

# **A Novel Approach for Fault Localization Method Based On Monitoring, Detecting and Segregation of Fault in an Underground Cable Using IoT**

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**ABSTRACT:** As a great attention has been paid to the Internet of Things (IoT), which allows the objects to be sensed and controlled remotely, related research and standardization are being conducted. However observing and controlling the devices at a satisfactory level is still being a challenging task. The aim of this project is to determine the exact fault location of underground cable fault from base station in kilometers. If any fault occurs in cable, we can easily identify with the help of current and gas sensor, based on the voltage and current drops occur in particular area by using GPS. LCD is interfaced with ARM7 microcontroller to display the status and location. Location of fault cable is automatically updated on the cloud (ubidots website). Here, we will be monitoring the status of the underground cables using Internet of Things (IoT).

**KEYWORDS:** IoT, NodeMCU, GPS Tracker, Sensor, Keil Software

## **I. INTRODUCTION**

Internet of Things (IoT) is an ecosystem of connected physical objects that are accessible through the internet. The 'thing' in IoT could be a person with a heart monitor or an automobile with built-in-sensors, i.e. objects that have been assigned an IP address and have the ability to collect and transfer data over a network without manual assistance or intervention. The embedded technology in the objects helps them to interact with internal status or the external environment, which in turn affects the decisions taken. An article by Ashton published in the RFID Journal in 1999 said, "If we have computer that knew everything there was to know about things – using data they gathered without any help from us – would be able to track and count everything, and greatly reduce waste, loss and cost. We would know when things needed replacing 'repairing or recalling, and whether they were fresh repast their best. We need to empower computers with their own means of gathering information, so they can see, hear and smell the world for themselves, in all its random glory'. This is precisely what IT platform did for us. It enables devices/objects to observe, identify and understand a situation or the surroundings without being dependent on human help. Internet of Things can connect devices embedded in various systems to the internet. When devices/objects can represent themselves digitally, they can be controlled from anywhere. The connectivity then helps us capture more data from more places, ensuring more ways of increasing efficiency and improving safety and IT security. It is a transformational force that can help companies improve performance through IoT analytics and IoT security to deliver better results. IoT platform can help organizations reduce cost through improved process efficiency, asset utilization and productivity. With improved tracking of devices/objects using sensors and connectivity, they can benefit from real-time insights and analytics, which would help to make smarter decisions. The growth and convergence of data, processes and things on the internet would make such connection more relevant and important, creating more opportunities for business and industries.

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The objective is to identify the type of fault occurs in the cable effectively and to determine exact fault location in the underground cables. Continuously we can monitor the underground cable by using IoT (Internet of Things).

## II. LITERATURE REVIEW

In 2016, the distance of underground cable fault from base station and displayed over the internet. This IOT technology is used to find out the exact location of the fault and to send data in graphical format to our website using an IOT module at the same time it display on the LCD screen. This paper uses the standard theory of ohms law, i.e., when a low DC voltage is applied at the feeder end through a series resistor(Cable lines), then the current would vary depending upon the location of the fault in the cable as the resistance is proportional to the distance. In case there is a short circuit (Line to Ground), The voltage across series resistors changes according to the resistance that changes with distance.

In 2015, there are two methods which will be very useful to identify the exact distance of fault underground system from base station. One method is murray loop and other one is ohm's law, murray loop method uses the whetstone bridge to calculate exact distance of fault location from base station and send it to the mobile. In ohms law method when fault occurs voltage drop will vary depending on the length of fault in cable, since the current varies. Both the methods use voltage converter, microcontroller and potentiometer to find the fault location under LG,LL,LLG faults.

In 2014, incipient faults in underground cables are largely caused by voids in cable insulations or defects in splices. This type of fault would repeatedly occur and subsequently develop to a permanent fault sooner or later after its first occurrence. Two algorithms are presented to detect and classify the incipient faults in underground cables at the distribution voltage levels. Based on the analysis of the superimposed fault current and negative sequence current in the time domain, the other algorithm is particularly suitable to detect the single-line-to-ground(SLG) incipient faults which are mostly occurring in underground cables. Both methods are designed to be applied in real systems.

In 2012, a new fault location algorithm is proposed for underground cables in particular. The algorithm is able to precisely calculate the fault distance depending on modifying the basic apparent impedance approach to cope with the aforementioned characteristics of cable segments. Different investigation tests are performed depending on a typical 11KV underground distribution feeder. The performance of the proposed algorithm is compared with the original apparent impedance approach using the same simulation platform.

