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Automatic Isolation for Faulty Distribution Line and Load Shearing

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ABSTRACT

The demand on electric power supply in the world has increased drastically both quantitatively and qualitatively. This necessitates increases need for a steady power supply with minimum power interruption and fast fault restoration. To meet these demands computer-aided monitoring, control and management of electric power distribution system are to be adopted. Electrical Engineers who are in charge of designing power distribution systems carry a huge responsibility since their work determines the operational efficiency, productivity and safety of homes, offices and commercial sectors. Designs need to be fool-proof, providing protection against faults and overloads, while at the same time ensuring safety for the consumers**.** Protect system from unnecessary service interruptions and disconnect faulty lines, transformers or other apparatus. Overhead distribution systems are subject two types of electrical faults, namely, transient (or temporary) faults and permanent faults. Necessary backup must be provided to avoid the total hut down situation. That means suppose the any one area is isolated due the abnormal condition. The second backup supply must be provided to that particular area. Automation is considered as the important aspect in current scenario. Automation of electrical distribution field can be helpful in enhancing of efficiency, increase in reliability and most important is the electric service quality. Automation helps in reduction of human efforts, enhance human operator capability and most important save lot of time. Insulation and damage of appliances due to under and over voltage problem is typically seen in Indian scenario. This work is about the catastrophic condition due to under and over voltage problem. This problem can be economically reduced by the automation methodology. In this paper GSM Module with SMS alert system is designed and developed to automate the electric distribution system.

INTRODUCTION

An electric power system or electric grid is known as a large network of power generating plants which connected to the consumer loads. Electrical energy is a form of energy where we transfer this energy in the form of flow of electron. So, electrical energy is obtained by converting various other forms of energy. Historically, we have done it from chemical energy using cells or batteries. In light of the increasing importance of distributed energy resources (DERs) in the electricity system, there is an ongoing need to understand the current status of electric power distribution across the world. This review paper compiles key information about the distribution systems in 175 countries worldwide. The findings for each country include the number, legal structure and ownership of distribution system operators, the access to electricity they provide, distribution level voltages, electric power frequency and the significance of renewable electricity generation. This study covers 99.4% of the world's population. As of June 2018, there are around 7600 distribution system operators in these 175 countries. After reviewing today's distribution system status, this paper also reviews the various Discussions and proposals for tomorrow's electric power distribution. In the existing system monitoring of transformer is done using wired network here continuous monitoring is not possible all the time which may lead to malfunction or failure of distribution transformer. Our proposed system provides effective monitoring and protection of distribution transformer by measuring it oil level, oil quality, temperature and tank leakage, short circuit, over voltage, over current, copper theft, fault location of transformer without involving human intervention. As they are located at different geographical areas periodical monitoring is not possible all the time due to insufficient man power. Due to this reason transformer failure may occur which leads to unexpected power shutdown. To overcome this shutdown due to transformer failure we proposed a system for monitoring the transformer. The aim of this project is to monitor and protect oil quality, temperature, and current, fuse open or closed and voltage level of transformer without involving man power. If any critical condition occurs the SMS will be send to the operator through IOT modem as well as any faulty condition occur then fault is directly display on the LCD.

1 **Types of faults:** There are mainly two types of faults in the electrical power system. Those are as following: a) symmetrical and b) unsymmetrical faults. Symmetrical faults: These are very severe faults and occur infrequently in the power systems. These are also called as balanced faults there are mainly two types namely a) line to line to line to ground (L-L-L-G) and b) line to line to line (L-L-L). Analysis of these faults is easy and usually carried by per phase basis. Three phase fault analysis or information is required for selecting set-phase relays, rupturing capacity of the circuit breakers and rating of the protective switch gear. Unsymmetrical faults: These are very common and less severe than symmetrical faults.

