Underground Cable Fault Distance Detector using ATmega328 Microcontroller

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Abstract: The installation of an underground cable system is a standard practice in many places and industrial units. When a problem arises in this system for any reason, the mending procedure for that damaged cable becomes complicated due to the inability to pinpoint the particular position of the faulty cable. In this paper, the basic concept of Ohm's law is used to determine the location of fault in underground cable lines from the source station to exact location of fault in any units here in kilometers. The basic notion of Ohm's law is employed in this article to establish the exact position of a fault in subterranean cable lines from the source station to any units here in kilometers. That is, if there is a short circuit in the form of a line to ground, the voltage across series resistors changes accordingly, which is then fed to an ADC built into an already programmed microcontroller to create the exact data that will display the exact location of the fault in kilometers from the source station on the connected LCD, as well as the corresponding R, Y, B phase where the fault occurred with the exact distance. The Atmega 328P microcontroller and a rectified power supply are utilized in this research. The current sensing of circuits formed using a mixture of resistors is interfaced to the ATmega328 microcontroller using an internally included ADC to provide digital data to the microcontroller. The collection of switches is the source of the malfunction . The Solid-State Relay driver is in charge of the Solid-State Relays. The phase and position of the fault in kilometers are shown on a 16x2 LCD display linked to the microcontroller.

KEYWORDS: Underground Cable, Ohm’s Law, Time domain Reflectometer, Atmega 328P micro controller, LCD.

I. INTRODUCTION

Power supply networks are constantly expanding, and their dependability is more critical than ever. The network's complexity includes several components that might fail and cause the end user's power supply to be interrupted. Underground cables have been utilized for decades for the majority of the world's low voltage and medium voltage distribution lines. Because they are not affected by weather conditions, such as severe rain, storms, snow, or pollution, underground high voltage cables are becoming increasingly popular. Despite the fact that cable production technology is always improving, there are still factors that might cause cable to break during testing and operation. A properly fitted cable can last up to 30 years if it is in good condition. However, faulty installation or badly executed jointing may readily damage cables, as can future third-party damage from civil works such as trenching or curb edging. A cable fault is defined as any flaw or inconsistency produced by conductor breakage, insulation failure, and cable weakness or non-homogeneity that impacts the cable's performance. A cable is a bundle of electrical conductors used to transport power. One or more conductors are usually wrapped with adequate insulation and a protective cover in an underground cable. Insulation materials such as varnished cambric or impregnated paper are commonly utilized. A cable fault can be any flaw that causes the cable's performance to be disrupted. As a result, the error must be corrected. Both overhead and subsurface cables can be used for power transmission. However, unlike subterranean cables, overhead cables have the disadvantage of being susceptible to the impacts of rain, snow, thunder, and lightning, among other things. This necessitates cables with higher dependability, safety, toughness, and serviceability. Many localities, particularly in metropolitan ones, prefer underground connections. It is not feasible to identify and rectify defects in an underground cable by just looking at it, as it is with an overhead line. It is difficult to discover problems in them since they are buried deep in the earth. Even if a flaw is discovered to be present it is very difficult to detect fault. This leads to debugging of the entire area to detect fault between two sub section unit, which in turn causes wastage of money and manpower.

II. EXISTING SYSTEM

Over the years, researchers have made several efforts to design and implement an electronic underground cable fault detector that will help to overcome the problems as well as challenges encountered in the use of underground cables and detection of faults that occurs in the underground cables but unfortunately, there were limitations to their designs.2 International Journal of Science and Engineering Investigations, Volume 8, Issue 87, April 2019 47 www.IJSEI.com ISSN: 2251-8843

