IOT BASED UNDERGROUND CABLE FAULT DETECTOR USING ATMEGA16 MICROCONTROLLER

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Abstract*:*Undergroundcable system has advantages therefore meanly used in urban areas. One of the major limitations of underground cable is fault detection in cable. If fault occurs in underground cable for some reason, it is difficult to clear it as early as possible, due to not knowing the exact location of the fault occurring in the cable. The purpose of this paper is to introduce fault detection techniques for underground cable systems. This process uses normal concept of ohm's law i.e. as a less value of DC voltage feeds to the feeder with the help of a group of resistors then current would vary, depending upon the position of the fault in underground cable as resistance is proportional to the distance. It uses an IOT module and the fault display on a 16X2 LCD screen interfaced with ATMEGA16 microcontroller to make the necessary calculations.

Keywords: Underground cable fault, Fault detection, Atmega16 microcontroller, IOT module, 16X2 LCD display.

I. INTRODUCTION

A few years ago cables were laid by overhead transmission lines and currently it uses underground transmission lines due to its advantages, as it less sensitive with weather conditions such as snow, storm, etc. Faults are caused either by insulation failures or by conducting path failure [7]. The failure of insulation results in short circuit which are very harmful as they may damage some equipment of the power system. Some major causes for cable failures are improper selection of cable according to its end use, due to mechanical failure in cable, corrosion sheath, temperature rise in cable, electrical puncture, etc. [2]. Hence the occurrence of such faults can be reduce by improving the system design, by using components and materials of good quality and by better operation and maintenance [6]. This method is mostly used in urban areas. If cable is going through any faulty conditions such as improper insulation, over current, etc.it is difficult to fix it in less time due to not knowing exact location of fault inthe cable. If fault is not clearedquickly it will affect the whole system. [1]

a) TYPES OF FAULTS

1. Open circuit fault

When anyone conductor is open due to some reason, is called as open circuit fault and it is identified with the help of its infinite resistance.

2. Short circuit fault

When two or more conductors of same cable come in electrical contact with oneanother, then this is called as short circuit fault. The resistance between any two conductors is measured with megger. If the megger reads zero for both conductors, then it is a short circuit fault.

3. Earth fault

If a conductor comes in contact with the earth conductor it is called earth fault. This fault occurs in cable mainly due to breaking of sheath. [3,4]

b) EFFECTS OF FAULTS

The faults in power system will cause over current, under voltage, unbalance of the phases, reversed power and high voltage surges. This results in the interference of the normal operation of the network, failure of equipment, electrical fires, etc. These faultsoccur due to the failure of one or more conductors. The major effects are as follow:

a. A heavy short circuit current may cause damage to equipment or any other element of the system due

to overheating and high mechanical forces set up due to heavy current [10].

b. Arc associated with short circuits may cause fire hazards. Such fires, resulting from arcing, may destroy the faulty elements of the system. There is also a possibility of fire spreading to other parts of the system if the fault is not isolated quickly.

c. There may be reduction in supply voltage of the healthy feeders, resulting in the loss of industrial loads.

d. Short circuits may cause the unbalancing of supply voltage and currents, thereby heating rotating machines.

e. There may be a loss of system stability. Individual generators in a power station may lose synchronism, resulting in a complete shutdown of the system. Loss of stability of interconnected system may also results.

f. The above faults may cause an interruption of supply to consumers, thereby causing a loss of revenue.

c) METHODS TO DETECT THE FAULT

It requires an accurate and fast method to identify fault and its clearance so that power disturbance can be resolved. Till now, many techniques had been implemented are as follow:

a. Sectionalizing
It reduces cable reliability due to physical cutting and splicing of cable. It divides cable into equivalent smaller sections to search the fault. The cable is cut into smaller equal sections and resistance is measured both ways with ohmmeter or high voltage insulation resistance tester. The defected section shows less insulation resistance than the good one and that section of cable allows repairing the fault [5].

b. Thumping
It is a portable high voltage surge generator. When a high voltage is supplied to the faulty cable, the resulting high current arc makes noise loud enough to hear it from ground. It requires a very high current of the order of tens of thousands of amperes and voltage of about 25KV to make an underground noise loud enough. This high current will also cause heating and degrades cable insulation. The damage can be minimized by reducing power sent to the cable. It can locate open circuit faults very accurately [5].

