IJISET - International Journal of Innovative Science, Engineering & Technology, Vol. 2 Issue 10, October 2015.
www.ijiset.com
ISSN 2348 – 7968

Data Acquisition System Using Programmable Logic Controller

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Abstract

Industry needs less manpower, more and accurate throughput. Accuracy enhances by exact reading of data from sources which further uses to control the whole system. The main objective is to design fully automatic system to achieve the industrial requirement. Our proposed system work at remote location for supervisory control and data acquisition with the help of appropriate Programmable Logic Controller (PLC). Main aim to design automatic system implemented using ABB 564 Ethernet PLC having control builder plus and panel builder tools. This data acquisition system used to monitor accurate temperature, pressure, voltage and current using PLC implemented with the aid of ladder logic. Communication between PLC and human machine interface carried out by TCP/IP protocol. Expected outcomes are graphical representation of accurate acquire parameters also indication of alarm for over limit values. Addition of energy analyzer in this system is used to monitor total system power consumption.

Keywords: *Programmable Logic controller (PLC), supervisory control and data acquisition system.*

1. Introduction

Large industrialized amenities often contain number of automation devices such as sensors, actuator sand controllers that can be distributed over large area. They differ in amount of information they generate, refresh rate and required reliability. Specific requirements forced by industrial environment, possibly harsh conditions and cost saving factor must be also taken into consideration [1]. Such diverse demands led to development of various industrial automatic systems. Programmable logic controller (PLC) and Supervisory Control and Data Acquisition (SCADA) are becoming increasingly popular in the daily work. A general approach is presented to exploit models in data acquisition and controlling the different parameters, by integrating them with Programmable logic controller (PLC) and Supervisory Control and Data Acquisition (SCADA). A Programmable Logic Controller (PLC) is a special computer device used for industrial control systems. They are used in many industries such as oil refineries, manufacturing lines, conveyor systems and so on. Where ever there is a need to control devices the PLC provides a flexible way to "soft wire" the components together. Since the late 1970s, PLCs have replaced hardwired relays with a combination of ladder–logic software and solid state electronic input and output modules. Following fig 1.1 explores the programmable logic controller architecture (PLC).[3] They are often used in the implementation of a SCADA RTU as they offer a standard hardware solution, which is very economically priced. SCADA is the main feature of any automation system. The ability to remotely monitor and control electric power system facilities found its first application within the power generation and transmission sectors of the electric utility industry.

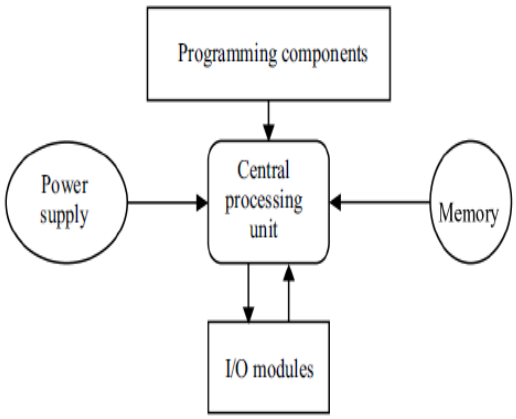

Fig 1 Programmable Logic Architecture [3]

Data Acquisition plays a very important role in the modern industry controlling system. These systems are masterly of gauging outlining approach, gift to analyze and processes information in real time, and the capacity of data storage. Data-Acquisition maxims embraces on the lookout conditioning and interconnecting devices based on PCI module.[4] The basic concept behind the Data-Acquisition system is to assemble all the constraints utilizing recent technology in minimum cost. There are varieties of systems available on the support, which performs data acquisition along with categorization but at very high rates. The proposed system interacts repeatedly with its atmosphere and carries out a variety of tasks, by definite timing constraint to meet the desires of system performance. The processor consumes low power with a high instruction throughput. Data-Acquisition Systems are

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hybrid electronic devices with the major role of interfacing the digital signal to the atmosphere.

2. System Overview

The system introduced a system which helps in controlling and monitoring the numerous parameters such as temperature, pressure, and voltage, current. A graphical user Interface called as human machine interface (HMI) has been developed using supervisory control and data acquisition (SCADA) and the encoding of the control system has been done using programmable logic control (PLC).Ladder logic is used to build a programmed. A descriptive study has been incorporated to formulize all factors responsible for the change in valve characteristics. The customer of the system is able to supply input parameters so as to efficiently control the specific parameters. Following Fig 2 shows the system architecture of proposed system. The system is highly efficient and cost effectual, as only one interfaced digital system along with a PLC can control many specific parameters.

