues of LPG leakage and fire accidents in domestic households. The authors suggested the rule-based detection system, which utilizes gas sensors, flame sensors, SMS alerts, and alarm systems. The system worked well in terms of early detection and notifications for enhancing safety. It did not have an IoT cloud integration and scalability with larger applications [13].

This paper reviewed different leak detection techniques used in water distribution systems. The study involved a discussion of smart sensors, automated monitoring and real-time data analysis techniques to improve the efficiency of leak detection. The review provided informative information, but was mainly focused on water leak detection systems and didn't have any practical electrical fault detection models [14].

The study focused on leakage current problems of EV charging stations. The authors proposed a novel improved accuracy and temperature-stable smart fluxgate based current leakage sensor.A smart fluxgate based current leakage sensor with improved accuracy and temperature stability has been proposed by the authors. Performance of sensing was improved using simulation and modeling technologies. However, most of the work were directed towards the design of the sensor itself, and not much was mentioned regarding IoT based alert systems and automatic fault management systems [15].

International Journal of Innovative Research of Science, Engineering and Technology (IJIRSET)

Impact Factor 9.935

|www.ijirset.com |A Monthly, Peer Reviewed & Refereed Journal| e-ISSN: 2319-8753| p-ISSN: 2347-6710|

Volume 15, Issue 5, May 2026

|DOI: 10.15680/IJIRSET.2026.1505111|

B. Research Gap

Majority of the systems are configured to perform a specific function like gas leakage monitoring or water leakage monitoring or safety monitoring for EV charging, and very few systems are able to provide a holistic monitoring of the power distribution systems. There are many ways to detect leakage currents, but they cannot detect other types of faults, such as wire cuts or voltage drops or failures in communications. Furthermore, there are several systems which do not provide IoT remote monitoring, automatic power off and alert features. Most traditional approaches are manual methods, which will cause longer response time and reduced efficiency.

III. METHODOLOGY

The proposed system, Smart Electrical Leakage Detection and Alert System, will continuously monitor the electrical parameters in power distribution networks, and will communicate directly with the action when abnormal conditions are detected. Incorporating voltage and current sensors, ESP32 microcontroller units, IoT communication interfaces, relay modules, and alert systems, the system ensures seamless fault detection and enhanced electrical safety. The entire system architecture consists of five major modules namely Input Module, Data Processing Module, IoT Communication Module, Fault Detection and Control Module and Output Alert Module.

System Architecture

The system architecture proposed includes two coupled ESP32 hubs coupled with sensing, processing, cloud communication and safety control modules. The voltage and current sensors are placed at some points of the transmission lines of the transformer, and data is sent to Hub-1. The information gathered is processed and sent to Hub-2 via wireless.

Hub-2 verifies faults and regulates output modules like siren alerts, relay-controlled power shutoff, and notification transmission. Both hubs relay data to the cloud platform for data storage and continual monitoring.

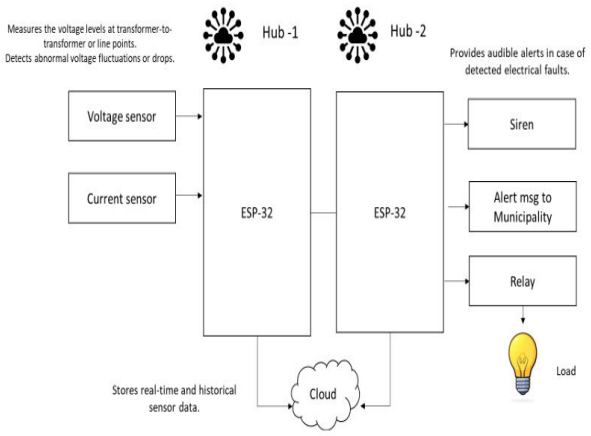


Fig. 1. System Block Diagram

Architecture in figure 1 enables continuous monitoring and quick fault isolation. The architecture is scalable and can be easily extended with extra sensor nodes and processing hubs, suitable for large scale smart grid and industrial applications.

