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Under Ground Cable Fault Detection Using Machine Learning Algorithm

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ABSTRACT
In this project work is to detect the location of fault in underground cable lines from the base station in km using an ARDUINO controller and also a Machine Learning Algorithm. The concept uses in this paper is Ohm's law which states that current flow through the cable depends on the length of fault occur in the cable. The prototype is modeled with a set of load sensors representing cable length in km and fault creation is made by a load sensor at every known distance to cross check the accuracy of the same. In case of fault, the voltage across load sensor changes accordingly, which is then fed to a programmed ARDUINO that further displays fault location in distance. The fault occurring distance, phase, and time is displayed on LCD. IOT is used to display the location information over Internet using GSM MODULE.

Keywords: *Machine learning algorithm, ARDUINO controller, load sensor, IOT*

INTRODUCTION

Nowadays the biggest problem is to supply power uninterrupted and reliable to the customer. Generally, this can be done mainly by either Overhead lines or Under Ground cables. Overhead lines are preferred for high voltages and less crowded regions. Underground cables are preferred for low and medium voltage levels as well as more crowded regions. This is because they are not affected by climate conditions such as storm, heavy rain, and snow. In overhead lines, we can easily identify the faults but in rushed places we couldn't use overhead lines. So, we are moving to underground cables. Even though the manufacturers introducing new technologies to produce cables, these may fail during test and operation.[7]

The life time of a cable in good condition and installed perfectly is about 30 years. However, the cables can be damaged easily by wrong installation or improper joints. Basically, this type of fault will be done by third party civil workers. Identifying the fault source is very difficult and entire cable should be taken out from the ground to check and rectify the faults. For this reason, the cable must be tested for faults.

Generally, there are three frequently occurring faults namely,

- Open Circuit Fault,
- Short Circuit Fault &
- Earth Fault

In Open Circuit Fault, there is a break in the conductor of the cable. This fault can be checked by megger. It will indicate Zero resistance for conductor not broken and infinite resistance for broken conductor. In Short Circuit Fault, two conductors of a multi-core cable come in electrical contact with each other due to insulation failure. It can be identified by the cable drawing large current through it. In Earth Fault, the conductor of the cable

comes in contact with earth. This fault also can be checked by megger. When the conductor is earthed it shows Zero resistance value.

Generally, fault location techniques for underground cable network can be categorized in two groups namely,

- Tracer method
- Terminal method

The tracer method is atime expensive method to locate a faulted segment by walkingthrough the cable circuits. A faulted segment can be determined from audible or electromagnetic signals and requires large number man power. In the terminal method, the fault location of an underground cable network from one or both ends without tracing. [1-6]

The disadvantages in the existing techniques are

- Exact fault location not determined
- Need more man power
- Insulation problems occur at high voltages
- Need entire cable is to be reconstructed
- Requires high initial cost
- Require more time to fault location

PROPOSED SYSTEM

In Our proposed system we use ARDUINO Controller, GSM and GPS Module and the simulation with new proposed technology "ML (MACHINE LEARNINGALGORITHM)". With the help of Arduino and GSM module the exact location of the UG (Under Ground) Cable fault is determined and the notification will be sent through the SMS. In real time system with the use of the camera the fault images are train by machine learning algorithm. And the fault notification sends through the SMS. The fault occurring distance, phase, and time is displayed on a LCD interfaced with the ARDUINO.

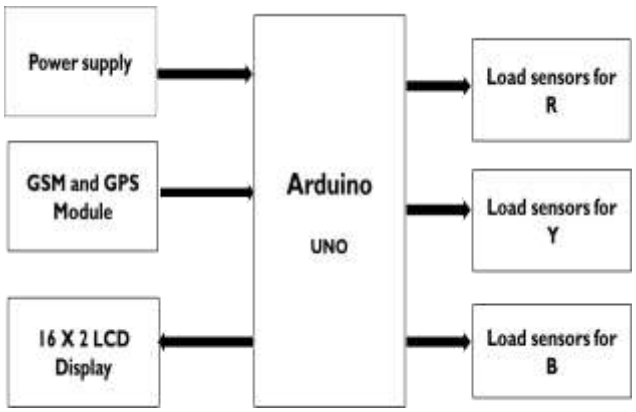

Fig. 1: *Block Diagram of Proposed System.*

Here, Arduino act as heart for this project. It senses a signal from the load sensor and according to coding in Arduino; it gives the position of fault location in LCD display. A load sensor is a type of transducer, specifically a force transducer. It converts a force into an electrical signal that can be measured and standardized. The force applied may be in any form such as such as tension, compression, pressure, or torque. When the force applied to the load sensor increases, the electrical signal increases proportionally. The main types of load sensors used are hydraulic, pneumatic, and capacitive and strain gauge.[8,9]

The GSM (Global System for Mobile) Communications is a standard which was developed by the European Telecommunications Standards Institute (ETSI). It is to make communication between digital devices such as mobile phones and tablets through SMS or call. GSM/GPRS RS232 Modem from rhydo LABZ is suitable for SMS as well as DATA transfer application in M2M interface.

