Cyber Security Distributed Line Protection and Control Relay Communication in Substation

K. Kranthi Kumar[1], K. Pranay[2], P. Swathi[2], M. Lokeswar Reddy[2], Uzair Sulthana[2]
[1]Assistant Professor, [2]UG Scholar, [1,2]Department of EEE
[1,2]Kommuri Pratap Reddy Institute of Technology, Ghatkesar, Hyderabad, Telangana

Abstract: The main aim of the project is to design an underground cable fault detection and location identification with distance in LCD and IOT using microcontroller. Earth fault or leakage of current is a very common problem in underground cable circuits. This leads to unnecessary power loss. The purpose of this project is to develop a system that senses the earth fault in the cables and alerts the user about it with distance The line-to-line fault and the open circuit faults are identified based on the voltage drops occurred at the lines. The system also calculates the distance of the fault occurrence, and the location can be identified exactly. Upon identification of fault, it operates a Relay. The microcontroller-based control system continuously monitors the amount of voltage passing through the power supply circuit. In case of fault, the amount of voltage will be dropped in the circuit. In such situations the microcontroller-based system alerts the user about this in the form of text message displayed on LCD and IOT along with the distance. The system also alerts through buzzer alarm. The microcontroller is programmed using embedded C language.

Keywords: Arduino controller, Internet of things, LCD, relay.

1. Introduction

Underground cables are prone to a wide variety of faults due to underground conditions, wear and tear, rodents etc. Also detecting fault source is difficult and entire line is to be dug in order to check entire line and fix faults. So 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. The system detects fault with the help of potential divider network laid across the cable. Whenever a fault gets created at a point shorting two lines together, a specific voltage gets generated as per the resistors network combination. This voltage is sensed by the microcontroller and is updated to the user. The information conveyed to the user is the distance to which that voltage corresponds to. The microcontroller retrieves the fault line data and displays over LCD display, also it transfers this data over internet to display online. We use IOTGecko to develop the online system that links with the system to display the cable faults online. The Internet of Things is an infrastructure that includes physical devices, modern vehicles, Underground cables have been widely used with the development of power system grid. Till last decades cables were made to lay overhead & currently it is to lay underground which is superior to earlier method. Because the underground cable are not affected by any adverse weather condition such as storm, snow, heavy rainfall as well as pollution. But when any fault occur in underground cable, then it is difficult to locate the exact location of fault. Today the world is become digitalized so this paper is intended to detect the location of fault in digital way. The underground cable system is more common practice followed in many urban areas. While faults can occur for different reason in cable line, the repairing process related to that particular cable is difficult due to not knowing the exact location of cable fault. As it is very difficult to find the exact location or faulty location

manually, which suddenly affects the efficiency of the cable wire due to losses occurred. Nowadays many techniques had already been implemented in order to detect cable line fault. But the problem came up is how to detect fault in cable wire when it is under grounded, and how to access or retrieve those data related to faulty location whenever it is required. In order to fill those gaps, we proposed the system which detects the exact location of the fault and through the means of IoT it's serially communicated towards server. The project "IoT based underground cable line fault detection system "is used for find out and locating the faults. The manual method is very time consuming. Here, we propose a cable fault detection over IoT that detects the exact fault position over IoT that makes repairing work very easy. For most of the worldwide operated low voltage and medium voltage distribution lines underground cables have been used from many decades. The complexity of the whole network comprises numerous components that can fail and interrupt the power supply for the end user. Use of underground power cable is expanding due to safety considerations and enhanced reliability in transmission and distribution in recent times. Due to safety reasons and high power requirements use of underground cables has been increased. To increase the reliability of the system proper fault detecting and locating techniques are required. The inaccessibility of the underground cable makes the location and detection of fault in the cable a challenging task. The fault detecting and locating techniques play a very important role in maintaining the system and thereby increasing the reliability.