In 2010, it deals with detection and location of faults in underground cable network. For precision a three step process is followed in this paper, with creation of transmission system model using a Matlab/Simulink and followed by creation of faults in the system. In second step the fourier analyzed fault voltages and currents obtained from the SIMULINK model are fed to the training set of artificial neural network(ANN) in order to detect the type of fault. In the last step, an independent software Orcad is used to locate the fault distance from the either ends using the principle of time domain reflectometry in a simulated practical underground distribution system

## III. PROPOSED SYSTEM

Here, we propose an cable fault detection over IOT that detects the exact fault position over IoT that makes repairing work very easy. The repairmen 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. We use IOT technology that allows the authorities to monitor and check faults over internet.

In our project we will be monitoring the status of the underground cables. With the help of the sensors we will obtain the value, with that value we can predict the status of the wire. By using the voltage sensor we will check whether there availability of voltage or not. By using the gas sensor we can check the status of the cable whether it is burnt or not. Here, we will be using a LPC2148 arm board which will obtain values from the sensor and process the values. The node MCU is a controller which has a inbuilt ESP8266 through which we will access the internet. The LPC2148

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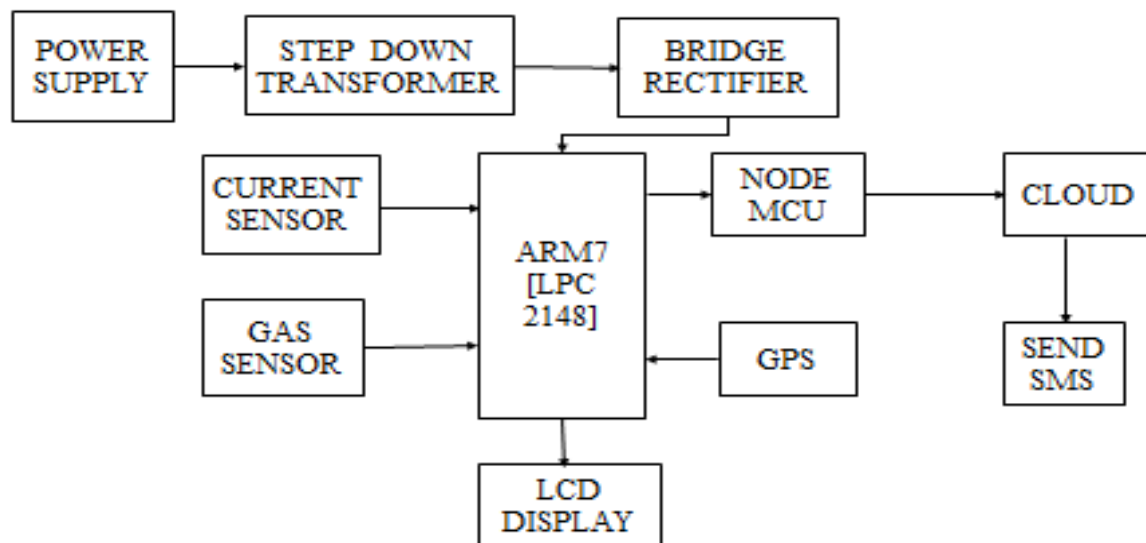
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communicates with the node MCU through serial transmission. After obtaining the sensor values the node MCU it will compare the values with the set point values. These sensor values are uploaded in ubidots website so that any officials can log on and check the values. If in case the sensor values exceeds the threshold value then the ubidots website will send a SMS to the authority. If there is any fault in the cable then based on the sensor values we can easily identify the type of fault and using IoT we will send a SMS to the authority. In that SMS we will specify the kind of fault that has occurred in the underground cable. We will be using a GPS so as to find the location between which two sensors the cable fault has occurred. We will send the location also in that SMS so that they can identify the exact place where the fault has occurred.

### BLOCK DIAGRAM OF PROPOSED SYSTEM



### CURRENT SENSOR

A current sensor is a device that detects and converts current to an easily measured output voltage, which is proportional to the current through the measured path. When a current flows through a wire or in a circuit, voltage drop occurs. Also, a magnetic field is generated surrounding the current carrying conductor. Both of these phenomena are made use of in the design of current sensors. Thus, there are two types of current sensing: direct and indirect. Direct sensing is based on Ohm's law, while indirect sensing is based on Faraday's and Ampere's law. Direct Sensing involves measuring the voltage drop associated with the current passing through passive electrical components. Indirect Sensing involves measurement of the magnetic field surrounding a conductor through which current passes.

