A large number of stepping motor network construction by PLC

Lin Mei [1, a],Zhang Kai[2,b],Guo Hongqiang[3,c]

[1, 3] Binzhou Polytechnic No.919, Huanghe 12 Road,Binzhou, Shandong Province
[2]SHANDONG BEFAR BINYANG FUEL CHEMICAL CO.,LTD Binzhou, Shandong Province
[a]Linq_0324@163.com, [b]bygczk@163.com, [c]guohongqiang0708@163.com

Abstract. In the flexible automatic line, the equipment is complex, the control mode is flexible, how to realize the large number of step and servo motor information interaction, the orderly control become a difficult control. Based on the existing flexible production line, this paper makes a comparative study of its network strategy. After research, an Ethernet + PROFIBUSE communication configuration based on PROFINET IO and profibus was proposed, which can effectively improve the data interaction efficiency of the equipment and stable data interaction information.

1. Introduction

The coming of industry 4.0, the product's function and quality are more and more demanding, and the product renewal cycle is shorter and shorter. In the past, the production pattern of products such as single, large batch, special equipment, technological stability and high efficiency has not fully satisfied the demand of today's industrial age. In this situation, flexible automatic production line is born. It is a control model with complex technology and high automation. This control mode, through the analysis of the typical technical requirements of processed products, design sequence of the modules of each device, so as to form various forms of modular flexible systems with material flow and information flow. That is, according to the production process and process of the product, the flexible and flexible production of machine tool electrical equipment can be adjusted. The flexible production line improves the adaptability of various products, and solves the contradiction between high automation and high adaptability of machinery. The PLC control technology of flexible manufacturing system is used to produce products, which can guarantee both quality and efficiency, and bring production into the information field. And in the actual flexible manufacturing products in the precision machining, step motor and servo motor as executive component application is becoming more common, PLC control of stepping motor and servo motor, due to the frequent motor number, Information interaction is frequently changeable, relatively complex sequence of reason, which increase the difficulty of its control.

On the basis of experiment, this study proposes a set of use Siemens PLC control of stepping motor flexible automatic generation of line network strategy and implementation plan, using the combination of Ethernet and profibus network for layered management of the equipment.

2. The flexible production line

The thmszc-2 closed-loop flexible automatic production line is based on the highly precise flexible automatic production equipment built in the industrial production environment, which is the actual

reproduction of the production technology environment. It Is mainly composed of feeding device, five-axis robot equipment units, industrial robot, multi-axis machining equipment unit, unit hydraulic stamping equipment unit, handling equipment unit, blanking equipment unit, image processing unit and the equipment unit, wearing pin equipment units, spraying drying equipment, testing equipment, bar code identification equipment units, sorting conveyor equipment, logistics, warehousing equipment units, etc. 17 units.as shown in Fig1.

Figure1. Thmszc-2 closed-loop flexible automatic production line

Each unit of equipment is designed with industrial standard parts, and all of them are actuating parts, such as stepper motor and servo motor. It is fair to say that this flexible automatic production line is already in the leading position in industrial production.

3. Design ideas of control system

The flexible automatic production equipment control system needs to have the independence of each unit of flexible action, different unit an orderly flexible combination, orderly control of stepper motor, servo motor precision work is to realize the organic whole work, the key problems of high speed running. Considering the large amount of data interaction between unit equipment, frequent data interaction, this paper design the hierarchical distribution based on PROFIBUS DP design, make the control hardware has an organic whole, improve the system operation and maintenance convenience.

Hardware control system requires flexible control of 17 units of work, we designed for each unit independent control module, make its can work independently, at the same time, considering the number of control module is more, we also need to set up a main control module, realize the flexible arrangement of 17 units of work, efficient combination. We use PLC300 combined with PLC200, S7-300 PLC as the main controller, by reading the 17 execution unit S7-200 PLC state information, and then through the software programming method to adjust and control the execution unit.PLC200 controls the precise work of stepping motor in each unit.

4. Layer structure

In view of the characteristics of the information integration and the decentralization of system field equipment, the system adopts hierarchical control. As shown in Fig2: The system is divided into three levels. The first layer is the management, and the overall control and monitoring interface of the system is responsible; the second layer is responsible for the control of the on-site equipment and the transmission of network information through profibus DP, The third layer is the equipment layer, which is clear at the level of the structure, so that the dispersed equipment can be conveniently controlled by the management.

