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A Recent Development and Technology in Web Based Automation : An Experimental Study

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ABSTRACT

Automation plays a vital role in order to increase the productivity in industries but still the production was delayed because of various reasons. In order to overcome these problems industries now focuses on web-based manufacturing system. This paper mainly concentrated on the development of web-based technology for manufacturing and process plants with there impact in the field of automation . This paper provides an web-based automation with necessary experimental set up for controlling XYZ table direction of D.C servo motor using SCADA and PLC programming with PI controller for an drilling operation in an CNC milling machine.Today internet leads the way to provide much more sophisticated technological advancement The impact of world wide web with the help of web-based automation leads to development of globalized industries.

KEYWORDS: Programmable logic controller (PLC), Supervisory and Data acquisition (SCADA), Object linking and enabling Protocol (OPC), computer numerical control (CNC)

1 INTRODUCTION

Automation is the use of control systems such as numerical control, programmable logic control, and other industrial control systems, in concert with other applications of information technology such as computer-aided technologies like CAD, CAM, in order to control industrial machinery and processes, reducing the need for human intervention. In the Scope of industrialization, automation is a step beyond mechanization. Engineers strive to combine automated devices with mathematical and organizational tools to create easy manufacturing solution due to the globalizations industries have hubs around the world which gradually increase the need of web-based automation for carrying the business activities. Web-based automation have there own advantage which much more intact with both manufacturing and business activates. These have the following advantages like immediate and proactive response, data logging, and fault annunciation etc.

1.1 SUPERVISORY AND DATA AQUSITION

Web-based control is widely adopted in industries like pipe line process industries, power distributions, process automation industries etc. These industries mostly use SCADA as platform to adopt web automation. SCADA stands for Supervisory control and Data Acquisition which has a good control over the PLC's (programmable logic control), field devices, machineries based on the instructions given by the operator.

1.2 SCADA IN MANUFACTURING PLANT

Today's manufacturing success lies in efficient and increased production. Open system or Open architecture has been recognized as a key to development and maintenance of better CIM (Computer Integrated Manufacturing) systems. Revolutions in Object-oriented relational database and Workstations technology have given added power to CIM. MES (Manufacturing Execution System) software has emerged to link Business systems and Control systems (i.e., [1]) Improved data communication infrastructures for example, fiber optic, radio or satellite linked LAN WAN (Local wide area networking) and standardized protocols have enhanced system flexibility. Despite the above developments, manufacturing industries often experience problems of system flexibility, complexity, connectivity, obsolesce, high capital expenditure approval for automation etc. SCADA tends to wipe off all the above disadvantages. SCADA packages are available to many processes such as the followings

a) Water Supply
b) Irrigation System
c) Sewage lift station
d) Oil field and pipeline control
e) Power generation and transmission

1.4 REMOTE MONITORING

When an unscheduled outage does happen, time is spent for the following reasons notifying support resources that a problem has occurred, support resource to respond to the issue, troubleshooting and resolve the problem. With remote monitoring and expert diagnostic support in real time, the response time to begin to address the issue is eliminated. Further, the remote monitoring team is already familiar with the process and machine and can more quickly identify or resolve the problem (i.e., [2]). One of the most basic capabilities of remote monitoring is alarm and fault annunciation and timely notification to plant operators and maintenance personnel. Timely notification is correcting the problem before production is interrupted, product quality suffers or equipment damage occurs. Having a dedicated team of experts continuously to monitor the machine and process, and using system knowledge and experience to assess the importance of anomalies, It has a direct impact on machine health, machine uptime and product quality.

2.0 WEB BASED NETWORK ARCHITECTURE

A typical SCADA system architecture is shown in Fig. 2.0. In this architecture, data systems are on the highest level, used for planning .Typically, a web access based SCADA system contains five elements namely SCADA nodes, clients, project nodes, thin client, and network. The SCADA node communicates in real time with automation equipment. Typical automation equipment includes programmable logic controllers (PLC's), single loop controllers direct digital control systems (DDC), distributed control systems (DCS), and I/O modules. A full animation ActiveX control inside an Internet Explorer web browser is used to view real-time data, acknowledge alarms, and change set points, status, and other data (i.e., [3].

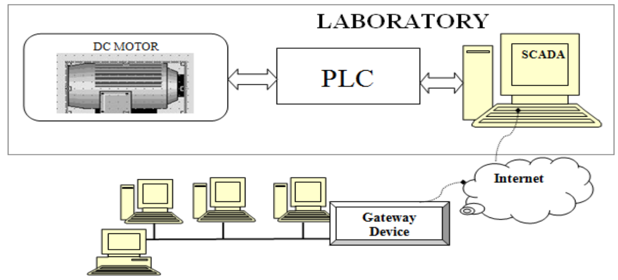

Fig 2.0 Web based network architecture

The client then communicates directly with the SCADA node using proprietary communication links over a TCP/IP network connection. The project node is a centralized database server. It can be physically separated from the SCADA node or combined with it. A copy of the database of all SCADA nodes is kept on the project node. Remote configuration and graphics building occur on the project node using a Web server to exchange data with remote clients. The configuration of database and graphics are then downloaded to the SCADA node from the project node, which is a web server.

