



INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

IOT BASED TRANSMISSION LINE MULTIPLE FAULT DETECTION AND INDICATION TO EB

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ABSTRACT:

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. 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 automatically detects faults, analyses and classifies these faults and then, calculates the fault distance from the control room using an impedance-based algorithm method. 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.

Keywords: Global System for Mobile Communication.

1. INTRODUCTION:

Power system is classified into power generation, transmission and distribution. Transmission network is considered to be one of the vital parts of power system, as it connects the supply and the demand. The loss in transmission and distribution network is considered to be very high, compared to other parts of power system. Currently, the electric power infrastructure is highly vulnerable against many forms of natural and malicious physical events, which can adversely affect the overall performance and stability of the grid. The faults in the transmission network obstruct the supply of power to the consumer. Usually when a fault occurs in the

transmission line it will not be seen unless it is severe. But gradually these small faults can lead to transformer damage and destruction to human life. It can also start a fire.

At present in India, a system is not notified us the fault in real time when a fault occurs. What worrying about is not having a real-time system, this can lead to damage to the underlying connected devices and become a threat to the humans around us. In order to avoid such incidents to the maximum extent, maintenance or checking of the transmission lines are generally carried out on a frequent basis. This leads to increased manpower requirement. The fact remains that the real intention of this is not met as many a times line failure may be due to rain, toppling of trees which cannot be predicted. Hence the transmission network fault identification and clearance should be very fast.

To overcome these, this project is proposed an Internet of Things based Transmission Line Multiple Fault Detection and Indication to EB. Whenever the preset threshold is crossed, the microcontroller instantly initiates a message to be sent to the area lineman and the Control Station stating the exact pole to pole location. This helps us to realize the real time system.

This will ensure a shorter response time for technical crew to rectify these faults and thus help save transformers from damage and disasters. A smart GSM based fault detection and location system is used to adequately and accurately indicate and locate where fault has occurred. The system uses a current transformer, a voltage transformer, PIC 16F877 Microcontroller, RS-232 connector, and a GSM modem.

The system automatically detects fault, analyze and classify these faults and then, calculate the fault distance from the control room using an impedance-based algorithm method. Finally, the fault information is transmitted to the control room by IOT technology.

2. TRANSMISSION LINE FAULTS:

Different types of faults occurred in transmission lines are Single line-to-ground fault, Line-to-line fault, Double Line-to-ground fault and Balance three phase fault.

Single line-to-ground fault: The most common type of faults is Single Line-to-ground faults (SLG). This type of fault occurs when one conductor falls to the ground or gets into contacts with the neutral wire. It could also be the result of falling trees in a rainy storm. This type could be represented.

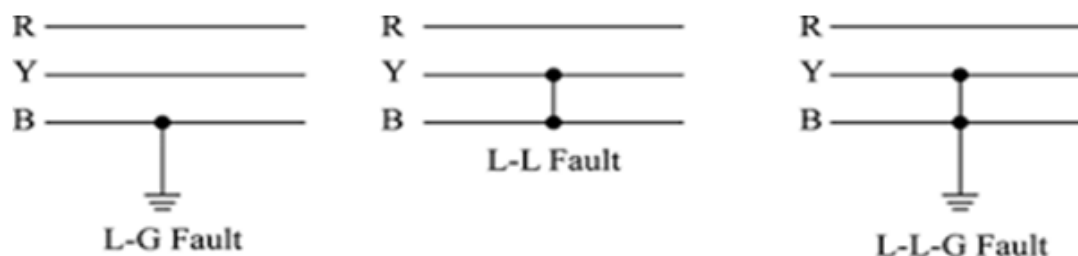


Figure: 1. Types of Transmission Line Faults

Line-to-line fault: The second most occurring type of faults is the Line-to-Line fault (LL). This is said to occur when two transmission lines are short-circuited. As in the case of a large bird standing on one transmission line and touching the other, or if a tree branch happens to fall on top of two power transmission lines.

Double Line-to-ground fault: The third type of fault is the Double Line-to-Ground fault (DLG) in figure below. This can be a result of a tree falling on two of the power lines, or other causes.

Balance three phase fault: The fourth and the real type of fault is the balanced three phases, which can occur by a contact between the three power lines in many different forms.

3. IMPEDANCE BASED ALGORITHM METHOD:

This Section reviews the one- and two-ended impedance-based fault location algorithms that are commonly used to locate faults in a transmission network. The goals are to define the input data requirement of each method and identify the different factors that affect the accuracy of location estimates.