Paper ID: 88719-07 Reference [4] proposed fault location model for underground power cable using microcontroller. The hardware model of Underground Cable Fault Locator is implemented and favorable results were brought forward. This hardware model can locate the exact fault location in an underground cable. There needs to further enhance the work so that it can also locate open circuited cable. [5] Developed a prototype that uses the idea of OHMs law to detect faults in cables. The proposed system uses a set of resistors representing cable distance in Kilo meters and fault detection is by a set of switches at every Kilometer (kms) to validation the accuracy of the detection. The type of fault at any particular distance is displayed on the LCD interfaced with the microcontroller. Their work is only simulation as no design and construction work is involved. [6] Presented a system that can detect the location of open circuit and short circuit fault in the underground cable from the base station in kms with the help of Atmega16 microcontroller. Only the simulation was done using PSIM simulator. Reference [7] proposed a microcontroller based underground cable fault distance locator. However, there was no evaluation to know the performance of their proposed system. [8] Introduced a smart GSM based fault detection and location system that can be used to accurately locate the specific place where fault had occurred. All the above work has one limitation or the other. For this reason, we designed and implemented a microcontroller based underground cable fault detector that is capable of running on dual power supply i.e. AC mains supply as well as a DC battery pack, and display results on an LCD module. This is an improvement on the previous work available in literature. This design also runs on computer software program because it uses an ATmega328p microcontroller that also requires sketch or source code. Another advantage of this proposed system is that it is cheaper when comparing to its Arduino based counterpart

III. WORKING OPERATION:

Principle • Underground Cable Fault Distance Detector using ATmega328 Microcontroller works mainly on the principle of Ohm's Law where a low DC voltage is applied at the feeder end through set of series resistors (which is the equivalent model of underground cable). • Time Domain Reflectometer (TDR) The TDR transmits a low-energy signal across the cable that does not degrade the insulation. The signal is returned in a given time and profile by a hypothetically flawless connection. Impedance differences in a "real-world" cable change the time and profile, which is visually shown on the TDR screen or printout. This graph (also known as a "trace") shows the user estimated distances to "landmarks" such openings, splices, Y-taps, transformers, and water ingression." TDR has the disadvantage of not being able to pinpoint errors. The TDR is accurate to within 1% of the testing range. This knowledge is sometimes adequate on its own. Sometimes it's only to allow for more accurate beating. Nevertheless, this increased precision can produce substantial savings in cost and ime. Another weakness of TDR is that Reflectometer cannot identify faults-to-ground with resistances much greater than 200 ohms. • In addition to this, it also incorporates the concept of the Milliman's Theorem. • Besides this, the project is a slight modification of Clavier's Test Method. Explanation "When current flows through the set of series resistors in each of the three sets of lines, the current varies depending on the length of the cable from the point of fault if there is any short circuit fault with the Single Line to Ground Fault, Double Line to Ground Fault, or Three Phases to Ground Fault. The voltage drop between the series resistors changes as a result, and the fault signal is sent to the microcontroller's inbuilt ADC for development of accurate digital data. The digital data is then processed by the microcontroller, and the result is shown in kilometer's on the LCD attached to the microcontroller, according to the programming requirements. The circuit is powered by a 230V ac supply, which is delivered to a step-down transformer (9 V-0 V) that reduces the voltage from 230 V to 9V, which is then fed to a full wave bridge rectifier, which converts the ac voltage to pulsing dc voltage. A 1000 microfarad electrolytic capacitor is used to reduce the ripple in the rectified output. Because our circuit requires a continuous 5 V voltage source because the Microcontroller (ATmega328), 16x2 LCD (Liquid Crystal Display), Solid State Relay Drivers, Solid State Relays, and other components all operate at 5V, we are utilizing two voltage regulators (7805). The filtered output is converted to a 5V constant supply voltage by these voltage regulators. The first voltage regulator, U2, supplies power to the microprocessor, LCD, and a series of resistors. The Solid State Relay is fed by the second voltage regulator, U3..".

