IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

ADVANCED SUBSTATION MONITORING AND CONTROLLING SYSTEM

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Abstract:

In this project The Electric Power System is divided into many different sections. One of which is the transmission system, where power is transmitted from generating stations and substations via transmission lines into consumers. Both methods could encounter various types of malfunctions is usually referred to as a "Fault". Fault is simply defined as a number of undesirable but unavoidable incidents can temporarily disturb the stable condition of the power system that occurs when the insulation of the system fails at any point. A smart GSM based fault detection and location system was used to adequately and accurately indicate and locate the fault had occurred.

This will ensure a shorter response time for technical crew to rectify these faults and thus help save transformers from damage and disasters. The system uses PIC 16F877 Microcontroller, RS-232 connector, and a GSM modem, Node MCU. The system automatically detects faults, analyses and classifies these faults and then, calculates the fault distance. Finally, the fault information is transmitted to the control room. In conclusion, the time required to locate a fault is drastically reduced, as the system automatically and accurately provides accurate fault location information. By using this project, we can detect the faults of three phase transmission lines one can monitor the Temperature, Voltage, Current by means of GSM modem by sending message.

***Index Terms* –voltage sensor; current sensor; Android; Arduino; smart**

I. INTRODUCTION

An embedded system is a special-purpose computer system designed to perform one or a few dedicated functions, often with real-time computing constraints. It is usually embedded as part of a complete device including hardware and mechanical parts. [5]In contrast, a general-purpose computer, such as a personal computer, can do many different tasks depending on programming. [6]Embedded systems control many of the common devices in use today. Since the embedded system is dedicated to specific tasks; design engineers can optimize it, reducing the size and cost of the product, or increasing the reliability and performance. [2]Some embedded systems are mass-produced, benefiting from economies of scale.

Physically, embedded systems range from portable devices such as digital watches and MP3 players, to large stationary installations like traffic lights, factory controllers, or the systems controlling nuclear power plants. Complexity varies from low, with a single microcontroller chip, to very high with multiple units, peripherals and networks mounted inside a large chassis or enclosure.

In general, "embedded system" is not an exactly defined term, as many systems have some element of programmability. For example, Handheld computers share some elements with embedded systems such as the operating systems and microprocessors.[2] which power them but are not truly embedded systems, because they allow different applications to be loaded and peripherals to be connected. [1]Embedded systems span all aspects of modern life and there are many examples of their use. [7]Telecommunications systems employ numerous embedded systems from telephone switches for the network to mobile phones at the end-user. Computer networking uses dedicated routers and network bridges to route data.

There are many courses of faults in power transmission leading to power outages, if not properly managed. Notable among them includes:

- Faults at the power generation station
- Damage to power transmission lines (tree falling on lines)
- Faults at the substations or parts of distribution subsystem
- Lightening

II. TYPES OF FAULTS

Electrical fault is the deviation of voltages and currents from nominal values or states. [5]Under normal operating conditions, power system equipment or lines carry normal voltages and currents which results in a safer operation of the system. [1]But when fault occurs, it causes excessively high currents to flow which causes the damage to equipment's and devices. [2]Fault detection and analysis is necessary to select or design suitable switchgear equipment's, electromechanical relays, circuit breakers and other protection devices.

III. SYMMETRICAL FAULTS

There are mainly two types of faults in the electrical power system. [2]Those are symmetrical and unsymmetrical faults. [3]These are very severe faults and occur infrequently in the power systems. [5]These are also called as balanced faults and are of two types namely line to line to line to ground (L-L-L-G) and line to line to line (L-L-L).

