Fault Detection in Transmission Line using Arduino Uno

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ABSTRACT

Transmission line fault detection is a crucial aspect of maintaining a stable power supply. This paper presents a paper that uses Arduino Uno to detect faults in transmission lines. The system is designed to detect faults such as Line to Ground, Line to Line, Line to Line to Ground, and three phase fault. The fault detection system can quickly identify the type of fault and its distance (in km) & notify the maintenance team through an alarm (buzzer). The paper's implementation involved using the Arduino Uno microcontroller board, relay module, buzzer, transformer, voltage regulator, diode, resistor, capacitor, LCD Display, push button, jumper wires, plain PCB, breadboard, thermal sensor, potentiometer, bulb, holder. The relay module was used to switch the power supply of the transmission line on and off, while the buzzer was used to sound an alarm when a fault was detected. The results of this research indicate that the proposed system is an effective method for detecting transmission line faults. The system is simple, low-cost, and can be easily implemented. The fault detection system can help prevent power outages and reduce maintenance costs.

Keywords: Transmission line fault detection, Arduino Uno, Relay, Buzzer

1 Introduction

The transmission line is an essential component of the electrical power system, and its faults can cause power outages, equipment damage, and even fires. The detection of transmission line faults is crucial to maintain a stable power supply and prevent accidents. Traditional fault detection systems involve manual inspection, which is time-consuming, costly, and often unreliable. To address these challenges, this paper proposes a paper that uses Arduino Uno, relay, and buzzer to detect faults in transmission lines. The system can quickly identify the faults and notify the maintenance team through an alarm. This paper uses the following components - Arduino Uno microcontroller, relay module, buzzer transformer, voltage regulator, diode, resistor, capacitor, LCD Display, push button, jumper wires, plain PCB, breadboard, thermal sensor, potentiometer, bulb, holder. The relay module is used to switch the power supply of the transmission line on and off, while the buzzer is used to sound an alarm when a fault is detected [1].

The transformer is used to step down the high voltage AC power to a lower voltage that can be used by the circuit. Here, 4 - 12V transformer is used in this system [2]. The voltage regulator is used to regulate the voltage and ensure that the voltage supplied to the circuit remains constant. The Arduino UNO is the main microcontroller used in the system. It is responsible for receiving input from the sensors, processing the data, and triggering the relay and buzzer in case of a fault. The diodes are used to make rectifiers, which converts 12V AC supply into 5V DC. Capacitors are used in rectifiers to stabilize the voltage and filter out noise. The LCD display is used to display the type of fault and its distance & the push button is used to create the fault for analysis. The potentiometer is used to adjust the sensitivity of the system & the thermal sensor is used to protect the transmission line from fire [3].

2 Mathematical Modeling

As we know that, resistance of the conductor can be calculated as

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$$R = \frac{\rho L}{A}$$

So,

$$R \propto L$$

By changing the length of the conductor, the resistance will also change.
According to Ohm's law

$$I = \frac{V}{R}$$

Here, the voltage of the transmission line is constant.

