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Research Article

Underground cable fault detection using IOT

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Abstract

In the present work, the main objective is to find out the location of fault occurred in Underground cable of single phase AC line. The components used to find the fault in Underground cable are Current sensor, PIC Microcontroller, LCD, Relay, IOT. The current sensor is connected in series with the phase line of Underground cable. It works on the principle of Electro Magnetic Flux. The current sensor will monitor the voltage value of the phase line. The output of the current sensor is interfaced with the PIC Microcontroller. The LCD will display both input and output (voltage & current) value through the microcontroller. If any fault occurs in the phase line, the relay will trip the circuit by using PIC Microcontroller. The IOT intimate the user through PIC Microcontroller.

Keywords: PIC Microcontroller; Current sensor; Internet of things; Liquid crystal display; Power Relay.

Introduction

In the present work, authors proposed a fault location model for the underground cable lines with Peripheral Interface Controller [1]. Underground cable project is commonly followed in major areas like metro cities and urban areas. Underground cables are unaffected by any adverse weather condition such as storm, snow, heavy rainfall as well as pollution.

In case any fault occurs in Underground cable like Short circuit, Open circuit and Leakage fault, these faults are identified by our project [2]. In our project we used a simple concept of Ohm‟s Law. Now the world has become digitized so, the project is to detect exact location of the fault in digital form [5].

When a fault occurs in the underground cable project the exact latitude and longitude of the fault is immediately intimate through the IOT [6, 8]. The LCD will display both input and output (voltage & current) value through the microcontroller. If any fault occurs in the phase line, the relay will trip the circuit by using PIC Microcontroller. The IOT intimate the user through PIC Microcontroller [3].

Existing system

Electrical energy is generated at the power generating stations which are usually situated far away from the load center. Hence, an extensive network of conductors/cables between the power generating stations and the consumer is required. This network of conductors or cables may be called the transmission and distribution project. Mostly the high voltage transmission is carried out by overhead projects due to low cost.

However, the distribution of electrical energy in congested areas and in modern cities is carried out by underground cables. Underground cables are unaffected by any adverse weather condition such as storm, snow, heavy rainfall, as well as pollution. The most common types of fault that occur in cables are open circuit fault, short circuit fault and earth fault. Study of underground cable failures and development of accurate fault detection and location methods has been interesting research topics in the past and present [2].

Fault detection entails determination of the presence of a fault, while fault location detection includes the determination of the physical location of the fault [1]. There are many ways to find the cable fault location. This paper deals with the method to locate faults in the underground.

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Proposed system

The proposed system block diagram is shown in Fig. 1. [3,4].

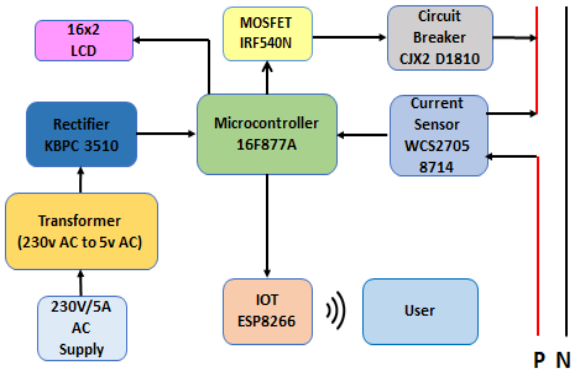

Fig. 1. Block diagram

It primarily consists of the following hardware components. The heart of the system is PIC Microcontroller which uses Embedded C software for writing the instructions on it.

- PIC Microcontroller
- Current Sensor
- IOT
- LCD
- Circuit breaker.

Working principle and operation

Underground cable fault detector is working on the principle of Electro Magnetic Flux using current sensor. Single phase AC supply is given to the Underground cable, the current sensor is connected in series with the phase line, the sensor continuously sense the value of current and display the value in LCD through Peripheral Interface controller [4]. Weather any fault occur in underground cable the fault is sensed with current sensor with the principle of Electromagnetic flux and it check the range weather it is more or less then the fixed range in PIC microcontroller. In case the voltage range is greater or lesser than the fixed range in the controller, it display the fault value in LCD and then circuit breaker trip the supply line through the relay at the same time the fault location is intimated through IOT [3].

PIC microcontroller

PIC microcontroller, used in the project is 16f877a. The PIC has 40 pins and has only 35 single word instruction except for program branch. The operating speed of PIC in DC is 20 MHz and clock input in DC is 200ns instruction cycle. There are two types of memory in Pic 16f877a, one is program memory and another one is data memory. The PIC has 8K x 14 words of flash Program Memory, 368 x 8 bytes of Data Memory (RAM). In PIC 8 channel A/D converter with 10-bit each. In this project PIC is connected with current sensor output signal, LCD, MOSFET, and finally connected to the IOT device.

