

IoT Based Three Phase Power Monitoring and Failure Using SMS Alerts

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Abstract. When one among the three-phases of a system gets lost, it may cause a phase loss. This type of loss is referred as a 'single phasing' and it is caused by a lightning strike, broken power line, or mechanical failure in switching equipment. This advanced system monitors the power failure. We have R, Y, and B as three phases, when there is a failure in one among the three phases this system alerts the authorized person through an SMS. This IOT based system is connected to the GSM module for configuration purpose. This system indicates the power failure by displaying the value of voltage on the LCD display. Then this system alerts the authorized person by informing about the disconnected phase through an SMS. When the power is re-connected to the system, it informs that the phase is working fine through a text message, to the authorized person's mobile number. This is the way by which the authorized person gets notified about the power failure and he can take the necessary steps to solve the issue.

Keywords: Three phase failure detection, SMS alerts, IOT

1. Introduction

When a line fault occurs in the three phase transmission line, a change occurs in the current and voltage at the point of fault that generates a high frequency. The fault impedance being low, the fault current is relatively high, during the fault and the Voltage becomes unbalanced. We found that IOT is very powerful and effective concept for today's scenario. This IOT based technology allows the devices to connect to the internet and helps in monitoring and controlling the devices from anywhere in the world. The number of internet users is rapidly increasing as the advancement in computers and smart phones are developing day-by-day. About 70 billion devices will be provided with internet service by the year 2023. The most important requirements are the reliability and the security of the system and to provide good quality and uninterrupted power supply to the consumers. Due to lack of monitoring the system's utility do not get timely data on the health of lines. Utility comes to, only when there is a serious damage/failure. The power flow towards the fault and supply to the nearby zone is affected [1]-[8].

2. Problem Statement

The problems that are caused due to the phase failure are listed below:

- ❖ It may damage the heavy and costly equipment.
- ❖ It leads to complete failure of the equipment and damage of the component internally.
- ❖ Severe conflicts may occur due to the unexpected phase failures.
- ❖ At the time of phase loss the equipment like motor, blower, pump etc. will draw excessive current that leads to overheating of motor windings.

3. Block Diagram

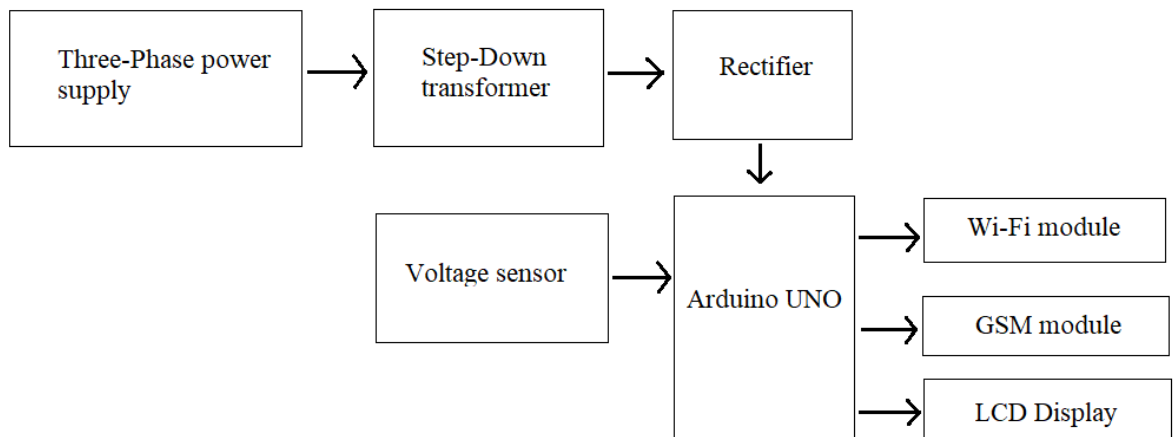


Fig 3.1: Block diagram

With the increase in the power supply need for the growing population and improvement in the technology it is mandatory to maintain an uninterrupted power supply and in case of any fault occurring in the transmission or distribution side the phase must be rectified as soon as possible to provide consumer with an uninterrupted supply. In case of any phase fault occurring in the system and to monitor the current and voltage flow in the transmission line we have done a project based on IoT and GSM. In the block diagram the power supply unit represents the three-phase AC transmission line supply which represents the real time three-phase power AC power supply [9]-[19]. The three-phase AC supply is connected with the voltage sensor and step-down transformer for reducing the voltage that is given as input to the Arduino. The voltage sensor is used to measure the voltage flow in the line and used to regulate the voltage that is supplied to the Arduino. The step-down transformer is connected to a rectifier circuit which converts the AC to DC to feed input to Arduino. The Arduino is connected to the IoT module, GSM module, and LCD display. The LCD displays the value of

