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FAULT DETECTION IN 3-PH UNDERGROUND SYSTEM USING ARDUINO AND IOT MODULE

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Abstract: This project proposes fault distance locator model for underground power cable using an Arduino uno microcontroller. The use of underground cables arises a problem of identifying the fault location and the distance of cable fault as it is not open to view as in case of overhead cable. Thus, the underground cable fault distance locator is developed to detect the exact fault location and the distance of underground cable fault from based station in kilometers as the system will detect the faulted cable on underground and will send the information to the control room by using IOT cloud. A 16x2 LCD display is connected to the microcontroller to display the information. In case of fault the voltage across series resistors changes accordingly, which is then fed to a microcontroller ADC pin to develop precise digital data to a programmed Arduino microcontroller that further displays exact fault location from base station in kilometers. Same information will update on IOT cloud.
Incidents of underground cable faults in the distribution and power transmission system is unpreventable due to several reasons thus a rapid rectification and Therefore, automatic fault location is used to minimize the time to mend faults to make system reliable by figuring out the weak areas quickly which results into decreased restoration time and interruption.
Proper fault locating and detecting approaches are required to diminish the intervention time fault and an improvement in reliability.

***Keywords*: Arduino UNO, Underground cable, fault, microcontroller, IOT, Cloud, LCD, reliability**

I. INTRODUCTION

Electrical power can be transmitted in two main ways by use of overhead electrical cables or underground ones. Years ago the use of an overhead electric cable was most prominent. But due to reasons such as the risk of electrocution, the risk to low flying aircraft, damages in the cable due to weather conditions etc., made it a less reliable one. In the year 1884 W.M.Callender proposed the idea of underground wires. In his paper Underground Wires, he described the structure of the cable, how the cable joints are designed, how are they to be laid etc. The research on transmitting power through underground cables has been done and this sector has seen a lot of advancement in two decades. But when any fault occur in cable, then it is difficult to locate fault. So we will move to find the exact location of fault. Now the world is 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
- Inconsistency
- Weakness or non-homogeneity that affects performance of cable
- Current is diverted from the intended path.

Fault in cable can be classified in three groups:

1) **Open circuit fault**: Open circuit faults are better than short circuit fault, because when this fault occurs current flows through cable becomes zero. This type of fault is caused by break in conducting path. Such faults occur when one or more phase conductors break.

2) **Short circuit fault**: Further short circuit fault can be categorized in two types: a) Symmetrical fault: Three-phase fault is called symmetrical fault. In this all three phases are short circuited. b) Unsymmetrical fault: In this fault magnitude of current is not equal & not displaced by 120 degree.

3) **Earth Fault**: When the conductor of the cable comes in contact with earth, it is called earth fault or ground fault. Henry G. Stott proposed a simple technique for cable fault identification in 1901. Today, the methods to find fault became increasingly complex and these methods include usage of Fourier analysis, Wavelet Transformation etc. But still, the time is taken to report the fault and to rectify it is reduced slightly. Thus came the use of Microprocessor, GPS and GSM technology followed in by IoT. The fault is identified and is stored in the cloud. The stored data is updated in the database for an app and HTML page. Thus the repairmen are given as much information about the fault is provided.

1.1 Causes of Faults in Underground

Cables Most of the faults occur when moisture enters the insulation. The paper insulation provided inside the cable is hygroscopic in nature. Other causes include mechanical injury during transportation, laying process or due to various stresses encountered by the cable during its working life. The lead sheath is also damaged frequently, usually due to the actions of atmospheric agents, soil and water or sometimes due to the mechanical damage and crystallization of lead through vibration.

This project basically uses microcontroller, IOT and LCD for determination of exact location of fault in underground cables. In this project resistance plays leading role and. Every cable has a different resistance which depends on the length of the cable and also the material used. Any deviation in resistance will help in detection of fault.

Programs uploaded in Arduino UNO to detect faults from the cables. When a fault occurs in the underground cables, we can find out faults through Arduino controller. LCD display which displays the faults in Kilometers. IOT Service is used for get update about fault, from anywhere of remote location. We will able to see fault on any smart phone or PC. In this project we created faults manually.

II LITERATURE SURVEY

The idea of Underground transmission cable was first introduced by W. M. Callender before the American Institute of Electrical Engineers, at Philadeithia, September, 1884.he told in his paper that ― For underground work, the first thing to be decided upon is the conduit.

A practical algorithm with wavelet Multi Resolution Analysis (MRA) coefficients are designed by Tag Eldin (2010) for fault detection and classification. The line currents at the two ends are evaluated through an online WT algorithm with MRA for fault identification. The magnitudes of spikes in wavelet coefficients are used in the fault detection and classification process.