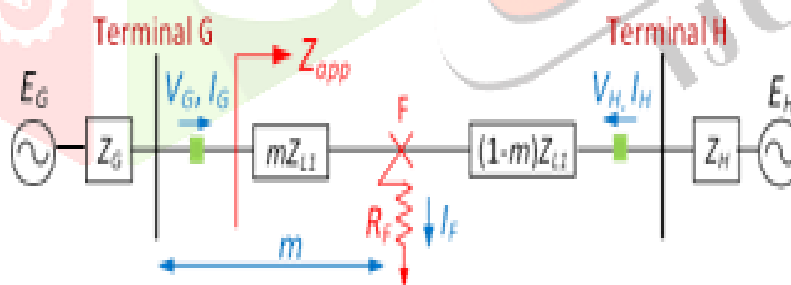


Figure: 2. One-line Diagram of a Two-terminal Transmission Network

As the name suggests, one-ended impedance-based fault location algorithms estimate the location of a fault by looking into a transmission line from one end as illustrated. Voltage and current waveforms captured during a fault by an intelligent electronic device (IED) at one end of the line are used to determine the apparent impedance between the IED device and the location of the short-circuit fault. Given the impedance of the transmission line in ohms, the per-unit distance to a fault can be easily obtained. The advantages of using one-ended algorithms are that they are straight forward to implement, yield reasonable location estimates, and

require data from only one end of a line. There is no need for any communication channel or remote data and hence, fault location can be implemented at the line terminal by any microprocessor-based numerical relay.

To illustrate the principle of one-ended methods, consider the two-terminal transmission network. The transmission line is homogeneous and has a total positive sequence impedance of Z_{L1} between terminals G and H. Networks upstream from terminals G and H are represented by their respective Thevenin equivalents having impedances Z_G and Z_H . When a fault with resistance R_F occurs at a distance m per unit from terminal G, both sources contribute to the total fault current I_F . The voltage and current phasors recorded at terminal G during the fault are V_G and I_G , respectively. Similarly, the voltage and current phasors recorded at terminal H during the fault are V_H and I_H , respectively.

The fundamental equation that governs one-ended impedance-based fault location algorithms. Unfortunately, because measurements from only one end of the line are used, has three unknowns, namely, m , R_F , and I_F . In order to eliminate R_F and I_F from the fault location computation, several one-ended algorithms have been developed and are discussed.

