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# Underground Cable Fault Detection using GSM

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**Abstract-** *To supply electric power we use Power cables. To avoid unwanted interference, we place them underground. This makes it very tough to work out the precise location of the faults that occur. A fault might occur thanks to a many of reasons such as digging, earthquake, construction work, etc. The maintenance process associated with that specific line is difficult thanks to unknown location of the fault within the line. The motive of the project is to detect and locate the fault in underground cable. The system developed here works on the idea of Ohm's law. The proposed technique is used for identification as well as it is also used to send the information about the fault to the authority using GSM and for security of people it cut the power supply on that particular location and display the fault location in KMs on LCD Display*

***Key Words:*** **Underground Cable Faults, GSM Module, PIC16F877A Microcontroller, LCD, USART.**

## 1.INTRODUCTION

The underground cable is frequently followed in many urban areas. While fault occurs for a few reasons, at that point the repairing process associated with that specific cable is difficult thanks to not knowing the precise location of cable fault. Fault in cable is represented as:

- Any defect,
- Inconsistency,
- fragility that affects purpose of cable
- Current is diverted from the intended path,

From many decades, low voltage and high voltage distribution lines of underground cables are operated worldwide. To reduce the effect of distribution networks to environment underground high voltage cables are used more and more. Underground cables are widely utilized in power distribution networks thanks to the benefits of underground connection, involving more security than overhead lines in inclemency, less susceptible to damage by storms or lightning. It is less costly for shorter distance, eco-friendly and low maintenance.

But if any fault occurs in cable, then it is difficult to locate fault. So, this project is employed to detect the situation of fault in digital way. The main purpose of locating the faulty point in an underground cable in order is to ease quicker repair, improve the system stability and reduced blackout period. The underground cable system is very convenient for distribution mainly in urban areas such as, metropolitan cities, airport and defense services.

The paper uses the quality concept of Ohms law. This project contains a set of resistors representing cable length in KM's to find the distance of fault in KMs and fault creation is made by a set of switches at every known KM. The fault generated at a specific distance and therefore the respective phase is displayed on a LCD interfaced to the microcontroller.

## 2. CIRCUIT DIAGRAM

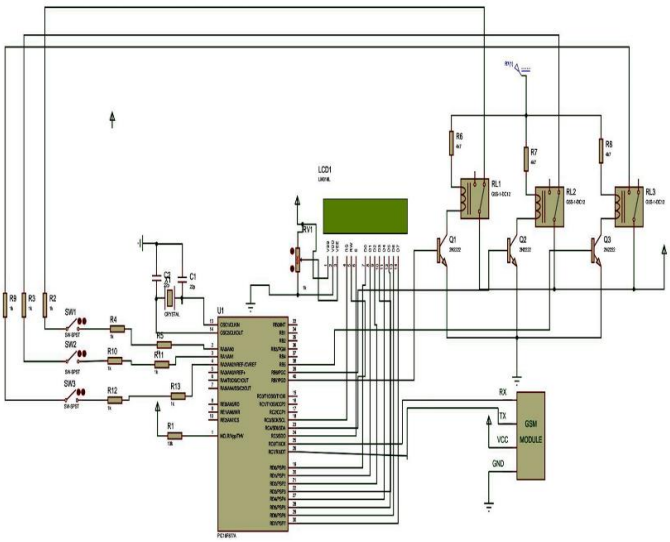


**Fig -1**: Circuit Diagram of the Project.

## 3. WORKING PRINCIPLE

The project uses the straight forward concept of Ohm's law where a low DC voltage is applied at the provider end

through series resistor. The current would change depending upon the length (in km) of fault of the cable in case there is a short circuit of LL fault or 3L fault or LG fault etc. The series resistor voltage drops changes according to the fault which is then fed to an Analog to Digital Converter to develop a digital data which the programmed microcontroller would display the same in KM's. The project is fabricated with a set of resistors representing cable length in KMS and fault is generated by a set of switches at every known KM to check the accuracy of the same.