2. Literature survey

Literature survey earlier to begin a research project is essential in understanding fault in underground cable lines, as this will supply the researcher with much needed additional information on the methodologies and technologies available and used by other research complement around the world. Dhivya Dharani.A, Sowmya.T [1] the paper titles as―Development of a Prototype Underground Cable Fault Detector‖ —Cable faults are damage to cables which affects the resistance in the cable. If allowed to persist, this can lead to a voltage breakdown. To locate a fault in the cable, the cable must first be tested for faults. This prototype uses the simple concept of OHMs law. The current would vary depending upon the length of fault of the cable. This prototype is assembled with a set of resistors representing cable length in Kilo meters and fault creation is made by a set of switches at every known Kilo meters (km's) to cross check the accuracy of the same. The fault occurring at what distance and which phase is displayed on a 16X2 LCD interfaced with the microcontroller. The program is burned into ROM of microcontroller. The power supply consists of a step down transformer 230/12V, which steps down the voltage to 12V AC. This is converted to DC using a Bridge rectifier. The ripples are removed using a capacitive filter and it is then regulated to +5V using a voltage regulator 7805 which is required for the operation of the microcontroller and other components. Nikhil Kumar Sain, Rajesh Kajla [2] paper titled as ―Underground Cable Fault Distance Conveyed Over GSM. This paper proposes fault location model for underground power cable using microcontroller. The aim of this project is to determine the distance of underground cable fault from base station in kilometers. This project uses the simple concept of ohm's law. When any fault like short circuit occurs, voltage drop will vary depending on the length of fault in cable, since the current varies. A set of resistors are therefore used to represent the cable and a dc voltage is fed at one end and the fault is detected by detecting the change in voltage using analog to voltage converter and a microcontroller is used to make the necessary calculations so that the fault distance is displayed on the LCD display. R.K.Raghul Mansingh, R.Rajesh, S.Ramasubramani, G.Ramkumar [3] titled as ―Underground Cable Fault Detection using Raspberry Pi and Arduino‖-The aim of this project is to determine the underground cable fault. This project uses the simple concept of CT Theory. When any fault like short circuit

occurs, voltage drop will vary depending on the length of fault in cable, since the current varies CT is used to calculate the varying. The signal conditioner manipulates the change in voltage and a microcontroller is used to make the necessary calculations so that the fault distance is displayed by IOT devices.

3. Proposed system

The operation of the system states that when the current flows through the fault sensing circuit module the current would vary depending upon the length of the cable from the place of fault that occurred if there is any short circuit fault with the Single Line to ground fault, or double line to ground fault, or three phase to ground fault. The voltage drops across the series resistors changes accordingly and then the fault signal goes to internal ADC of the microcontroller to develop digital data. Then microcontroller will process the digital data and the output is being displayed in the LCD connected to the microcontroller in kilometers and phase as per the fault conditions. This Output is also displayed in the webpage through the IoT Wi-Fi Module ESP8266 connected to the system.

