Substation Monitoring and Control Using Microcontroller & GSM

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Abstract - *The purpose of this project is to acquire the remote electrical parameters like voltage, current and frequency and send these real time values over gsm network using gsm modem/phone along with temperature at power station. This project is also designed to protect the electrical circuitry by operating an spdt relay. This relay gets activated whenever the electrical parameters exceed the predefined values. The relay can be used to switch off the main electrical supply. User can send commands in the form of sms messages to read the remote electrical parameters. This system also can automatically send the real time electrical parameters periodically (based on time settings) in the form of sms. This system can be designed to send sms alerts whenever the relay trips or whenever the voltage or current exceeds the predefined limits. This project makes use of a microcontroller. The controller can efficiently communicate with the different sensors being used. The controller is provided with some internal memory to hold the code. This memory is used to dump some set of assembly instructions into the controller. And the functioning of the controller is dependent on these assembly instructions. The controller is programmed using embedded c language*

Key Words:
Microcontroller, Real time monitoring, Arduino compiler for Embedded C programming, Proteus for hardware simulation, 3- Phase supply

1. INTRODUCTION

The distance between the generators and load may be in terms of hundreds of miles hence the amount of huge power exchange over long distances has turned out as a result of the lack of quality of the electric power. During the earlier development stages the issues on quality of power were not frequently reported. Demanding the quality of power being delivered at the user side has raised the alarm due to the increase in demand of electricity in the customer side. A huge amount of power is lost during the transportation of the general power which leads to the reduction in the quality of power received at substation.

To Improve the quality of power with suffer solution it is necessary to be familiar with what sort of constraint has occurred. Additionally if there is any inadequacy in the protection, monitoring and control of a power system. The system might become unstable. Therefore it necessary a monitoring system that is able to automatically detect, monitor, and classify the existing constraints on electrical lines.[1]

Today electricity still suffers from power outages and blackouts due to the lack of automated analysis and poor visibility of the utility over the grid.WSN will give the utility provide the needed view by collecting information from the different sub-systems of the grid. A sensor node will decide information or to slightly delay this notification (whether to immediately notify the sink about this information.).PB COOP operation

1) The evaluation of sense data: we define three priority levels {0, 1, and 2}

2) The selection of a communication policy: priority 0-no further action is performed, priority 2-value is sent to the sink because it is considered as urgent and a notification needs to be directly sent, priority 1-we consider that value should be reported because it may signal as fault or a problem that is less urgent than priority-2 data.[2]

Development of intelligent electronic devices (IED's) brings a leap in the development of substation. Large scale development of IED's create huge amount of data either recorder continuously or captured when IED's triggered by an event such as a fault or disturbance. Criteria for the new system: cost, reliability, cyber security, scalability and maintainability and minimal co-dependencies.the high voltage substation includes the primary equivalent such as C.B, transformer, protection devices and the secondary equivalent such as monitoring, control and protection devices. In addition, due to large number of wires in a highly electromagnetically "polluted" substation switchyard

environment, the wiring may experiences significant electromagnetic interference.[3]

1.1 OBJECTIVE OF PAPER

- ➤ To improve quality of power
- ➤ Remote sensing
- ➤ To Maintain Continuity of supply
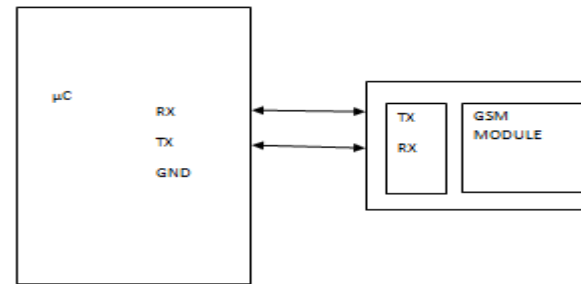- ➤ Real time monitoring.