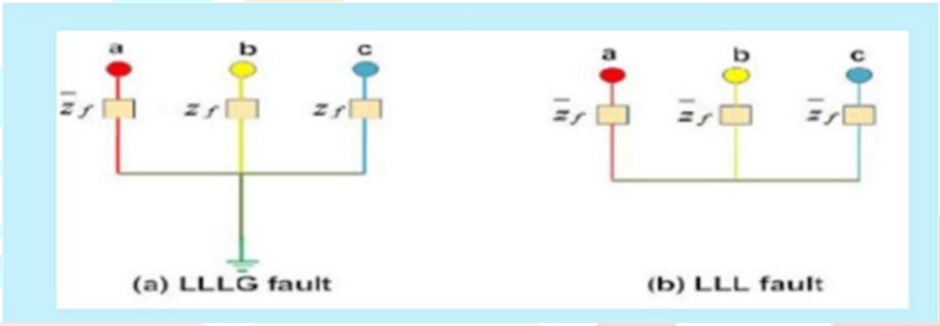

Fig 1 Symmetrical Faults

If these faults occur, system remains balanced but results in severe damage to the electrical power system equipments. [3]Above figure shows two types of three phase symmetrical faults. Analysis of these faults is easy and usually carried by per phase basis. [6]Three phase fault analysis or information is required for selecting set-phase relays, rupturing capacity of the circuit breakers and rating of the protective switchgear.

IV. UNSYMMETRICAL FAULTS

These are very common and less severe than symmetrical faults. There are mainly three types namely line to ground (L-G), line to line (L-L) and double line to ground (LL-G) faults.Line to ground fault (L-G) is most common fault and 65-70 percent of faults are of this type.

[2]It causes the conductor to make contact with earth or ground. 15 to 20 percent of faults are double line to ground and causes the two conductors to make contact with ground. Line to line faults occur when two conductors make contact with each other mainly while swinging of lines due to winds and 5- 10 percent of the faults are of this type.

These are also called unbalanced faults since their occurrence causes unbalance in the system. [2]Unbalance of the system means that that impedance values are different in each phase causing unbalance current to flow in the phases. [5]These are more difficult to analyze and are carried by per phase basis similar to three phase balanced faults.

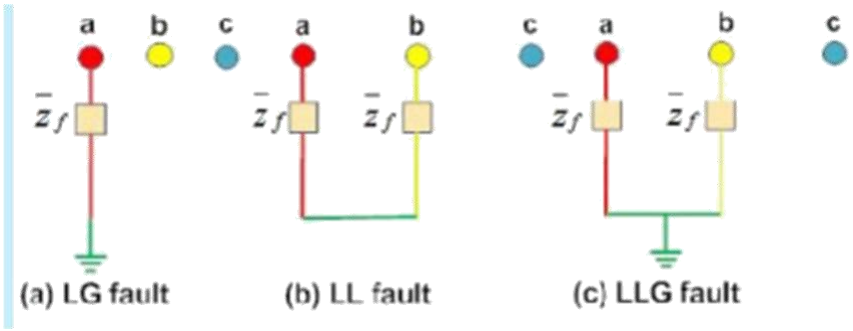

Fig 2 Unsymmetrical Faults

V. GLOBAL SYSTEM FOR MOBILE (GSM)

Global System for Mobile Communications (GSM) is the world ‘s most popular standard for mobile telephony systems. [2]The GSM Association estimates that 80% of the global mobile market uses the standard. GSM is used by over 1.5 billion people across more than 212 countries and territories. [6]This ubiquity means that subscribers can use their phones throughout the world, enabled by international roaming arrangements between mobile network operators. GSM differs from its predecessor technologies in that both signaling and speech channels are digital, and thus GSM is considered a second generation (2G) mobile phone system. This also facilitates the wide-spread implementation of data communication applications into the system.

Fig 3GSM smart modem

VI. SERIAL CABLE DETAILS

Serial Cable provided has following pins connected with RS232 level (+12V / -12V) output

Pin 2 is RS232 level TX output Pin 3 is

RS232 level RX input Pin 5 is Ground.

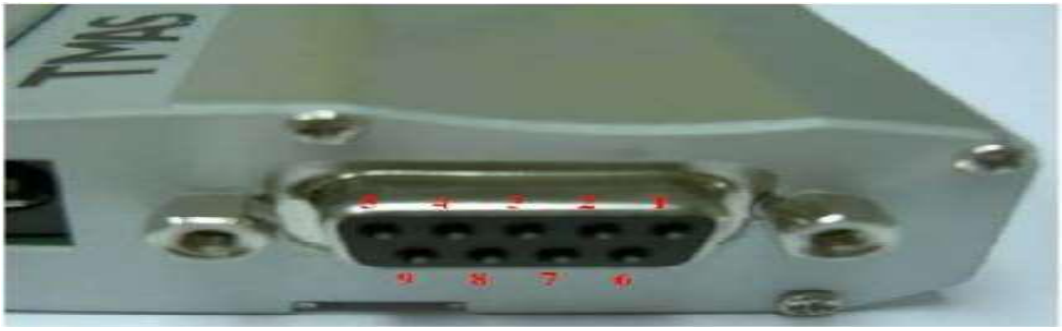

Fig 4 GSM RS232 interface

Pin no.	Signal name	I/O	Function
1	/DCD	O	Data carrier detected
2	/RXD	O	Receiver data
3	/TXD	I	Transmitter data
4	/DTR	I	Date terminal ready
5	GND	-	Ground
6	/DSR	O	Data set ready
7	/RTS	I	Request to send
8	/CTS	O	Clear to send
9	/IR	O	Ring indication

