RESEARCH ARTICLE OPEN ACCESS

Distance Calculation for Underground Cable Fault Using Iot

ABSTRACT
The underground cable system is a common practice followed in many urban areas. While a fault occurs for some reason, at that time the repairing process related to that particular cable is difficult due to not knowing the exact location of the cable fault. The objective of this project is to determine the distance of underground cable fault from base station in kilometers. When a low DC voltage is applied at the feeder end through a series resistor (Cable lines), then current would vary depending upon the location of fault in the cable. In case there is a short circuit (Line to Ground), the voltage across series resistors changes accordingly, which is then fed to an ADC to develop precise digital data which the programmed microcontroller of 8051 family would display in kilometers. The project is assembled with a set of resistors representing cable length in KM's and fault creation is made by a set of switches at every known KM to cross check the accuracy of the same. The fault occurring at a particular distance and the respective phase is displayed on a LCD interfaced to the microcontroller.
Software Requirements:- Kiel Compiler
Language: - Embedded C or Assembly

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I. INTRODUCTION

Study of cable failures and development of accurate fault detection and location methods has been interesting yet challenging research topics in the past and present. Fault detection entails determination of the presence of a fault, while fault location includes the determination of the physical location of the fault. Accurate permanent fault detection techniques and relatively accurate fault location methods have been developed for overhead distribution systems.

Underground distribution systems are valuable assets of electric utilities[1], which supply power to the end customers at low voltages. Many of the system components, particularly underground cables, fail over time, in part due to the deterioration of the insulating materials used in their structure. fault detection and location technology for underground distribution systems

is still in developing stages. From a macroscopic perspective, cable faults refer to the abnormalities associated with any type of deterioration phenomena manifested in the cable electrical signals. In the past, analogue system was used to detect and locate faults. However, the need for improvement has made it necessary to shift from analogue to digital system of fault detection and location. This shift requires developing new tools and methods to detect and locate faults of underground distribution systems including power cables. Quick detection and location of cable faults within a minimum time would undoubtedly be a great benefit to the utilities enabling them to avoid catastrophic failures, unscheduled outages, and thus loss of revenues. This project presents a tool, digital underground cable fault locator (DUCFL) and a methodology for such a location system known as sectionalisation.

1.1 Anatomy of Underground Distribution Cables

The core component of any underground system is the cable that supplies power from the source to the load [2]. The longevity and reliability along with desired safety and aesthetic issues of underground cables have made underground distribution systems an unprecedented substitute for overhead distribution lines. Underground cables have been designed for various applications and voltage levels and extensive improvements in design process have been achieved. Today pressurized cables are available up to 765 KV and even 1100 KV through the gradual advancements in materials and manufacturing processes [7]. For primary distribution systems, cables are typically

designed with the following major components, conductor, conductor shield, insulation, insulation shield, concentric neutral, and jacket.These components are illustrated in figure 1.

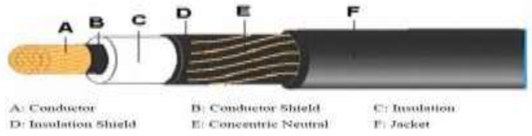


Fig.1: Anatomy of single phase underground cable

1.2 Ageing mechanisms in underground cables

Deterioration of insulation is an inevitable phenomenon in underground cables leading to insulation failures. The aging is caused by single or synergistic action of several aging factors that include thermal, electrical, mechanical and environmental [4][5].

Activation of aging mechanisms either change the bulk properties of the insulating materials referred to as intrinsic aging or cause degradation known as extrinsic aging. The degradation is the result of the presence of contaminants, defects, voids, and protrusions in the insulation material and their interaction with different aging mechanisms [5][6]. Under normal conditions, electrical stresses are the predominant aging factors that may fail cables through partial discharge and treeing mechanisms aggravated by the presence of water.

Underground cable incipient faults are the primary causes of catastrophic failures in the distribution systems. These faults develop in the extruded cables from gradual deterioration of the solid insulation due to the persisting stress factors. The initial incipient activity is caused by the electrical stresses applied to the voids or protrusions near the conductor shield insulation interference.

To date, various research studies have been conducted to develop methods for fault identification and location in underground systems [9]-[11] and some commercial detection systems are also available for diagnostic testing [12]-[13]. The present methods, although conceptually different, can be categorized in terms of the mutually exclusive active/passive terms. The term active describes detection schemes that require an external electric source to energize the system and generate the diagnosis signals. The opposite holds true for passive methods in which there is no external injection to the cable system. Active methods are often destructive which implies that they may further degrade cable insulation that has not already failed. Thus, the portion of the system involved in the fault must be replaced before restoring power. Offline methods consist of detection techniques that operate while a section of the cable is de-energized. Passive methods are preferred over active diagnosis techniques because it is not destructive.

