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Modelling of Fault Detection in Underground and Overhead Transmission System Using Arduino

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***Abstract*: This Paper represents that to compute the distance of the underground and overhead transmission cable from fault location to the base station using Arduino. In this paper, a smart technology based fault detection and location system was used to adequately and accurately indicate and locate the exact spot where fault had occurred. This will ensure a shorter response time for technical crew to rectify these faults and thus help save transformers and other electrical equipment from damage and disasters. For underground cables (UC) fault detection, we use the concept of ohm's law. UC has many types and it has different resistance that depends upon the length of the cable. The low DC voltage is applied at the feeder end through series resistor (cable lines), the current would be vary depending upon the location of fault in the cable. When, there is short circuit (Line to ground), the voltage across series resistor change accordingly, which is the fed to the inbuilt ADC of Arduino to develop precise digital data for display in meters. In this paper the set of resistor representing cable length (in meters) and fault is created by the set of suitable at every instant in meters, to verify the accuracy. The fault is displayed on Liquid Crystal Display (LCD) interfaced to Arduino. For overhead cables (OC) fault detection, when the open circuit and short circuit fault occur, our sensing device i.e. relay sense the fault and send information to the microcontroller. The microcontroller senses that command and display on Liquid Crystal Display (LCD). The system uses an Arduino board, Liquid Crystal Display (LCD), Relay, Resistors, voltage supply etc. Arduino system detects the faults, analyses and classifies these faults and then, determines the fault distance. Then, the fault information is transmitted to the control room.**

***Keywords*: Underground Cables, Overhead lines, Liquid Crystal Display (LCD), Voltage Regulator, Rectifier, Relay driver.**

1. Introduction

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.

A. Objective of the paper

The motivation of the paper is to detect and determine the location of various types of fault of a transmission line model, while considering both accuracy and speed. The main objectives of the paper are:

1) To design an efficient and robust automatic fault detection and location system for overhead and underground power transmission lines.
2) To reduce response time needed to rectify and save expensive transformers from damage or theft which usually occurs during longer power outages.
3) To increase productivity of technical crews since the time needed to locate faults will be minimized.
4) To ensure stability and reliability of the power supply system in the country to boost economic growth.

2. Underground and Overhead Cable

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.

A. Classifications of Cables

Cables for underground service may be classified in two ways according to

a) The type of insulating material used in their manufacture
b) The voltage for which they are manufactured.

However, the latter method of classification is generally preferred, according to which cables can be divided into the following groups:

1) Low-tension (L.T.) cables — up to 1000 V
2) High-tension (H.T.) cables — up to 11,000 V
3) Super-tension (S.T.) cables — from 22 kV to 33 kV
4) Extra high-tension (E.H.T.) cables — from 33 kV to 66 kV
5) Extra super voltage cables — beyond 132 kV.

3. Block Diagram

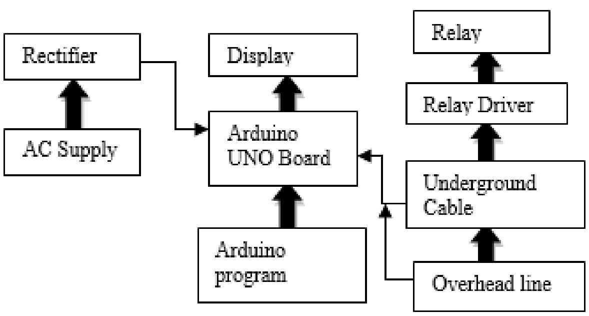

Fig. 1. Block diagram

4. Working Principle

In this paper, we have two systems i.e. underground cable and overhead lines. We make the fault in cables by switching the buttons. The project uses four sets of resistances for overhead lines and three sets of resistances for overhead 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 in overhead lines and for underground the resistors R21 to R32(12 resistors). One set for each phase in underground cables. Each series resistors represent the resistance of the underground cable for a specific distance (assume 1□ as 1m). 6 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 and R24, R28, R32 are connected to pins A1, A2, A3 which are 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) in both models 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 microcontroller Analog port. Program while executed displays an output in the LCD display depend upon the distance of the fault occurring in meter's. When no fault occurs in underground and overhead line the LCD display shows that R:NF, Y:NF, B:NF, span1:NF, span2:NF. When the fault occurs in R phase on 100 meters then LCD display R:100m, Y:NF, B:NF.

