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IoT Based Three Phase Transmission Line Fault Detection and Analysis

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Abstract: *This project provides automatic tripping mechanism for the three phase supply system for prevention from damage due to faults. In case of temporary faults the outputs resets automatically after a brief interruption In case of permanent fault the output remains in the tripping condition. Faults like LG, LL, LLG and LLL one can be sensed and automatically disconnects the supply to avoid large scale damages to the equipments connected. Our goal is to develop efficient fault detection techniques that can quickly identify and locate faults, ensuring the uninterrupted flow of electricity. By implementing these techniques, we can enhance the reliability and stability of power transmission systems. So get ready to explore the fascinating world of fault detection and power system reliability. This paper presents an IoT-based approach for the detection and analysis of faults in three- phase transmission lines. Traditional fault detection systems encounter challenges such as labor shortages, heightened risks, and time-consuming processes. To address these issues, we propose a cost-effective and easily implementable solution suitable for modern power transmission systems. The IoT-based fault detection system swiftly identifies faults upon line breakdown, automatically interrupting power supply. Fault monitoring is conducted sequentially across R, Y, and B phases, with prompt notifications sent to the monitoring station upon detection. The system also provides detailed information on the faulty line and the distance and exact location of the fault. Furthermore, real-time line Current data transmitted to the monitoring station. Our research offers a comprehensive framework to enhance the reliability and efficiency of transmission line fault detection, contributing to the advancement of power distribution networks.*

Keywords: ESP8266 (NODE MCU), Relay, GPS Module, LCD Display, Transformer

I. INTRODUCTION

In now a days the electricity is very important in our life. In the power system there are various types of fault occurs due to natural calamity (like lightning, collisionof branches of trees with the transmission line). Due to this short circuit or fault may occurs like (line to line, line to ground, double line to ground and these three phase fault). Out of these three phase fault is moresevere in the power system which coulddamage the electrical equipments. So this fault should be remove as soon as possible. Mostly line to ground fault is occurred about the 80% in the power system. This project aims to explore fault detection techniques that can help identify and locate faults quickly, minimizing downtime and ensuring a smooth flow of electricity. By implementing these techniques, we canenhance the efficiency and stability of power transmission systems. In the worldof power systems, ensuring the reliability oftransmission lines is essential. One critical aspect is detecting faults in three-phase transmission lines. This project aims to explore fault detection techniques that can help identify and locate faults quickly, minimizing downtime and ensuring a smooth flow of electricity. By implementing these techniques, we can enhance the efficiency and stability of power transmission systems.

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II. LITERATURE SURVEY

2.1 PROBLEM STATEMENT

Ensuring the reliable and efficient operation of three-phase transmission lines is crucial for maintaining a stable and secure power grid. Faults on transmission lines can lead to significant power outages, causing disruptions to businesses, homes, and critical infrastructure. Traditional fault detection systems rely on detecting anomalies in voltage, current, or impedance measurements, which can be inaccurate or unreliable in certain situations. Advanced three-phase transmission line monitoring and fault detection systems are needed to address these limitations and provide more accurate, reliable, and real-time fault detection and analysis capabilities.

2.2 OBJECTIVES

The primary objectives of advanced three-phase transmission line monitoring and fault detection systems are to: Accurately detect and classify various types of faults, including single-line-to-ground (SLG), double-line-to-ground (DLG), and three-phase faults, with minimal false positives and negatives. Precisely locate the fault's position along the transmission line, enabling prompt repair and minimizing outage duration. Offer real-time insights into the nature and severity of faults, facilitating informed decision-making for grid operators. Identify potential fault precursors and vulnerabilities in the transmission line, enabling preventive maintenance and reducing the likelihood of fault occurrence. Monitor transmission line parameters, such as voltage, current, temperature, and conductor sag, to optimize performance and extend equipment lifespan.