2 **Fault identification/service restoration:** Distribution systems are operated as a set or sets of radial feeders supplied from one or more substations. Upon the occurrence of a fault the feeder breaker will trip and automatically recluse a number of times. If the fault clears before the enclosure is complete, there is no further action required. However, if the breaker again trips and locks open, the automation system determines the fault location, by interference from monitored information on the flow of fault current, and insolates the faulted line section by opening appropriate line switches.

3 **Transformer Load Management:** Transformer Load Management is executed to maximize the utilization of Transformer capacity or to reduce system losses. The remote monitoring capability provides for operating a supply transformer up to its maximum allowable loading. Load can be controlled at this stage by reconfiguring the downstream system, by suppressing customer loads using the load management function. When more than one transformer supplies the distribution system, transformer loads may be balanced to reduce losses, and during light load periods, one or more supply transformers may be switched out of the system for further loss reduction.

4 **Detection and Working System:** The Proposed distribution system for theft detection shown in following Figure 2 is used for low voltage and limited consumer's distribution system. The system shown in Figure 2 belongs to only one distribution transformer network and should be repeated for every distribution network. In the Proposed distribution system, every consumer has a GSM based smart energy meter assigned to a specified address. These smart energy meters having featured sending to send their reading values to a central base station through GSM. Meters supporting automatic meter reading (AMR) can report demand to utilities automatically via communication Networks. While in case of bypassing or neutral grounding it will detect that the consumer stopped the meter. It will stop the Power supply to the consumer by sending a signal, to operate the circuit breaker and then send SMS to the central station to charge the consumer for doing illegal acts. Similarly, this proposed distribution system also having a GSM based energy meter connected to the secondary winding of a distribution transformer; it will also send total reading value to the central base station.

5 **Automation of Distribution System**: DA functions provide a means to more effectively manage the minute-by- minute continuous operation of a distribution system. A DAS has three basic capabilities: 1. Monitoring 2. Control 3. Protection 2.1 Monitoring: Monitoring refers to the ability of the automation systems to be determined the state of the distribution system including status (contacts opened or closed etc.), analog values (voltage, current) etc. 2.2 Control: Control refers to the ability of the automation system to alter the state of the distribution system, so that the system operates to achieve utilization and quality of service objectives. 2.3. Protection: Protection refers to the ability of the automation system to detect and identify the location of distribution system faults and to isolate the faulted circuit or equipment from the distribution system by the operation of fault interrupting devices.

I. BLOCK DIAGRAM

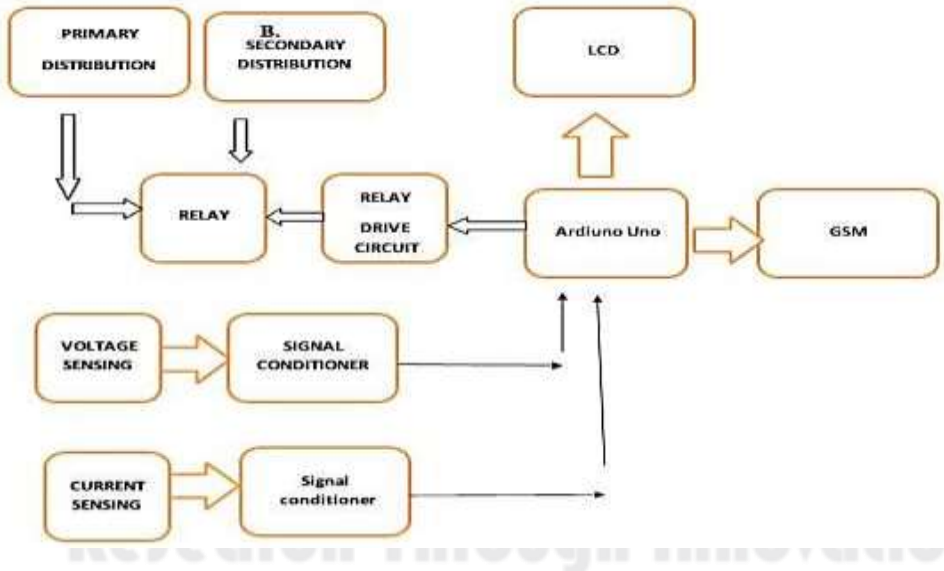


Figure1: Functional block diagram of the project

II. HARDWARE DESCRIPTION

➢ POWER SUPPLY

The potential transformer will step down the power supply voltage (0-230V) to (0-6V) level. Then the secondary of the potential transformer will be connected to the precision rectifier, which is constructed with the help of op–amp. The advantages of using precision rectifier are it will give peak voltage output as DC, rest of the circuits will give only RMS output.