Table 1 GSM Rs232 Pin Assignment

VII. SUBSCRIBER IDENTITY MODULE (SIM)

A subscriber identity module (SIM) on a removable SIM card securely stores the service-subscriber key (IMSI) used to identify a subscriber on mobile telephony devices (such as mobile phones and computers). [2]The SIM is a small smart card which contains both programming and information. [5]It provides the actual identity for the subscriber. During initial registration all the relevant subscriber data are inserted into the SIM card and the activity is known as personalization. [2]A mobile phone cannot make or receive any calls except emergency calls without a SIM. Each SIM card is registered in a particular GSM network(HPLMN), and can be recognized by another network only if the HPLMN have agreement between themselves to support the subscriber, i.e., the subscriber has roaming facility.

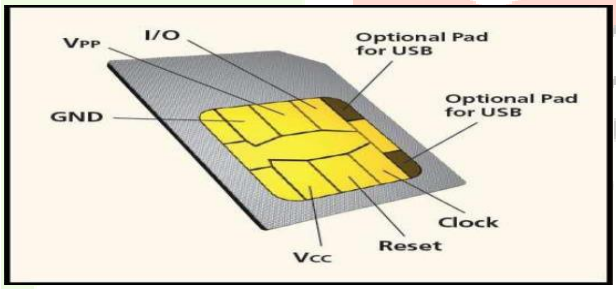

Fig 5 SIM Pin Out

VII. INSERTING/ REMOVING THE SIM CARD

To insert or Remove the SIM Card, it is necessary to press the SIM holder ejector button with Sharp edged object like a pen or a needle. With this, the SIM holder comes out a little, then pulls it out and insert or remove the SIM Card.

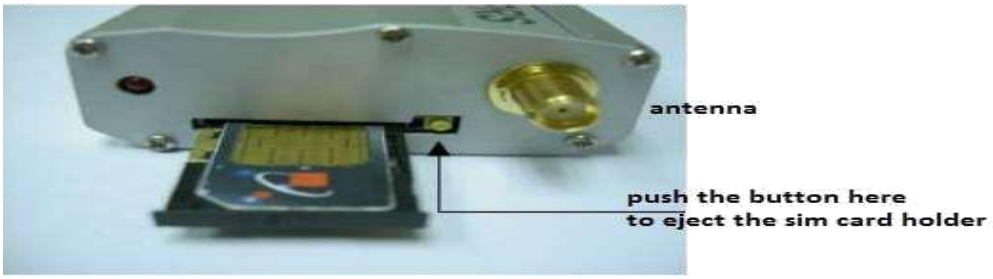

Fig 6 Inserting/Removing the Sim card into the modem

VIII. ARDUINO

Arduino is open-source hardware. [2]The hardware reference designs are distributed under a Creative Commons Attribution Share-Alike 2.5 license and are available on the Arduino website. Layout and production files for some versions of the hardware are also available.

Although the hardware and software designs are freely available under copy left licenses, the developers have requested the name Arduino to be exclusive to the official product and not be used for derived works without permission. [1]The official policy document on use of the Arduino name emphasizes that the project is open to incorporating work by others into the official product. [5]Several Arduino-compatible products commercially released have avoided the project name by using various names ending in - duino. (ATmega8 ATmega168, ATmega328, ATmega1280, or ATmega2560) with varying amounts of flash memory, pins, and features. [2]The 32-bit Arduino Due, based on the Atmel SAM3X8E was introduced in 2012. The boards use single or double-row pins or female headers that facilitate connections for programming and incorporation into other circuits. These may connect with add-on modules termed shields. [4]Multiple and possibly stacked shields may be individually addressable via an I²C serial bus. Most boards include a 5 V linear regulator and a 16 MHz crystal oscillator or ceramic resonator. Some designs, such as the LilyPad, run at 8 MHz and dispense with the onboard voltage regulator due to specific form-factor restrictions.

