International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 07 Issue: 05| May- 2023 Impact Factor: 8.176 ISSN:25823930

LEAKAGE CURRENT DETECTION SYSTEM

Viraj Koli[1], Aditya Gandhi [2], Shivam Kore [3], Saurav Kumbhare [4], Prof. A. S. Jaibhai[5]

[1]*Student, Electrical Department & BSCOER,Pune.*
[2]*Student, Electrical Department & BSCOER,Pune.*
[3]*Student, Electrical Department & BSCOER,Pune.*
[4]*Student, Electrical Department & BSCOER,Pune.*
[5]*Professor, Electrical Department & BSCOER,Pune.*

---***---

Abstract –The "Leakage Current Detection System" project focuses on the development of an advanced and efficient system for detecting and monitoring leakage currents in electrical networks. Leakage currents can occur due to insulation breakdown, faulty equipment, or improper grounding, posing safety hazards and potential damage to electrical infrastructure. Therefore, the accurate and timely detection of these currents is crucial to ensure the reliability and safety of electrical systems.

The proposed Leakage Current Detection System employs a combination of sensing technologies, data analysis algorithms, and real-time monitoring capabilities to identify and analyze leakage currents. Specialized current sensors are strategically placed in critical points of the electrical network to capture and measure the flow of current. The acquired data is processed and analyzed using sophisticated algorithms that can distinguish between normal operating currents and abnormal leakage currents.

The system offers several key features that enhance its effectiveness. It provides continuous monitoring of the electrical network, enabling immediate detection of any abnormal current behavior. Alerts and notifications are generated in real-time, allowing for prompt response and necessary corrective actions. The system also includes data logging and historical analysis capabilities, facilitating the identification of recurring leakage patterns and assisting in predictive maintenance strategies.

***Key Words*:** leakage current detection, electrical networks, safety, real-time monitoring, data analysis, predictive maintenance, electrical infrastructure, sensor technology, reliability, corrective actions.

1. INTRODUCTION

Failures in transmission lines can occur suddenly, intermittently, or gradually, leading to outages. These outages can be monitored and predicted by detecting potential flaws in the insulation. Insulation problems often arise from stress, natural degradation, or vandalism, and transmission line insulators are exposed to extreme environmental conditions, resulting in the deposition of various contaminants on their surface. Contaminant deposition reduces the surface's conductivity, causing a leakage current across the insulator due to dielectric stress.

As pollution levels increase, the leakage current intensifies, eventually leading to flashovers and compromising long-term insulation performance. Local heating further promotes the formation of dry bands, which deteriorate the insulator's resistive surface. The leakage current exhibits nonlinear characteristics and may contain unusual harmonics.

Monitoring the leakage current provides valuable insights into the operating conditions of insulators, enabling diagnostics and identification of potential failure causes. Recent research has focused on identifying insulation flaws in transmission lines, often using partial discharges as indicators. By analyzing the leakage current and identifying patterns, faults can be characterized and localized. This characterization aids in the development and validation of mathematical models for transmission line simulations, facilitating the inclusion of faulty insulator models and validating leakage current behavior.

1.1 OBJECTIVES

- Minimize power loss and promptly address leakage currents.
- Ensure safety of personnel.
- Implement the system cost-effectively.

2.LITRATURE REVIEW

"IoT Based Transmission Line Fault Monitoring System" by R Navaneetha Krishna (Dec 2020)

This paper proposes a model for fault monitoring in transmission lines using IoT technology. The model utilizes Ohm's law to detect fault locations quickly, reliably, and cost-effectively. The approach offers the potential for efficient fault detection and localization in power systems.

"Transmission Line Fault Detection" by Hui Hwang Goh (2017)

This paper emphasizes the importance of fault analysis in power systems to quickly clear faults and restore the system with minimal interruption. While specific details of the fault detection method are not provided, the paper highlights the significance of addressing fault detection as a critical issue in power system engineering.

"Automatic Fault Detection and Location of Transmission Lines using IoT" by Sajal Menon and Don Tommey (2019)

This paper presents a device that utilizes sensors to detect anomalies in incoming and outgoing values of transmission lines. The system is integrated with IoT technology to provide real-time information on fault location and the scale of leakage. The proposed approach aims to enhance fault detection and facilitate prompt response by notifying responsible individuals through an accompanying app.

