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Design and Implementation of Underground Cable Fault Distance Locater using RF communication

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Abstract

Before some decade's cables are made to lay overhead but currently it is lay to underground cable which is superior to earlier method. Because the underground cable is not affected by any weather conditions such as storm, heavy rainfall etc. But when any fault occurs in cable then it is challenging task to locate the fault and it is more challenging in populated area like Mumbai, Pune etc. Therefore, we will move to find the location of fault. This project evaluated underground cable fault distance from base station in kilometre using microcontroller system using RF communication at 434 Mhz. The project uses the concept of ohms' law. whenever the fault occurs like short circuit voltage drop as well as resistance will vary depending on length of fault. Therefore, the set of resistance or resistive network are used to represent the cable and a DC voltage is fed to one end and fault is detected by detecting change in voltage and resistance of the cable. It uses the analog to digital converter. Then it gives commands to the RF transmitter which uses ASK (Amplitude shift keying) modulation 434 MHz which Encoded the data by using encoder IC-HT12E in 4 & 8 bit's and transmit the data through air to the receiver which Decoded the same data by using decoder IC-HT12D and microcontroller do the necessary calculations so the fault distance is displayed on (16X2) LCD displayed. after knowing the particular distance necessary action are taken by utility to clear the fault.

Index Terms: *Underground cable, Encoder, Decoder, LCD, RF, Resistance, Voltage Drop.*

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1. INTRODUCTION

In the urban areas, the electrical cable runs underground instead of overhead lines. Cable Fault are damages to cables which affects the resistance in the cables. Remote fault finding for underground cables using wireless communication is approach to settle such problems. The objective is to determine the distance of fault in underground cable at small distances. The underground cable system is a common practice followed in urban areas. While a fault to occur for Some reason, at that time the repairing process related to that particular cable is difficult due to improper knowledge the location of the cable fault. The proposed system is to find the location of the fault. The Damages in the cable affects it's Resistance which can lead to a voltage breakdown. The system developed here works on the basis of Ohm's law. i.e., if low DC voltage is applied at the feeder end through a series resistor assumed to be Cable lines, then voltage or current would vary depending upon the location of fault in the cable. The current in the cable varies with the distance variations. The wireless communication helps in distant communication with Radio frequency. system which reduce the laborious, cost and time of work of fault detection in underground cables.

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1.1 Types of Faults

Frequently occurs the faults in the underground Cables are:

1. Short Circuit Fault
2. Open Circuit Fault
3. Earth Fault

Short Circuit Fault:

Short circuit faults occur due to insulation failure Between two phases or between phases and earth.

Open Circuit Fault:

Open circuit faults are occurring due to interruption or failure in supply system or tripping of the supply.

Earth Fault:

An earth fault is contact between an energized conductor and earth or equipment frame.