current and voltage. The IoT module is used to upload the data regarding the voltage and current in the transmission line. The GSM module is used as a device that transmits SMS alert to the authorized person and maintenance team to alert about any fault occurring in the transmission line. When phase fault occurring in the transmission line or any change in the value of the current and voltage the Arduino sends signal to the GSM module and IoT module which transmits the data to the cloud and alert message to the authorized person mobile number which is linked with the Arduino program. With the help of this technology, it will be easy to monitor and rectify the faults occurring in the transmission line as soon as possible.

4. Components

The components used in the three phase power monitoring and indicating the failures requires:

Arduino

The Arduino is a microcontroller board which has 14 digital input/output pins and it develops open-source hardware and software. The Arduino acts as the main controller of the system, as it controls all the activities of the system. The activities of each devices in the system are programmed into the Arduino board. The code is uploaded to the Arduino UNO ATmega 328 from the arduino IDE. The Arduino is connected to a GSM module and to the IoT module to display and store the system's data that has been recorded.

Current Transformer

Current transformer is a device which used to produce a reduced value of current from the three phase power supply to the various instruments like meters, protective relays and other instruments. The current produced in the secondary which is proportional to its primary winding. The principle of the current transformer is slightly different form the principle of voltage transformer. Current transformers are used in different areas like generating stations, electrical substations, industrial and commercial purpose.

GSM Module

GSM(Global System for Mobile Communication) is a device that is developed for the second generation digital cellular network by the European communication standards. It is considered as the replacement for the second generation analog cellular networks.

It has evolved over a period of time with the inclusion of circuit switched data transport network and packet data transport using the GPRS technology. Packet data transmission was later increased using the EDGE technology. Later the GSM networks were advanced by using third generation Universal Mobile Telecommunication System(UMTS) by using the 3rd Generation Partnership Project(3GPP). GSM networks will be advanced further to incorporate with fourth generation advanced standards.

Thingspeak

ThingSpeak is a software which is written using the Ruby language which allows users to visualize and analyse the data of their work through internet. It is view data instantly which is uploaded by the user's device. It is a platform for analytic purpose. The MATLAB code can be used in the software for the purpose of online analysis and data processing. It is considered as a proof for IoT system which requires analytics.

- The devices are build in order to send data to ThingSpeak.
- More data are provide to the third party sources on-demand.
- We can use the MATLAB to make sense of your IoT data.
- Ability to analyse the data on the schedule time and events.
- Prototype and build IoT systems without developing the web software or setting up the servers.

Sensors

The sensor is a device that is used to sense the devices which can detect and control items in both the physical and digital worlds. The sensors acts as the medium of input for the devices. The sensor used is,

- **Voltage Sensor:** It is a device that is used to calculate and monitor the value of voltage. If there is any phase failure occurs voltage drop will occur which convey signal to Arduino.

LCD Display

A 16*2 display is used as shown in figure 4.2. It displays the status of the loads. It is one kind of electronic display module used in an extensive range of applications like various circuits & devices like mobile phones, calculators, computers, TV sets, etc. These displays are mainly preferred for multi-segment, light-emitting diodes, and seven segments.

The main benefits of using this module are inexpensive; simply programmable, animations, and there are no limitations for displaying custom characters, special and even animations, etc.

5. Software Description

Proteus 8 Professional Software

Proteus 8 Professional is software that can be used to draw schematics, PCB layout, and code and even simulate the schematic. It is developed by Labcenter Electronic Ltd.

Features

The circuit is tested using Proteus's simulation feature. Many of the components in Proteus

can be simulated. There are two options for simulating: Run simulator and advance frame by frame. The "Run simulator" option simulates the circuit at a normal speed (If the circuit is not heavy). The "Advance frame by frame" option advances to the next frame and waits till you click this button for the next time. This can be useful for debugging digital circuits. It can also simulate microcontrollers. The microcontrollers which can be simulated include PIC24, dsPIC33, 8051, Arduino, ARM7 based microcontrollers. We can download the compilers for Proteus or use a different compiler and dump the hex files in the microcontroller in Proteus. You can even interact in real-time with the simulation using switches, resistors, LDRs, etc. There are even virtual voltmeter, ammeter, oscilloscope, logic analyzer, etc.

