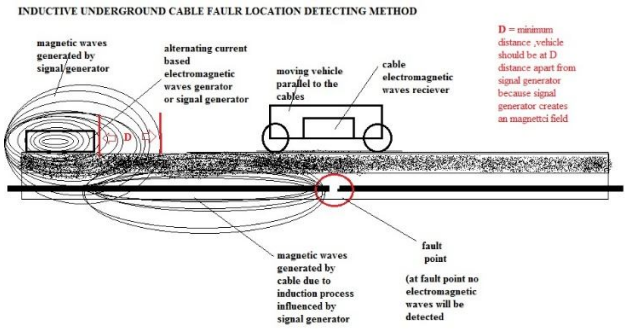
# Review on Underground Cable Fault Detecting Robot

**Sahil Narvekar[1], Ajmal Balbale[2], Jay Patil[3], Tamanna Attar[4], Dr. S. V. Chougule[5]**
Department of Electronics and Telecommunication Engineering
[1,2,3,4,5] Finolex Academy of Management and Technology, Ratnagiri

***Abstract-*** *The basic principle of Electromagnetic and infrared theory is used to detect discontinuity in the cables laid below the ground. These underground cables are used for many applications. It may be telephone, cable service or may be for internet and data services. Companies prefer laying the cables underground because the climatic adversities don't affect this. With advantages come challenges. There are many difficulties in laying the cables and once laid in case of any complaints, it is difficult and costly to fix it. This paper reviews various methods related to underground cable fault detecting robot.*

***Keywords***- Electromagnetic and infrared theory, cable discontinuity, underground cable fault detector.

## I. INTRODUCTION




Till the last decade the cables where made to lay overhead and currently the scenario is to lay underground cable, which is superior to the earlier method. This is because the underground cables are not affected by the adverse weather conditions. Neither the hot sunny day nor the rain can influence it. But when the cable breaks due to some reasons it's very difficult to locate that. Currently what is done is they find the approximate location and dig the cables out from the location and check it manually to find the exact point of discontinuity [1]. The aim of this project is to determine the distance of underground cable fault from base station in kilometers. 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. In case if any fault occurs for any reason at that time the repairing process related to that particular cable is difficult due to not knowing the exact location of cable fault [2]. Concerns about the reliability of overhead lines, increases in their maintenance and operating costs, and issues of public safety and quality-of-life are leading more and more utilities and municipalities to the realization that converting overhead distribution lines to underground is the best way to provide high quality service to their customers, undergrounding provides potential benefits through reduced operations and maintenance costs, reduced tree trimming costs, less storm damage and reduced loss of day-to-day electricity sales when customers lose power after storms[3].

The paper is organized as follows: Section 2 describes system overview, section 3 describes literature review, section 4 describes applications, section 5 describes proposed system, section 6 describes conclusion, section 7 describes references.

## II. SYSTEM OVERVIEW

The basic principle behind the system is Faraday's law. If a current is flowing inside the wire there will be an EMF generated around it. An inductor circuit is used to generate a voltage using the EMF. In cases of short circuit, the EMF generated will be zero and there will be negligible voltage generated. Hence, a condition is provided where voltage is less than say 20 (binary value), the robot will stop and that will be the point of discontinuity. This voltage is amplified using a LM386 circuit and compared with the reference voltage in PIC and based on the values, the robot is driven forward or to the right or to the left.

The fault detection robot consists of a signal generator part and robotic part. Short circuit cable is checked for its continuity by passing a 3 KHz low frequency signal. A signal generator can be used to generate this signal. The AC signal passing through wire produces a magnetic field around it. This magnetic field is sensed by the robot using a inductor circuit. The AC signal sensed by robot is then amplified using a LM386 circuit. This amplified signal is then rectified and converted to DC. DC level is provided to the analog input of microcontroller. Microcontroller converts this analog input to digital signal. Based on the program programmed in the microcontroller the robot's movement is controlled.

Short circuit cable is checked for its continuity by passing a infrared light through the faulty cables.an series of infrared transmitter lights is to be implemented below the

cables so that in case when the cables become faulty and degrade due to natural phenomenon, in that case cable will parts will be degraded and infrared light emits from that section,when detecting robots moves above the cables it can sense the presence of infrared light below the wires,and by this method we can detect underground cable fault.