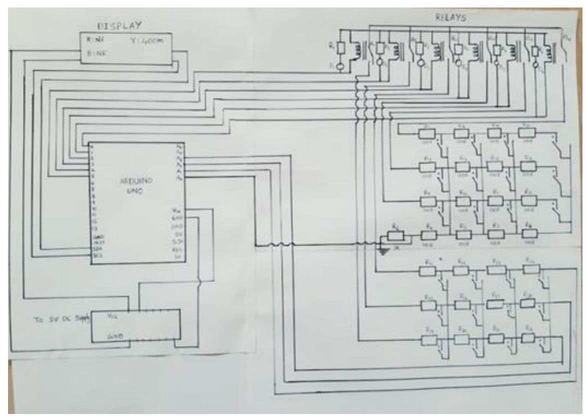

Fig. 2. Circuit diagram

5. Arduino Code

```
int raw1= 0;
int raw2= 0;
int raw3= 0;
int raw4= 0;
int raw5= 0;
int raw6= 0;
int Vin= 5;
float Vout= 0;
int R1= 1000;
int R2= 0;
int R3= 0;
int R4= 0;
int R5= 0;
int R6= 0;
int R7= 0;
float buffer= 0;
#include <Wire.h>
#include <LiquidCrystal_I2C.h>

LiquidCrystal_I2C lcd(0x27,20,4);
```

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```
void setup () {
pinMode (A0, INPUT);
pinMode (A1, INPUT);
pinMode (A2, INPUT);
pinMode (A3, INPUT);
pinMode (A4, INPUT);
pinMode (A5, INPUT);
 pinMode (1, OUTPUT);
 pinMode (2, OUTPUT);
 pinMode (3, OUTPUT);
 pinMode (4, OUTPUT);
 pinMode (5, OUTPUT);
 pinMode (6, OUTPUT);

 digitalWrite(1, HIGH);
 digitalWrite(2, HIGH);
 digitalWrite(3, HIGH);
 digitalWrite(4, HIGH);
 digitalWrite(5, HIGH);
 digitalWrite(6, HIGH);
 lcd. begin (16, 2);
 lcd.backlight();
 }

void loop () {
// Underground transmission line
 lcd.clear();
 lcd.setCursor(1, 0);
 lcd.print    (" OVERHEAD");

  lcd.setCursor(2, 1);
 lcd.print("TRANSMISSION ");


 delay (500);

 raw1= analogRead(A0);
 delay(500);
   lcd.clear();
 if(raw1){
 buffer= raw1 * Vin;
 Vout= (buffer)/1024.0;
 buffer= (Vin/Vout)-1;
 R2= R1 * buffer;
 lcd.setCursor(0, 0);
 lcd.print("R:");
 lcd.print(R2);
 lcd.print("m");
  digitalWrite(1, LOW);}
else {

 lcd.setCursor(0, 0);
 lcd.print("R:");
 lcd.print("NF ");
 digitalWrite(1, HIGH);

}

 delay (500);

 delay(500);

 raw2= analogRead(A1);
 delay (500);
 if(raw2) {
 buffer= raw2 * Vin;
 Vout= (buffer)/1024.0;
 buffer= (Vin/Vout)
-1;
 R3= R1 * buffer;
 lcd.setCursor(8, 0);
 lcd.print("Y:");
 lcd.print(R3);
 lcd.print("m");
 digitalWrite(2, LOW);}
else{

 lcd.setCursor(8, 0);
 lcd.print("Y:");
 lcd.print("NF ");
digitalWrite(2,HIGH);
}

 delay (500);


 delay (500);

 raw3 = analogRead(A2);
 delay (500);

 if(raw3){
 buffer= raw3 * Vin;
 Vout= (buffer)/1024.0;
 buffer= (Vin/Vout) -1;
 R4= R1 * buffer;
 lcd.setCursor(0, 1);
 lcd.print("B:");
 lcd.print(R4);
 lcd.print("m");
  digitalWrite(3, LOW);}
else {

 lcd.setCursor(0, 1);
 lcd.print("B:");
 lcd.print("NF ");
 digitalWrite(3, HIGH);
 }
```

