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UNDERGROUND CABLE FAULT DETECTION

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Abstract- The objective of this paper is to determine the distance of underground cable fault from base station in kilometers using an Arduino. 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. The proposed system is to find the exact location of the fault. The paper is assembled with a set of resistors representing the cable length in km and the fault creation is made by a set of switches at every known km to cross check the accuracy of the same. The fault occurring at a particular distance, the respective phase along with the distance is displayed on the LCD. The same information is also sent over IOT, interfaced to the Arduino.

Index Terms— IoT, Arduino Uno, Underground Cable fault, LCD, Web page, Resistance, Resistor network.

I. INTRODUCTION

A million miles of cables are threaded in the air across the country. But currently it is laid in the underground, which is larger to an earlier method. Because, underground cables are not affected by any adverse weather condition like pollution, heavy rainfall`, snow and storm, etc. But, when any problem occurs in cable, it is very difficult to find the exact location of the fault due to not knowing he exact location of the cable. Day by day, the world is becoming digitized so the project is proposed to find the location of fault in digital way, the process of repairing related to that particular cable is very difficult. The fault of the cable mainly occurs due to many reasons. They are: inconsistent, any defect, weakness of the cable, insulation failure and breaking of the conductor. To overcome this problem, here is a project namely underground cable fault distance locator, used to find the location of the fault for underground cable. As India emerging as a developing country, civilized area is also increasing day by day. Even though most lines are laid overhead method, underground line method finds its application in large areas like hospital, colleges etc. because they ensure safety. The concept of UG cable emerges for power transmission due to its obvious advantages. But in case of faults occurs then detection becomes difficulty due its invisible character .An advance method to prevent digging out cable without knowing the exact location of the cable fault.

1.1 FAULTS IN UNDER GROUND CABLES

1) 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.

2) SHORT CIRCUIT FAULTS

A short circuit can be defined as an abnormal connection of very low impedance between two points of different potential, whether made intentionally or accidentally. These are the most common and severe kind of faults, resulting in the flow of abnormal high currents through the equipment or transmission lines. If these faults are allowed to persist even for a short period, it leads to the extensive damage to the equipment. Short circuit faults are also called as shunt faults. These faults are caused due to the insulation failure between phase conductors or between earth and phase conductors or both. The various possible short circuit fault conditions include three phase to earth, phase to phase, single phase to earth, two phase to earth and phase to phase. In single line to ground fault, fault occurs between any one of the three lines and the ground. In double line to ground fault, fault occurs between any two of the three lines and the ground. In line to line fault, fault occurs between any two lines. When fault occurs there is an abrupt change in voltage. This change in voltage may cause serious damages to the system if not corrected in time].So immediate step of fault correction is isolation of the faulty part from the rest of the system.

II. LITERATURE SURVEY

[1] Abhishek Pandey, Nicolas H. Younan, Presented underground cable fault detection and identification via fourier analysis[7]. 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.

[2]A. Ngaopitakkul, C. Pothisarn, M. Leela jindakrairerk, presented behaviour of simultaneous fault signals in distribution underground cable using DWT. The simulations were performed using ATP/EMTP, and the analysis behaviour of characteristics signals was

Performed using DWT. Various case studies have been carried out including the single fault and simultaneous fault.

[3]Yuan Liao, Ning Kang has presented fault location algorithms without utilizing line parameters. By utilizing unsynchronized voltage and current measurements from both ends of line without requiring line parameters based on the distributed parameter line model. The fault location estimatie is not sensitive to measurement errors while line parameter estimates are sensitive to measurement errors. Thus relatively precise measurements are required to obtain accurate line parameter estimates.

[4]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[3].So the algorithm predicts cable fault location between two adjacent manholes.The ANNs are a family of statistical learning algorithm inspired by biological neural networks and are used to appropriate functions that depend on the large number of inputs. The proposed algorithm exactly pin-points the exact fault in the underground cable.

[5] H. Shateri, S. Jamali *Et Al.,* Proposed An impedance based fault location method for phase to phase and three phase faults[6] . This method utilized the measured impedance by distance relay and the super imposed current factor to discriminate the fault location. This method is ensitive to the measured impedance accuracy and super imposed current factor.