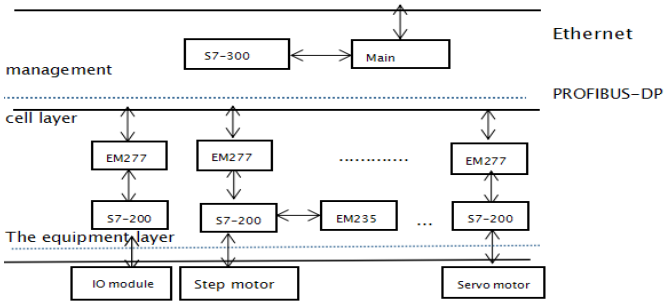

Figure2. Hierarchical structure diagram

The management adopts Siemens S7-300PLC as a type of main station, interacting with the upper machine touch screen and PC compute. The s7-300 main station serves as the data management center of the whole system; Read the status information of the lower level, and make coordinated planning and processing tasks; The receiving layer sends the information sent by the PC from the touch screen, and converts it to the equipment layer for processing sequential logic.

5. Hardware configuration

Master control module: In terms of PLC selection: according to the system's hierarchical control requirements, this system uses PLC300 and PLC200 combination control mode.PLC300 choose CPU315-2 DP as the main control module, this model is a kind of bring large program memory and CPU module of PROFIBUS DP master/slave interface. With medium and large capacity of program memory and data structures, and can provide PROFIBUS DP master station/from the interface, except with the production structure of centralized I / 0, also can realize distributed automation system can be used to establish a high speed and easy to use. It is commonly used as the standard PROFIBUS DP main station in SIMATIC S7-300.

PLC 200: According to the control characteristics of each unit, especially for stepper motor, servo motor control, it need to select the transistor type such as cup224DC/DC/DC, Only the model can realize the high speed pulse output match the control frequency of the step motor and servo motor. With PPI communication, MPI communication and free mode communication capacity, it is a small controller with stronger control capability.

Communication module: CP343-1 LEAN communication processor is a network device designed to operate in PLC300, which capable of connecting S7-300 to industrial Ethernet and supporting profinet I/O.EM277 module is an open, non-dependent standard communication that supports the use of an intelligent extension module. The PLC300 must use the EM277 module to connect the s7-200 CPU from the station to the network when the main station is to have a large number of PLC200 hierarchical profibus network intelligent data transmission.

6. The network configuration

The first layer is management, which communicates with the network via the industrial Ethernet profinet I/O. The second layer, via profibus for network information transmission. The third layer is the equipment layer and the distributed communication control is realized through the EM277 module.

6.1. Ethernet Configuration

Through the CP343-1 LEAN module access Ethernet network, s7-300 communicates with the upper computer through the Ethernet module. The steps are divided into: CP module first configure PROFINET IO device, and the data is delivered through PROFINET IO. Then using the simatic S7 to write communication program. Download it to the s7 CPU at the same time. The way will be in IO Application relationship between controller and I/O devices (Application base, AR), process data can be forwarded to PROFINET IO controller before, after receiving after processing, and output to process I/o. The network layered graph is shown below:

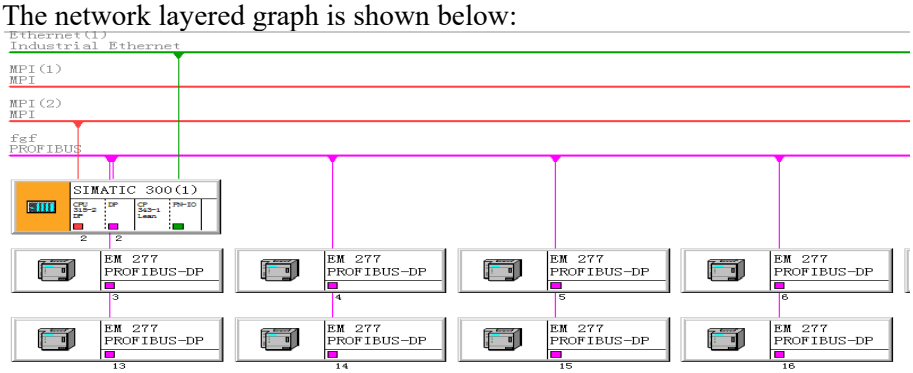

Figure3. Ethernet Construction Diagram

6.2. Profibus DP configuration

According to the control requirements of the ring stations, the 17 units in the flexible production line are independently controlled by PLC200.In order to achieve the control of a large number of step terminals, the central processing unit adopts distributed control method to build profibus-dp network. The s7-300 host collects and processes the corresponding information of each station and completes the linkage control between stations. The main steps are as follows:

1) Run the SIMATIC Manager software, create a 300 site project, make the hardware configuration, and then edit the user Program under the S7 Program directory of the corresponding CPU after completing the hardware configuration.