1.2 Existing System

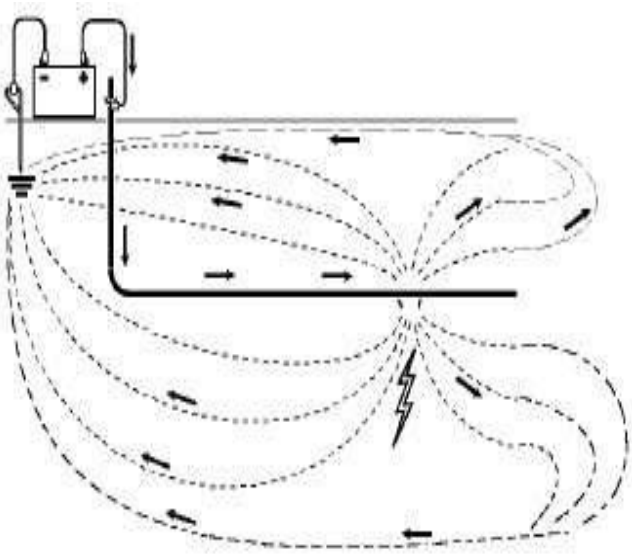

Fig -1 A-Frame method of finding cable fault location

Above figure shows the schematic arrangement of existing A-Frame method for finding underground cable fault location. In A-frame method, a pulsed direct current (DC) is injected into the faulty cable and earth terminal to locate the ground fault. The DC pulse will flow through the conductor and return via earth from the earth fault location back to the ground stake as shown in Figure 1. The flow of pulsed DC through the ground will produce a small DC voltage. A sensitive voltmeter is used to measure the magnitude and direction of the DC voltage in segments of the earth along the cable route. Analyzing the results of the measuring voltage along the route, the location of the fault in the cable can be pinpointed A-Frame is an accurate method but it is not the fastest one, since the operator has to walk along the length of the cable from the transmitter to the ground fault. This method may face a problem if the return DC finds some easier path back to the earth stake of transmitter instead of returning through the ground. If the ground is sandy, paved which provides high resistance and consequently, less current flows through the ground. In that case, the voltmeter fails to measure the voltage and fault detection becomes complicated.

2. BLOCK DIAGRAM OF PROPOSED SYSTEM

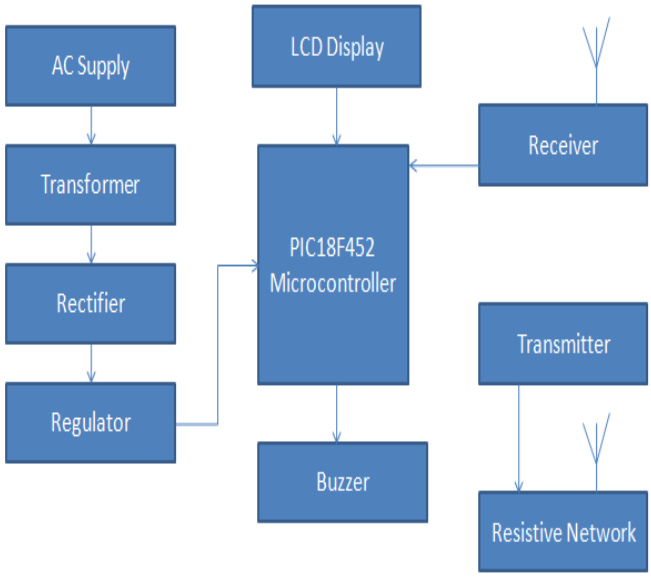

Fig-2 Block Diagram of underground cable fault locater system using PIC Microcontroller and RF system at 434MHz.

A Fig -2 shows the Basic Block diagram of the proposed system in this paper as shown. In this system PIC18F452 microcontroller is used along with the RF Communication system which uses ASK modulation at 434 MHz frequency.
As the resistance of cable is changed along the length as per formula given,

$$R = \frac{l}{a}$$

As per the above equation resistance of cable changes proportional to the length, therefore the resistive network is used as cable. When the fault occur i.e.-the switch is closed which is programmed for particular distance the resistance get's change and voltage drop occur and is sensed by the transmitter and the data is Encoded in 4 or 8-bit format and send to the receiver through the air. the data is received by the receiver and decoded in the same format and gives to the PIC controller which perform necessary operations according to program and the distance is shown on the LCD display which is interfaced with PIC microcontroller. The separate power supply is provided for microcontroller and to show open circuit fault also.

2.1 Circuit Diagram

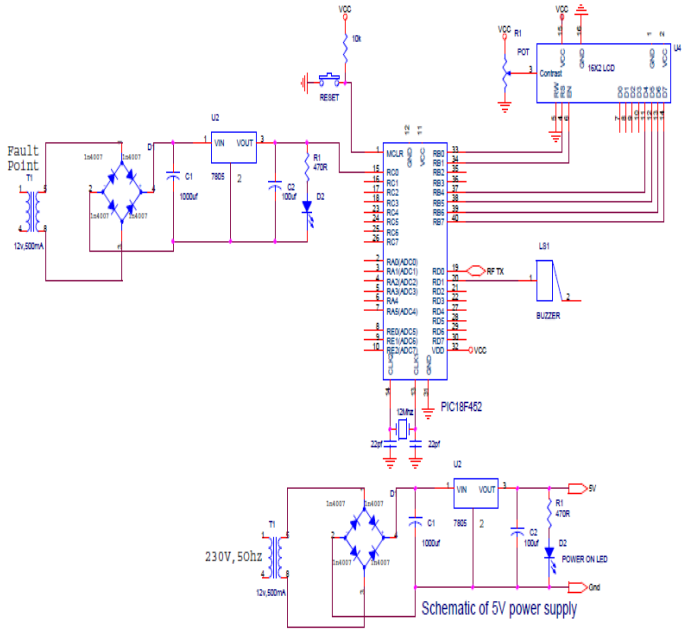

Fig-3: Circuit Diagram of underground cable fault detection system

2.2 Building Blocks of Experiment

For Building the whole experiment following Blocks are build up.

