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IOT Based Fault Detection Of Overhead Transmission Line

¹ Mr. Maqsood Kazi , ² Mr. Abhishek Chunge, ³ Mr. Suraj Patil

⁴ Mr. Jageshwar Khobragade

^{1, 2,3} Student And ⁴ Professor Department of Electrical Engineering

G H Raison College Of Engineering And Management, Pune, India

ABSTRACT :

The absence of a phase is a common and significant issue in both industrial and residential environments. Often, one or two phases in a three-phase supply can be lost, leading to situations where electrical appliances may function in one room but not in another. This causes major disruptions to daily operations. Power failures are frequent and can severely impact industrial production, the construction of new plants, and buildings. It is observed that around 70% of power interruptions in the distribution system are due to single-phase faults, even when the other two phases remain operational. Therefore, in any commercial or residential setting with a three-phase supply, an automatic phase selector system is essential to ensure continuous power to critical loads during phase failures. This system eliminates the need for backup power sources and operates quickly, switching phases automatically within seconds. The reliable operation of overhead transmission lines is critical to the stability and efficiency of power distribution networks. However, faults in these transmission lines can lead to system outages, equipment damage, and potential safety hazards. Traditional fault detection methods rely on manual inspections and scheduled maintenance, which are time-consuming, labor - intensive, and prone to human error. To address these challenges, this paper presents an IoT-based fault detection system for overhead transmission lines, leveraging real-time monitoring, data analytics, and automated fault identification.

Keyword:- IoT, fault detection, overhead transmission lines, wireless communication

1. **INTRODUCTION** : Power transmission occurs via either overhead or underground transmission lines. Overhead lines are more susceptible to transient faults, which may arise from factors such as lightning strikes, swinging wires, or contact with objects. These transient faults can often be cleared by briefly de-energizing the line, whereas permanent faults necessitate the line to stay tripped. This project focuses on developing an automatic tripping mechanism for three-phase supply systems to protect control equipment in grid substations from damage caused by faults.

The system employs three single-phase transformers configured in a star input and star output arrangement, with a delta connection. The system uses a 220-volt input and a 12-volt output. To manage short and long-duration fault conditions, 555 timers are utilized, while switches simulate Line-to-Line (LL), Line-to-Ground (LG), and three-line (3L) faults on the low-voltage side to trigger the tripping mechanism. Given the extensive length of transmission lines, faults can occur and disrupt the power supply.

Transmission and distribution networks are more prone to significant losses compared to other parts of the power system. Faults within the transmission network can cause transformer damage, pose risks to human life, and potentially lead to fires. The proposed solution involves an Internet of Things (IoT)-based system designed for transmission lines, which includes fault detection and notification capabilities. This system utilizes sensors to identify faults and transmit the data to power stations. By providing real-time information, the system allows power station teams to respond faster, reducing response times and preventing severe transformer damage and other potential disasters. With this setup, faults in transmission lines can be swiftly detected and cleared, minimizing the risk of damage and catastrophic event.

2. LITERATURE SURVEY

[1] Vinesh Gamit, Vivek Karode, Karan Mistry, "Fault Analysis on Three Phase System by Auto Reclosing Mechanism" The study involves simulating various faults to develop an automatic tripping mechanism for a three-phase power supply system. It distinguishes between temporary and permanent faults, where a short-duration fault results in an automatic return of power to the load, referred to as a "temporary trip." A long-duration fault leads to a "permanent trip." The system uses a 555 timer and relay for fault detection and analysis.

[2] Sathish Bakanagari, A. Mahesh Kumar, M. Cheenya, "Three Phase Fault Analysis with Auto Reset for Temporary Fault and Trip for Permanent Fault" This project designs a hardware-based automatic tripping mechanism for a three-phase supply system, using three single-phase transformers (230V to 12V output). The system distinguishes between temporary and permanent faults using a 555 timer and relay. A temporary fault is reset, returning power to the load, while a permanent fault results in disconnection. Future improvements include the potential integration of a GSM modem to send SMS notifications to authorities in case of faults.

[3] Deendayal Nagar, Deep Singh Bhalla, Deepesh Paliwal, “Three Phase Auto Recloser Scheme”

This project also involves hardware-based development using three single-phase transformers (230V to 12V output) for an automatic tripping mechanism in a three-phase supply system. The system automatically handles both temporary and permanent faults by detecting the issue and disconnecting the power supply accordingly.

