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Identification of Fault in the Underground Cables Using Raspberry Pi through the MIT App Inventor

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ABSTRACT

This paper deals with focuses on finding out the location of fault occurred in any phase in the underground cable system using the basic principle of Ohm's Law.The main objective of this project is to detect the underground cable faults and abnormalities occurring in underground cables using Raspberry Pi and notification is sent through the MIT app Inventor. The aim of the project is to determine the distance of the underground cable fault from base station in kilometres and provide a real time picture of fault itself in a web page when there is a fault such as insulation fault occurs, voltage drop varies upon the length of the fault in cable as current varies. These fault details are after sent to any access point through the internet and displayed the output on the LCD display and the output is available on the MIT app Inventor web pages. Thus, it saves a lot of time, money and allows to service underground cable lines faster.

Keywords— Ohms's law, Raspberry Pi, Underground cable fault, web page, LCD display ; MIT Inventor App

I. INTRODUCTION

This project is to determine underground cable fault using specific application. Power supply networks are growing continuously and their reliability getting more important than ever. The replacement of these overhead cables and lines by underground ones or inculcating a hybrid system (i.e. merging of the overhead lines and the underground cables) has been considered by power systems operators in the power sectors in various countries. The complexity of the whole network comprises numerous components that can fail and interrupt the power supply for end user. For most of the worldwide-operated low voltage and medium voltage distribution lines, underground cables have been used for many decades. The reason behind this is within underground cable, as they are not affected by any weather condition such as storm, heavy rainfall as well as

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pollution. When a fault occurs in the system the distance located on liquid crystal display (LCD). Until the last decade, cables were designed to be placed above the head and, at present, there is no underground cable that is higher than the previous method. adverse weather conditions such as storms, snow, torrential rains and pollution does not affect on underground lines. But when a fault occurs in underground lines it is difficult to locate the fault in underground cable.

Three types of Fault:

Generally, there are three frequently occurring faults namely,

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

Causes of fault:

- Fault in the cable can caused by
- Any defect Inconsistency
- Weakness or non-homogeneity that affect performance of cable
- Caused by breaking of conductor and failure of insulation

We will find the exact location of the fault. So we will move to find the exact location of a fault. Now the world is become digitalized so the project is intended to detect the Location of fault in digital way. The underground cable system is more common practice the followed in many urban areas. While fault occurs for some reason, at that time the repairing process related to the particular cable is difficult due to not knowing the exact location of cable fault. 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. 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. A plurality of resistors is used to represent the cable and a DC voltage is supplied at one end and the defect detected by detecting the voltage variation the defect area to accelerate the tracking of the buried cable.

The technicians know exactly which part has fault and only that area is to be dug to detect the fault source. This saves a lot of time, money and efforts and also allows to service underground cables faster. The voltage is sensed by the relay module and is updated to the user. The information conveyed to the user is the distance to which that voltage corresponds. The Raspberry Pi retrieves the fault line data and displays over LCD display, also it transfers this data over internet to display and the same time output result will show on the MIT App Inventor.

II. LITERATURE SURVEY

[1]. Gilany et.al distributed in January 2007, introduced a wavelet-based issue area conspire for matured cable frameworks when synchronized advanced deficiency recorded information are accessible at the two terminals of the cable. The wavelet peculiarity identification hypothesis is utilized as an amazing sign handling device to appraise the area of the issue in multiend-matured cable frameworks.

[2]. Behavior of simultaneous fault signals in distribution underground cable using DWT is presented by A.Ngaopitakkul, C. Pothisarn, M. Leelajindakrairerk The simulations were performed using ATP/EMTP, and by using DWT the analysis behavior of characteristics signals was Performed. Various case studies have been carried out including the single fault and simultaneous fault.

[3]. Zhao, W in August 2000, proposed a superior way to deal with cable flaw area framework, basically comprising of synchronized testing method, wavelet investigation and voyaging wave standard. Alongside the prologue to three significant methods and a blueprint of the new plan, this paper presents a definite wavelet examination of broken transient waveforms and consequently decides the best wavelet levels for this specific application.

[4]. Dhekale P.M., Bhise S.S., Deokate N.R. (2015): This paper proposes fault place model for secretive power cable using microcontroller. The main concept underground cable fault from base station in kilometres. A set of resistors are therefore used to symbolize the cable and a dc voltage is fed at one end and the fault is detect by detect the vary in voltage using analog to voltage converter and a microcontroller is used to make the necessary calculation so that the fault distance is display on the LCD display.

