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Analysis and Detection of Three Phase Transmission Line Faults

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ABSTRACT: Electricity has become the most essential amenity for all of us. Gone are the days when electricity would be only limited to cities. It is now reaching to every distant part of the country. So, we now have a complex network of power system. This power is being transmitted from generating station to distribution station through transmission lines. So, fault occurring is natural. These fault damages many vital electrical equipment's like transformer, generator, transmission lines. For the uninterrupted power supply, we need to prevent these faults as much as possible and also need to detect them in the shortest possible time. So, this project will detect faults within the shortest possible time and also provide you about the information like where did the fault happened and also the distance from the nearest substation to the place where fault took place.
The simulation circuit is designed in the proteus 8.13 version software with proper arrangements. The proteus software along with Arduino IDE is used to run and simulate the three-phase transmission line fault detection system.

KEYWORDS: Power system, Protection, Fault, Simulation, Transmission, Proteus, Arduino Uno.

I. INTRODUCTION

The protection of electricity system transmission lines significantly impacts any country's economic importance. It also has an immediate impact on people's lives and has an indirect impact on the progress of any nation. An unwanted fault in the transmission line or power system, there can be happened a huge damaged. Which basically impacts normal living. In the three-phase transmission line, there are different kinds of protection systems are applied which can be the non- unit type or unit types. The non-unit type of protection basically is time-graded overcurrent protection, current- graded overcurrent protection, and distance protection. And, the unit type protection is pilot-wire differential protection, carrier-current protection based on phase comparison method, etc. Generally, ground faults are more common on overhead transmission lines than phase faults, and the amplitude of ground-fault current varies from phase fault current, separate protection mechanisms are required.

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II. PROBLEM STATEMENT

To reduce the duration of outages and minimize response time to major faults, and to optimize reliability of supply, it is inevitable for power transmission companies such as GRID to design a sustainable device for identifying the faults occurred with low power consumption that will relay accurate fault information at real-time back to the control center.
The project is designed for the automatic identifying mechanism when temporary faults and permanent faults occur. The faults that occur in the transmission line can be Undervoltage, overvoltage, overcurrent, temporary and permanent faults.

III. OBJECTIVES

To design a simulation model using proteus software along with Arduino IDE to detect fault in Transmission lines and to calculate the distance from the fault occurred. A smart Arduino based fault detection and location system was used to adequately and accurately indicate and locate the exact spot where fault had occurred.
The time required to locate a fault is drastically reduced, as the system automatically and accurately provides accurate fault location information. To design an efficient impedance-based and robust automatic fault detection and location system for overhead power transmission lines. To reduce response time, we need to rectify and save expensive

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transformers from damage which usually occurs during longer power outages. To increase productivity of technical staff the time needed to locate faults will be drastically reduced. To ensure stability and reliability of the power supply system will boost economic growth of the nation.

IV. ARDUINO UNO (ATMEGA 328P)

The Arduino Uno is an open-source microcontroller board based on the Microchip ATmega328P microcontroller and developed by Arduino.cc and initially released in 2010. It is similar to the Arduino Nano and Leonardo.
The word "uno" means "one" in Italian and was chosen to mark a major redesign of the Arduino hardware and software. The Uno board was the successor of the Duemilanove release and was the 9th version in a series of USB-based Arduino boards. Version 1.0 of the Arduino IDE for the Arduino Uno board has now evolved to newer releases. The ATmega328 on the board comes preprogrammed with a bootloader that allows uploading new code to it without the use of an external hardware programmer.
Arduino UNO is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.

PIN DIAGRAM OF ARDUINO UNO (ATMEGA328P):

