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A PATH FOR HORIZING YOUR INNOVATIVE WORK

DOUBLE COLUMN LATHE VERTICAL MACHINE CONTROL USING PLC

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Abstract

As PLCs are now involved in most industrial processes, there for, development of a program to handle the control of a Double Column Lathe Vertical Machine will reduce maintenance rate and enhance machine performance. Further, a sigle PLC unit may control more than one motor via programming extra inputs and outputs already implemented in the PLC or simply by attaching additional input/output modules. The aim of this study is to control a Double Column Lathe Vertical Machine, using programmable logic controller (PLC) instead of conventional control.

The proposed control system will be equipped with S7_300 CPU controller, digital I/O module, and digital drives for DC motors and human machine interface (HMI).The communication between system components through Profibus. The system is programmmed with statement list language (STL). The Siemens Simatic Maneger and Win CC Flexible are used to configure the hardware and for simulating the operation.

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INTRODUCTION

Early machines were controlled by mechanical means using cams, gears, levers and other basic mechanical devices. As the complexity grew, so did the need for a more sophisticated control systems which contained wired relay and switch control elements. These elements were wired as required to provide the control logic necessary for the particular type of machine operation. That was acceptable for a machine which never need to be changed or modified. But as manufacturing techniques improved and plant changeover to new products it became more desirable and necessary to develop a more versatile means of controlling these equipments. Hardwired relays and switch logic was cumbersome and time consuming to modify. Many factories use PLC in automation processes to diminish production cost and to increase quality and reliability[1–5].

Wiring had to be removed and replaced to provide for the new control scheme. This modification was difficult and time consuming to design and install and any small "bug" in the design could be a major problem to correct since that also required rewiring of the system. A new means to modify control circuitry was needed[6].

The system is Lathe vertical machine used to operate with contactors relays and analogue drives as conventional control. The first motor is the main motor used to rotate the piece under treatment clockwise and anti clockwise. The second motor is used in x column for moving the tool head up or down depeding on operation. The third motor is used in y column for moving the tool head up and down depending on operation[7].

For choosing the hardware, there are many criteria for selecting the type of controller. For small control operations the main criteria are the number of inputs and outputs and the size of the user program. For larger plants you need to ask yourself whether the response time is short enough, and whether the user memory is big enough for the volume of data to be managed (recipes, archives). To be able to estimate the resources, data from the system alone are required with a lot of experience .there is no rule of thum [8].

A New Proposed Control Design is shown in Figure 1, the analogue drives are replaced with digital drives. The new control panel will be provided with human machine interface (HMI). Depeding on the existing control PLC (programable logic controller) SIEMENS S7_300 CPU controller with digital and analogue input output module can be used.

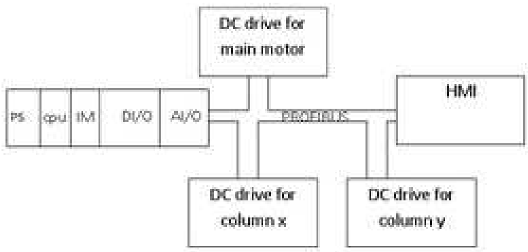

Figure 1 Block Diagram of the New Control

To facilite the comunication between them a Profibus can be used. The block diagram of the new control is shown in figure 1.

PROGRAMMABLE LOGIC CONTROLLER (PLC)

All PLCs have four basic stages of operations that are repeated many times per second. Initially when turned on the first time it will check it's own hardware and software for faults. If there are no problems it will copy all the input and copy their values into memory, this is called the input scan. Using only the memory copy of the inputs the ladder logic program will be solved once, this is called the logic scan. While solving the ladder logic the output values are only changed in temporary memory. When the ladder scan is done the outputs will updated using the temporary values in memory, this is called the output scan. The PLC now restarts the process by starting a self check for faults. This process typically repeats 10 to 100 times per second[9].

A Profibus Communication system uses a bus master to poll slave devices distributed in multi-drop fashion on an RS485 serial bus. A ProfiBus slave is any peripheral device (I/O transducer, valve, network drive, or other measuring device) which processes information and sends its output to the master. The slave forms a "passive station" on the network since it does not have bus access rights, and can only acknowledge received messages, or send response messages to the master upon request. It is important to note that all Profibus slaves have the same priority, and all network communication originates from the master [10, 11].

Human Machine Interface (HMI) allow control systems to be much more interactive than before. The basic purpose of an HMI is to allow easy graphical interface with a process. These devices have been known touch screens, displays, Man Machine Interface (MMI) and Human Machine Interface (HMI)[12].

As in all forms of industrial and precision control, digital implementations have replaced analogue circuitry in many electric drive systems but there are few instances where this has resulted in any real change to the structure of existing drives. In most cases understanding how the drive functions is still best approached in the first instance by studying the analogue version[13].

SYSTEM PROGRAMMING

For programming the system to cope with the new control, first the inputs and outputs has to be determined. The inputs and outputs for one motor are shown in Appendex (A1). Because there are no differeces on programming of the three motor except addresses will be changed.