[5]. Prof. Arjun Nichal, Mr. Sudarshan Bhosal Mr. Vaibhav Shirsavade, Mr. Yogesh Jadhav (2016): This paper propose about fault location model for underground power cable using microcontroller and the thing which is based on the internet means the in order will transfer from end to end the internet access.

[6]. H. Shateri, S. Jamali Et Al., Proposed An impedance based fault location method for three phase faults and phase to phase. This method utilized the measured impedance by distance relay and the super imposed current factor to discriminate the fault location. This method is sensitive to the measured super imposed current factor and impedance accuracy.

[7]. Nikhil Kumar Sain, Rajesh Kajla, Mr. Vikas Kumar (2016): This paper suggest fault position model for underground power cable using microcontroller. The aim of this scheme is to conclude the distance of underground cable fault from base station in kilometers. This scheme uses the easy idea of ohm's law. When any fault like short circuit occurs, voltage drop will vary depending on the length of fault in cable, because the current varies. A set of resistors are consequently used to represent the cable and a dc voltage is fed at one end and the fault is detect by detecting the change in voltage using analog to voltage converter and a microcontroller is used to make the required calculation so that the error distance is displayed on the LCD display.

[8]. In Abhishek Pandey, Nicolas H. Younan, they have Presented underground cable fault detection and identification through Fourier analysis. The methods of impedance calculation by sending end voltage and differential voltage can be used for differentiating between the different types of cable defects from phase information. It needs study to find the best way of visualizing the results and especially the magnitude response.

III. WORKING OPERATION

This paper is the extension of fault distance locator system Using Raspberry Pi and GSM and showing indication of Replacement Message of damaged cable after occurrence of certain no of faults.

PRINCIPLE

It works mainly on the principle of Ohm's Law [9] where a low DC voltage is applied at the feeder end through set of four series connected resistors (which are an equivalent Model of underground cable).

We know that the resistance of a cable is given by

$R = (\rho \times l) / A$

where ρ is the resistivity of the cable, l is the length of the cable in kilometers.

Generally, this ρ and A are constant as far as the temperature is constant. Thus,

$R \;\alpha\; l$

Hence, the resistance of the cable increases as the length of the cable increases.

Now by Ohm's Law,

$V = I \times R$

Or

$V / I = R$

For this paper, we have scaled down the resistance of a cable by assuming that actual cable resistance R0 is being the product of scale factor 'k' and the per phase resistance R of the fault sensing circuit. Thus,

$R0 = k \times R$

It is to be noted that the actual resistance R0 of the cable may be of the order few MΩ depending upon the material and the resistivity of the actual underground cable while the resistance R of each of the resistors used in this fault sensing circuit is of 10 KΩ .

Thus, it is shown that resistance of the cable is directly proportional to the voltage drop across the cable and it is inversely proportional to the flow of current through it. So it means that as the length of the cable increases the resistance and hence the voltage drop across it also increases.

IV. EXISTING METHOD

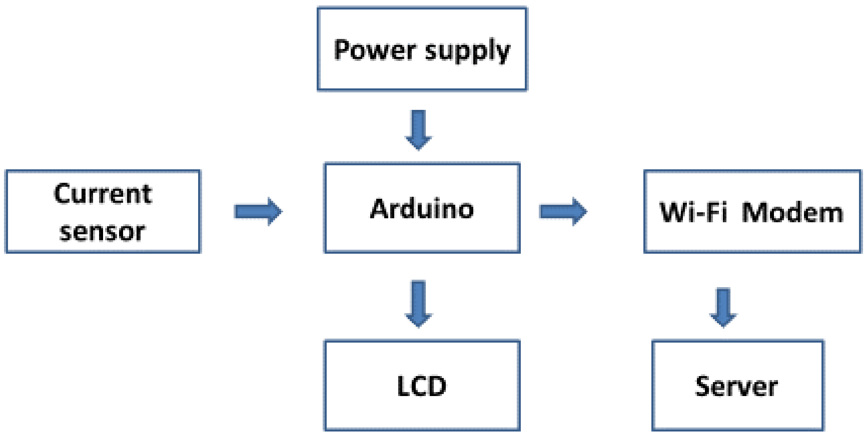

Fig.1: Block diagram of Existing method

The project uses the standard concept of Ohms law i.e., when a low DC voltage is applied at the feeder end through a series resistor (Cable lines), then current would vary depending upon the location of fault in the cable. In case there is a short circuit (Line to Ground), the voltage across series resistors changes accordingly, which is then fed to inbuilt ADC of Arduino board to develop precise digital data for display in kilometres. The fault occurring at a particular distance and the respective phase is displayed on a LCD interfaced to the Arduino board.

