International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 09 Issue: 05 | May 2022 www.irjet.net p-ISSN: 2395-0072

Underground Cable Fault Detection Using IOT

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Abstract - *The goal of this work is to spot the particular location of a fault in underground cable lines from the supply station to the precise location of the fault in any unit, during this case kilometers. When a fault arises in an underground cable line for any cause, the mending method for that faulted cable becomes problematic because of the absence of a correct system for tracking the precise position of the fault and also the kind of fault that happened within the cable. For this, a system should be designed to find the precise position of the fault within the distribution line system for all 3 phases R, Y, and B, and for varied sorts of fault circumstances. Single line to ground, double line to ground, and 3 section faults are mentioned during this work. have been regarded A systems program a microprocessor, lcd|LCD|digital display|alphanumeric display} display, Fault Sensing Circuit Module, LoRa Module, and proper power supply arrangement with regulated power output is made in this project. As a result, if there's a short circuit within the kind of a line to ground in any phase/phases, the voltage across series resistors changes an, associate degreed an analogue signal within the variety of a dip is made by the fault sensing circuit of the introduced system, that is then fed to associate degree ADC built-in within the already programmed microcontroller to make the precise digital knowledge, and once process the info, the output are going to be displayed within the connected liquid crystal display with the precise location of the fault. Correlating R, Y, B section with the measurement the gap wherever the fault occurred Through the connected IoT Wi-Fi Module, a similar processed data output can show on the webpage. The AT Mega 328P microcontroller is employed during this system. the present sensing of circuits fashioned employing a combination of resistors is interfaced to the ATmega328 microcontroller exploitation associate degree internally enclosed ADC to produce digital knowledge to the microcontroller. The fault sensing circuit is formed of a series of resistors and a collection of switches adjacent to every resistance. The relay driver is answerable of the relays. The microcontroller is coupled to a 16x2 liquid crystal {display |LCD| digital display| alphanumeric display} display that displays the phase/phases data additionally because the location of the defect in kilometers.*

Key Words: **IOT, Fault Detection, Lora**

1. INTRODUCTION

The detection of faults is one of the biggest drawbacks of underground wires. Visual inspection procedures are ineffective because the cables are placed beneath the surface (directly or inside pressurized ducts). In the case of Overhead Lines, this is not the case. We'll need to create unique methods to detect cable failures.

- Fault with an open circuit
- A short circuit has occurred.
- Earth faults

When moisture enters the insulation, the majority of the defects arise. Inside the cable, the paper insulation is highly absorbent. Mechanical loss during transit, the lying process, or numerous stresses faced by the wire during its operational life are some of the other causes. The lead sheath is frequently destroyed, mainly as a result of atmospheric pollutants, soil, and water or, on rare occasions, caused by mechanical damage and lead crystallization caused by vibration.

i Open Circuit Fault (OCF)

Is a type of fault that occurs when a circuit issue is caused by an open circuit in the conductors, as the name implies. Discontinuity occurs when one or more cable conductors (cores) break. Mechanical tension causes the cable to come out of its joint, causing this discontinuity. This is referred to as an open circuit fault.

ii Short Circuit Fault

It can only be found in multi-cored cables. A short circuit occurs when two or more conductors of the same cable come into touch with each other. Visual detection is impossible without dismantling the cable. When the individual insulation of the cables is destroyed, a short-circuit issue arises. A megger can also be used to detect it.

1.1 LITERATURE SURVEY

A. A. Khan, et Al [2012], For electricity delivery, the power distribution system must provide on a vast network of medium voltage (MV) underneath wires.

Condition - based tools can thus play an important role in seeking to pinpoint the cables that provide the greatest risk of failure. Most network owners are focused on maintaining or improving the reliability of their power sources at a low cost.

