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Substation Monitoring and Controlling Using Microcontroller

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Abstract: The goal of this project is to collect remote electrical characteristics such as voltage, current, and frequency, and to send these real-time values, together with the power station temperature, over the GSM network using a GSM modem / phone. This project also includes the use of an Electromagnetic Relay to protect the electrical circuits. When the electrical parameters surpass the predefined values, this Relay is activated. This system can also provide real-time electrical parameters as SMS messages on a regular basis(depending on time settings). Electricalcharacteristics such as current and voltage will be compared to their rated value on a regular basis to safeguard the distribution and power transformer from overload, short circuit faults, overvoltages , and surges. Under such circumstances, the entire device is shut down, with transfers detecting it and the electrical switch being killed instantly. This project takes use of a microcontroller, which is a type of onboard computer. This internal computer is capable of communicating effectively with the many sensors in use. The substation becomes intelligent as a result of the usage of GSM, since it is able to communicate alarms and information as well as accept commands.'

keywords: Microcontroller, Real time monitoring, transformer, Substation, Arduino Uno, Temp Sensor, Voltage Sensor, Current Sensor.

1. INTRODUCTION

Electricity is an extremely practical and useful energy source. In our current industrialised culture, it is becoming increasingly crucial. A substation is a small building with transformers, switches, voltage regulators, and metering equipment for altering voltages andmonitoring circuits.

For cost savings, increased dependability, and operational benefits, these electric power systems are linked together. They are one of the most critical elements of both national and global infrastructure, and their failure has significant direct and indirect economic and national security implications. The alarm was triggered as a result of increased customer demand for electricity, which has resulted in a rise in the quality of power delivered to users. A substantial amount of energy is wasted during the transportation of general power, resulting in a drop in the nature of the intensity received at the substation.
It is vital to understand what type of limitation has happened in order to improve the quality of power with suffer solution. In addition, if a power system's protection, monitoring, and control are insufficient. It's possible that the system will become unstable. As a result, monitoring current, voltage, and other important characteristics on the distribution side can assist to enhance both the output produced at the main station and the quality of power delivered to customers. It can also detect heat, excessive temperature, and overvoltage-related failures. Demanding the quantity of power given at the user side has sparked concern due to an increase incustomer demand for electricity. Before reaching thesubstations, the power generated at the main stations is carried hundreds of miles via transmission lines.

During the transportation of generated electricity, a significant amount of power is lost, resulting in a reduction in the amount of power received at the substations. Users of electric lines have also noticed that the number of problems caused by electrical power quality changes is steadily increasing. These variations have always existed in electrical systems, but they have recently become a major source of concern. A change from preventive maintenance based on time (TBM) to maintenance based on condition (CBM) is takingconducted in order to increase the cost-effectiveness of maintenance. CBM techniques provide for lower maintenance and operation expenses while also improving the quality and consistency of the electrical supply due to better asset use. It was necessary to install a monitoring system that could automatically discover, monitor, and classify existing electrical line restrictions.

Because of the lack of automated analysis and the utility's inadequate sight over the grid, there are still power failures and blackouts today. WSN will provide the utility with the required view by gathering data from the grid's many subsystems.

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2. BLOCK DIAGRAM

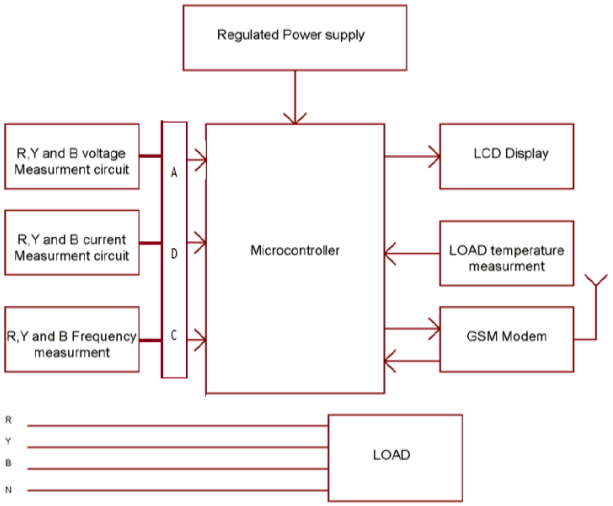

Fig 1-Block Diagram of the Model

3. HARDWARE IMPLEMENTATION:

Current Measurement circuit:

The current sensor ACS712 is used in this circuit. The upper maximum is currently fixed at 1.A. If the load changes, the limit can be readily modified. As a load, two bulbs are connected. Limits are set so that the circuitworks properly even if only one lamp is switched on. The relay activates when the second lamp is turned on, isolating the circuit. A notice appears on the LCD, stating that the status is DAGER OVERLOAD. When the second lamp is turned off, the relay activates again, connecting the load to the supply. A message is delivered once more announcing that power has been restored.