2) The host configuration. In STEP7, the configuration of the main frame can be completed by simply dragging and dropping. In the configuration process, the order number that is added to the module in the host frame should be consistent with the actual hardware. The hardware configuration screen.

3) The EM277 module is selected from the hardware directory to configure the station number for each function station. The first station is the drop-off unit, which is set as no.6; the second station is building block unit, which is set as no.7By analogy, each station does not duplicate the number. The configuration diagram is shown below:

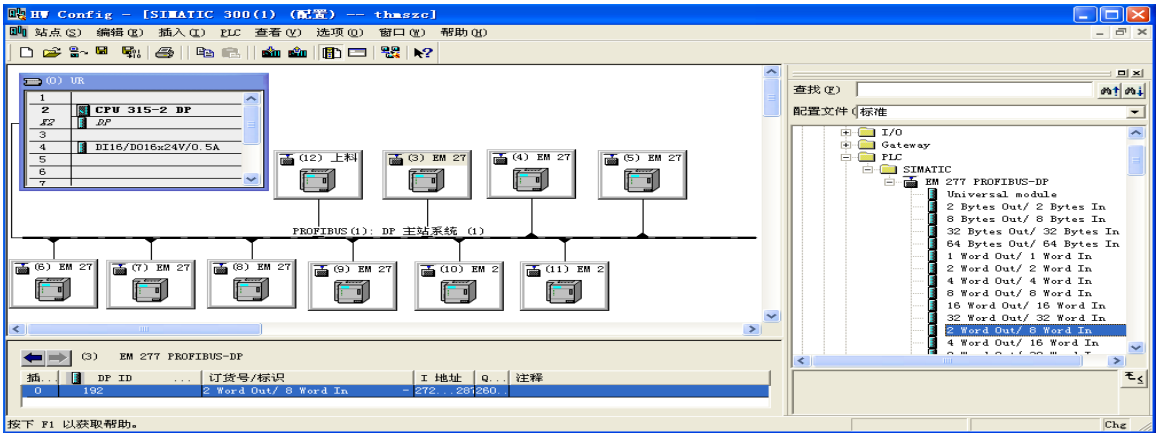

Figure 4. Profibus DP configuration diagram

4) Change the starting position of the input and output address, make sure each station EM277 corresponds to the input and output points, with 6 station as an example, application allocated I15.0 ~ I18.7, Q15.0 ~ Q18.7 as input and output points. Among them, 200 hosts send data to 300 hosts as input data, 300 hosts transmit data to 200 hosts as output data.

5) In the 200 program, V0.0 ~ V3.7 is used as the input point for transmitting data to 200 hosts for 300 hosts,V4.0 ~ V7.7 is used as the output point for sending data from 200 hosts to 300 hosts. For example, the I0.0 of 200 stations can be transferred from V4.0 ~ V7.7 to 300 main stations, and the 300 main station can be transferred to 200 stations by a point from V0.0 ~ V3.7.

After downloading the program of 200 and 300 separately, the running switch of each host will be hit to RUN position. After a few seconds, the RUN green indicator on the 300 host will be on, indicating normal. If any red alarm light is on, check whether the hardware configuration and procedures are wrong. Until the green indicator lights up, the whole network is completed.

7. Conclusion

We use the layered network structure of Ethernet and profibus for this flexible production line. After debugging and running, it can effectively carry out the information interaction of multiple sites and make a good network transmission platform. A good network support is provided for the follow-up of a large number of step motor and other precision equipment.

References

[1] Kovacic, Z, Bogdan, S, Smolic-Rocak, N, et al. Teaching flexible manufacturing systems by using design and simulation program tools[C]//Eurocon 2003. Computer As A Tool. the IEEE
[2] Cao Haiquan , PLC Control of capping Manipulator of Flexible Manufacturing system.
[3] Han jian, Automatic surfacing welding application of step-motor controlled by PLC
[4] Chen wanqiang,The flexible manufacturing system is covered by the manipulator
[5] Kong Xiangdong, Resrarch and Implenmentation of Multi-Microstepping Driver for Three-Phase Hybrid Stepper Motor