2.1 A WEB-BASED REAL TIME CNC LABORATORY USING SCADA

The Internet provides an opportunity for student's to access laboratories from outside the campus. The control of a D.C servo motor is used as an example to demonstrate the effectiveness of this remote CNC laboratory, using real instruments. A programmable logic controller (PLC) is programmed to control the operation of the system. SCADA system is installed to monitor and control the process. Limitations made in the PLC program to protect the motor from going over speed by means of a PI controller. The remote laboratory presented here offers an economical solution for multiple users in a laboratory environment. This system allows the students to access real instruments in a real laboratory via the Internet. Additionally, the suggested architecture helps improve student skills on SCADA systems in use in industry. In this paper, a Web-based real-time CNC laboratory is presented where all the instruments used in the experiment are remotely accessed via the Internet. A SCADA system is installed to control, monitor, and manage the process and providing access to all inputs and outputs in real time. A user friendly interface allows students to perform a number of useful operations like supervising, measuring, monitoring, in a CNC machine which intended to do various machining operations.

During the experimentation phase, every change in the input variables is immediately shown in the graphical user interface. Users can monitor the behaviours of the system. After completing the experimentation, the user can download the experimental data .This Web-based remote access CNC laboratory is developed to allow students to access remotely the Automation Control Laboratory of Kongu engineering college, Erode .This paper is intended to help students in Process Control, Industrial Automation, and Electrical Machinery labs.

Fig. 2.1 A view of the experimental demo setup for controlling a DC motor.

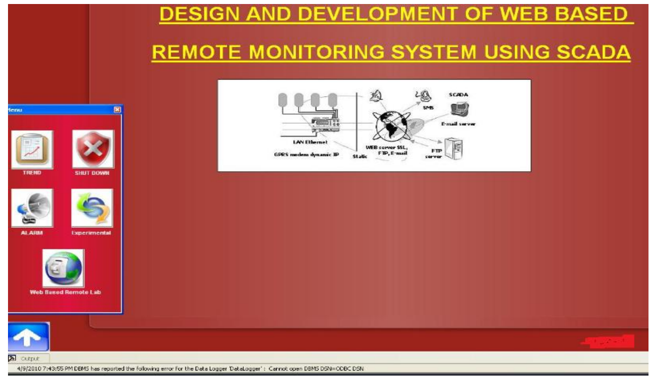

Fig. 2.2 A view of the welcome page of experimental setup.

Fig 2.3 SCADA screen for controlling 5DC motors in an CNC machine

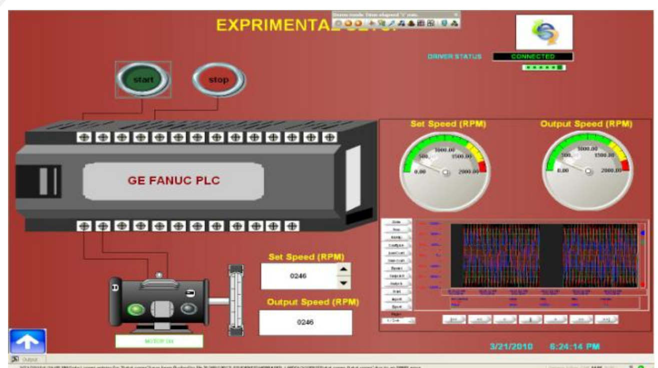

Fig 2.4 The view of the SCADA Experimental Screen

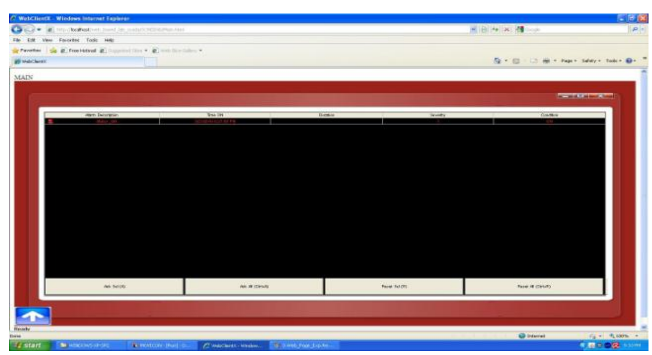

Fig. 2.5 A view Alarm page of experimental setup.