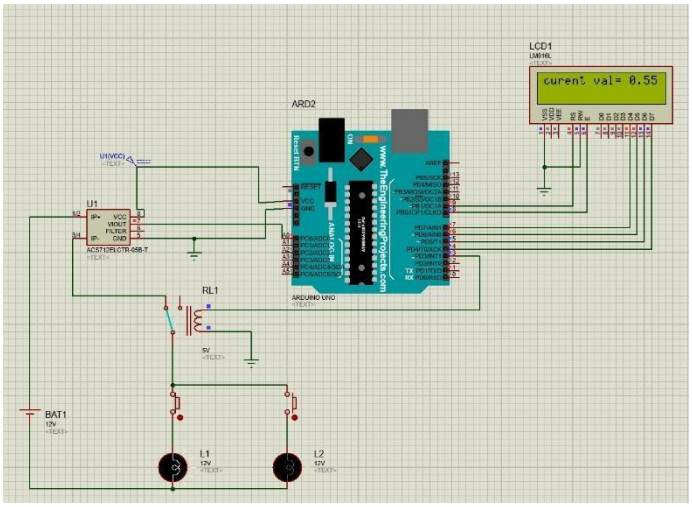

Fig 2 - Normal Condition of Current Measurement Unit

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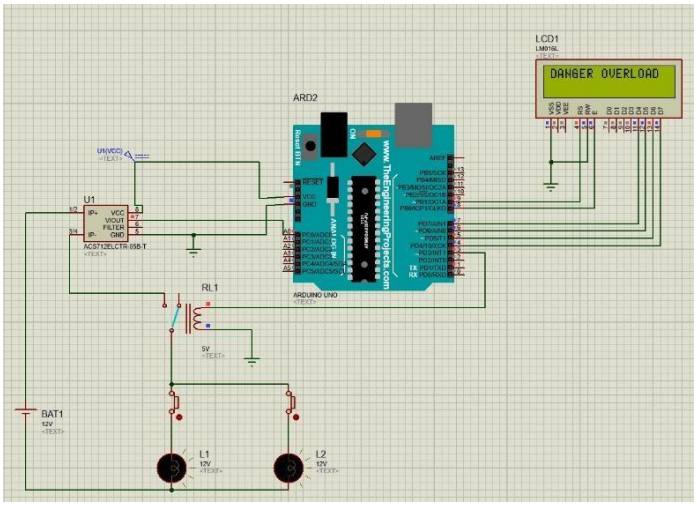

Fig –3 Overload Condition of Current MeasurementUnit

Voltage Measurement circuit:

Stepping down voltage is performed with the use of transformers. We chose a working voltage range of 210V to 250V for our project. With the help of a variac, the voltage can be changed. The limit can easily bechanged to suit your needs. If the voltage stays within the limitations, the circuit works fine. If the voltage falls outside the stated parameters, the relay activates andisolates the circuit. The LCD displays a message indicating whether the sensed condition is under or over voltage. When the voltage falls below the set point, the relay reconnects the load to the supply.

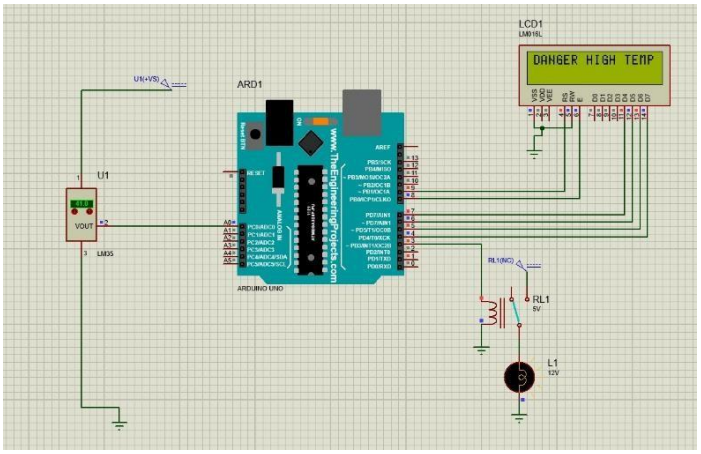

Fig –4 Voltage Measurement Unit

Temperature Measurement circuit:

The temperature sensor LM35 is used in this circuit. It contains three pins that are attached to the controller: VCC, Output, and Ground. The temperature limit is set at 40 degrees Celsius. The limit can easily be changed to suit your needs. If the temperature rises beyond 40 degrees Celsius, the relay activates and separates the circuit. The condition is overheating of the equipment with which the sensor is linked, and the relay is turned off, according to the message displayed on the LCD screen. When the temperature drops below the setpoints,the relays reconnect the equipment to the power source.