To segregate the ground faults from phase-to-phase faults, the smooth coefficient examination of neutral current is employed. The designed technique by Reddy et al. (2009) with a mixture of impedance calculation and CWT method identifies the disturbance with fault occurrence. There are many schemes with the relay for identification of the proper faulty phase in order to protect the power system from transmission line faults. The scheme employs the NN, WT or both, to address the issues. WT with exact tools are used by Mohammad Ali et al. (2014) for transient signal in transmission lines. An ANN has a large variation between the measured signal and associated signal.

A fault detection method has been designed by Durga Prasad & Srinivasu (2015) for protection of transmission lines by root mean square values of 3- phase power. Input signal for detection algorithm is changed during faults and non-fault cases. The designed method is authenticated for faults of many types at various moments and various locations. The transmission line is an important part, susceptible to fault of electrical power system, because of its large physical dimension.

Dhivya Dharani.A, Sowmya.T the paper titles as―Development of a Prototype Underground Cable Fault Detector ― Cable faults are damage to cables which affects the resistance in the cable. If allowed to persist, this can lead to a voltage breakdown. To locate a fault in the cable, the cable must first be tested for faults. This prototype is assembled with a set of resistors representing cable length in Kilo meters and fault creation is made by a set of switches at every known Kilo meters (km's) to cross check the accuracy of the same. The fault occurring at what distance and which phase is displayed on a 16X2 LCD interfaced with the microcontroller.

Nikhil Kumar Sain, Rajesh Kajla paper titled as ―Underground Cable Fault Distance Conveyed Over GSM. This paper proposes fault location model for underground power cable using microcontroller. The aim of this project is to determine the distance of underground cable fault from base station in kilometres. This project uses the simple concept of ohm's law. When any fault like short circuit occurs, voltage drop will vary depending on the length of fault in cable, since the current varies.

2.1 Outcome of Literature Survey

By the literature survey we came to know that we can solve the problem of underground fault detection. We can implement advanced form of fault detection in 3 phase underground system using Arduino and IOT module from ohms law. Fault is determined the distance of underground cable fault from the base station and also find the exact location of that faulty place.
When any fault like short circuit occurs, voltage drop will vary depending on length of fault in cable, since the current varies. The fault is detected by detecting the change in the voltage and a microcontroller is used to make the necessary calculation.

III PROBLEM STATEMENT

Underground cables are prone to a wide variety of faults due to underground conditions, wear and tear, rodents etc. Diagnosing fault source is difficult and entire cable should be taken out from the ground to check and fix faults. In this way, visual inspections are not helpful, then the whole length of the cable which is replaced. The fault location model for underground power cable using microcontroller and the thing which is based on the internet means the information will transfer through the internet access
This type of solution is not only economically expensive but also long outage of electrical cables from services results in the more heavy losses of revenue for the company which distributes power. The production losses in the industries as well as critical conditions for the general public hence the consumers can left it without the electricity for entire period taken to the unearth the electrical cable and carried out necessary repairs.

IV OBJECTIVES

The objective of this project is to determine the distance of underground cable fault from base station in kilometres using an Arduino board i.e., automatic fault location to minimize the time to mend faults to make system reliable by figuring out the weak areas quickly which results into decreased restoration time and interruption. Also, to get update about fault, from any whereof remote location on any smart phone or PC.
we propose an 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.

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. 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.

