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GSM Based Underground Cable Open and Short Circuit Fault Detection

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Abstract: ***The underground cable system is a common practice followed in many urban areas. While a fault occurs for some reason, at that time the repairing process related to that particular cable is difficult due to not knowing the exact location of the cable fault. Hence, the main objective of this project is to determine the distance of underground cable fault from base station in kilometers using an Arduino board and GSM. The project uses the standard concept of Ohms law and voltage division rule to detect and locate the fault. The fault occurring at a particular distance and the respective phase is displayed on a LCD interfaced to the Arduino board and information regarding fault occurrence is sent to control areas using GSM modules.***
Keywords: Arduino Board, Ohms Law, Underground fault, Resistance, LCD, ADC (Analogue to digital converter).

I. INTRODUCTION

An bundle of electrical conductors used for carrying electricity is called as a cable. An underground cable generally has one or more conductors covered with suitable insulation and a protective cover[1].Commonly used materials for insulation are varnished cambric or impregnated paper. Fault in a cable can be any defect or non-homogeneity that diverts the path of current or affects the performance of the cable. So it is necessary to correct the fault. Power Transmission can be done in both overhead as well as in underground cables. But unlike underground cables the overhead cables have the drawback of being easily prone to the effects of rainfall, snow, thunder, lightning etc. This requires cables with reliability, increased safety, ruggedness and greater service. So underground cables are preferred in many areas specially in urban places. When it is easy to detect and correct the faults in overhead line by mere observation, it is not possible to do so in an underground cable. As they are buried deep in the soil it is not easy to detect the abnormalities in them. Even when a fault is found to be present it is very difficult to detect the exact location of the fault. This leads to dugging of the entire area to detect and correct the fault which in turn causes wastage of money and manpower. So it is necessary to know the exact location of faults in the underground cables. Whatever the fault is,the voltage of the cable has the tendency to change abruptly whenever a fault occurs. We make use of this voltage change to detect the fault.

II. OBJECTIVES

To detect the exact location of short circuit cable fault in the underground cables from the feeder end in km by using resistors and dc supply. To detect the exact location of open circuit cable fault in an underground cable from feeder end at any distance with respect to cable by using capacitors and ac supply.

III. LITERATURE SURVEY

In Abhishek Pandey, Nicolas H. Younan, Presented underground cable fault detection and identification via fourier analysis [3]. The methods of impedance calculation via sending end voltage and differential voltage can be used for differentiating between the different types of cable defects from phase information. It needs study to be conducted to find the best way of visualizing the results, especially the magnitude response. S. Navaneethan, J. J. Soraghan, W. H. Siew, F. McPherson, P. F. Gale [6], presented an automatic fault location method using TDR. This method uses acquired data from an existing TDR instrument. It enables user of TDR equipment to locate ULVDN cable faults without user interpretation.

H. Shateri, S. Jamali Et Al., Proposed An impedance based fault location method for phase to phase and three phase faults [7]. This method utilized the measured impedance by distance relay and the super imposed current factor to discriminate the fault location. This method is sensitive to the measured impedance accuracy and super imposed current factor.

Pooja P.S and Lekshmi.M developed a resilient incipient fault location algorithm in the time-domain, which utilizes data collected by PQ monitors to estimate the fault location in terms of the line impedance by taking into account the arc voltage associated with the incipient cable faults[8].So the algorithm predicts cable fault location between two adjacent manholes. The proposed algorithm exactly pin-points the exact fault in the underground cable.

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IV. RELATED WORK

Tasks moved in Arduino UNO pack to perceive issues from the underground connections. Right when a fault occur in the underground connections, we can find faults through Arduino controller pack. LCD show which demonstrates the insufficiencies in Kilometre. In this endeavor we made faults physically. Connection has various sorts .Every connections has different deterrent which depends on the material used. The estimation of the hindrance is depends on the length of the connection. In here resistance is the principle occupation of the errand .If any deviation occur in the deterrent, the estimation of the voltage will be changed that particular point is called fault. We find those imperfection