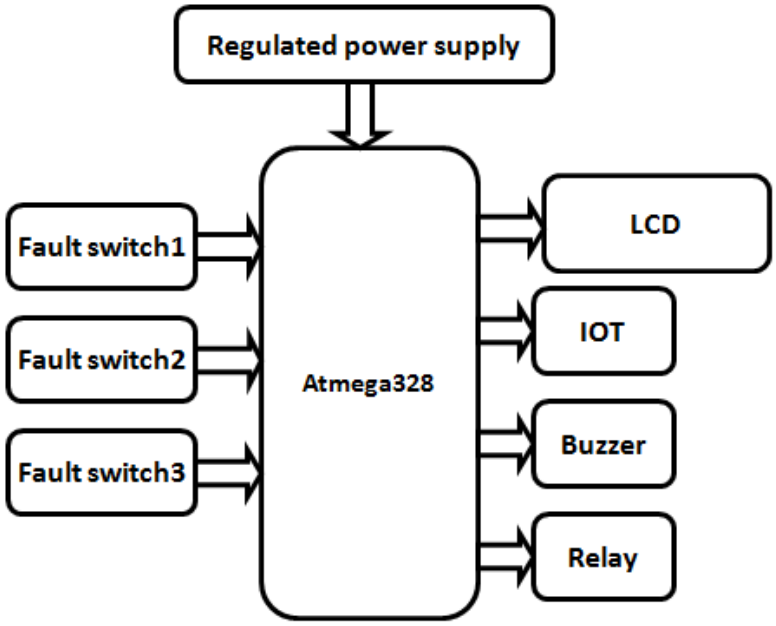

Fig. 1: Proposed block diagram.

The main aim of the project is finding the fault distance location where the occurred for this we used 3 fault switches those are connected to the ARDUINO micro controller. When the corresponding fault switches activated corresponding distance for fault location identified through buzzer as well as IOT. The power supply given to the system is 230V ac supply. This 230 V supply is fed to the two Adapter Modules (12 V, 2 Amps. each). The adaptor module 1 and 2 converts the AC voltage to DC. The ripple in output of adaptor module 1 is then removed with the help of a 1000 microfarad electrolytic capacitor. Since a constant 5 V voltage source is desired for our system, because the Microcontroller (ATmega328), 16x2 LCD (Liquid Crystal Display), Fault Sensing Circuit Module [9] , IoT Wi-Fi Module[10], etc. and the other components work at 5V supply, hence we are using three voltage regulators (7805). These voltage regulators convert the filtered output to 5V constant supply voltage.

