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IOT Based Substation Automation

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Abstract: This project is aimed to design a system which can monitor and control the substation by using a wireless technology called IOT. An IOT module provides the communication interface. By using IOT module we can update data on web server. In our project we are considering substation parameters, voltage and current, temp. The project will be designed in such a way that an sensor will be interfaced to the controller. Here the inputs for the ADC are the analog values of voltage, current. In this project microcontroller is connected to IOT module through serially. By varying these two pots microcontroller detects voltage and current, temp fluctuations and sends that particular values to the web server. According to voltage and current fluctuations relays has to be triggered for protecting substation at that time bulb will OFF. A 16x2 LCD is also provided to display the status of the system. This project uses regulated 5V, 500mA power supply. Unregulated 12V DC is used for relay. 7805 three terminal voltage regulator is used for voltage regulation. Bridge type full wave rectifier is used to rectify the ac output of secondary of 230/12V step down transformer.

Keywords: Controller, Temp Sensor, Voltage Sensor, Current Sensor.

I. INTRODUCTION

The distance between the generators and load may be regarding hundreds of miles hence the amount of enormous 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 to the user side has raised the alarm due to the increase in demand for electricity in the customer side. A massive amount of energy is lost during the transportation of the general power which prompts the decrease in the nature of intensity got at the substation. To Improve the quality of power with a different 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 can automatically detect, monitor, and classify the existing constraints on electrical lines. Today power still experiences control blackouts and power outages because of the absence of mechanized examination and poor deceivability of the utility over the grid. Electricity is an extremely handy and useful form of energy. It plays an ever growing role in our modern industrialized society. The electrical power systems are highly non-linear, extremely huge and complex networks [1]. Such electric power systems are unified for economical benefits, increased reliability and operational advantages. They are one of the most significant elements of both national and global infrastructure, and when these systems collapse it leads to major direct and indirect impacts on the economy and national security [2]. A power system consists of components such as generators, lines, transformers, loads, switches and compensators. However, a widely dispersed power sources and loads are the general configuration of modern power systems [3].

II. LITERATURE REVIEW

The purpose of this project is to acquire the remote electrical parameters like voltage, current and Temperature and send these real time values over IOT network 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 notifications to read the remote electrical parameters. This system also can automatically send the real time electrical parameters periodically. This system can be designed to send notifications 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. As complexity of distribution network has grown [7], automation of substation has become a need of every utility company to increase its efficiency and to improve quality of power being delivered [5]. The proposed project which is IOT network based monitoring of substation [5][12] will help the utility companies, by ensuring that their local-substation faults [8][9][10] are immediately realized

and reported to their concerned departments via IOT, to ensure that duration of power interruption is decreased. The measured parameters will be Monitoring in the form of notifications. The microcontroller will interact with the sensors installed at the local substation and perform task as commanded [3]. Electrical parameters like current, voltage will be compared continuously to its rated value [13] will help protect the distribution and power transformer from burning due to overload, over voltages and surges. Under such conditions, entire unit is shut down via the control section comprising of relays sensing it, and immediately turning the circuit breaker off. This enables to reduce labor cost at substation and saves time. Thus the monitoring and working efficiency of the sub-station will drastically increase.

III. HARDWARE DESCRIPTION

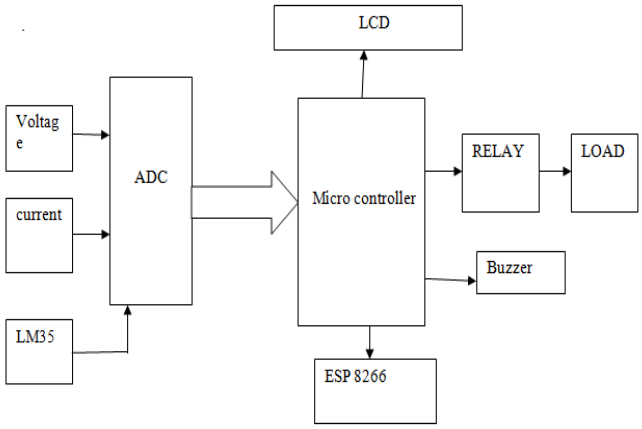

Fig1. Block diagram.

A. Microcontroller

Micro-controller unit is constructed with ATMEL 89C51 Micro-controller chip. The ATMEL AT89C51 is a low power, higher performance CMOS 8-bit microcomputer with 4K bytes of flash programmable and erasable read only memory (PEROM). Its high-density non-volatile memory compatible with standard MCS-51 instruction set makes it a powerful controller that provides highly flexible and cost effective solution to control applications.Micro-controller works according to the program written in it. The program is written in such a way, so that the output from the ADC will be converted into its equivalent voltage and based on the magnitude of the voltage, it calculates the parameter value. Now this magnitude is again digitalized and fed to 7-segment display unit through the latch.Micro-controllers are "embedded" inside some other device so that they can control the features or actions of the product. Another name for a micro-controller, therefore, is "embedded controller". Micro-controllers are dedicated to one task and run one specific program. The program is stored in ROM (read-only memory) and generally does not change. Micro-controllers are often low-power devices. A battery-operated Microcontroller might consume 50 milli watts. A micro-controller has a dedicated input device and often (but not always) has a small LED or LCD display for output. A micro-controller also takes input from the device it is controlling and controls the device by sending signals to different components in the device.

B. ADC

It is a device that converts a continuous physical quantity (usually voltage) to a digital number that represents the quantity's amplitude. In 8051 inbuilt ADC is not there that what external ADC is required. Which automatically reads the signal and converts to its digital equivalent value.