The simplest five D.C servo motor control system is represented in figure shown in fig 2.4 in which motors 1 and 2 is used to control X,Y, table direction movements where the work component is fixed direction using fixtures. D.C servo Motor 3 is connected to spindle and motor 4 is used to control the Z direction and motor 5 is used for machine door operations .The reference speed of the spindle and X,Y and Z direction motors is compared with the actual speed of the motor sensed through a optical speed sensor, The error is processed through the speed controller, The speed controller sets the required voltage to be applied to the motor, Although the system would achieve the desired speed, it has a drawback. The armature motor presents very low impedance to the applied voltage. Under study state condition most of the applied voltage is balanced by back emf and only the remainder drives the armature circuit. However during the transient, there is a mismatch between the applied voltage and the back emf as the speed changes slowly. Therefore excessive current may be drawn from the converter. The above closed loop control D.C servo motor consists of an error amplifier which compares the reference speed, with the actual speed. The output is a voltage proportional to the differences between the set speed and actual voltage. The controller which processes the error signal gives an output that sets the required voltage to be applied to the motor through PWM power controller, to achieve the set speed. The Output of the controller is called control voltage.

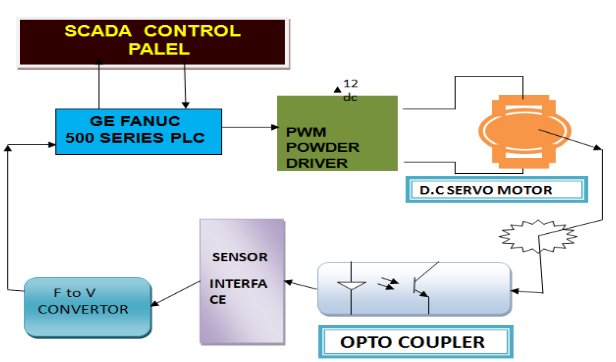

Fig 2.4 Block Diagram DC servo motor controls

A PWM power controller takes the input as control voltage signal Vc from the controller produce the required voltage to be applied to the motor, The power amplifier in a chopper whose average output voltage depends on the duty cycle ratio. The duty cycle ratio is adjusted by the control voltage set by the controller. A speed feedback circuit constitutes the speed sensor and the associated amplifier. In this DC servo motor control system, speed is sensed through an optical sensor consisting of a slotted disc, infra-red LED and photo-transistor. The output of the photo transistor is a series of pulses (8000 pulses per100 revolution), which is converted into analog voltage signal using frequency to voltage convertor. The output of the F/V convertor is 0 to 5 volts which corresponds to 0 to 1500rpm.

2.2 Closed Loop Transfer Function with PI Controller

The fig 2.5 shows the block diagram of the speed control loop with PI controller from the block diagram, setting TL=0

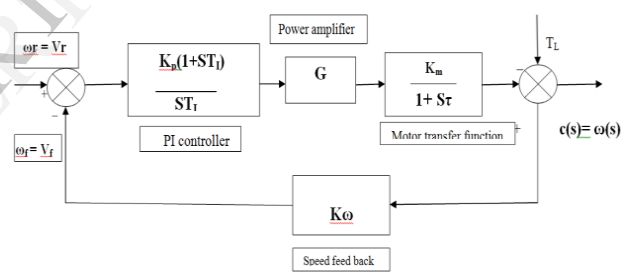

Fig 2.5 Closed loop transfer function block diagram of DC motor

2.3DESIGN ISSUES IN WEB- BASED FEATURES

The Fig 2.6 shows the general structure of Internet-based control system. The remote control system is based on a client/server architecture, which is used primarily for computer network communication. Information exchange between process plants and Internet-based clients allows the clients to remotely monitor and adjust the behaviors of the process plant. Thus, there exists a significant communication delay between the client controller and the object under control, which result in systems instability. New communication architecture and optimal control strategy must be employed towards solving the problems associated with time-delay communication. Therefore, in the course of designing internet-based monitoring and control systems, implementing the effective end-to-end network communication architecture and ideal control strategy, which aid to decrease the influence of Internet transmission time-delay and maintain systems stability are the main challenges (i.e., [4])..

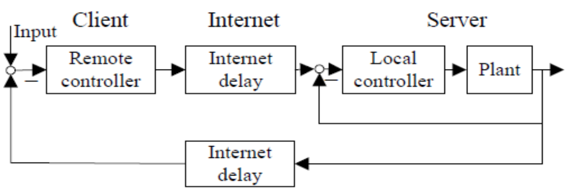

Fig 2.6 Structure of remote control systems over the Internet

3.0 Conclusion

This paper concentrates on the resent technological advancement in the field of remote monitoring using SCADA through a CNC milling D.C servo motor experimental setup which is being used has remote laboratory . The above experiment set up verified by using PLC programming for a drilling operation in a rectangular work component of with drill bit of 5mm,depth of drill is 10mm and distance between the drill is 15mm .But still there is many technical inabilities like time delay factor, security and more complicated machining operation etc . Hence much can be done in order to reduce these factors and by make use of GPRS communication channel we can easily establish these remote monitoring over the web. More experiments can be developed with more controllable process variables using SCADA which will help students to utilize laboratory placed remotely.

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