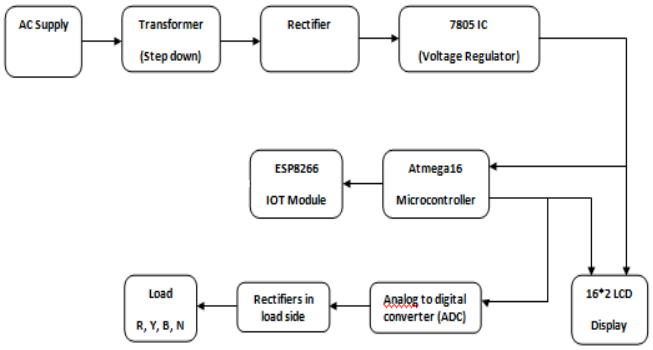
c. Time domain reflectometry (TDR)
It supplies low energy signal about 50V through cable causing no degradation of insulation of cable. Impedance variations in a real-world cable alter both the time and profile, which the TDR screen or printout graphically represents. This graph gives the user approximate distances to landmarks such as opens, splices, transformers, and water ingression. [5]

The major limitation of underground cable is detecting the fault because the cables are laid under the surface [7] and it is not possible to detect the fault by visual inspection method and it needssome special technique and this paper is intended to detect underground cable fault with the help of ATMEGA16 and result being shown on 16*2 LCD display.

This paper helps to detect the fault in cable in a digital way. The paper has been organized as follows. Section II contains full methodology about the technique and also explains working principle of the system in brief. Section III describes the hardware components used in the proposed system with their end use in the system. Section IV explains software used to run the system with its applications in the system. Section V provides the conclusion of the work.

II. METHODOLOGY

The entire digital system has different designs according to its utilities. This method uses simple ohm's law to detect the fault in cable. The AC power supply circuit used to run the set up consists of step-down transformer 230/12V which step-down the voltage to 12V DC. The AC voltage converted to DC voltage using bridge rectifier [6]. The bridge rectifier is formed using 4 diodes which deliver pulsating DC voltage and then fed to capacitor filter. Capacitive filter used to remove ripples using capacitive filter and then restricted to +5V using voltage regulator (7085 IC). [1, 6]



A DC voltage is supplied at the end of the feeder end through a group of resistor, depending upon the length of fault of the cable current varies. The voltage drop across the cable uses to detect the fault in cable. In cable part we use group of resistor with along with switch. This switch used as a fault creator to indicate the fault by sensing the change in current by sensing the voltage drop [8].

Microcontroller (Atmega16) is used to make some necessary calculations regarding fault detection and gives

signal to IOT. ADC receives input signal from load and convert it from analog to digital signal and send it to microcontroller and it gives result to LCD display and IOT module. [6]

III. HARDWAREDESCRIPTION

The Hardware's required for these systems are as follow:

1) Transformer
It is a static device which transfers electrical energy from one circuit to another without changing its frequency. DC voltages required to operate several electronic devices are 5V, 9V, 12V and the input of the transformer is 230 V AC [7].

2) Atmega16 Microcontroller
Atmega16 is an 8 bit, 40 pin low power microcontroller used for requirement. It has 16KB programmable memory, RAM of 1KB and frequency f 16MHz. The size of hardware is less because of the single chip microcontroller. [3]

3) Rectifier
It is an electrical device that converts alternating current to the direct current which flows in only one direction. Bridge rectifier is used to deliver pulsating DC voltage to the system. [1]

4) IOT Module (ESP8266)
It is a 32-bit microcontroller type IOT module. It is capable of either hosting as application or offloading all Wi-Fi networking functions from another application processor. It is self-contained SOC with integrated TCP/IP protocol stack that can give any microcontroller access to your Wi-Fi module. [3]

5) ADC
The analog to digital converter is an electronic integrated circuit use to convert the analog signal with respect to time.

6) 16*2 LCD Display
A liquid crystal display is an electronic display module of liquid crystal to produce visible image. The 16*2 indicates a display of 16 characters per line of 2 lines. This display interfaced with microcontroller. It's a low electrical power consumption enable it to be used in battery powered electronic apparatus [9].

7) Voltage Regulator
This is used to maintain constant voltage level to give constant power supply to the system and improve the performance of the system. It may use an electromechanical mechanism, or electronic components [7].

IV. SOFTWAREDESCRIPTION

The Software tools required for this system are as following.

1) AVR Studio 4 used for programming of algorithms.
2) Proteus 8 used for circuit designing and its simulation.
3) Express PCB used for design of PCB.

V. CONCLUSION

It detects and classifies the different fault types as line to ground, line to line, line to line to ground, and short circuit fault. It indicates exact type of fault over the 16*2 LCD display and due to these the fault will repair easily and quickly and improves system performance. For this simple ohm's law methodology is used.

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