Cable Fault Detector In Underground Using Bot Technology

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Abstract- *Fault identification in underground system is quite challenging. The aim of the project is to develop cable fault detector in underground using BOT technology which is to be integrated for public works department. Normally fault diagnosis in underground system is quite difficult and at present it is identified with human intervention, which is time consuming, also repairing and bringing back the place in its actual form takes too time. The recent advancement in miniature sensors and technology, made remote fault detection as possible. Accurate and real time information about the aging status of underground cable makes the premature replacement of cables easier.*

It consists of robot which is placed over the underground cable line, moves forward for the detection of fault, whenever fault occurs in underground cable line, the sensing unit passes the pulse variation to the microcontroller. According to the pulse input to the microcontroller, it gives command for the movement of the robot. The LCD will display the status of the robot.

I. INTRODUCTION

Normally most of the companies prefer to lay wires through underground. Wires are laid underground for various purposes. The reason for doing this is to protect the wires from any climatic conditions and changes. But while considering this positive factor there are cons of this method too. There occur problems while laying wires and during service and maintenance it becomes very costly, time consuming and difficult to fix and solve the issue. Also, cable can break due to any reason then it gets difficult to locate them and replace it. Fault diagnosis in underground system is quite difficult and presently it is identified manually. Commonly meggar is used as cable fault detector. It uses TDR which cannot pinpoint the exact location of faults. It gives an approximate distance to locate the fault. Sometimes, this information alone is sufficient while rest of the times it only serves to allow more precise thumping. When the TDR sends a test pulse, reflections that may occur during the time of outgoing test pulse may be obscured from the user. Also, a TDR cannot see high resistance (generally above 200 Ohms) ground fault. If there is surrounding electrical noise, it may interfere with the TDR signal. This measurement is being carried out manually which results in error and quite time consuming.

This project gives a solution to the problem prevailing in the development of cable fault detector in underground using BOT technology that can be integrated into public works department. The recent advancement in miniature sensors and technology remote fault detection is possible. Accurate and real time information about the aging status of underground cable makes the premature replacement of cables .easier. The hardware used here is simple and cost effective. It mainly consists of PNP/NPN as sensors, microcontroller, LCD unit and DC motor. In this project PNP/NPN is used to capture pulses from the underground cable and passes the signal to the microcontroller.

II. LITERATURE REVIEW

From the literature survey, detection of underground fault is made inaccurate. Underground power cables have been widely implemented due to reliability and environmental concerns. To improve the reliability of a distribution system, accurate identification of a faulted segment is required. In the conventional way of detecting fault, an exhaustive search in larger scale distance has been conducted. This is time consuming and inefficient, Not only that the manpower resources are utilized, but also the restoration time may vary depending on the reliability of the outage information. Hence an efficient technique to locate a fault can improve system reliability.

A. EXISTING METHODS

1) Locating Underground Cable Fault Using Time Domain Reflectometer:

A Time Domain Reflectometer (TDR**)** sends a short-duration low energy signal (of about 50 V) at a high repetition rate into the cable. This signal reflects back from the point of change in impedance in the cable (such as a fault). TDR works on the similar principle as that of a RADAR. A TDR measures the time taken by the signal to reflect back from the point of change in impedance (or the point of fault). The reflections are traced on a graphical display with amplitude on y-axis and the elapsed time on x-axis. The elapsed time is directly related to the distance to the fault location. If the injected signal encounters an open circuit (high impedance), it results in high amplitude upward deflection on the trace. While in case of a short-circuit fault, the trace will show a high amplitude negative deflection[2].

It cannot pinpoint the exact location of faults. It gives an approximate distance to the location of fault. Sometimes, this information alone is sufficient and other times it only serves to allow more precise thumping. When the TDR sends a test pulse, reflections that may occur during the time of outgoing test pulse may be obscured from the user. This can happen with the faults at near end and called as blind spots. Also, a TDR cannot see high resistance (generally above 200 Ohms) ground fault. If there is surrounding electrical noise, it may interfere with the TDR signal.

2) Problem Identified:

Some instruments have low accuracy, difficult to apply because of surrounding environment, and give unwanted damage to healthy neighbouring cable and facilities.

Pulse echoing method use time difference between incident and reflected pulse to calculate fault location detection and it has relatively high accuracy because it use short period pulse. When this method is used to low impedance accident, the error will be increased. If cable is not open circuit and there is no impedance change, there are no reflected pulse waves, and it is difficult to find fault location. It is also very expensive system.

III. HARDWARE REQUIREMENTS OF FAULT DETECTOR

A. Block Diagram of Fault Detector

The block diagram of fault detector is shown in the Fig. 3. It consists of cable, sensing unit, pic 16F877A controller, power supply unit, motors and LCD display.

