DETECTION AND LOCATION OF FAULTS IN UNDERGROUND CABLES

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Abstract:

The Objective of this project is to locate the detected faults accurately. In the field of communication, the requirement of OFC cable is increasing exponentially day by day. There are many OFC cables installed earlier whose life time is getting reduced and some of the cables are getting damaged due to temperature variations and various stresses encountered. So, for the proper communication and internet it has become necessary to detect the faults and repair the OFC. For detecting there are machines which are highly expensive. This proposed project is built using Arduino UNO and it uses GSM and GPS modules for locating faults over the internet using latitude and longitude coordinates. It uses NEMA protocol to find out the coordinates of latitude and longitude.

Keywords — **Optical Fibre Cable (OFC), Cable fault, GSM, GPS Module, Arduino UNO.**

I. INTRODUCTION

From the past few years, after the invention of Optical fibre cables communication has been advanced. The invention of the optical fibre cable has changed the face of communication which uses technology where the power signal is transmitted using light energy. So, by using this, we can transmit signal to the destination with speed of light. As a result of using OFCs, technique of laying OFCs cables under the ground has invented. This has increased safety and decreased noise in the communication. There are some discontinuities that are encountered by the OFC cables. Whenever there is a break in the OFC that may be due to natural problems like temperature variation, cable breakdown or re-digging etc., communication will be lost between host and recipients. Occurrence of fault can be known just by communication loss but the locating the fault is the complex problem. So, the system we are proposing is location and detection of cable fault using Arduino (UNO), GSM, and GPS modules.

A. Types of faults

Faults may be occurred due to moisture or mechanical injury during transportation or may be when the OFCs encounter stresses during its working life.
The faults that occur in the underground cables are of three types. They are as follow.,
A. Short circuit fault
B. Open circuit fault
C. Earth faults

1) Short circuit fault: This type of fault can be found in multi-cored cables. Usually when there are multiple conductors in single cable, there may be a chance of getting contact with each other. This results in short circuit fault. Its possibility is high when the insulation of the individual cable is damaged.

2) Open Circuit Fault: This is the type of fault that involves an open circuit. When the core breaks or comes out of the joint, it leads to discontinuity. This discontinuity results in open circuit fault.

3) Earth fault: Earth fault occurs when any of the conductor gets in contact with the ground. When the outer sheath is damaged or due to mechanical crystallization, earth fault in the cable occurs. As the current takes the least resistive path to the earth, it is very similar to short circuit fault.

B. Fault location methods

Advanced methods like Fault detection, Fault diagnosis have become important for many technical processes for the improvement of reliability, safety and efficiency. There are two types of fault location methods namely Online and Offline methods.

1) Online Method: It is the method in which fault points are determined through sampling of voltages and currents.

2) Offline Method: In this method instruments are taken to the fields for checking of faults in cables. Offline methods are two types. They are tracer method and termination method.

i. Tracer Method:

In the tracer method faults are checked by driving instruments along the length of cable. Electromagnetic signals are used for indicating the fault points. Sheath coil method and Tracing current method are some of the examples of Tracer method.

ii. Termination Method:

In this method instruments are installed either at one end or both ends of the cable instead of driving them along the length of the cable. Murray loop method and Impulse current method are some of the examples of Termination method.

II LITERATURE REVIEW

There are several projects done for detecting and locating underground cable faults.

Some of them as follows:

Priyanka R, Priya B (2016), This project contains ARM 11 MSP430 microcontroller as the main hardware unit. For the detection of faults in the underground cable the concept of Ohms Law is used. This idea is about determining resistive variation, short circuit fault and open circuit fault. According to this project, a low DC voltage is fed at one end through a resistor in series and variation of current is observed for determining the location of faults in the cable.

There is other project made using ATmega microcontroller to detect and locate the faults in the underground cable. An analog circuit detects the faults and passes the data to the microcontroller and this analog data is converted to digital data with help of ADC present in microcontroller and using this digital data distance in kms is calculated.

Limitations

The above two projects will display the fault located data at that particular place where the instrument or module is installed for the detection of fault . And this data collected is not communicated further to base stations directly through instruments.

III PROPOSED METHOD

We are proposing a method that locates fault using Arduino UNO and GPS module locates latitude and longitude coordinates and the data is sent to base station using GSM module. The components used for the proposed system are Arduino UNO, Relays, Relay driver IC, GPS and GSM modules, Power Supply circuit, 16X2 LCD display and R-G-Y switch network for manual fault generation.

A. Description of components

1) Arduino UNO: It is a microcontroller board built using based on ATmega 328 IC. Its operating voltage is 5V with clock speed of 16MHz. Some of its digital pins have specialised functions**.** For example, Pin0(RX) and Pin1(TX) serve as serial port communication for receiving and transmitting serial data. Pins 10 to 13 support SPI Communication. These Ports can be utilised for interfacing GSM and GPS modules.

Fig. 3.1 Arduino UNO

2) GSM Module: GSM Sim800L is used in this project. It is a quad-band module works with the frequency 850MHz and supports GPRS coding schemes CS-1, CS-2, CS-3 and CS-4. Operating Voltage of this module ranges from 3.4V-4.4V and the typical power consumption in sleep mode is 0.7mA which results in power saving. It can withstand the temperature of -45^{o} C to +90^{o} C. It has a SIM interface compatible with 3V and 1.8V SIM cards. It supports MT, MO, CB, Text and PDU mode for SMS. It's serial port baud rate ranges from 1200bps to 115200bps which is compatible with Arduino UNO.