IV. Hardware Implementation:

In this approach, a set of series resistors in each phase of the line is divided into four portions, each separated by one kilometer and connected to the supply by a slider switch. When the switch is maintained on, current flows through the resistor, resulting in a voltage drop, indicating a fault to ground. Various case studies have been undertaken using each of the three phases (R, Y, and B) of the cable line separately. Each phase features four slider switches, for a total of 12 slider switches over all three phases.

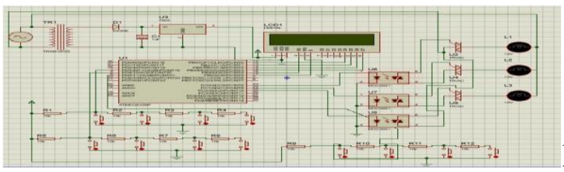

Fig 1: Circuit Diagram of Fault Detector

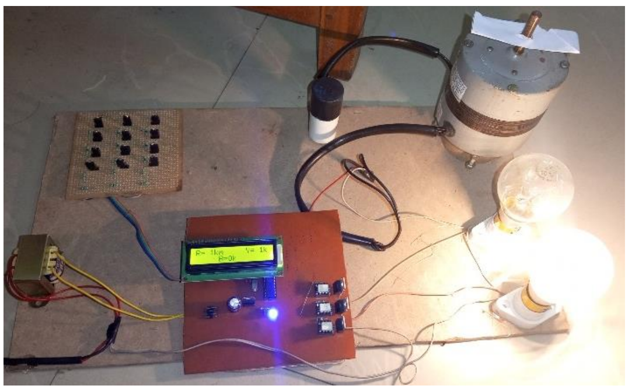

Fig 2: Fault Occurred at 1 km In R phase

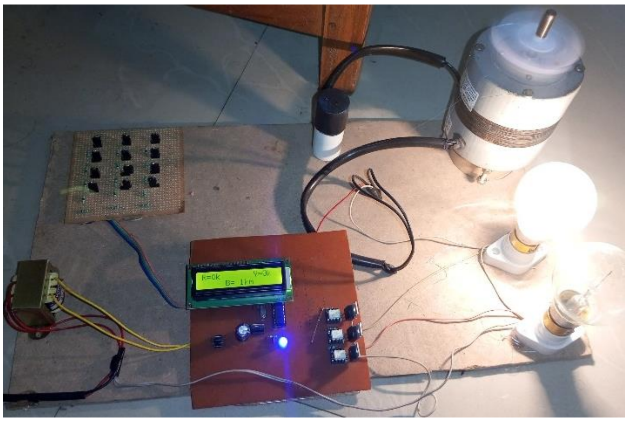

Fig 2: Fault Occurred at 1 km In B phase

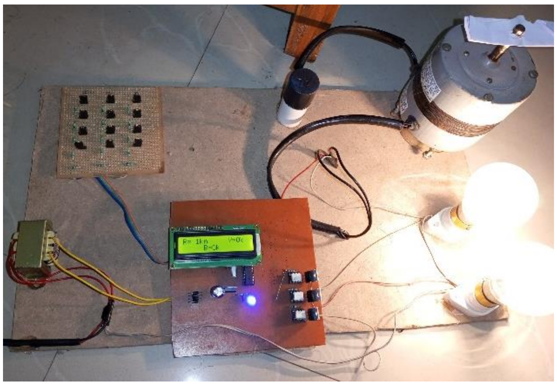

Fig 3: Fault Occurred at 1 km In Y phase

V. CONCLUSION

A microcontroller-based underground cable failure detector was conceived and built in this work. A low-cost underground cable fault detector has been successfully built, deployed, and tested. Our approach can identify both open and short circuits in subterranean cables at a distance of up to 4 kilometer's. In the future, efforts will be focused on increasing the maximum distance for fault detection to 6 kilometers or more, and a graphical display monitor to better the information of the underground cable fault may replace the LCD display.

VI. REFERENCES :

[1]. P. Sawatpipat and T. Tayjasanant, "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), pp. 636 – 640, 2010.