Conclusion: In summary, these papers focus on different aspects of fault detection in transmission lines using IoT technology. The first paper highlights the use of Ohm's law for fault location detection, the second paper emphasizes the importance of efficient fault analysis, and the third paper introduces a device integrated with IoT for automatic fault detection and location, providing real-time information to relevant stakeholders

3.BLOCK DIAGRAM

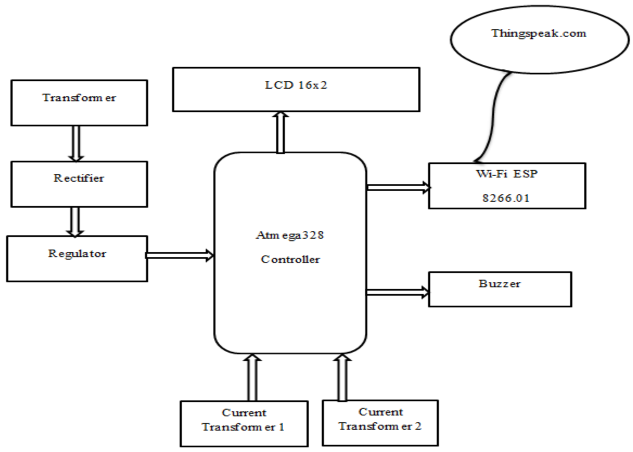


Fig 1: BLOCK Diagram

The current transformers measure the leakage currents, which are then fed to the Atmega 328 controller for processing. The controller determines if the measured currents exceed the predetermined threshold for normal operation. If abnormal currents are detected, the buzzer is activated to alert users, and the LCD display may show the relevant information.

The Atmega 328 controller also communicates with the WiFi module, which sends the measured current data to ThingSpeak.com using internet connectivity. This enables remote monitoring and data logging for further analysis and visualization of the leakage current trends over time.

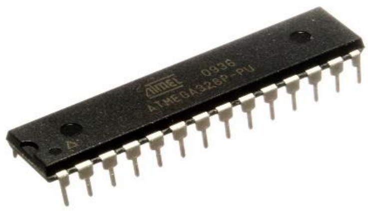
3.1 DETAILED DIAGRAM DECRIPTION

- Transformer: Steps down the voltage from the main power supply.
- Rectifier: Converts AC obtained from the transformer into DC.
- Regulator: Ensures a stable DC voltage supply.
- Current Transformers 1 & 2: Measure leakage currents in the electrical network.
- WiFi ESP8266.01: Enables wireless communication and internet connectivity.
- Buzzer: Provides audible alerts for abnormal leakage currents.
- LCD 16x2: Displays system status, measurements, and notifications.
- Atmega 328 Controller: Controls the system and processes data from current transformers.

3.2 COMPONENT USED

- **ATMEGA 328 CONTROLLER**

The Atmega 328 controller is a microcontroller that serves as the main control unit in the Leakage Current Detection System. It is responsible for managing the overall operation of the system, processing data from the current transformers, and controlling other components such as the buzzer and LCD display.



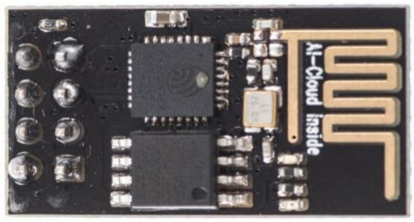
- **CURRENT TRANSFORMER**

The purpose of the current transformer in the Leakage Current Detection System is to step down the current flowing through the primary winding to a lower, measurable level that can be accurately processed by the system's controller (such as the Atmega 328 in this case). By measuring the secondary current, the system can analyze and detect any abnormal or excessive leakage currents that may indicate insulation faults or other electrical issues.

The current transformer ensures the safety and accuracy of the leakage current measurement by providing galvanic isolation between the primary circuit and the monitoring system. This isolation prevents any direct electrical connection between the high-voltage primary circuit and the low-voltage measurement system, eliminating potential hazards and ensuring the integrity of the measurement data.