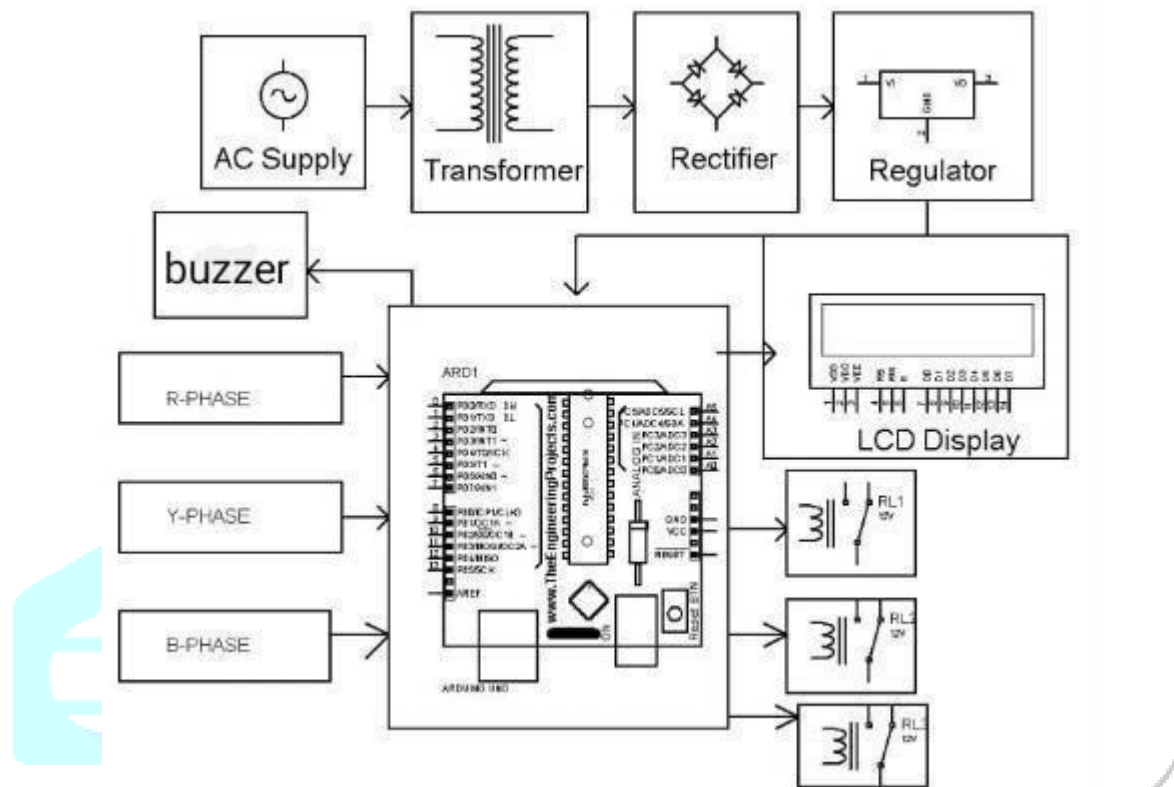
3. PROCEDURE

A system has been developed to detect faults in three-phase power supply systems and automatically disconnect the supply to prevent damage to control equipment. The system is constructed using basic components and is supported by a block diagram. Software development is underway to implement the program and create a fully functional model. Automated systems are increasingly preferred across various industries because of their ability to reduce manual interventions, offer greater flexibility, and enhance reliability and accuracy.

This project specifically addresses the common issue of phase loss in three-phase power systems by using three individual single-phase supplies to ensure an uninterrupted power supply. The system leverages an Arduino, a versatile microcontroller, known for its ease of use in multidisciplinary projects. The Arduino platform consists of open-source hardware and a standard programming language compiler, allowing it to be used for creating interactive systems or for data exchange with a computer.

The system is designed to detect various faults in the supply system, such as Line to Ground (LG), Line to Line (LL), and Three Lines (3L) faults, which can disrupt the power system. To address this issue, the system automatically disconnects the supply when faults are detected, preventing significant damage to the control gears at grid substations. The project methodology involves assembling components and creating a circuit based on the block diagram, and ongoing software development is focused on creating the full program to complete the model.

4. BLOCK DIAGRAM OF THE SYSTEM



In today's world, automation is a key solution to meet new challenges across various systems. Automated systems are now widely preferred due to their minimal manual intervention, enhanced flexibility, reliability, and accuracy. These features make them highly beneficial, particularly in the field of electronics, where they contribute to improved performance.