4. PROPOSED SYSTEM BLOCK DIAGRAM:

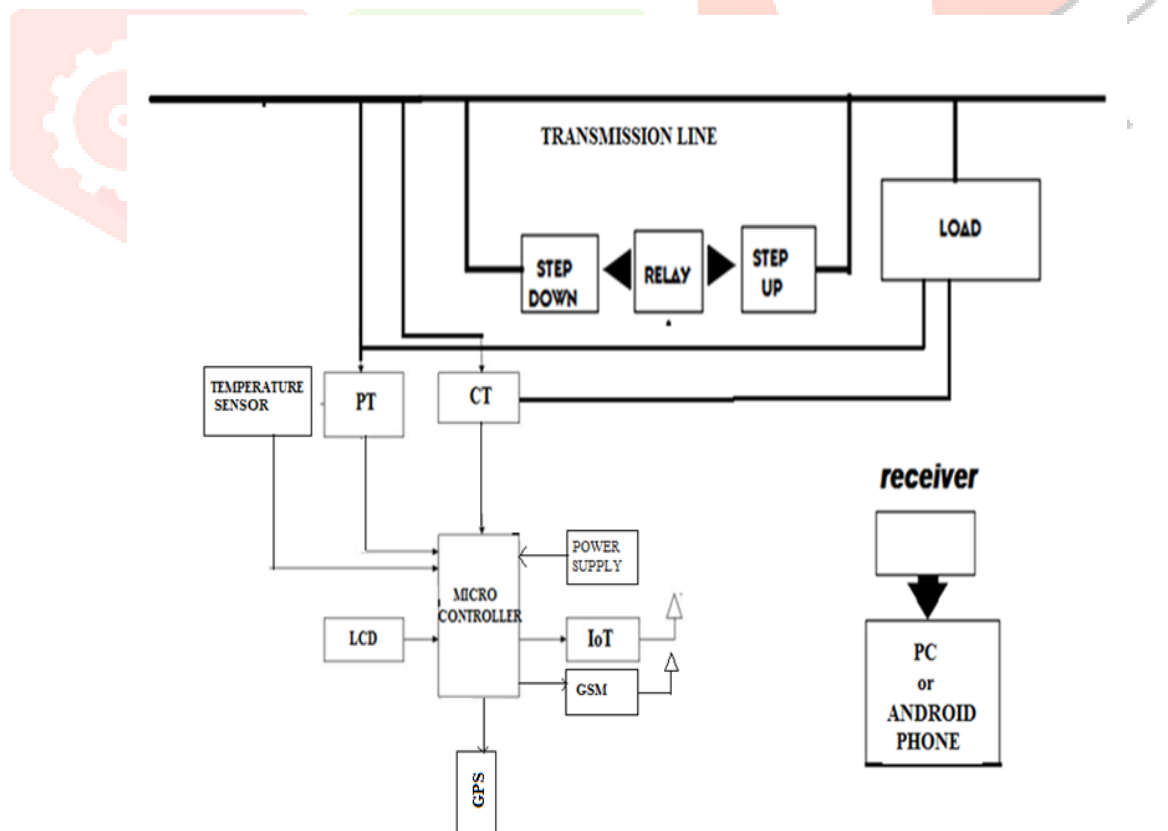


Figure. 3. Block Diagram

Electricity is very essential to understand and monitor the behaviour of the system. We present a survey of electric transmission line monitoring system. The goal of this project is to provide a better understanding of the design challenges of electric distribution line monitoring system and identify important research in this increasing important field. Proposed system used IOT (ESP8266) module and message notification send by using GSM SIM800 module.

To attain our concepts, we need to use PIC16F877 microcontroller, Voltage Transformer, Current Transformer, Temperature Sensor, LCD. The project is assembled with a set of resistors representing cable length in meters and fault creation is made by a set of sensors at every known meter to cross check the accuracy of the same. The voltage drop across the feeder resistor is given to an ADC which develops a precise digital data which the programmed microcontroller would display the same in meters. The fault occurring at what distance and which phase is displayed on LCD interfaced with the microcontroller. If the temperature higher than the threshold value at that time LCD will give intimation. Calculated value are sends to the internet with the help of IOT.

The microcontroller also calculates the fault distance, relative to the device based on an impedance-based algorithm and then relays this information to the modem for transmission. In summary, the microcontroller classifies, calculates the fault distance and relays the information to the modem for transmission via the serial communication interface (SCI) which serves as an interface between the microcontroller and the modem. The RS-232 serves as the connector between the microcontroller's serial communication port and the modem.

The device is placed in the boundary of the sectionalised regions in the transmission system and the location of the fault is calculated relative to the position of the device. The unique identity of the SIM card in the GSM modem is used.

