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Creation of Indigenous Web-page for the Automation of a Cascade Control System

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ABSTRACT

The paper presents a customized web enabled platform for monitoring and controlling a cascade control system which is interfaced with internet server through MODBUS communication. The simultaneous monitoring of both flow and level is done by reading the MODBUS register values and that are eventually converted to the appropriate user understandable format. The control option is obtained by changing the register value of the control valve. The web enabled architecture provides the monitoring access to more number of clients simultaneously without depending on any software as it being implemented as platform independent environment using ASP.NET. The obtained performance metrics prove that the values remain unchanged when compared with the real time control system.

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INTRODUCTION

Automation involves set of technologies that results in operation of machines and systems without significant human intervention. The revolution in semiconductor's industry brings enormous changes in industrial automation through which software modules shared maximum space with hardware components. Also, in last four decades various communication standards have been introduced which play the dominant trend in automation of industrial processes (Waqas and Thornhill, 2010). The internet based control system has been demonstrated as small-scale by Sun Microsystems, Cyberonix, Foxboro, and Valmet. Of these, most of internet architecture are developed in Java. The standards such as, OPC (Open Process Control) makes internet based control becomes reality by supporting XML within Visual Studio (Sangeetha *et al*. 2012a). For the internet based control system, the time delay and security are the two great challenges. In the last two decades, lots of research works have been done to develop application which involves the web architecture to supervise and control industrial process. Some of these technologies are based on the platform dependency process (Chaabene *et al*., 2007, Sebastian *et al*., 2007, Dormido *et al*., 2008 and Guzman *et al*., (2005)). Each year the control industries are refined with more sophisticated instruments with higher data rate.

In this study, a cascade control system is interfaced with internet server through MODBUS communication and it is controlled from remote locations (Sangeetha *et al*., 2012b). The main objective is to make a stand alone control system as an internet enabled one. A website is created for monitoring and controlling the process (Slobodan *et al*., 2012). The system performance has been analysed by the histroy of input and output parameter which are stored in the database.

Description on Cascade Control System:

The description about the cascade control system and its performance characteristics are validated and it has been described elsewhere (Sangeetha *et al*., 2012a). The functional operation of cascade system is summarized as the level transmitter measures the level in the tank and gives it to the controller based on the error value. The controller produces controller output in the ranges between 4-20mA and the same is given to I/P (current to pressure) converter which produces equivalent pressure in the range of 3-15 psi. The cascade process is considered as the product of the transfer functions of primary loop (level process) and secondary loop (flow process). The functional block of the system is shown in Fig.1. The transfer function for the cascade control system is obtained

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using two time constant method. The transfer function is given in Eq. (1) as obtained from the experimental data.

$$\text{Transfer Function} = \left(\frac{0.604}{158s+1}\right)\left(\frac{0.4}{4.2s+1}\right)e^{-6s} \quad (1)$$

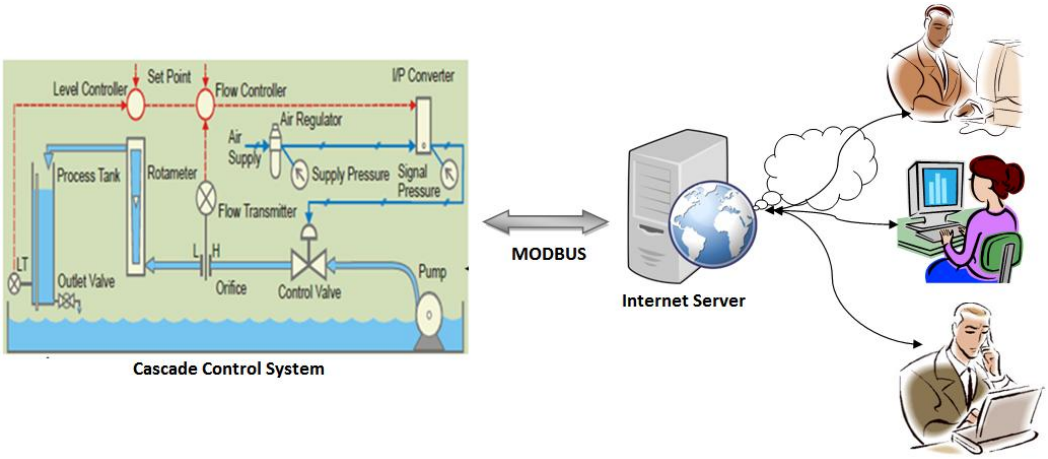

Fig. 1: Block diagram representation of internet based cascade control system

Website creation:

NET platform is used for developing a common software solution for industrial process. .NET programming languages can be clearly mapped to specific real aspects of automation objects. In this study, various web pages are created such as master page, user page, home page, new user page, reference page, description page, virtual page, admin page, about us page, guest page which are linked together. The GUI options are used for creating a flexible user environment. The Hyperlinks, Drop Down List are used for creating the high level web page design. In database connectivity, the Sql Data Source control is used for accessing the data and a Grid View control is used for displaying the data. The front end of the project is created by using the ASP.NET and the SQL Database is used for logging and retrieving the process data.