A. Types of Faults

Faults has many types. Frequently Occurring faults are given below,

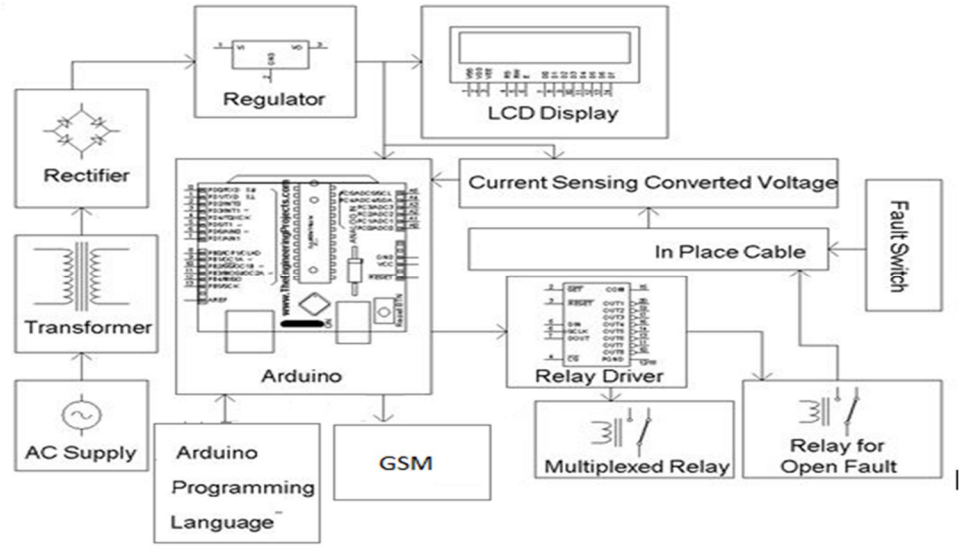
1) Short Circuit Fault
2) Open Circuit Fault
3) Earth Fault

a) *Short Circuit Faults:* A short out fault happens when there is an insurance dissatisfaction between stage conductors or between stage conductor(s) and earth or both. A protection disillusionment results into plan of a short out way that triggers a short out conditions in the circuit.

b) *Open Circuit Faults:* These faults occur due to the failure of one or more conductors. The most common causes of these faults include joint failures of cables and overhead lines, and failure of one or more phase of circuit breaker and also due to melting of a fuse or conductor in one or more phases. Open circuit faults are also called as series faults. These are unsymmetrical or unbalanced type of faults except three phase open fault.

c) *Earth Faults:* An earth fault is an unplanned contact between an engaged conductor and earth or equipment frame. The entry method for the fault current is through the setting up structure and any work power or rigging that ends up being a bit of that system.

V. PROPOSED SYSTEM



The circuit consists of a power supply, 4 line display, arduino and resistance measurement circuit. To induce faults manually in the kit, fault switches are used. About 12 fault switches are used which are arranged in three rows with each row having 4 switches. The 3 rows represent the 3 phases namely R,Y and B. The fault switches: have 2 positions- No fault position(NF) and fault position(F).Main component of the underground cable fault detection circuit is low value resistance measurement. It can measure very low value resistance as the cables have around 0.01 Ohm/meter resistance. For 10meter cable resistance becomes 0.1 Ohm. This circuit can measure resistance up 50 Ohm,Maximum cable length it can check up to 4 kilometres.