So,

$$I \propto \frac{1}{R}$$

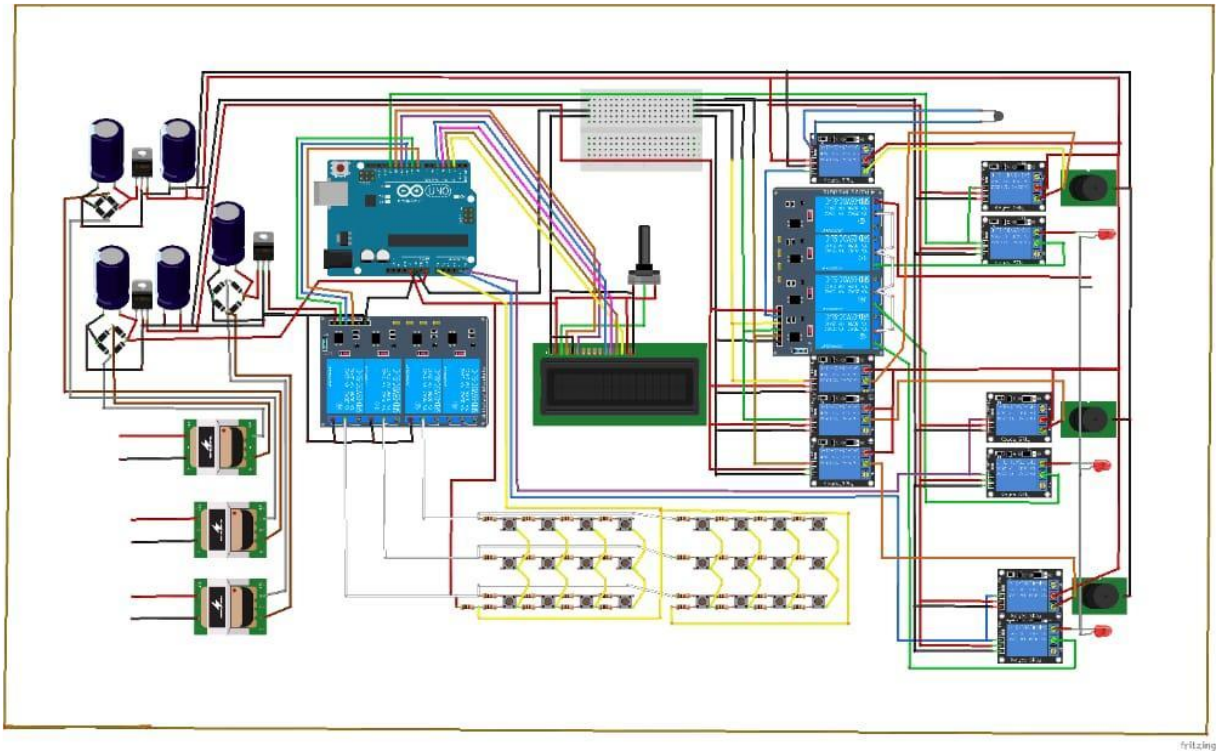

Figure 1: *Architecture of Fault Detection System*

When the resistance of the transmission line is changed due to the change of length in the transmission line according to their fault location then the fault current will also be changed, so we calibrate this fault current to find the distance of fault location in our paper. Architecture of the fault detection system is shown in Fig. 1.

Here we have shown a prototype model or 3p fault detection, so we make the fault line by using switches. We know that the impedance of the line increases with increase in length. So, we use resistance combination in senses, for each phase a different set of resistance is used and for each phase one relay is used to isolate the load at the time of fault which gives exact length of fault occur on line [4]. The mastermind of our paper is Arduino uno. The DC supply is required for controlling the board which is provided with the help of a rectifier and transformer combination. Output switch is given an analog pin of Arduino uno and display is connected to digital output pin of arduino. So, when we move the fault it indicates the display with exact

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distance, and at the same time the arduino gives output to the relay and it disconnects load from supply. This all happens as soon as fault occurs in line [5].

3 Methodology

The paper's implementation involved the following steps:

Step 1: Hardware Setup

The hardware setup involved connecting the Arduino Uno to the relay module and buzzer. The connection/circuit diagram is shown below.

Step 2: Coding

The code for the paper was written using the Arduino Integrated Development Environment (IDE). The code included the following functionalities:

Read the voltage values from the sensors.

Compare the voltage value with predefined thresholds.

If the voltage exceeds the thresholds, switch off the relay and sound the buzzer.

If the voltage returns to normal, switch on the relay and turn off the buzzer [6].

Step 3: Testing

To test the paper, different types of faults, such as L-G, L-L, L-L-G, L-L-L & L-L-L-G were created by the use of a push button. The system was able to detect the faults and notify the maintenance team through the buzzer. The Hardware Model of the paper is shown in Fig. 2. [7].

