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Cable Fault Detection Using IOT

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Abstract

This paper deals with fabrication of an IoT device intended to detect the distance of fault in cable lines from the base station using an Arduino micro controller kit and display the result through a web page. In the urban areas, the electrical cable runs in undergrounds instead of overhead lines. Whenever the fault occurs in underground cable it is difficult to detect the exact location of the fault for process of repairing that particular cable. The Cables are prone to a wide variety of faults due to underground conditions, wear and tear, rodents etc. The repairmen know exactly which part has fault and only that area is to be dug to detect the fault source. 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 a network to display in a web browser.

Keywords: *IoT, Arduino, Cable fault, Web page, resistor network*

INTRODUCTION

The main function of the electrical transmission and distribution systems is to transport electrical energy from the generation unit to the customers. Generally, when fault occurs on

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transmission lines, detecting fault is necessary for power system in order to clear fault before it increases the damage to the power system. Although the underground cable system provides higher reliability than the overhead line system, it is hard to seek out the fault location.

The demand for reliable service has led to the development of technique of locating faults. Cable faults are damage to the cable which affects a resistance in cable. If allowed to persist, this can lead to a voltage breakdown. As the cable fault detection is the process of locating the periodic fault, a programmed arduino microcontroller will display the precise digital value of series resistance voltage drop converted by ADC in unit distance from the base station. This paper deals with arduino and LCD. This system greatly reduces the time and operates effectively.

PROBLEM DEFINITION

Prefer underground cable instead of overhead for the transmission because the underground cable are not affected by any weather condition like lightning, high-speed, winds ,earthquake earth tremors , snow , frost etc. But when a fault is occur at underground cable, it is difficult to find the location of the fault to clear the fault before it increases the damage to the power system. So we will move to detect the exact location of fault. Now the world become digitalized so the project is intended 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.

Fault in cable is represented as:

- Any defect and in consistency.
- Caused by breaking of conductor& failure of insulation.
- Weakness or non-homogeneity that affect performance of cable.
- Current is diverted from the intended path .

Fault in cable can be classified in two groups:

Open circuit fault: These faults occur due to the failure of one or more conductors. The most common causes of these faults include joint failures of cables an overhead lines, and failure of one or more phases of circuit breaker and also due to melting or conductor in one or more phases. Open circuit faults are also called as series faults and better than short circuit fault, because

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when these fault occurs current flows through cable becomes zero.

Short circuit fault: Short circuit faults are also called as shunt faults. These faults are caused due to the insulation failure between phase conductor or between earth and phase conductors or both. Further short circuit fault can be categorized in two types:

Symmetrical fault: A symmetrical fault give rise to symmetrical fault current that are displaced 120* each other. Symmetrical fault is also called balanced fault. This fault occurs when all the three phases are simultaneously short circuited [2].

Unsymmetrical fault: The most common fault that occur in the power system network are unsymmetrical faults. This kind of fault gives rise to unsymmetrical fault current (having different magnitudes with unequal phase displacement). These faults are also called as unbalanced faults as it causes unbalanced current in the system.

METHODOLOGY

The Prototype of this cable fault detection using IOT technique uses the following steps:

1. The Complete Setup is depicted in the form of block diagram.

2. Fault gets created at a point shorting two lines together, a specific voltage gets generated as per the resistors network combination

3. This voltage is sensed by the microcontroller and is updated by user.

4. The information conveyed to the user is the distance to which that voltage corresponds to. The message receiver number is pre stored in the EEPROM.

5. The microcontroller retrieves the fault line data and displays over LCD display, also it transfers this data over a network to display in a web browser.

ATMEGA 328P (ARDUINO)

Arduino is an open source company, hardware and software, projects and users that designs and manufactures microcontrollers and microcontroller kits to create digital cameras and interactive objects that can detect and control objects in the physical world. Project products are distributed in the form of open source hardware and software under the GNU Lesser General Public License (LGPL) or the GNU General Public License (GPL)

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[1] for the manufacture of Arduino boards and software distribution for any person .Arduino boards are available commercially in pre-assembled form, or as do-it-yourself kits. Arduino table designs use a variety of microprocessors and controllers. The panels are equipped with input / digital pin assemblies and analog (I / O) outputs that can be coupled with various expansion cards (Shields) and other circuits. Maps include serial communication interfaces, including Universal Serial Bus (USB) on some models, which are also used to load personal computer programs.

WI-FI (ROUTER)

WIFI is used cable fault detection over IoT that detects the exact fault location over IoT that makes repairing very easy.., we use IOT technology that allows the authorities to monitor and checks over internet. The system detects fault with the help of potential divider network laid across the cable.