This is prescribed model of underground cable fault using microcontroller. It is divided in four parts –DC power, supply, cable, controlling, display part. The Part of DC power supply consist of ac supply of 230v is step down using transformer, bridge rectifier converts alternating current to direct current & regulator is used to produce constant dc voltage. The part of cable is represented by the set of resistors along with switches. Current sensing part of cable represented as set of resistors & switches are used as fault generators to show the fault at each location. This part senses the change in current by sensing the potential drop. Next is controlling part which comprises of analog to digital converter which receives input from the current sensing element, converts this voltage into digital signal and feeds the microcontroller with the signal. The microcontroller is also a part of the controlling unit and makes necessary computations regarding the distance of the fault.

The microcontroller also operates a relay driver which controls the switching of a set of relays for interconnection of the cable at each phase. In case fault occur, it sends messages through GSM and display the distance on LED screen KMs and cellphone.

## 4.COMPONENTES USED

### 4.1 Power Supply

The power supply circuit consists of step-down transformer which is 230 volts step down to 12 volts. In this circuit four diodes are used to made bridge rectifier circuit which supply pulsating dc voltage and then supply to capacitor filter the output voltage from rectifier is supply to filter to remove any AC components present even after rectification. The rectified DC voltage is given to regulator to produce 12 volts constant DC voltage.

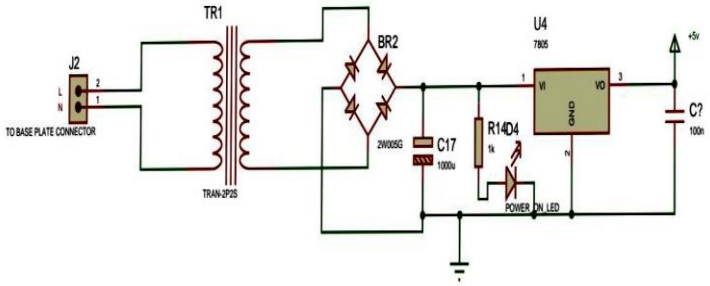


**Fig -2**: Circuit Diagram of Power Supply

### 4.2 Voltage Regulator

A voltage regulator is an electrical device which is manufactured to maintain a constant voltage level. In this project, power supply 12 volts are required. In order to get these voltage levels, voltage regulators are used. In order to obtain these voltage levels, 7812 voltage regulators are used. The first number 78 represents positive supply and the number 12 represent the required output voltage levels. The L78xx series of three-terminal positive regulators is out there.

### 4.3 Microcontroller (PIC16F877A)

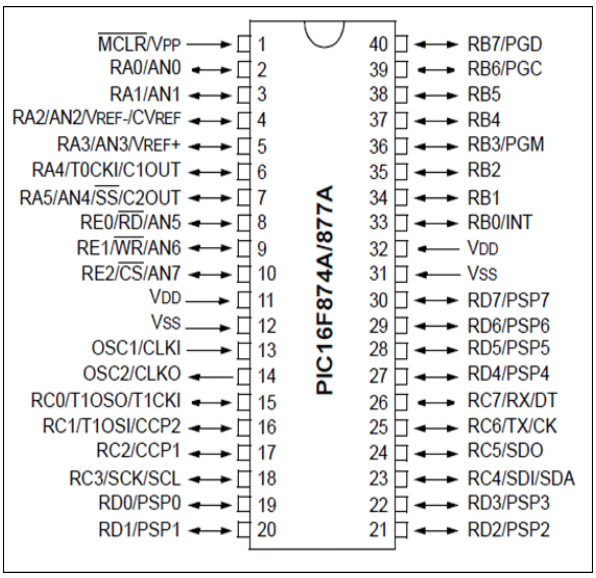


**Fig -3**: Pin Diagram of Microcontroller

PIC16F877A devices are available in 40-pin and44-pin packages. It Have 5 I/O ports. It Have 15 Interrupts and 3 timers. It has eight 10-bit A/D input channels. Data Memory 368 bytes Program memory 256 bytes.

### 4.4 Relay

Relay is used as a sensing device which senses the fault to send a trip signal to circuit breaker which isolates the faulty section. A relay is an automatic device by which an electrical circuit is indirectly controlled and is supervised by change in the same or another electrical circuit. Numerical relay, Static relay and electromagnetic relay are the various types of relays. The relays periodically scan the three phases and send the signal to the PIC18F877A Microcontroller controller. 12V is the rating of each relay.