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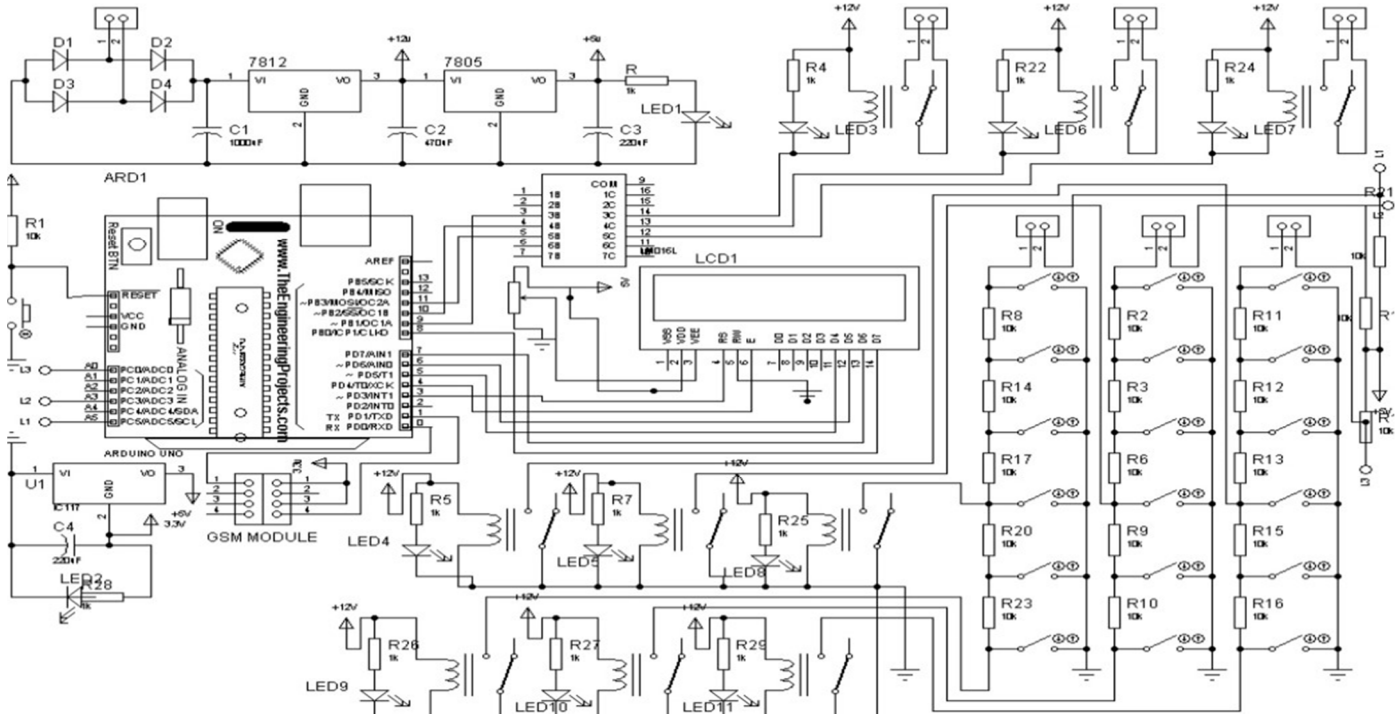
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So starting from the reference point 4 sets of resistances are placed in series. These 4 sets of resistances represent the three phases and the neutral .Short circuit faults, Symmetrical and unsymmetrical faults can be determined by this method. As supply needed for the relays is higher than that of the Arduino.

Relay driver is used to boost the supply and provide it to the relays. A 230V AC supply is applied to the transformer from where it is stepped down to 12V AC.From the transformer the alternating current gets converted into direct current when it passes through a Bridge wave rectifier. The 12V DC then goes to the voltage regulator where it gets converted from 12V DC to 5V DC. Voltage regulator is used also converts the variable Dc supply into constant DC supply. This 5V DC is used to supply power to the arduino and the LCD.

When fault is induced by operating any of the 12 switches (to F position), they impose conditions like LG, LL, LLG fault as per the switch operation. As a result of the fault, there is a change in voltage value. This voltage value measured across the resistance is fed to the ADC of the Arduino. Using this value, the arduino computes the distance. Finally the distance of the fault from the base station is displayed in kilometres.

VI. CIRCUIT DIAGRAM



VII. WORKING

The circuit uses standard power supply comprising of a step-down transformer from 230v to 12v and 4 diodes forming a Bridge Rectifier that delivers pulsating dc which is then filtered by an electrolytic capacitor of about 470microf to 100microF. The filtered dc being unregulated, IC LM7805 is used to get 5v constant at its pin no 3, irrespective of input dc varying from 9v to 14v. The regulated 5volts dc is further filtered by a small electrolytic capacitor of 10 microf for any noise so generated by the circuit. One LED is connected to this 5v point in series with a resistor of 330ohms to the ground i.e. negative voltage to indicate 5v power supply availability.

Voltage regulator feeds the voltage to microcontroller, LCD, the set of series resistors and the relay and relay driver IC ULN2003A. Also this model consists of three relays which are driven by a relay driver IC ULN2003A. The relay used here drives the bulb load to indicate the fault being occurred in corresponding phases and can be used to trip the power supply to the set of series resistors. The fault creation environment is made by a set of switches at every known equivalent kilometre as indicated by the set of series resistors to cross check accuracy of the same.

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When a fault is occurred at the distance in a phase (or two phases or three phases) current flows through the shorted line and developing drops across corresponding phase resistors.

This drop is sensed by the ADC (built inside the microcontroller) through Port and converts it into equivalent digital data. The microcontroller then process these data according to fault conditions pre programmed into the microcontroller. It sends out display signals about the location of fault to LCD and simultaneously send the information regarding faults to the control area using GSM module. To find the open fault we have arranged a relay set at two stages as per our requirements. At the first step, first stage relay set which is present in the middle of the cable becomes on and providing ground to all cables. Due to the ground connect at the middle, the voltage at the beginning point of the cable should be changed. If not change means the open fault is present between the starting points to middle relay point. The same concept is applicable for the second stage relay to find out the open fault between the middle point first stage relay and second stage relay.