Software architecture:

Software architecture is based on supporting the high level security and created by using a supporting tool. The Data Flow Diagram (DFD) is used to represent the software architecture which is shown in Fig.2. The software architecture is implemented by making user, process, database as the three main components.

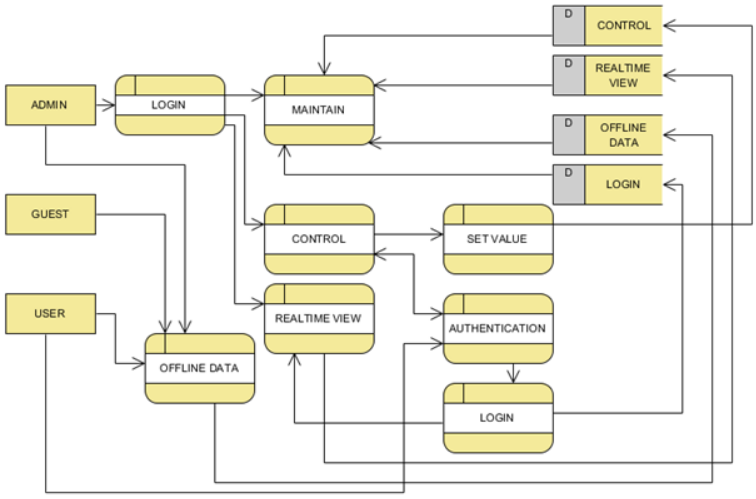

Fig. 2: Software architecture.

It is noted that admin has higher level authority to view the offline data, virtual view of the process and control the process. The high level authority provides the login services to other users and maintains the services. The second level authority is given to the users who should get the authentication

from admin to view the virtual process; also they can view the offline data without authentication. The third level authority is provided to the guest who need not require any login service for viewing the offline data about the process.

RESULTS AND DISCUSSIONS

The client server architecture is established by .NET platform and the client can access the system by using the URL of the web browser. The main advantage of this approach is platform independent services. The result shows that this system supports various Web Browsers, such as Mozilla Firefox, Internet Explorer, Google Chrome, Opera, Safari, etc. Hence a common software solution for all kind of industry process is achieved. The high level security is obtained by authentication process for accessing the services. The new login process, control process are performed sucessfully and the obtained results are compared with PLC SCADA based automation system. The user can access the services by using the login option as shown in the Fig.3.

Fig. 3: Home page.

If the user wants to create a new account to access the virtual view, they have to give the basic information like name, age, designation etc. These details are verified by the admin and authentication is provided to the user, along with the communication port number and bandwidth value should be given to the user before enables the process. As shown in the Fig.4, the flow, control, level buttons are used for monitoring the values and the write button is used for controlling the process.

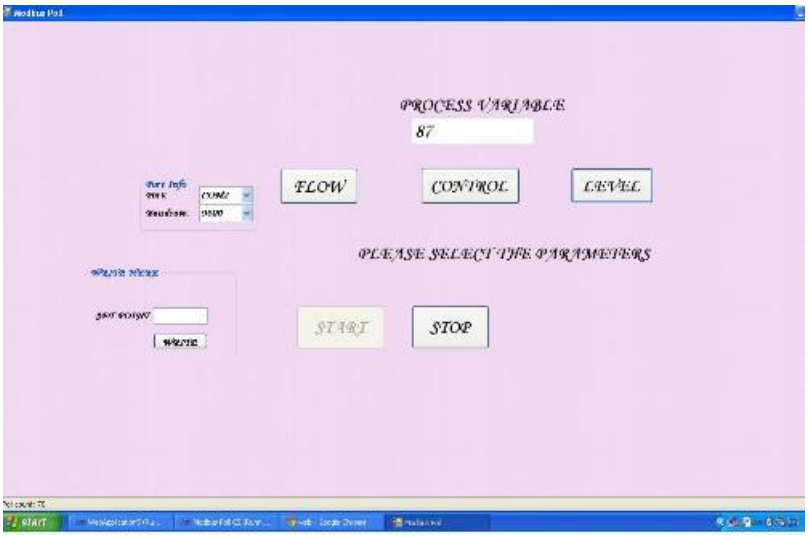

Fig. 4: Control page.

Conclusions:

From the performance analysis, the authentication process has been effectively controlled by the administrator. The control functions are executed perfectly with no significant error. Using the database all the activities of the user and guest are maintained successfully. Further experimental analysis is required on the resultant data obtained for the effective usage of internet communication interface in industrial applications. In addition, intelligent controllers need to be adopted to make the control system compatible to the operators. Security systems also need to be strengthened and eventually safety of operators should be ensured. In the near future, miniaturization of components used here is envisaged. Further to this, the effect of delay in internet communication on the process parameters is noted insignificantly. In details, there is no significant time delay and its impact on the monitoring of process parameter of system is observed.

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