MACHINE LEARNING

Machine Learning (ML) is a form of Artificial Intelligent that trains a system to learn from data. Machine Learning is an application of Artificial Intelligence.If you create any machine like a robot (with camera), you have to train your machine through ML application.Without a learning human being don't have the knowledge,Same thing without a M-learning a Machine doesn't become an Artificial intelligence.

Our human brain already stored the structure of the all objects and trained. And if you see the object, your brain says to you that are what by seeing through the eye.Using this simple Machine learning technique, the Wavelet diagram of fault occurs, and then the machine indicates that fault occurs in your system.So, we have to train our machine for fault calculation. We trainMachine through MATLAB the pictures of fault are trained to Machine in the form of wavelets.

Processes to train pictures using machine learning algorithm,

- Preprocessing
- Feature extraction
- Segmentation
- Correction

In Preprocessing, Colored picture is changed into the grace file, because colored picture has 24 bits but MATLAB not process the 24 bits.All pictures are changed into common size.Noise in pictures is removed. Filter used is medial filter.Pictures in special domain are transformed into the frequency domain using Discrete Wavelet Transformation.

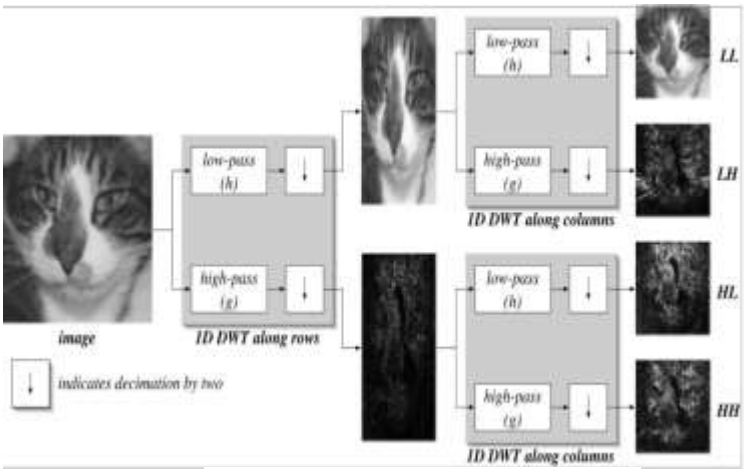

Fig. 2: *Discrete Wavelet Transformation.*

Feature extraction means the characteristics of objects. Classified into the two groups

- External features
- Internal features

Fuzzy logic-based Simulink model is used for this segmentation.Correction is the last process which is important is classifier to

depict the fault.Languages to be used to train pictures for machine learning algorithms mostly used are C & C++. In our project C Language is used. Sample trained pictures are as follows.

(a)……(b)

(c) (d)

(e) (f)

(g) (h)

Fig. 3: *Sample Trained Pictures.*

SIMULATION OUTPUT

For this paper one damaged cable is taken for simulation purpose. The simulation is done in MATLAB software. It takes four steps to detect the cable is fault or not.

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Fig. 4: *Input Image of the Cable.*

