

UNDERGROUND CABLE FAULT DETECTION AND TRANSMISSION OF INTIMATION THROUGH SOIL WIRELESS TRANSCEIVER

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Abstract – The project is intended in order to find a solution to detect the fault in underground supply lines in an efficient manner and in less cost. For this purpose, we use the Wireless Underground Sensor Networks to transmit the data from transmitter side to receiver side. Whenever the fault occurs in the underground cable it is transmitted to the PC using this WUSN. It is used in this fault detection because of its less complexity and less cost. WUSN mainly makes use of the moisture present in the soil. This does not involve any kind of waves to transmit the data and it makes the detection harmless. Arduino microcontroller plays a major role and it is coded with the embedded C to detect the fault in the underground supply lines with the help of AC current sensor connected to the supply lines. Wireless soil transmitter and receiver is used to transmit the data from the Arduino microcontroller connected to the supply lines via current sensor to the pc via serial converter

Key Words: WUSN, Arduino microcontroller, soil wireless transmitter.

1. INTRODUCTION

An embedded system is so important in today's automation as it has been widely used in all kind of industries and automation. This project is to determine the distance of underground cable fault from base station in kilometers using an PIC Microcontroller. Generally, we use overhead lines where we can easily identify the faults but in rushed places or familiar cities we couldn't use overhead lines. So, we are going to use underground cables. Underground cables are used largely in urban area instead of overhead lines. We cannot easily identify the faults in the underground cables. This project deals with PIC microcontroller, current sensor, soil wireless transceiver, serial converter. This project greatly reduces the time and operates effectively. Many types of faults occur due to construction works and other reasons. At this time, it is difficult to dig out cable due to not knowing the exact location of the cable fault. Many urban areas follow the underground cabling system. Sometimes faults occur due to construction works and other reasons. Nowadays the world is becoming digitalized so the project was intended to detect the location of fault in digital way.

2. OBJECTIVES

The main objective is to establish an efficient wireless communication between the transceivers in challenging underground medium.

To detect any fault in underground power supply lines and to indicate the precise location of the fault.

To detect the location that where the cable has got damaged.

To reduce the cost and making it more effective in long distance applications and to reduce the complexity.

3. RELATED WORKS:

In this work, the recent advances in MI-WUSNs and related areas (WUSNs, NFC, magnetic communication in liquids) have been reviewed [1]. The advances in the related areas provide an important insight into the typical problems of system modeling and design. For MI-WUSNs, the advances are related to various aspects of wireless communication and networking.

In particular, the important aspects of channel modeling, digital signal transmission and processing, synchronization, network design, WPT, and localization, have been discussed. Through this, a better understanding of the underlying research challenges and design problems has been elaborated.

These interfaces might give rise to some novel applications of IoT.

The development of an outdoor WUSN test bed and the realization of WUSN experiments are challenging [2]. This work provides a set of guidelines that result in a balanced approach between high accuracy and a practical implementation of a WUSN test bed. The identification and elimination/mitigation of each variable which significantly affects the experiment results is the basic approach behind the proposed guideline.

The main aim of this paper is to detect the fault in a cable using Arduino microcontroller kit [3]. The cable is placed underground of the farming land. Usually it is difficult to detect the fault but this paper uses a simple solution such as Wireless underground sensor networks to detect the fault. It simply uses the soil wireless transmitter and receiver to pass

the information that where the fault occurs by placing the sensors to a particular range. The main advantage is that it does not use any kind of waves inside the soil, it uses the electrons to transmit the information obtained from the microcontroller kit.

This work introduces the concept of a Wireless Underground Sensor Network (WUSN) that can be used to monitor a variety of conditions, such as soil properties for agricultural applications and toxic substances for environmental monitoring [4]. WUSN devices does not require any wired networks and it is completely laid below ground. All necessary sensors, memory, a processor, a radio, an antenna, and a power source are needed for each device that makes the deployment much simpler than existing underground sensing solutions. Wireless communication is significantly more challenging within a dense substance such as soil or rock than through air. This factor requires that communication protocols, that combined with the necessity to conserve energy due to the difficulty of unearthing and recharging WUSN devices.

