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Design and Development of Data Acquisition and Controlling Unit for Power Generation

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ABSTRACT —The most important factor to be considered for economic and efficient generation of power depends on the effective monitoring and controlling of various parameters such as voltage, current, power and power factor. Continuous monitoring of these parameters provides us information regarding factors which affect the generation and transmission of power. The optimal adjustments of these parameters can enable us to improve efficiency and to achieve remarkable energy savings.
The Designed Data Acquisition and Control unit for power generation was simulated in LabVIEW 2016 Pro Software which is interfaced with hardware through serial communication port. The circuit consisting Micro-Controller, LCD, Transformer, Relay, current transformer built on wooden board. All the connections are made and soldered so as to maintain proper stable circuit connection. The required supply is provided to all components used in circuit. Different sensors are used to control different parameters. The simulation of power plant is achieved by using LabVIEW software.
Keywords: LabVIEW, Microcontroller, LCD, voltage sensor, current sensor.

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I. INTRODUCTION

A power plant is a facility used to generate electric power with the help of one or more generators which converts different energy sources into electrical power. Electricity is a secondary energy source which means that electricity is obtained from the conversion of other primary sources of energy such as coal, hydel natural gas, nuclear, solar or wind energy. The energy sources can be renewable or non -renewable.

A power plant or generating station is necessary for the generation of electric power. Most power stations contain one or more generators, a rotating machine which converts mechanical power into electrical power. Hence monitoring and controlling the parameters involved in the process of generation is an important task. Our project is based on designing and developing of a data acquisition and controlling unit for power generation by using LabVIEW. Data acquisition is the process of sampling signals that measure real world physical conditions and converting the resulting samples into digital numeric values that can be accepted by a computer. Data acquisition systems, abbreviated by the acronyms DAS or DAQ typically convert analog waveforms into digital values for processing.

ATMega32 microcontroller is used in the hardware for conversion of all analog data from sensors to digital signals. It is an 8-bit high performance microcontroller of Atmel's Mega AVR family. ATMega32 is based on enhanced reduced instruction set computing architecture with powerful instructions. Most of the instruction execute in one machine cycle. ATMega32 can work on a maximum frequency of 16MHz. The other hardware components include voltage sensors LM7805, current transformer, transformers and relays.

LabVIEW software which is basically used in virtual instrumentation domain. This system provides an efficient monitoring and data acquisition arrangement. It reduces the complexity in cable installation and maintenance costs. It provides a platform for secure and reliable data acquisition in critically controlled environment in power plant.

II. LITERATURE REVIEW

The use of data acquisition systems proposes a new concept of a low cost power generation applied to de-centralized renewable energy plants with an USB interface. The use of such systems contributes to disseminate these plants recognizing in real time local energy resources, monitoring energy conversion efficiency and sending information concerning failures. These aspects are important, mainly for developing countries, where decentralized power plants based on renewable sources are in some cases the best option for supplying electricity to rural areas.

Nevertheless, the cost of commercial DAS is still a barrier for a greater dissemination of such systems in developing countries. The proposed USB based DAS presents a new dual clock operation philosophy, in which the acquisition system contains two clock sources for parallel information processing from different communication protocols. To ensure the low cost of the DAS and to promote the dissemination of this technology in developing countries, the proposed data acquisition firmware and the software for USB microcontrollers programming is a free and open source software, executable in the Linux and Windows operating systems.[1]-[2]

The wireless data acquisition, data logging and supervisory control are the basic building blocks of plant automation. In this paper plant consisting of multiple boilers where multiple process variables of the boilers need to be acquired from the field is considered and studied. The data of the process variables needs to be logged in a database for further analysis and supervisory control. A Lab VIEW based wireless data logging and supervisory control program simulates the process and the generated data are logged in to the database with proper indication about the status of the process variable. This gives the overview of modern day data acquisition system, data loggers and supervisory control techniques. Wireless data acquisition and data logging program is used to log the measurements of different process variable data in a database. The database also shows the status of the process variable as normal or abnormal. The Monitoring and controlling of parameters such as voltage, current and power is an essential process in critically controlled environments of Thermal Power Plants. This provides a cost effective and energy efficient monitoring and control system. With very little modifications this platform can be utilized for various industrial needs. [3]- [4]

III. OBJECTIVES AND METHODOLOGY

Objectives:

The objectives of project are given below:

- To study the existing circuit that can develop data acquisition and controlling system for generation of power.
- To arrive at the design specification for generation parameter monitoring and controlling unit.
- To develop data acquisition and controlling unit for power generation.
- To test and control the power generation and data acquisition unit to meet the design specifications.

Methodology:

Methodology of objective-1:

- Literature survey will be made to understand the design and development of data acquisition and controlling for power generation.

Methodology of objective-2:

- Pre-requisite data for the design and specifications of design and development of data acquisition and controlling for power generation is extracted from the available reference journal publications meeting the desired specifications.
- The designed power generation unit will be simulated in lab view.

Methodology of objective-3:

- The power generation unit will be developed after choosing the appropriate components to match the obtained design as closely as possible.

Methodology of objective-4:

- The power generation and controlling is implemented with the development of data acquisition unit and its functioning is observed and recorded.
- Conclusions will be drawn based upon the validation studies.