C. Current Transformer (CT)

The Current Transformers (CT's) are instrument transformers that are utilized to supply a reduced value of current to meters, protective relays, and other instruments. A current transformer is an instrument transformer used to step down large values of currents associated with big loads, such that smaller size meters can measure the actual current of the feeder.

D. Temperature sensor

The LM35 series are precision integrated-circuit temperature sensors, whose output voltage is linearly proportional to the Celsius(Centigrade) temperature. The LM35 thus has an advantage over linear temperature sensors calibrated in° Kelvin, as the user is not required to subtract a large constant voltage from its output to obtain convenient Centigrade scaling. The LM35 does not require any external calibration or trimming to provide typical accuracies of ±1/4°C at room temperature and ±3/4°C over a full -55 to +150°C temperature range. Low cost is assured by trimming and calibration at the wafer level. The LM35's low output impedance, linear output, and precise inherent calibration make interfacing to readout or control circuitry especially easy. It can be used with single power supplies, or with plus and minus supplies. As it draws only 60 µA from its supply, it has very low self-heating, less than 0.1°C in still air. The LM35 is rated to operate over a -55° to +150°C temperature range, while the LM35C is rated for a -40° to +110°C range (-10°with improved accuracy). The LM35 series is available packaged in hermetic TO-46 transistor packages, while the LM35C, LM35CA, and LM35D are also available in the plastic TO-92 transistor package. The LM35D is also available in an 8-lead surface mount small outline package and a Plastic TO-220 package.

E. Voltage sensor

In this project work for generating high voltage, autotransformer is used so that the line voltage can be increased to more than 240V. For monitoring the line voltage, a step-down transformer of 6V-0-6V center-tapped secondary is used as a line voltage sensor. As this transformer primary voltage increases, according to that secondary voltage also raises, and this secondary voltage is rectified, filtered and it is applied to the analog to digital converter for converting the analog information in to the digital information.

IV. RESULTS

The project “microcontroller based substation monitoring and control system with iot module ” was designed such that the devices can be monitored using iot module. Integrating features of all the hardware components used have been developed in it. Presence of every module has been reasoned out and placed carefully, thus contributing to the best working of the unit. 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.

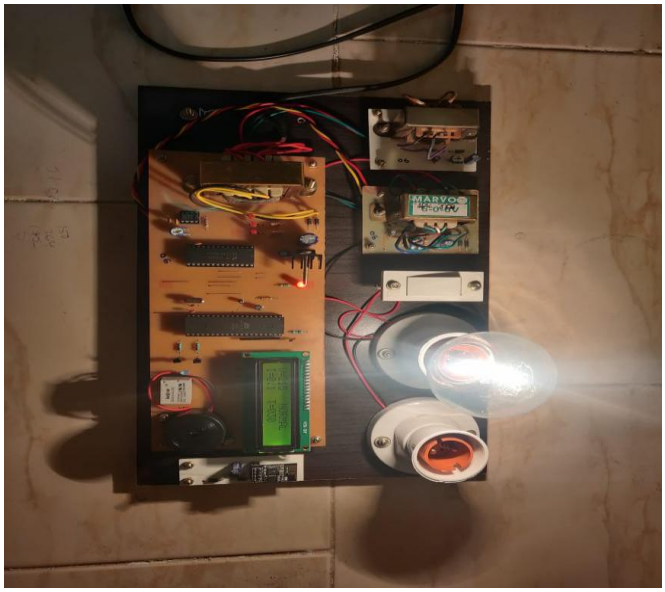

Fig2. Hardware Model.

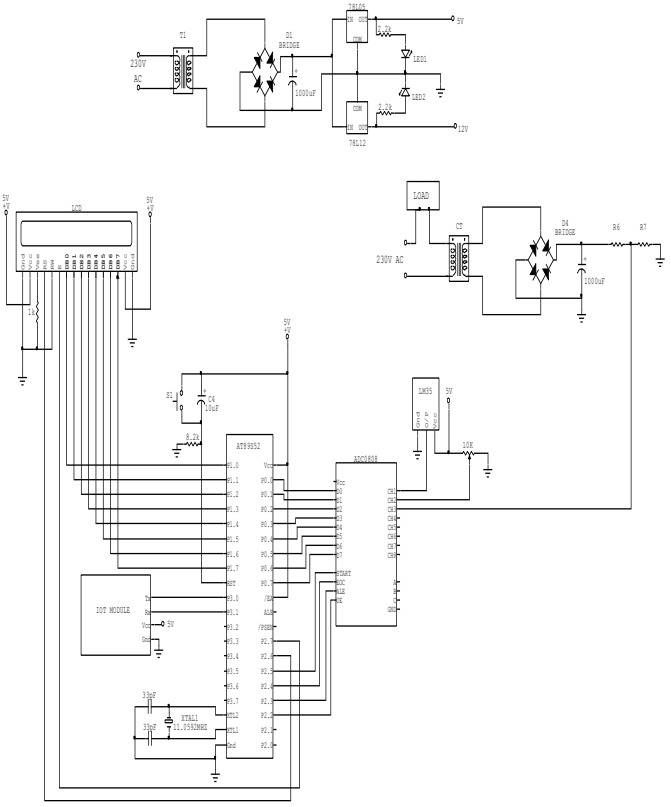

Fig3. Circuit Diagram.

V. CONCLUSION

On completion of our project "Substation Monitoring and Control using Microcontroller and IOT," we can improve the quality of power transferred and provide uninterrupted power supply. Also, real time monitoring of different parameters is done which can ensure safety to the substation and its equipment. Besides, utilizing much propelled IC's with the assistance of developing innovation, the undertaking has been effectively executed. In this manner, the undertaking has been effectively composed and tried the designed system provides easy control of remote substation. The exact location of the substation can also be determined by sending location coordinates of the substation .finally the experimental output verified.

VI. REFERENCES

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