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Advance Substation Monitoring And Protection System

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ABSTRACT

This project aims at continuously monitor the load conditions of the substation. It also monitors the temperature of the devices present in the substation. If the load increases beyond the substation's rated capacity, the microcontroller will automatically shut down the substation and intimates the same to the operator by sending a message through a GSM modem. The GSM modem provides the communication interface. It transports device protocols transparently over the network through a serial interface. A GSM modem is a wireless modem that works with a GSM wireless network. A wireless modem behaves like a dial-up modem. The main difference between them is that a dial-up modem sends and receives data through a fixed telephone line while a wireless modem sends and receives data through radio waves. If the temperature of the substation increases, then the microcontroller will automatically start the cooling system for the substation. AT any point, if the operator wants to know the loads conditions and the temperature, he has to send a predefined message to the modem which is interfaced with the microcontroller and the controller acknowledges the operator with the required information.

Keywords: Microcontroller, Protection System

1. INTRODUCTION

Supplying electricity to consumers necessitates power generation, transmission, and distribution. Initially electric power is generated by using electric generators such as: nuclear power generators, thermal power generators and hydraulic power generators and then transmitted through transmission systems using high voltage.

Power departs from the generator and enters into a transmission substation, where huge transformers convert the generator's voltage to extremely high voltages (155kV to 765 kV) for long-distance (up to about 300 miles) transmission.

Then, the voltage level is reduced using transformers and power is transferred to customers through electric power distribution systems. Power starts from the transmission grid at distribution substations where the voltage is stepped-down (typicaly to less than 10kV) and carried by smaller distribution lines to supply commercial, residential, and industrial users.

Monitoring and controlling of substations is an important task for supplying healthy power to the consumers in this automated era. But due to the aging infrastructure of the distribution grids (substations) and lack of automation systems that monitors the critical conditions at the substations, the risk of blackouts, brownouts and fire are rapidly increasing. Substations consist of different electronic components like transformers, circuit breakers, relays etc.

The transformer fluid leaks or internal insulation breakdown cause overheating that leads to failures.

The traditional method includes periodic manual checking of the system which is time consuming and with very low accuracy. Also the substations in the rural areas are even more difficult to monitor manually and hence requires more time to take respective actions.

2. METHODS & Material

[A] GSM MODULE:

GSM/GPRS module is used to establish communication between a computer and a GSM-GPRS system. Global System for Mobile communication (GSM) is an architecture used for mobile communication in most of the countries. Global Packet Radio Service (GPRS) is an extension of GSM that enables higher data transmission rate.

GSM/GPRS module consists of a GSM/GPRS modem assembled together with power supply circuit and communication interfaces (like RS-232, USB, etc) for computer. The MODEM is the soul of such module.

[B] WIRELESS MODEMS:

Wireless MODEMs are the MODEM devices that generate, transmit or decode data from a cellular network, for establishing communication between the cellular network and the computer. These are manufactured for specific cellular network (GSM/UMTS/CDMA) or specific cellular data standard (GSM/UMTS/GPRS/EDGE/HSDPA) or technology (GPS/SIM). Wireless MODEMs like other MODEM devices use serial communication to interface with and need Hayes compatible AT commands for communication with the computer (any microprocessor or microcontroller system.

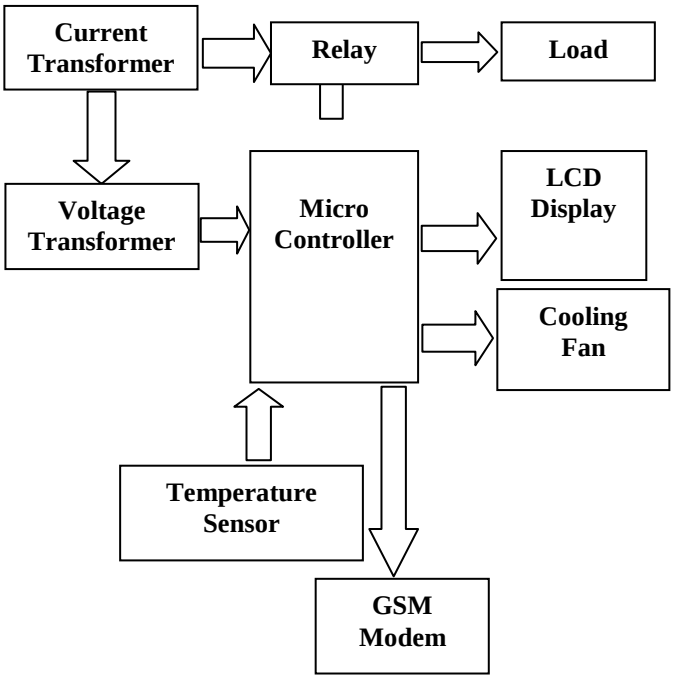
[C] GSM/GPRS MODEM:

GSM/GPRS MODEM is a class of wireless MODEM devices that are designed for communication of a computer with the GSM and GPRS network. It requires a SIM (Subscriber Identity Module) card just like mobile phones to activate communication with the network. Also they have IMEI (International Mobile Equipment Identity) number similar to mobile phones for their identification. A GSM/GPRS MODEM can perform the following operations:

1. Receive, send or delete SMS messages in a SIM.
2. Read, add, search phonebook entries of the SIM.
3. Make, Receive, or reject a voice call.

The MODEM needs AT commands, for interacting with processor or controller, which are communicated through serial communication, these commands are sent by controller/processor. The MODEM send back a result after it receives a command. Different AT commands supported by the MODEM can be sent by the processor/controller/computer to interact with the GSM and GPRS cellular network.

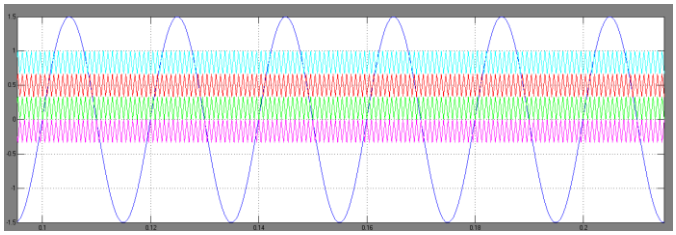
3. BLOCK DIAGRAM:



[Block Diagram of System]

The solution to all these problems is automation of the substations. The various parameters like current,

temperature and voltage are continuously sensed with the help of different sensors. The outputs of these sensors is given to Ana log to Digital Converter (ADC) and then to the microcontroller. Microcontroller is pre-programmed in such a way that if the parameters exceed predefined threshold value then it will inform the intermediate or main station with the help of wireless comunication technologies like GSM.



Sinusoidal Waveform

System is divided into two different modules. One is located at the local substation and another at the intermediate station. Current and temperature are sensed by using the respective sensors. For voltage measurement AC to DC step down circuitry is used and potentiometer to vary the voltage. All these parameters will be displayed on LCD 16X2. If any of the parameter exceeds to some threshold value, buzzer will beep for indication purpose. Also an SMS will be send to some authorised person. Heart of the system is Microcontroller. AVR Microcontroller is used to monitor and control the system. Module at local substation Fig. consists of isolation transformer that represents substation, also known as distribution transformer.

The system not only controls the distribution transformer in the substation by shutting it down, but also displays the values on LCD. This claims that the proposed design of the system makes the distribution transformer more robust against some key power quality issues which make the voltage, current or temperature to peak .

Design Procedures: The design procedures for the proposed microcontroller based system is described as follows define the interfacing parameters for LCD and Data Registers. Assign a value for the circuit elements such as Relay, LED, Buffer and Fan. Initialize the input and output ports of the microcontroller. The functions defined for capturing the current, voltage and temperature values are called and executed. The displaying function is called and the parameter values are displayed.

4. ADVANTAGES:

1. Devices can be operated from anywhere in the world.
2. Feedback of the devices being operated is present.
3. Efficient and low cost design.
4. Low power consumption.
5. Real time monitoring.

5. DISADVANTAGE:

1. Depends on the network signal strength.

6. APPLICATION:

1. This system can be implemented in industries.
2. This system can be used to monitoring and controlling the home appliances.

7. CONCLUSION:

The current project describes a monitoring system for distribution transformers utilize the existing GSM communication network, which has low investment and operation costs. It is also easy to install and use. It may reduce human efforts with the automation of the substation which increase transformer life, reduce faults and increase stability. It increases the efficiency of the system. This leads to accurate and reliable operations. It will provide fast and easy monitoring with more efficient way as compared to existing manual monitoring of the sub-station.

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