Current sensor

The current sensor used in the project is ACS712 (Fig. 2). The ACS712 Module IC is to measure current using Hall Effect principle. This ACS712 module can measure both AC and DC current. This modules output is Analog voltage range up to 0 to 5 voltage based on the current flowing through the phase line. The current sensor is connected in series with the phase line [5]. The output of the current sensor is connected with the microcontroller, if any voltage drop occur in the phase line it send a signal to Microcontroller.

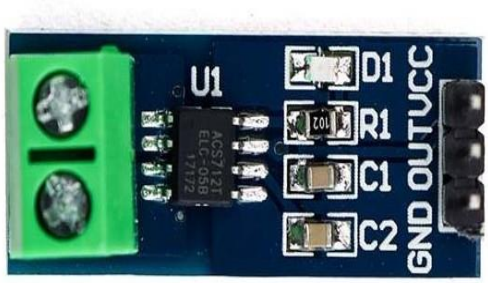

Fig. 2. Current sensor

Internet of things

The IOT used in this project is ESP8266. Programmable RAM/ROM interfaces, which can be connected with memory controller and can also be used to visit flash. Data RAM interface, which can connected with memory controller. The memory of ESP8266 Wi-Fi SoC integrates memory controller and memory units including SRAM and ROM. The operating range is 3.2 to 3.4V. In this project the IOT is connected with the microcontroller. When fault occur in the UG cable the microcontroller will sent the signal to the relay at the same time it will sent the signal to the IOT. That IOT will intimate the fault location with latitude and longitude to the user [3].

16x2 LCD module

The operating voltage to the display is 4.7 to 5.3 V. It is an alphanumeric LCD display which mean, it can display both alphabets and numbers (Fig. 3). It consists of two rows and each row can print 16 characters. The LCD is connected with the microcontroller and it continuously displays the output value of current sensor through the microcontroller. Weather any fault occurs in the Underground line the fault range is displayed in the LCD [9].

Fig. 3. 16x2 LCD module

Power relay

The relay used in this project is SR401DC12V (Fig. 4). In our project the relay is working in DC supply. It works on the principle of Electro Magnetic Flux. The relay will act as a circuit breaker. The relay is connected with the microcontroller through the MOSFET. If a fault occurs in the line, the signal is passes through the microcontroller. The microcontroller send the signal to the relay, the MOSFET will boost the signal and give to the relay.

Fig. 4. Power relay

Hardware setup

The hardware setup used in the present work is shown in fig. 5.

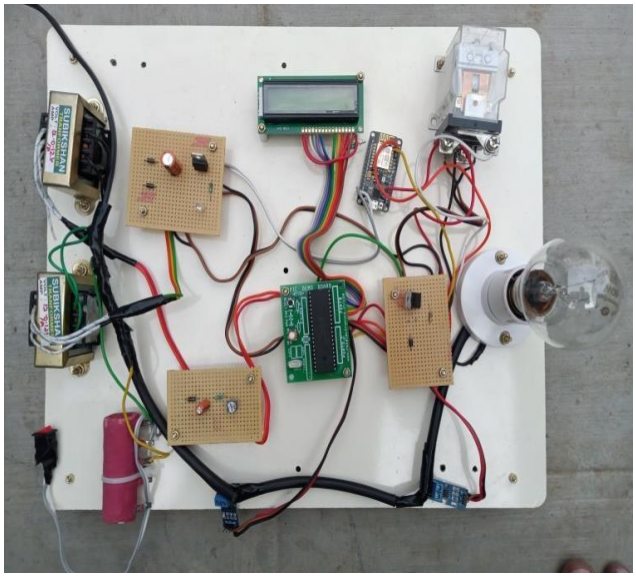

Fig. 5. Hardware setup

Results and discussion

The hardware of current sensor and software of Embedded C is implemented in this project. This modules output is Analog voltage range up to 0 to 5 voltage based on the current flowing through the phase line. The current sensor output is connected with the microcontroller, if any voltage drop occur in the phase line it send a signal to the microcontroller. The LCD is connected with the microcontroller and it continuously displays the output value of current sensor through the microcontroller.

Conclusion

The hardware of current sensor and software of Embedded C is implemented in this project. This modules output is Analog voltage range up to 0 to 5 voltage based on the current flowing through the phase line. The current sensor output is connected with the microcontroller, if any voltage drop occur in the phase line it send a signal to the microcontroller. The LCD is connected with the microcontroller and it continuously displays the output value of current sensor through the microcontroller. Weather any fault occurs in the Underground line the fault range is displayed in the LCD. The signal is passes through the microcontroller. The microcontroller send the signal to the relay, the MOSFET will amplify the signal and give to the

relay. Then the relay will trip the phase line and at the same time the IOT will intimate to the user. This project will be implemented in power projects, windmills, urban areas and populated cities. This project will accurately find the fault location of Underground cable.

Conflict of interest

Authors declared no conflict of interest.

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