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Device for avoiding underground cable cut using microcontroller

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Abstract -*As we seen many times during road construction that fiber or cable get cut. Frequent fiber cut is serious problem being faced by Telecom Industry and it is leading to their poor services. This paper focuses on hardware device which will keep inside the ground and besides cable and it will help to avoid underground cable cut. Basically that device consists of Arduino Uno, ADXL335 Accelerometer, and SIM800L GSM module and decibel meter. Existing solutions are regarding to this but they work after cable getting cut which is not effective enough. This paper aimed to implement hardware device which will send message and call to authorize person also stop construction at location that is digging the road by firing an alarm. It works on vibration and noise of Jack Hammer without using internet or Wi-Fi module*

***Key Words*: Accelerometer, GSM Module, Decibel Meter, Vibration sensing, Buzzer, Underground cable cut, Arduino, Breadboard.**

1. INTRODUCTION

Fiber optics communication has grown widely in the past decades. It provides the feature like it transmit the data at very high speed and at very long range. It has been used by telecommunication companies for providing telephone or internet services. Optical fiber cables are being used as these are very long and use light pulse for transmission having diameter of human hair and made of pure glass. It is similar to a light pipe which is used to transmit light between two ends. Optical fibers are very pure in its function and inside fault is very rare case. It can be damaged by external equipment's at the time of road construction majorly. As we have seen many times that during construction of road fibers or cables getting cut. Frequent fiber cut is a serious problem being faced by Telecom industry, leading to poor up time of the Telecom Network and poor service to Citizen. There is need of a preventive system which will surely take a responsibility that underground cable fiber should not get cut and if any circumstance like that seems to be happen the authority person should get an alert regarding the same .In this project optical fiber is to be prevented by cutting down because of construction working like jackhammers and other devices by implementing a device which has to put under the ground at the time of cable construction. During road construction fiber cut will be avoided due to that device which consists of alarm system and cable prevention can be achieved.

2. LITERATURE REVIEW

There are some general methods to find underground fault detection like we can detect fault by observing resistance as well as voltage. Each cable has particular resistance and it changes by its length. If length increases resistance also increased. So this principle helps to find fault in cable. It will also vary the voltage. Resistance and voltage are directly proportional to each other. If voltage remains constant through the wire then there's no fault but if varies then fault is detected. But this location we can find after cutting of wire not before. In addition to that there is another method to detect exact location by using Ohm's Law and Reflectometer. If there is no cable cut then there is no reflection by Reflectometer but if there is any cut it given by Reflectometer. But using this method we cannot avoid cable cut because these methods work after cable cut. The existing systems mainly focus on the resistance of the cable and works on the principle of ohms law. Exiting system deals with cure after damage and gives the location where the fault has occurred. This paper puts one step forward to prevent in the cable before it gets damaged and authority person will get notification regarding the same. This paper introduces the different strategy and uses vibrations and noise level to prevent underground cable from damage. This paper is the prototype of the proposed model. The aim of this paper is to protect the underground optical fiber cable while the time of road construction and fires an alarm so worker who is doing construction should stop. This paper focuses more on prevention of underground cable rather than finding exact location where cable gets damaged.

3. COMPONENTS USED

3.1 HARDWARE REQUIREMENTS:

1. Arduino Uno:

The Arduino Uno is a microcontroller based on the ATmega328. It has 20 digital input/output pins, a 16 MHz resonator, a USB connection, a power jack, an in-circuit system programming header, and a reset button.

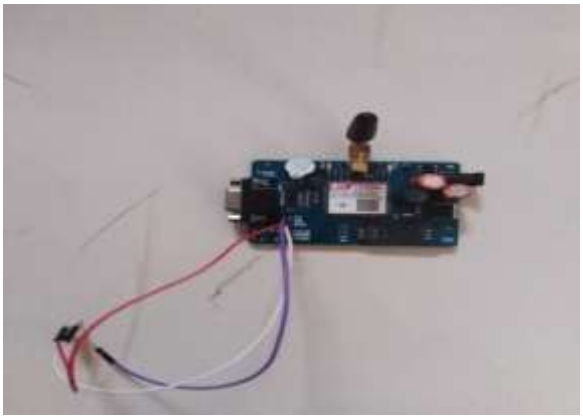
(Fig 1)

2. SIM800L GSM Module:

SIM800L is a miniature cellular module which allows for

GPRS transmission, sending and receiving SMS and making and receiving voice calls.

