International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 06 Issue: 04 | Apr 2019 www.irjet.net p-ISSN: 2395-0072

Design of Arduino based Underground Cable Fault Detector

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Abstract - *This paper present new method of underground cable fault detection using Arduino. Normally in urban areas electrical cable runs in underground instead of overhead line. Whenever some issues occur in underground cable it is very difficult to determine the exact location of fault. The fault occurring at what distance and which phase is displayed on a LCD interfaced with the Arduino. Arduino is an open source hardware and software. This system uses an Arduino microcontroller kit and a rectified power supply. The circuits build with a group of resistors are interfaced to Arduino micro controller kit to help of the internal ADC device for providing digital data to the microcontroller representing the cable length in kilometers. Manually the fault creation is made by the set of switches. The relays are controlled by the relay driver. A 16x2 LCD display connected to the Arduino microcontroller to display the information. In case of short circuit the voltage across series resistors changes accordingly, which is then fed to an ADC to develop precise digital data to a programmed Arduino micro controller kit that further displays exact location of fault from base station in kilometers. This paper model is advantageous to minimize the cost, losses and also save time and difficulties of differentiation of faults and also upgrade power to consumer through increasing overall efficiency of system.*

Key Words: **Arduino, LCD, Underground cable, Analog to digital converter(ADC) etc.**

1. INTRODUCTION

The basic aim of this project model is to detect the exact location of underground cable fault from base station using an Arduino board. Normally we use overhead lines. We can simply detect the faults but in rushed places or cities we couldn't use overhead lines. So, we are using underground cables. Underground cables used mostly in urban area instead of overhead lines. The underground cable system is important one for distribution specially metropolitan cities, airport and defence service, because underground cable are not affected by bad weather condition such as snowfall, heavy rainfall, storm. But when any fault occur in cable, then it is difficult to find out the fault. The cable fault detecting equipment presently being used is comparatively heavy. However in some cases, only one method is not sufficient and correct fault determination may required more than one method together. Different fault detection methods like as Murry loop methods and acoustic detection methods are not used much because they suffer many disadvantages. The sectionalizing method is cannot be preferred because inspecting of underground cable is not possible .The Murry loop method is base on the wheat stone bridge concept and is very improper caused by lead resistances. The failure of the underground cable reproduce a serious hazards to the reliability and efficiency of power system causing breakdown of the cable. The objective of this fault detector is to find out the exact distance of underground cable fault from base station in kilometers. A DC voltage is supplied to an arrangement of series resistors representing a cable depend on the distance of fault as the current varies, the potential drop also changed across the resistors accordingly and this potential drop is helps to determine the exact location of fault occurring in the cable. In the case of short circuit fault this potential drop is fed to the ADC to create correct digital data which the programmed Arduino families would display in kilometers. In this project we have calculated correctly the exact location of a cable fault, minimize the noise causing by arcing voltage of cable by using Arduino programming and software named IDE (Integrated Development Environment)

1.1 TYPES OF FAULTS

There are different types of faults. Normally occurs the faults are given below

- Short circuit fault
- Open circuit fault
- Earth fault

Short circuit fault

When two or more conductors of the cable come in contact with each other, then this is called short circuit fault. A short circuit fault occurs when the insulation of the cable is damaged

Open circuit fault

As the name suggests, this fault include an open circuit in the conductors. When there is a break in the any conductor of a cable, it is called open circuit fault. The open circuit fault can be detected by a megger.

Earth Fault

When any of the conductors of the cable breaks and comes in contact with the earth, it is known as an earth fault. This fault usually occurs when the outer sheath of the cable is damaged due to chemical reactions with soil or due to vibrations and mechanical crystallization.

1.2. FAULT LOCATION METHODS

There are various types of fault location methods it can be classified as follows:

1) Online method

To determine the fault points this methodology utilizes & processes the sampled voltages & current. This method for underground cable is less than other lines.

2) Offline method

This methodology uses special instrument to check out sservice of cable within the field. The offline Methods are as follows,

a) Tracer method

In this methodology fault point in the cable lines is determine by walking on ground. The fault point detected by using signal like as audible signal or electromagnetic signal. It is used to point out fault location very accurately.

Example:

1) Tracing current method

2) Sheath coil method

b) Terminal method

Terminal method is used to determine fault location of cable from one or both ends without using tracing method. The general area of fault is located by the use of this method, to expedite tracing on buried cable.

Example:

1) Murray loop method

2) Impulse current method [3].

1.3. PROPOSED SYSTEM

The proposed system is to find out the precise location of the fault. The system become cost effective and compact as the components such as a LCD, regulators, relays, relay driver IC etc. are integrated with Arduino. Arduino is compiled with c language and program is uploaded in the Arduino board. When power is on Arduino start its programming cycle and send signal to relay driver to operates the relay. When Arduino performs its program cycle then all three phases are scanned with a delay of 500ms. During scan if any switch is closed (fault is created manually) current is changed and it causes drop in voltage. The drop in voltage is recorded and fed to the analog pins of Arduino and it is programmed with c language. Processes and executes input data and converts analog data into digital data using ADC. Digital data is display on the LCD with its phase and location of fault.

