IOT Based Underground Cable Fault Detection

Naveen V[1], Abhishek M G[2], Ajay N P[3], Chandan C M[4],Chandan G M[5]
[1]Assistant Professor, Dept of Electronics and Communication Engineering
[2, 3, 4, 5]Dept of Electronics and Communication Engineering
[1, 2, 3, 4, 5] East West Institute of Technology, Karnataka.

Abstract- *The project is intended to detect the location of fault in underground cable lines from the base station in kilometers using Arduino micro-controller. This project uses the standard concept of Ohms law i.e., when a low DC voltage is applied at the feeder end through a series resistor to the Cable lines, then current would vary depending upon the location of fault in the short circuited cable.*

In the urban areas, the electrical cables run 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 proposed system finds the exact location of the fault.

This system uses a Arduino-controller and a rectified power supply. Here the current sensing circuits made with combination of resistors are interfaced to controller with help of the ADC device for providing digital data to the microcontroller representing the cable length in KM's. The fault creation is made by the set of switches. The relays are controlled by the relay driver IC which is used for switching the power sequentially to all the lines. A 16x2 LCD display connected to the microcontroller to display the information.
In case of short circuit (Line to Ground), the voltage across series resistors changes accordingly, which is then fed to an ADC to develop precise digital data to a programmed Renesasboard that further displays fault location in kilometers.

The project future can be implemented by using capacitor in an ac circuit to measure the impedance which can even locate the open circuited cable.

Keywords- Renesas microcontroller, Gprs , watt resistor, bulb, cloud and LCD Display.

I. INTRODUCTION

Till last decades cables were made to lay overhead& currently it is lay to underground cable which is superior to earlier method. Because the underground cable are not affected by any adverse weather condition such as storm,snow,heavy rainfall as well as pollution.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.

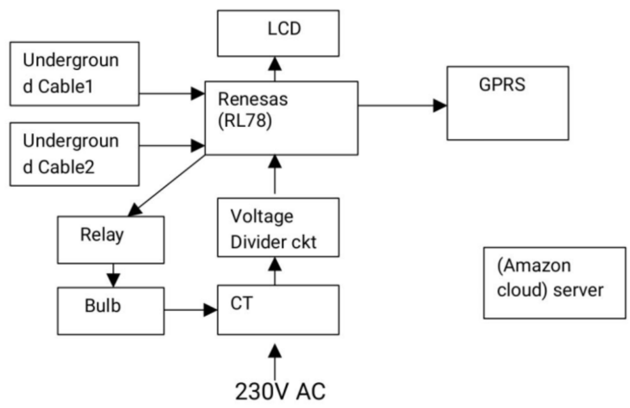
II. TYPES OF FAULTS

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

Fault location method: Fault location methods can be classified as:

- **Online method**: This method utilize process the sampled voltages& current to determine the fault points. Online method for underground cable is less than overhead lines.
- **Offline method**: In this method special instrument is used to test out service of cable in the field. There are two offline methods as following
- **Tracer method**: In this method fault point is detected by walking on the cable lines. Fault point is indicated from audible signal or electromagnetic signal.It is used to pinpoint fault location very accurately. Example: 1) Tracing current method 2) Sheath coil method.
- **Terminal method**: It is a technique used to detect fault location of cable from one or both ends without tracing. This method use to locate general area of fault, to expedite tracing on buried cable. Example:1) Murray loop method 2) Impulse current method.

III. BLOCK DIAGRAM



The figure represents the block diagram of IOT Based 0.4 Underground Cable Fault Detection.. It consist of hardware components such as renesas microcontroller, LCD, Voltage divider circuit, bulb, relay, current transformer, server, cables.

Many techniques have been developed in cable line fault detection over the last few decades. Generally we use overhead lines. It can easily identify the faults but in rushed places or familiar cities we can't use overhead lines. So, we are moving to underground cables. In this paper it 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. As the existing system is not efficient ,this paper propose a system based on IoT. The objective of this project is to determine the distance of underground cable fault from base station in kilometers using an IoT Gecko platform.

The underground cable line system is used in many urban areas. Various fault locating methods like the sectionalizing methods, acoustic detection method, Murray loop methods are not used much because they suffer from many disadvantages. The sectionalizing method can't be employed because section wise checking of underground cable is not possible. The acoustic method may become disastrous at the time of rain and it is a bit cumbersome method too.

