International Journal of Enhanced Research in Science, Technology & Engineering
ISSN: 2319-7463, Vol. 12 Issue 3, March-2023, Impact Factor: 7.957

Digitalized Method of Fault Detection in Underground Cable

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ABSTRACT

The underground cables are not affected by any adverse weather condition such as storm, snow, heavy rainfall as well as pollution. But when any fault occurs in cable, then it is difficult to locate the fault. So we will move to find the exact location of fault along with indication of type of fault. Now the world is become digitalized, so this paper is intended to show how to detect the location of fault in digital way. The underground cable system is more common practice followed in many urban areas. While fault occurs for some reason, at that time the repairing process related to that particular cable is difficult due to not knowing the exact location of cable fault. So the type of fault and the position is indicated by using a GPS system. A message is sent to the dedicated mobile number using GSM module .Once the fault is cleared, it displays a message on LCD indicating that the fault is cleared.

Keywords: underground Cable fault, Digitalized method, GPS, GSM, LCD

INTRODUCTION

Electric power can be transported from generating stations to load areas either by overhead lines system or by underground cables. Underground cables are the electric power transmission cables. Because of their reliability on transmitting, they used in urban areas and in thick population areas, where overhead transmission is dangerous. Underground cables have low maintenance cost, less chances of faults ,smaller voltage drop .In recent improvements in the design and manufacture have led to development of cables suitable for use at high voltage.

The design and construction of underground transmission lines differ from overhead lines. The first underground transmission line was a 132KV line constructed in 1927.The cable was fluid –filled and paper insulated. The fluid was necessary to dissipate the heat. For decades, reliability problem continued to be associated with constructing longer cables at higher voltages. The most significant issue was maintenance difficulties. Not until mid-1960s did the technology advance sufficiently so that a high-voltage345KV line could be constructed underground. The lines though were still fluid filled.

In the 1990s the first solid cable transmission line was constructed more than one mile in length and greater than 230KV.Cables are generally laid directly in the ground or in ducts in the line underground distribution system. For this reason, there are little chances of faults in underground cables.

However, if a fault does occur, it is difficult to locate and repair the fault because conductors are not visible. Nevertheless, the following are the faults most likely to occur in underground cables. Underground cables are the electric power transmission cables. Because of their reliability on transmitting, they used in congested urban areas and in thick population areas, where overhead transmission is dangerous. Underground cables have low maintenance cost, less chances of faults, smaller voltage drop. In recent improvements in the design and manufacture have led to development of cables suitable for use at high voltage.

EXISTING SYSTEM

A. Online Method

This method utilizes and processes the sampled voltages and current to determine the fault points. Online method for underground cable is less common than overhead lines.

B. Offline Method

In this method special instrument is used to test out service of cable in the field. This offline method can be divided into two methods. They are tracer method and terminal method.

C. Tracer Method

The tracer method is an exhaustive way to locate a faulted segment by walking through the cable circuits. A faulted segment can be determined from audible or electromagnetic signals and requires dispatching crew members to the outage area. There have been various techniques largely used in the industries, including the tracing approach through acoustic, electromagnetic or current.

D. Terminal Method

The terminal method is a technique used to determine a fault location of a distribution cable network from one or both ends without tracing exhaustively. A bridge technique is one of the most popular terminal methods that links with a resistor to determine a fault location .It is a technique used to detect fault location of cable from one or both ends without tracing.

PROPOSED SYSTEM

The proposed system is used to monitor and detect high voltage stress in MV or HV Underground cables. To implement the system we use a step-up & step down transformer, and PIC micro controller. Every one kilometer sensor (slaves) is placed to measure the voltage stress level. Thus conversely provide the information about the UG cables. The data can be stored in master controller. Here we are using PIC micro controller as a master. In case any abnormal voltage stress across the UG cable, the correction can be done in input side by using step-down transformer. In output side can be controlled by step up transformer. So that balanced output is maintained in the UG cables.

When there is no fault in the system, it displays a message good condition on the LCD. The standard of distance (KM) from the base station is represented by the fault point. This value displayed by display unit LCD. Also one more feature is that using GSM the of fault detection, location of fault and distance of fault from base station in kilometers this all information is send to base station.