1. Power supply unit.
2. Pin description .
3. RF Transmitter .and RF Receiver.
4. LCD Interfacing.

2.2.1 Power Supply Unit

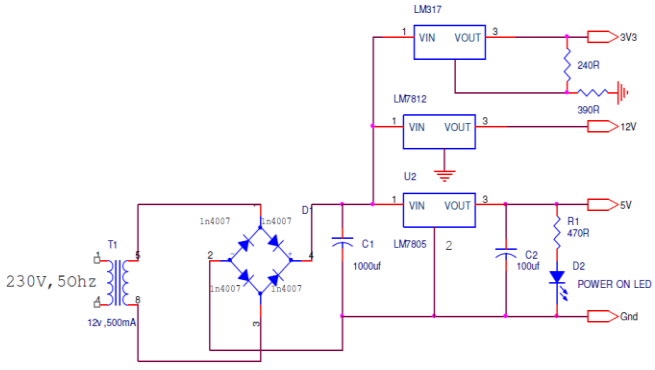

Fig – 3: 5v Power supply design

To get 5V regulated output we use LM7805.Output voltage of LM7805 regulator is 5V. Dropout Voltage of LM7805 is 2V,So minimum input voltage required at input of regulator To get 5V output is

Output of LM7805 + Dropout voltage=5+2=7V
So minimum input voltage is 7V and maximum input voltage is 35V (Ref. Datasheet)
For which LM7805 gives 5V regulated output

Transformer Design:

RMS secondary output voltage of transformer is
Vs= (Vm +n*1)/1.42
n=1 for FWR or HWR
n=2 for BWR.
But Vm = Vdc* pi /2=14.13=15
So,
V s= (15+2)/1.42
Vs=12V

Rectifier Design :

Diode Selection
I(f) average =Io/2=300mA/2=150mA
Now Im = 300mA
PIV rating=Vm=pi*Vc(DC)/2
=3.14*9/2=15V
So diode with PIV rating greater then 15V is suitable.IN4007 is more than sufficient as it has
PIV=1000V;

Bulk Decoupling capacitor:

We connected 100 µF at output of regulator as a decoupling Capacitor. It is optional. When devices connected to the 5V supply heavy current from power supply, output of regulator may fall down and become unstable. In such cases 100uF provides power to the devices by discharging itself to maintain 5V output constant. Value of decoupling capacitor may be >10 µF.

