

II. DESIGN

The design is composed of three sections:

- Section-I** The first section comprises of the microcontroller receiving electrical parameters at periodic intervals from the transformer through the sensors (the interval is set at the time of programming of the microcontroller). Parameter like voltage, current, frequency and angle are stored in the registers of the microcontroller and among them voltage and current are compared with the threshold values fixed, the threshold value for example could be taken as the rated values of the transformer; and dangers due to the overload and high voltage are sensed.
- Section-II** In the second section the analog parameters are converted to digital via analog to digital converter (ADC) and transmitted via the GSM cellular network in the second.
- Section-III** The third consist of the GSM receiver that receives the parameters and outputs to the concerned user on a mobile phone. The output can also be shown on a digital display connected to the output port of a receiver microcontroller at the main substation. This microcontroller can itself decide intelligently to shut down the sub-station via sending instruction commands if the condition is too severe or wait for the user to send commands via SMS message.

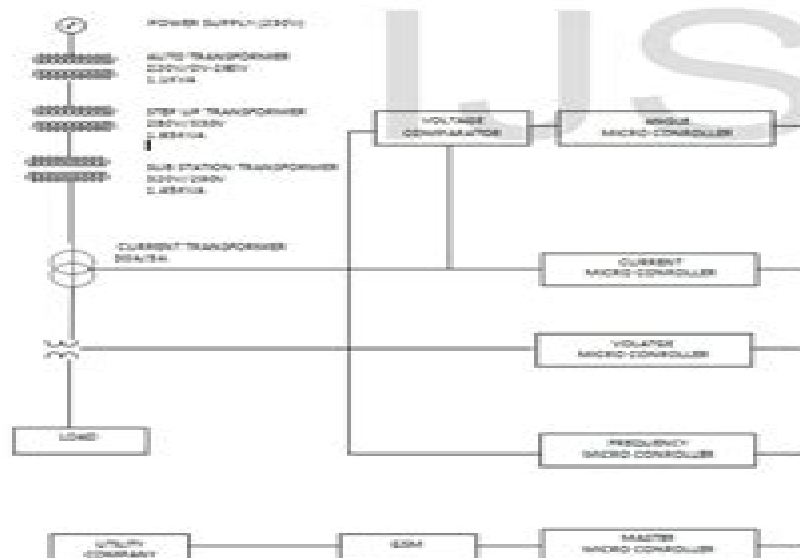


Fig. 1: Single In-Line diagram of the whole system.

III. MEASUREMENT PARAMETERS

A PIC microcontroller was utilized which was programmed to calculate the following parameters coming from the transformer:

- Voltage Measurement:** Voltage is measured by using the concept of a millimeter which measures voltage by connecting a resistor parallel to the load. This resistance is of very high value. This concept was utilized in the project. A potential transformer of 300V/5V was used. Secondary voltage of the potential transformer was applied on the potential divider made of a series combination of resistors of 1 ohm and 2.2 ohm. The use of the potential divider ensured that the voltage that had to be inputted to the microcontroller, never exceeded 5V which was the maximum analog voltage that the microcontroller could sense. In case of voltage exceeded 5V microcontroller would get damaged.

$$V_{out} = 1000 * V_{pt} / (1k + 2.2k)$$

Such a concept was used to create over voltage faults at the substation designed in the project.

The value of the resistor used in making the potential divider was found considering the maximum modeled voltage that would rise across the secondary of the potential transformer in case of over voltage faults.

The peak detector algorithm works by taking the equivalent voltage due to actual load current or the line voltage and converts it to digital by the build in ADC of the controller. The sampling rate is set in the programming. The sample are continuously measured, stored and compared to the previous one taken. The algorithm lets the program to proceed only, if the current value measured is greater than the previous value measured. One sample taken after the peak of the sinusoid is measured causes the current value to be less the previous, causing the program to terminate. Hence peak is measured. Rms value of voltage and current is calculated by using the formula:

$$RMS\ VALUE = PEAK\ VALUE / \sqrt{2}$$

Microcontroller Based Substation Monitoring And Control

K Morrison



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