Second configuration is done with Simatic Step 7. Some instructions are there to describe how a MASTERDRIVES drive with speed control can be coupled to a SIMATIC S7 CPU. Only the ON/OFF command, the fault acknowledges and the speed set point are operated as control commands. Status word 1 (ZSW1) and the main actual value are read back as actual values.

First, commissioning must be performed via terminals or Drive Monitor; the Profibus communication must be set up afterwards, i.e. when the drive can already rotate without problems.

• Insert a MASTERDRIVES from the STEP7 hardware into the Profibus. The Master drives converters are included as standard components in the STEP7 hardware. SIEM8045 is the corresponding General Station Descrition (GSD) file. All connections between the bus and the converter are set up via parameters in the converter.

• Select the telegram type “Standard telegram 1“or”PPO3“.

• The I/O start addresses specified for this drive via the hardware configuration (further description is based on I/O address 260).

- Save and compile the created hardware configuration and load it on the CPU.
- Third program for every motor will be written in separate function (FC), and then called in main organization block (OB1).

Because the program for the three motors is the same except the address, a single program for one motor is shown in appendix A2.

The overall cycle for program excution is shown in Figure 2.

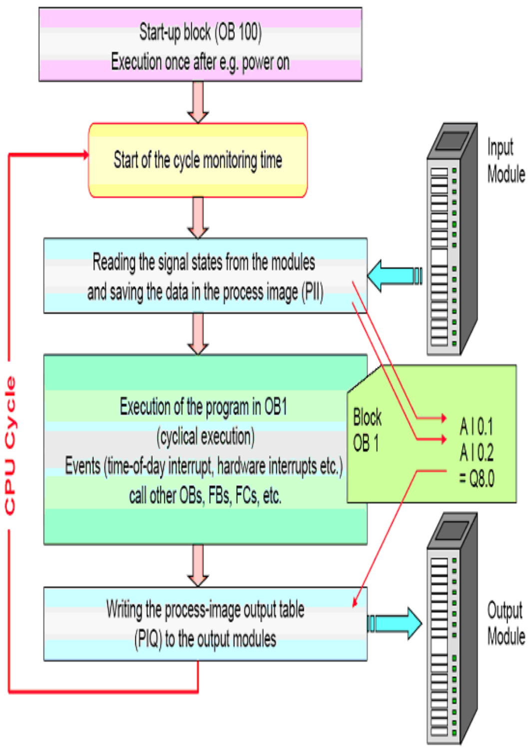

Figure 2 Cyclical Program Excution

SIMULATIONS

After writing the program and download to PLC the simulation of the program execution are shown in Figure 3 & 4.

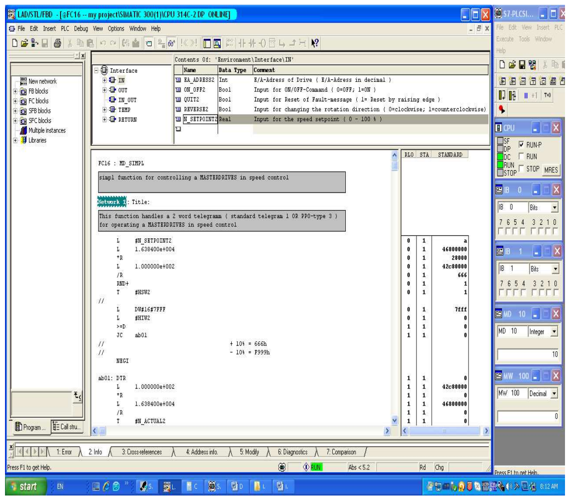

Figure 3 Program Simulation Screen after Execution

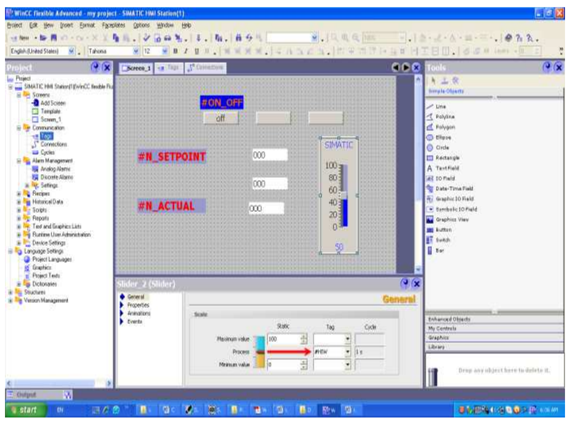

Figure 4 Screen of Human Machine Interface

CONCLUSIONS

In this study, control of double column vertical machine is done based on programmable logic controller (PLC). The original control of the double column vertical machine was a conventional control. Through this study Simatic Step 7_300 is used and analogue drives are replaced with digital drives and control panel replaced with human machine interface (HMI). To reduce wiring cable Profibus Deceterlized Prepherals is used to communicate between different systems parts. As a result of successful simulation program when set point is entered from the human machine interface the motor tracks the set point.

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