Input Sensing Module

The input sensing module is used for the collection of real-time electrical parameters of transmission lines. The suggested system has voltage sensors and current sensors placed between the transmission points of the transformer to continuously observe the voltage level and current flow. These sensors detect any fault in the voltage, leakage current and transmission failure. The voltage sensor detects the voltage difference between the two parts of the transmission line and the current sensor measures the current flowing through the conductor. Sensed analog values are converted to digital then sent to ESP32 controller for further processing.

International Journal of Innovative Research of Science, Engineering and Technology (IJIRSET)

Impact Factor 9.935

|www.ijirset.com |A Monthly, Peer Reviewed & Refereed Journal| e-ISSN: 2319-8753| p-ISSN: 2347-6710|

Volume 15, Issue 5, May 2026

|DOI: 10.15680/IJIRSET.2026.1505111|

The voltage monitoring equation is given as:

$$V = IR \qquad (1)$$

where:

- V= Voltage
- I= Current
- R= Resistance

Leakage current is detected in equation 1, if current measured under normal operation conditions is greater than the specified value.

The sensing module is always active and always monitoring, allowing for continuous monitoring and early detection of any faults.

C. Data Processing Module

The ESP32 microcontroller is used as the core of the system. It is responsible for receiving digital sensor data from several sensing nodes and then comparing the received data with the predetermined threshold limits in its memory. The ESP32 is chosen for its powerful processing power, its ability to communicate efficiently, its low power consumption, its Wi-Fi connectivity, and its high processing speed.

The controller continuously analyzes the electrical parameters in real time to decide if the electrical parameters are operated within safe limits or not. If they are sensed within the threshold range, the monitoring process goes on normally. If something goes wrong, such as abnormal voltage drop, leakage current or missing communication signals are detected, the system detects the condition as a fault.

The threshold comparison condition is expressed as in equation 2:

$$I_{measured} > I_{threshold} \qquad (2)$$

where:

- $I_{measured}$= Measured current value
- $I_{threshold}$= Safe operating current limit

If the current is higher than the set value, the controller starts the fault response mechanism.

D. IoT Communication Module

The IoT communication module enables remote monitoring and real-time data transmission between the sensor hubs and cloud platform. Using the inbuilt Wi-Fi capability, the ESP32 microcontroller sends sensor data and fault data to the cloud database. This enables electrical parameters to be monitored at a remote location from the maintenance authority or monitoring center. Realtime sensor data and historical sensor data is stored on the cloud platform for analysis and future maintenance. Inter Hub-1 to Hub-2 communications provides reliable data transfer and the ability to detect communication issues or wire cuts in the data transmission network. Communication enhances the scalability of the system and facilitates its integration with future smart grid and smart city infrastructure.

E. Fault Detection and Control Module

The Fault Detection and Control Module keeps track of the voltage and current readings gathered from the sensors and detects any abnormal conditions in the electrical system. Then the ESP32 microcontroller performs fault detection by comparing the measured data with the set threshold values, including voltage drop, leakage current, wire cut and communication failure. Any electrical parameter variation that is outside of the normal range will be deemed to be a possible fault.

A monitoring relationship on electrical power is:

$$P = VI \qquad (3)$$

International Journal of Innovative Research of Science, Engineering and Technology (IJIRSET)

Impact Factor 9.935

|www.ijirset.com |A Monthly, Peer Reviewed & Refereed Journal| e-ISSN: 2319-8753| p-ISSN: 2347-6710|

Volume 15, Issue 5, May 2026

|DOI: 10.15680/IJIRSET.2026.1505111|

where:

- P= Electrical Power
- V= Voltage
- I= Current

In the equation 3,when the voltage drops abnormally or when the leakage current is exceeding the safe level, the system will detect it as an unsafe condition. When a fault is found, the ESP32 controller immediately triggers the control mechanism to correct the fault. The relay module automatically cuts off the power to avoid electric shock, fire and equipment damage. While this, the siren gives an audible warning and IoT notifications are sent to the maintenance authorities for quick response. The continuous monitoring and automatic control process increases the safety of the system, reaction time and reliability of electrical distribution network.

