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Fault Detecting Robot for Underground Electrical Cables Using ATMEGA Aurdino

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ABSTRACT

Nowadays in urban areas electrical cables run underground instead of overhead. A wide variety of faults occur in underground cables due to improper conditions, wear and tear damages. For overcoming these, cables has to be replaced, which will affect the resistance and may leads to voltage breakdown. Therefore robots are designed to help during faulty condition where human interface is difficult. In this paper by implementing robotic features with a underground cable faults distance locator is done by using a microcontroller. The fault occurring at any point is displayed on LCD which is interfaced with the microcontroller that is used to make the necessary calculations. Robotics is considered as the fastest growing field helps human and minimize the gap of the underground cable faults through base station in kilometers and even as future scope robot can advanced with technologies like artificial intelligence and machine learning capability.

Keywords :ATMEGA328, Aurdino, Microcontroller, Robot

I. INTRODUCTION

Electrical power transmission is the transformation of the generated electrical energy from the generating plants, to an electrical substation where the electricity is distributed to various other locations. The interconnected lines which are responsible for this movement are known as a transmission network. This is a different from the local wiring process between high voltage substations and customers in need, called electric power distribution. This combination of transmission and distribution of networks is known as power grid. Transmission lines are usually of high voltage three phase alternating current, although there are single phase alternating current is sometimes used in systems. High Voltage Direct Current technology is basically used for greater efficiency over very long distances transmission typically hundreds of long miles.

Overhead Transmission line: High Voltage Direct Current technology is almost all used in submarine power cables which is typically more than 30 miles or more and also in the exchange of power between grids which are usually not mutually connected nor synchronized. HVDC links are almost being used to stabilize the large power distribution networks where the process of sudden new loads occur or in places where blackouts are happening in one part of a network which can therefore result in problems like synchronization, connection and cascading failures.

Underground Cable Transmission: Electric power can also be transmitted underground using underground power transmission cables instead of overhead power transmission cables. Underground cables usually take up less risk and less right of way compared or considered with overhead transmission lines, because they have lower visibility and less affected by bad weather. However, the costs of the insulated cables and excavation are very much higher than compared to overhead construction costs. Transmission level voltage lines are usually considered to be 110 kV or more. Voltage less than 33 kV are usually for distribution purpose. Extra High Voltage lines are which are above 765 kV. Faults which are in transmission lines take longer to locate and repair. One of the major limitations of underground cables is the detection of faults. Since the cables are laid beneath underground it is impossible to visually inspect the fault. This is not the case in Overhead Lines. In order to identify the faults in the cable, we need to develop special methods which have been implemented in this project. The various types of faults occurring in Underground cables and their causes are,

- Open circuitfaults.
- Short circuitfaults.
- Earthfaults.

Most of the fault occurs when moisture enters the insulation of the cables. The paper insulation provided inside the cables is hygroscopic in nature. Other causes include mechanical injuries during transportation, transmission and laying process or due to various stress encountered by the cable during its working life. The lead sheath is also damaged frequently, usually due to the actions of atmospheric conditions, soil, water or sometimes due to the mechanical damage and crystallization of lead through vibrations.

II. METHODOLOGY

A. ExistingSystem

A wide variety of technologies and tests are currently available to evaluate underground cables but there is often little relation between the diagnostic results and the actual detraction. If there is a failure in the underground power distribution cables then it represents a serious threat to the reliability of power infrastructure. The replacement of damaged cable should be careful. Because, the cost estimated to be no less than hundred thousand dollars per kilometer of cable in area. Few examples of existing system are:

1. EARTH FAULT LOCALIZATION BY A BRIDGEMEAGER.
2. PULSE ECHO TESTER or ECHOMETER.

B. Proposedsystem

The methodology of this project is to design and develop a robot by the user to test underground fault distribution lines to detect the faults occurring on that cables and which will help in reduce the risk of human life and reduce very long maintenance work. The underground fault detection using the robot will help humans not to risk their lives while detecting HVAC faults occurring in underground cables and will prevent long maintenance and time taken to detect faults in the undergroundcables.

When we first connect the robot with Arduino. The robot moves in the direction of the cable wires and inside a underground pipe gallery, collects the results for various inputs and gives the output to the Arduino. We can also get a live video coverage through the camera that is present in front of the robot in PixyMon Software. We can even take the screen shots of the faults and the conditions of inside pipe gallery, so that it will give a better test coverage of the defects present in the cable faults detected and the results are provided in analog.