The WCS2705 provides economical and precise solution for both DC and AC current sensing in industrial, commercial and communications systems. Typical applications include motor control, load detection and management, over-current fault detection and any intelligent power management system etc... The WCS2705 consists of a precise, low-temperature drift linear hall sensor IC with temperature compensation circuit and a current path with 8.3 mΩ typical

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internal conductor resistance. This extremely low resistance can effectively reduce power loss, operating temperature and increase the reliability greatly. Applied current flowing through this conduction path generates a magnetic field which is sensed by the integrated Hall IC and converted into a proportional voltage. Current measurement is of vital importance in many power and instrumentation systems. Current sensing has emerged as a method to monitor and enhance performance. Knowing the amount of current being delivered to the load can be useful for wide variety of applications. Current sensing is used in wide range of electronic systems.

## GAS SENSOR

The MQ5 is used in gas leakage detecting equipment in consumer and industry applications, this sensor is suitable for detecting LPG, natural gas, coal gas. Avoid the noise of alcohol, cooking fumes and cigarette smoke. The sensitivity can be adjusted by the potentiometer. The working principle behind the MQ-5 gas sensor is as follows: The sensor has a sensitive filament made of SnO<sub>2</sub>. In the presence of clean air, this filament tends to have lower electrical conductivity. When a combustible gas such as LPG is introduced, the filament's conductivity rises, and the amount of change in its conductance/resistance can be used to indicate the equivalent gas concentration. This effect tends to be particularly pronounced at higher temperatures, and resistive heating element is present as well. SnO<sub>2</sub> is particularly sensitive to Methane, Butane and Propane, but is also sensitive to other combustible gases as well.

## GLOBAL POSITIONING SYSTEM (GPS)

Every single location in the entire globe can be specified in terms of geographical coordinates. The geographical coordinate is a system which specifies any given location on the earth surface as latitude and longitude. There are devices which can read the geographical coordinates of a place with the help of the signals received from a number of satellites orbiting the earth. The system of satellites which helps in the positioning of a place is called Global Positioning System (GPS).

The GPS module continuously produces a set of data regarding the position of the earth surface where it is situated which includes the current position with respect to the equator of the earth in terms of Latitude and Longitude. This data can be decoded and printed into the readable format with the help of a microcontroller only. In this project the data regarding the geographical coordinate is extracted from the GPS output with the help of the Arduino.

The LPC2148 can be used as a stand-alone board of which the output or inputs can be taken from the boards or given to the board. They can communicate using standard communication ports like USART, TWI, SPI etc. which enables them to be connected with various kinds of devices. The Arduino board is designed for easy prototyping and for coding is very simple and provides so many libraries for interfacing with common external devices.

The GPS module used in our project is SR-91 based GPS module which can communicate the data regarding the current location to a PC or microcontroller through the serial port. The ARM7 board used in this project is the LPC2148 board and the IDE version of the arduino is 1.0.3 for windows.

Since LPC2148 has no circuitry for interfacing it with the serial port or the USB port of the PC, an external USB to TTL converter board is required to connect it with the PC. This hardware helps in programming the arduino board and also helps in the serial communication with the USB port of the PC.

The microcontroller read the serial data from the GPS module using the serial communication functions provided by the Arduino library. The functions like Serial.begin() which helps to initialize the serial port with a given baud rate, Serial.write() to send a data to the serial port, Serial.available() and Serial.read() functions to read data from the serial port are used.

## NODEMCU:

The NodeMCU (Node Microcontroller Unit) is an open source software and hardware development environment that is built around a very inexpensive System-on-a-Chip (SoC) called the ESP8266. The ESP8266, designed and manufactured by Espressif Systems, contains all crucial elements of the modern computer: CPU, RAM, networking (wifi), and even a modern operating system and SDK. When purchased at bulk, the ESP8266 chip costs only USD a piece. That makes it an excellent choice for IoT projects of all kinds.

However, as a chip, the ESP8266 is also hard to access and use. We have to program it in low-level machine instructions that can be interpreted by the chip hardware. While this level of integration is not a problem when the

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ESP8266 is used as an embedded controller chip in mass-produced electronics, it is a huge burden for hobbyists, hackers, or students who want to experiment with it in their own IoT projects.

ESP8266 development. It has two key components.

1. An open source ESP8266 firmware that is built on top of the chip manufacturer's proprietary SDK. The firmware provides a simple programming environment based on eLua (embedded Lua), which is a very simple and fast scripting language with an established developer community. For new comers, the Lua scripting language is easy to learn.
2. A DEVKIT board that incorporates the ESP8266 chip on a standard circuit board. The board has a built-in USB port that is already wired up with the chip, a hardware reset button, wifi antenna, LED lights, and standard-sized GPIO (General Purpose Input Output) pins that can plug into a bread board. Figure 1 shows the DEVKIT board, and Figure 2 shows the schema of its pins.

