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Underground Cable Fault Detection Using IOT

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Abstract — *Nowadays, underground cables are facing huge variety of faults due to weather conditions, wear and tear, rodents etc. Determining the fault source is challenging and entire cable could be taken out from the ground to check and fix faults. The project work's intention is to detect the location of fault in underground cable lines from the base station in km using Node MCU and AT89S52. To find the location of a fault in the cable, the cable must be tested for all the faults. This system uses the simple concept of Ohms law. The current would vary depending upon the length at which fault on the cable is detected. Whenever the fault occurs in underground cable it becomes difficult to find the exact specific location of the fault so that the process of repairing that specific cable can be conducted. The proposed system finds the exact location of that fault. The system is then modelled with a set of resistors representing cable length in km and generation of the fault is done by a set of switches placed at every known distance to cross check the accuracy of the system. When a fault is detected, the voltage across series resistors varies accordingly, which is then transferred to an ADC to develop precise digital data for a programmed microcontroller that further displays fault location in distance. A 16X2 LCD interfaced with the microcontroller is used to display the fault location.*

I. INTRODUCTION

Power supply networks are growing continuously and their reliability is getting more important than ever. The complexity of the entire network comprises numerous components which will fail and interrupt the power supply facility for end user.

For most of the worldwide operated low voltage and medium voltage distribution lines, underground cables have been used for several decades.

Underground high voltage links are utilized more since they are not impacted by climate conditions, overwhelming precipitation, tempest, day off contamination. Despite the fact that the Cable assembling innovation is being improved consistently, there are still impacts which may make the cable to fail the test and operation.

However, cables cab easily be damaged by incorrect installation or poorly jointing, or by subsequent external damage caused by civil works such as trenching, digging or curb edging.

It is easy to detect and correct the faults in overhead line by mere observation but is impossible to do so in an underground cable. These cables are buried deep inside the soil it is not easy to detect the faults in them. Even if a fault is detected it still becomes very difficult to detect the exact location of that fault. This leads to digging of the entire channel to detect and correct the fault which in turn causes waste of money and manpower. So, it is necessary to know the exact location of the defects in the underground cables. Whatever the fault is, the voltage of the cable has the tendency to change abruptly according to ohm's law.

We make use of this voltage fluctuations across the series resistors to detect.

II. FAULTS IN UNDERGROUND CABLES

There are majorly two types of faults:

A. Open circuit faults

These faults occur due to the failure of one or numerous conductors. These occur due to an opening in the circuit. The common causes of these openings include joint failures in the cables, failure of one or more phase of circuit breaker or because of melting of a fuse or conductor in one or many phases. Open circuit faults are also known as series faults. These are unsymmetrical or unbalanced sort of faults except the open circuit faults.

B. Short circuit faults

A short circuit are often defined as an abnormal connection of very low impedance between two points of varied potential whether made deliberately or accidentally. These are the most common and severe kind of faults, resulting in the flow of abnormal large currents through the equipment or transmission lines. If these faults are allowed to persist even for a short time, it can severely damage the equipment. Short circuit faults are also known as shunt faults. These faults are caused because of the insulation failure between phase conductors or between earth and phase conductors or both. The various possible short circuit fault conditions are: phase to phase, single phase to earth, two phase to earth and phase to phase to phase. In single line to ground fault, fault occurs when any one of the three lines is short

circuited with the ground. In double line to ground fault, fault occurs when any two of the three lines and the ground get connected.

In line to line fault, fault occurs between any two lines. When the fault occurs it makes an abrupt change in voltage. This change in voltage can cause serious damages to the system when not corrected in time. So immediate step of fault correction is to isolate the faulty part from the rest of the system.