Condition monitoring provides the data required for safe and dependable operation, as well as replacement plan, and so improves system durability. Because of the increased demand for dependable power, alternative solutions such as condition-based maintenance are being used more frequently. One of the most accurate diagnostic tools for determining the insulation status of MV cables is partial discharge (PD) monitoring. Online PD evaluations provided the data for this study can aid in determining impending failures in certain cable networks and even forecasting the insulation's remaining useful life. The condition monitoring and diagnostic approaches for buried power cables are discussed in this work. Power cables, which are the most critical component of the power system, are prone to failure owing to ageing or flaws that develop over time. The cable is commonly made out of an aluminum or copper conductor wrapped in semiconductive and insulation layers, regardless of the working voltage or frequency. The ground shield is formed by a metallic screen over the insulating semi-conductive layer, that is encased in an exterior outer covering.

F. B. Ajaei and colleagues [2011] For modelling of CT to address the effects on digital protective relays, a current transformer (CT) is precisely modelled. The effects of CT saturation on the present Phasor calculation are investigated using simulated experiments performed on the PSCAD/EMTDC system. A new method for detecting and compensating CT saturation effects is also suggested, which is predicated on a lowest failure squares (LES) filter that estimates the phasor variables of the CT secondary current; a new saturation sensing method that uses the output of the LES filter for saturation detection; and a minimum acceptable average error tracking approach that improves the Phasor estimation precision. The suggested saturation identification method is unaffected by CT settings, burden, or other factors. The electrical system The findings of the study reveal that the suggested algorithm: 1) reproduces the deformed current waveform with the appropriate precision and speed under dc and ac saturation situations, and 2) operates satisfactorily under inductive burden and deep and mild saturation states. Saturation of the current transformer (CT) results in erroneous current measurements, which might cause safety relays to fail. 1) dc saturation due to the high fading dc source of the fault current and/or the CT core's premagnetization, and 2) ac saturation due to the enormous ac current magnitude. If adequate mechanisms for saturation detection and/or correction are not used, a protective relay is practically exposed to maximize the value of the related CT, which has a negative impact on the efficiency.

S. Kucuksari et. Al [2010] Optical current transformers (OCTs) are available from several vendors to replace magnetic current transformers (CTs). The efficiency of certain currently available optical and conventional CTs is compared in this research. In a laboratory, the steady and transient reactions of the two systems are evaluated. Field data is also collected and analyzed to ensure that optical systems may take the role of traditional instrument transformers. In addition, the impact of ambient temperature on OCT performance and OCT step response have been examined. Optical CTs are more than available to replace conventional CTs, according to the findings. In addition, the findings reveal that OCT has a better frequency response than traditional CT. The differences between field and lab readings are due to experimental mistakes. Unlike traditional CTs, the OCT may produce a digital output that adheres to the IEC 61850 standard. The frequency-amplitude characteristic of the OCT's digital output is evaluated. Due to the limited sampling rate given in a UCA guide to IEC61850-9-2, the digital output of the OCT has a smaller bandwidth than the low energy analogue output. The steady state and transient characteristics of conventional magnetic and optical current transformers are compared in this research. The high voltage laboratory at ASU was used for all of the tests. The reactions of both current transformers were compared under real-world settings (load current and fault current). A step-function was used to assess the OCT's transient performance. The effect of increased temperatures on OCT measurements was investigated. Increased sensor head temperature was used to determine the impact of greater temperature on OCT measures.

Laxmi Goswami et Al [2020] . Underground cables, rather than above transmission lines, are employed in downtown areas. It's difficult to find the exact location of the flaws. India's reputation as a progressive country is growing by the day, and the civilized field is expanding as well. Underground lines are beating under the same conditions, and their use is increasing as a consequence of clear advantages like fewer line losses, lower maintenance costs, and less vulnerability to severe climate influences. Because it is unclear, it goes to great lengths to pinpoint the source of the problem. We are attempting to address this issue in this suggested study by offering a strategy that is suitable for the digital age. In this paper, we'll look at with the help of the Node MCU Wi-Fi Module, we used an IOT-based approach with a Google database for defect detection in this work. It is entirely based on the Internet of Things. Node MCU was used to connect Arduino sensors to the Internet. We had set up a communication hotspot using a router. We linked each MCU Module to a transformer and checked the condition of the transformers using a Google database. When compared to

previous strategies, our proposed method is more accurate and efficient.