## SOFTWARE IMPLEMENTATION

Keil Software, world's leading developer of Embedded Systems Software, makes ANSI C compilers, macro assemblers, real-time kernels, debuggers, linkers, library managers, simulators, integrated environments, and evaluation boards for the 8051 251, ARM7, and C16x/ST10 microcontroller families. Keil Software implemented the first C compiler designed from the ground-up specifically for the 8051 microcontroller.

$\mu$ Vision IDE combines project management, run-time environment, build facilities, source code editing, and program debugging in a single powerful environment.  $\mu$ Vision is easy-to-use and accelerates your embedded software development.  $\mu$ Vision supports multiple screens and allows you to create individual window layouts anywhere on the visual surface. The  $\mu$ Vision Debugger provides a single environment in which you may test, verify, and optimize your application code. The debugger includes traditional features like simple and complex breakpoints, watches windows, and execution control and provides full visibility to device peripherals.

With the  $\mu$ Vision Project Manager and Run-Time Environment you create software application using pre-build software components and device support from Software Packs. The software components contain libraries, source modules, configuration files, source code templates, and documentation. Software components can be generic to support a wide range of devices and applications.

Keil development tools offer a complete development environment for ARM, Cortex-M, and Cortex-R processor-based devices. They are easy to learn and use, yet powerful enough for the most demanding embedded applications.

- The MDK Core contains all development tools including IDE, Compiler, and Debugger. The new Pack Installer adds and updates Software Packs for devices, CMSIS, and middleware.
- Software Packs that add support for a complete microcontroller family are called Device Family Packs.
- Today only some devices are supported by Device Software Packs, but we will add support for more microcontroller devices shortly

MDK includes two ARM C/C++ Compilers with assembler, linker, and highly optimize run-time libraries that are tailored for optimum code. Software Packs may be added any time to MDK-Core or DS-MDK making new device support and middleware updates independent from the tool chain. They contain device support, CMSIS libraries, middleware, board support, code templates. New is the IPv4/IPv6 networking communication stack that is extended with ARM embedded<sup>TM</sup> software components to enable Internet of Things (IoT) applications.