2. BLOCK DIAGRAM

Fig.1. Block diagram[5]

2.1. BLOCK DIAGRAM DESCRIPTION

Usually people have been using voltage 230V.This voltage is step-down to the 12V by using step down transformer. Transformer is an static device which transfer electrical energy from one circuit to another. Generally, transformers are used to step up or step down the voltages.These step-down voltage supply to rectifier unit. Rectifier is power electronic device which convert an AC supply into DC supply. In this project bridge rectifier is used which convert 12V AC supply into 12V DC supply. These voltage gives to the regulator unit. Regulator is an electrical component that maintains a constant voltage level. It stabilizes the voltage. Here we were using 7805 voltage regulator.7805 voltage regulator maintains the 5V DC supply.These voltage is used to operate the Arduino. We uploaded the program in the kit. The Arduino has a many types but we selected Arduino UNO.

The project is assembled with a collection of resistors representing cable length in KM's and fault creation is created by a collection of switches at every known KM to cross check the accuracy of the same. The fault occurring at a specific distance and the respective phase is displayed on a LCD interfaced to the Arduino board. LCD is connect the Arduino kit which is used to where the fault occurs and to display itself.

2.2. SOFTAWRE DESCRIPTION

For programming of Arduino IDE software is use. Arduino integrated development environment (IDE), which is across platform application written in the programming languages processing and wiring. It has a code editor with tool like a text cutting and pasting, searching and replacing text automatic indenting, brace matching, and syntax highlighting and provides very easy one click process to compile and upload programs to an Arduino board. It also includes a message area, a text console, a toolbar with buttons for common functions and a hierarchy of operation menus. A program written with the IDE for Arduino is termed a sketch. sketches are saved on the development computer as text file extension. ino. The Arduino IDE supports the languages C and C++ using particular rules of code structuring. The Arduino IDE supplies a software library from the wiring projects, which provides many common input and output procedures.

3. FLOWCHART AND ALGORITHM

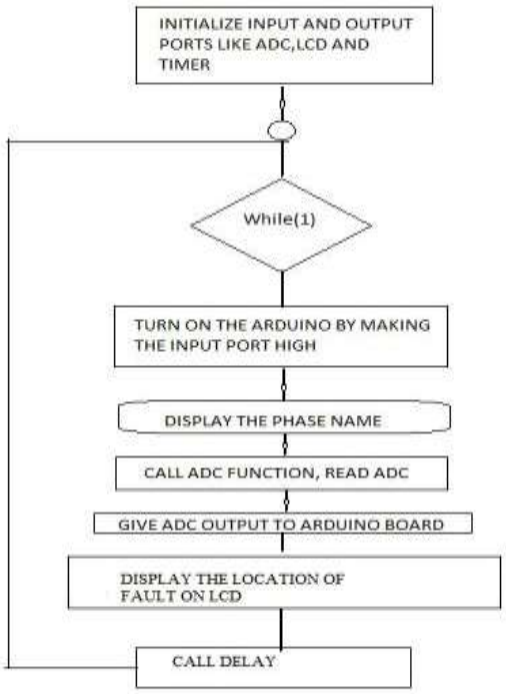

Fig.2. Flow chart

The steps of algorithm are:

1) Initialize the ports, ADC, LCD, declare timer.

2) Start an infinite loop, turn on relay 1 to start scanning phase R

3) Display "R" at starting of first row in LCD

4) Call ADC, base on the output of the ADC the fault location is display.

5) Call delay

6) Repeat steps from 3 to 5 for Y and B phases.[2]

4. ADVANTAGES

1. Provides definite accuracy in determining the location of fault.
2. Consumes low power
3. Compact size, Easy to handle
4. Serial on board programming
5. No external programming voltage needed
6. Less maintenance cost
7. It has higher efficiency.
8. Safe and secure to use
9. High reliable and efficient to use.
10. Useful for all types of underground cable
11. Public safety is improved.

5. LIMITATIONS

1. Arduino and other component require 5V DC supply.
2. Angular value required time to read so some delay occur.[3]

6. CONCLUSION

This is a proposed model of underground cable fault distance locator using Arduino board. The project is build with a set of resistors representing cable length in KM's and fault creation is made by using a set of switches at every known KM to cross check the accuracy of the same. The fault occurring at a specific distance and the respective phase is displayed on a LCD interfaced to the Arduino board.

7. FUTURE SCOPE

The project only determine the exact location of the short circuit fault in the underground cable. Further this project enhanced by measuring capacitance of cable which can even locate the open circuited faults in the cable.

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