- Quad-band 850/900/1800/1900MHz
- Controlled by AT Command
- Supports Real Time Clock
- Supply voltage range 3.4V ~ 4.4V
- Compact size 23mm x 35mm x 5.6mm
- Micro SIM Card

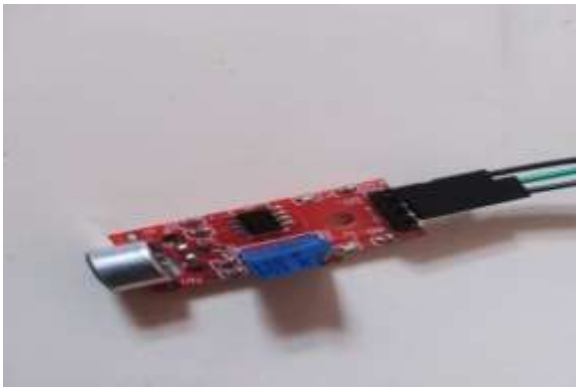


(Fig 2)

3. Decibel Meter:

A sound level meter is a measuring instrument used to assess noise or sound levels by measuring sound pressure. It referred to as a sound pressure level (SPL) meter, decibel (dB) meter, noise meter.

- Measuring Range: 30-130dBA
- Measurement Error: -1.5 to +1.5dB
- Frequency: A weighted



(Fig 3)

Here we have used a sound sensor for prototype purpose which is having Specifications:

Table-I: Specification of Sound sensor

IC Chip	LM393
Operating Voltage(VDC)	3.3 to 5
Induction Distance	0.5 Meter
Length (mm)	43
Width (mm)	17
Height (mm)	8
Weight (gm)	3

4. Passive Buzzer:

Passive buzzer produce audio signals in our project it works as alarm. It has sound level from 80dB to 105dB

(Fig 4)

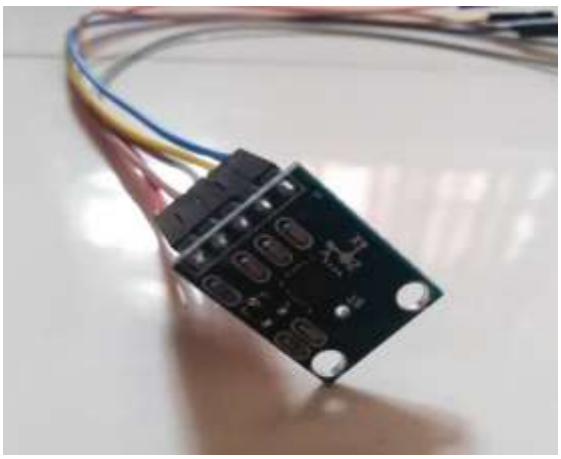
5. Jumper cables:

These are the cables which use to connect the circuit. Male to male, male to female and female to female are the types of cables we need.

6. ADXL335 Accelerometer: The *ADXL335* is a small, thin, low power, complete 3-axis *accelerometer* with signal conditioned voltage outputs.

- Sensing Range: -3 to +3g (full scale)
- Temperature Range: -40 to 85C

- Sensing Axis: 3 axis



(Fig 5)

3.2 SOFTWARE REQUIREMENTS:

Arduino IDE:

It is open source Arduino software which will make easy to write code and upload it on board. This is widely used application for hardware devices as it is simple to use and gives the output with accuracy. It is user friendly software and efficient to work.

4. WORKING OPERATION:

A container consists of all sensors, Arduino and GSM module. In sensor it consists of Accelerometer sensor, Decibel meter (Noise meter) and buzzer. When construction of road is going on, that Jack Hammer going inside the ground then vibration increases. Beyond the certain vibrations that container which consist of sensors is also vibrate and displacement due to vibration is given by Accelerometer. Sound due to Jack Hammer is measured by Decibel meter. When remarkable displacement is happen & at same time loud sound is measured then buzzer get activated. Jack Hammer sound range: 80-85dbA.