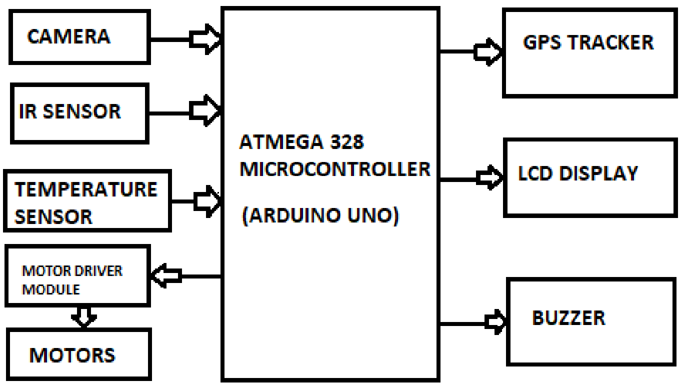


Fig 1: Block Diagram Of Underground Cable Connection Fault Detecting Robot

III. IMPLEMENTATION

Arduino microcontroller is attached to a robot controlling its functions. We are using two driver circuits, one circuit is for the movement of DC motors in different directions that are connected to the robot and another one is for the rotation of camera various angles in order to capture the images of faults and can be visually detect using PIXYMON software. Sensor is used to check the temperature of cable outer layer and if thetemperature exceeds certain limit buzzer will signal. Power supply for the entire system is about 12V, taken from Arduino Microcontroller.

The motor is used for the movement of robot and is controlled by motor driver. This robot when passed through the line it detects fault and sounds the buzzer. IR sensors are used to detect the faults on the cable line. Wherever the line fault or the damage in the line, the moving robot will detect the fault and stop at the location. The fault detected will be displayed on the LCD at client site.

IV. WORKING OF THE PROJECT

The project consists of System can be enhanced with automation that can detect, locate and isolate the fault remotely from any location. A robot with all the sensors, a camera are monitored through an Arduino and PixyMon software which is present at the client site. Arduino UNO is the heart of the system which controls the various modules and it also generate the result. LM 35 – Temperature sensor monitors the temperature and provide the result to the microcontroller.

The robot is made to move in a underground tunnel gallery where the cables are present. The robot moves and starts to collect all the data by following the wires. We can check if the cable faults are present or not. The infrared sensor is to help the robot to move in the particular direction where the cables are present. After detecting the connection fault, the robot immediately stops and displays the message on the LCD panel. The GPS tracker sends the location data to the Arduino app and by using the Serial Monitor option in the Arduino software we can track the exact location of the fault.

Fig 2: Hardware implementation fault detecting of the Robot

The robot camera can captures the images of fault site and can be seen in laptop using PixyMon software. Since this system has all the features to detect faults in one system, the proposed system is less expensive and robust compared to the previous systems and are utilized efficiently.

V. DISSCUSSION AND RESULT

ATMEGA328 Arduino is a high performance device having 8-bit microcontroller. It consists of a 32KB ISP flash memory and it also consist of a read while write capability. It consist of 14 digital input pins and it consist of 6 analog input pins. The main difference between arduino and other microcontrollers is, in microcontrollers once if the program is burnt it cannot be rewritten or uploaded, Whereas in arduino we can upload the program “n” number oftimes.

In this project the GPS Tracker is connected to the arduino using jumper wires. VCC and GND pins of GPS module are connected to respected VCC and GND of Arduino board and also the transmitter and receiver pins are also connected to the arduino.We have to make sure that the TX and RX pins disconnected while uploading the program.

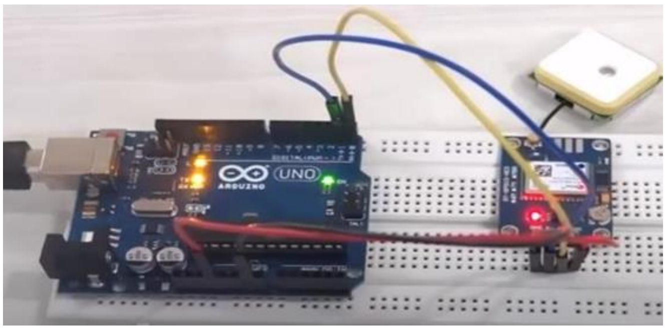


Fig3: Connecting GPS Tracker with Arduino

After uploading the code open serial monitor in arduino software and set the baud rate to 9600 and wait for 25 to 30 seconds to get the GPGLL(Geographic position Latitude / Longitude) data. After the data is received open NMEA editor or website where that particular data is parsed into the location in themap.

Fig 4: GPS Data in the Arduino Software

Fig 5: NMEA GPS Data Decoder

As soon as you click on the position option below the details the editor shows you the exact location.