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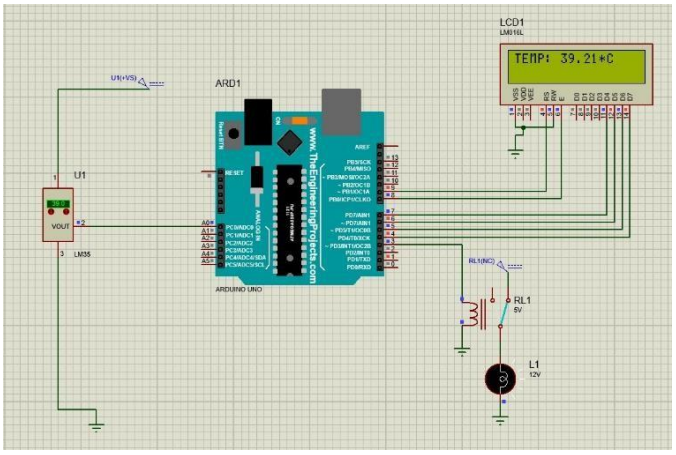

Fig-5 Temperature Measurement at Normal Condition

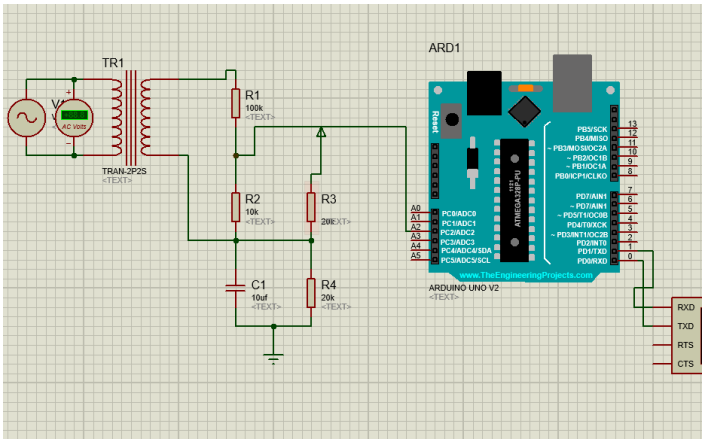

Fig-6 Temperature Measurement at Over- TemperatureCondition

4.. RESULT

The system takes a current reading every 0.4 seconds and turns off the relay when the current in the circuit exceeds 1 amp, which may be changed inthe arduino code to meet our needs. Similarly, every 0.5 seconds, a voltage reading is taken, and every 0.5 seconds, a temperature reading is recorded, with the threshold temperature set at 40°C, and the relay switches off when the value surpasses it.

	Current	Voltage	Temperature
Time interval for recordingreadings manually	60 minutes	60 minutes	60 minutes
Time interval for recordingreadings with our system	0.4 seconds	0.5 seconds	0.5 seconds

Table-1: Time comparison between the intervals ofreading with and without our system.

5. CONCLUSIONS

It has been designed to integrate functionality from all the hardware components used. Every module's presence has been carefully considered and arranged, resulting in the best possible operation of the unit. Second, the idea was effectively implemented employing modern integrated circuits and growing technology. We can improve the safe

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operation of all equipment by increasing the frequency of recording measurements using a substation monitoring system. It will also lengthen the life of the dedicated equipment and improve the safety of electric power transmission, both of which will have an impact on end-users. There are numerous parameters that must be quantified and monitored on a regular basis, which is both costly and difficult to do by designating a person to each location, and the data would also be prone to error if the monitoring was done manually. All of the concerns mentioned above can be greatly alleviated with our proposed method. By installing the GSM module, it will be possible to send Personalised SMS to the authorities in the future, allowing them to stay informed about the plant while they are outside. Furthermore, the microcontroller is designed to send SMS in a specific format.

6. REFERENCES

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