4. PROPOSED SYSTEM

Our system is intended to locate the fault in underground cable line from the base station to exact location in kilometers using an Arduino Microcontroller kit. Whenever the fault occurs in underground cable it is difficult to detect the location of fault for process of repairing the particular cable.

The proposed technology used is controller (PIC Microcontroller) to identify the fault and it is indicated using. WUSN have many application wireless soil transmitter and receiver. WUSN is defined as a group of nodes whose means of data transmission and reception is completely subterranean like infrastructures, security, environmental, monitoring.

5. BLOCK DIAGRAM

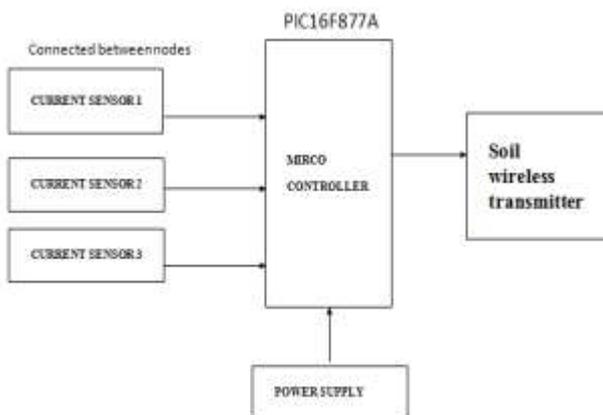


Fig -1: Transmitter Unit

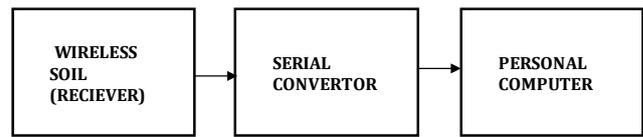


Fig -2: Receiver Unit

5.1 BLOCK DIAGRAM DESCRIPTION

Initially the current sensors are connected to the underground cables and it is kept to a certain range o cables depending on the current sensor used. Then the current sensors are connected to the PIC16F877A Arduino microcontroller.

This microcontroller continuously monitors the readings given by the current sensors connected to the underground cables. this gained information is transmitted to the receiver PC via the soil wireless transmitter and receiver.

Microcontroller is coded using the embedded c programming language to detect any kind of changes from current sensors.

Embedded C is a set of language extensions for the C programming language by the c standards committee to address commonality issues that exist between C extensions for different embedded systems. Embedded C programming support exotic features such as fixed-point arithmetic, multiple distinct memory banks and basic I/O operations. It has a number of features that are not available in normal C programming, such as fixed-point arithmetic, named address spaces and basic I/O hardware addressing.

Then the information is transmitted to the receiver unit which comprises of soil wireless receiver, to the serial converter and connected to the personal computer.

The serial converter uses the UART protocol. The pc has an output displayed in the spreadsheet which just shows whether the current is flowing between the various nodes. This done using coding language C. C programming is a very simple language used in order to simplify the work of the user.

6. INTERNAL CIRCUIT DIAGRAM

The PIC16F877A is a microcontroller board based on the PIC Series controller. It has 33 digital input/output pins (of which can be used as PWM outputs), and 8 analog inputs. It also has 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button.

PIC16F877A is 8bit microcontroller packs Microchip's powerful PIC architecture into a 40 package and is upwards compatible with the PIC16C5X, PIC12CXXX and PIC16C7X devices.

The underground cable lines are continuously monitored by the current sensors if there is any leakage or fault in cable lines. The current sensor generates a signal proportional to it.

The generated signal could be analog output and even digital output. The signal is passed to the PIC16F877A which identify the exact location of the fault in the cable lines. This information is transmitted and received via using WUSN and the displayed in PC.



Fig -3: Internal Circuit Diagram

7. DESIGN FLOW

The flow chart is diagrammatical representation about the working of underground cable fault detection using the Wireless underground sensor networks.

The current sensor 1 which is attached between node 1 to 2 sends information whether the current flows in the node which it is attached to, then current sensor 2 sends the information as same as current sensor 1 to the microcontroller and the as many as nodes we require also does the something. The Arduino microcontroller fetched the information from the various current sensors which is coded with embedded c and transmits the information's using the WUSN.