Hans, M. R., et Al [2017] As India evolves as a developed country, the amount of civilized land grows. Since underground cables perform best in these kinds of situations, their use is increasing due to clear benefits like as less transmission losses, lower maintenance costs, and reduced susceptibility to the effects of severe weather, among others. However, it has some drawbacks, such as high installation costs and the inability to detect defective locations. It's impossible to pinpoint the specific location of the defect because it's not apparent. We provide two techniques in this study that will be particularly beneficial in finding the precise distance of an underground system fault from of the base station. Murray is one of the approaches. Murray loop method and Ohm's Law method are two of the ways available. The Murray loop approach employs the whetstone bridge to calculate the exact distance of the fault location from the base station and provides that information to the user's mobile device. When using the Ohm's law method, the voltage drop varies based on the length of the fault in the cable since the current varies. Under LG, LL, and LLL faults, both approaches require a voltage converter, microcontroller, and potentiometer to locate the fault.

Heena Sharma and colleagues [2013]: This paper is primarily concerned with the causes, types, and location of cable faults. The document depicts various disturbance and fault states at a given period. The goal of this work is to tackle the problem of fault location, which is utilized to prevent unwelcome outages, cable damage, and failure. This research also examines the voltage-time and current-time relationships in both normal and abnormal conditions. Simulation with PSCAD software is used to evaluate the proposed condition. It has been tested and found to have a fault location error of less than 5%.

1.2 PROPOSED SYSTEM

This paper presents a fault location example for underground power cable by using the Internet of Things, which is dependent on the internet, signifying that information will be delivered via the internet. The idea of this technique is to determine the distance in kilometers between a cable fault and a base station, as well as the location of the cables fault. The simple notion of Current Transformer Theory is used in this study (CT Theory). When a fault develops, such as a short circuit, the voltage drop varies based on the length of the issue in the cable; because the current fluctuates, a current transformer is used to calculate the fluctuating current. The signal modifier manipulates the voltage change, and the required computations are performed by a microcontroller. So that LoRA devices can indicate the fault distance These fault information are then broadcast over the internet to any access point and displayed. While current is flowing through the fault sensing circuit module, the current varies depending on the length of the cable from the point of fault if there is a short circuit fault with the single line to ground fault, double line to ground fault, or three phase to ground fault, according to the system's operation. The voltage drop across the series resistors changes as a result, and the fault signal is subsequently sent to the microcontroller's internal ADC for development of digital data. The digital data is then processed by the microcontroller, and the outcome is presented. In kilometers and phase according to the fault conditions, LCD attached to Arduino controller.