Existing methods target two main categories of insulation categories. While some of the methods are used to provide an overall assessment of the insulation, there are other methods that perform an incremental condition assessment of the underground cable. From a field application point of view, the existing methods can be categorized into the following classes [10]: i) Thumping method ii) Methods based on sectionalisation.

II. PROPOSED METHOD FOR FAULT DISTANCE CALCULATION USING IOT

The proposed system is assembled with a set of resistors representing cable length in KM's and fault creation is made by a set of switches at every known KM to cross check the accuracy of the same. The fault occurring at a particular distance and the respective phase is displayed on a LCD interfaced to the microcontroller.

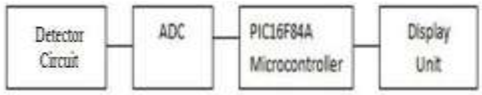


Fig.2: Block diagram for proposed method

The fundamental concept of the detector circuit is voltage divider principle. In itsbasic application, a dc voltage is applied to the locator circuit. The value of R2 is precisely known. An unknown resistance R1 is connected which is determined by the resistance of the faulty cable and it varies with the length of location of fault. Since resistance is directly proportional to the length of a cable (∝), R1 varies with the point at which the fault is detected on the cable.

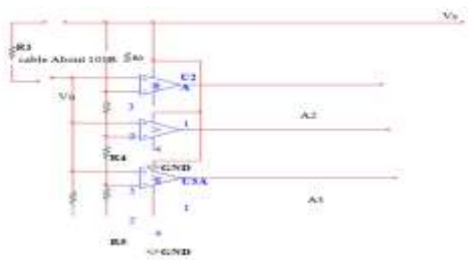


Fig .3: Detector Circuit

2.1 Proposed System Circuit Diagram

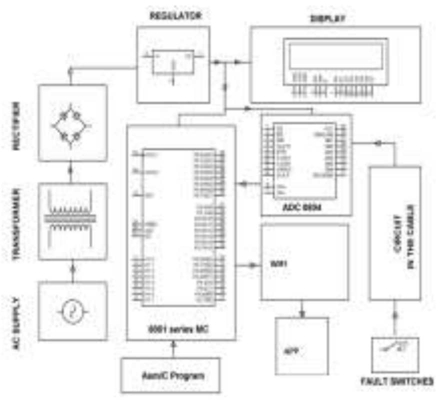


Fig.4: Circuit Diagram

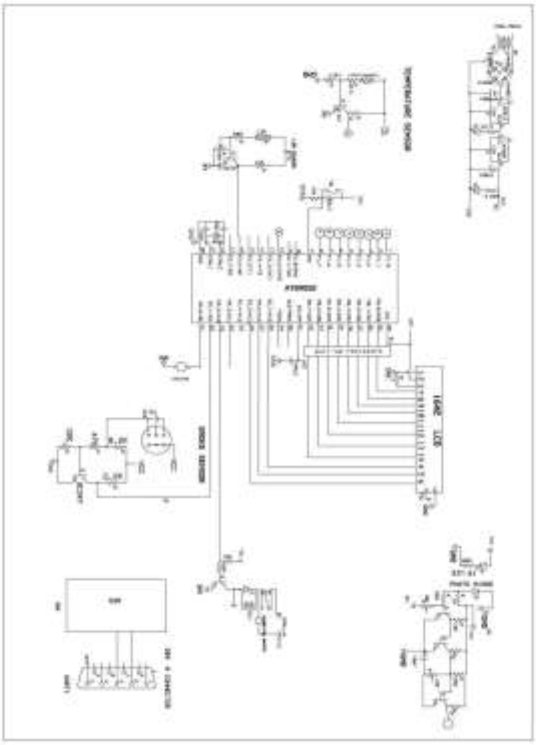


Fig.5: Schematic Diagram

2.2 INTERNET OF THINGS

The **Internet of things** (**IoT**) is the network of physical devices, vehicles, home appliances and other items embedded with electronics, software, sensors, actuators, and connectivity which enables these objects to connect and exchange data.Each thing is uniquely identifiable through its embedded computing system but is able to interoperate within the existing Internet infrastructure.

The IoT allows objects to be sensed or controlled remotely across existing network infrastructure,[7] creating opportunities for more direct integration of the physical world into computer-based systems, and resulting in improved efficiency, accuracy and economic benefit in addition to reduced human intervention.When IoT is augmented with sensors and actuators, the technology becomes an instance of the more general class of cyber-physical systems, which also encompasses technologies such as smart grids, virtual power plants, smart homes, intelligent transportation and smart cities. "Things", in the IoT sense, can refer to a wide variety of devices such as heart monitoring implants, biochip transponders on farm animals, cameras streaming live feeds of wildanimals in coastal waters, automobiles with built-in sensors etc.. These devices collect useful data with the help of various existing technologies and then autonomously flow the data between other devices.