Fig 3.2. GSM 800l Modem

3) GPS Module: GPSNEO-6MV2 is the module used in this project. The operating voltage ranges from 2.3V to 3.6V. Its RX and TX are connected to corresponding serial port pins in Arduino. NEMA is the protocol used to read latitude and longitude data.

Fig. 3.3. GPS Module

4) Relay: An array of Single Pole Double throw (SPDT) relays is used in this project. It has one common terminal and two different contacts in different configurations. Here relays are used for indicating the faults at particular distances.

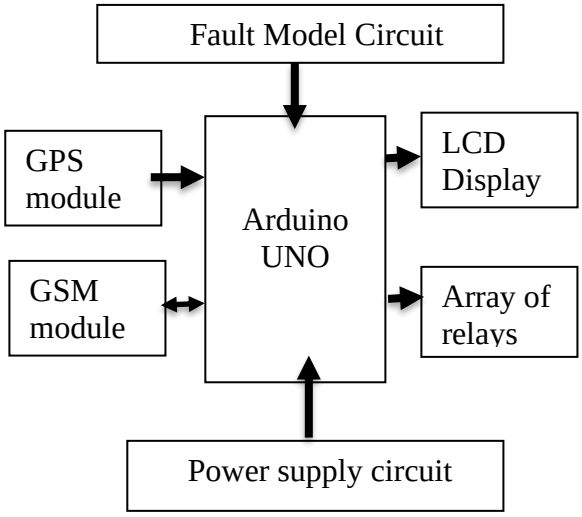
Fig. 3.4. Relay

5) LCD display: A 16 x 2 LCD display is used to display the message about the faults, their distance and latitude and longitude coordinates. In addition to this, it can be used to know what process is

Fig.3.5 LCD display

going on in the microcontroller from initialisation of the devices. Its working voltage is 5V. It is interfaced with Arduino in 4-bit operating mode.

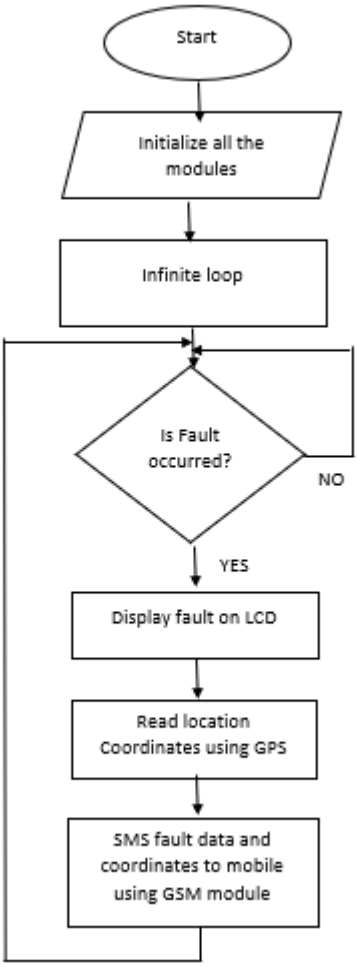
B. Block diagram



C. Detailed description

Whenever the power is switched ON, all the devices are initialised. This initialisation process is done in the setup function of the program. Workflow of the project is done in the loop function of the program. First of all, microcontroller will be waiting for the input from the fault circuit model. Fault circuit model contains switches to representing the cable. Faults are considered to be generated by switching them ON/OFF. Thus, the faults are generated manually by using a model circuit. Whenever the fault is generated the data form this fault model circuit is sent as input to the Arduino. Arduino processes the information about location of fault. Then the fault location data is displayed on LCD. This step is followed by GPS event. GPS module uses NEMA protocol for reading latitude and longitude coordinates. Once the GPS module is triggered, it will take 20 to 25 seconds to establish stable connection between satellite and GPS module. Then it gets the exact values of latitude and longitude. This data is passed to serial interface in the form of NEMA sentences. From there it is passed to Arduino. The data obtained from the NEMA sentences is converted to decimal format in the microcontroller. Then the Arduino will initialise the GSM module to send SMS about location data i.e., distance of the fault location in kilometres and latitude, longitude coordinates. These coordinates can be observed through google maps to observe exact location.

D. Flow Chart



IV RESULTS

After getting the fault location data it is sent to mobile number using GSM module. The SMS includes distance of location and its coordinates as link and using this link the fault location can be clearly monitored in Google Maps

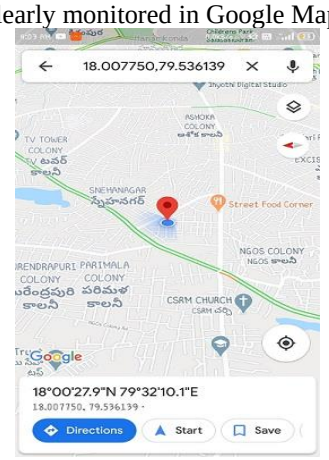


Fig 4.1. Figure showing fault location in google maps

V CONCLUSION

Therefore, this proposed approach to detect and locate fault location uses GSM and GPS modules for communicating with base stations about the fault data including latitude and longitude values which enables the officers to have a clear and detailed information about the faults in OFC's. Since the circuit can intimate the fault data to the respective station there is no need of supervision of experts on field.

Further this project can be implemented effectively when the detection of faults in underground cables becomes easy avoiding the usage of expensive machinery.

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