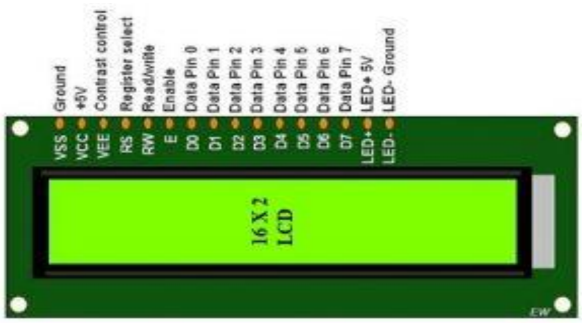
- **WIFI ESP8266.01**

The WiFi ESP8266.01 module acts as a bridge between the Leakage Current Detection System and the internet. It allows the system to send data, such as measured leakage currents, to cloud platforms like ThingSpeak.com for storage, analysis, and visualization. This connectivity enables real-time monitoring and remote access to the system's data.



- **LCD 16x2**

By providing a visual output, the LCD 16x2 display enhances the usability and user-friendliness of the Leakage Current Detection System. It allows users to monitor system status, view real-time leakage current readings, and receive alerts or notifications regarding potential faults or abnormal conditions.



- **BUZZER**

The buzzer is an essential component that serves as an audible indicator to alert users or maintenance personnel when abnormal leakage currents are detected.

3.4 DETAILED DIAGRAM

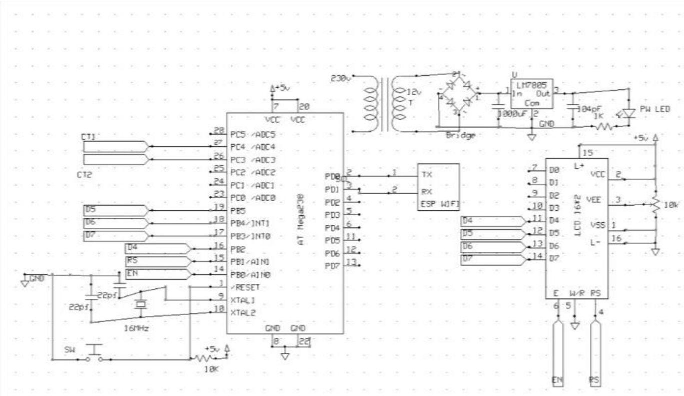


Fig 2: Detailed Diagram

4.METHODOLOGY

- To utilize IoT for detecting current leakage from a device, sensors capable of measuring the current flow on the device's body are integrated. These sensors are installed within the device and connected to an IoT device, such as a microcontroller. The choice of current sensors depends on the specific load being monitored and the desired level of accuracy.
- The IoT device is programmed to collect data from the sensors and transmit it to an IoT platform or application hosted on the cloud. Platforms like ThingSpeak or Google Cloud IoT can be employed for receiving and processing data from the IoT devices. These platforms offer tools for data representation, analysis, and storage.
- The collected data from the sensors is analyzed to identify any signs of current leakage within the device. This can be achieved through the utilization of machine learning algorithms or by setting threshold-based rules for detection. When current leakage is detected, appropriate actions are triggered, such as generating alerts to notify maintenance personnel, initiating a device shutdown, or creating a repair request.
- By integrating current sensors, IoT devices, and cloud platforms, real-time detection of current leakage becomes feasible. This enables prompt actions to be taken, thereby preventing potential damage or injury caused by the leakage.

5.DIFFERENT TECHNIQUES USED

- Current Sensing Techniques: Utilize Hall Effect sensors or Rogowski coils for non-invasive measurement of leakage currents.
- Signal Processing and Data Analysis: Apply filters, calculate RMS values, and set threshold levels to analyze and classify normal and abnormal conditions.
- Communication and Monitoring: Utilize the WiFi module (ESP8266.01) for wireless connectivity and send measured data to an online platform like ThingSpeak for real-time monitoring and analysis.
- User Interface and Alert System: Connect a buzzer for audible alerts and an LCD display to show system status, measurements, and notifications.
- System Control and Processing: The Atmega 328 controller acts as the central unit, responsible for reading current measurements, processing data, controlling alerts, LCD display, and communication with the WiFi module.

CONCLUSION

In conclusion, the developed leakage current detection system successfully addresses the need for accurate and reliable detection of leakage currents in electrical networks.