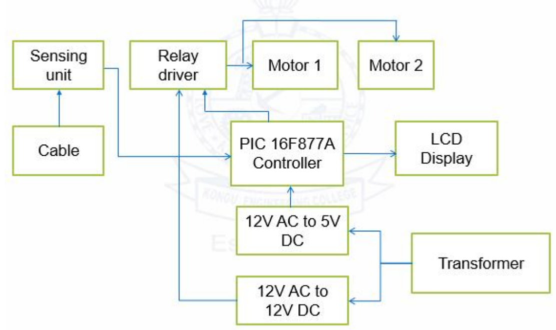

Fig. 1Block Diagram of Underground Cable Fault Detector

The underground cable fault is detected by the sensing unit which consists of NPN and PNP transistor which acts as sensors. The negative pulse from the cable is given to PNP which produces positive pulse output to trigger NPN and the negative pulse output from NPN is given to the microcontroller. Microcontroller controls the action and works according to the input detected by the sensor, so that it actuates the relay for the movement of the robot and the corresponding output is displayed in the LCD. The power to microcontroller and relay is provided by power supply unit. Thus the fault is detected in the underground cable.

IV. OVERALL INTERFACING CIRCUIT OF FAULT DETECTOR

The overall interfacing circuit of fault detector is shown in Fig. 2.

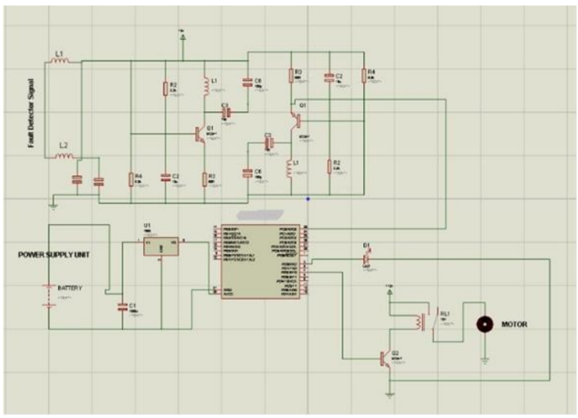

Fig. 2 Circuit Diagram of Underground Cable Fault Detector

The important hardware components used in this project are

- Power Supply Unit
- Power Supply Circuit
- PIC Microcontroller
- DC Motor
- Sensing Unit

A. Power Supply Circuit

1) Power Supply Circuit for Microcontroller:

The step down transformer is used to step down the supply AC voltage 230V AC to 12V AC. It is given to the bridge rectifier of 1A circuit for rectifying to the desired DC voltage. The rectified output signal is then passed through capacitor of 1000µF to remove the noise signal and to regulate.

2) Power Supply Circuit for DC Motor:

The step down transformer is used to step down the supply AC voltage 230V AC to 12V AC. It is given to the bridge rectifier of 10A circuit for rectifying to the desired DC voltage. The rectified output signal is then passed through capacitor of 2200µF to remove the noise signal and to regulate.

B. PIC Microcontroller:

The microcontroller that has been used in the Cable Fault Detector is from PIC (Peripheral Interface Controller) series. The power supply to the microcontroller is given by transformer which is rectified using rectifier and is converted into 12V DC. Since the power required for microcontroller is 5V,the 12V DC is converted into 5V DC by voltage regulator 7405 and is given to the supply port of the microcontroller. According to the pulse input to the microcontroller from the sensing unit it controls the movement of the robot. If negative pulse is given to the microcontroller it commands the relay to continue its movement for further detection of fault i.e., there is no fault in the cable. If positive pulse is given to the microcontroller it commands the relay to stop the motor because the fault is detected in the particular portion.

Meanwhile the command to the LCD is also given. When negative pulse is given to the microcontroller there is no display on the LCD because there is no fault. If positive pulse is given to the microcontroller LCD displays "Fault is Detected" and the robot movement stops so that there is fault in the cable.

C. DC Motor

When there is no fault in the underground cable, according to the command from the microcontroller relay driver circuit actuates the DC motor for the movement of the robot. If fault is detected microcontroller commands the relay driver circuit to stop the movement of the robot so that the motor stops its movement.

Specification of DC motor and the parameters obtained and their range is specified in the Table 1. Operating voltage, nominal voltage, maximum speed, maximum torque and the maximum output for the DC motor are tabulated.

D. Sensing Unit

When current flows in the underground cable magnetic flux is produced around the cable. Negatively charged electrons flows around the cable. This negative pulse is acquired by the PNP which amplifies and gives positive pulse as output. The positive pulse from PNP is given as trigger to NPN which gives negative pulse as output. This negative pulse is given to the microcontroller which commands the relay to run the motor because there is no fault in the cable. If fault occurs in the cable there will be no current flow so that there is no pulse input from the sensing unit to the microcontroller. The microcontroller commands the relay to stop the motor and so the LCD is displayed as “Fault is Detected”.