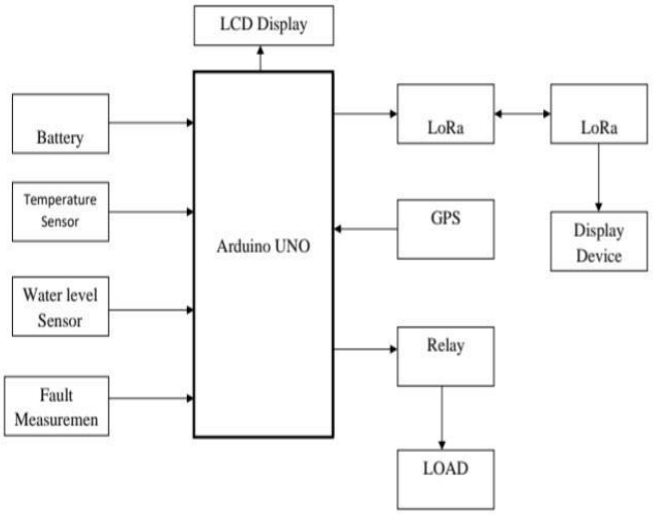

Fig - 1 : Block Diagram

Software

The Arduino Software (IDE) comprises a message box, a text console, a text editor for writing code, a toolbar with buttons for basic functions, and a set of menus. It communicates with the Arduino and Genuino devices by connecting to them and uploading code. The Arduino Software (IDE) created with Sketches are programs . The message part contains faults issues and gives feedback when storing and sending. The Arduino Software (IDE) outcome to the console, which covers the described error messages and other information. The window's bottom right corner shows the configured board and serial port . You may verify and upload programs, create, open, and save sketches, and the toolbar buttons contain the serial monitor to be open.

2. HARDWARE DESCRIPTION

POWER SUPPLY UNIT

The power force is a critical component of any electronic circuit. This circuit necessitates a constant 5 V voltage,

hence a voltage controller is required. We used the IC7805 as a voltage controller in this project. A voltage controller generates a preset fixed affair voltage that remains constant regardless of changes in its input voltage or cargo conditions. Direct and switching voltage controllers are the two types of voltage controllers. Then a direct controller is used, which uses an active pass device (series or shunt) operated by a high speed discrimination AL amplifier. It adjusts the pass device to maintain a constant affairs voltage by comparing the affair voltage to an unresisting reference voltage and a precise reference voltage.

LCD DISPLAY

The Liquid Crystal Display (TV) is an Alphabetic Display, it can display Basics, Figures, and Special Symbols, making it a slacker Display device that can be used to display colourful dispatches rather than the seven-member display, which can only display figures and some of the basic fundamentals. The only drawback of a television over a seven-member display is that a seven-member display is more resilient and can be imaged from a greater distance than a television. Then we utilised alphanumeric screens with a resolution of 16 x 2.

RELAY

A relay is a switch that is controlled by electricity. Many relays employ an electromagnet to manually activate a switch, but they can also use alternative operating principles, such as solid-state relays. Relays are employed when a circuit has to be controlled by a separate low-power signal or when multiple circuits need to be controlled by a single signal. The early relays were employed as amplifiers in long-distance telegraph circuits, repeating the signal from one circuit and transmitting it on another. Relays were widely employed to conduct logical operations in telephone exchanges and early computers. A contractor is a type of relay that can manage the high power required to control an electric motor or other loads directly. Solid-state relays use a semiconductor device to switch power circuits rather than a moving tunnel to control them. To protect electrical circuits from load or failures, relays with calibrated operating characteristics and occasionally several operational coils are employed; in innovative and modern electric power systems, similar functions are fulfilled by digital instruments still referred to as "defensive relays."

TEMPERATURE SENSOR

The LM35 is a temperature detector with a precession Integrated circuit whose affair voltage fluctuates depending on the temperature around it. It's a compact, low-cost IC that can monitor temperatures from -55 to 150 degrees Celsius. For every degree Celsius increase in temperature, the voltage will climb by 0.01 V (10mV).

WATER LEVEL SENSOR

There are ten exposed bobby traces on the detector, five of which are power traces and five of which are sensing traces. These traces are combined so that each pair of power traces has one sense trace. When submerged, these traces are usually not connected but are crossed by water.