LITERATURE SURVEY

A literature review was conducted to determine the technological and / or industrial techniques available or used to meet this need for power companies as described in the previous chapter. The investigation is limited to the United States. Patents listed in the last five years; Technical journals (IEEE Transactions on instrumentation and measurements, IEEE Transactions on Circuits and Systems and transactions); The indices of the publication of the energy industry; The periodic disclosure of products during the last seven years; And the manufacturer's documentation.

1. Manual system is adopted.

2. Detect the fault in cables is a crucial process in the system.

3. Required wifi (router) because of the pathway detection.

4. The Automated system is used fault detection.

5. This system IoT will communicate with transfer data towards server along with the everything becomes smart, the message to the more accidents during short circuit and open circuit can be saved using this automated system.

Considering all the drawbacks into account we have formulated a proposed system which covers all the above mentioned drawbacks.

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DESCRIPTION

The project depends on the concept of OHMs law where a low DC voltage is applied at the feeder end through a series resistor. The current would vary depending upon the length of fault of the cable in case there is a short circuit of LL or LG etc.

The series resistor voltage drop changes accordingly which is then fed to an ADC to develop precise digital data which the programmed microcontroller would display the same in Kilo meters. The project is assembled with a set of resistors representing cable length in KMs and fault creation is made by a set of switches at every known KM to cross check the accuracy of the same.

This is proposed model of underground cable fault distance locator using Arduino. It is classified in four parts –DC power supply part (230v step down transformer, bridge rectifier converter and regulator), cable part, controlling part, display part.

When a supply is applied to the step down transformer, its convert into low voltage then this low voltage is applied to bridge rectifier which convert ac signal to the dc signal and we used a regulator which produce constant dc voltage. In the cable part we use a set of resistor along with switches. Current sensing part are used as fault creators to indicate the fault at each location. This part senses the change in current by sensing the voltage drop .

After that there is a controlling part which consists of analog to digital converter that receives input signal from the current sensing circuit and converts this input signal into digital signal and send it to the microcontroller.

The microcontroller also a part of the controlling units and makes a necessary calculation regarding the distance of the fault [4.. The microcontroller also drives a relay driver which in turn controls the switching of a set of relays for proper connection of the cable at each phase.

(See Block Diagram:-1)

HARDWARE DESCRIPTION

The most common set of requirements defined by any operating system or software application is the physical computer resources, also known as hardware. The hardware requirements required for this paper are:

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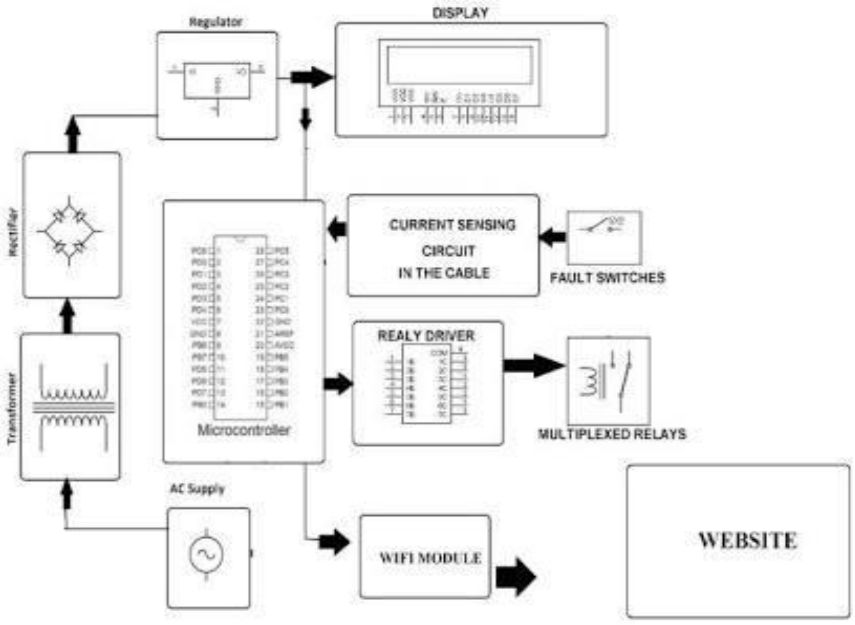


Fig -1: Block Diagram

LCD Display

LCD (Liquid Crystal Display) is the technology used for displays in notebook and other smaller computers. Like light-emitting diode (LED) and gas-plasma technologies, LCDs allow displays to be much thinner than cathode ray tube (CRT) technology. LCDs consume much less power than LED and gas- display displays because they work on the principle of blocking light rather than emitting it. LCD is an Alphabetic Display. It means that it can display Alphabets, Numbers as well as special symbols. Thus LCD is a user friendly display device which can be used for displaying various messages.