When the robot reaches the point where the discontinuity lies, the magnetic field will be zero. In such case the input signal at the analog input port will be substantially low. When the input signal strength is less than 10 (binary reading), the ATmega328 is programmed to display, short circuit Detected and is displayed in LCD.

## III. LITERATURE REVIEW

In [1], the underground cable fault distance locator is implemented by using microcontroller. The target of this project is to work out the gap of underground cable fault through base station in kilometers. It uses the straight forward conception of ohm's law, voltage drop can vary counting on the length of fault in cable, since the current varies. A group of resistors are used to represent the length of cable in kilometers and a dc voltage is fed at one end and the fault is detected the change in voltage using analog to voltage converter. The fault occurring at what distance is shown on LCD which is interfaced with the microcontroller that is used to make the necessary calculations [2].

In [3], the detection of fault in an underground cable is still a challenging task in power system. In order to detect an underground cable fault, the standard concept of OHM'S LAW is used. This idea is used to determine short circuit fault and open circuit fault. This project provides accuracy in determining the exact location of fault, when a low DC voltage is applied at the feeder end through a series resistor (Cable lines), then current would vary depending upon the location of fault in the cable from the base station. This project provides detection of fault and also indication of cable's temperature at varying voltage using a developed prototype from a microcontroller family. In the hardware setup the hardware developers have used the microcontroller launch pad and a low cost low power 2.4Ghz transceiver and a readable current sensor [4].

In [5], the author has explained importance of accurate fault detector. For electrical usage, transmission lines form the backbone of power systems. Accurate fault location for transmission lines is of vital importance in restoring power services and reducing wastage of time as much as possible. Underground power cables have been widely implemented due to reliability and environmental concerns. In the conventional way of detecting fault, an exhaustive search in larger scale distance has been conducted. This is time consuming and inefficient. Hence an efficient technique to locate a fault can improve system reliability. Power systems need an accurate and automatic fault location method due to number of key factors namely: reliability of supply, quality of supply, reducing operating costs of repairs and charging staff works practices, and low tariff charges to maintain a competitive edge [6]. The trend of transmission line construction from overhead to underground is increasing even though the underground system costs more for initial construction. However, the underground system requires faster detection and correction of accidental faults along the lines for more reliable service. Various methods have been developed to reduce damage and inference [7]. But most of fault detection methods have shortcomings. Some have low accuracy also some are difficult to apply because of surrounding environment. Another method that is pulse echoing method is also used. This method uses time difference between incident and reflected pulse to calculate fault location detection and it has relatively high accuracy because it uses short period pulse. Although it has high accuracy, pulse echoing method has some drawbacks. When we apply this method to low impedance accident, the error will be increased. If cable is not open circuit and there is no impedance change, there are no reflected pulse waves, and it is difficult to find fault location. Because it is also very expensive system, on-line monitoring and fault location detection of cable using Arduino or microcontroller is a better automatic digital way to locate faults [8].

In [9], The author has proposed a model of underground cable fault distance locator using microcontroller. It is classified in four parts –DC power supply part, cable part, controlling part, display part. DC power supply part consist of ac supply of 230v is step-down using transformer, bridge rectifier converts ac signal to dc & regulator is used to produce constant dc voltage. The cable part is denoted by set of resistors along with switches. Current sensing part of cable represented as set of resistors &switches are used as fault creators to indicate the fault at each location. This part senses the change in current by sensing the voltage drop. Next is controlling part which consists of analog to digital convertor which receives input from the current sensing circuit, converts this voltage into digital signal and feeds the microcontroller with the signal. The microcontroller also forms part of the controlling unit and makes necessary calculations regarding the distance of the fault. 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. The display part consists of the LCD display interfaced to the microcontroller 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 [10].

## IV. APPLICATIONS

Its main application is the detection of underground cable fault which is very hard to detect as it is not possible to see such faults which are quite possible in the case of overhead transmission line. Thus, for such cases our project is very helpful as the distance at which the fault has occurred can be calculated and then further action regarding the fault can be taken to overcome them. [4]. The underground cable fault distance locator is widely used in telecommunication sector.