```
delay (500);

  lcd.clear();
lcd.setCursor(3, 0);
lcd.print("UG CABLE ");
  delay (500); delay (500);


raw4= analogRead(A3);
delay(500);
if(raw4){
buffer= raw4 * Vin;
Vout= (buffer)/1024.0;
buffer= (Vin/Vout)
-1;
R5= 10000 * buffer;
lcd.setCursor(0, 1 );
lcd.print("FAULT at ");
lcd.print(R5);
lcd.print("m");

digitalWrite(4, LOW);
digitalWrite(5, LOW);
digitalWrite(6, LOW);
delay (500); delay (500);}


else {

lcd.setCursor(0, 1);
lcd.print("STATUS ");
lcd.print("NO FAULT");
digitalWrite(4, HIGH);
digitalWrite(5, HIGH);
digitalWrite(6, HIGH);
 delay (500);

 delay (500);
delay (500);

 }
}
```

6. Result

This paper 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.

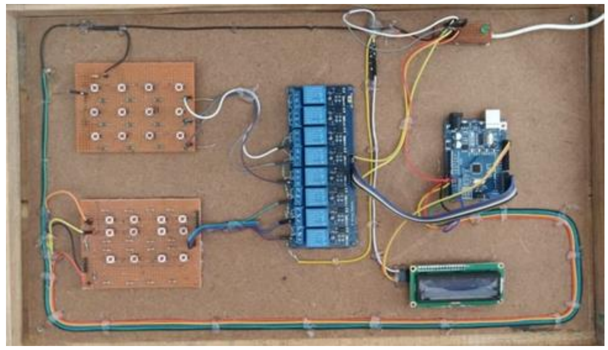

Fig. 3. Hardware result of the project

7. Conclusion

This paper proposed a fault location scheme for transmission systems consisting of an overhead line in combination with an underground power cable. In this method, the short circuit fault at a particular distance in the underground cable can be located using simple concepts of OHM's law enables to rectify fault efficiently feeder end in meters by using Arduino. For this we use simple concept of OHM's law so fault can be easily detected and repaired. By using Arduino controller, we can find out exact fault location. Once faults occur in the cable, the display unit displays the exact fault location that displays which phase is affected in the cable and how long it's affected.

References

[1] Yang, Xia, et al. "Fault location for underground power cable using distributed parameter approach.", IEEE Transactions on Power Systems, vol. 23, no. 4, pp. 1809-1816, 2008.

[2] Westrom, Arthur C., and James W. Larsen. "Fault distance locator for underground cable circuits." U.S. Patent No. 5,600,2 48. 4 Feb. 1997.

[3] Zhao, W., Y. H. Song, and W. R. Chen. "Improved GPS travelling wave fault locator for power cables by using wavelet analysis," International journal of electrical power & energy systems 23.5 (2001): 403-411.

[4] M. Gilany, D. k. Ibrahim and E. S. Tag Eldin, "Traveling-Wave-Based Fault-Location Scheme for Multiend-Aged Underground Cable System," in IEEE Transactions on Power Delivery, vol. 22, no. 1, pp. 82-89, Jan. 2007.

[5] Raghu Raja Kalia and Preeti Abrol. Article: Design and Implementation of Wireless Live Wire Fault Detector and Protection in Remote Areas. International Journal of Computer Applications 97(17):14-20, July 2014.

[6] B. Clegg, Underground Cable Fault Location. New York: McGraw- Hill, 1993. International Journal of Engineering Science and Computing, April 2017 6463.

[7] M. S. Choi, D. S. Lee, and X. Yang, "A line to ground fault location algorithm for underground cable system," KIEE Trans. Power Eng., pp. 267–273, Jun. 2005.

[8] E. C. Bascom, "Computerized underground cable fault location expertise," in Proc. IEEE Power Eng. Soc. General Meeting, Apr. 10–15,1994, pp. 376–382.

[9] J. Clerk Maxwell, A Treatise on Electricity and Magnetism, 3rded., vol. 2. Oxford: Clarendon, 1892, pp. 68–73.

[10] K. K. Kuan, K. Warwick, "Real-time expert system for fault location on high voltage underground distribution cables", IEEE Proceedings-C, Vol. 139, No. 3, May 1992.

[11] Tarlochan S. Sidhu, Zhihan Xu, "Detection of Incipient Faults in Distribution Underground Cables", IEEE Transactions on Power Delivery, vol. 25, no. 3, July 2010.

[12] J. Densley, "Ageing mechanisms and diagnostics for power cables—an overview," IEEE Electr. Insul. Mag., vol. 17, no. 1, pp. 14–22, Jan./Feb. 2001.