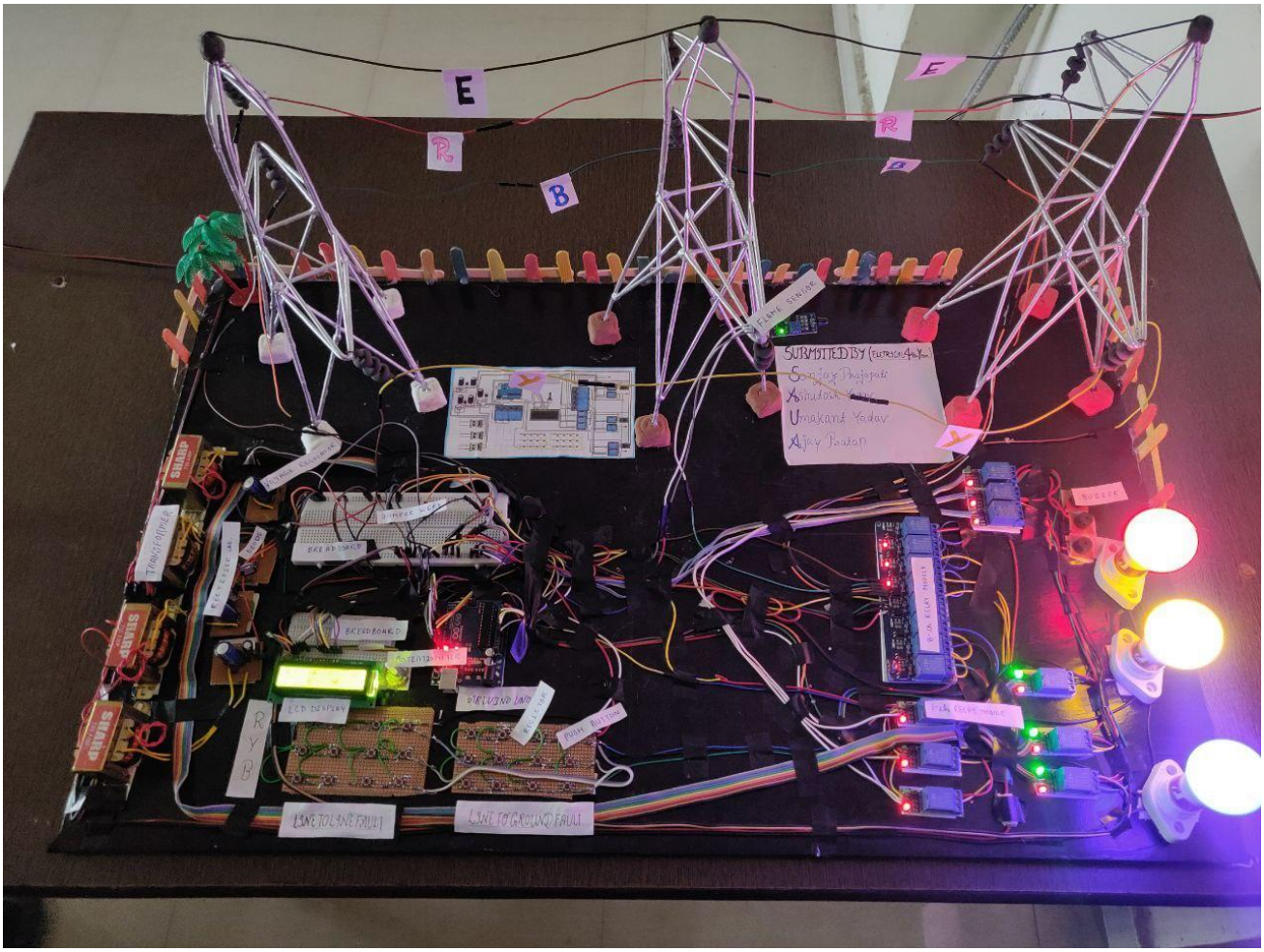

Figure 2: *Hardware Model*

4 Conclusion

The paper's results indicate that the proposed system is an effective method for detecting transmission line faults. The system can quickly identify the type of fault and its distance & notify the maintenance team through an alarm. The fault detection system can help prevent power outages and reduce maintenance costs. The future implications of the paper are very great considering the amount of time it saves. This paper can be used as a reference for making a protection scheme to be implemented in transmission lines of higher level. The current system can be made to work with GSM, Node MCU, and IoT to operate remotely [8]- [10]. It is used in transmission line fault detection systems. It is used in the Industrial Fault detection system. It can be used in underground fault detection. It detects the exact fault location. It minimizes human effort.

5 Declarations

5.1 Competing Interests

The authors declare no conflict of interest.

5.2 Study Limitations

There are no limitations that significantly affect the research outcome.

5.3 Warning for Hazard

This work does not involve any chemicals, procedures, or equipment with unusual hazards.

5.4 Ethical Approval

Ethical approval is not required for this study.

5.5 Informed Consent

No human or animal subjects were involved in this research; hence no informed consent was obtained.

5.6 Publisher's Note

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