[2]. R. Ali and M.A. Jamal, "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, pp. 261-274, 2014 .

[3]. M. Jaya, R.D. Baraga, R. Vanuatu and D.K. Mohanta, "Robust transmission line fault classification using wavelet multi-resolution analysis.", Computers & Electrical Engineering, Volume 39, Issue 4, pp. 1219-1247, May 2013.

[4]. B. Bhuvneshwari, A. Jenifer, J. John Jenifer, S. Durga Devi and G. Shanthi, "Underground Cable Fault Distance Locator", Asian Journal of Applied Science and Technology (AJAST), Volume 1, Issue 3, Pages 95-98, 2017.

[5]. D. Dhivya and T. Sowmya, "Development of a Prototype Underground Cable Fault Detector". International Journal of Electrical, Electronics

and Computer Systems (IJEECS) Volume 2, Issue 7, pp. 2347-2820, 2014.

[6]. J. P. Singh, N. S. Pal and S. Singh, “Underground Cable Fault Distance Locator”, International Journal of Scientific Research and Management Studies (IJSRMS), Volume 3 Issue 1, pp. 21-26, 2016.

[7]. S. Reshma, G. Monika, P. Ashwini, T. Saurabhi and S.S Chaudhari, “Underground Cable Fault Distance Locator By Using Microcontroller”, International Journal of Engineering Sciences & Research Technology, Vol. 5, Issue 2, pp. 26-29, 2016.

[8]. S. Shahir, S. Tariq, A. Bangi and K. Khot, “Underground Cable Fault Detector Using GSM” International Journal of Research In Science & Engineering, Special Issue 7, pp. 337-344, 2017.

[9]. Gupta, V. Kumar, R. Sharma, R. Meena, R. Choudhary and R. Kumar, "Distance Calculation for Underground Cable Fault", International Journal of Engineering and Management Research, Volume 6, Issue 2, March - April 2016.

[10]. D.W. Bascom and D. T. Von, ”Computerized underground cable fault location expertise,” in IEEE Power Engineering Society Transmission and Distribution Conference, pp. 376-382,10-15, 1999.

[11]. D. Choi, S Lee, X. Yang, and X. yang, “A line to ground fault location algorithm for underground cable system,” KIEE International Transactions on Power Engineering, Vol. 54, pp.267-273, June 2010.

[12]. B. Clegg, “Underground Cable Fault Location. McGraw- Hill, 1993.

[13]. K. K. Densley, “Ageing mechanisms and diagnostics for power cables - an overview,” IEEE Electronic Insulation Mag., vol. 17, no. 1, pp. 14– 22, Jan./Feb 2001.

[14]. P.M. Dhekale and R.R. Suryawanshi, “Underground Cable Fault Distance Locator”, IJIERT, vol-2, April 2015.

[15]. S.O. Kuan and K. Warwick,“Real-time expert system for fault location on high voltage underground distribution cables”, IEEE Proceedings, Vol. 139, No. 3, 1992.

[16]. J. J. Navaneethan and W. H. Soraghan, “An Automatic Fault Detection and Location Technique in Low Voltage Distribution Networks,” Proc. of Energy Management and Power Delivery ’98, pp. 732-736, March 1998.

[17]. S. Pabla, “Electric Power Distribution”, McGraw Hill 2004.

[18]. P. Potivejkul, ”Design of low voltage cable fault detector,” in Proc. IEEE Power Engineer. Society. Winter Meeting, Vol .1,pp.724-729, 2000.

[19]. J.P. Steiner, W.L. Weeks, and H.W, “An Automated Fault Locating System”, IEEE Trans. on Power Delivery, Vol.7, No 2, pp. 967-978, April 1992.

[20]. C.M. Wiggins,D.E. Thomas, T.M. Salas,F.S Nickel, and H. W. Ng, "A novel concept for underground cable system," IEEE.