V. PROPOSED METHOD

In our proposed system detects underground cable fault distance from base station using OHM's law. The underground fault finding using the presented system which is fault detection using Raspberry Pi Zero W only allows a exacting user to get the details about the location of the fault. Only a particular user can have the access to the facts of fault. The operating speed of Arduino is relatively lower than the raspberry pi hence the duration between rate of fault and display of result will be more. The circuit consists of a power supply, 4 line display, Raspberry Pi and resistance measurement circuit. To induce faults manually in the kit, fault switches are used. About 12 fault switches are used which are arranged in three rows with each row having 4 switches. The 3 rows represent the 3 phases namely R,Y and B. The fault switches. It is constructed using a constant current source of 100mAmps. It can measure very low value resistance as the cables have around 1K Ohm/meter resistance. For 10-meter cable resistance becomes 1K Ohm. This circuit can measure resistance up 50 Ohm, Maximum cable length it can check up to 4 kilometres. So starting from the reference point 3 sets of resistances are placed in series. These 3 sets of resistances represent the three phases and the neutral.

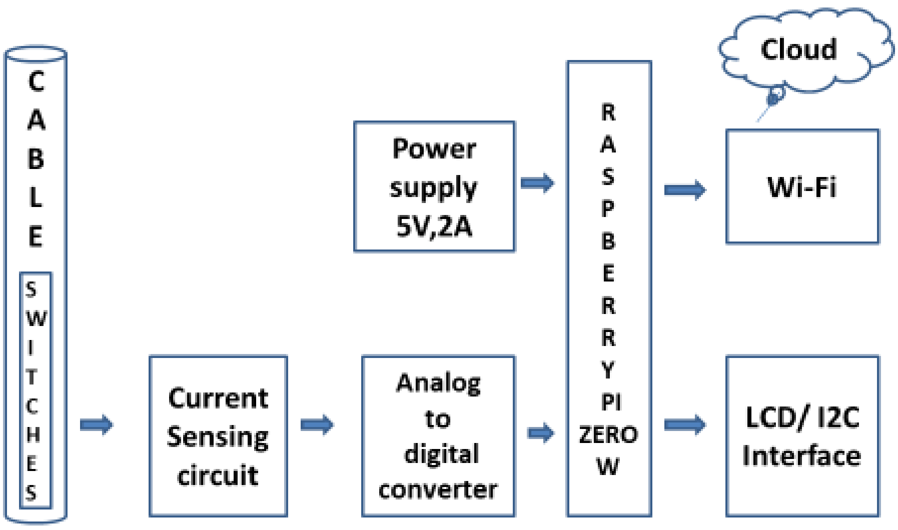

Fig.2: Block Diagram of Proposed Method

This project uses three set of resistances in each phase. Each series resistor represents the resistance of the underground cable for a particular distance and so here four resistances in series represent 1-4kms.Value of each resistance is 1ohm.The underground fault detector deals with finding of the exact fault location from the base station itself. Cables have some resistance. We are mainly focusing that the resistance. Resistance can vary with respect to the length of the cable.