2.3 CHALLENGES

Developing and implementing advanced three-phase transmission line monitoring and fault detection systems presents several challenges, including:
Handling and analyzing large volumes of real time data from various sensors and sources efficiently and accurately. Developing sophisticated algorithms to distinguish between different fault types and accurately determine fault locations. Seamlessly integrating the fault detection system with existing power grid monitoring and control systems. Protecting the system from cyber attacks and ensuring data integrity and confidentiality. Balancing the benefits of the system against the costs of implementation and maintenance.

III. METHODOLOGY

The methodology behind advanced three-phase transmission line monitoring and fault detection systems involves a combination of hardware and software components. Here's a simplified overview:

- Sensor Installation: Sensors are installed along the transmission lines to collect real-time data. These sensors can measure various parameters like current and voltage.
- Data Acquisition: The collected data from the sensors is transmitted to a central monitoring system. This can be done through wired or wireless communication methods, depending on the infrastructure and requirements.
- Data Processing: The monitoring system processes the acquired data using advanced algorithms and techniques. This involves analyzing the data to identify patterns, trends, and anomalies that could indicate potential faults or issues.
- Fault Detection and Localization: By comparing the collected data with predefined thresholds and models, the system can detect and localize faults on the transmission lines. This is achieved by analyzing changes in parameters such as voltage drops, current imbalances, or abnormal temperature readings.
- Alert Generation: Once a fault is detected, the system generates alerts or notifications to the operators or maintenance personnel. These alerts can be in the form of visual displays, alarms, or even automated messages sent to designated individuals or teams.
- Maintenance and Repair: The fault detection information helps maintenance crews to quickly locate and address the issues on the transmission lines. This allows for efficient repairs and reduces the downtime for the power supply.

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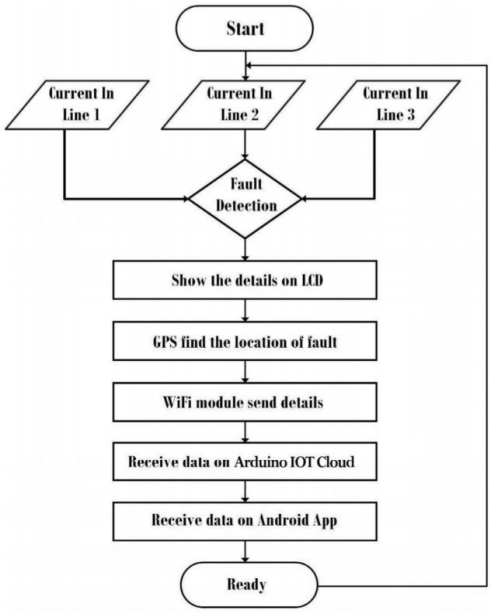
- Continuous Monitoring: The system continuously monitors the transmission lines, providing real-time updates on the condition and performance of the network. This helps in proactive maintenance and ensures the reliability of the power supply.

It's important to note that the specific methodology and techniques used can vary depending on the system's design, complexity, and the requirements of the power grid.



At first, we power up or start the project and it is going to read the three- phase line .if our program detects the fault in line then it sends the data to user and if not occurred any fault, then keep sensing the fault. Every time it checks the conditionand continuously run in a cycle or loop.

Block Diagram of IOT Based ThreePhase Transmission Line Fault Detection And Analysis Power Supply: The power supply block covert the voltage from 220v to 5v. Here we used a rectifier circuit to convert the voltage

- Node MCU: Node MCU is an Arduino microcontroller. It sends the controlling signal to the all equipment used in the circuit and receive the signal from theequipment's.
- Wi-Fi: A Wi-Fi chip is situated on the Node MCU with which we connect the internet to the circuit.
- Sequencing Unit/Relay: we use the relay for three phase line to connect with NODEMCU.
- Load: we use the prototype load bythe Dc LED light and if any fault detects inTransmission Line, then turn off the Load. Mobile Application: we download a software named "Fault Detector" to monitor our circuit from anywhere through the Internet.