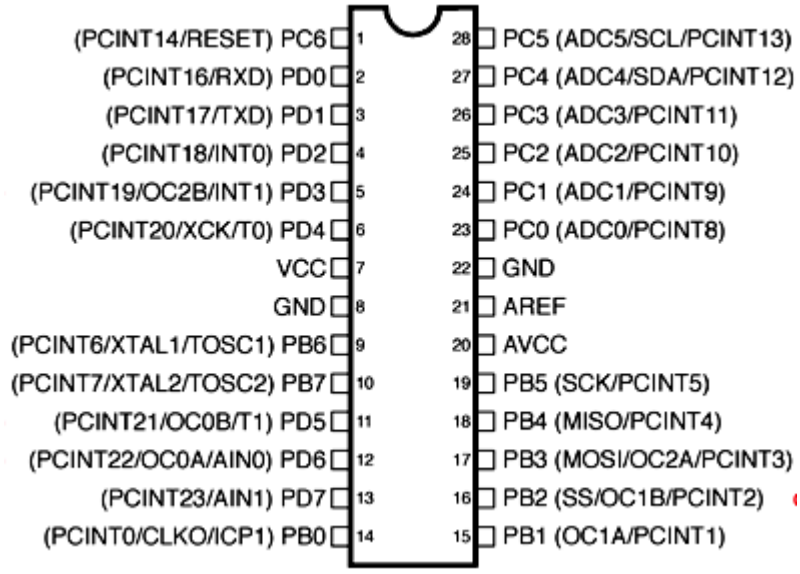

Figure 1: Pin diagram of ArduinoUNO

V.TRANSFORMER

The potential transformer will step down the power supply voltage (0-230V) to (0-6V) level. Then the secondary of the potential transformer will be connected to the precision rectifier, which is constructed with the help of op–amp. The advantages of using precision rectifier are it will give peak voltage output as DC; rest of the circuits will give only RMS output.

VI.RELAY

A Relay is a simple electromechanical switch. While we use normal switches to close or open a circuit manually, a Relay is also a switch that connects or disconnects two circuits. But instead of a manual operation, a relay uses an electrical signal to control an electromagnet, which in turn connects or disconnects another circuit.

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Relays can be of different types like electromechanical, solid state. Electromechanical relays are frequently used. Let us see the internal parts of this relay before knowing about it working. Although many different types of relays were present, their working is same. The below figure shows how a relay looks in a real world.

VII.LIQUID CRYSTAL DISPLAY

A liquid crystal display (LCD) is a flat panel display, electronic visual display, video display that uses the light modulating properties of liquid crystals (LCs). LCs don't emit light directly.
They are used in a wide range of applications, including computer monitors, television, instrument panels, aircraft cockpit displays, signage, etc. They are common in consumer devices such as video players, gaming devices, clocks, watches, calculators, and telephones. LCDs have displaced cathode ray tube (CRT) displays in most applications. They are usually more compact, lightweight, portable, less expensive, more reliable, and easier on the eyes. They are available in a wider range of screen sizes than CRT and plasma displays, and since they do not use phosphors, they cannot suffer image burn-in.

VIII.METHODOLOGY

The project setup consists of three fundamental components, transformer, microcontroller (Arduino Uno), and relay. LCD is connected to the microcontroller. It is used to display the desired location which the microcontroller has sensed. In the relay, there are three LEDs are connected to separate the three- phase transmission line. A buzzer is added to the microcontroller which identifies the fault current by creating a sound. An ammeter and voltmeter are added with the buzzer so that the fault current and voltage can be measured. The LED display will basically show the red, yellow, and blue three transmissions line with their fault occurring identification.

In our project, it is designed to maintain a 5V (dc) constant voltage which is supplied to the microcontroller. The microcontroller works as a CPU of the setup. It contains a set of programming codes that have been stored in EEPROM which enables it to classify the fault type based on the voltage values. Based on the program, the microcontroller compares these values to see whether they are within the range required. If the voltage values are out of range as compared to the reference it gives an indication of a fault and creates a signal to trip the relay and send it towards the microcontroller. The microcontroller then serves the signal to the LCD display and the buzzer. So that, the buzzer will tune, and the LCD display shows.

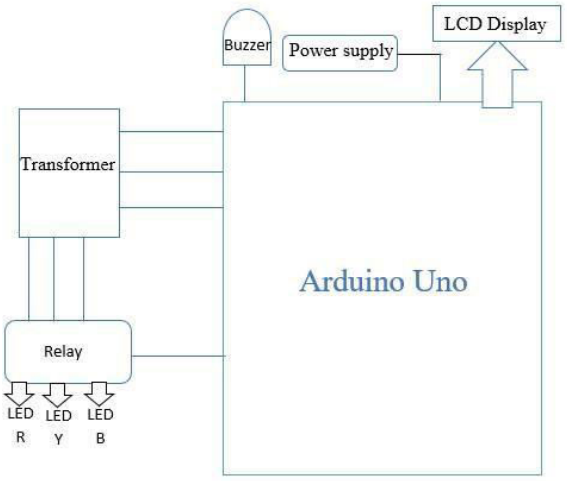

Figure 2: Block Diagram

The project is designed for the automatic identifying mechanism when temporary faults and permanent faults occur. The faults that occur in the transmission line can be Undervoltage, overvoltage, overcurrent, temporary and permanent faults.

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The automatic protective measure may affect the functioning of the circuit into a defect that has not been resolved for those problems that are permanent, which may have a negative impact on system stability. There are some features that are added to our project: -

1. If the fault is isolated, the fault current is also isolated.
2. Indication of the fault and which location it occurred that will display in the 16/2 LCD.
3. The fault current and voltage are shown in the ammeter and voltmeter.
4. When the fault occurs, there is a buzzer that is tuned at that time.
5. The relay is added to the transmission line which continuously changes the direction.