2.3 Assembly Language Program For Fault Detection

```
#include <reg52.h>
#define lcd_data P2
sbit sw21=P1^4;
sbit sw22=P1^5;
sbit sw23=P1^6;
sbit sw24=P1^7;
sbit sw31=P3^4;
sbit sw32=P3^5;
sbit sw33=P3^6;
sbit sw34=P3^7;
void delay(unsigned int ch)
{
unsigned int i=0,j=0;
for(i=0;i<=ch;i++)
for(j=0;j<=i;j++);
}
void clcd(unsigned char ch)
{
lcd_data=ch&(0xf0);
lcd_rs=0;
lcd_en=1;
delay(25);
lcd_en=0;
lcd_data=((ch<<4)&(0xf0)); //send lsb 4 bits
lcd_rs=0;
lcd_en=1;
delay(25);
lcd_en=0;
}
void dlcd(unsigned char ch)
{
lcd_data=ch&(0xf0);
lcd_rs=1;
lcd_en=1;
delay(25);
lcd_en=0;
lcd_data=((ch<<4)&(0xf0)); //send lsb 4 bits
lcd_rs=1;
lcd_en=1;
delay(25);
lcd_en=0;
delay(3);
}
void stringlcd(unsigned char ch,const unsigned char *chrt)
{
unsigned int ix=0;
if(ch==0x80) clcd(0x01);
clcd(ch);
for(ix=0;chrt[ix]!='\0';ix++)
{
dlcd(chrt[ix]);
}
    }
```