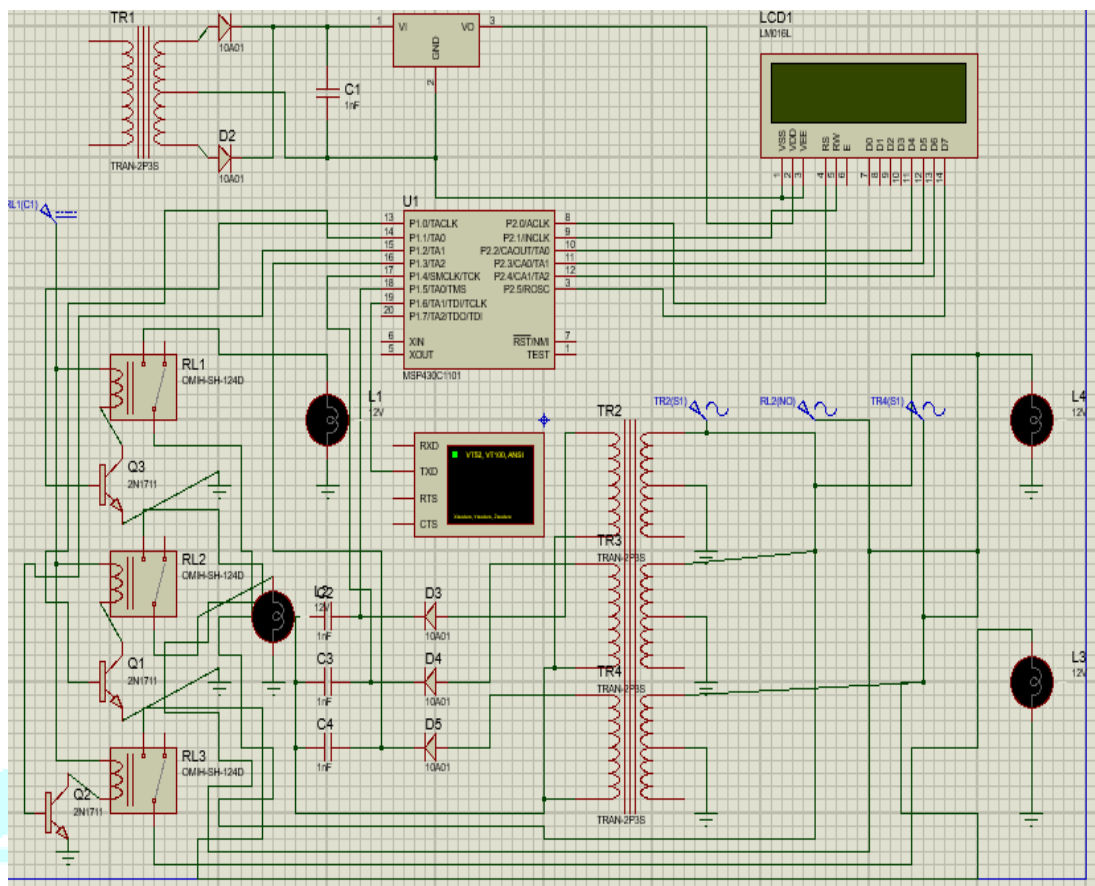


Figure: 4. Circuit Diagram

The Circuit consists of instrument transformer (CT & PT), 7805 regulator, PIC16F877A Microcontroller, NODEMCU, Relay driver, GSM SIM800 and LCD display. The primary winding of CT & PT is connected to the line to sense the corresponding current & voltage value of the system & feed the output to the ADC of the microcontroller. The ADC is inbuilt in the microcontroller. It converts analog signal to digital signal in order to be processed by the CPU of the microcontroller.

The development of the programming codes in microcontrollers for detecting the faults on the transmission lines has been progressed, especially in recent years. These several decision-making programming codes in microcontrollers have different solutions and techniques. Transmission and distribution lines are vital links between generating units and consumers. They are exposed to atmosphere, hence chances of occurrence of fault in transmission line is very high, which has to be immediately taken care of in order to minimize damage caused by it. The microcontroller contains a set of programming codes which have been stored in memory which enable it to classify the fault type based on the voltage and current values.

We have read the ac voltage by using pic microcontroller with the help of transformer, bridge rectifier & displayed over 16*4 lcd display. Then we have compared the AC voltage with predefined limits and displayed the alert message over the Lcd accordingly. Like if voltage below 150 v then we have shown low voltage and

if voltage is above 240v then we have shown high voltage text over the lcd. We can further add a relay to attach any ac appliances to auto cut off on low or high voltages.

5. POWER SUPPLY

A power supply (sometimes known as a power supply unit or PSU) is a device or system that supplies electrical or other types of energy to an output load or group of loads. The term is most commonly applied to electrical energy supplies, less often to mechanical ones, and rarely to others.

All digital circuits work only with low DC voltage. A power supply unit is required to provide the appropriate voltage supply. This unit consists of transformer, rectifier, filter and a regulator. AC voltage typically of 230Vrms is connected to a transformer which steps that AC voltage down to the desired AC voltage level. A diode rectifier then provides a full wave rectified voltage that is initially filtered by a simple capacitor filter to produce a DC voltage. This resulting DC voltage usually has some ripple or AC voltage variations. Regulator circuit can use this DC input to provide DC voltage that not only has much less ripple voltage but also remains in the same DC value, even when the DC voltage varies, or the load connected to the output DC voltage changes. The required DC supply is obtained from the available AC supply after rectification, filtration and regulation.

The main components used in the power supply unit are Transformer, Rectifier, Filter and Regulator. The 230V AC supply is converted into 12V AC supply through the transformer. The output of the transformer has the same frequency as in the input AC power. This AC power is converted into DC power through diodes. Here the bridge diode is used to convert AC supply to the DC power supply. This converted DC power supply has the ripple content and for normal operation of the circuit, the ripple content of the DC power supply should be as low as possible. Because the ripple content of the power supply will reduce the life of the circuit. So, to reduce the ripple content of the DC power supply, the large value of capacitance filter is used.