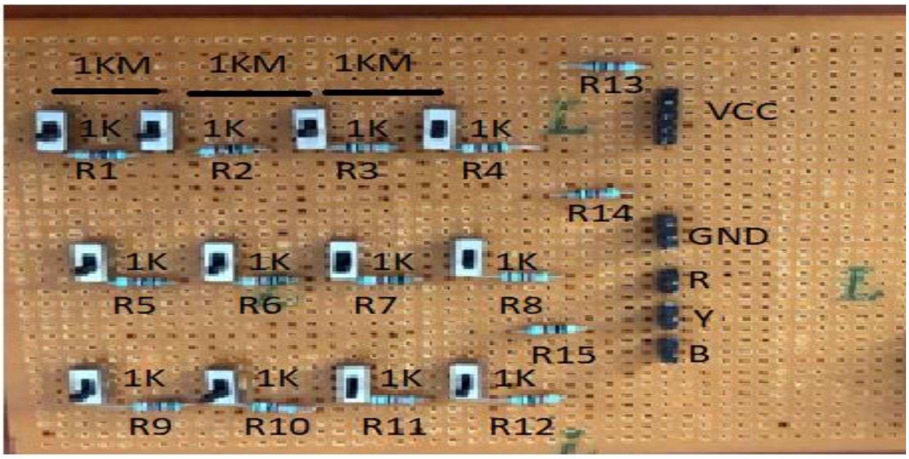

Fig: PCB Board connection

If the length of the cable is increase, the value of the resistance will also increase. If any deviation occurs in the resistance value, we will call that is the fault point and finding that place through of the MIT App Inventor. That fault point is representing standard of distance (kilometer) from the base station. This value displayed by display unit. The fault site information sends it to the end users through Wi-Fi to a desktop web page developed using available web technologies in **MIT App Inventor**.

VI. BLOCK DESCRIPTION

A) RASPBERRY PI ZERO

The Raspberry Pi Zero W extends the Pi Zero family and comes with added wireless LAN and Bluetooth connectivity. The Pi Zero W has been designed to be as flexible and compact as possible with mini connectors and an unpopulated 40-pin GPIO, allowing you to use only what your project requires. At the heart of the Raspberry Pi Zero W is a 1GHz BCM2835 single-core processor with 512MB RAM. Quite frankly, this Pi is about four times faster than the original Raspberry Pi and is only a fraction of the cost of the current RPi3.

The setup for the Raspberry Pi Zero W is a little more complicated than on other Pis. Because of the small size, many of the connectors on the Pi Zero are not standard. For starters you will want a Mini HDMI to HDMI cable or adapter to connect to your monitor. You will also need a USB OTG cable to connect a USB device, as well as a unique CSI camera cable. No matter how you want to use your Raspberry Pi Zero W, you will need a micro SD card with an operating system and a high-quality 5V power supply to power your board.

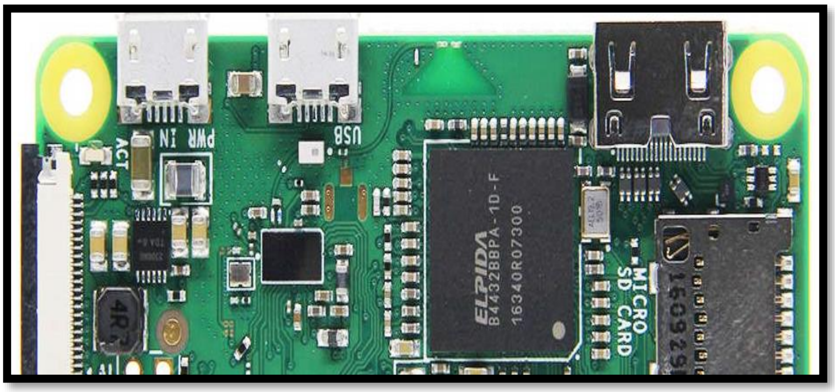

Fig: Rasbpeery Zeo W

B) 16*2 LCD Display

A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. The 16 x 2 intelligent alphanumeric dot matrix display is capable of displaying 224 different characters and symbols. This LCD has two registers, namely, Command and Data. These displays are mainly preferred for multi-segment light-emitting diodes and seven segments. The main benefits of using this module are inexpensive; simply programmable, animations, and there are no limitations for displaying custom characters, special and even animations, etc.

Fig.3.2: LCD Display

The main benefits of using this module are inexpensive; simply programmable, animations, and there are no limitations for displaying custom characters, special and even animations, etc. In this display of underground cable fault distance over a internet system The LCD display is used for displaying the fault location or distance in Kilometer.

C) I2C INTERFACE

I2C is a serial communication protocol, so data is transferred bit by bit along a single wire. With I2C, data is transferred in messages. Messages are broken up into *frames* of data. I2C stands for Inter-Integrated Circuit. It is a bus interface connection protocol incorporated into devices for serial communication. The ADS1115 are great analog to digital converters that are easy to use with the Raspberry Pi using its I2C communication bus. The ADS1115 is a 12bit ADC with the 4 Channels.