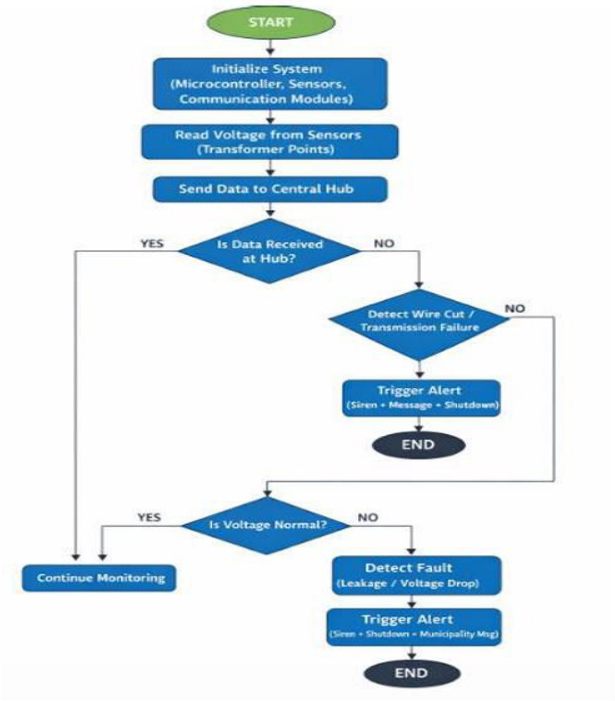


Fig. 2. Flowchart of the Proposed System

This flowchart in figure 2 shows the working of the Smart Electrical Leakage Detection and Alert System. The system starts by configuring the sensors, microcontroller and communication modules and then constantly polls the transmission points for voltage readings. The gathered data then is passed to the central hub for analysis. When no data is received, the system will recognize a wire cut or transmission error and alert. In case of abnormal voltage, voltage leakage and voltage fault are detected and siren alarm, relay shutdown and notification messages are triggered. Normally, the system runs continuously to monitor.

Output Alert Module

The output warning module is used to generate warning signals in the event of a fault and to take protective measures. The module is composed of a siren, relay unit and an IoT notification system. The siren emits a warning sound when electric leakage or unusual voltage is detected to warn surrounding people. At the same time, the relay module switches off the electric power to protect the safe operation of the circuit and avoid accidents. The IoT communication system provides alert notifications to the maintenance authorities and it contains all fault information, which immediately informs the maintenance authorities. Audible alerts, automatic shutdown and remote notification all play a role in enhancing electrical safety and reducing the response time in hazardous conditions.

International Journal of Innovative Research of Science, Engineering and Technology (IJIRSET)

Impact Factor 9.935

|www.ijirset.com |A Monthly, Peer Reviewed & Refereed Journal| e-ISSN: 2319-8753| p-ISSN: 2347-6710|

Volume 15, Issue 5, May 2026

|DOI: 10.15680/IJIRSET.2026.1505111|

IV. RESULTS AND DISCUSSION

The performance analysis and experimental testing of the proposed Smart Electrical Leakage Detection and Alert System is presented. The system was tested in various fault conditions including voltage drop, leakage current and wire cut to ensure its accuracy and reliability. The findings show the capability of the system to monitor the electrical parameters continuously, identify the abnormal conditions and trigger the automatic safety systems like sirens, power shut down using relays and notifications through IoT. The effectiveness, response time and overall performance of the proposed system to enhance electrical safety and fault management is also analyzed.