The Murray loop method is based on the principle of Wheatstone and due to different resistances of leads There are many electrical, telephone and other signal cables are laid underground. In normal methods we have to check with the machine where the fault is occurred .It required lot of time and the workload is also more. In IoT based underground cable line fault locator whenever a fault is occurring in the cable line we can see the location in the IoT Gecko online system. Then the admin can inform to the repairman. Many time faults occur due to construction works and other reasons. It is difficult to dig out cable lines full because it do not know the exact location of the cable line fault. In case if it is a short circuit , the voltage across series resistors changes accordingly. 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 fault occurring at a particular distance and the respective phase is displayed on a LCD and also it transfers this data over internet to display online. This paper use Thing Speak to develop the online system that links with the system to display the cable faults online. The project is assembled with a set of resistors representing cable length in KM's and fault creation is made bya set of switches at every known KM to cross check the accuracy of the same.

IV. COMPONENTS REQUIRED

Hardware components:

1. Arudino micro-controller
2. LCD
3. Watt Resistors
4. ESP8266 wifi module
5. Voltage divider circuit
6. Transformer
7. Relay
8. Bulb.

Software Used:

1. Embedded C.
2. Arduino sketch.

V. LITERATURE SURVEY

Underground cables have been widely applied in power distribution networks due to thebenefits of underground connection, involving more secure than overhead lines in badweather, less liable to damage by storms or lightning, no susceptible to trees, lessexpensive for shorter distance, environment-friendly and low maintenance. Every cable has its own resistance. As the length of the cable increases, so does the resistance value of the particular cable increases.

The only disadvantages of utilizing underground cables is that, it is 8 to 15 timesmore expensive than equivalent overhead lines, moreliable to permanent damage following a flash-over, and difficult to locate fault.

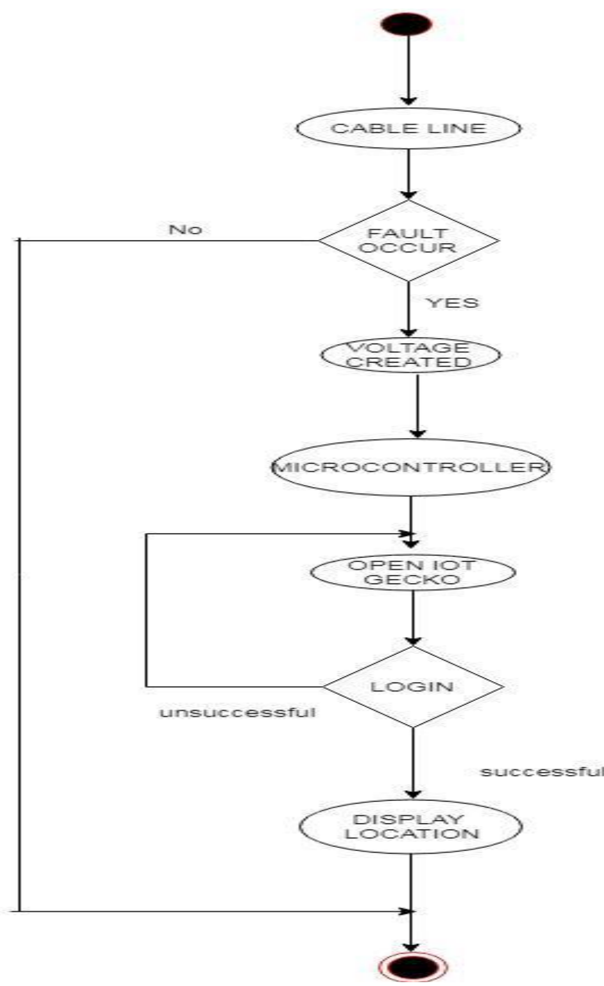
Faults in underground cables can be normally classified as two categories: incipient faultsand permanent faults. Usually, incipient faults in power cables are gradually resultedfrom the aging process, where the localized deterioration in insulations exists. Electricaloverstress in conjunction with mechanical deficiency, unfavorable environmentalcondition and chemical pollution, can cause the irreparable and irreversible damages ininsulations. Eventually, incipient faults would fail into permanent faults sooner or later.