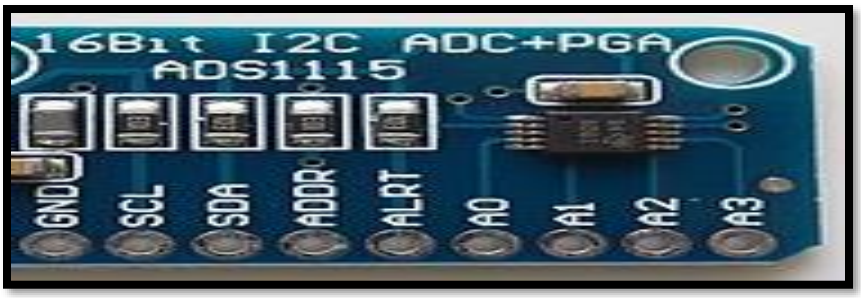

Fig.3.3: Inter Integrated Circuit

D) 4-CHANNEL RELAY MODUL

A 4-channal relay module is a combination of 4 relays on a single board. It is 4 Channel Isolated 5V 10A Relay Module, A wide range of microcontrollers such as Arduino, Raspberry Pi, PIC, ARM and so on can control it. It is also able to control various appliances and other types of equipment with large current. Relay output maximum contact is AC250V 10A and DC5V 10A. One can connect a microcontroller with standard interface directly to it. The relays terminal (COM, NO and NC) is being brought out with screw terminal. It also comes with a LED to indicate the status of relay. The Relay is sensing device which sense the fault and send a trip signal to circuit breaker to isolate the fault section.

Fig.3.4:4-Channal Relay Module

E) THREE PINS SLIDING SWITCH

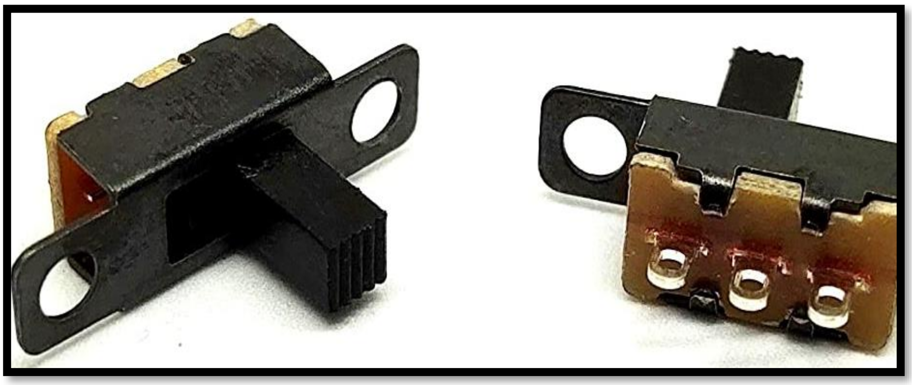

Fig.3.5: Three pins sliding switch

This is a simple single pole double throw (SPDT) slide switch - great for use as an ON/OFF button, or just as a general control switch. The pins are spaced by 0.1". The switch is rated for 0.3A at 50VDC. A slide switch is a mechanical switch that slides from the open (off) position to the closed (on) position and allows control of a circuit's current flow without having to manually splice or cut wire. Pin 3 is where the switch is either connected to ground or left open. This is the pin where the rocker switch receives its voltage. This is the pin that connects to the load of the circuit, whatever the rocker switch turns on when it's switched on. Ex: lights, motor, etc.

VII. EXPERIMENTAL SETUP

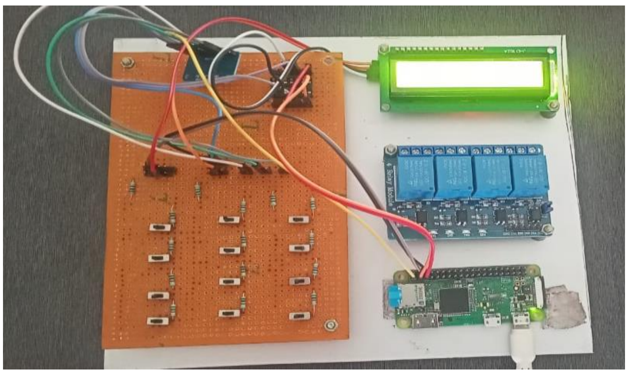

Fig.4.1: Hardware output

Fig 4.2: ADC value in LCD

In this project simple OHM's law is used to locate the short circuit fault. A DC voltage is applied at the feeder end through a series resistor, depending upon the length of fault of the cable current varies. The voltage drop across the series resistor changes accordingly, this voltage drop is used in the determination of fault location. The project is assembled with a set of resistors representing cable length in KMs and fault creation is made by a set of switches at every known KM to cross check the accuracy of the same. The voltage drop across the feeder resistor is given to an ADC which develops a precise digital data which the programmed inter integrated circuit would display the same in Kilo meters. The fault occurring at what distance and which phase is displayed on a 16X2 LCD and the output will be available on MIT App Inventor.

