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Fault Analysis Of Three Phase Transmission Lines And Smoke Alert Using Iot And Arduino

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Abstract: The main aim of this project is to design a three phase fault detection using an Arduino UNO and display the fault type on LCD module .This system detects three types of faults line-line fault, open circuit fault, line to line-line .This proposed model uses the concept of Ohms law to detect the open circuit fault, line-line fault and line to line-line , line –mine ground which is quick, reliable and cost effective. This system consists of smoke sensor which detects the combustible smokes. This system consists of ESP8266 WI-FI module to send the data into the thingspeak cloud. If any abnormal condition in system it will alerts the user through buzzer . This system uses an Arduino microcontroller and a rectified power supply.

Index Terms – Temporary fault; permanent fault; L-G and L-L faults; three-phase system

I. INTRODUCTION

A fault in a power system can be referred to any abnormality in the electric current flowing in it. For example, if the current is interrupted by some failure in the circuit, the resulting fault is an open circuit fault. If the current in the circuit bypasses the normal load, it results in a short circuit fault. In a three-phase system, the fault may occur between one or more phase and ground or only between phases of the system. Generally, protective devices are used in transmission systems to detect fault conditions and result in operation of circuit breakers or isolators that help in limiting the damage due to the failure. In three-phase or polyphase systems, a fault may affect some phases (causing asymmetrical faults). If all the phases are affected equally, it results in a symmetrical fault. Symmetrical faults are easier to analyze than asymmetrical faults.

OBJECTIVES

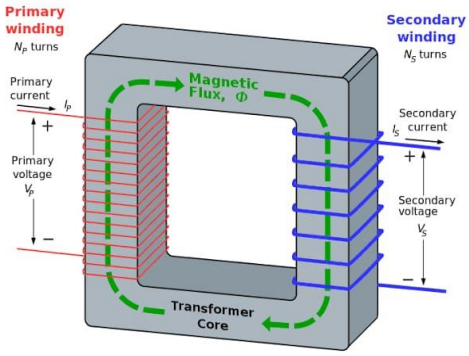
The primary objectives of this Fault Analysis of Three Phase Transmission Lines And Smoke Alert Using IoT And Arduino are as follows:

- **Detection of Faults:** To detect and identify various types of faults that occur in three-phase transmission lines, such as single line-to-ground faults, line-to-line faults, and three-phase faults.
- **Fault Location:** To determine the location of the fault in the transmission line, which is essential for quick repair and restoration of power supply.
- **Reducing Power Outages:** To minimize power outages by quickly detecting and isolating faults, thereby reducing the impact on consumers.
- **Improving Grid Reliability:** To enhance the reliability of the power grid by identifying and addressing potential faults before they occur.

COMPONENTS USED

The system comprises the following Main essential components:

i. **Microcontroller 89C51:** The AT89C51 is a low-power, high-performance CMOS 8-bit microcomputer with 4K bytes of flash programmable and erasable read only memory (PEROM). The device is manufactured using Atmel's high density non-volatile memory technology and is compatible with the industry-standard MCS-51 instruction set and pin out. The on-chip Flash allows the program memory to be reprogrammed in-system or by a conventional non-volatile memory programmer. By combining a versatile 8-bit CPU with Flash on a monolithic chip, the Atmel AT89C51 is a powerful microcomputer which provides a highly-flexible and cost-effective solution to many embedded Control Application.



ii. **Transformer:** A transformer is a static electrical device that uses inductive coupling between its winding circuits to transfer energy. Due to a varying primary winding current, a varying magnetic flux is generated in the core of the transformer which is then induced to the secondary winding. Due to this varying magnetic flux, a varying electromotive force (EMF) or voltage is generated in the secondary winding. Transformers can vary the relative voltages of the circuit or isolate them, or both. In this system step down three-phase transformers are used, out of which three are connected in star in star out configuration and the rest three are connected in delta configuration which have input at 220 volts and provide an output at 12 volts.

iii. **Voltage regulator:** Voltage regulator A three terminal voltage regulator is a regulator in which the output voltage is set at some predetermined value. Such regulators do not require an external feedback connection. Hence, only three terminals are required for device of such types, input (Vin) output (Vo) and a ground terminal. Since the regulator operates at a preset output voltage the current limiting resistor is also internal to the device. The main advantages of such regulators are the simplicity of connections to the external circuit and the minimum of external components. Fig. Shows the basic circuit configuration of the three terminal voltage regulator.

1SYSTEM ARCHITECTURE

The proposed system architecture consists of the following modules:

Hardware Components:

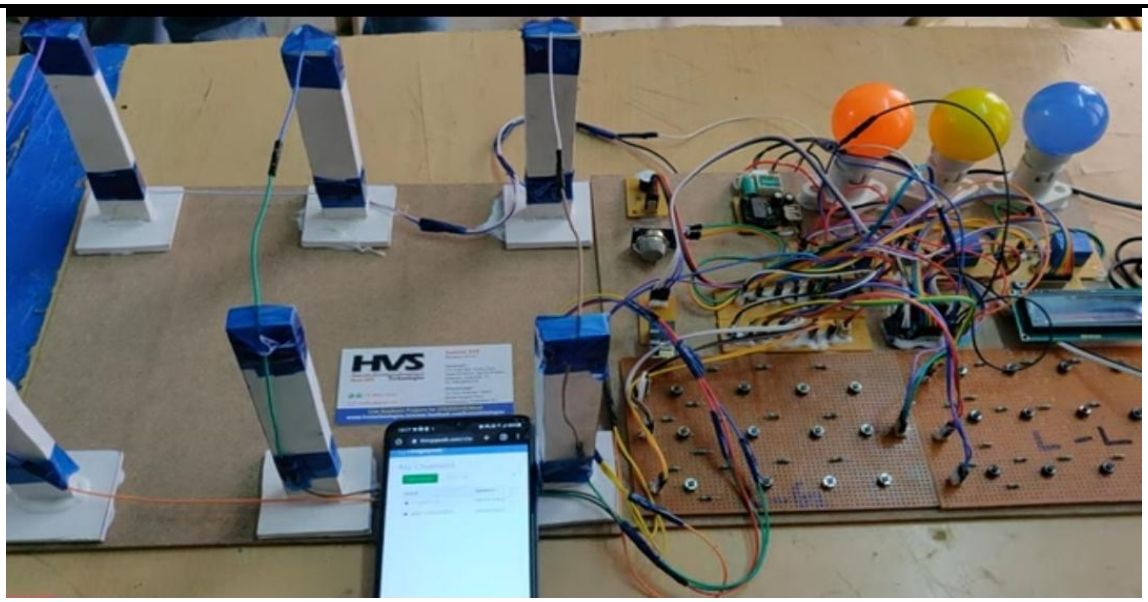
- Arduino Board: Arduino Mega or Arduino Due for processing and controlling the system.
- Current Transformers (CTs): Measure current in each phase of the transmission line.
- Potential Transformers (PTs): Measure voltage in each phase of the transmission line.
- Smoke Sensors: Detect smoke in the environment.
- Wi-Fi Module: ESP8266 or ESP32 for connecting to the internet and sending data to the cloud.
- Relay Module: Control the alarm and notification system.

Software Components:

- Arduino IDE: Program the Arduino board to read data from sensors and send it to the cloud.
- IoT Platform: Use an IoT platform like thingSpeak, Cayenne, or Blynk to collect and analyze data from the sensors.
- Machine Learning Algorithm: Implement a machine learning algorithm to detect faults and anomalies in the transmission line.
- Notification System: Develop a notification system that sends alerts to authorities and stakeholders in case of a fault or fire.

WORKING PRINCIPLE

The project uses 4 numbers step-down transformers for handling the entire circuit under low voltage conditions of 12v only to test the 3-phase fault analysis. The primary of transformers are connected to a 3-phase supply in star configuration, while the secondary of the same is also connected in star configuration. The other set of transformers with its primary connected in star to 3 phase have their secondaries connected in Delta configuration. The outputs of all the transformers are rectified and filtered individually and are given to 6 relay coils. 6 push buttons, every button connected across the relay coil is meant to create a fault condition either at star i.e. LL Fault or 3L Fault. The NC contacts of all the relays are made parallel while all the common points are grounded. The parallel connected points of NC are given to pin2 through a resistor R5 to a 555 timer i.e. wired in monostable mode. The output of the same timer is connected to the reset pin 4 of another 555timer wired in a stable mode. LEDs are connected at their output to indicate their status. The output of the U3 555 timer from pin3 is given to an Op-amp LM358 through wire 11 and d12 to the non-inverting input pin3, while a potential divider RV2 keeps the inverting input at fixed voltage. The voltage at pin2 coming from the RV2 (potential divider) is held such that it is higher than the voltage at pin3 of the Op-amp used as a comparator. As a result, pin1develops zero logic that fails to operate the relay through the driver transistor Q1. This relay Q1 is 3CO relay i.e. it disconnects the load to indicate fault condition.



RESULTS AND OBSERVATIONS

The Three Phase Transmission system was tested under various conditions to evaluate performance and reliability. Key findings include:

- Various faults have been created to develop an automatic tripping mechanism for the three phase supply system while temporary fault and permanent faults occur.
- Here timer 555 has been used with relay for the fault analysis.
- Short duration fault returns the supply to the load immediately called as temporary trip while long duration shall result in permanent trip. Also we adjust the time duration for permanent fault by adjusting capacitors charging periods.
- Whenever any type of fault: LG temporary/permanent or LL temporary / permanent & under voltage and over voltage occurs regarding faults is displayed on LCD.
- **Safety Features:** The push button acted effectively as an emergency stop, halting the motors instantly.

ADVANTAGES

- **Reduced downtime:** By detecting faults early, an IoT-based system can help reduce downtime, which can be costly for industrial and commercial applications.
- **Improved reliability:** With real-time monitoring and early detection, the system can improve the reliability of the power grid, ensuring a consistent power supply.
- **Reduced maintenance costs:** Traditional fault detection systems require regular maintenance and inspection, which can be time-consuming and costly. IoT-based systems can reduce these costs by automating the monitoring process.

CONCLUSION

This three phase fault analysis system is built using single phase transformers. The input to the transformers is 220 volt and output is 12 volt. For introducing faults on the low voltage side, set of switches are used that create LL, LG, and 3L faults. The supply returns to the load in the case of a short duration fault and is referred as a temporary trip while long duration disconnection of supply and load shall result in a permanent trip.

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