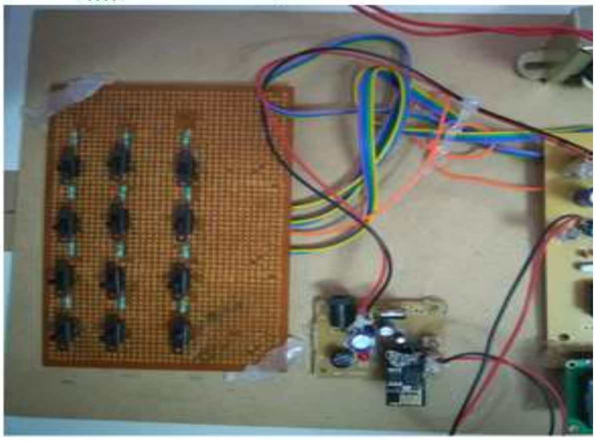
```
void initlcd()
{
clcd(0x02);
clcd(0x02);
clcd(0x28);
clcd(0x28);
clcd(0x0e);
clcd(0x06);
clcd(0x01);
clcd(0x80);
}
void serialinit()
{
TMOD=0x20;// timer1,mode2
SCON=0x50;
TH1=-3;
TR1=1;
}
void tx(unsigned char ch)
{
SBUF=ch;
while(TI==0); //wait until TI=1
TI=0;
}
void txs(unsigned char *chr)
{
unsigned char i=0;
for(i=0;chr[i]!='\0';i++)
tx(chr[i]);
}
unsigned char rx()
{
unsigned char ch;
while(RI==0);
ch=SBUF;
RI=0;
return ch;
}
#include <stdio.h>
void okc()
{
unsigned char rr;
do{
rr = rx();
}while(rr != 'K');
}
void wifiinit()
{
stringlcd(0x80,"Wifi Initilizing");
txs("AT\r\n");
//okc();
delay(400);
txs("ATE0\r\n");
//okc();
delay(400);
txs("AT+CWMODE=3\r\n");
delay(400);
txs("AT+CWSAP=\"msr\",\"msr1235\",5,3\r\n");
delay(400);
txs("AT+CIPMUX=1\r\n");
delay(400);
txs("AT+CIPSERVER=1,23\r\n");
stringlcd(0x80,"WAITING FOR CONNCT");
stringlcd(0xC0,"project");
while(rx()!='C');
}
void sendwifi(unsigned char *chr,unsigned int length)
{
unsigned char temp[20];
txs("AT+CIPSEND=0,");
sprintf(temp,"%u",length);
txs(temp);
txs("\r\n");
while(rx()!='>');
delay(100);
txs(chr);
}
void main()
{
//unsigned char rec=0;
sw11=sw12=sw13=sw14=sw21=sw22=sw23=sw24=sw31=sw32=sw33=sw34=1;
serialinit();
initlcd();
stringlcd(0x80,"WELCOME");
wifiinit();
stringlcd(0x80,"CONNECTED");
loop:
clcd(0x01);
stringlcd(0x80,"EVERYTHING FINE");
while(1)
{
if(sw11 ==0)
{
clcd(0x01);
stringlcd(0x80,"R:NODE 1 PROBLEM");
stringlcd(0xC0,"DISTANCE 0TO1KM");
sendwifi("R:NODE 1 PROBLEM && DISTANCE 0 TO 1KM \r\n ",42);
delay(800);
goto loop;
}
if(sw12 ==0)
{
clcd(0x01);
stringlcd(0x80,"R:NODE 2 PROBLEM");
stringlcd(0xC0,"DISTANCE 1TO2KM");
sendwifi("R:NODE 2 PROBLEM && DISTANCE 1 TO 2KM \r\n ",42);
delay(800);
goto loop;
}
if(sw13 ==0)
```

```
{
clcd(0x01);
stringlcd(0x80,"R:NODE 3 PROBLEM");
stringlcd(0xC0,"DISTANCE 2TO3KM");
sendwifi("R:NODE 3 PROBLEM && DISTANCE
2 TO 3KM \r\n ",42);
delay(800);
      goto loop;
}
if(sw14 ==0)
{
clcd(0x01);
stringlcd(0x80,"R:NODE 4 PROBLEM");
stringlcd(0xC0,"DISTANCE 3TO4KM");
sendwifi("R:NODE 2 PROBLEM && DISTANCE
3 TO 4KM \r\n ",42);
delay(800);
goto loop;
}
if(sw21 ==0)
{
clcd(0x01);
stringlcd(0x80,"G:NODE 1 PROBLEM");
stringlcd(0xC0,"DISTANCE 0TO1KM");
sendwifi("G:NODE 1 PROBLEM && DISTANCE
0 TO 1KM \r\n ",42);
delay(800);
goto loop;
}
if(sw22 ==0)
{
clcd(0x01);
stringlcd(0x80,"G:NODE 2 PROBLEM");
stringlcd(0xC0,"DISTANCE 1TO2KM");
sendwifi("G:NODE 2 PROBLEM && DISTANCE
1 TO 2KM \r\n ",42);
delay(800);
goto loop;
}
if(sw23 ==0)
{
clcd(0x01);
stringlcd(0x80,"G:NODE 3 PROBLEM");
stringlcd(0xC0,"DISTANCE 2TO3KM");
sendwifi("G:NODE 3 PROBLEM && DISTANCE
2 TO 3KM \r\n ",42);
delay(800);
goto loop;
}
if(sw24 ==0)
{
clcd(0x01);
stringlcd(0x80,"G:NODE 4 PROBLEM");
stringlcd(0xC0,"DISTANCE 3TO4KM");
sendwifi("G:NODE 2 PROBLEM && DISTANCE
3 TO 4KM \r\n ",42);
delay(800);
goto loop;
}
if(sw31 ==0)
{
clcd(0x01);
stringlcd(0x80,"B:NODE 1 PROBLEM");
stringlcd(0xC0,"DISTANCE 0TO1KM");
sendwifi("B:NODE 1 PROBLEM && DISTANCE
0 TO 1KM \r\n ",42);
delay(800);
goto loop;
}
if(sw32 ==0)
{
clcd(0x01);
stringlcd(0x80,"B:NODE 2 PROBLEM");
stringlcd(0xC0,"DISTANCE 1TO2KM");
sendwifi("B:NODE 2 PROBLEM && DISTANCE
1 TO 2KM \r\n ",42);
delay(800);
goto loop;
}
if(sw33 ==0)
{
clcd(0x01);
stringlcd(0x80,"B:NODE 3 PROBLEM");
stringlcd(0xC0,"DISTANCE 2TO3KM");
sendwifi("B:NODE 3 PROBLEM && DISTANCE
2 TO 3KM \r\n ",42);
delay(800);
goto loop;
}
if(sw34 ==0)
{
clcd(0x01);
stringlcd(0x80,"B:NODE 2 PROBLEM");
stringlcd(0xC0,"DISTANCE 3TO4KM");
sendwifi("B:NODE 2 PROBLEM && DISTANCE
3 TO 4KM \r\n ",42);
delay(800);
goto loop;
}
}
      }
```

III. CONCLUSION

In this project, a methodology (sectionalisation) for an efficient, non-destructive digital underground cable fault locator (DUCFL) was developed by using iot . The device can detect underground cable faults such as short circuit and open circuit and also indicates a correct cable when the cable is normal and it when cable fault detected then automatically shows on iot app. The digital cable fault locator is a precision instrument and easy to use. For sensing the data, the instrument is provided with two terminals which are to be connected to the cable under test. The built-in microcontroller with the locator circuit and analogue to digital converter circuit collects analyses the data and spontaneously display the result (the particular type of fault on the line) in digital format on the seven segment LED display unit within 10m range.

Hardware Implementation



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