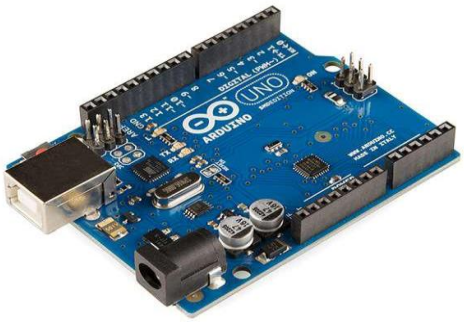

Fig 7 Arduino

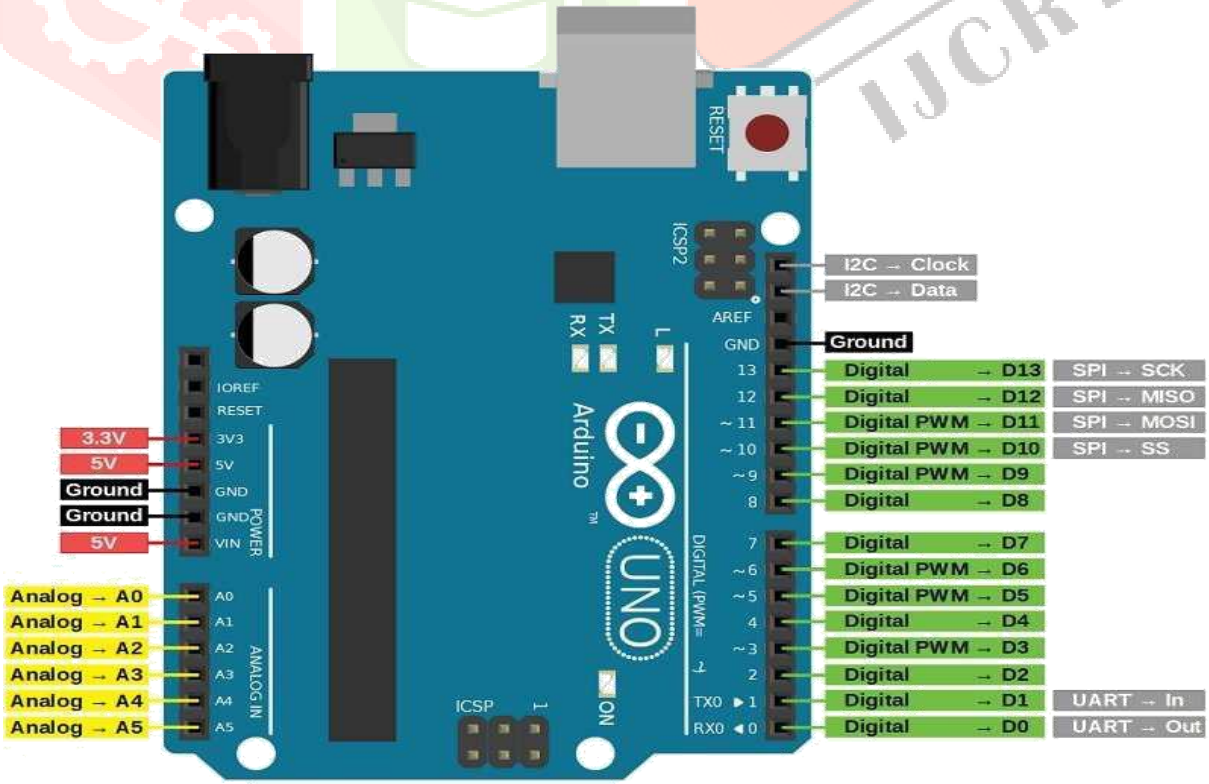

Fig 8 Arduino Pin configuration

IX. Code used in project

```
#include <LiquidCrystal.h>
#include <TinyGPS++.h>
#include <SoftwareSerial.h>
static const int RXPin = 2, TXPin = 3;
static const uint32_t gps_baudrate = 9600;
TinyGPSPlus gps;
SoftwareSerial soft(RXPin, TXPin);
String textMessage;
float Lat, Lon;
void setup()
{
soft.begin(gps_baudrate);
Serial.begin(19200);
pinMode(12,INPUT);
pinMode(4, OUTPUT);
}
id loop()
{
int key = digitalRead(12);
while (soft.available() > 0)
{
gps.encode(soft.read());
if (gps.location.isUpdated())
{
      Lat = gps.location.lat();
      Lon = gps.location.lng();
    }
    else;
  }
  if(key==1)
  {
    digitalWrite(4,HIGH);
    sendsms("Open circuit");
    digitalWrite(4,LOW);
  }
```

```
    if(key==2)
   {
    digitalWrite(4,HIGH);
    sendsms("short circuit");
    digitalWrite(4,LOW);
   }
    if(key==3)
   {
    digitalWrite(4,HIGH);
    sendsms("Fire detected ");
    digitalWrite(4,LOW);
   }
   }
void sendsms(String val)
{
    Serial.print("AT+CMGF=1\r");
    delay(100);
    Serial.println("AT+CMGS =\"+919502089771\""); delay(100);
                Serial.println(String(val)+"!!!Location:" + String("Lat: ") +String(Lat) + " "+String("Lon: ")
+  String(Lon));
    delay(100);
    Serial.println((char)26);
    delay(100);
    Serial.println();
    delay(5000);
}
```

X. RESULT

The IOT based smart energy meter monitoring is shown in the fig6. Considering as 5seconds equals to 1day and 1pulses equals0.1unit power consumption. By taking 5Rs per unit power the bill for two months will be calculated. The same amount will bepaid for two months if the user paid the bill the supply will be given continuously after two months. After two months if hedoesn't pay bill buzzer will be ON for alert purpose.

Until and unless paying bill the supply line will be disconnected. Using Wi-Fi technology is more advantageous for both user side and provider side. There is no need to go at consumer side to disconnect thesupply line, using IoT it can be monitored by online only.