V METHODOLOGY

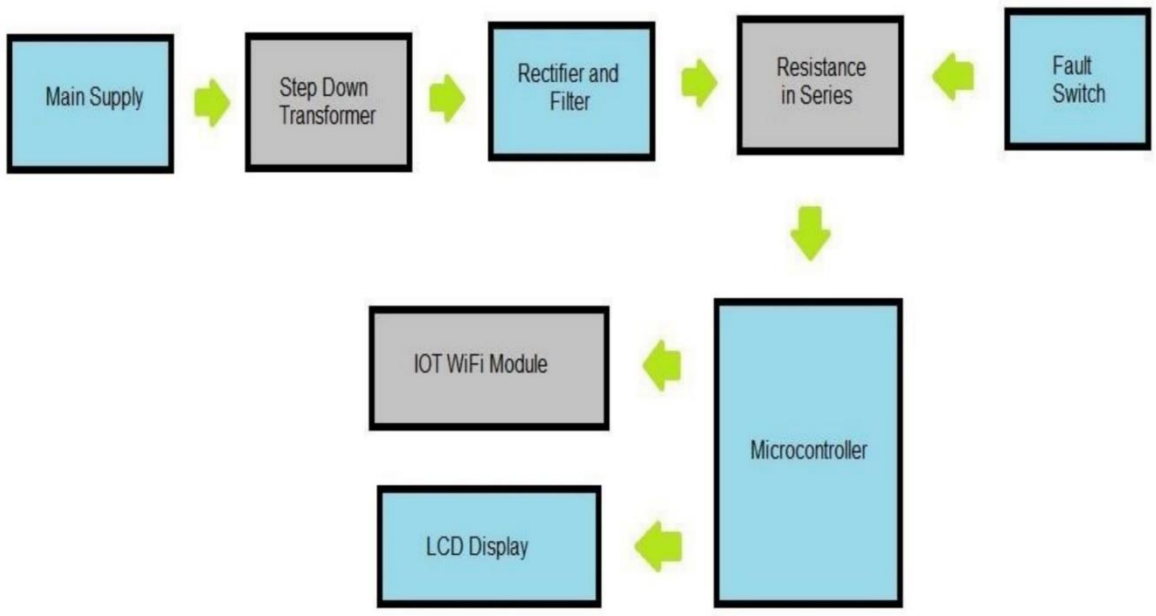

Fig.5:Block Diagram

Programs uploaded in Arduino UNO to detect faults from the cables. When a fault occurs in cables, we can find out faults through Arduino controller. LCD display which displays the Kilometre. Microcontroller will update this all information to IOT cloud using with module esp8266. In this project different resistance which depends upon the length of the cable.

In here Methodology Fig.5a Model Circuit Connection Diagram Programs uploaded in Arduino UNO to detect faults from the cables. When a fault occurs in out faults through Arduino controller. LCD display which displays the Kilometre. Microcontroller will update this all information to IOT cloud using with project we created faults manually. Cable has many depends upon the material used. The value of the here resistance is the leading role of the project. Programs uploaded in Arduino UNO to detect faults from the cables. When a fault occurs in the out faults through Arduino controller. LCD display which displays the faults in Kilometre. Microcontroller will update this all information to IOT cloud using with help of IOT WIFI many types. Every cable has the resistance is depending project.

If any deviation occurs in the resistance, the value of the voltage will be changed that particular point is called FAULT. We are finding out those faults. This project is assembled with a set of resistors that represents the cable length in kilometre's and fault creation consists of a set of switches on every kilometre is known to cross check the accuracy of the same. This is the model for the proposed cable fault locator distance using the microcontroller. It is divided into four parts, the DC power supply part, cable part, controlling part and display part or communication part. The DC power supply consists of AC supply, transformer, rectifier and voltage regulator. AC supply of 230 V in step-down by transformer, bridge rectifier converts the AC signal to a DC signal while the regulator is used to generate a constant DC voltage.

The cable is represented by a set of resistors with switches. The sensing part on the cable represented as a set of resistors and switches used as fault creator to specify fault at each location. Next is the controlling part that comprising an Analog to Digital Converter (ADC) that receives input from the sensing circuit. ADC converts this voltage to a digital signal in microcontroller.
The display part consists of the LCD display interfaced to the Arduino which shows the status of the cable of each phase and the distance of the cable at the particular phase, in case of any fault. IOT Esp8266 WIFI module Is connected with TX and RX pin of microcontroller and this module is used for IOT cloud service. It will update the status on IOT cloud and with that we will able to monitor the fault from anywhere of remote location.

ADVANTAGES/DISADVANTAGES/APPLICATIONS

Advantages:

- Less maintenance
- It has higher efficiency
- This method is applicable to all types of cable
- It will provide location of fault
- LCD interfaced for Locally display information
- Easy to use
- No Men Power required
- Continues Monitoring 24X7
- Wireless WIFI IOT technology-based system

Disadvantages:

- Underground cables have **higher initial cost** and insulation problems at high voltages.
- It is difficult to locate and repair the fault because fault is invisible.

Applications:

- Used in Industrial Hubs inside Metropolitan cities.
- Electrical cable fault detection.
- It also applicable in large areas like hospital, colleges, companies

VI CONCLUSION

This Project proposed a fault location scheme for transmission systems consisting of cables. In this method, particular distance in the cable can be located using simple concepts of OHM's law that enables to identify fault type quickly for all feeders from the substation by using Arduino board prepared. For this we use OHM's law so that fault can be easily detected. By using Arduino controller, we can find out exact fault location. Once faults occur in the cable, the display unit displays the exact fault location and affected phase in the multicore cable. This information is stored in a cloud space. Using IOT cloud service, app can be developed to help O&M engineers to know the details of the fault. Hardware is successfully tested and fault is detected and displayed also.
The short circuit fault at a particular distance in the underground cable is located to rectify the fault efficiently using simple concepts of Ohms law. The work automatically displays the phase, distance and time of occurrence of fault with the help of Wi - Fi module in a webpage. The benefits of accurate location of fault are fast repair to revive back the power system, it improves the system performance, it reduce the operating expense and the time to locate the faults in the field.

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