SYSTEM MODELLING

A. Block Diagram

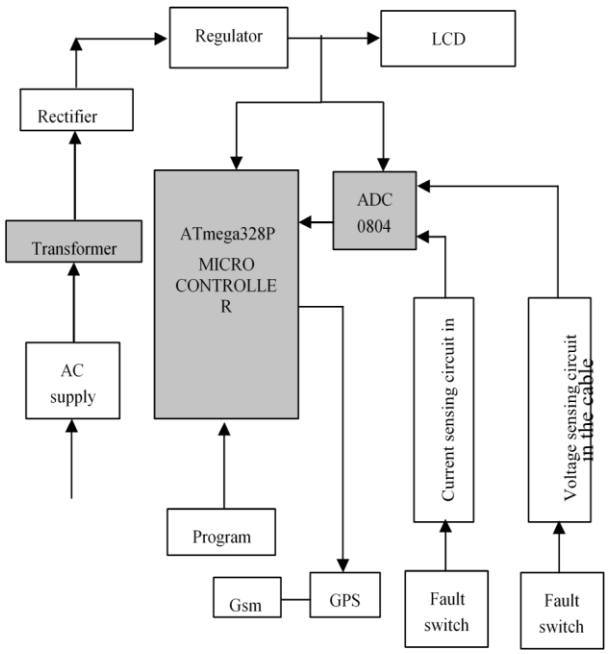

Figure 1. Block diagram of Arduino based underground fault detection system

B. POWER SUPPLY

Fig 1. Shows 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 and then fed to capacitor filter the output voltage from rectifier is fed to filter to eliminate any AC components present even after rectification. The filtered DC voltage will be given to regulator to produce 12v constant DC voltage.

C. ARDUINO

Fig 1. Shows the Arduino is a micro controller board based on the ATmega328 (data sheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 Analog inputs, a 16 MHz crystal oscillator, a USB connection, anICSP header, and a reset button.

D. LCD

Fig 1. Shows the Liquid crystal display are interfacing to microcontroller 8051.Most commonly LCD used are 16*2 and20*2 display. In 16*2 display means 16 represents column and 2 represents rows. LCDs are available to display arbitrary images (as in a general-purpose computer display) or fixed images with low information content, which can be displayed or hidden, such as preset words, digits, and 7- segment displays as in a digital clock. They use the same basic technology, except that arbitrary images are made up of a large number of small pixels, while other displays have larger elements.

E. GSM

Fig 1. Shows GSM is an open and digital cellular technology used for transmitting mobile voice and data services operates at the 850MHZ, 900MHZ, 1800MHZ and 1900MHZ frequency band. GSM system was developed as a digital systemusing time division multiple access technique (TDMA) for communication purpose.