Experimental Setup

A prototype model for the electrical power distribution system was used for the testing of the proposed Smart Electrical Leakage Detection and Alert System, which was composed of voltage sensor, current sensor, ESP32 microcontroller, relay module, siren alert module and IoT communication module. The sensors were placed in various transmission points where voltage and current values are monitored in real time. The ESP32 controller read the sensor data and perform a comparison with a set of pre-defined threshold conditions to determine if there was abnormal electrical conditions. Simulated fault scenarios, including voltage drops, leakage currents, and wire cuts were created to test the system's performance. In the fault situation, the system was able to correctly identify the failure and trigger the relay module, alarm and IOt notification module. The experimental results verified the proposed system to give quick response, fault detection and enhanced electrical safety.

TABLE.I EXPERIMENTAL OBSERVATION TABLE

Test Condition	Voltage (V)	Current (A)	System Response
Normal Condition	230	0.8	Continuous Monitoring
Voltage Drop	170	1.1	Alert Generated
Leakage Current	120	2.5	Relay Shutdown Activated
Wire Cut Condition	0	0	Notification Sent
Severe Fault Condition	90	3.0	Siren + Power Cutoff

The results in table I indicate that the system is capable of detecting abnormal electrical conditions and automatically taking action accordingly.

A. Voltage Monitoring Results

The voltage monitoring module was tested to check the capability of the proposed system to monitor voltage levels continuously with varying operating conditions. The ESP32 controller was used to measure the actual voltage readings from the transmission line, with the voltage sensor connected to it. In normal operation, the measured voltage values were within the safe range of values set and no interruption of the monitoring function took place. To assess the fault detecting ability, various abnormal conditions like voltage sag and unstable transmission conditions were deliberately introduced into the system. The ESP32 controller was able to detect the abnormal condition and trigger the fault detection mechanism correctly when the voltage level went below the safe operating range. The system generated warning alerts and triggered relay-based power shutdown depending on the severity of the voltage drop, to avoid any electrical hazard or equipment damage.

International Journal of Innovative Research of Science, Engineering and Technology (IJIRSET)

Impact Factor 9.935

|www.ijirset.com |A Monthly, Peer Reviewed & Refereed Journal| e-ISSN: 2319-8753| p-ISSN: 2347-6710|

Volume 15, Issue 5, May 2026

|DOI: 10.15680/IJIRSET.2026.1505111|

TABLE.II VOLTAGE MONITORING RESULTS

Condition	Measured Voltage	System Status
Normal Condition	230V	Safe Monitoring
Moderate Voltage Drop	170V	Fault Detected
Severe Voltage Drop	120V	Alert Activated
Critical Voltage Failure	90V	Relay Shutdown
Transmission Failure	0V	Notification Sent

It was found from the experimental results in table II, that the voltage monitoring system is able to detect the moderate and severe voltage variations and it is correct in real time. The quick response of controller allowed for the improved system reliability and allowed for fast action during fault conditions.

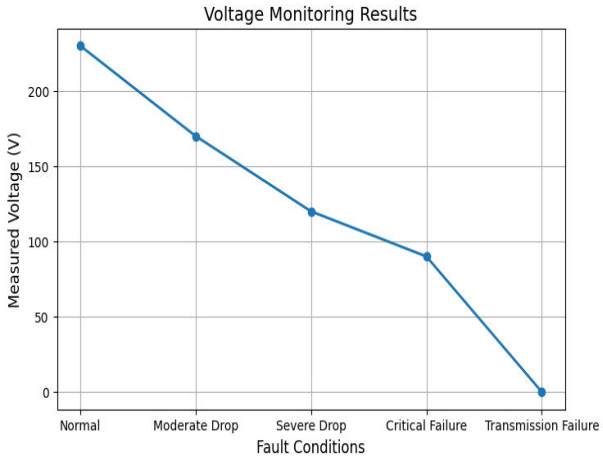


Fig. 3. Voltage Monitoring Performance

The results in figure 3, illustrate that the realized system is able to monitor the voltage level and will react immediately if abnormal voltage conditions are observed.