1.2 BLOCK DIAGRAM

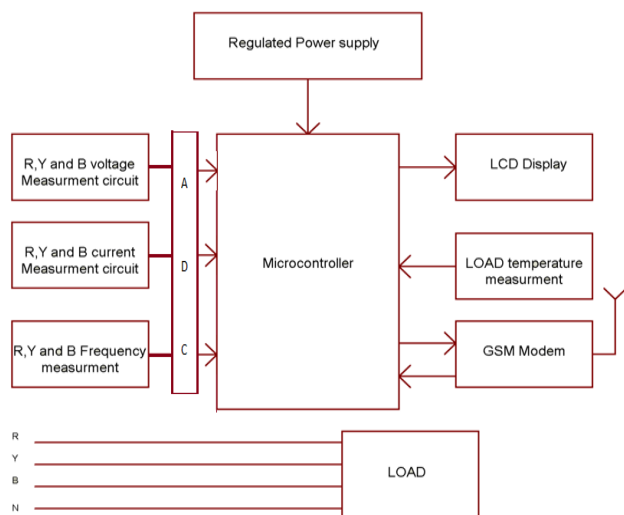**Fig -2**: GSM interfacing with Microcontroller
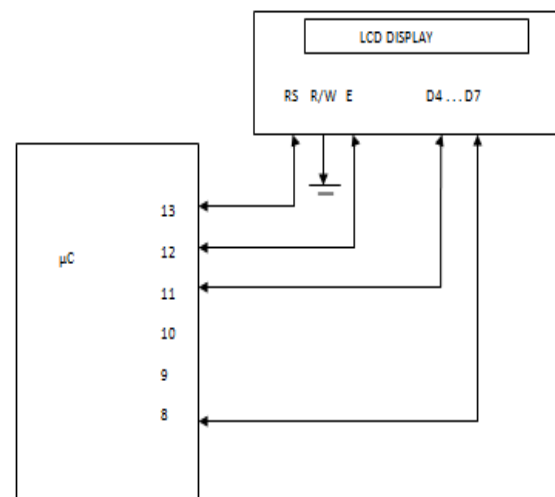

Fig -1: Block Diagram of project

2. RELATED WORK

GSM interfacing with microcontroller:

Features of SIM GSM SIM 900A: dual band 900/1900HZ, low power consumption up to 10mA, operating temp -40˚C t0 85˚C.input voltage is 7.5V. AT commands are used for interfacing.

(“AT+CMGF=1”); //enable text configuration,

(\r’);=enter

(“AT+CMGS=”); //enable phone number command

(“+9197………); //phone number

(0×1A); //to sends SMS

Fig -3: LCD interfacing with Microcontroller

Design Procedures:

The design procedures for the proposed microcontroller based system is described as follows
1. Define the interfacing parameters for LCD and Data Registers.
2. Assign a value for the circuit elements such as Relay, LED, LCD, and Analog Inputs.
3. Initialize the input and output ports of the microcontroller.
4. The parameter values are displayed.

3. HARDWARE IMPLEMENTATION:

3.1 Current Measurement circuit:

- ACS712 current sensor: 185mv/A output sensitivity, supply voltage=8V, output voltage=8V, storage temp=-65°C t0 165°C

- Pin no: VCC=+5v, OUT, GND
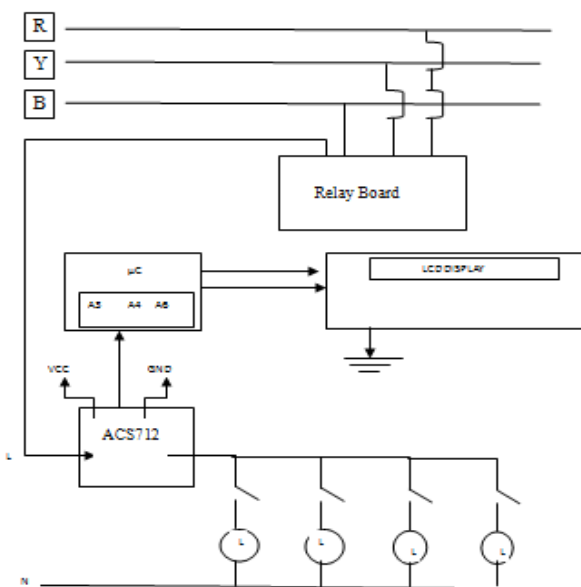
- Apparatus: Load, relay (10A capacity), GSM, LCD

Fig -4: Block diagram representation of current measurement circuit

Working:

The circuit makes use of current sensor ACS712. Three current sensors are employed for the purpose of measuring currents in all 3 phases. One connection is done with the incoming phase wire and on the other connection is done with the wire on which the load is connected. For current the upper limit is set at 1.6A. The limit can be easily altered in case the load is changed. Here 4 lamps are connected as load. Limits are set such that the circuit operates satisfactorily if 3 lamps are turned ON. When the 4th lamp is switched ON the relay operates and isolates the circuit. A message is sent through GSM stating the condition as overload. When the 4th lamp is switched OFF, the relay again operates to connect the load with the supply. Again a message is sent stating that the power has been restored.