Relay

A relay is a simple electromechanical switch made up of an electromagnet and a set of contacts. Relays are found hidden in all sorts of devices. It is an electrically operated switch. Many relays use an electromagnet to mechanically operate a switch, but other operating principles are also used, such as solid- state relays. Relays are used where it is necessary to control a circuit by a separate low-power signal, or where several circuits must be controlled by one signal.

Transformer

Electrical power transformer is a static device which transforms electrical energy from one circuit to another without any direct electrical connection and with the help of mutual induction between two windings. It transforms power from one circuit to another without changing its

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frequency but may be in different voltage level.

A transformer is a device that is used to either raise or lower voltages and currents in an electrical circuit. In modern electrical distribution systems, transformers are used to boost voltage levels so as to decrease line losses during transmission. It is used to control the voltage. There are step up and step down transformers

Diodes

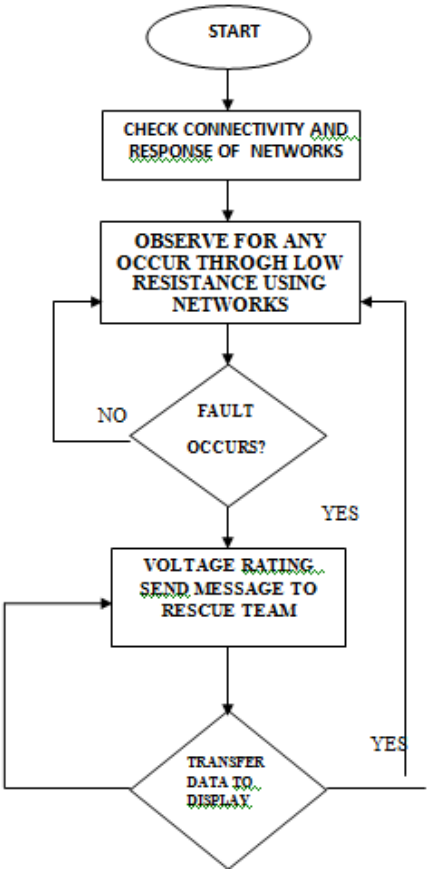
The most common function of a diode is to allow electric current to pass electric current in one direction while blocking the current in the opposite direction. Thus, the diode can be viewed as an electronic version of a check valve .This unidirectional behavior is called rectification and is operated within a rated specified voltage level. A diode only blocks current in the reverse direction while the reverse voltage is within a limited range otherwise reverse barrier breaks and the voltage at which this breakdown occurs is called reverse breakdown voltage.

Voltage Regulator

A voltage regulator is designed to automatically maintain a constant voltage level. It generates a fixed output voltage of a preset magnitude that remains constant regardless of changes to its input voltage or load conditions.

Capacitors

A capacitor is a passive two-terminal electrical component that stores electrical energy in an electric field. It is a device used to store an electric charge, consisting of one or more pairs of conductors separated by an insulator.



Flow Diagram of Cable Fault Detection system

Fig -2: Flow Chart

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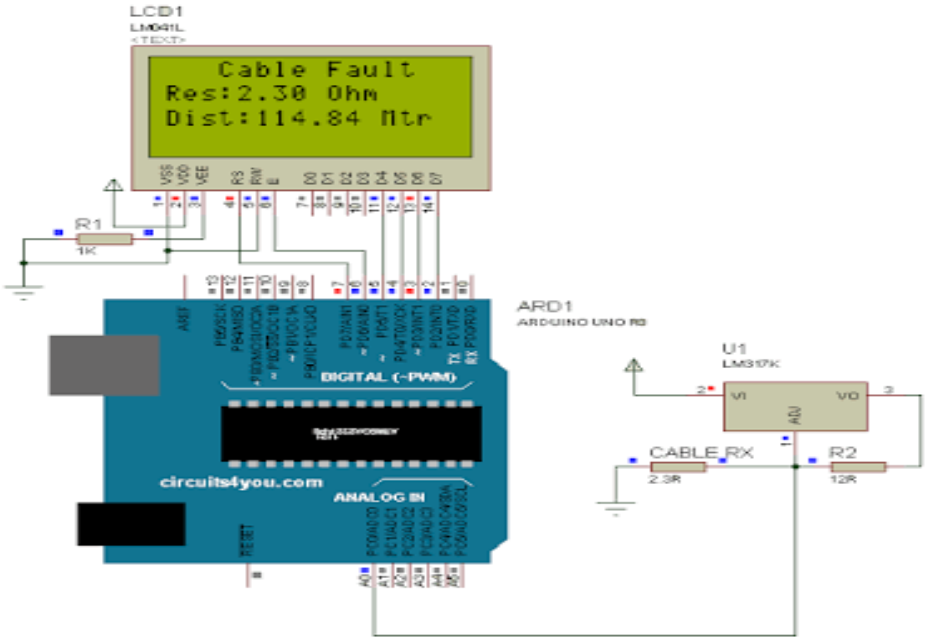