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## IV. RESULTS

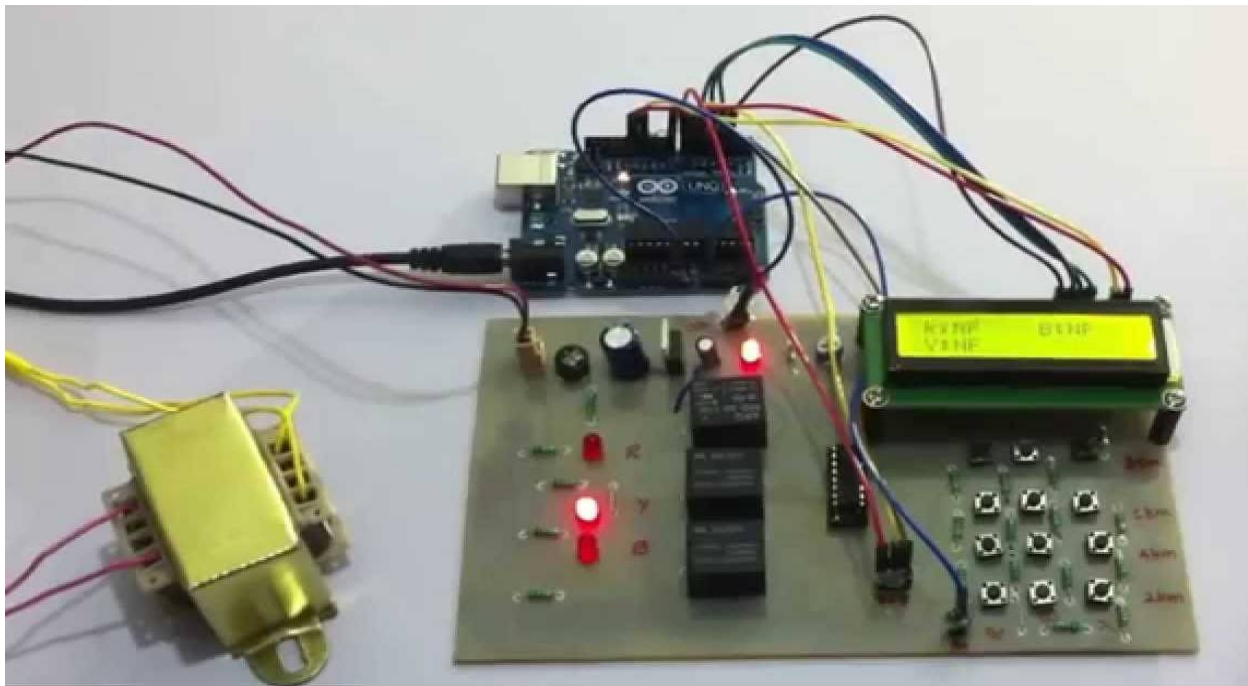
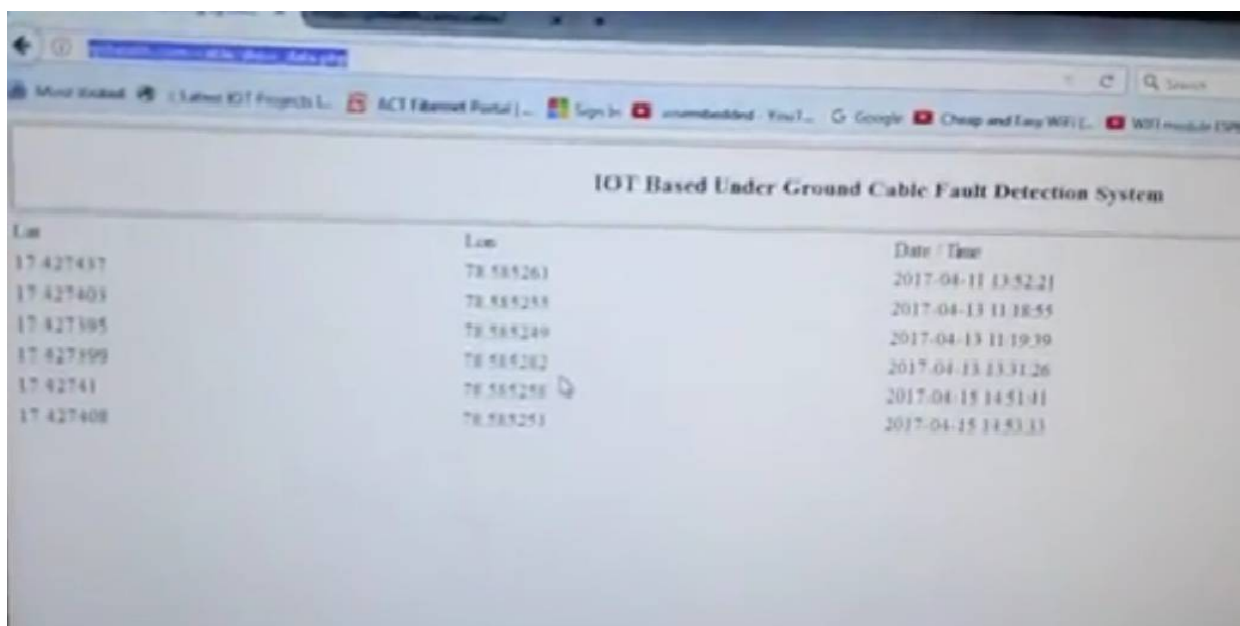


Fig.1: HARDWARESNAPSHOT



Lat	Lon	Date / Time
17.427437	78.585261	2017-04-11 13:52:21
17.427403	78.585255	2017-04-13 11:38:55
17.427395	78.585249	2017-04-13 11:19:39
17.427399	78.585282	2017-04-13 13:31:26
17.42741	78.585258	2017-04-15 14:51:41
17.427408	78.585251	2017-04-15 14:53:33

Fig.2 CURRENT STATUS OF THE CABLE

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In Fig.2, Current status of the underground cable will be monitoring through IoT .

## V. CONCLUSION

The final conclusion is that we can monitor the data and control the devices using iot in a remote environment. Multiple parameters can be monitor and controlled using single microcontroller. Hence the number of microcontrollers used is less and thus it occupies less space, so it is the major advantages in our proposed system. Through client-server implementation we can connect multiple pc where we can monitor the parameters. In future we can control the whole power system through internet and we can access from anywhere. Future developing this project we can control the power plant through mobile phone also. This proposed system saves time and life of the human beings. In future the whole world is accessed by internet so, our proposed system suits very well to the current environment. Therefore our proposed system has best modification and more advantageous when compared with the existing system.

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