Through the utilization of current sensing techniques such as Hall Effect sensors or Rogowski coils, the system can effectively measure leakage currents without interfering with the electrical network. Signal processing techniques, including filtering and RMS calculation, ensure precise and stable measurements, while threshold settings enable the identification of abnormal leakage current levels.

The integration of the WiFi module enables seamless wireless communication and internet connectivity, allowing the system to transmit data to an online platform like ThingSpeak for real-time monitoring and analysis. The buzzer provides audible alerts, ensuring prompt notification of abnormal leakage current conditions, while the LCD display offers a user-friendly interface for system status, measurements, and notifications.

With the Atmega 328 controller as the central control unit, the system efficiently processes data from the current transformers, compares it with predefined thresholds, and controls the alerts, LCD display, and communication with the WiFi module.

Overall, the leakage current detection system provides a robust and effective solution for detecting and monitoring leakage currents in electrical networks. It enhances safety by promptly identifying abnormal conditions, enabling timely action to mitigate potential risks.

RESULT

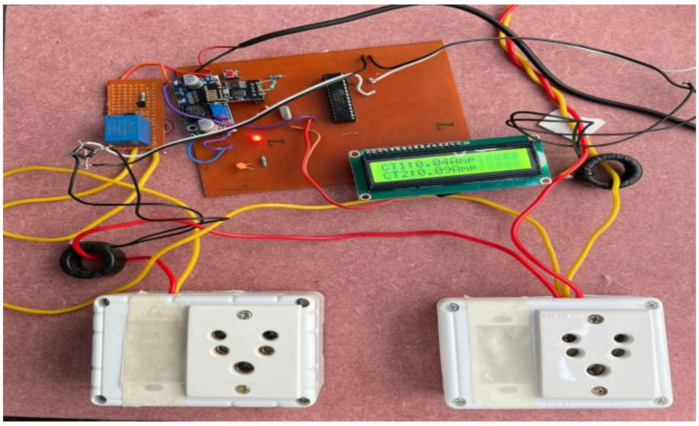


Fig 3: Hardware Model

Fig 3: Graphical visualization of Current leakage detected

REFERENCES

1. Czapp, Stanisław, and J. Guzinski. "Electric shock hazard in circuits with variable-speed drives." Bulletin of the Polish Academy of Sciences: Technical Sciences (2018): 361-372.
2. Parise, Giuseppe, Luigi Parise, and Luigi De Rosa. "Electrical safety in street lighting systems against loss of service continuity and shock hazards." IEEE Transactions on Industry Applications 54, no. 6 (2018): 5711-5716.
3. Aljamali, Nagham Mahmood, Afaq Jaber Kadhium, and Alaa Hamza Jaber Al-Jelehawy. "Review in Protection of Laboratory and Electrical Equipment in Laboratories and Institutions." Journal of Controller and Converters 6 (2021): 24-30.
4. Luo, Xiang, Ya-ping Du, X. H. Wang, and M. L. Chen. "Tripping characteristics of residual current devices under nonsinusoidal currents." IEEE Transactions on Industry Applications 47, no. 3 (2011): 1515-1521.
5. Sutanto, E., Nurwahyuni, S., Yunardi, R.T., Escrivá-Escrivá, G., 2021. Filtered Leakage Current Measurement for Various Loads. International Journal of Technology. Volume 12(2), pp. 401- 411.
6. Sutanto, E., Ain, K., Aziz, M., Escrivá-Escrivá, G., 2019. A Study on DC Limit Parameters in RCD Operation using Capacitor. Journal of Engineering Science and Technology Review, Volume 12(4), pp. 7–14.
7. Choudhary, Anurag, Shefali Jamwal, Deepam Goyal, Rajeev Kumar Dang, and Shankar Sehgal. "Condition monitoring of induction motor using internet of things (IoT)." In Recent Advances in Mechanical Engineering, pp. 353-365. Springer, Singapore, 2020.
8. Despa, Dikpride, Gigih Forda Nama, Meizano Ardhi Muhammad, and Khairul Anwar. "The implementation Internet of Things (IoT) technology in real time monitoring of electrical quantities." In IOP Conference Series: Materials Science and Engineering, vol. 335, no. 1, p. 012063. IOP Publishing, 2018.