IV. EXPERIMENTAL WORK

Figure 1 represents the block diagram of our monitoring and controlling unit for power generation.. It contains all the individual components required for monitoring and controlling voltage, current, and power in a power generation system. The microcontroller used in the circuit monitors the different parameters inside the power plant. The circuit is designed to control all the specific parameters of power generation like voltage and current.

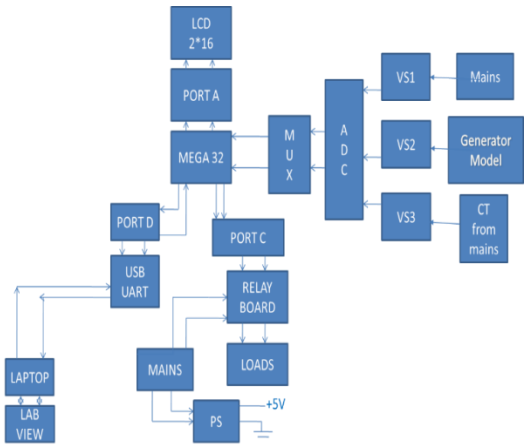

Figure 1: Block diagram

The first phase of the project involved the simulation of the project on a Circuit Simulative Software.

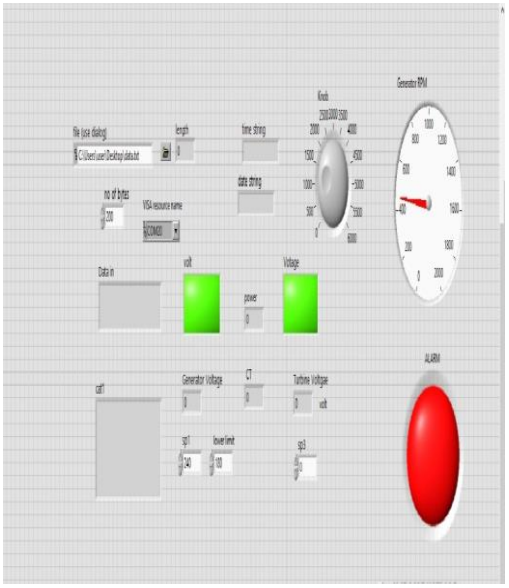

Figure 2: Simulation results

Figure 2 shows the simulation results obtained in lab view Simulation Software. This Simulative Software is interfaced with the hardware in order to keep control over the output. Port C of the ATMega32 is connected to the Relay which is used as a feedback which in turn controls the working of the load. Voltage Sensors are used to sense the desired voltage and current. Incandescent bulbs are used as loads. When there is any abnormal condition like Under Voltage condition the load switches off one by one and during Over Voltage or Current abnormality the load switches off all at once. Relay is used as a protecting device and it is used to cut off the load. All the components are connected to the Microcontroller and LCD is used a display for the sensed parameters.

The bulb glows when the voltage is between 180 to 240V. When the voltage falls below 180V, the bulb stops glowing as it is an under voltage (Over load) condition. When the Voltage is above 240V, this is the condition of over voltage and the bulb stops glowing. The monitored data is recorded in LabVIEW. The different loads for an ampere range of 5A can be tested through the module.

S.N	Voltage Sensors (ACD0 &ACD1)	Ranges (V)	Indicator (bulb)
1.	ACD0	180-240	ON
		Below 180	OFF
2.	ACD1	Above 240	OFF

Table 1: Working of Current transformer

S.N	Current transformer	Ranges (A)	Indicator (Bulb)
1.	ACD2	0-5	ON
		Above 5	OFF

Table 2: Different load voltage control

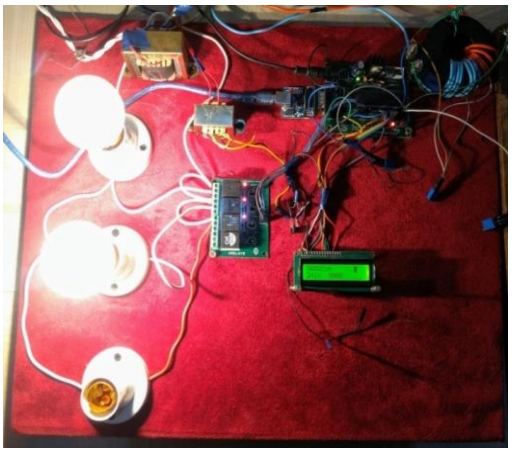

Figure 3: Data Acquisition Model

Figure 3 shows the complete data acquisition mode including all the sensors (voltage sensors and current transformer) and all the other components.

V. CONCLUSION

The financial resources of developing countries are limited. Low cost solutions are welcome to contribute to a decentralized power generation system. In the data acquisition system modeled in our work an USB channel which is the most diffused peripheral-to-PC connection standard was used to program the firmware microcontroller ATMega32 and to establish a virtual serial communication with the PC.

This system provides an efficient monitoring and data acquisition unit. The front panel so obtained is installed in the centralized control unit of the power plant. The continuous monitoring system for voltage, current and generator RPM have been integrated to a single control panel which enables easy access to the operator.

The error data acquired can be sent immediately without interrupting the processes involved in power generation. The results obtained by simulating the front panel designed in the professional platform of LABVIEW presents an excellent platform for different parameters involved in the complex task of power generation.

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