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Fault Detection in Three-Phase Transmission Lines

Omkar Lohar[1], Shreyash Lohar[2], Sanket Shinde[3], Prathamesh[4], Tashildar[5]
Students
Department of Electrical Engineering
Sharad Institute of Technology Yadrav, Ichalkaranji
Corresponding Author's Email: - *omkarlohar1508@gmail.com[1]*

Abstract

In a world where electricity is indispensable for daily life, ensuring a reliable supply is paramount. Addressing faults in transmission lines is crucial, and the 8051 microcontroller stands out as a powerful tool for fault detection and localization. This innovative prototype employs a network of resistors to simulate cable lengths in kilometers, allowing the microcontroller to accurately pinpoint faults based on predefined switch settings corresponding to specific kilometer markers. Through the utilization of relays, fault detection signals are efficiently transmitted and displayed on a 16/2 LCD screen under the guidance of the 8051 microcontroller. Power is sourced from a step-down transformer, converting 230V AC to 12V AC, subsequently rectified to DC for stable operation. In three-phase systems, three transformers are employed for enhanced efficiency. Additionally, fire sensors, strategically positioned on transmission towers, detect and alert to fire incidents caused by faults, ensuring prompt response and mitigation measures.

Keywords: *Transmission line, Electrical energy, Electrical system, Fault detection*

INTRODUCTION

As we seen our surrounding the fault occurred in the transmission line is very common in rainy season and it is very dangerous for us. The electrical power system is growing in size and complexity in all sectors such as generation, transmission, distribution, distribution so in this complex network fault is happened which results in several economic losses and reduce

reliability of electrical system. We take care to resolve this fault as soon as possible, if we failed to resolve this then it can cause complete black our or grid failure. Generally, the 70% to 90% of faults on overhead lines, most of the faults occurred due to lighting smiles, storm, flashover these is very harmful for the society. In transmission line this type of faults line to line faults line to ground fault there are many types of faults, so, due to this fault many losses are occurred and damage of electrical equipment's. Here we created the prototype model of 3 phase fault detection. We make line faults with the help of switches. For each line separate switch set is used to make the fault. The DC supply is used for controlling board with the help of rectifier to convert AC to DC and transformer to step down. In our controlling board master mind is Arduino uno. It display's the fault occurred in line with distance. Three bulbs are used for indication of line. If any line fault is happened the bulbs shows which line fault is occurred. The Electric Power System is divided into many different sections. One of which is the transmission system, where power is transmitted from generating stations and substations via transmission lines into consumers. While using this system faults are occurred. What is fault? Fault is simply defined as a number of undesirable but unavoidable incidents can temporarily disturb the stable condition of the power system that occurs when the insulation of the system fails at any point. If a conducting object comes in contact with a bare power conductor, a short circuit, or fault, is said to have occurred. The causes of faults are many, they include lighting, wind damage, trees falling across transmission lines, vehicles or aircraft colliding with the transmission towers or poles, birds shorting lines or vandalism. In this study, we studied about overhead transmission lines were the focus of the research. Some of the many causes of faults and some detection methods will be discussed. These faults lead to substantial damage to the power system equipment. In India it is common, the faults might be LG (Line to Ground), LL (Line to Line), 3L (Three lines) in the supply systems and these faults in three phase supply system can affect the power system. For this problem this project is created.