VIII. RESULTS AND ANALYSIS

The implementation of underground cable fault distance detection using Raspberry Pi Zero W on which Programmed in python for detecting faults by analog to digital value read from an ADC module. The ADC module connected between Underground cable line and Raspberry pi processor and sends ADC to the processor at every second. If there is change in ADC values, the fault occurrence detected.
Each series resistor represents the resistance of the underground cable for a particular distance and so here four resistances in series represent 1-3kms.Value of each resistance is 1kΩ.
No fault Occurred when processor receiving ADC the values from Channel R, Channel Y and Channel B are all high values (1024). Fault occurred when Switch 1 across Resistance R1 of phase R is closed to ground. Due to this occurred fault the value of R channel is changed from R's ADC value= 1024 to ADC value = 512.Similarly, Fault occurred carried out by closing Switch 2 and 3 to ground. The across Resistance R2 and R3 of phase closed to ground, Due to that occurred fault the ADC value of R channel is changed from R's A 1024 in- between 512.

MIT APP INVENTOR

MIT App Inventor is a web application integrated development environment originally provided by Google, and now maintained by the Massachusetts Institute of Technology (MIT). It allows newcomers to computer programming to create application software(apps) for two operating systems (OS): Android, and iOS, In creating App Inventor, Google drew upon significant prior research in educational computing, and work done within Google on online development environments.
App Inventor and the other projects are based on and informed by constructionist learning theories, which emphasize that programming can be a vehicle for engaging powerful ideas through active learning. MIT App Inventor is an intuitive, visual programming environment that **allows everyone even children to build fully**

functional apps for smart phones and tablets. Those new to MIT App Inventor can have a simple first app up and running in less than 30 minutes.

CABLE FAULT DETECTION

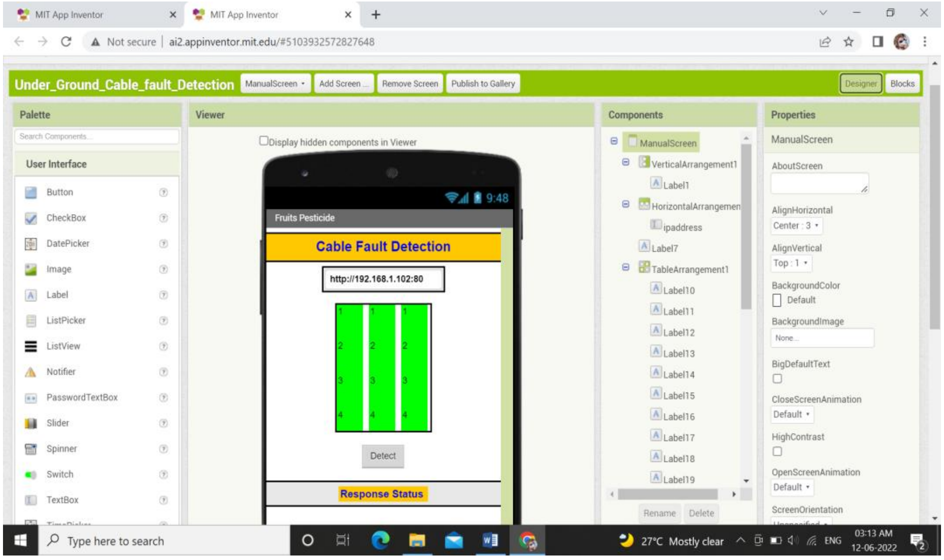

Fig 5: Cable fault detection using MIT App Inventor

In our project is to determine the fault in the underground cables using Raspberry Pi. When fault occur in the cables some changes in the resistance value. This value displayed by display unit and sends it to the end users through Wi-Fi to a desktop web page developed using available on web technologies.

Raspberry Pi is predicts the exact location of the UG (Under Ground) Cable fault is determined and then notification will be sent through the MIT App inventor using Wi-Fi. The fault occurring distance, phase and time is displayed on a LCD interfaced with I2C interface and also available output in MIT app Inventor web pages.