3. RESULT

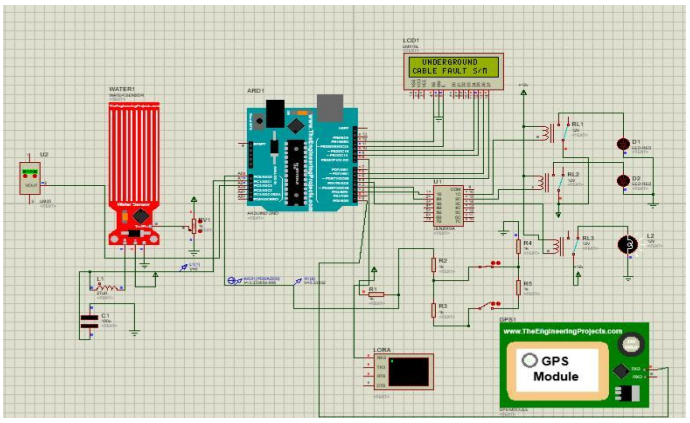

Fig - 2 : Initialize the Sensors

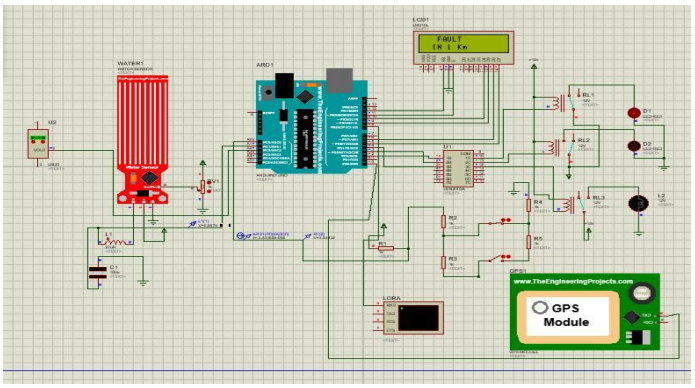

Fig - 3 : Fault in 1 km

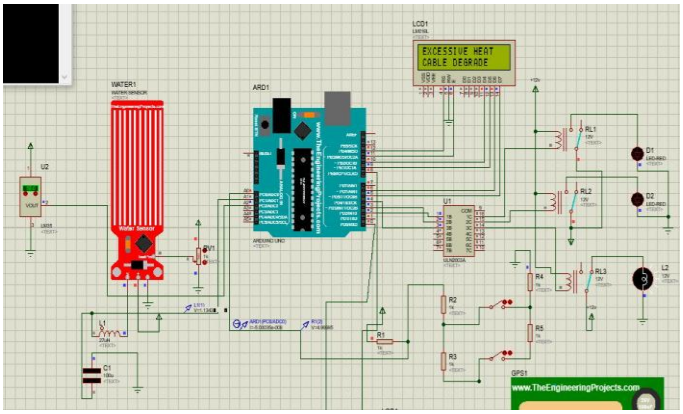

Fig - 4 : Area power shutdown

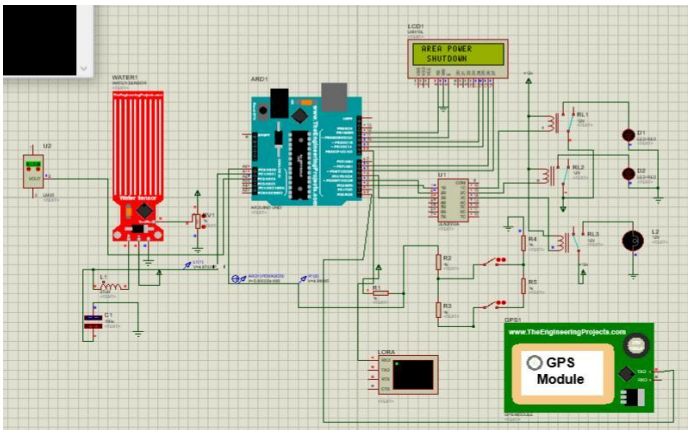

Fig - 5 : Cable Degrade

4. CONCLUSION

The underground string fault discovery system has been successfully designed and tested. This system is intended to descry the circuit fault in the underground lines by using Arduino microcontroller. The Arduino microcontroller works grounded on the affair of the detector values. By using Arduino regulator find out exact fault position. Once faults do in the string, the display unit displays the exact fault position. In this system, the measured current is detected as being in the small or medium current range. The RMS value per current cycle is transmitted to a back- end covering system to negotiate real- time monitoring. This system detects only the position of short circuit fault in underground string line, and descry the position of open circuit fault, to descry the open circuit fault capacitor is used in ac circuit which measure the change in impedance & calculate the distance of fault.

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