PLC Based X-Y Plotter

[1]Allen Anthony,[2]Vikas Gupta,[3]Suraj Bhosale,[4]Mr.Anant R. More

[1]B.E E&TC, R.M.D Sinhgad college of Engineering, Pune, India , [2]B.E E&TC, R.M.D Sinhgad college of Engineering, Pune ,India, [3]B.E E&TC, R.M.D Sinhgad college of Engineering, Pune ,India,[4]Asst. Prof E&TC, R.M.D Sinhgad college of Engineering, Pune, India

Abstract

The goal of this project is to design and implement X-Y plotter using PLC to draw/cut shapes in such way to prevent wastage of sheet because of irregular shapes. In this project PLC work as a heart of system. Here we use two motors one for X-axis and other for Y-axis. Motors are used to decide position of the pen. Here dimensions of rectangle or triangle or square are given to the PLC input. According to the dimensions PLC will generate the control signal and drive the pen by controlling motors. We propose this system to control an old XY Plotter with a PLC system. It makes the lab works more practical, getting people closer to real world applications.

IndexTerms: **Delta PLC (DVP SA2), sensors, Motors.**

INTRODUCTION

A PLC is an industrial computer control system that continuously monitors the state of input devices and makes decisions based upon a custom program to control the state of output devices. Most of the production line, machine or process can be greatly enhanced using this type of control system. However, the biggest benefit in using a PLC is the ability to change and replicate the operation or process while collecting and communicating vital information. Another advantage of a PLC system is that it is modular. That is, you can mix and match the types of Input and Output devices to best suit your application. These controllers eliminated the need for rewiring and adding additional hardware for each new configuration of logic. Switches, sensors can be used as a input device. Motors of both axis can be driven by PLC according to input.

The essential parts of a Plotter are:

1. Two Motors moving simultaneously to draw the pattern.
2. A pneumatic switch to make the pen move up and down.
3. A frame which supports the whole process.

LITERATURE SURVEY

Automatic Cutting Machine

Global competitions and technological advances are forcing manufacturers, designers and engineers to constantly innovate new product manufacturing strategies in reducing product development cost and time. Contemporary manufacturers have the option of selecting optimum technologies or processes to suit their manufacturing environment. CNC is one in which the functions and motions of a machine tool are controlled by means of a prepared program containing coded alphanumeric data. This technique is basically used for industrial application. This paper presents that how to work profile cutting machine by using PLC technique.

PLC and Supporting Function (DVP-SA2 , PLC)

A PLC is a computer, or more precisely an industrial computer. PLC's are designed to withstand harsh environments; assembly lines, mines, food-processing plants, automotive plants and more. Most PLC's are modular; they can be scaled up or down as needed. Inputs cards, output cards, communication cards, motion control cards all can be added or removed to satisfy most engineering needs. They are designed for a very specific purpose, machine control. The PLC is the brain of any intelligent control system. Just as the integrated circuit chip replaced multiple transistor circuits in electronics, the PLC replaced multiple electromechanical relays in industrial circuits. Complex machines contained thousands of relays. Today a single PLC can replace all the logical relays, timers, and other peripheral devices common in the machines of the past. The modern PLC can control machines, collect data, crunch numbers and so much more. All they need is an architect, someone to tell them what to do.

PROPOSED SYSTEM

Block Diagram

Scada is used to provide input to plc. PLC has 24v DC supply and output is used to run the motor driver and thus run motor of both axis.

SOFTWARE

ISPSoft Version 3.03

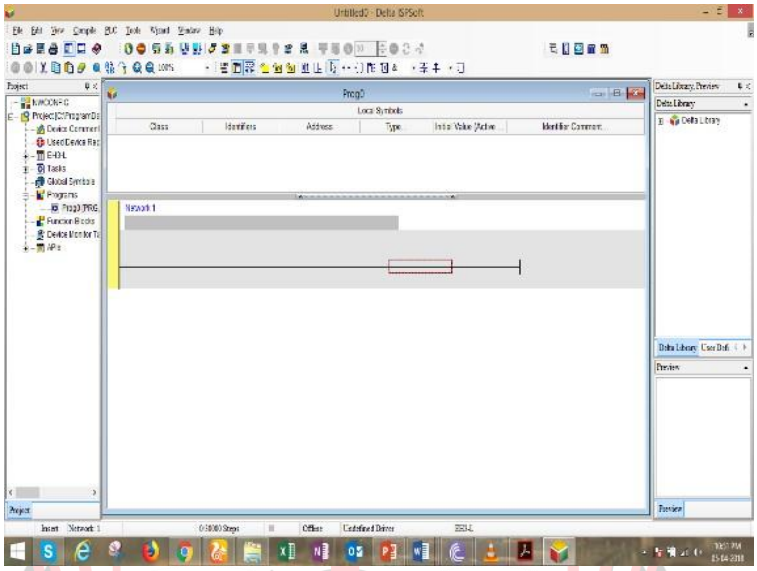

Fig. 1 GUI for ISPSoft Version 3.03

ISPSoft is a software development tool for Delta's programmable logic controllers. IEC 61131-3, which supports five programming languages and a large number of applied instructions, is adopted. In addition to basic programming functions, ISPSoft also contains many auxiliary tools.

The multilingual environment and the friendly user interface provide users with a convenient and efficient development environment.

Characteristics:

- It supports the international standard IEC 61131-3 and a large number of applied instructions.
- It supports five programming languages. They are ladder diagrams (LDs), sequential function • charts(SFCs), function block diagrams (FBDs), instruction lists (ILs), and structured texts (STs).
- Users can use more than one programming language in one project.
- It supports traditional Chinese, simplified Chinese, and English.
- The Find and Replace functions can be applied to a present window, or a whole project.
- It provides a user-defined operating environment.
- The project management adopts an interface which uses a hierarchical tree structure.
- Users can develop several models in a group of projects.