Arduino IDE

The Arduino Integrated Development Environment - or Arduino Software (IDE) - contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions and a series of menus. It connects to the Arduino and Genuino hardware to upload programs and communicate with them.

6. Simulation and Analysis

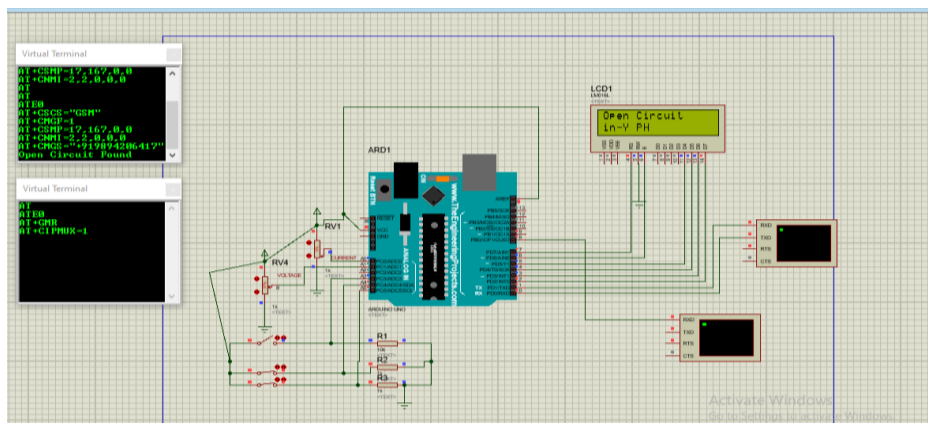


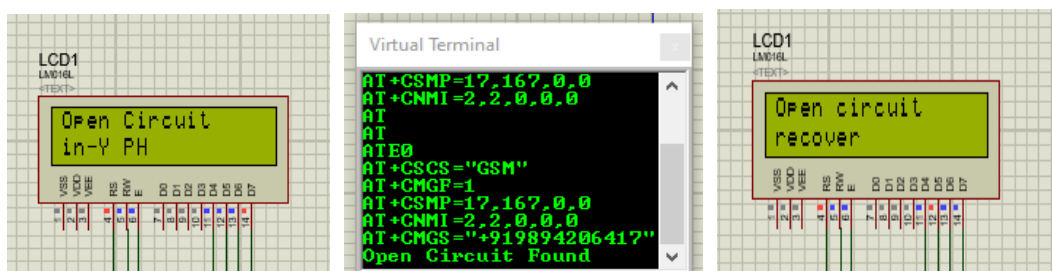
Fig6.1: Simulation

This simulation model is for IoT-based three phase power monitoring and failure with SMS alerts. This simulation analysis was carried by the Proteus Software which is used to add and modify the components after compiling the program source code.

7. Results and Discussion

Simulation Result

The design of the prototype is done in the simulation software and developing the Arduino program, the program is loaded to the Arduino Uno by using Arduino IDE.



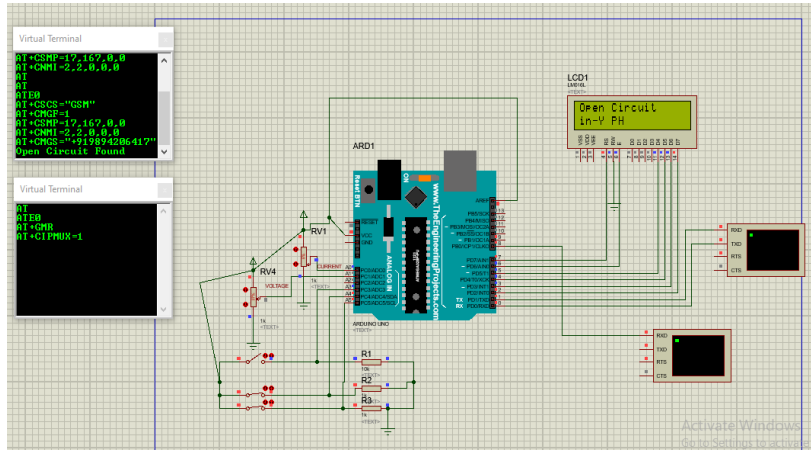
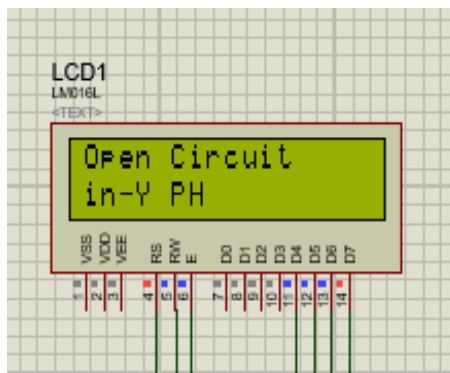


Fig 7.1:Simulation Result

The above figure shows the simulation result of IoT-based Three-Phase Power Monitoring and Failure with SMS Alerts which helps the user to detect the fault in advance and monitor the power supply through the IoT platform.