## V. PROPOSED SYSTEM

The basic principle behind the proposed system is Faraday's law. If a current is flowing inside the wire there will be an EMF generated around it. An inductor circuit is used to generate a voltage using the EMF. In cases of short circuit, the EMF generated will be zero and there will be negligible voltage generated. Hence, a condition is provided where voltage is less than say 20 (binary value), the robot will stop and that will be the point of discontinuity. This voltage is amplified using a LM386 circuit and compared with the reference voltage in PIC and based on the values, the robot is driven forward or to the right or to the left.

## VI. CONCLUSION

Current scenario of digging along the cable laid and then pulling the cable out and checking whether the fault exists in the cables is a tedious work. This is not only being wastage of manpower and money for the companies, but this also causes a lot of inconvenience to the normal public. Cable fault detection robot will solve this issue to a great extent and will be really helpful for such application.

## REFERENCES

[1] Jitendra pal Singh, Sanjana Singh, toshika Singh & mohd. Shahrukh "underground cable fault distance locator" International Journal of Scientific Research and Management Studies (IJSRMS) Vol 3, July 2013

[2] Priyanka R, Priya B "Underground Cable Fault Detection" Published in International Journal of Trend in Research and Development (IJTRD), ISSN: 2394-9333, Volume-3 | Issue-3, June 2016.

[3] 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.

[4] E. C. Bascom, "Computerized underground cable fault location expertise" IEEE Power Eng. Soc. General Meeting, Apr. 10–15,1994, pp. 376–382. J. Clerk Maxwell, A Treatise on Electricity and Magnetism, 3rd ed., vol. 2. Oxford: Clarendon, 1892.

[5] Tarlochan, Sidhu, S., Xu, Zhihan, "Detection of Incipient Faults in Distribution Underground Cables" IEEE Transactions on Power Delivery, Vol. 25, No. 3, July 2010.

[6] Fakhrul Islam, Md. Amanullah M T Oo, Salahuddin Azadl, "Locating Underground Cable Faults" A Review and Guideline for New Development‖, 2013

[7] Kuan, K.K and Prof. Warwick, K. "Real-time expert system for fault location on high voltage underground distribution cables" IEEE PROCEEDINGS-C, Vol. 139, No. 3, MAY 1992.

[8] Sawatpipat, P., Tayjasanant, T., "Fault classification for Thailand's transmission lines based on discrete wavelet transform", International Conference on Electrical Engineering/Electronics Computer Telecommunications and Information Technology (ECTI-CON), 2010.

[9] M. Jaya Bharata Reddy, D. Venkata Rajesh, D.K. Mohanta,"Robust transmission line fault classification using wavelet multi-resolution analysis.", Computers & Electrical Engineering, Volume 39, Issue 4, Pages 1219-1247., May 2013

[10] Ali Rafinia, Jamal Moshtagh, " A new approach to fault location in three-phase underground distribution system using combination of wavelet analysis with ANN and FLS ", International Journal of Electrical Power & Energy Systems, Volume 55, Pages 261-274, February 2014.

[11] Abhishek Pandey, Nicolas H. Younan, "Underground Cable Fault Detection and Identification via Fourier Analysis", 2010.

[12] Swapnil Gaikwad, Hemant Pawar, Ajay Jadhav, Vidhut Kumar, "Underground cable fault detection using microcontroller," IJARIIE-ISSN(O)-2395-4396, Vol-2 Issue-3, 2016.

[13] Akash Jagtap, Jayesh Patil, Bhushan Patil, Dipak Patil, Aqib Al Husain Ansari, "Arduino based Underground Cable Fault Detection", IJREAM ISSN: 2454-9150 Vol-03, May 2017.

[14] Dhivya Dharani. A, Sowmya. T "Development of a Prototype Underground Cable Fault Detector", International Journal of Electrical, Electronics and Computer Systems (IJEECS), ISSN (Online): 2347-2820, Volume -2, Issue-7, 2014.

[15] V. Kirubalakshmi, C. Muthumaniyarasi, "IOT Based Underground Cable Fault Detector". Volume 8, Issue 8, pp. 1299–1309, Article ID: IJMET_08_08_132, August 2017.