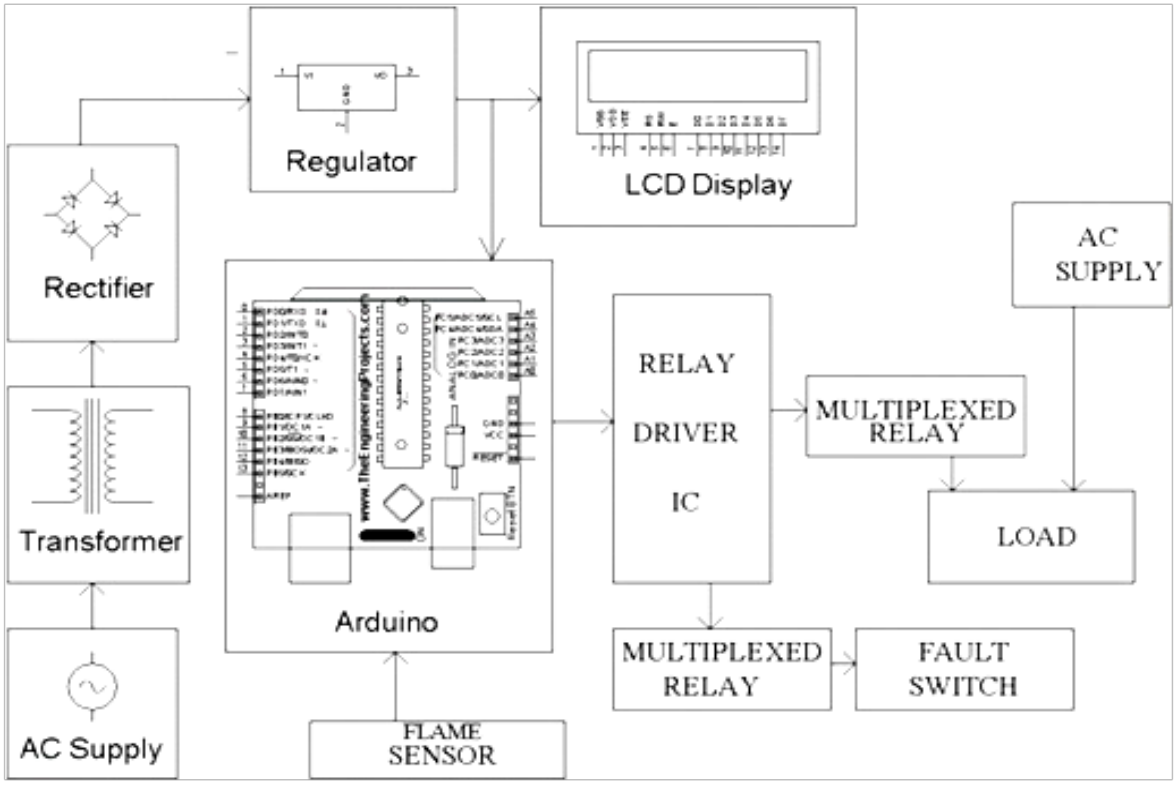
PROBLEM STATEMENT

Fault introduces serious danger on both electrical apparatus and people. Therefore, we have to protect ourselves as well as the equipment's from these faults. Without its power system will fail in no time. Various issues need to be protected are-

- Safety for People
- Equipment safety: Keeping equipment safe from various electrical abnormal and faulty conditions.

- Power system stability: Maintaining a continuous and reliable power supply.

Block Diagram



Hardware Requirement

- Transformer
- Rectifier
- Regulator
- Arduino
- Flame sensor
- Relay driver IC ULN 20003
- Relay
- Fault switch

Software Requirement

- Eagle
- Proteus
- Arduino id

Specification Components

- **Transformer**

Transformer it is a device used to reduce or increase the voltage level of an alternating current.

- **Rectifier**

Rectifier it is a device used to convert alternating current to direct current by allowing flow the current in one direction.

- **Arduino**

Arduino is an open source platform based on program. It can read input signals like light on sensor or finger on button etc. this device used to control device easily.

- **Flame sensor**

Flame sensor is an artificial sensor used to detect and respond in the presence of flame or fire.

- **Relay driver IC ULN 2003**

Relay driver IC ULN 2003 is high voltage and high current integrated IC which used Darlington array. It can control at a time seven relay devices to tripe at high voltage and high current. It has high carrying capability.

- **Relay**

Relay is a device that open or close the contacts at the cause's operation of other electrical devices or controls. It cans séance the fault in contacts.