B. Leakage Current Detection

The leakage current detection module was tested to check the capability of the proposed system to detect abnormal current leakage under various fault conditions. The current sensor was installed to continuously measure the current flow in the transmission line and the measured current value was passed to the ESP32 controller for analysis. Under normal operating conditions, a current lower than the set safe level was measured and the system continued with the normal monitoring routine without triggering any alarms. The fault detection capability was tested by introducing different leakage conditions in the system artificially. Once the measured current is above the threshold value, the ESP32 controller is able to detect the condition to be an electrical leakage. When the leakage is small, the system produced warning alerts to alert abnormal current flow. The relay module automatically isolated the power supply and avoided electric shocks, fire and damage of the equipment during major leakage.

International Journal of Innovative Research of Science, Engineering and Technology (IJIRSET)

Impact Factor 9.935

|www.ijirset.com |A Monthly, Peer Reviewed & Refereed Journal| e-ISSN: 2319-8753| p-ISSN: 2347-6710|

Volume 15, Issue 5, May 2026

|DOI: 10.15680/IJIRSET.2026.1505111|

TABLE.III LEAKAGE CURRENT DETECTION RESULTS

Condition	Leakage Current	System Response
Normal Condition	0.5A	Continuous Monitoring
Minor Leakage	1.2A	Warning Alert Generated
Moderate Leakage	1.8A	Fault Detected
Major Leakage	2.5A	Relay Shutdown Activated
Severe Leakage	3.0A	Siren + Power Cutoff

The experimental test results in table III proved the real-time leakage current detection capability and fast response to abnormal situations.

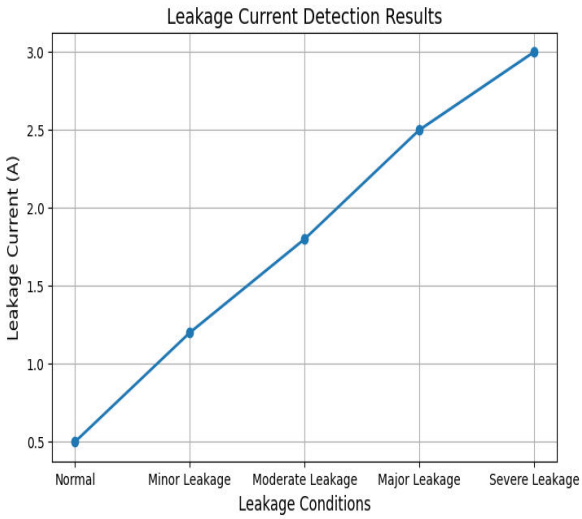


Fig. 4. Leakage Current Detection Performance

The rapid detection in figure 4, and automatic control system greatly enhanced safety and reliability of the electrical distribution system. The obtained results have proved the effectiveness of the proposed system in detection of variations in leakage current and taking protective actions in hazardous electrical situations.

C. Alert and Relay Operation

To check the capability of the proposed system during abnormally electrical conditions, the Alert and Relay Operation Module was tested. The alarm function was immediately activated when the ESP32 controller detected faults like drop in voltage, leakage current or wire-cut situation. The siren produced audible warning signals to alert people around the area to the dangerous situation, while the relay module automatically turned off the power to isolate the bad section and prevent electrical accidents. The relay module proved its fast switching during tests and was able to switch off the supply in an extremely short time period after fault detection. The average response time of the relay system was measured to be less than 2 seconds, which means a fast fault isolation and better electrical security. At the same time, IoT notification messages with fault information are delivered to the monitoring authorities and the action for maintenance is taken accordingly.