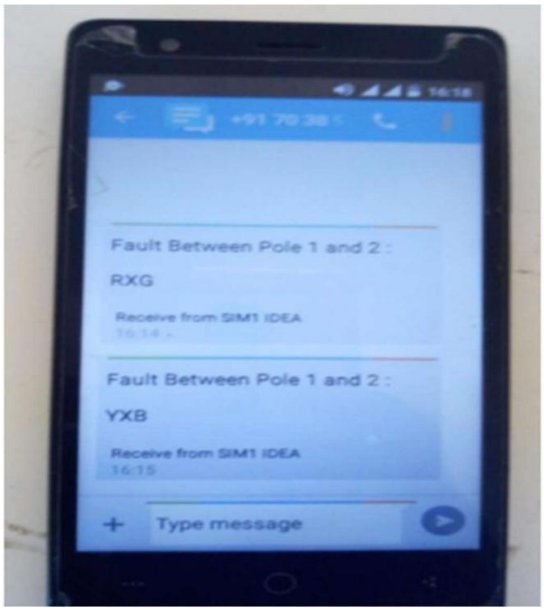

Fig 9 Output message

XI. CONCLUSION AND FUTURE SCOPE

Here, in this project we have designed a GSM based transmission line monitoring and indication system that sends information of the same to control room via SMS. The implemented system design mainly concentrates on the distribution system. It provides the way to detect the faults such as wastage of energy and power theft. The system continuously monitors various parameters of the system. It also helps to detect the fault at the appropriate time and hence avoids illegal use of electricity. Automatic monitoring, analyzing and recording is done on the PC screen through hyper terminal. The project has continuous monitoring system integrating the GSM communication technology and the microcontroller technology. It also represents the hardware architecture and the software flow. The implementation of the system will save large amount of electricity and thereby electricity will be available for more number of consumers in a highly populated country such as India.

VIII.FUTURE SCOPE

Internet of things (IoT) is an emerging technology that is influencing every aspect of modern-day life. The idea is to provide a common platform irrespective of the underlying technologies, wherein the data from multiple devices can be integrated. The main aim of IoT is to provide better services to the users, thereby, improving the quality of life, and the idea of integrating IoT with other emerging technologies like AI, Block-chains and Cloud Computing can lead to the development of systems that are more robust, intelligent, secure and powerful. So, we replace GSM technology with IoT technology and increase the efficient working of system.4G and 5G is the technology for the future. The need for Higher speed ,higher capacity, much more service like multimedia, internet is growing GSM has to upgrade for 4G.

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