2.2.2 Pin Description

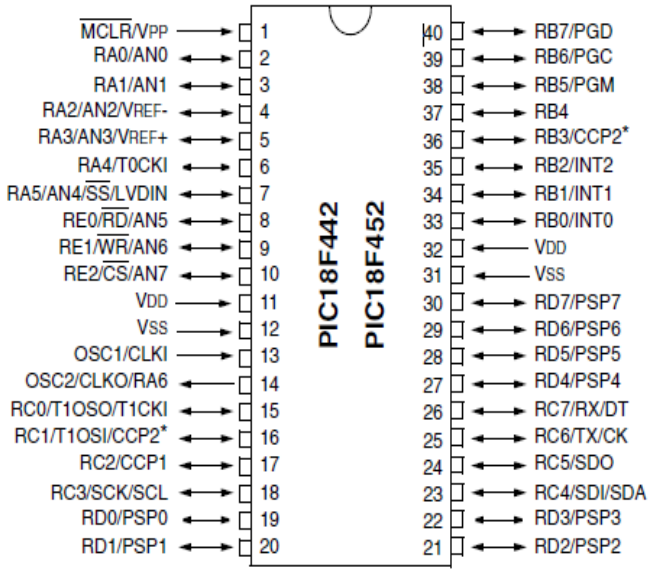

Fig – 4: Pin Diagram of PIC18F452

2.2.3 RF Transmitter And Receiver

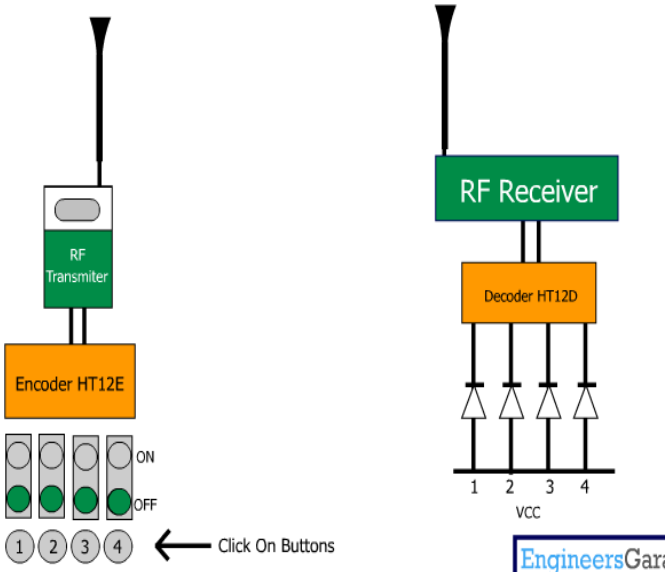

Fig – 5: RF Transmitter and receiver

This circuit utilizes the RF module for making a wireless remote, which could be used to drive an output from a distant place. RF module, as the name suggests, uses radio frequency to send signals. These signals are transmitted at a particular frequency and a baud rate. A receiver can receive these signals only if it is configured for that frequency.

A four channel encoder/decoder pair has also been used in this system. The input signals, at the transmitter side, are taken through four switches while the outputs are monitored on a set of four LEDs corresponding to each input switch. The circuit can be used for designing Remote Appliance Control system

This radio frequency (RF) transmission system employs Amplitude Shift Keying (ASK) with transmitter/receiver (Tx/Rx) pair operating at 434 MHz. The transmitter module takes serial input and transmits these signals through RF. The transmitted signals are received by the receiver module placed away from the source of transmission.

The system allows one-way communication between two nodes, namely, transmission and reception. The RF module has been used in conjunction with a set of four channel encoder/decoder ICs. Here HT12E & HT12D have been used as encoder and decoder respectively. The encoder converts the parallel inputs (from the remote switches) into serial set of signals. These signals are serially transferred through RF to the reception point. The decoder is used after the RF receiver to decode the serial format and retrieve the original signals as outputs. These outputs can be observed on corresponding LED.