International Journal of Innovative Research of Science, Engineering and Technology (IJIRSET)

Impact Factor 9.935

|www.ijirset.com |A Monthly, Peer Reviewed & Refereed Journal| e-ISSN: 2319-8753| p-ISSN: 2347-6710|

Volume 15, Issue 5, May 2026

|DOI: 10.15680/IJIRSET.2026.1505111|

TABLE IV ALERT AND RELAY OPERATION RESULTS

Fault Condition	Siren Status	Relay Action	Response Time	IoT Notification
Voltage Drop	Activated	Power Cutoff	1.8 sec	Sent
Leakage Current	Activated	Relay OFF	1.5 sec	Sent
Wire Cut Condition	Activated	Power Shutdown	1.9 sec	Sent
Severe Fault	Activated	Immediate Cutoff	1.2 sec	Sent
Normal Condition	OFF	Monitoring	--	Not Required

The experimental results in table IV have been validated that the proposed system yields a rapid warning generation, accurate relay function and effective remote warning during fault condition. The inclusion of automatic warning and shutoff will greatly enhance the safety and reliability of the electrical distribution network.

D. IoT Communication Performance

The IoT communication module was tested to check the real time communication of the proposed Smart Electrical Leakage Detection and Alert System. The voltage and current sensor data was successfully sent from Hub-1 to Hub-2 and uploaded to the cloud platform regularly by the ESP32 microcontroller. Communication process was stable during normal operating conditions and electrical parameters could be monitored without any interruption. The cloud platform contained real-time and historical sensor data that can be leveraged for future monitoring, maintenance analysis and fault tracking. When an alert is triggered by a fault, the ESP32 module sent wireless alerts to monitoring authorities as soon as they were generated. The system also checked the availability of communication links between the transmission hubs.

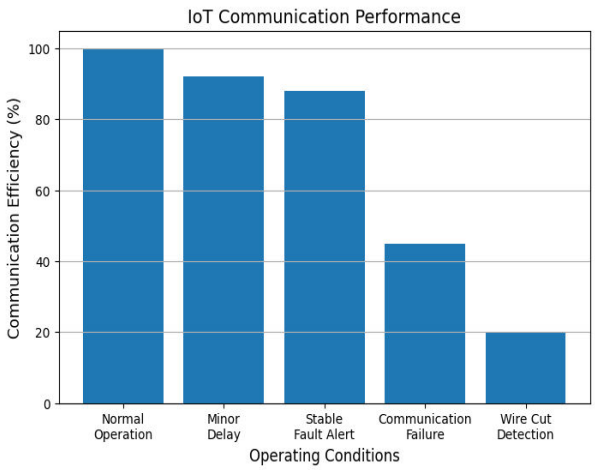


Fig. 5. IoT Communication Performance

Experimental testing in figure 5 demonstrated good communication performance with negligible delay in communication. The capability and reliability of the proposed architecture was enhanced by successful detection of communication interruptions which contributed to the overall fault management capability. The inclusion of the IoT integration was also a plus for the remote access, thus making the system suitable for smart grid and smart city applications.

E. Discussion

The experimental test results demonstrate the ability of the proposed system to achieve a high reliability of electrical distribution network real-time monitoring and efficient fault detection. This integration of voltage sensors, current sensors, ESP32 controllers, and IoT communication increased the accuracy and rapid response in identifying faults. The automated siren system and power down relay system resulted in greater electrical safety, preventing the possibility of electric shocks and fire.System has found to be efficient in identifying the voltage drop, leakage current, communication

failure in different test scenario. Furthermore, the proposed architecture of IoT system is scalable, making it suitable to be applied in smart grid and smart city applications. However, in a real deployment with a large number of sensors, there are some variations in the performance of the system, which may be caused by the inaccuracy of the sensors' calibration, environmental disturbances and communication delay.

F. CONCLUSION

The implemented Smart Electrical Leakage Detection and Automated Alert System was able to detect the voltage and current in real time and also it could detect the fault condition such as leakage current, voltage drop, wire-cut, etc., which was found accurate. ESP32 controller, sensor, relay module and integration of IoT communication increased the speed of fault detection, automated safety response and remote monitoring. Experimental results showed good system performance, rapid generation of alerts and automatic shutdown of the power supply when hazardous conditions are present. The proposed design is scalable which can be used in smart grid and industrial safety applications. When deployed on a large scale, however, the delay of the communication, the error of calibration of sensors, or the interference of the environment, can affect the system's performance. To improve the accuracy of fault prediction, monitoring capabilities, and smart grid reliability, the integration of artificial intelligence, cloud analytics, and GPS-based fault localization systems could be part of the future.

