

Development & Implementation of Client – Server Architecture for PLC Based Miniature Bending Machine

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Abstract - This paper describes the development & implementation of a client – server architecture for PLC based automation. Objective of this work is to integrate industrial automation with Internet & web technology. The architecture was developed using National Instruments LabVIEW, Rexroth IndraWorks (IW) and IWOPC server. For implementation, a PLC based bending machine was devised. Program was written in ladder logic on IW. Additional programming for data representation and human – machine interface (HMI) was carried out in LabVIEW. Finally, the architecture was deployed to the Internet & web for control, monitoring and analysis.

I. Introduction

The Internet is an important medium for distributing information worldwide without time constraint. This is particularly true for scientists and engineers, because designers of development systems view the Internet as a cost-effective worldwide standard for connectivity and distributing data [1].

However, integration of internet with industrial automation lags mainly due to lack of connectivity. Much of the information that resides on the end device that could be useful is not gathered. Data is also not consumed at the field or process levels in the traditional industrial automation hierarchy [2].

Publishing data related to the automated system on the web also changes how users interact with the machine. Incorporating Internet & Web technologies can mean a change in HMI architecture. Integrating Internet and the Web with automation will make it possible to send data over

the cloud and performing various functionalities, such as analysis of data, documentation, remote monitoring and control.

II. Objectives

- Understand elementary and networking concepts of LabVIEW.
- Utilize the OPC server to link LabVIEW and IndraWorks.
- Implement various data transfer techniques to share data over a network.
- Create a multi – platform client and server architecture.
- Identify and develop PLC based industrial applications.
- Deploy the client server architecture for development, control, monitoring and documentation of the PLC applications.

III. Methodology

The basic principle is to develop a client – server system for the control and monitoring of PLC application. Server handles connectivity, program development, data publishing and management of clients. Client (any device with internet connectivity) sends request to the server for control and monitoring of applications.

The PLC is connected to the server PC with an Ethernet cable. On the server PC, IW is used to configure the PLC, define the various inputs and outputs (I-Os). and develop the PLC program. PLC I-Os are declared as global variables, which publishes them to IndraWorks Secure Copy Protocol (IwSCP) server. This server links IndraWorks with LabVIEW.

LabView is a graphical control, test and measurement environment development package [3]. In the LabVIEW environment, the PLC variables are imported using DataSocket and Shared Variables [4].

LabVIEW virtual instruments (VI) can be created to run the actual application or just the HMI for the PLC program. Finally, LabVIEW networking technologies are utilized for accessing the applications through Internet/Web.

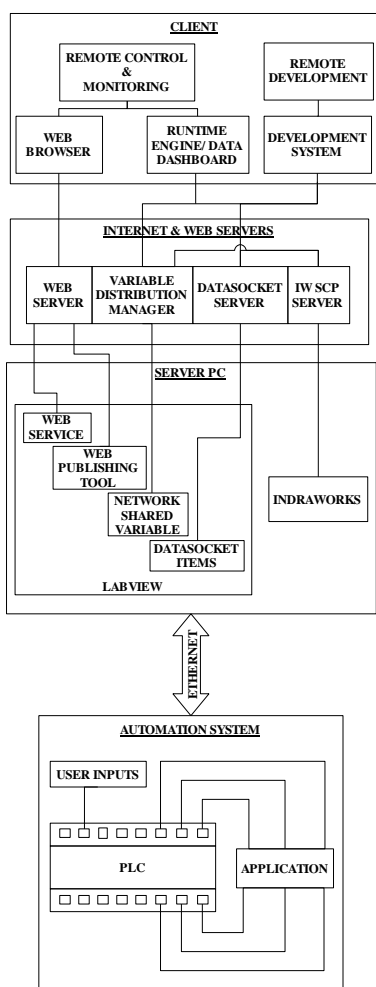


Fig. 1 Architecture Block Diagram

IV. Implementation

For the implementation of the architecture, a PLC based pneumatic bending machine is utilized. Pneumatics is concerned with generation, control and application of compressed air.



Fig. 2 Bending Machine Setup

In the bending machine setup (Fig. 2), cylinder A extends to clamp the work piece, cylinders B & C extend to bend the work piece. Finally, all three cylinders retract and work piece is released.

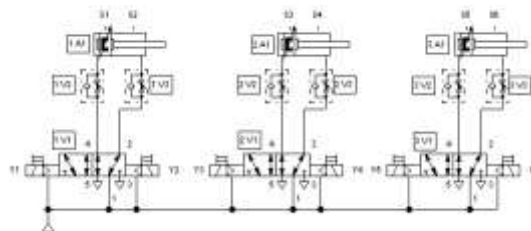


Fig. 3 Pneumatic Circuit for Bending Machine

The bending system circuit (Fig. 3) consists of three cylinders which are actuated in the sequence A+, B+, C+, B-, C- & A-.

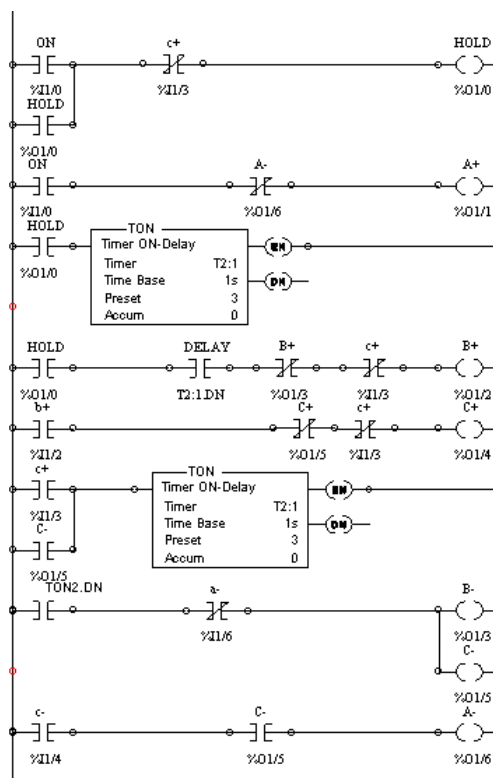


Fig. 4 Ladder Diagram

Figure 4 shows the ladder diagram for the bending sequence. Once the program created, the

PLC I-O variables are uploaded to the OPC server to link it with LabVIEW.

LabVIEW is used to create the HMI panel (Fig. 5) consisting of relevant controls and indicators to represent the I-Os. LabVIEW is also used to write additional programs for calculation of various parameters, such as, stroke velocity and air flow/consumption.

For application deployment, four different methods are used: web publishing tool, network variables, web service and data socket.

Web publishing [5] is the simplest method. Here, the front panel (Fig. 5) is published to the internet in the form of a web page. Users access the application by entering the relevant URL and requesting control.



Fig. 5 LabVIEW Front Panel

The limitation of the previous method is that it can be accessed only on PCs. For mobile devices, Data Dashboard app (Fig. 6) can be utilized. In this method, controls and indicators are created and linked to VI through shared variables. Thus allowing users to control and monitor applications through their smart phone or tablet.



Fig. 6 Data Dashboard

The third method of deployment is web service [5]. This can be utilized for monitoring the application. Figure 7 shows a web service deployed for monitoring of the bending system.



Fig. 7 Web Service for Monitoring

V. Conclusion

The LabVIEW based client – server architecture has been successfully developed and implemented for control and monitoring of a pneumatic bending machine. Deployment of the HMI to Internet & web provides quick & easy access to the application without any additional cost. In addition, various deployment methods, allows diverse client devices to be integrated into the system. Finally, availability of data relevant to the application reduces the time required to document and analyze the system.

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