This filtered output will not be the regulated voltage. For this purpose, IC7805 regulator IC is used in the circuit.

5.1 Transformer

Transformer is a device used either for stepping-up or stepping-down the AC supply voltage with a corresponding decrease or increases in the current. Here, a transformer is used for stepping-down the voltage so as to get a voltage that can be regulated to get a constant 5V.

5.2 Rectifier

A rectifier is a device like semiconductor, capable of converting sinusoidal input waveform units into a unidirectional waveform, with a nonzero average component.

5.3 Filters

Capacitors are used as filters in the power supply unit. The action of the system depends upon the fact, that the capacitors store energy during the conduction period and delivers this energy to the load during the inverse or non-conducting period. In this way, time during which the current passes through the load are prolonged and ripple is considerably reduced.

5.4 Voltage Regulator

The LM78XX is three terminal regulators available with several fixed output voltages making them useful in a wide range of applications. IC7805 is a fixed voltage regulator used in this circuit.

6. PIC16F877A MICROCONTROLLER

The PIC microcontroller PIC16F877a is one of the most renowned microcontrollers in the industry. This microcontroller is very convenient to use, the coding or programming of this controller is also easier. One of the main advantages is that it can be write-erase as many times as possible because it uses FLASH memory technology. It has a total number of 40 pins and there are 33 pins for input and output. PIC16F877A is used in many pic microcontroller projects. PIC16F877A also have much application in digital electronics circuits.

PIC16F877a finds its applications in a huge number of devices. It is used in remote sensors, security and safety devices, home automation and many industrial instruments. An EEPROM is also featured in it which makes it possible to store some of the information permanently like transmitter codes and receiver frequencies and some other related data. The cost of this controller is low and its handling is also easy. It is flexible and can be used in areas where microcontrollers have never been used before as in microprocessor applications and timer functions etc.

7. GSM

The GSM system is the most widely used cellular technology in use in the world today. It has been a particularly successful cellular phone technology for a variety of reasons including the ability to roam worldwide with the certainty of being able to be able to operate on GSM networks in exactly the same way - provided billing agreements are in place.

The letters GSM originally stood for the words Groupe Special Mobile, but as it became clear this cellular technology was being used worldwide the meaning of GSM was changed to Global System for Mobile Communications. Since this cellular technology was first deployed in 1991, the use of GSM has grown steadily, and it is now the most widely cell phone system in the world. GSM reached the 1 billion subscriber point in February 2004, and is now well over the 3 billion subscriber mark and still steadily increasing.

7.1 GSM Services

Speech or voice calls are obviously the primary function for the GSM cellular system. To achieve this the speech is digitally encoded and later decoded using a vocoder. A variety of vocoders are available for use, being aimed at different scenarios.

In addition to the voice services, GSM cellular technology supports a variety of other data services. Although their performance is nowhere near the level of those provided by 3G, they are nevertheless still important and useful. A variety of data services are supported with user data rates up to 9.6 kbps. Services including Group 3 facsimile, videotext and teletex can be supported.

One service that has grown enormously is the short message service. Developed as part of the GSM specification, it has also been incorporated into other cellular technologies. It can be thought of as being similar to the paging service but is far more comprehensive allowing bi-directional messaging, store and forward delivery, and it also allows alphanumeric messages of a reasonable length. This service has become particularly popular, initially with the young as it provided a simple, low fixed cost.

8. NODE MCU

Node MCU is an open source IoT platform. Which includes firmware which runs on the ESP8266 Wi-Fi Module from Expressive Systems, and hardware which is based on the ESP-12 module. The term “Node MCU” by default refers to the firmware rather than the dev kits. Node MCU firmware was developed so that AT commands can be replaced with Lua scripting making the life of developers easier. So, it would be redundant to use AT commands again in Node MCU.