[6] S. Navaneethan, J. J. Soraghan, W. H. Siew, F.

McPherson, P. F. Gale [10] , 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.

III. PROBLEM STATEMENT AND OBJECTIVES

3.1 PROBLEM STATEMENT:

The certain frequents fault in underground electrical cables because of the plastic insulation because of the chemical actions. Reaction or also poor workmanship at the time of installation and difficulty in indicating the appropriate fault area has a very serious problem. Most underground electrical cable faults, that are situated by without earthing the whole length of armored cable to enable the visual inspection to the carried out. In this way, visual inspections are not helpful, then the whole length of the cable which is replaced. This type of solution is not only economically expensive but also long outage of electrical cables from services results in the more heavy losses of revenue for the company which distributes power. The production losses in the industries as well as critical conditions for the general public hence the consumers can left it without the electricity for entire period taken to the unearth the electrical cable and carried out necessary repairs.

3.2 OBJECTIVES:

1) The objective of this paper is to determine the distance of cable fault from the base station in unit distance using arduino board.

2) Cable fault detector is an advanced method for finding fault location in cables

3) To measure the distance of the faults from BS (base station).

IV. PROPOSED SYSTEM

Underground fault detector where as in this we are added IOT. Hardware part of this project step down transformer, voltage regulator circuit, Arduino board, LCD display, Wi-Fi module, demo purpose we are use register instead of cable. In reality need to connect cable because as resistance of the cable is directly proportional to the length of the cable. As length of the cable increase resistance of the cable also increases. Again here to create a fault we are used switches in reality also we are need not connect the switches each switch indicates distance of 5Km.Now we will see what you actually need to do .Here we can use 3 relay which indicate each phase R-phase, Y-phase, B-phase.

4.1.1 BLOCK DIAGRAM:

You just need to extend cables. Need not connect these resistors or switch. As have said early that length of cable has some resistance that R directly proportional to length. Length of the cable is increases, it resistance increases. So in this project we can actually know and what distance fault has been created.

So, I just give the supply whenever i give the supply underground cable fault it is supply underground cable fault it is displayed on LCD and this module getting connected to Wi-Fi it is displayed Wi-Fi is connecting. When it is connected to Wi-Fi at this module it will be displayed Wi-Fi connected.

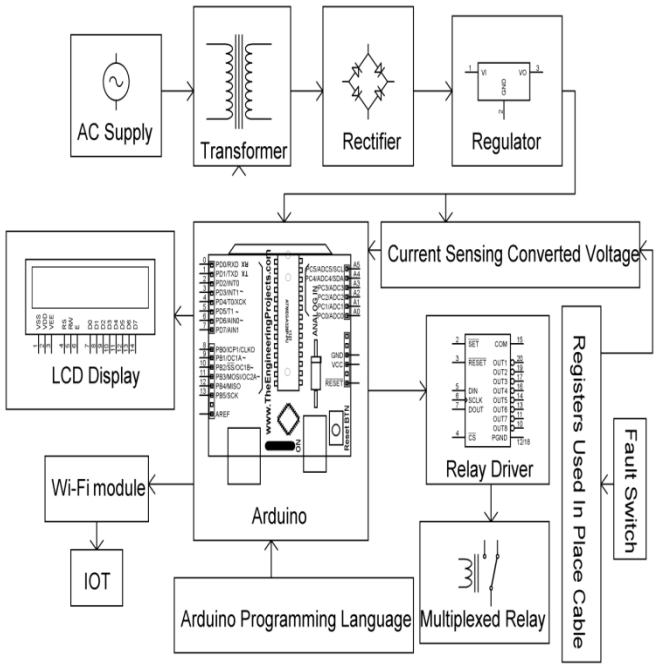

Fig 4.1: Block Diagram of Underground cable fault detection

Initially it shows R=0 Y=0 B=0Km .If I want to create a fault in "R" phase at the distance of 10Km. I just slide this switch toward the ground. This switch is grounded shows that R=10Km.Respective R-phase relay goes off which is indicated by LED. If I want to create a fault in Y-phase at a distance of 20Km.i just slide at this switch to ground Y=20Km. If I want to create a fault in B-phase at a distance of 20Km.i just slide at this switch to ground B=20Km.