E. LCD Display

LCD (Liquid Crystal Display) screen is an electronic display module and find a wide range of applications. A 2X16 LCD display is very basic module and is very commonly used in various devices and circuits. A 2X16 LCD means it can display 16 characters per line and there are 2 such lines. The LCD (Liquid Crystal Display) display is used to display the output of various components that are used in the Underground Cable Fault Detector. When the project is energized LCD turns ON. Whenever the cable fault is detected “FAULT IS DETECTED” is displayed on the LCD. The Fig. 10 shows the pairing connection between microcontroller and LCD display.

When fault occurs in the underground cable, pic microcontroller commands the LCD to display the message “FAULT IS DETECTED”. If there is no fault in the underground cable there no display message in the LCD.

F. Software Used

The name of the software’s used in this project for programming purpose is given below:

- CCS C Compiler
- Proteus ISIS

1) CCS-C Compiler:

The CCS C Compiler is software used here for writing Embedded C programming in PIC microcontroller. This compiler provides a complete integrated tool suite for developin and debugging embedded applications running on PIC,MCU's and dsPIC etc.,

2) Proteus ISIS:

Proteus is software used for simulation of Microcontroller for and printed circuit Board(PCB) design. It is developed by Labcenter Electronics.

G. Flow Chart

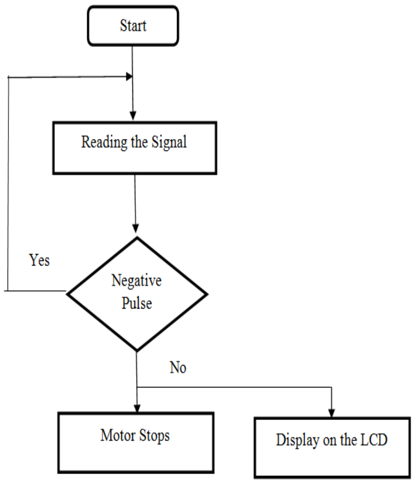

Fig. 3 Flow Chart

V. RESULTS AND DISCUSSION

A. *Result Analysis*

Thus the Underground cable fault detector has been designed to identify the fault in the underground cables. When the fault occurs in the cables, microcontroller transfers the signal to motor to stop its movement that is already programmed and fed into the microcontroller.

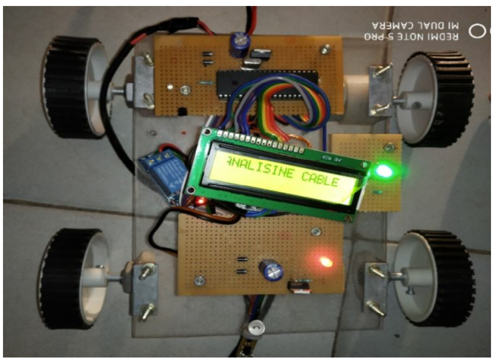

Fig. 4 Fault not Detected

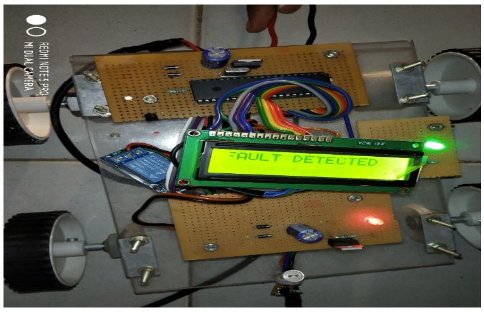

Fig. 5 Fault Detected

When there is no fault in the cable, LCD doesn't displays the message. It is shown in Fig. 4. If fault occurs in the cable LCD receives command from the microcontroller and it is displayed as "FAULT IS DETECTED" . It is shown in Fig. 5.

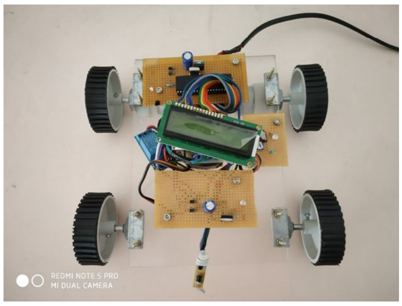

Fig. 6 Hardware Model

B. *Conclusion*

This underground cable fault detector detects the fault in the underground cable. The main aim is to reduce time consumption and to make work easier. The goal is to help the PWD to make work easier with accurate measurement. If underground cable fault detector technologies could be integrated successfully into the PWD department, there could be a striking improvement in the easier fault detection in the cables.

C. *Future Scope*

The cable fault detection can also provide the future society with time consumption, reduce manual work, and even a way to communicate covertly. The future systems include GPS monitoring to provide information directly to PWD department.

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