3.2 Frequency Measurement circuit:

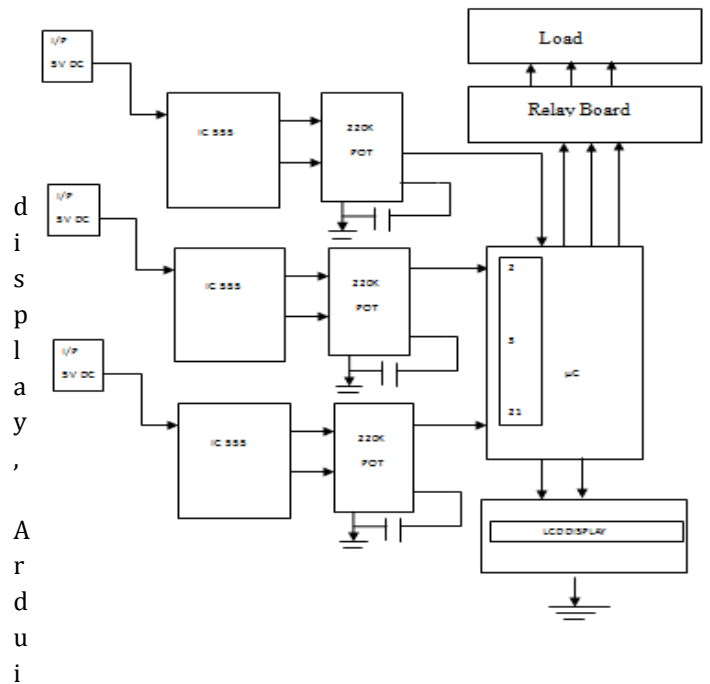- Apparatus: IC 555 Timer, 220K POT, +5V DC, GSM, LCD display,

Fig -5: Block diagram representation of Frequency measurement circuit

Working:

The circuit makes use of IC555 timer. The IC555 is made to work in Astable mode. Three IC's are employed for the purpose of varying frequency in all 3 phases (As it is not possible to change the supply frequency). The lower limit for frequency is 48Hz and the upper limit is kept as 52Hz for the purpose of the project.. The limit can be easily altered as per the requirement. The circuit operates satisfactorily if the frequency is within the limits. The relay operates and isolates the circuit if the frequency falls outside the above limits. A message is sent through GSM stating the sensed condition as under frequency or over frequency. As the frequency comes back within the limit, the relay connects the load with the supply.

3.3 Voltage Measurement circuit:

- Apparatus: 3-Phase supply, 3-Phase variac, Transformer, Bridge Rectifier, register, LCD Display, Arduino
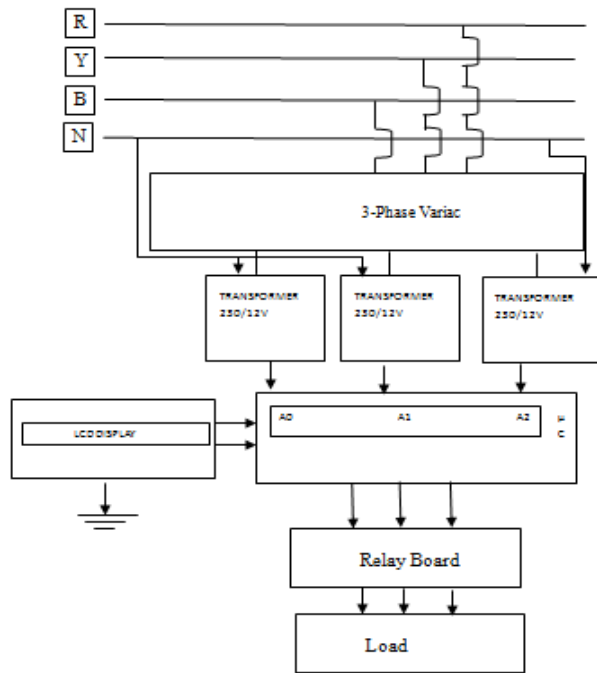