Whenever fault is created at a particular phase those respective relay goes off which indicated by LED, RED, YELLOW, GREEN. Now whole data will be uploaded over the IOT. Now this is displaying in LCD. IOT page will open thingspeak.com whenever the fault is created the data will be uploaded here. This will be shows in graphical representation and pointer representation. Whenever fault occur the graph changes a value initially it is "0Km" fault is created in R phase at the distance of 10Km and pointer represents pointer toward 10Km.

4.2 HARDWARE REQUIREMENTS:

1. Arduino UNO
2. Power supply
3. Voltage Transformer
4. Bridge rectifier
5. Voltage Regulator
6. LCD display
7. Wi-Fi module
8. Resistors
9. Relay driver IC10
10. Relay
11. LEDs

4.2.1 DESCRIPTION OF HARDWARE REQUIREMENTS:

1. ARDUINO UNO:

The Arduino platform has become quite popular with people just starting out with electronics, and for good reason. Unlike most previous programmable circuit boards, the Arduino does not need a separate piece of hardware (called a programmer) in order to load new code onto the board – you can simply use a USB cable. Additionally, the Arduino IDE uses a simplified version of C++, making it easier to learn to program. Finally, Arduino provides a standard form factor that breaks out the functions of the micro-controller into a more accessible pack.

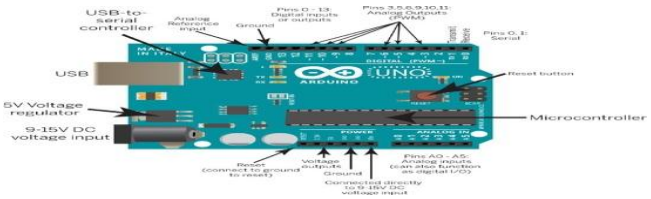

Fig2: ARDUINO DIAGRAM

2. POWER SUPPLY:

The power supply circuit consists of step down transformer which is 230v step down to 12v.In this circuit 4diodes are used to form bridge rectifier which delivers pulsating dc voltage and then fed to capacitor filter the output voltage from rectifier is fed to filter to eliminate any ac components present evenafter rectification. The filtered DC voltage is given to regulator to produ constant.

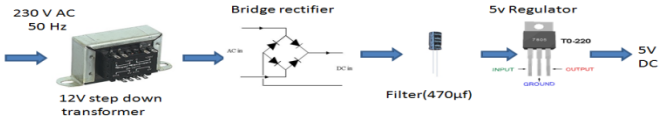

Fig3: POWER SUPPLY

3. VOLTAGE TRANSFORMER:

The Voltage Transformer can be thought of as an electrical component rather than an electronic component. A transformer basically is very simple static (or stationary)

electro-magnetic passive electrical device that works on the principle of Faraday's law of induction by converting electrical energy from one value to another.

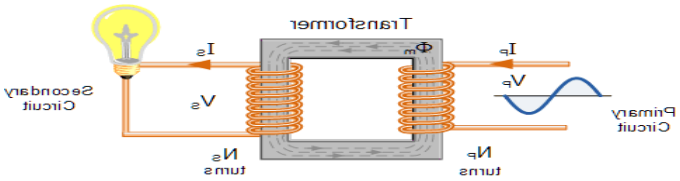

Fig4: TRANSFORMER

4. RECTIFIER:

A rectifier is an electrical device that converts alternating current (AC), which periodically reverses direction, to direct current (DC), which flows in only one direc on. The process is known as rectification.

Rectifiers have many uses, but are often found serving as components of DC supplies and high-voltage direct current power transmission systems. Rectification may serve in roles other than to generate direct current for use as a source of power.