8.1 ESP8266 Feature

- Open-source
- Interactive
- Programmable
- Low cost
- Simple
- Smart
- WI-FI enabled
- USB-TTL included
- Plug & Play



Figure: 5. NODE MCU

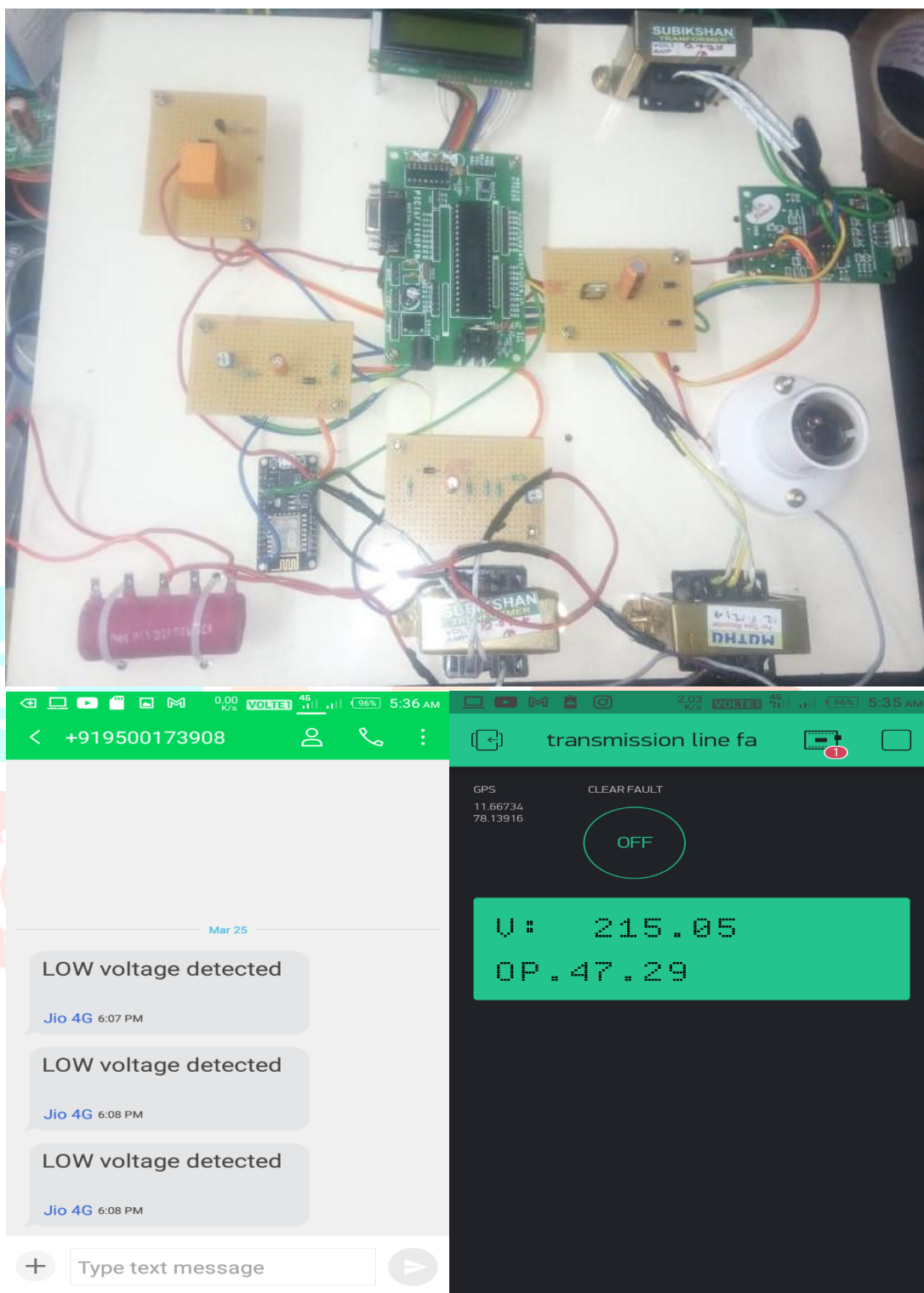
Advantages

- ❖ System cost is low compared to SCADA.
- ❖ We can see the data through online communication.
- ❖ Large number data aggregation.
- ❖ Predictive analysis.
- ❖ Time saving.

Applications

- ❖ Power grid primary distribution.
- ❖ High voltage transmission line.
- ❖ Micro grid.

9. RESULT AND PHOTO KIT:



10. CONCLUSION:

The proposed project inherits all drawbacks of the existing system. 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 a greater number of consumers in a highly populated country such as India.

11. FUTURE SCOPE:

In future, this project will enhance the fault detection in underground cables using Raspberry PI. It helps to detect which type of fault occurred and exact location of fault also.

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