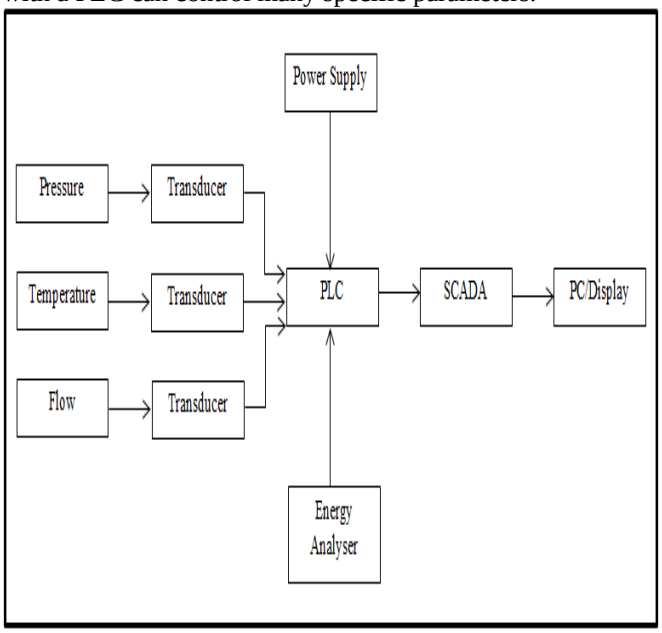

Fig 2.Proposed System Architecture.

In Real Time resources consumption both hardware and software must be capable of interacting with physical "actions" external to the processor itself, and this interaction must be adequately high-speed as to confine and conserve the vital in sequence interconnected to the event. The objective of our data acquisition is to integrate the signal conditioning, data acquiring, data collection and processing function into a distinct board based embedded system. Embedded Data Acquisitions system using PLC and SCADA acts as the central DAQ System is used as the controlling system that reins the devices connected to it. Depending upon the sensor equipment used, integrated applications have emerged. The data-acquisition system constitutes the central point in complex systems in which numerous signals must be sampled, monitored and recorded, in real-time. External devices with digital and analog outputs can be connected directly to the system.

3. Methodology

Process to develop a Data acquisition system using PLC involves both Hardware and Software developments as follows:

3.1 Hardware.

- As the system is PLC based Data acquisition system, it is essential to select a PLC, sensor to sense a data and power supply.
- ABB PM-564 PLC is selected on the basis of I/O requirement, memory requirement, execution time and communication protocol.
- Temperature sensor and Pressure transmitter is selected to acquire a real time data. Klemsans Energy analyzer is added to acquire a electrical parameters such as voltage, current and power factor.
- Integration of all the components is done with help of manuals of specific devices.
- Communication between hardware system and HMI is done with the MODBUS TCP/IP server protocol [4][10].

3.2 Software

- ABB Control Builder Plus software tool is selected for Configuration of the PLC. By using ABB Control Builder Plus software tool, development of Ladder logic for data acquisition system is done for PLC.[6]
- The main objective of system is to control and monitor specific parameters of Remote location industry from control room, to achieve the aims we need to develop a display panel.
- To develop display panel for user interface, we need a ABB panel builder 600 software tool. With the help of this tool we create screens of Human interface machine which includes virtual process, parameters display, trends, and Alarms indications.

4. Implementation

This design incorporates a temperature sensor and pressure transmitter installed in industrial environment. The hardware requirements are significantly curtailed using the Programmable logic controller and SCADA. The

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programming and interfacing of Energy analyzer is concluded, it is used to measure the total power consumption of the system. Following fig 2 leads to a smarter industrial automation design.

Fig 2 Implemented system

5. Results

Table.1 Results showing values of specific parameters acquire during experiments

Sr. No	Parameter	Real Time Reading	Acquire Reading	Alarm
1	Temperature (^{0}C)	1) 53.24 ^{0}C	1) 53.20 ^{0}C	High
		2) 32.01 ^{0}C	2) 32.02 ^{0}C	No
		3) 15.05 ^{0}C	3) 15.05 ^{0}C	Low
2	Pressure (bar)	1) 88.66 bar	1)88.65 bar	High
		2) 55.13 bar	2)55.13 bar	No
		3) 19.15 bar	3)19.14 bar	Low
3	Voltage (V)	1) 235.5 V	1) 235.5 V	No
		2) 230.5 V	2) 230.5 V	No
		3) 230.0 V	3) 230.0 V	No

This section includes the successfully simulated results of the implemented system. It also elaborates the outcomes of conducted experiments. The various forms of real time data is presented using SCADA software control builder plus and panel builder 600 which is very important to monitoring and controlling the various industrial parameters simultaneously. The optimum design model has been simulated using the HMI simulator. Control builder plus and panel builder 600 is installed for PLC configuration and control panel development. The specific parameter data is obtained from the experiment is given in table 1.