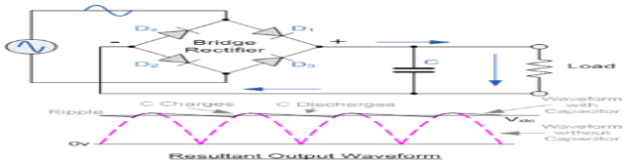

Fig5: BRIDGE RECTIFIER

5. VOLTAGE REGULATOR:

A voltage regulator is an electrical regulator designed to automatically maintain a constant voltage level. In this project, power supply of 5V and 12Vare required. In order to obtain these voltage levels, 7805 and 7812 voltage regulators are to be used. The first number 78 represents positive supply and the numbers 05, 12 represent the required output voltage levels. The L78xx series of three-terminal positive regulators is available.

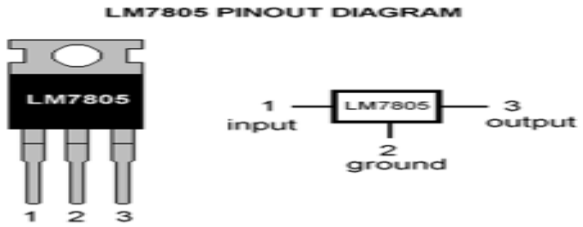

Fig6: REGULATOR

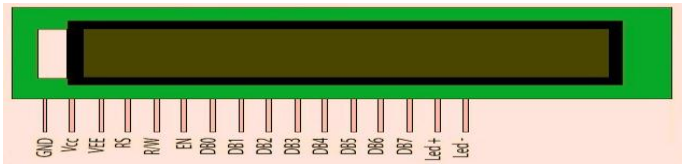

Fig7: LCD DIAGRAM

6. Wi-Fi MODULE:

The ESP8266 Wi-Fi Module is a self contained SOC with integrated TCP/IP protocol stack that can give any microcontroller access to your Wi-Fi network. This module has a powerful enough on-board processing and storage capability that allows it to be integrated with the sensors and other application specific devices through its GPIOs with minimal development up-front and minimal loading during runtime. Its high degree of on-chip integration allows for minimal external circuitry, including the front-end module, is designed to occupy minimal PCB area.

Fig8: Wi Fi MODULE

7. RESISTORS:

A resistor is a two-terminal electronic component designed to oppose an electric current by producing a voltage drop between its terminals in proportion to the current, that is, in accordance with Ohm's law:

$$V = IR$$

Resistors are used as part of electrical networks and electronic circuits. They are extremely commonplace in most electronic equipment. Practical resistors can be made of various compounds and films, as well as resistance wire (wire made of a high-resistivity alloy, such as nickel/chrome).

Fig9: RESISTORS

8. RELAY DRIVER IC:

Driver Circuit is used to boost or amplify signals from micro-controllers to control power switches in semi-conductor devices. Driver circuits take functions that include isolating the control circuit and the power circuit, detecting

malfunctions, storing and reporting failures to the control system, serving as a precaution against failure, analyzing sensor signals and creating auxiliary voltages. In this project, ULN2003 is used as the relay driver circuit. It is an integrated circuit which functions as the relay driver and boosts up the supply going to the relay.

9. RELAY:

Relay is sensing device which senses the fault and sends a trip signal to circuit breaker to isolate the faulty section. A relay is an automatic device by means of which an electrical circuit is indirectly controlled and is governed by change in the same of another electrical circuit. There are various types of relay: Numerical relay, Static relay and electromagnetic relay. Relay are housed in panel in the control room. Here three mini power relay are used each for one of the three phases. The relays periodically scan the three phases and send the signal to the arduino controller. The rating of each of the relays is about 12V.

Fig 11: Relay

10. LED:

LEDs are semiconductor devices. Like transistors, and other diodes, LEDs are made out of silicon. What makes an LED give off light are the small amounts of chemical impurities that are added to the silicon, such as gallium, arsenide, indium, and nitride. Detects accurate fault location. .emits photons as a byproduct. Normal light bulbs produce light by heating a metal filament until its white hot. Because LEDs produce photons directly and not via heat, they are far more efficient than incandescent bulbs. Not long ago LEDs were only bright enough to be used as indicators on dashboards or electronic equipment. But recent advances have made LEDs bright enough to rival traditional lighting technologies. Modern LEDs can replace incandescent bulbs in almost any application. LEDs are based on the semiconductor diode. When the diode is forward biased (switched on), electrons are able to recombine with holes and energy is released in the form of light. This effect is called electroluminescence and the color of the light is determined by the energy gap of the semiconductor. The LED is usually small in area with integrated optical components to shape its radiation pattern and assist in reflection.