The detection of incipient faults can provide an early warning for the breakdown of thedefective cable, even trip the suspected feeder to limit the repetitive voltage transients.The location of permanent faults in cables is essential for electric power distributionnetworks to improve network reliability, ensure customer power quality, speed uprestoration process, minimize outage time, reduce repairing cost, dispatch crews moreefficiently and maintain network reliability. The state estimation (SE) is an auxiliary toolto provide the necessary information for theproposed location algorithms. The relatedmethods published in journals and proceedings are reviewed, summarized and comparedin the next subsections.

VI. EXISTING SYSTEM

A variety of technologies and tests are currently available to evaluate underground cables but there is often little correlation between the diagnostic results and the actual deterioration. The failures of underground power distribution cables represent a serious threat to the reliability of power infrastructure. Replacement must be done selectively, since cable replacement is very expensive, being estimated at no less than $100,000 per km of cable in an urban area (Ponniran and Kamarudin, 2008). A common underground (U/G) cable failure mechanism is water treeing, where water-filled voids grow in the insulation promoted by the electric field which reduces the dielectric breakdown potential of the cable, eventually causing catastrophic breakdown of the cable. CN degradation is one of the failure mechanisms of underground distribution cables which causes loss of protective shielding, and in some instances, lack of current return path. Presently available diagnostic techniques require the cable to be disconnected from the grid, hence causing service disruptions during the testing.

VII. PROPOSED SYSTEM



The project contains Renesas microcontroller, LCD, GSM/GPRS, voltage Divider circuit, Transformer, Under ground cables(resistors).In this project Renesas is the heart of the project located at the centre of the block diagram, and control all the operation of the project. Resistors(shown in fig) are connected in series to form two under ground cables, and those two cables are connected to in built ADC of micro-controller that converts analog inputscoming from cables to digital value these values are sent to the micro controller. A the joining(series) point of two resistors toggle switches are used to create(show) fault ,around 2 to3 toggles witches are used in each of the cable to create faults at 1km,2km,3km on each cable.

Consider in first cable,2nd toggle switch is turned on then an less voltage(compared to the voltage which will get when there is no toggle switches Are turned on) from cable to ADC will be receive and ADC will convert this analog voltage to digital value, this digital value is compared with the threshold value that is stored inside Renesas controller. If there is any variations occurred then micro controller will send an alert to concernedauthority (cloud)through GPRS .the underground cable condition is updated to cloud via GPRS and stored in data base so that the data can be viewed any time any where globally. One more feature that is overload condition is detected by using different voltage consuming loads(bulbs-40W,60W,100W),if the load is more than specified one connected to kitthen the condition will be detected by micro controller an also sends an Overload condition is up -dated to cloud.

VIII. OBJECTIVES

- Achieving higher detection accuracy, especially for high impedance, Incipient faults
- supervising almost the entire length of cable (i.e., less detectiondead zone)
- detecting and classifying the different fault types
- detect the exact fault location of the cable and to fix that problem by providing instant information about fault that at what distance the cable fault has been detected through thingspeak

IX. CONCLUSION

The project is designed using structured modeling and is able to provide the desired results. It can be successfully implemented as a Real Time system with certain modifications.

Science is discovering or creating major breakthrough in various fields, and hence technology keeps changing from time to time. Going further, most of the units can be fabricated on a single along with microcontroller thus making the system compact thereby making the existing system more effective. To make the system applicable for real time purposes components with greater range needs to be implemented.

REFERENCES

[1] Voloh, C. G. Jones, and G. Baroudi, "Detection of incipient faults in underground medium voltage cables,"
[2] Qinghai Shi, Troeltzsch U, Kanoun O. Detection and localization of cable faults by time and S. M. Miri, and A. Privette, "A survey of incipient fault detection and location techniques for extruded shielded power cables.
[3] W. Charytoniuk, W. Lee, M. Chen, J. Cultrera, and T. Maffetone, "Arcing fault detection in underground distribution networks-feasibility study.
[4] N. T. Stringer, L. A. Kojovic, "Prevention of underground cable splice failures,"
[5] T. T. Newton and L. Kojovic, "Detection of sub-cycle, self-clearing faults,"