Fig -6: Block diagram representation of Voltage measurement circuit

Working:

Three transformers are employed for the purpose of stepping down 3 phase voltage. One connection is done with the incoming phase wire and the other connection is done with the neutral wire. For our project we have set the working voltage range between 210V to 250V. The voltage is varied with the help of 3 phase variac. The limit can be easily altered as per the requirement. The circuit operates satisfactorily if the voltage is within the limits. The relay operates and isolates the circuit if the voltage falls outside the above limits. A message is sent through GSM stating the sensed condition as under voltage or over voltage. As the voltage comes back within the limit, the relay again connects the load with the supply.

3.4 Temperature Measurement circuit:

- Apparatus: LM 35 Temperature Sensors, Load, LCD Display, Arduino
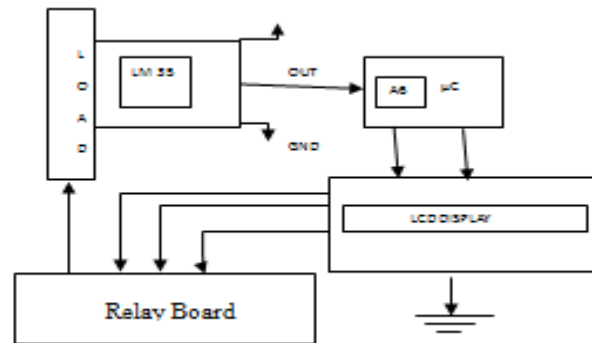

Fig -7: Block diagram representation of Temperature measurement circuit

Working:

The circuit makes use of temperature sensor LM35. Only one sensor is employed for the purpose of measuring the temperature. It has 3 pins namely VCC, Output & ground which are connected with the controller. The limit is kept at 80°C. The limit can be easily altered as per the requirement. The relay operates and isolates the circuit if the temperature exceeds 80°C. A message is sent through GSM stating the condition as overheating of the equipment with which the sensor is connected. When the temperature comes within the limits, the relays connect to the equipment with the supply. A message is sent stating that the power has been restored.

4   ADVANTAGES & APPLICATION

4.1 ADVANTAGES

1. Efficient and low cost design.
2. Low power consumption.
3. Real time monitoring.

4.2 APPLICATIONS

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

5. RESULTS

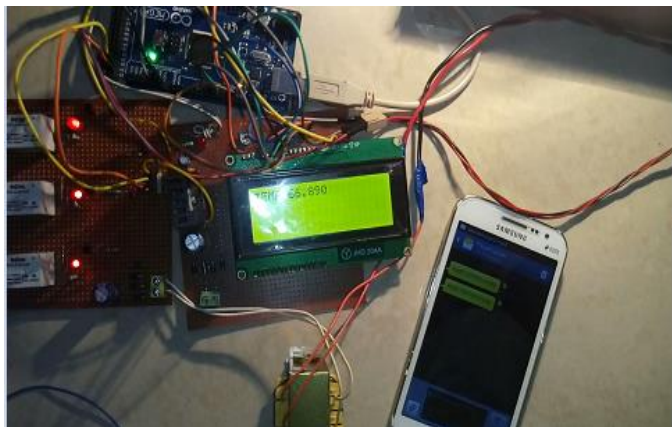**Fig -8**: Actual Frequency measurement circuit

Fig -9: Actual Temperature measurement circuit

6. CONCLUSION

On completion of our project "Substation Monitoring and Control using Microcontroller and GSM" we can improve the quality of power transferred and provide uninterrupted power supply. Also real time monitoring of different parameters is done which can provide safety to the substation and its equipments. Secondly, using highly advanced IC's with the help of growing technology, the project has been successfully implemented. Thus the project has been successfully designed and tested.

7. ACKNOWLEDGEMENT

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BIOGRAPHIES

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