CIRCUIT DIAGRAM

A. Circuit Diagram

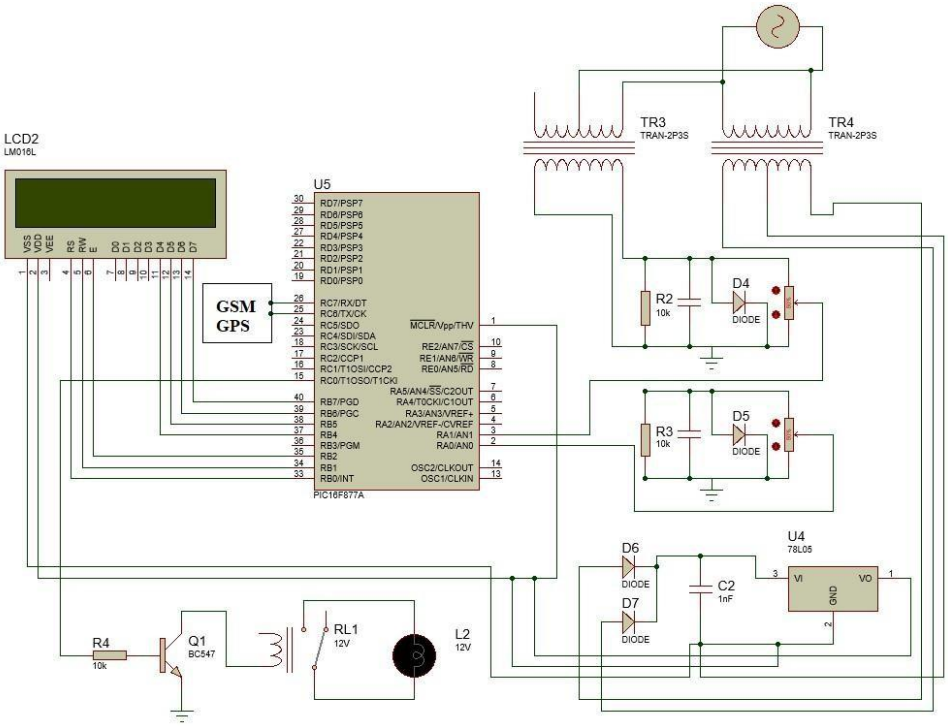

Figure 2. Circuit diagram of Arduino based underground fault detection system

B. Component Description

When any faults occur in a cable like over voltage, over current, short circuit and etc. From Fig 2. .there is a circuit which is connected to transformer and that transformer is also connected to underground cable, thus the fault are indicate by using GSM module to base station. This circuit consists of rectifier, voltage regulator, current transformer, arduino, GSM, relay and LCD display. If any deviation in resistance value then there is a difference in the supply voltage that is over current flowing in the cable this is called as open circuit fault. Arduino Microcontroller is a powerful single board computer, an open source hardware platform allowing creating interactive electronic objects. It consists of Arduino board, set of various analog and digital I/O pins, serial communication interfaces, including USB on some models, for loading programs from personal computers. The power supply circuit consists of step down transformer which is 230v step down to 12v. The filtered DC voltage will be given to regulator to produce 12v constant DC voltage. Liquid crystal display are interfacing to microcontroller 8051.Most commonly LCD used are 16*2 and20*2 display. In 16*2 display means 16 represents column and 2 represents rows. LCDs are available to display arbitrary images (as in a general-purpose computer display) or fixed images with low information content, which can be displayed or hidden, such as preset words, digits, and 7- segment displays as in a digital clock. A GSM is an open, digital cellular technology which accepts a SIM card and operates over a subscription to a mobile operator; it works just like mobile phone. In this

paper GSM is also used when user is at long distance. Where the fault is occurred this information sends in the form of message via GSM.

C. Working Principle

It is divided into four parts – DC power supply Part, cable part, controlling part, display part. DC power supply part consist supply of 230v AC then it is step down using transformer, bridge rectifier converts ac signal to dc & voltage regulator 7805 is used to produce constant dc voltage. The set of resistors denote the cable part along with switches. The set of resistors & switches are used as fault creators to indicate the fault at each location this shown by the current sensing part of cable. The change in current is sensed by this part by sensing the voltage drop. Controlling part uses the analog to digital (ADC) to converter the input current sensing signal from the current generating circuit to the voltage drop into digital signal and supply the Microcontroller. The microcontroller makes necessary calculations regarding the distance of the fault. The driver is run by the microcontroller and controls the switching of the relays for proper connection of the cable at each phase. Display part consists of the LCD display interfaced to the microcontroller and it shows the status of the cable of each phase and the fault distance of the cable at the particular phase, in case of any fault and GSM used to send message to the base station. Buzzer is used to alerts the field workers.