OUTPUT

The output has in a two cases:

CASE 1:

When all the switches in 'ON' condition then the output will be 'NO FAULT' (i.e.) '1'

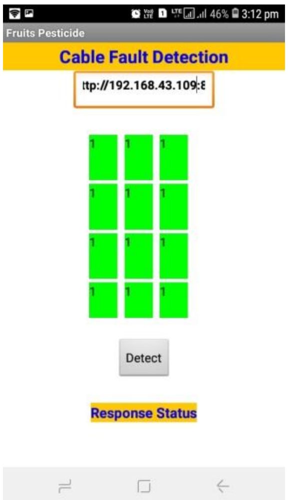

Fig 6.1: No fault in MIT App

CASE 2:

In this case, any the switches in 'OFF' condition then the output will be ' FAULT' (i.e.) '0'

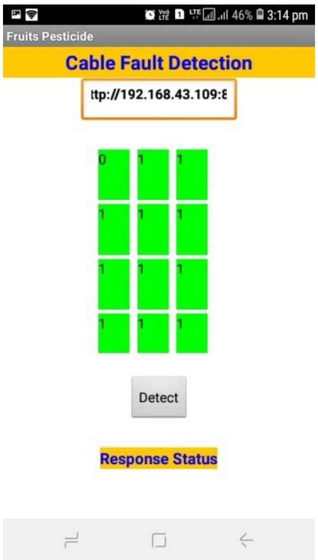

Fig 6.2: Fault in MIT App

IX. CONCLUSION

It can accomplish advanced fault detection precision in underground cable, mainly for high impedance early faults. It uses the effortless conception of Ohm's law so the fault can be easily detected and repaired using Raspberry Pi through the MIT App inventor.This model also indicates the life span of the cable used in the system by replacing the damaged cable after certain number of faults that occurred in the particular phase line. This model can be further enhanced by interfacing it with the MIT App Inventor Technology for the sake of the convenience of the End User. Therefore, it is believed that this model will be a promising one and more user friendly. The display unit displays the exact fault location that displays which phase is affected in the cable and how long it's affected. This project will reduce live wire contact injuries. They are quick to fix whenever fault develop however they are move suspect to damage and many people to don't like the way they look. They are quicker to repair their so money and reduce the amount of time that business is without power. This project has been developed to demonstrate the detection of fault in cable lines. The fault location is determined and the distance is displayed on the LCD screen and At same time the output will show on MIT App Inventor. Thus by getting to know the location of the fault, the technician can easily repair the fault.

X. REFERENCES

[1]. Shambulingangouda -"Display of Underground Cable Fault Distance over Internet (Iot) Of Things Using Gsm". International Journal of Recent Research Aspects ISSN: 2349-7688,Special Issue: Conscientious Computing Technologies, April 2018, pp. 89-92.

[2]. K.Y. Parikh, B. Kumar, V. Raval-" GSM based underground cable fault distance locator" IJSRD 6(4), 1174–1176 (2018)

[3]. Mr. N. Sampathraja, Dr. L. Ashok Kumar, Ms. V. Kirubalakshmi and Ms. C. Muthumaniyarasi, " UNDERGROUND CABLE FAULT DETECTOR"Volume 8, Issue 8, August 2017, pp. 1299–1309, Article ID: IJMET_08_08_132.

[4]. A. Gupta-" Distance calculation for underground cable fault" IJEMR 6(2), 243–247 (2016)

[5]. Nikhil Kumar Sain, Rajesh Kajla, Mr.Vikas Kumar - " A New Approach to Underground Cable Fault Distance Conveyed Over GSM ",IEEE Journaln on Power Delivery e-ISSN: 2278-1676,p-ISSN: 2320-3331 Volume 11, Issue 2 Ver. III (Mar. – Apr. 2016), PP 06-10 .

[6]. Prof. Arjun Nichal, Mr. Sudarshan Bhosale, Mr. Vaibhav Shirsavade, Mr. Yogesh Jadhav Assistant Professor - "IOT Based Underground Wire Fault Detection Technique" Electronics & Telecommunication Department, AITRC, Vita, India 1 Student (2016).

[7]. Darvhankar.G.S,Gharpande.A.S,Bhope.S.D,Meshram.A.S,Bobad.A-"Study of 3-ph Underground Cable Fault Locator Using Acoustic Method",SJIF,(2015),Vol. 2.

[8]. R. R. Kalia, P. Abrol,-"Design and implementation of wireless live wire fault detector and protection in remote areas" IEEE 97(17),14–20 (2014)