REFERENCES

[1] M. I. Henderson, D. Novosel, and M. L. Crow, “Electric power grid modernization trends, challenges, and opportunities,” IEEE Power Energy, 2017.
[2] J. De La Ree, Y. Liu, L. Mili, A. G. Phadke, and L. Dasilva, “Catastrophic failures in power systems: causes, analyses, and countermeasures,” Proc. IEEE, vol. 93, no. 5, pp. 956–964, 2005.
[3] E. U. Weber, “Experience-based and description-based perceptions of long-term risk: Why global warming does not scare us (yet),” Clim. Change, vol. 77, no. 1, pp. 103–120, 2006.
[4] N. Kayastha, D. Niyato, E. Hossain, and Z. Han, “Smart grid sensor data collection, communication, and networking: a tutorial,” Wirel. Commun. Mob. Comput., vol. 14, no. 11, pp. 1055–1087, 2014.
[5] A. K. Al Mhdawi and H. S. Al-Raweshidy, “A smart optimization of fault diagnosis in electrical grid using distributed software-defined IoT system,” IEEE Syst. J., vol. 14, no. 2, pp. 2780–2790, 2019.
[6] A. Railean, “FAULT-TOLERANT, REAL-TIME, SECURE NOTIFICATION SYSTEM,” Accessed Jan, vol. 6, 2025.
[7] M. E. El-Hawary, “The smart grid—state-of-the-art and future trends,” Electr. Power Compon. Syst., vol. 42, no. 3–4, pp. 239–250, 2014.
[8] A. K. Al Mhdawi and H. S. Al-Raweshidy, “A smart optimization of fault diagnosis in electrical grid using distributed software-defined IoT system,” IEEE Syst. J., vol. 14, no. 2, pp. 2780–2790, 2019.
[9] A. Varma, S. Prabhakar, and K. Jayavel, “Gas leakage detection and smart alerting and prediction using IoT,” in 2017 2nd International Conference on Computing and Communications Technologies (ICCCT), IEEE, 2017, pp. 327–333.
[10] G. Senthil, P. Suganthi, R. Prabha, M. Madhumathi, S. Prabhu, and S. Sridevi, “An enhanced smart intelligent detecting and alerting system for industrial gas leakage using IoT in sensor network,” in 2023 5th International Conference on Smart Systems and Inventive Technology (ICSSIT), IEEE, 2023, pp. 397–401.
[11] M. R. Islam, S. Azam, B. Shanmugam, and D. Mathur, “An intelligent IoT and ML-based water leakage detection system,” IEEE Access, vol. 11, pp. 123625–123649, 2023.
[12] P. Sokolowski, “Developing a smart monitoring system for leakage currents from insulators on wooden poles,” PhD Thesis, RMIT University, 2024.
[13] J. Ayeni and S. Akinola, “IoT-Based Gas and Smoke Detection System using Blynk application with Automatic SMS and Alarm Notifications,” Univ. Ib. J. Sci. Log. ICT Res., vol. 11, no. 2, pp. 98–105, 2024.
[14] A. Alshami, E. Ali, M. Elsayed, A. E. Eltoukhy, and T. Zayed, “IoT innovations in sustainable water and wastewater management and water quality monitoring: a comprehensive review of advancements, implications, and future directions,” Ieee Access, vol. 12, pp. 58427–58453, 2024.
[15] M. Lin, C. Photong, and others, “Smart Sensor for Current Leakage Detection for EV Charger Station,” PhD Thesis, Mahasarakham University, 2024.

INTERNATIONAL STANDARD SERIAL NUMBER INDIA

INNO SPACE
SJIF Scientific Journal Impact Factor

doi cross ref

निस्केयर
NISCAIR

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

9940 572 462 6381 907 438 ijirset@gmail.com

www.ijirset.com

Scan to save the contact details