VIII. CONCLUSION

Finally, we have done this project for location of fault in underground cable in the rural areas where underground transmission system is used. It is difficult to find the fault in the cable. So this project is beneficial to use to detect the fault location. So the fault can easily locate and extinguish. The Arduino has several advantages over the microcontroller, so arduino based underground fault detection is more advantageous than microcontroller based underground fault detection.

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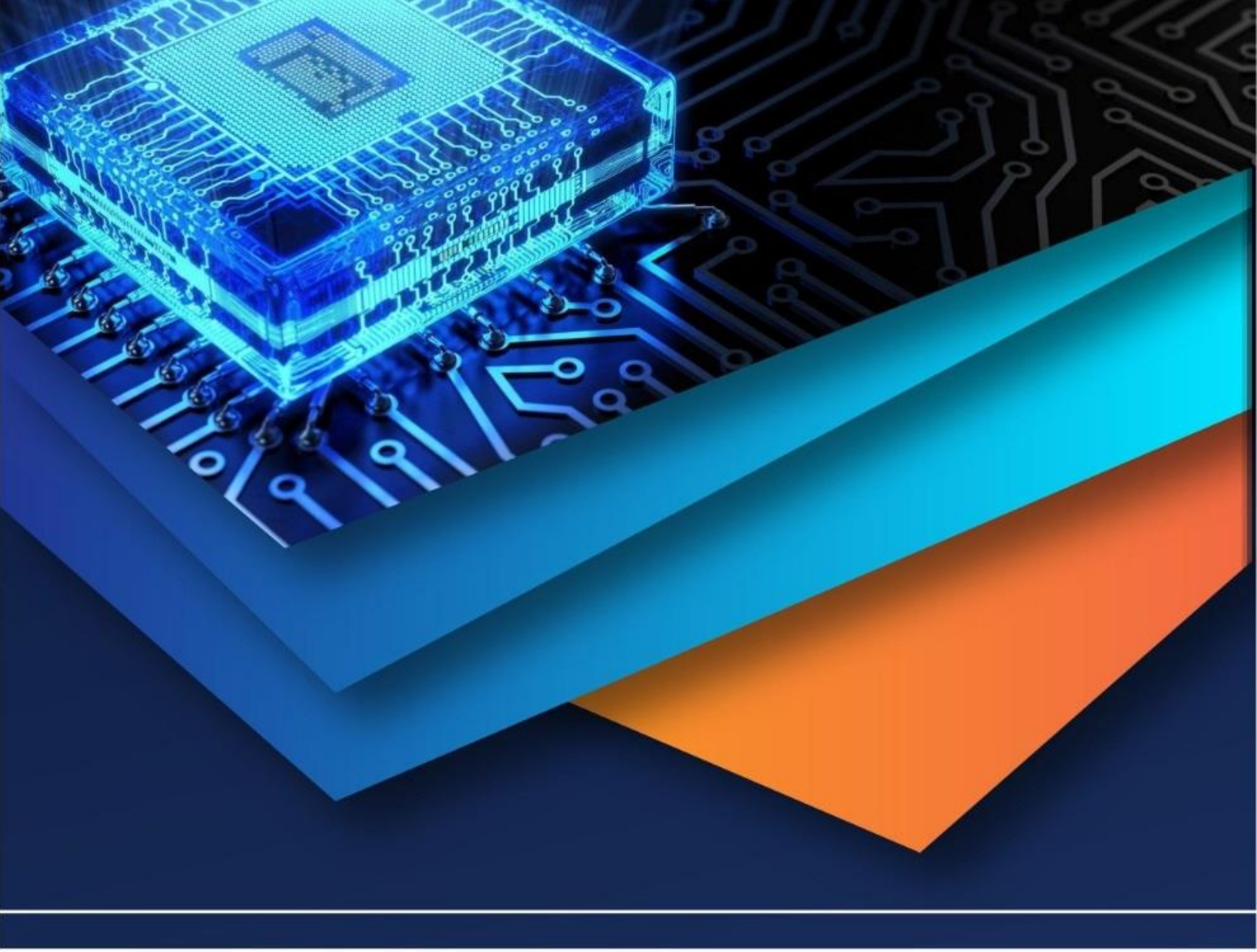
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