Fig12.LED

V. APPLICATIONS & ADVANTAGES

5.1) APPLICATIONS:

1. Used in Industrial Hubs inside Metropolitan cities.

2. Electrical cable fault detection.

3. It also applicable in large areas like hospital, colleges, companies etc…

5.2) ADVANTAGES:

1. Less maintenance.

2. It has higher efficiency.

3. Less fault occur in underground cable.

4. Time spent for searching damaged point in cables are reduced.

5. Less consumption of power.

6. Reduced human Effort.

VI. RESULT AND DISCUSSION

1: Initially shows R=0, Y=0, B=0Km

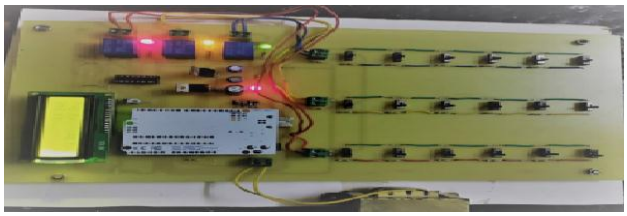

Fig: A

In this module we have used underground cable fault detector, we have used resistors instead of cable initially it is showing R=0, Y=0, B=0Km

2: It shows a fault in R-phase at distance of 10Km

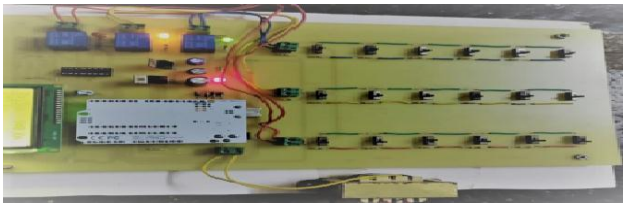

Fig: B

If we want to create a fault in "R" phase at the distance of 10Km. I just slide this switch toward the ground. This switch is grounded shows that R=10Km.Respective R-phase relay goes off which is indicated by LED.

3: It shows a fault in Y-phase at distance of 20Km

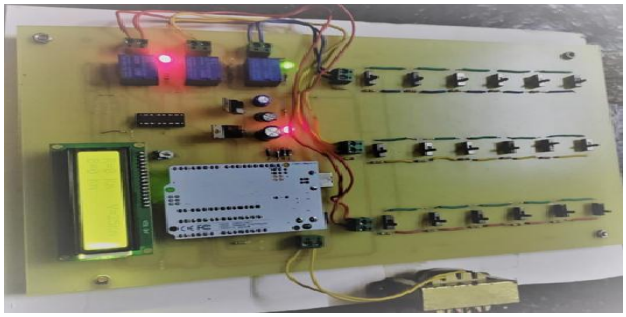

Fig: C

If we want to create a fault in Y-phase at a distance of 20Km. we just slide at this switch to ground

Y=20Km.Respective Y-phase relay goes off which is indicated by LED.

4: It shows a fault in B-phase at distance of 25Km

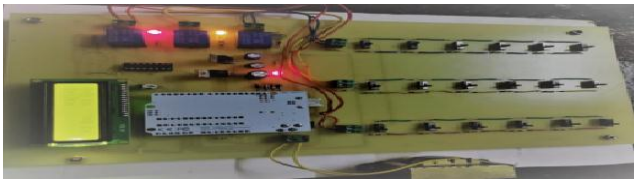

Fig: D

If We want to create a fault in B-phase at a distance of 30Km.i just slide at this switch to ground B=30Km. Respective B-phase relay goes off which is indicated by LED.

VII. CONCLUSION

Thus the project on Underground cable fault detection using Arduino was done and the distance of the fault from the base station in kilometers was displayed for the three individual phases R,Y and B. Circuit can be tested with different resistor values to simulate various fault conditions In this project faults upto a distance of 5km can be detected. When the fault switches are operated to fault condition then the phase corresponding to that particular switch is considered as the faulty phase. So the faulty section can easily be located.

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