➢ Basic Concept of GPS:

The GPS concept is based on time and the known position of specialized satellites. The satellites carry very stable atomic clocks that are synchronized with one another and to ground clocks. Any drift from true time maintained on the ground is corrected daily. Likewise, the satellite locations are known with great precision. GPS receivers have clocks as well; however, they are usually not synchronized with true time, and are less stable. GPS satellites continuously transmit their current time and position. A

GPS receiver monitors multiple satellites and solves equations to determine the precise position of the receiver and its deviation from true time. At a minimum, four satellites must be in view of the receiver for it to compute four unknown quantities (three position coordinates and clock deviation from satellite time).

- **Arduino Uno**:

The Arduino Uno is an open-source microcontroller board based on the Microchip ATmega328P microcontroller and developed by Arduino.cc and initially released in 2010. The board is equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards (shields) and other circuits. While the Uno communicates using the original STK500 protocol it differs from all preceding boards in that it does not use a FTDI USB-to-UART serial chip. Instead, it uses the Atmega16U2 (Atmega8U2 up to version R2) programmed as a USB-to-serial converter.

- **Relay Circuit**:

The traditional form of a relay uses an electromagnet to close or open the contacts, but relays using other operating principles have also been invented, such as in solid-state relays which use semiconductor properties for control without relying on moving parts. Relays with calibrated operating characteristics and sometimes multiple operating coils are used to protect electrical circuits from overload or faults; in modern electric power systems these functions are performed by digital instruments still called protective relays.

- **CT & PT:**

Current transformers are generally used to measure currents of high magnitude. These transformers step down the current to be measured, so that it can be measured with a normal range ammeter. A Current transformer has only one or very few number of primary turns. Potential transformers are also known as voltage transformers and they are basically step down transformers with extremely accurate turns ratio. Potential transformers step down the voltage of high magnitude to a lower voltage which can be measured with standard measuring instrument.

- **LCD DISPLAY**

LCD 16x2 is a 16-pin device that has 2 rows that can accommodate 16 characters each. LCD 16x2 can be used in 4-bit mode or 8-bit mode. It is also possible to create custom characters. It has 8 data lines and 3 control lines that can be used for control purposes.

- **GSM MODULE**

A GSM modem or GSM module is a device that uses GSM mobile telephone technology to provide a wireless data link to a network. GSM modems are used in mobile telephones and other equipment that communicates with mobile telephone networks. They use SIMs to identify their device to the network.

- **WORKING OPERATION**

In the existing system monitoring of transformer is done using wired network here continuous monitoring is not possible all the time which may lead to malfunction or failure of distribution transformer. Our proposed system provides effective monitoring and protection of distribution transformer by measuring it oil level, oil quality, temperature and tank leakage, short circuit, over voltage, over current, copper theft, fault location of transformer without involving human intervention. As they are located at different geographical areas periodical monitoring is not possible all the time due to insufficient man power. Due to this reason transformer failure may occur which leads to unexpected power shutdown. To overcome this shutdown due to transformer failure we proposed a system for monitoring the transformer. The aim of this project is to monitor and protect oil quality, temperature, and current, fuse open or closed and voltage level of transformer without involving man power. If any critical condition occurs the SMS will be send to the operator through IOT modem as well as any faulty condition occur then fault is directly display on the LCD.