For implementing this solution we are using different sensors and microcontroller. Microcontroller is for connecting different sensors as it is platform for attaching different electronic devices. IN our solution ADXL335 Accelerometer plays an important role. It measures the displacement of sensor itself about x, y and z axis. It generates the graph of acceleration due to gravity with respect to different co-ordinate in the space. Next one is decibel meter it is used to measure the noise in dbA as it measures the noise of decibel meter. Here we have used a sound sensor which basically measures the vibration in the air or vibration and gives the results in the decibels as being the prototype purpose. The GSM module is also essential for communicating with authorize person or stations in our solution as we are not using internet or Wi-Fi for communication. A GSM module is consisting of a SIM card which itself behaves as a unique identity for the detection of location that where the work is going on in real time situation. Also we are using buzzer and LED which work as indicator for person who is digging the road while construction is going on which can acts as the prevention to the underground cable So that he will able to stop his work and not to dig more downward direction. To understand it in a better way let's have a look here by actual scenario,

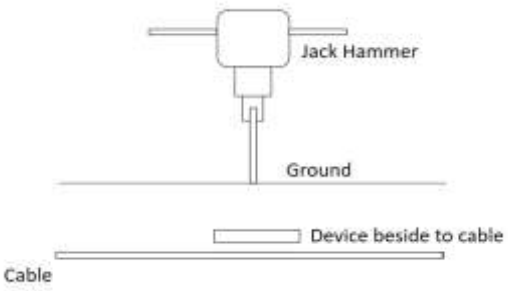


Fig 6

Above diagram represent the real time scenario how device is working. Device has kept just beside the cable which mainly occurs at 1.2 m to 2m below the ground. Jack Hammer has the fix minimum frequency below that frequency it will not able to dig. So that minimum frequency is about 20 to 25 hertz below that Jack Hammer cannot dig. This solution is for future wire installation and prevention for those cables. We are keeping device beside to cable as shown in the figure. Device contains all sensors and microcontroller. For power supply it has given a separate line (5V power supply) to the device continuously charging purpose. When Jack Hammer goes inside the ground near to the device vibrations goes on increasing and its continuously observing by sensors. According to frequency of Jack Hammer, we have set the threshold value which would be less than the working frequency of the jackhammer and that disturbance in acceleration would be sense by Accelerometer and would generate a graph regarding the acceleration along the X-Y-Z axis and compared with threshold values. At that stage it checks the noise/sound of Jack Hammer simultaneously (fix noise/sound of Jack Hammer is 80-85dbA). When both displacement & noise due to vibration crosses its threshold values then GSM module, LED and the buzzer get activated and then person on working site would stop its working before cable get cut and authorized person will be notified through message and call as well.

