Underground Cable Fault Detection System Using IOT

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Abstract- *Underground cables are prone to a wide variety of faults due to underground conditions, wear and tear, rodents etc. Also detecting fault source is difficult and entire line is to be dug in order to check entire line and fix faults. So here we propose a cable fault detection over IOT that detects the exact fault position over iot that makes repairing work very easy. The repairmen know exactly which part has fault and only that area is to be dug to detect the fault source. This saves a lot of time, money and efforts and also allows to service underground cables faster. We use IOT technology that allows the authorities to monitor and check faults over internet. The system detects fault with the help of potential divider network laid across the cable. Whenever a fault gets created at a point shorting two lines together, a specific voltage gets generated as per the resistors network combination. This voltage is sensed by the microcontroller and is updated to the user. The information conveyed to the user is the distance to which that voltage corresponds to. The microcontroller retrieves the fault line data and displays over LCD display, also it transfers this data over internet to display online. We use IOTGecko to develop the online system that links with the system to display the cable faults online.*

Keywords- Underground cable, fault location, fault detection, location methods, microcontroller.

I. INTRODUCTION

Power supply networks are growing continuously and their reliability getting more important than ever. The complexity of the whole network comprises numerous components that can fail and interrupt the power supply for end user. For most of the worldwide operated low voltage and medium voltage distribution lines, underground cables have been used for many decades. Underground high voltage cables are used more and more because they are not influenced by weather conditions, heavy rain, storm, snow and pollution. Even though the Cable manufacturing technology is improving steadily; there are still influences which may cause cable to fail during test and operation. A cable in good condition and installed correctly can last a lifetime of about 30 years. However, cables can be easily damaged by incorrect installation or poorly executed jointing, while subsequent third-party damage by civil works such as trenching or curb edging.

1.1. Types of Faults in Cables

1.1.1. Open Circuit

Fault When there is a break in the conductor of the cable, it is called open circuit fault of the cable. The open circuit fault can be checked by megger. For this purpose, the three conductors of the 3-core cable at the far end are shorted and earthed. Then resistance between each conductor and earth is measured by a megger. The megger will indicate zero resistance in the circuit of the conductor that is not broken. However, if the conductor is broken, the megger will indicate infinite resistance in its circuit.

1.1.2. Short Circuit Fault

When two conductors of a multi-core cable come in electrical contact with each other due to insulation failure, it is called short-circuit fault. The two terminals of the megger are connected to any two conductors. If the megger gives zero reading, it indicates short-circuit fault between these two conductors. The same step can be repeated for other conductors taking two at a time.

1.1.3. Earth Fault

When the conductor of the cable comes in contact with earth, it is called earth fault or ground fault. To identify this fault, one terminal of the megger is connected to the conductor and the other terminal connected to earth. If megger indicates zero reading, it means the conductor is earthed. The same procedure is repeated for other conductors of the cable.

II. LITERATURE SURVEY

2.1 Sectionalizing

This procedure reduces cable reliability, because it depends on physically cutting and splicing the cable. Dividing the cable into successively smaller sections and measuring both ways with an ohmmeter or high-voltage insulation resistance (IR) tester enable to narrow down search for a fault. This laborious procedure normally involves repeated cable excavation.

2.2. Thumping

When high voltage is supplied to faulty cable, the resulted high current arc makes a noise loud enough to hear above ground. While this method eliminates the sectionalizing method's cutting and splicing, it has its own drawback. Thumping requires a current on the order of tens of thousands of amps at voltages as high as 25 kV to make an underground noise loud enough to hear above ground. The heating from this high current often causes some degradation of the cable insulation. The limit of damage can be reduced by passing minimum required power to conduct the test.

2.3. Time-Domain Reflectometry

The Time domain reflectometer (TDR) is an electronic instrument that uses time domain reflectometry to characterize and locate faults in metallic cables. The TDR sends a low energy signal through the cable, causing no insulation degradation. A theoretically perfect cable returns that signal in a known time and in a known profile. Impedance variations in a "real-world" cable alter both the time and profile, which the TDR screen or printout graphically represents. One weakness of TDR is that it does not pinpoint faults.

2.4. Arc Reflection Method

This method is often referred to as a high voltage radar technique that overcomes the 200 Ω limitation of low-voltage radar. In addition to the TDR, an arc reflection filter and surge generator is required. The surge generator is used to create an arc across the shunt fault which creates a momentary short circuit that the TDR can display as a downward-going reflection. The filter protects the TDR from the high voltage pulse generated by the surge generator and routes the low-voltage pulses down the cable. Arc reflection is the most accurate and easiest pre-location method. The fault is displayed in relation to other cable landmarks such as splices, taps and transformers and no interpretation is required. Arc reflection makes it possible for the TDR to display "before" and "after" traces or cable signatures. The "before" trace is the low-voltage radar signature that shows all cable landmarks but does not show the downward reflection of a high resistance shunt fault. The "after" trace is the high-voltage signature that includes the fault location even though its resistance may be higher than 200 Ω. This trace is digitized, stored and displayed on the screen and the cursors are positioned in order to read the distance to the high resistance fault.

2.5. Blavier Test

When a ground fault occurs in a single cable and there is no other cable, then blavier test can be performed to locate the fault in a single cable. In other words, in the absence of a sound cable to locate fault in the cable, then measurement of the resistance from one side or end is called blavier test. Ground fault of a single cable can be located using Blavier's test. In this kind of test, low voltage supply, an ammeter and voltmeter are used in a bridge network. Resistance between one end of the cable (Sending End) and earth is measured while "Far End" is isolated from the earth.