2.2.4 LCD INTERFACING

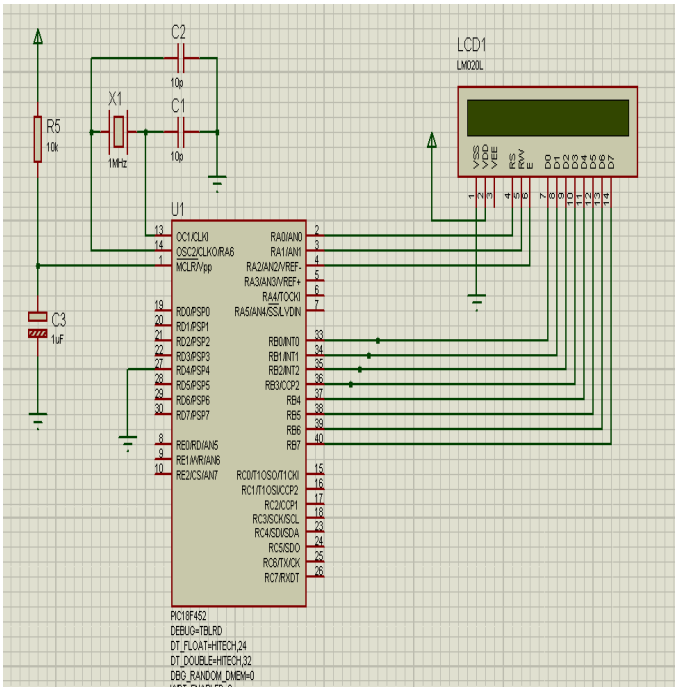

Fig-6: LCD Interfacing with PIC18F452

16×2 Character LCD is a very basic LCD module which is commonly used in electronics projects and products. It contains 2 rows that can display 16 characters. Each character is displayed using 5×8 or 5×10 dot matrix. It can be easily interfaced with a microcontroller. In this tutorial we will see how to write data to an LCD with PIC Microcontroller using Hi-Tech C Compiler. Hi-Tech C has no built in LCD libraries so we require the hardware knowledge of LCD to control it. Commonly used LCD Displays uses HD44780 complain. This is the pin diagram of a 16×2 Character LCD display. As in all devices it also has two inputs to give power Vcc and GND. Voltage at VEE determines the Contrast of the display. A 10K potentiometer whose fixed ends are connected to Vcc, GND and variable end is connected to VEE can be used to adjust contrast. A microcontroller needs to send two information to operate this LCD module, Data and Commands. Data represents the ASCII value (8 bits) of the character to be displayed and Command determines the other operations of LCD such as position to be displayed. Data and Commands are send through the same data lines, which are multiplexed using the RS (Register Select) input of LCD. When it is HIGH, LCD takes it as data to be displayed and when it is LOW, LCD takes it as a command. Data Strobe is given using E (Enable) input of the LCD. When the E (Enable) is HIGH, LCD takes it as valid data or command. The input signal R/W

(Read or Write) determines whether data is written to or read from the LCD. In normal cases we need only writing hence it is tied to GROUND in circuits shown above.

3 WORKING HARDWARE MODULE

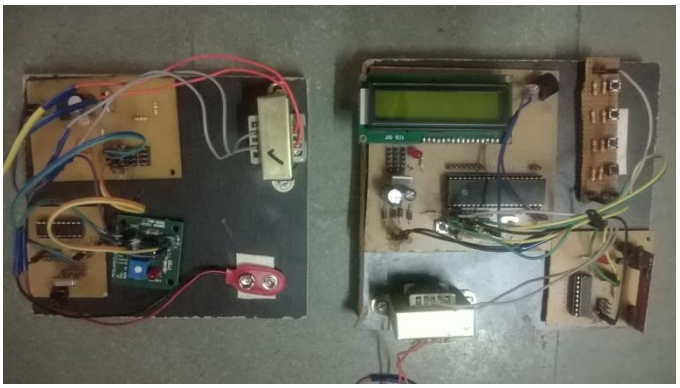

Fig – 7: Working hardware module

4 RESULTS

The results from hardware are fed to the LCD Display. Below Table shows the how fault distance is shown.

Table – 1: Observations

Address of checkpoint	Distance in meter, Km.
0	0-500m
1	500-1000m
2	1000-1500m
3	1500-2000m

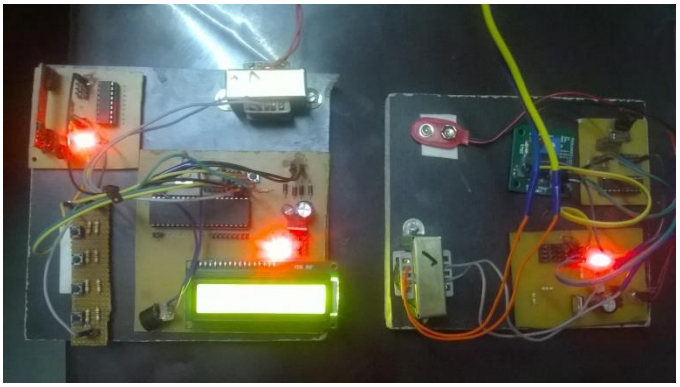

Fig – 8: Experimental Setup

5. CONCLUSOIN

As it's very difficult task to find underground cable fault. But above proposed system i.e - PIC18F452 Microcontroller and RF Communication based system will find fault location with distance to get more accurate result's the closeness between transmitters should be increases. In this way the system works effectively and efficiently.

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