5. BLOCK DIAGRAM:

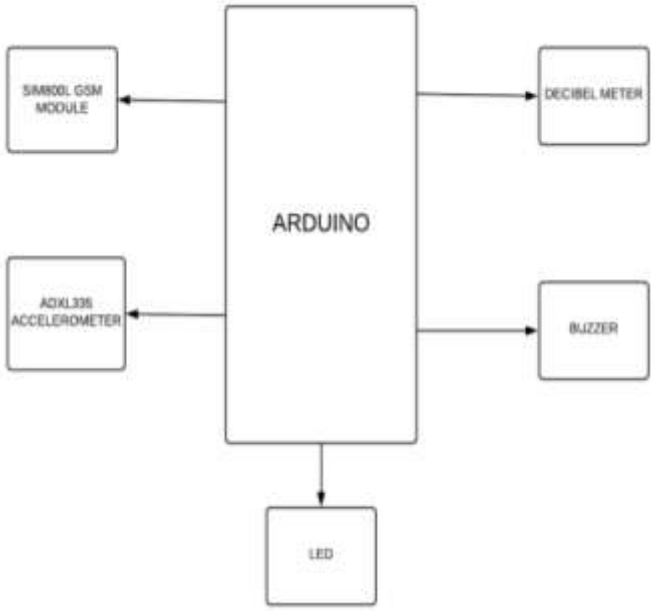


Fig 7

6. FLOW CHART:

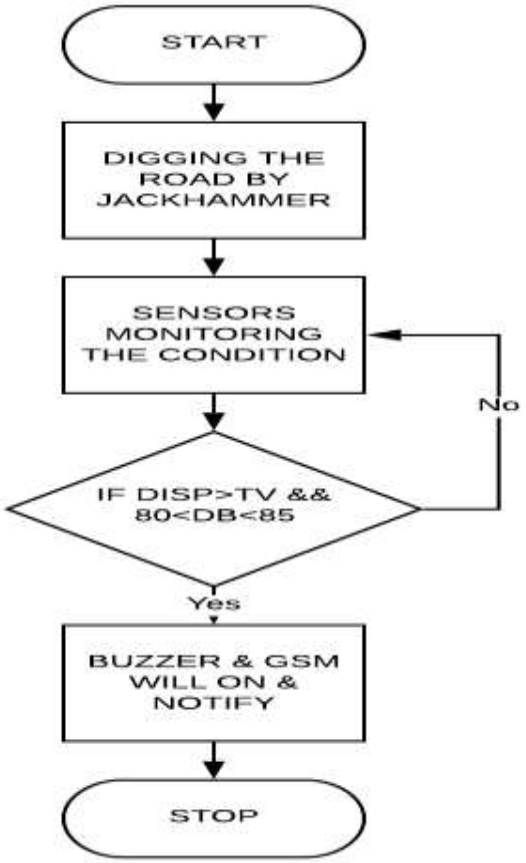


Fig 8

7.VARIATIONS OF X-Y-Z CO-ORDINATE:

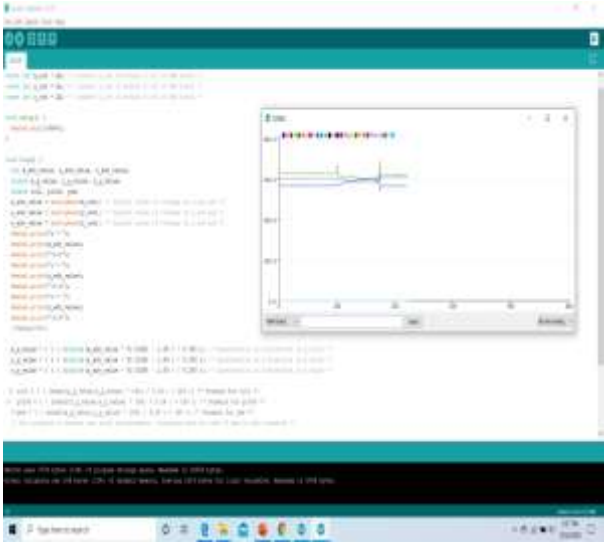


Fig 9

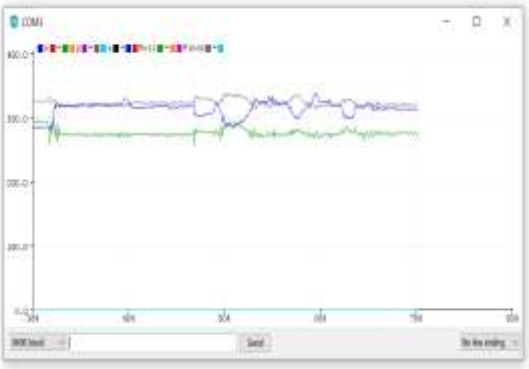


Fig 10

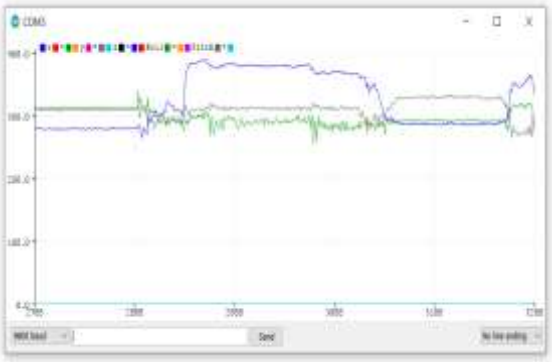


Fig 11

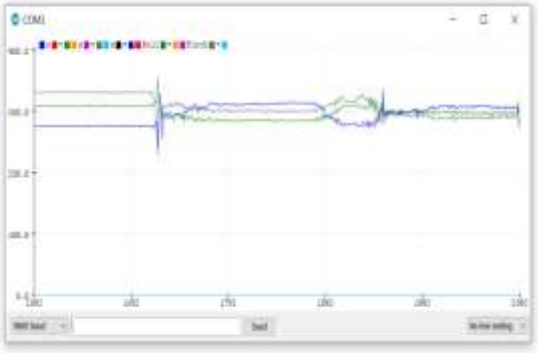


Fig 12

Here is the given code and the output which shows the variation of acceleration of the device with respect to three dimensional spaces as in X-Y-Z co-ordinate. We are more interested in the z axis variation of rigorous displacement because it is indicating the vibration of the incoming jackhammer toward underground cable.

8. HARDWARE RESULT

Hardware results are got as a message to the authorize person and that is as follows:

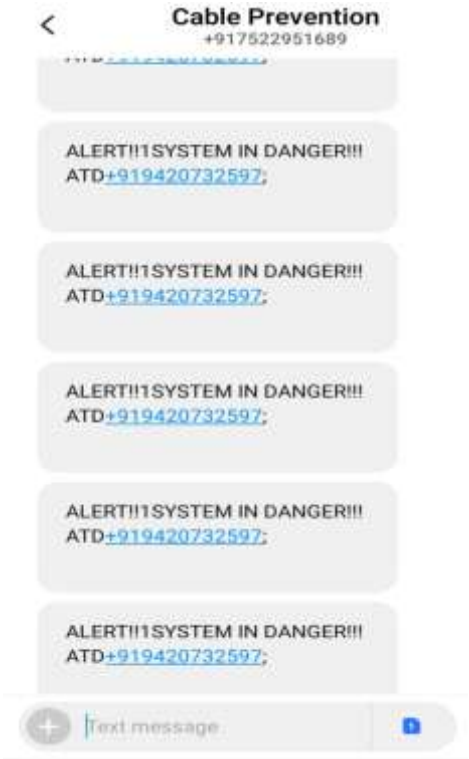


Fig 12

9. ACTUAL DEVICE:

Fig 13

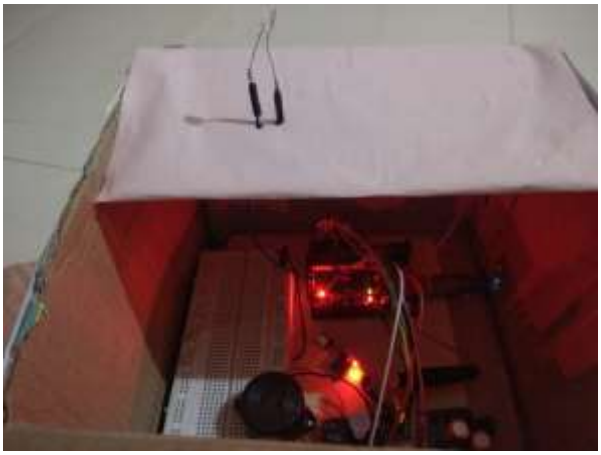


Fig 14

Fig 15

10. ADVANTAGES:

- This includes lower maintenance cost, fewer interruptions.
- Device manufacturing cost is less.
- It detects presence of wire before getting cut.
- It will reduce repairing and reinstallation cost.

- It sends notification to authorize person as well as work as indicator for digging person.
- Negligible chances of getting damage due to weather conditions.
- Due to protecting container it will be safer.

11. FUTURE SCOPE*:*

In the future scope, we are trying to implement a device for internal fault detection in the underground optical fiber cable by using the principle of Reflectometer

12. CONCLUSION:

This paper represents the hardware implementation of device which avoids the underground cable cut during road construction. It also gives the exact location of that device which we have placed inside the ground due to GSM module. In a worst case, if wire gets cut that location will find easily. In addition to that we can enhance our system by using Reflectometer to find fault in cable. It plots the graph of displacement of Accelerometer about x, y & z axis. After crossing threshold limit it automatically sends alert message to authorize & working person who dig the road to stop the construction. The hardware outcomes are satisfactory with the threshold limit and device is effective because it does not use internet service which causes many dynamic problems which is not case here. This system is used for future underground cable installation.

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