Arc interpolation

S_1	:	Number of output pulses of X axis
S_2	:	Number of output pulses of Y axis
S	:	Max. point-to-point output frequency
D	:	Pulse output device

Explanations:

When DPPMR instruction is executed, S_1 and S_2 perform 2-axis point-to-point "rectilinear" motion from output device D in frequency S. S_1 = number of output pluses on X axis; S_2 = number of output pulses on Y axis (indicated by relative coordinate position; +/- refers to forward/backward direction). This instruction is only applicable to EH2,SA2 and SV.

Axis Relative point to point movement

When DCIMR instruction is executed, **S_1** and **S_2** perform 2-axis point-to-point "arc interpolation" motion from output device **D** in resolution **n**. **S_1** = number of output pluses on X axis; **S_2** = number of output pulses on Y axis (indicated by relative coordinate position; +/- refers to forward/backward direction). This instruction is only applicable to EH2 , SA2 and SV.

Relative Position Control

When DRVI instruction is executed, PLC outputs the number of pulses (by relative position; +: forward direction, -: backward direction)assigned by **S_1** and direction control signals in the set frequency **S_2**from pulse output device **D_1** and rotation direction signal output device **D_2**.

Compare Funtion

The contents of S1 and S2 are compared and D denotes the comparision result. The contents of S1 and S2 are compared and D denotes the comparision result.

PLC (HARDWARE)

P.L.C (DVP SA2)

1. Adopt 32-bit cpu
2. Program capacity: 16K steps/Data register:10K words
3. Execution speed: LD: 0.35us,MOV:3.4us
4. Built-in 1 RS-232 and 2 RS-485 port(Master/slave)
   (MOTION CONTROL FUNCTION)
5. 4 point of high speed pulse output: 100khz/2 points 10khz/2 points
6. 8 points of high speed pulse input: 100khz/2 points 10khz/6 points, 1 set of A/B phase 50khz
7. Supports 2-axis linear and arc interpolation

Fig.2 Delta PLC (DVP-SA2).

Motor:

1. Current regulation by integrated PWM controller and internal current sensing
2. Programmable slew rate for EMC and power dissipation optimization
3. Two full bridges for max. 1.3 A load (RDSON= 500 m□)
4. All outputs short circuit protected with open load, overload current, temperature warning and thermal shutdown
5. All parameters are guaranteed for 3 V <Vcc< 5.3 V and for 7 V <Vs< 20 V The PWM signal of the internal PWM controller is available as digital output

Motor Driver

1. High bus voltage

2. 120 and 220 VAC models
3. Sophisticated current control
4. Advanced anti-resonance algorithm
5. Torque ripple smoothing
6. Fast 10/100 Ethernet port
7. Supports Ethernet UDP & TCP protocols
8. Available with built-in EtherNet/IP communications
9. Stall prevention/detection with encoder feedback 10. Microstepping to 51,200 steps/rev

RESULT AND DISSCUSION

Working Description

We used a 8 input 4 output Delta PLC (DVP 12 SA2) and applied 24V Dc supply using SMPS .The output of PLC connected to driver card .Driver used to run the motor .PLC has input of proximity sensor which are used to locate the home location while drawing .The program is downloaded in PLC using ISPSOFT and COM manager software .PLC receives its input through scada and when it is applied on run mode the plotter start moving .It works according to the logic in program with simultaneous synchronised motion of both the x and y axis.

There is another axis z it is only used to switch the pen button on and off, as its work is not significant and other push pull switches or pneumatic switch could be used so its function is not elaborated. The sensor is present at the corner of the paper to accurately give the home location from where the pointer has begun its tracing.

Algorithm which used to decide the working pattern and designed logically and mathematically. Plotter on uses this predecided patterns and draw by just analysing the conditions of dimension best for drawing a given patterns, this analysis is done mathematically, by the help of mathematical function given in the plc.

This is the overall working of the smart plotter. As it is a prototype its advance version can be made by using better material and by adding many more shapes either regular or irregular in future.

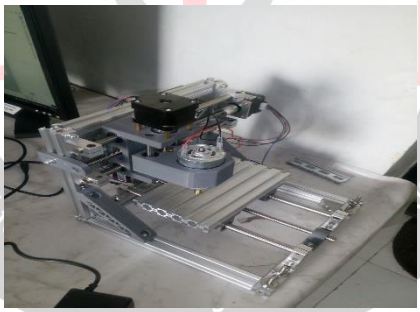

Fig.3 working of smart plotter

Future scope

1. The plotter can be used in any metal cutting and fabrication industries.
2. It have a very important use in Textile industries for cutting cloths.
3. It can also be used in Art & Craft industries
4. Local level tailors can also make use of it in cutting shapes for cloths.

Advantage

1. System is completely automatic.
2. Plotters are able to work on large sheets
3. Materials that a plotter can draw on include sheet steel, plywood, aluminium, plastic,

4. Cardboard and almost any flat sheet material.
5. Efficiency.
6. Stepper motors are used.

References

[1] Martin, J. D., 'Frequency scaling by digital means', IEEE Conference on Digital Instrumentation 1973, pp. 67-73. (IEE Conference Publication No. 106). 4.Bresenham, J. E., 'Algorithm for computer control of a digital plotter', *IBM* Systems J., 4, no. 1, pp. 25-30, 1965.
[2] DELTA user manual.
[3] ISPSOFT user manual.

.