III. PROPOSED SYSTEM

The proposed system is an IoT enabled underground cable fault detection system. The basic principle behind the system is Ohms law. When fault occurs in the cable, the voltage varies which is used to calculate the fault distance. The system consists of Wi-Fi module, Microcontroller, and Real-Time Clock. The block diagram of the fault detection system is shown in the Figure 1. The power supply is provided using step-down transformer, rectifier, and regulator. The current sensing circuit of the cable provides the magnitude of voltage drop across the resistors to the microcontroller and based on the voltage the fault distance is located.

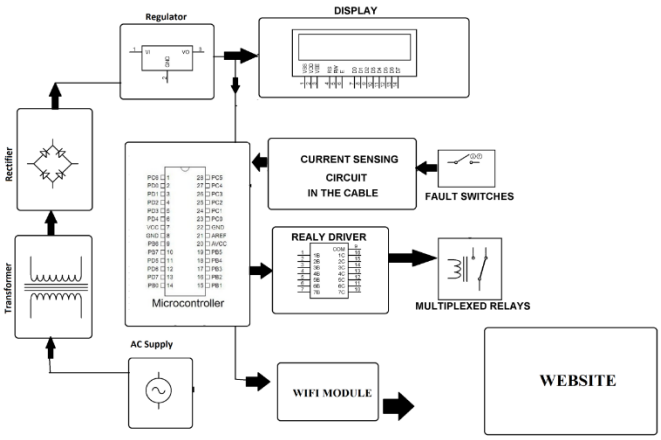

Fig 1: Block Diagram of Fault Detection System

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 & then fed to capacitor filter the output voltage from rectifier is fed to filter to eliminate any a.c. components present even after rectification. The filtered DC voltage is given to regulator to produce 12v constant DC voltage.

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 12V are 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 Electronic voltage regulators are found in devices such as computer power supplies where they stabilize the DC voltages used by the processor and other elements. In automobile alternators and central power station generator plants, voltage regulators control the output of the plant. In an electric system, voltage regulators may be installed at a substation or along distribution lines so that all customers receive steady voltage independent of how much power is drawn from the line.

RELAY

Relay is sensing device which senses the fault & send a trip signal to circuit breaker to isolate the faulty section. A relay is automatic device by means of which an electrical circuit is indirectly controlled & is governed by change in the same or another electrical circuit. There are various types of relay: Numerical relay, Static relay & electromagnetic relay. Relay is housed in panel in the control room.

MICROCONTROLLER

The AT89S52 it consumes low-power, high-performance. It is a CMOS 8-bit microcontroller with 8K bytes of programmable Flash memory. The device is manufactured by using Atmel's high-density non-volatile memory technology and is compatible with the 80C51 instruction set and pin out. The on-chip Flash allows the program memory to be reprogrammed in the system or conventional non-volatile memory programmer. It will combine a versatile 8-bit CPU within system programmable Flash on a monolithic chip, the Atmel AT89S52 is a powerful microcontroller. It is highly-flexible and cost-effective solution to many embedded control applications.

WIFI MODULE

WIFI Module is a self-contained SOC with integrated TCP/IP protocol stack that can give any microcontroller access to your WIFI network. The ESP8266 is capable of either hosting an application or offloading all Wi-Fi networking functions from another application processor.

LCD DISPLAY

A liquid-crystal display (LCD) is a flat-panel display or other electronically modulated optical device that uses the light modulating properties of liquid crystals. Liquid crystals do not emit light directly, instead using a backlight or reflector to produce images in colour or monochrome. Each pixel of an LCD typically consists of a layer of molecules aligned between two transparent electrodes, and two polarizing filters the axes of transmission of which are perpendicular to each other.

TRANSFORMER

Transformer is static device which transfer electrical energy from one circuit to other circuit with change in voltage or current without change in frequency. In this step-down transformer is used. Usually, DC voltage s are requiring d to operate various electronic equipment and these voltages are 5V, 9V or 12V.

IV. SOFTWARE SPECIFICATION

C LANGUAGE

A programming tool or software development tool is a program or application that software developers use to create, debug, maintain or otherwise support other programs and applications. The term usually refers to relatively simple programs that can be along with application and system software. C is a general-purpose, imperative computer programming language, supporting structured programming, lexical variable scope and combined together to accomplish a task, much as one might use multiple hand tools to fix a physical object.

EMBEDDED C

Use of microprocessor-specific assembly-only as the programming language reduced and embedded systems moved onto C as the embedded programming language of choice. C is the most widely used programming language for embedded processors/controllers. Assembly is also used but mainly to implement those portions of the code where very high timing accuracy, code size efficiency, etc. are prime requirements.

IOT GECKO

IOT Gecko is a free IOT systems development platform for students, researchers and developers. Opening doors to physical devices controlled over the internet, IOT Gecko provides you the tools and support to design your IOT based systems with ease. Get sensor/device data and use it over the internet.

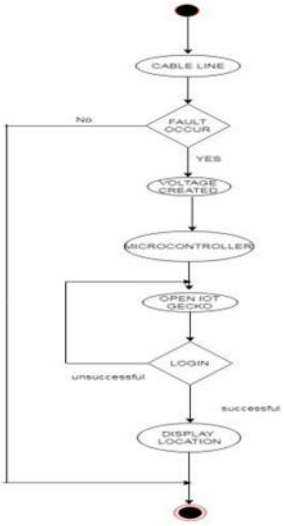

Fig 2: Flow Chart of the System

V. CONCLUSION

The paper IoT based underground cable line fault detection system was executed successfully. which makes fault detection very easier. It can clearly determine the location where the fault is occurred. The repair man only needs to dug the place where fault is occurred. This paper enables the researchers to detect and locate the faults in underground cable with the help of IoT Gecko. Hence, the method used in this paper operates in a sequential manner and proves to be useful in detection and location of faults in underground cables.

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