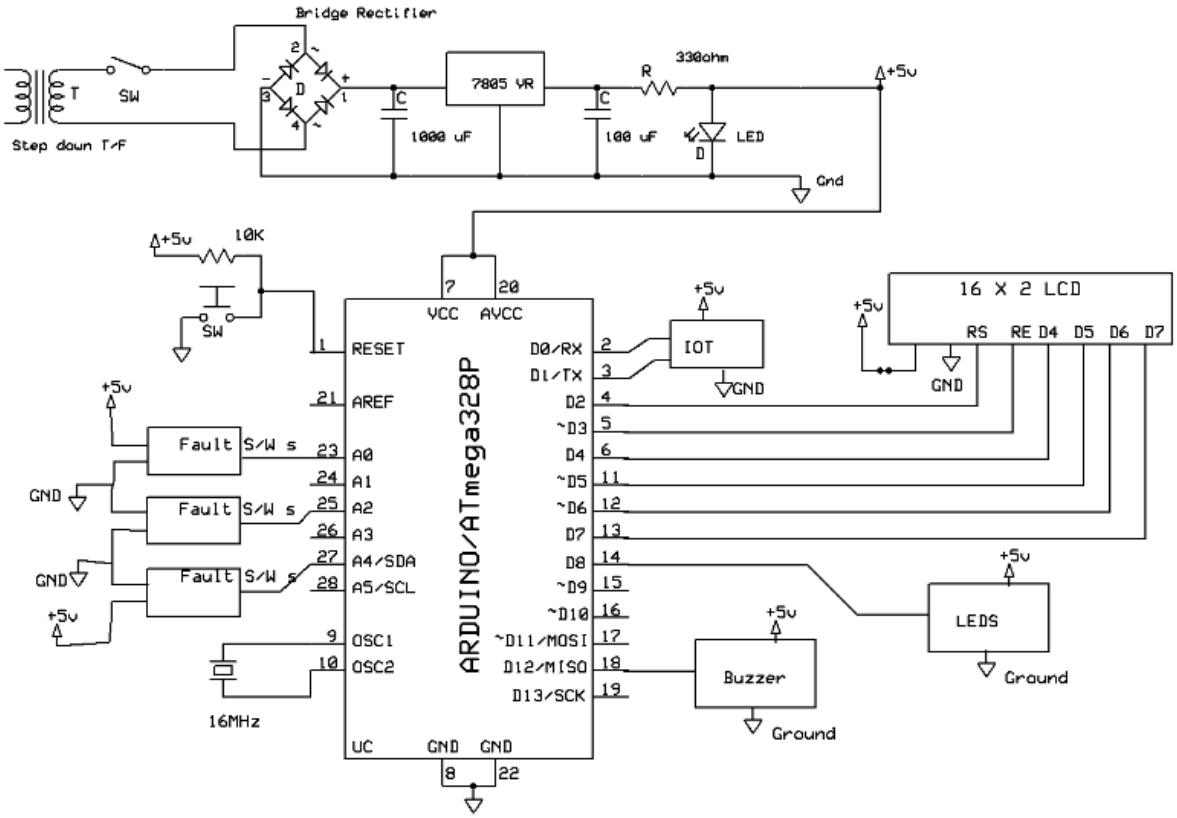

Fig. 2: Proposed circuit architecture.

Arduino

The Arduino Uno R3 is a open source microcontroller board based on the ATmega328 chip. This Board has 14 digital input/output pins, 6 analog input pins, Onboard 16 MHz ceramic resonator, Port for USB connection, Onboard DC power jack, An ICSP header and a microcontroller reset button. It contains everything needed to support the microcontroller. Using the board is also very easy, simply connect it to a computer with a USB cable or power it with DC adapter or battery to get started. The recommended range is 5v to 12v for Arduino Uno.

Features:

Microcontroller: ATmega328P, Operating Voltage: 5V, Input Voltage: 7-12V, Digital I/O Pins: 14 (of which 6 provide PWM output), Analog Input Pins: 6, DC Current: 40mA, Flash Memory: 32 KB, SRAM: 2 KB, EEPROM: 1 KB, Clock Speed: 16 MHz.

LCD Monitor

Liquid Crystal Display used to display the parameters for status of the proposed system. This can display 32 characters having 2 columns. When each sensor is activated corresponding massage will be displayed in 16*2 LCD modules. In this we use four data pins using this pins we transfer the data from micro preprocessor to LCD.

IOT- Module

Internet of things used for controlling any device or monitoring the device status through internet. This proposed system we use this IOT module for taking the all parameters data and post into the cloud called server. ESP8266 modules as IOT module it can operate through wifi

frequency concept.

Fig. 3. ESP 8266

Buzzer

Buzzer is the output module for alerting of any parameter changes. if any sensor increases the threshold value or if increases then microprocessor alert us by using this system.

Fig. 4. Buzzer

Software

Software is the important parameter to make the device automation. In proposed implementation we used embedded c programming language and compiler Arduino IDE we used. Here we used Arduino IDE software for programming write up and execution of entire system.

4. Experimental results

The operation of the system states that when the current flows through the fault sensing circuit module the current would vary depending upon the length of the cable from the place of fault that occurred if there is any short circuit fault with the Single Line to ground fault, or double line to ground fault, or three phase to ground fault.