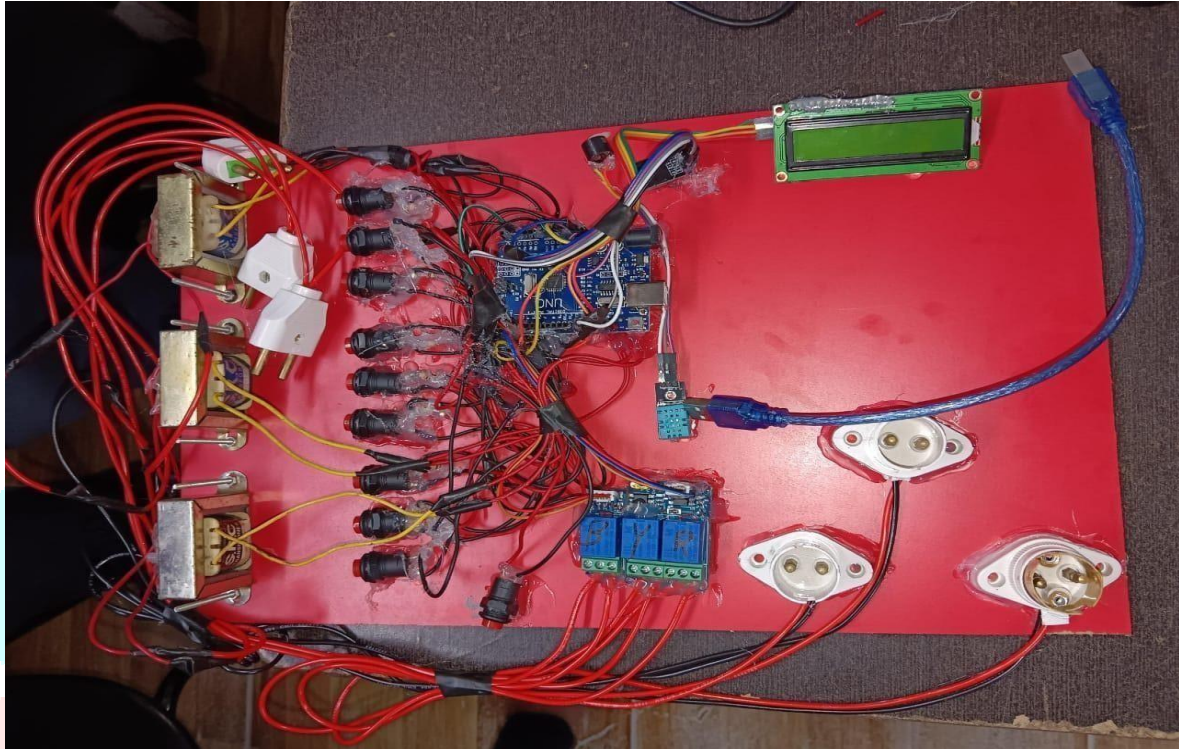
A common issue with three-phase power systems is the loss of one phase. To address this problem, this project utilizes a three-phase supply, consisting of three individual single-phase supplies (R-Ø, Y-Ø, B-Ø). The system is designed to continuously supply power to a load, ensuring that if one phase fails, the remaining phases can take over. Additionally, an LCD display is used to show which phase is currently operational.

BLOCK DIAGRAM DISCRIPTION

- In this project, the system continuously operates using three phases of power.
- If all three phases are present, the microcontroller activates the load on phase 1 and displays "Phase 1 selected" on the LCD.
- If the first phase is absent, the load is automatically shifted to phase 2 using a relay circuit.
- Similarly, if the first two phases are unavailable, the microcontroller switches the load to phase 3, again with the help of the relay circuit.
- The selected phase is displayed on the LCD at all times.

- The project utilizes a regulated 5V, 750mA power supply. A 7805 voltage regulator is employed for voltage stabilization, and a bridge-type full-wave rectifier is used to convert the AC output from the secondary side of a 230V/12V step-down transformer

PRATICAL VIEW OF : IOT Based Fault Detection Of Overhead Transmission Line



- This innovation effectively detects hazardous faults that necessitate line de-energization and distinguishes them from other types of events.
- It reduces unnecessary service interruptions by rapidly decreasing the secondary arc current, ensuring minimal disruption.
- The system is designed for long transmission lines carrying high voltage and incorporates a timer to differentiate between temporary and permanent faults, thereby preventing frequent trips.
- By implementing individual reclosure for each phase, the system ensures that only the faulty phase is deactivated, allowing the other phases to remain operational, which enhances overall system efficiency.
- This invention provides a reliable and cost-effective solution that accurately addresses phase- ground faults, even when they occur simultaneously on two out of the three phase lines.

5. CONCLUSION

- This system is designed to automatically switch the phase in the event of phase absence.
- The system was tested on hardware, going through several trial-and-error scenarios to ensure its functionality.
- A truth table was created to evaluate various conditions and to identify failure scenarios. Based on these conditions, the phase is automatically shifted.
- The system performs as expected, operating smoothly. It is durable, portable, and reliable. Additionally, the development cost is lower, making it more affordable compared to similar products.

6. REFERENCES :

Paper 1: "Fault Analysis on Three Phase System by Auto Reclosing Mechanism"

This paper focuses on simulating various types of faults in three-phase power systems. The authors developed an automatic tripping mechanism that can differentiate between temporary and permanent faults. Using a 555 timer and a relay, the system is able to automatically reclose the circuit in the case of a temporary fault while maintaining a trip mechanism for permanent faults.

Paper 2: "Three Phase Fault Analysis with Auto Reset for Temporary Fault and Trip for Permanent Fault"

In this study, the authors proposed a hardware-based solution that integrates three single-phase transformers. The system utilizes a 555 timer and relay to detect faults and is designed to automatically reset for temporary faults, while permanently tripping the circuit for more severe, lasting faults. This approach aims to enhance system reliability and reduce downtime.

Paper 3: "Three Phase Auto Recloser Scheme"

This paper describes the design of a hardware-based system that incorporates three single-phase transformers to implement an automatic fault detection mechanism. The proposed system features an automatic tripping mechanism that can address both temporary and permanent faults. Through the use of advanced relays and timers, the system aims to improve power system efficiency by quickly restoring normal operation after temporary disruptions.