III. BLOCK DIAGRAM

This project is composed of an arrangement of series resistors representing a cable, a step down transformer (230/12 volts), a bridge rectifier to convert 12 volts AC (alternating current) into 12 volts DC (direct current), regulator, LCD, AT89S52 microcontroller and NodeMCU to remotely forward the data over internet. The complete model/project is energized through power circuit which is composed of stepdown transformer, bridge rectifier and regulator ICs, this project uses 2 different voltage level 12V (for Relays and relay driver IC) and 5V (for AT89S52 and other components). Arduino is compiled with C language, when circuit is turned on start its programming cycle and sends signal to relay IC to operate relay. When Arduino executes its program cycle then all three cables are scanned with a delay of 500ms. During this scan if any switch is closed (fault is created), Current gets path to ground through relay contact. This flow of current causes drop in voltage, depending upon the path of current, resistance offered and relying on location of fault the drop in voltage is recorded and transferred to the analog pin of Arduino UNO board and it is programmed with C language, executes and processes all the input data and converts analog raw data into simplified digital data using ADC. Digital data is displayed into the 16*2 LCD along with its phase and location of fault. The same data which is displayed on screen is remotely forwarded to the responsible person through GSM module and can be monitored on laptop or pc using serial monitoring techniques. In this model three relays work to differentiate between the phases and relay driver IC employed to regulate relay through Arduino programming (C language). Fig.1 indicates the block diagram of underground cable fault detection and displays over mobile system through messaging. This project circuit diagram comprises of varied blocks like an influence supply block, Arduino UNO block, multiplexed relays, fault switches, LCD display and GSM module. Hence, this proposed project can be helpful in detecting the accurate location of the fault and also for sending the information to a mobile system in text messaging format along with displaying over an LCD

display using GSM module.

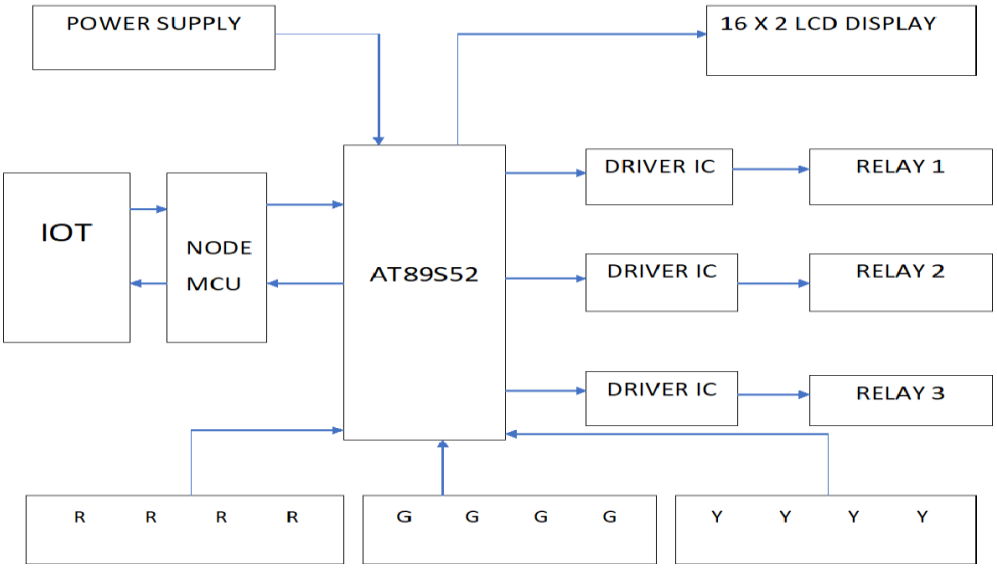

Fig 1: System Block Diagram

VI. RESULT

To measure the actual distance, an individual resister is connected between the zones. Solid state relay is a sensing device that will work in a particular location of cable and transfer the fault to microcontroller and hence, distance of fault is displayed on the 16x2 LCD display.

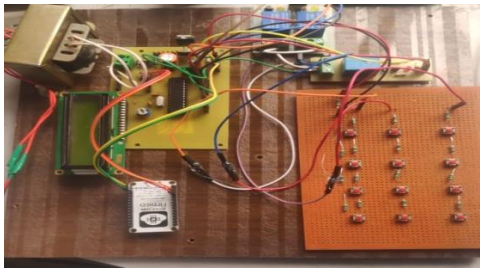

Fig 2: Result of the Model

IV. CONCLUSIONS

The developed hardware of underground cable fault distance locator is an economical and effective in protecting house-hold instruments and competitive marketing, tracking fault quickly, facilitating service, reliability and maintenance, diminishing the cost and production losses, improving the power availability for consumers and assisting the future maintenance plans and schedules by analyzing the location of these faults to prevent power outages and blackouts.

The implementation of node MCU in the hardware allows operator remotely to visualize faults on the LCD and at the same time isolate the circuit until the fault is cleared.

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