IV. WORKING PRINCIPLE

When the supply is turned on the 230V AC supply is given to the primary side of the transformer & from the secondary side 24V AC supply is taken out

. Now this supply is given to bridge circuit which convert this 24V AC into 24V DC byusing filter capacitor. Now the supply iscurrent flow in path Relay Transmission line load at the same time 5V DC supply is given to Node MCU and other electricalcomponents.

In normal condition current flows from the circuit smoothly & LED panel shows no fault has detected & show transmission line current of all 3 phase in Amps . In fault condition , when fault occure in the system , firstly it sense the fault whether is it L-L , L-G , L-L-G or 3 phase fault . After that relay circuit will trip& LCD panel shows that the fault has detected in any phase (R , Y , B) with exactfault type (L-L , L-G , L-L-G , 3 phase fault) & exact location of fault in the system andthis data is send to mobile phone with the help of ESP 8266 WiFi module . This Faulttype & location can be see in mobile phone using the single phase fault detection apk .

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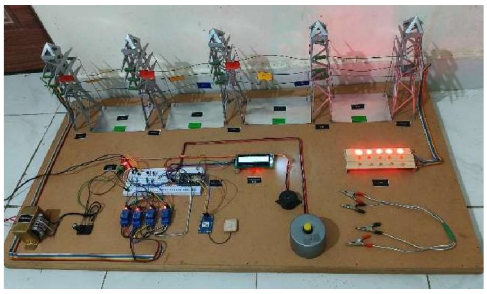
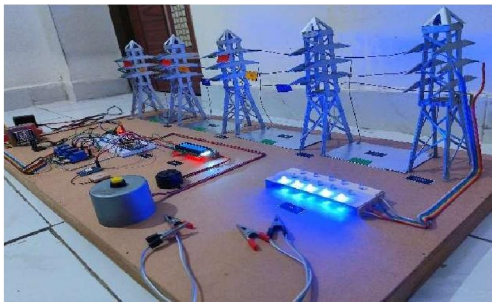
V. DESIGN AND FABRICATION





VI. COMPONENTS

Sr. No.	Component Name	Specification	Quantity
1	Resistor	10 Ohm	16
2	Transformer	24 V , 2 A	1
3	Dc Power Supply	5 V	1
4	Bridge Rectifier	2 A	1
5	Capacitor	1000 uf 35 V	1
6	Relay	5 V Dc	4
7	Transistor	2N4401 NPN	4
8	Node MCU	Esp 8266	1
9	Resistor	1 K Ohm	1
10	Push Button	12 V	1
11	Current Sensor	ACS 712 , 5 A	1
12	GPS Module	Neo-6mv	1
13	Arduino Display	16*2	1
14	Buzzer	5 V	1
15	LED	5 V	15
16	Bread Board	400 Tie Points	1

VII. FUTURE SCOPE

In future, this project will enhance the fault detection in underground cablesusing Raspberry PI. It helps to detect which type of fault occurred and exact location of fault also. The project it will help in future it can be used as reference in future forimplementing the base protection system in transmission line system. Also these systemis very reliable than the SCADA. This system it will control or signaling the mobile app this called IOT based system. This system shows the exact fault location and fault clearing is very quick this featuresmaking this project very unique and useful in future.

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VIII. CONCLUSION

As power grids become increasingly complex and integrated, the need for sophisticated fault detection and analysis systems becomes even more critical. By leveraging advancements in sensor technology, data analytics, and communication protocols, these systemswill continue to play a key role in ensuringa stable and efficient power supply for homes, businesses, and industries. We can easily detect the type fault and solve it and there distance in real time, this prototype model is very effective. Itworks in very less time and exact location of fault is detected.

ADVANTAGES

- Detect the exact fault location.
- Human efforts minimizes
- Improve the system performance
- System cost is low compared toSCADA.
- We can see the data through onlinecommunication.
- Large number data aggregation.
- Predictive analysis.
- Time saving.

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