**Fig -4**: Sugar Cube Relay

### 4.5 LCD Display

16×2 LCD has 16 Columns and 2 Rows. There are tons of combinations of LCD's are available like, 8×1, 8×2, 10×2, 16×1, etc. but the most common one is the 16×2 LCD. So, it will have total 32 characters and each character will be made of 5×8 Pixels. It has Operating Voltage 4.7V to 5.3V and Current consumption is 1mA. It has two rows and each row is able print 16 characters. Each character is built by a 5×8-pixel boxes. It can operate on both 8-bit and 4-bit mode.


**Fig -5**: LCD Display

### 4.6 GSM Module

GSM (Global System for Mobile Communication) is a digital module telephone system that is popularly used in many parts of the world. In GSM modem a wireless modem and a GSM wireless network works together. This utilizes the GSM standard for cellular technology. Here, one end has a wired connection which helps to receives and transmits data while the other end is connected to a RF antenna. The GSM modem acts like a cellular phone and transmits text and voice data it communicates GSM through SIM. GSM module can communicate to PIC Microcontroller using normal serial USART Protocol. For serial communication baud rate of GSM Module and Microcontroller must be same.

GSM (SIM 900_AT): The SIM900 has SMT module in which it contains complete Quad-band GSM/GPRS solution which can be embedded in customer applications. Featuring an industry-standard interface, the SIM900 delivers GSM/GPRS 850/900/1800/1900MHz performance for Data, voice, SMS and Fax during a small form factor and with low power consumption. SIM900 can fit most of the space requirements within the M2M application with dimensions of 24mm x 24mm x 3 mm.

SIM900 is meant a reality single-chip processor integrating AMR926EJ-S core. As per the customers application Quad - band GSM/GPRS module comes with a size of 24mmx24mmx3mm, SMT type suit. An embedded Powerful TCP/IP protocol stack Based upon mature and field-proven platform, backed up by our support service, from definition to design and production GSM, which stands for Global System for Mobile communications, retrieve the world's most widely used cell phone technology. Cell phones use a cell phone service carrier's GSM network by searching for cell phone towers in the nearby area.

The "AT" or "at" prefix is always set at the beginning of each Command line. The AT command set implemented by SIM900 is a combination of GSM07.05, GSM07.07.

#### 4.6.1 USART (Universal Synchronous Asynchronous Receiver Transmitter)

USART is a hardware communication protocol that uses synchronous serial communication. Serial communication is the technique of sending 1 bit at a time sequentially over a communication channel. The USART module is a full duplex, serial input communication peripheral. It contains all shift registers, clock generators and Dara buffers needed for serial communication. The USART uses two input and output pins to transmit and receive serial data, both transmission and reception can

occur at the same time that is 'Full Duplex' operation. The USART peripheral involves of three main parts:

1. Transmitter
2. Receiver
3. Baud Generator.

## 5. ADVANTAGES

- Lower tree-trimming cost.
- Enhanced Reliability: Increased reliability during severe weather such as wind storm damage will be greatly decrease for underground system, and provide minimal damage during flooding and storm surge
- During severe weather lesser the destruction.
- Far fewer transient interruptions.
- Boost up Public Safety.
- Motor vehicle accidents reduces.
- Live-wire contact injuries decreases.
- Potentially-Reduced Maintenance and Operating Costs.

## 6. DISADVATNDES

The only disadvantage of underground cable is that it has high preliminary cost and insulation issues at high voltages.

## 7. CONCLUSION

The short circuit fault at a specific distance within the underground power cable is found to rectify the fault efficiently using fault switch and straight forward concept of Ohm's law and Voltage Divider Rule is used. The fault displays on the LCD screen and sends message to user. Underground cables are susceptible to a good sort of faults thanks to underground conditions such as wear and tear, rodents etc. Also detecting fault source is difficult and full line is to be dug so as to see entire line and fix faults. So here we propose underground cable fault detection to detects the exact fault position. The repairmen know exact location of fault and which part is to be dug to detect the fault source. This saves a ton of time, money and efforts and also allows to faster service to underground cables. The system detects fault with the assistant of voltage divider network laid across the cable. Whenever a fault occurs, a specific voltage is generated as per the resistors network combination. This voltage is sensed by the PIC microcontroller and inform the user about fault through GSM.

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