Working of Project

Electricity is most important need in this world. We need electricity for day-to-day life. While supplying this electricity some steps are present, they are generation – transmission – substation – distribution – consumer. While this process faults are occurred in line. they are L-L (line to line), L- G (line to ground), L-L-L (line to line to line).

Electric power transmission lines are the veins which pump which life into the modern-day world, delivering electricity to consumers at their homes, offices and industries. It is important to ensure a smooth operation of transmission lines to deliver a minimally

interrupted power supply making necessary for reliable operation of electrical power lines. This need has given rise to fault location detection techniques so that the economic impact of the fault situations can be mitigated and their correction can be rendered simpler and precise. Underground and overhead cables have been widely implemented due to their reliability and limited environmental concerns. To improve the reliability of a distribution system, accurate identification of a faulted segment is required in order to reduce the interruption time during fault. Therefore, a rapid and accurate fault detection method is required to accelerate system restoration, reduce outage time, minimize financial losses and significantly improve the system reliability. When fault occurs on transmission lines, detecting fault is necessary for power system in order to clear fault before it increases the damage to the power system. When any fault occurs in cable, then it is difficult to locate fault. So, we will move to find the exact location of fault. Electric power can be transmitted or distributed either by overhead system or by underground cables. The underground cables have several advantages such as less liable to damage through storms or lightning, low maintenance cost, less chance of faults, smaller voltage drop and better general appearance.

However, their major drawback is that they have greater installation cost and introduce insulation problems at high voltages compared with the equivalent overhead system. For this reason, underground cables are employed where it is impracticable to use overhead lines. Such locations may be thickly populated areas where municipal authorities prohibit overhead lines for reasons of safety, or around plants and substations or where maintenance conditions do not permit the use of overhead construction underground cable and overhead cable.

We make the fault in cables by switching the buttons. The project uses four sets of resistances in series representing cables i.e., R4, R5, R7, R8 and R9, R10, R11, R12 then R13, R14, R15, R16 then R17, R18, R19, R20. One set for each phase. Each series resistors represent the resistance of the underground cable for a specific distance (200m). 3 relays are used to common point of their contacts are grounded while the points of input resistance R9, R13, R17are connected to the 3phase supply as an input. The common point of R6 & R4 is connected to pin of A0 which is ADC (Analog to digital) pint of Arduino.

Two switches are connected with Arduino digital pin 0 and 1 for overhead cable. They are pulling down by the 10K resistor. While any of the 12 switches (representing as fault

switches) are operated they impose conditions like line to ground (LG), line to line (LL), line to line to line(3L) fault as per the switch operation.

The program while executed continuously scans by operating the 3 relays in sequence of 1sec interval. Thus, any point while driven to GND through the common contact point of the relay, the current flows and if any of the fault switch pressed the fault is occurs, depending on the created fault. Thus, the voltage drop at the analog to digital (ADC) pin varies depending on the current flow which is inversely proportional to the resistance value representing the length of cable in meters. This varying voltage is fed to the ADC to develop an 8-bit data to the Arduino. Program while executed displays an output in the LCD display depend upon the distance of the fault occurring in meters. When no fault occurs in underground and overhead line the LCD display.

This project is underground cable. The Arduino system has the ability to locate the fault whether it is in the overhead line or in the underground power cable. In addition to, the proposed scheme gives an accurate estimation of the fault resistance at fault location.

CONCLUSION

This project represents that the fault location scheme for transmission systems consisting of an overhead line and underground cable. The Arduino system has the ability to locate the fault whether it is in the overhead line or in the underground power cable. In addition to, the proposed scheme gives an accurate estimation of the fault resistance at fault location.

FUTURE SCOPE

- By designing the snubbers more accurately, the whole drive can be made more sophisticated. Also by using micro controller the control circuit becomes simpler and the switching circuitry reduces.

- By applying this Project we can save more electricity up to next generation.

- Safety of electrical vehicles charging station. Reduce the number of losses.

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