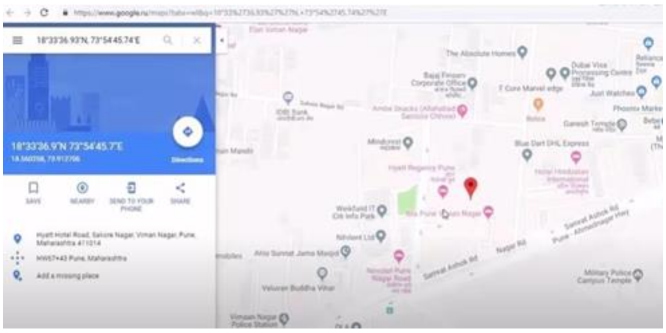
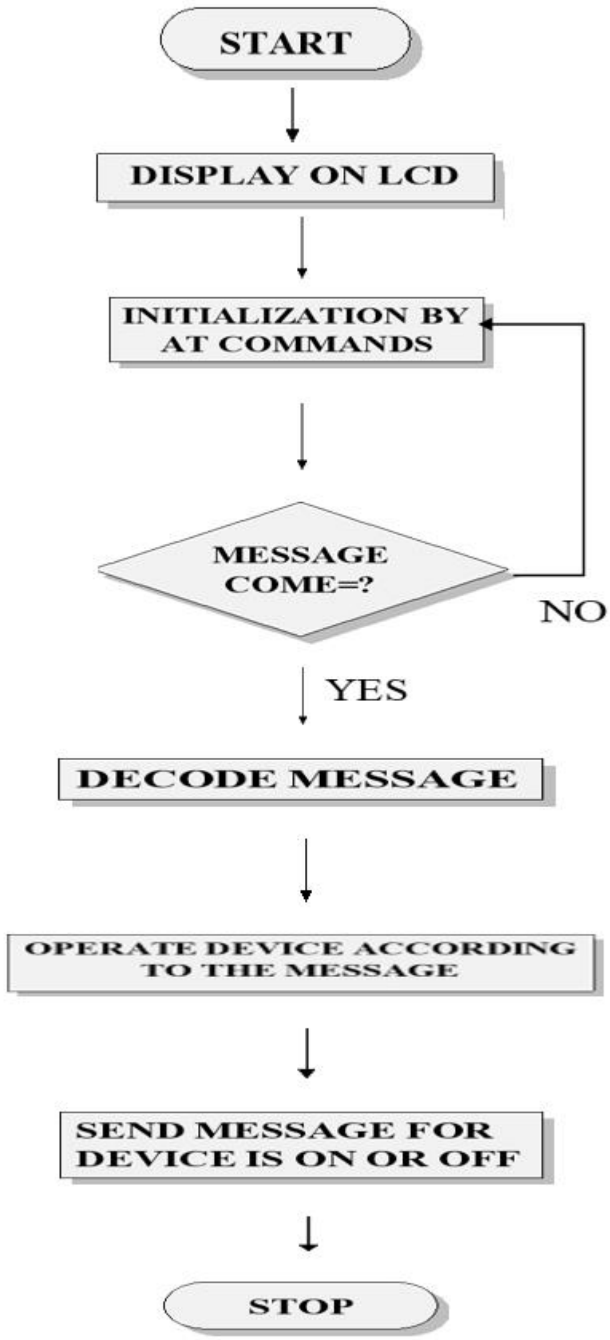


Fig 6: Location being detected in Google Maps

As a future scope ground penetrating radar technique which is used to detect the subsurface images of the ground can also be implemented, with enabling advance GPS technology, the robot will highly detect accurate fault location. Project Can be employed

to detect various internal faults like short circuit faults, open circuit faults and earth- ground faults.

VI. FLOW CHART



VII. CONCLUSION

The aim of the project is inspired by testing the inspection of a robot in a virtual environment conductive in producing real time operating atmosphere of an underground cable which can accurately detect the fault point and can send the location of the fault point, by using a GPS tracker. Present techinque of digging along the cables laid underground and then pulling the cables out and checking whether the fault exists in the cables or not is a tedious work. This is not only a wastage of human power and money for the companies, also causes a lot of inconvenience to the normal public. We strongly believe that our project the underground cable connection fault detection robot will solve this issue up to great extent and helpful for further such applications. The robot which we have designed is user friendly and can be easily controlled and implemented anywhere.

By developing this project we are greatly reducing the cost required to check the underground faults and defects in cable connection. Since this single unit can be used in both industries as well as to determine faults. We can further enhance this model by including a metal detector so that any metals or alloy present underground can also be detected through the same system.

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