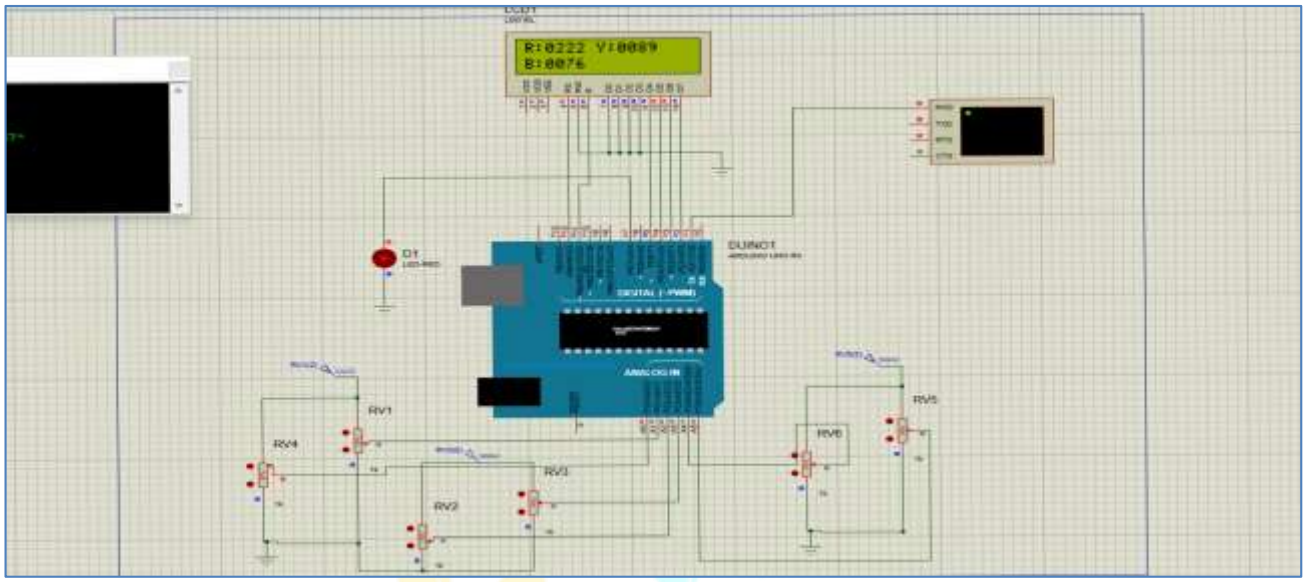
RESULT & SIMULATION DESIGN

- **Result**

Case 1: At normal operation condition distribution line supply electricity to the consumer in healthy condition. Above figure shows LED is an ON state and no fault detection in line. Voltage rating condition is programmed in Uno with the help of software. We give the condition of overvoltage and under voltage or cut in supply. Normal 230v is given condition to system when normal operation condition. Here supply continuously passes to the consumer without interrupting any disturbance.

Case 2: When transformer gets overloaded then then circuit is trip by relay with the help of measuring instrument of CT and PT. Measuring instrument is connected to the Arduino Uno. In overloaded condition value of current is increased than rated normal operating current, then relay is trip to system immediately. In above figure shows LED is an off state in overloaded condition. Also LED is off state in overloaded, faulty and open circuit condition. When fault clear then circuit starts in normal operating condition and LED is indicated ON state of Load.

- **SIMULATION DESIGN**



- **Result Table:**

Sr. No	Condition of system	Result
Case 1	Normally operated	LED is an on state, no fault
Case 2	Fault Detected	LED is an off state, At faulty condition Supply disconnected.

CONCLUSION

Conclude that the automation helps in reduction of human efforts, enhance human operator capability and most important save lot of time. Insulation and damage of appliances due to under and over voltage problem is typically seen in Indian scenario. This work is about the catastrophic condition due to under and over voltage problem. This problem can be economically reduced by the automation methodology. In this paper GSM Module with SMS alert system is designed and developed to automate the electric distribution system. Distribution Automation function provides a means to more effectively manage the minute-by-minute continuous operation of a distribution system.

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