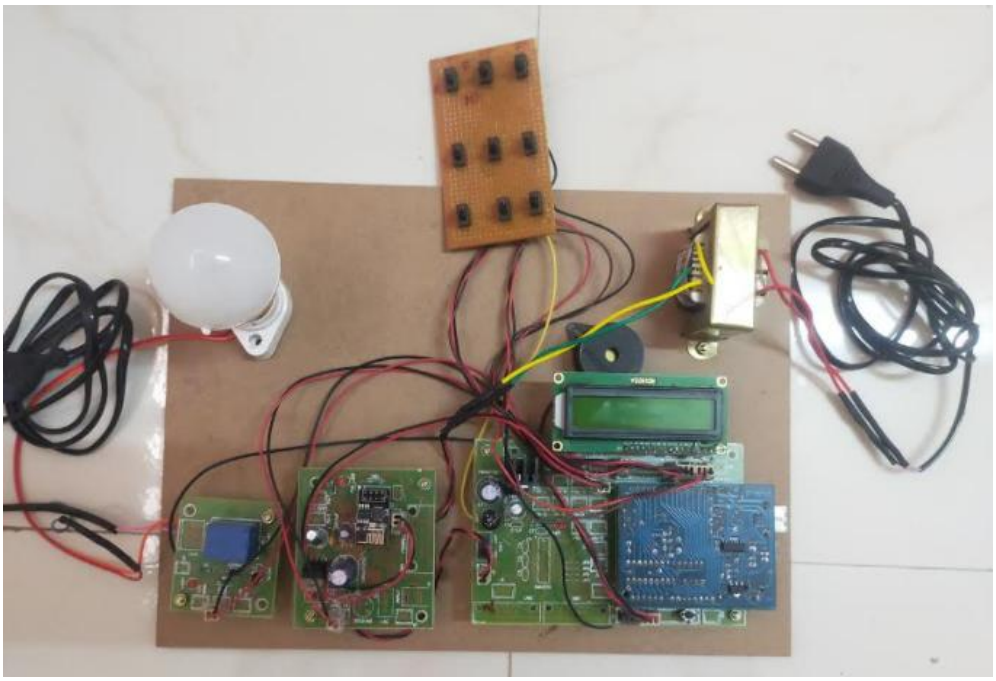

Fig. 5: Hardware setup.

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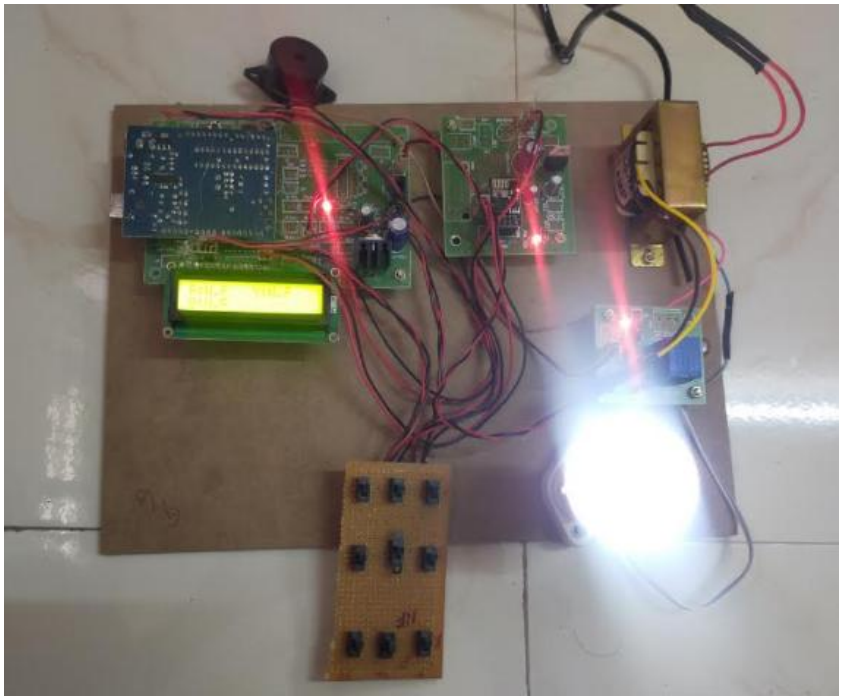

Fig. 6: Overall setup of hardware.

6. Conclusion

The short circuit fault at a particular distance in the underground cable is located to rectify the fault efficiently using simple concepts of Ohms law. The work automatically displays the phase, distance and time of occurrence of fault with the help of ARDUINO and ESP8266 Wi - Fi module in a webpage. The benefits of accurate location of fault are fast repair to revive back the power system, it improves the system performance, it reduces the operating expense and the time to locate the faults in the field.

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