The above LCD result shows that there is a phase fault that occurred in the transmission line which needs to recover.

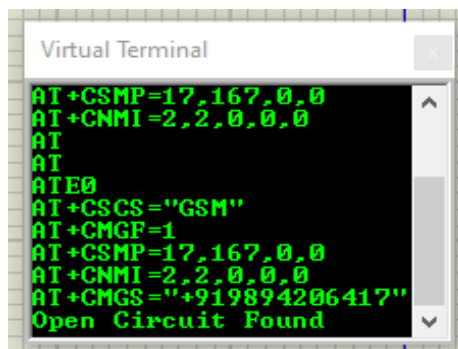


Fig 7.3: Alert sent to the mobile displayed in a virtual terminal

The above figure represents the virtual terminal that displays the message that will be sent to the registered mobile number. In real-time an SMS will be sent by the GSM module to the registered mobile number.

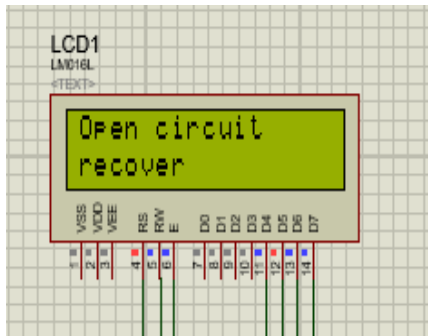


Fig 7.4: LCD result displaying system recovery

The above figure represents the LCD displaying the system recovery message and the circuit is in normal condition.

Hardware Result

The LCD shows the value of voltage and current from the supply.



Fig 7.5: Result Display on LCD

The details of the phase failure can be viewed and monitored through Arduino using the cloud server.

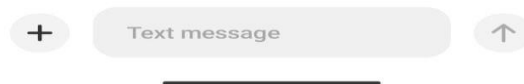
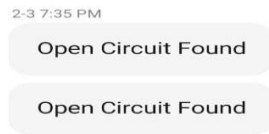


Fig 7.6: Result Display on Phone

The below graph represents the details of the current and voltage value of the system and it is monitored to improve uninterrupted supply. The monitoring of the system is based on these analyses to avoid the interruption in supply and these details are stored in the cloud server for later use.

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Fig 9: Result on IoT cloud platform

Result Display On Phone

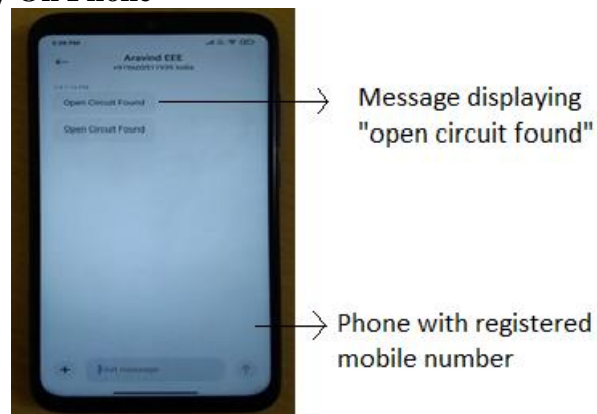


Fig 7.7: Result Display on Phone

The above picture represents the SMS alert that will be sent by the GSM module to the registered mobile number displaying the result as “open circuit found” about the phase fault in the circuit.

8. Conclusion

The three phase power monitoring and failure alert system works to get the knowledge about the phase failure using IoT. The power failure among the three phases is reported to the cloud server. The need for uninterrupted power supply is increasing day by day. By using this system we can get to know about the failure in advance and take necessary actions to solve the issue. Arduino system is used to detect the power failure, alert the authority through an SMS, and LCD display connected with the microcontroller used to display the value of voltage and current. This can be implemented by sensors for failure detection, through the alert system using IoT

Future Scope

- This prototype can be used in Electrical Substations, Industries, and all the places where there is use of three-phase supply.
- Since this is based on IoT it can be used in smart cities as Internet connectivity is high in these areas which helps in quick fault detection and uninterrupted supply of power.
- This system can be used by high-power consumers as they can monitor the supply 24x7 through IoT platform and avoid major interruption in supply.

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