Fig -3: Circuit Diagram

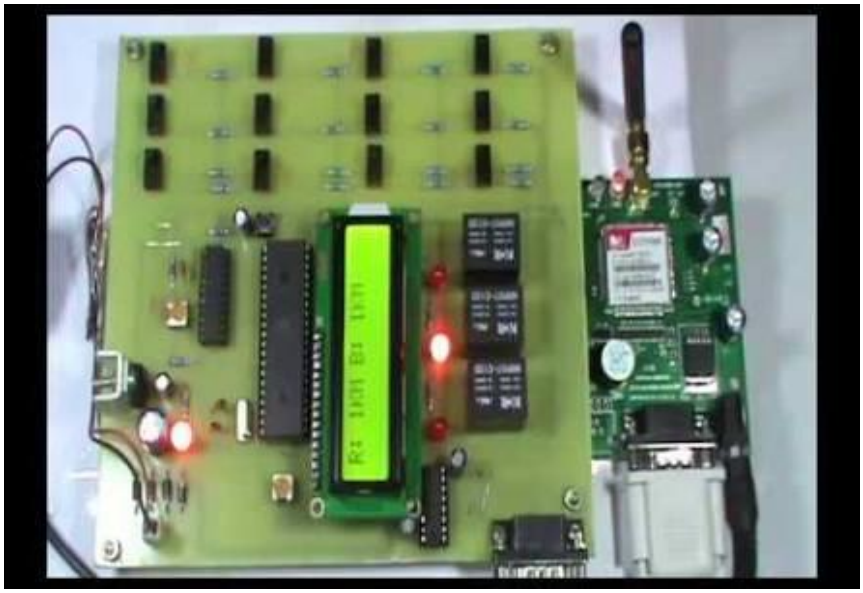


Fig -4: Hardware Implementation

ADVANTAGES

- Reliable system.
- Easy to operate.
- Monitors hazards and threats.
- Sophisticated security.
- Simple and Reliable Design.
- Low Maintains of project
- Improved public safety.
- Less consumption of power
- Easy to handle.

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RESULT

In this paper we detect the exact location of short circuit fault in the underground cable from feeder end in km by using microcontroller ATMEGA328P (ARDUINO).For this we use simple concept of OHM's law so fault can be easily detected and repaired. Finally, we have done this project for 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 project is beneficial to use to detect the fault location. So the fault can easily locate and extinguish.

SCOPE AND FUTURE WORK

In this project we detect only the location of short circuit fault in underground cable line, but we also detect the location of open circuit fault, to detect the open circuit fault capacitor is used in ac circuit which measure the change in impedance & calculate the distance of fault.

CONCLUSIONS

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

REFERENCES

1. T. S. Sidhu and Z. Xu, " Detection of incipient faults in distribution underground cables", IEEE Trans. Power Del., vol. 25, no. 3, pp. 1363–1371, Jul. 2010

2. Tarlochan S. Sidhu, Zhihan Xu, "Detection of Incipient Faults in Distribution Underground Cables", IEEE Transactions on Power Delivery, Vol. 25, NO. 3, JULY 2010.

3. Md. Fakhrul Islam, Amanullah M T O o, Salahuddin. A. Azad1,Locating Underground Cable Faults: A Review and Guideline for New Development" , 2013 IEEE

4. M.-S. Choi, D.-S. Lee, and X. Yang, ―A line to ground fault location algorithm for underground cable system KIEE Trans. Power Eng., pp. 267–273, Jun. 2005.

Page 21-30 © MANTECH PUBLICATIONS 2019. All Rights Reserved

5. DhivyaDharani.A, Sowmya.T, "Development of a prototype of Underground Cable Fault Detector", IJEECS, Vol-2, 2014.

6. Dhekale P.M., Prof. Suryawanshi R.R., "Underground Cable Fault Distance Locator", IJIERT, vol-2, April-2015.

7. J.Densley, "Ageing mechanisms and diagnostics for power cables—an overview," IEEE Electronic Insulation Mag., vol. 17, no. 1, pp. 14–22, Jan./Feb. 2001.

8. Qinghai Shi, Troeltzsch U, Kanoun O. Detection and localization of cable faults by time and frequency domain measurements. Conf. Systems and Signals and Devices, 7th International conference, Amman. 2010; 1-6.

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