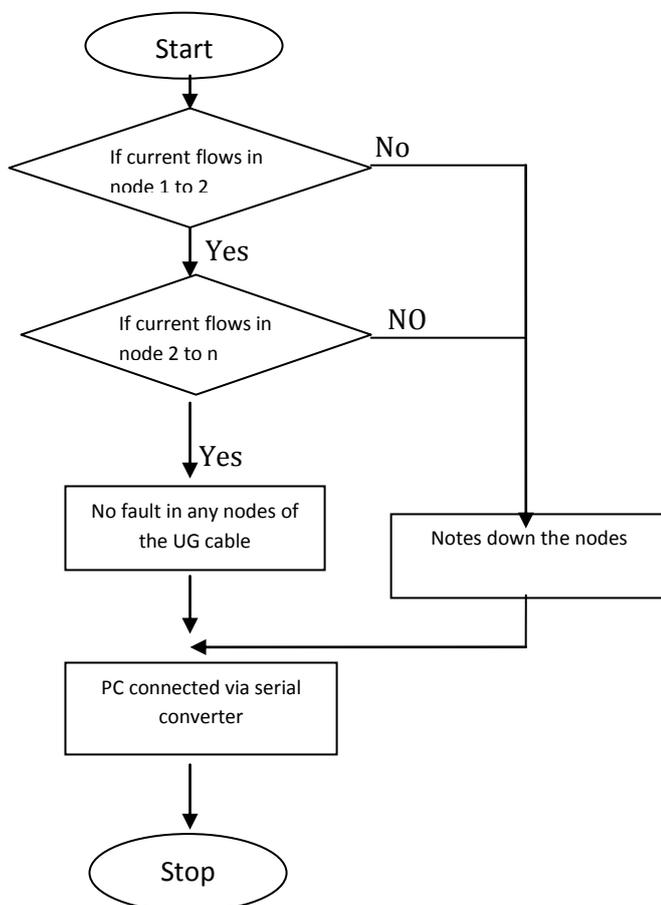


Chart-1: Flow Chart representation

The computer is attached to the WUSN using serial converter displays the live information about the underground cables in a spreadsheet which is coded with c programming language. In the flow chart 'n' represents that any number of nodes can be connected depending upon the value of the current sensor used. The exact node where the current doesn't flow is displayed in the spreadsheet else it just displays that there is no fault in the underground cable.

8. METHODOLOGIES

8.1. Embedded C Programming

Embedded C programming want to have a nonstandard extension to the C programming language in order to support exotic features such as fixed-point arithmetic, multiple distinct memory banks and basic I/O operations. It has a number of features that are not available in normal C, such as fixed-point arithmetic, named address spaces and basic I/O hardware addressing. Lot of syntax and standards are used by embedded C was main () function, variable definition, data type declaration, conditional statements (if, switch case), loops (while, for), functions (), arrays, strings, structures, union, bit operations, macros, etc.

8.2 WUSN

Wireless underground sensor networks are a way of transmitting the information's or data from soil wireless transmitter to receiver using the moisture of soil present in it. The transmitter transmits the information from source node to receiver attached to the destination node using electrons inside the moisture of soil.

8.3 BASIC METHOD

The AC current sensor is connected to the cable which is laid underground and the information whether the current flows through the cable or not is transmitted to the wireless soil transmitter using the Arduino microcontroller kit which is connected to the AC current sensor. The microcontroller kit is coded using the Embedded C.

The soil wireless receiver receives the data from the transmitter through the soil which contains moisture and it is connected to the serial converter which uses the UART protocol. It is coded using the Embedded C programming. The personal Computer is device used here in order to display the output from the microcontroller. It is displayed in the spread sheet in the form of table. The Output has three columns in which one displays number of nodes and the current sensor and status of the node whether the current flows between the nodes or not.