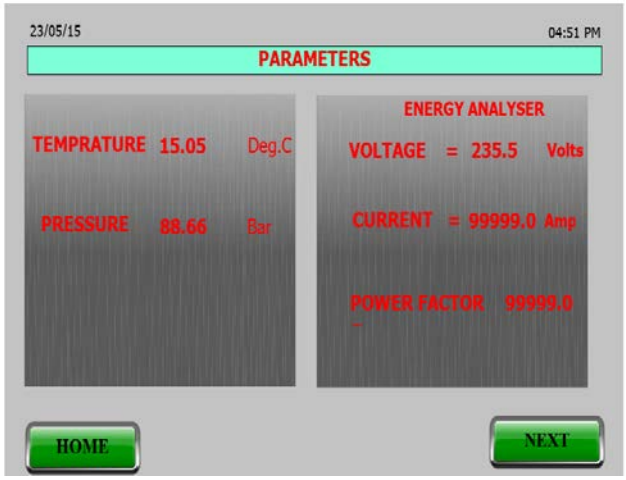

Fig 3 Parameter in tabular for on HMI software.

The real time data is displayed by the generated SCADA screens. The process includes the information about the industrial parameters such as voltage, current, power factor, temperature and pressure. Data can be presented in several ways. HMI screens displays the data in tabular form which is shown in following fig 3 and graphical form also called as trends showing the varying values of real time temperature and pressure is given in fig 4. With the help of Panel builder 600 software, the system provides the display of virtual operations that occurring in remote location industrial plant. The following fig 5 show some of the typical operator interface screens. Through this application the operator in control room is able to observe and monitor the current status of the system. To avoid the risk of getting damage, system provides alarms acknowledgment for low pressure, high pressure, low temperature and high temperature. Alarms screen is illustrated in fig 6.

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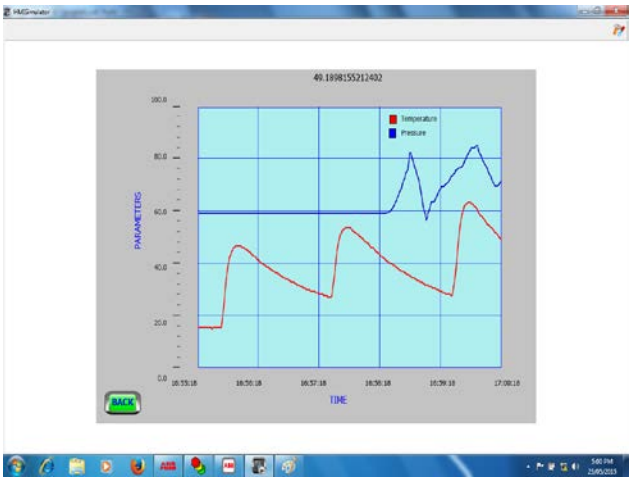

Fig .4 Trends showing the varying values of real time temperature and pressure

Fig.5 Real time process.

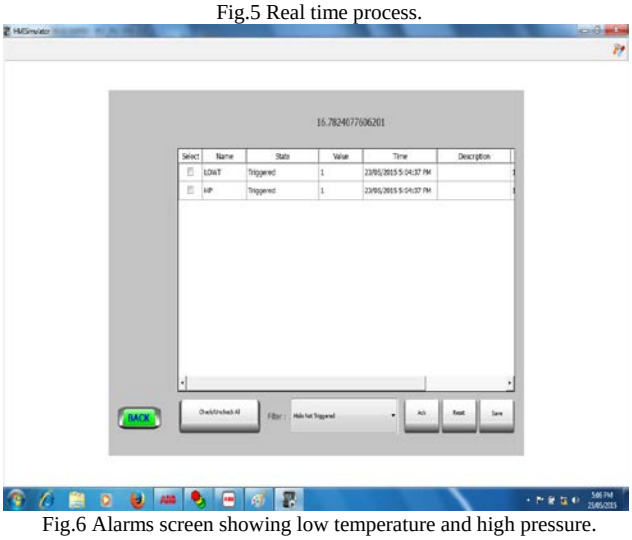

Fig.6 Alarms screen showing low temperature and high pressure.

6. Conclusions

Data Acquisition system using PLC and SCADA is successfully implemented for required application. In this, our prime concern was the development of demonstrating how industrial parameters automation can be made possible using little hardware and more refined software details. This system used for monitoring the various specific parameters such as temperature, pressure, flow and electrical parameter such as voltage, current, power factor. By using this information obtained from system, we can easily control any load in our system to improve system operation, system reliability and efficiency. Alternatively, SCADA and PLC communication system make it possible to integrate protection control and monitoring specific parameter together for maximum benefit..The system also can able to display the variation in parameter not only tabular but also in graphical forms.

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