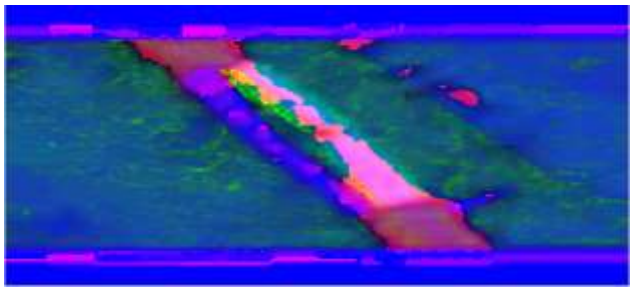

Fig. 5: *HSV Image.*

Fig. 6: *Level 2 Decomposition.*

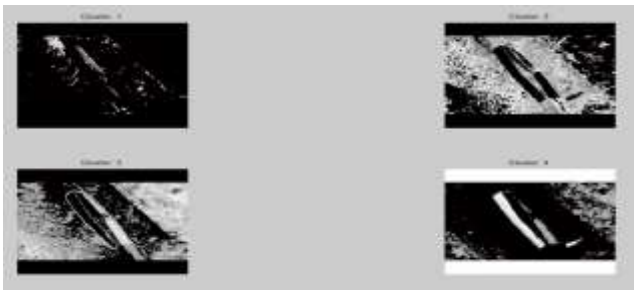

Fig. 7: *Segmented Images.*

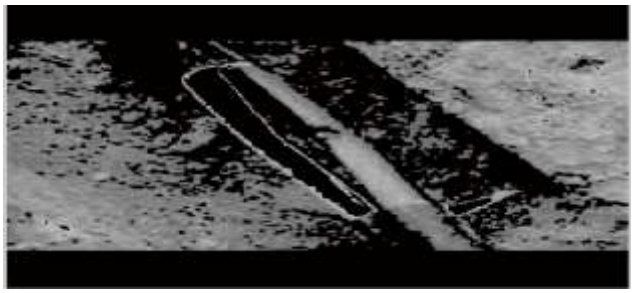

Fig. 8: *Output Image.*

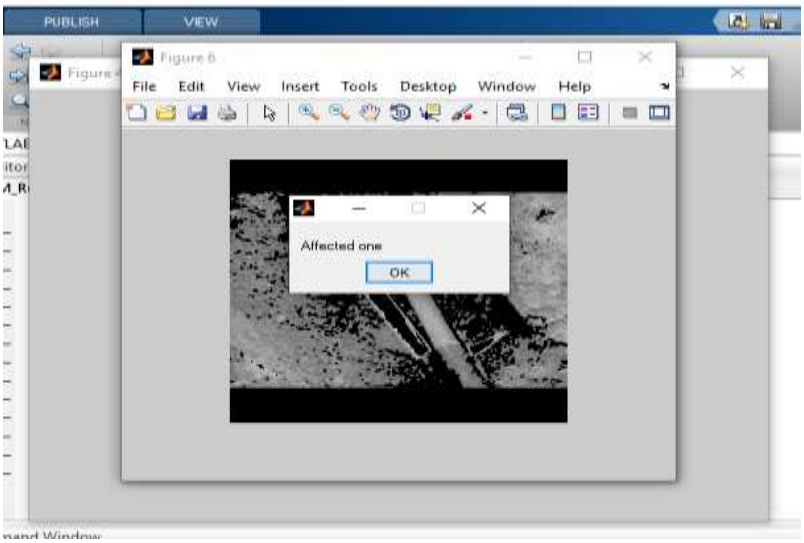

Fig. 9: *MATLAB Output.*

The given sample cable is damaged one. MATLAB takes four steps to identify the type of cable and shows that the sample cable is an affected one.

HARDWARE OUTPUT

Hardware kit consists of ARDUINO Controller, load sensor, GSM and GPS Module. With the help of Arduino and GSM module the exact location of the UG (Under Ground) Cable fault is determined and the notification will be sent through the SMS. And the fault notification sends through the SMS. The fault occurring distanceand cable name is displayed on a LCD interfaced with the ARDUINO.

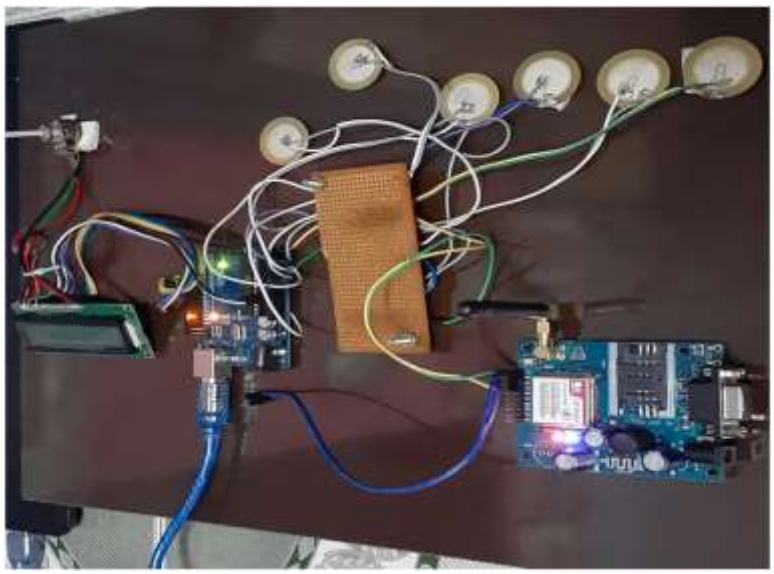

Fig. 10: *Hardware Kit.*

For prototype three cables are taken as R, Y & B and each cable has 2 load sensors (100 m or 200 m) to detect the distance of the fault cable from the source. To test the hardware kit, the load sensor B2, R1, B1, R2 & Y1 are activated. The output displayed in LCD and SMS received to the mobile phone through GSM technique.

(a) (b)

(c) (d)

(e)

Fig. 11: *Sample Fault Cable and Distance in LCD.*

Fig. 12: *Sample Fault Cable and Distance in SMS.*

CONCLUSION

This project is used to detect the exact location of fault in the underground cable. It shows the cable in which fault occurs and the distance of the fault occurs from the source point. The controller Arduino works based on the output of the cable resistance. Relay is used to isolate the faulty line from the healthy line. The future scope of this project is to findthe type of fault occurs and the exact location of the fault occurs from the base station by using the machine learning algorithm by train with fault images.

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