HARDWARE IMPLEMENTATION

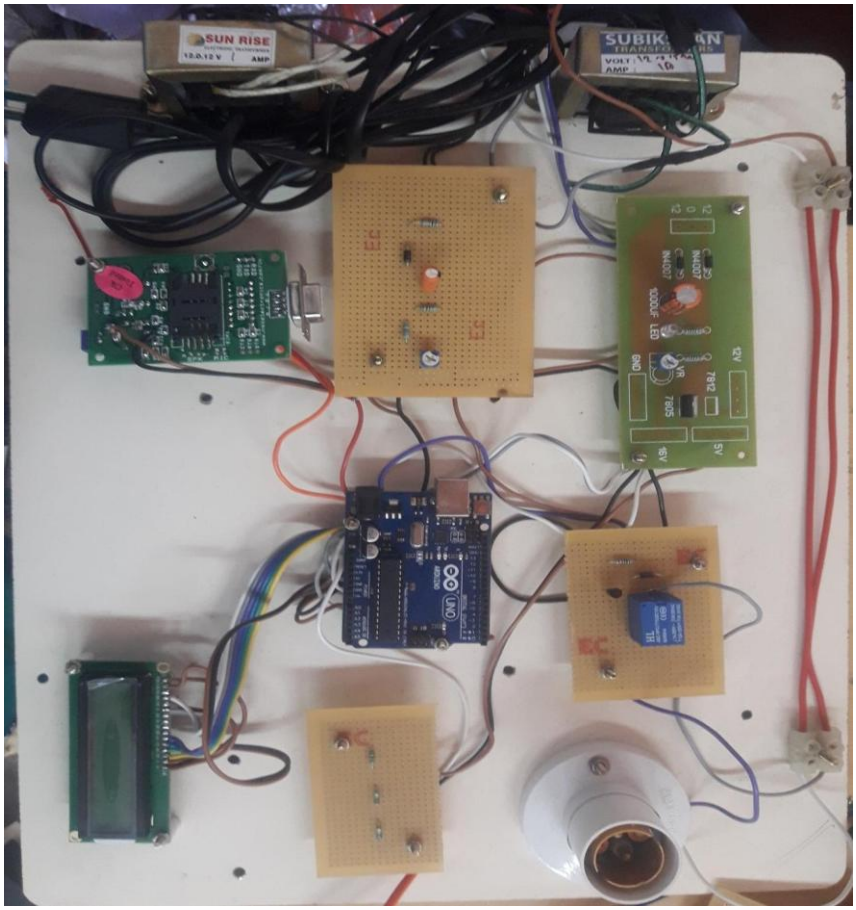

Figure 3. Hardware for digitalized method of fault detection in underground cable

SOFTWARE REQUIREMENT

A. Arduino Software

The open source Arduino software makes it easy to write code and upload it to the board. It runs on window, MAC OS X and LINUX. The environment is written in JAVA and based on processing and other open-source software. This software can be used with any Arduino board.

B. IDE

The Arduino integrated development environment (IDE) is a cross platform application (for windows, mac OS, Linux) that is written in the programming language Java. It originated from the IDE for the language processing &wiring. It includes a code editor with features such as text cutting and pasting, searching and replacing text, automatic indenting, brace matching and syntax highlighting ,and provides simple one click mechanisms to compile & upload programs to an

arduino board .It also contains a message area ,a text console, a toolbar with buttons for common functions and a hierarchy of operation menus. The source code for the IDE is released under the GNU General Public License, version 2. The Arduino IDE supports the languages C and C++ using special rules of code structuring. The Arduino IDE supplies a software library from the wiring project, which provides many common input and output procedures. user-written code only requires two basic functions, for stating the sketch and the main program loop, that are compiled and linked with a program stub main() into an executable cyclic executive program with the GNU tool chain ,also included with the IDE distribution .The Arduino IDE employs the program avrdude to convert the executable code into a text file in hexadecimal encoding that is loaded into the Arduino board by a loader program in the board's firmware.

CONCLUSION

This paper explained about the location of fault in underground cable in the rural areas where underground transmission system is used. It is difficult to find the fault in the cable. So this paper is beneficial to detect the fault location. So the fault can be easily located and extinguished. The Arduino has several advantages over the microcontroller. The Arduino based underground fault detection is more advantageous than microcontroller based underground fault detection. The paper has to be extended to the fault location in underground cables can be easily found by using Effective Global Positioning System, Global System for Mobile Communication, which thereby directly indicates the distance of fault from the nearby substation along with sending an SMS or Voice to the registered mobile number. This helps the repairing team to clear the fault within less time. This can be implemented for 3-Phase System also.

ACKNOWLEDGMENT

I would like to express my deep sense of gratitude and heartfelt thanks to Professor Dr.N. Shivakumar, Dr.Natarajan, and Dr. Nallathambi for their guidance to successful completion of this paper.

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