IX.EXPERIMENTAL RESULT

The project circuit is designed and simulated in the proteus software. The coding is coded in the Arduino IDE software. The code is compiled and uploaded in the Arduino Uno. Then, the simulation is run by the use of the run button.

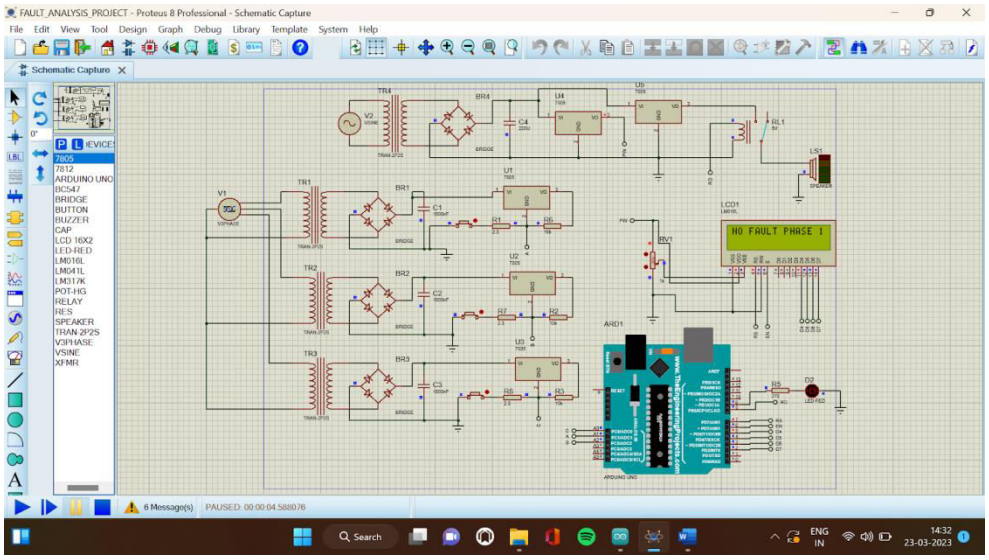

Figure 3: Proteus simulation in 8.13

Figure 4 shows that when the fault has occurred in the first phase and the distance is 11988m. So that, the distance of the fault is measured.

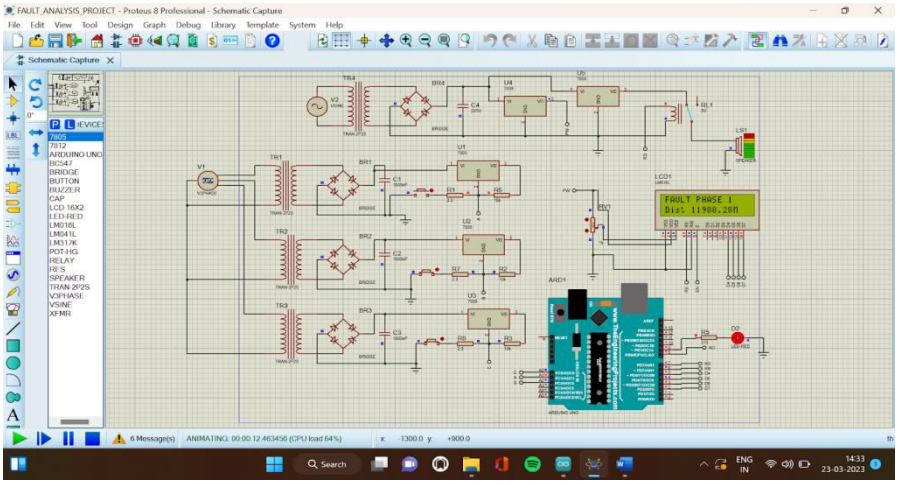

Figure 4: Output in Proteus 8.13

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X.CONCLUSION

The "ANALYSIS AND DETECTION OF THREE PHASE TRANSMISSION LINE FAULTS" project which is developed keeping the fact that the occurrence of fault in a transmission line damages not just the conductors but effects the entire power distribution system. So, in order to avoid this damage, there is a need to detect and protect the transmission lines. So, the simulation model we built in this project using the proteus software helps us to identify the fault where it has occurred i.e in which phase did the fault occur.

And this project also determines the distance from where the fault occurred and also alerts the substation in-charge with an alarming sound whenever a fault occurred. So, finally in addition to the current proposed model if we could be able to add extra features like identifying other kinds of unsymmetrical faults or faults due to lightning that would be a great add-on to this current project. This project also helps to increase the efficiency of power distributed form generating station to the load.

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