8.4 Power Supply

Electrical power is a reference to a source of electrical power. The component that supplies electrical power to the devices is called a power supply unit or PSU. This is commonly applied to most of the electrical energy supplies, less often to mechanical ones, and rarely to others. Power supply unit is the combination of Step down transformer, Bridge rectifier, filter circuit and the voltage regulator

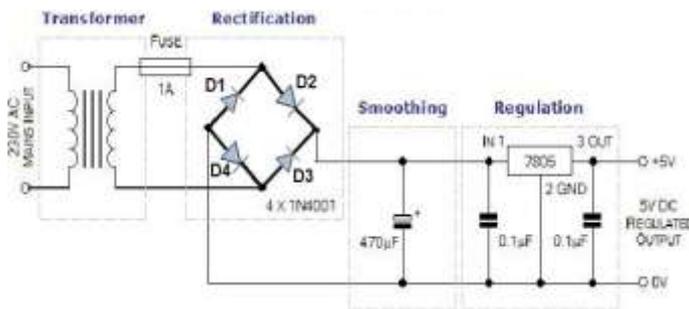


Fig -4: Power Supply Unit

8.5 PIC MICROCONTROLLER

PIC stands for Peripheral Interface Microcontroller which was developed by the general instruments microcontrollers. It is controlled by software and programmed in such a way that it performs different tasks and control a generation line. PIC microcontrollers are used in different new applications like audio accessories, advanced medical devices, and smart devices. This device is accessible in 40 pin and 44 pin packages. All devices within this family share common design with subsequent differences.



Fig-5: PIC Microcontroller

8.6 CURRENT SENSOR

Current detector could be a device that detects electric current in a wire and generates a signal proportional to that current. The generated signal could be analog output and even digital output. The generated signal may be then used to display the measured current in an ammeter or may be stored for any further analysis within the data or information acquisition system, or may be used for controlling purpose. The detected current and also the

output signal may be alternating current input and direct current input.



Fig -6: Current sensor

9. ADVANTAGES

The main advantage of this paper is, WUSN is harmless to the living beings. It does not use any kind of ways to transmit the information from the cable laid underground to the output device above ground. The cost is less and can be placed in any places like power station and it is risk free. Depending on the range of current sensor it can be used for long distance application. It is less complex circuit to build and it does not involve any radiation. The circuit built to detect the underground cable fault detection is radiation less and it is harmless.

10. CONCLUSIONS

In this work the short circuit fault at a particular distance in the Underground Cables can be detected using Ohm's Law which enables to rectify fault efficiently.

This system can be beneficial to underground cables fault finding as it is cost effective and can be accessed remotely. This system will help to implement the system to regulate the industrial use of underground cables and avoid power losses.

It gives the new dimensions in the field of underground cables fault finding with minimum cost and less time.

The circuit uses WUSN in an efficient manner to transmit the information from current sensor to the microcontroller without any harmful radiation.

REFERENCES

- [1] SURVEY ON ADVANCES IN MAGNETIC INDUCTION BASED WIRELESS UNDERGROUND SENSOR NETWORKS, Steven Kisseleff, Member, IEEE, Ian F. Akyildiz, Fellow, IEEE, and Wolfgang H. Gerstaecker, Senior Member, IEEE, 2014
- [2] DEVELOPMENT FOR A TESTBOD FOR WIRELESS UNDERGROUND SENSOR NET WORKS, Agnelo R. Silva and Mehmet C. Vuran, Department of Computer Science

and Engineering, University of Nebraska-Lincoln,
Lincoln, NE 68588, USA, 2009

- [3] INDUSTRIAL UNDERGROUND POWER CABLE FAULT IDENTIFICATION USING ARDUINO CONTROLLER, Prabakaran K, Assistant Professor, Department of Electronics and Instrumentation Engineering, Erode Sengunthar Engineering College, Tamilnadu, India,2018

- [4] WIRELESS UNDERGROUND SENSOR NETWORKS: RESEARCH CHALLENGES, Ian F. Akyildiz, Erich P., Broadband Wireless Networking Laboratory, Stuntebeck, School of Electrical and Computer Engineering, Georgia Institute of Technology, 75 5th St. NW, Atlanta, GA 30308, United States,2006.

- [5] K.K. Kuan, Prof. K. Warwick, "Real-time expert system for fault location on high voltage underground distribution cables", IEEE PROCEEDINGS-C, Vol. 139, No. 3, MAY 1992.

- [6] Tarlochan S. Sidhu, Zhihan Xu, "Detection of Incipient Faults in Distribution Underground Cables", IEEE Transactions on Power Delivery, Vol. 25, NO. 3, JULY 2010.