

Analysis of Electric Hybrid Control Method of Manipulator in Assembly Line Based on Plc

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Abstract: with the Rapid Development of Industrial Intelligence in China, Plc Technology is More and More Widely Used in Electrical Control. Plc Control Not Only Improves the Working Efficiency, But Also Maintains the Stability and Safety of the Equipment Operation. However, in the Extensive Use of Plc Technology, There Are Also Problems Such as Line Aging and Improper Operation of Equipment. in View of This, This Paper Analyzes the Control Requirements of Plc and Manipulator, and Puts Forward the Electric Hybrid Control Method of Manipulator in Assembly Line Based on Plc.

1. Introduction

1.1 Literature Review

Ma Minglong once believed that in the early industrialization process, there were control problems in the application of manipulator automation production line. When the task was assigned to industrial manipulator through unilateral machine system, it was rather complicated and could not accurately complete the assigned task (MA, 2019). Zhao Lu and Chen Bing once thought that with the progress of Chinese society and the development of science, intelligent production has become an essential element in industrial production, and manipulator is a tool to realize the application of automatic control and programming operation, which plays an important role in the global industrial automation control (Zhao and Chen, 2019). Zhang Yanxia and Wang Dengfeng once believed that in the process of manipulator movement, the tail end of the manipulator is contacted with the target object through visual guidance. When the contact is completely established, the manipulator controls the movement, which can prove the effectiveness of the hybrid control strategy of vision and force (Zhang and Wang, 2014). Guo Xiangyu and Wang Huanhuan pointed out that in order to improve the practical ability of college students, according to the advantages of PLC control system, such as high reliability, strong anti-interference ability and simple programming, a PLC teaching pneumatic manipulator control system was designed (Guo and Wang et al., 2017). He Huixiang once believed that in the course of modern electrical control technology, manipulator control is an important teaching project. Through the study of this project, college students can be trained in their professional ability for mechanical posts and improve their mastery of knowledge (he, 2017). Dong Lanbo and Zhang Haichao once pointed out that at present, most of the primary processing of China's products is carried out on ordinary lathes, which is easy to cause cost waste, and the safety and product accuracy are poor. By using the manipulator device controlled by PLC, the manipulator can be controlled to complete corresponding actions through programmable technology and corresponding hardware settings, and the production efficiency of traditional production line can be effectively improved (Dong and Zhang, 2016).

1.2 Purpose of Research

In view of the problems such as high labor intensity and difficult recruitment of workers in the production line of Chinese factories, an industrial manipulator based on PLC control should be designed, with air pressure as the driving system and PLC as the control mode, to carry out multi-directional integration, so as to solve the above problems (DU and Yao et al., 2019). With the acceleration of China's industrialization process, the production capacity of ordinary lathe has failed

to keep up with the demand of social development. The problems of low production efficiency, poor quality and low precision of ordinary lathe are frequent. Starting from PLC control, this paper studies the application of assembly line manipulator under the control of intelligent lathe PLC, so as to provide relevant method analysis, in order to optimize the electrical hybrid control method of assembly line manipulator.

2. Overview of Relevant Theories

2.1 Overview of Plc Automatic Control Technology

PLC (programmable logic controller), also known as programmable controller, belongs to the field of industrial automatic control of microcomputers, is also a member of the computer family. In PLC, there are usually several single-chip microcomputer systems, which can recognize and run simple computer instructions. At the same time of improving the function of single-chip microcomputer, it will be accompanied with other function expansion, such as communication function, etc., which will further strengthen the PLC function. There are two types of interfaces in the external interface of PLC, one is the output function, the other is the input function. Various external switches input the input through the input interface, and then through the detailed calculation of the internal microprocessor, to achieve the function of external port control output signal, and effectively control the external equipment system. The communication function of advanced PLC can form a communication protocol which can be connected internally. Through data communication with related equipment, the control equipment can complete relatively complex operation, and the data technology can be uploaded to the terminal in time, so that the operator can clearly grasp the system operation status, so as to optimize and adjust the system at any time.

2.2 Analysis of Manipulator Control Requirements

Because the model and grade of CNC system are different, so are all kinds of CNC systems. In order to control industrial manipulator by numerical control system, it is necessary to analyze the function and structure of manipulator and select the right manipulator to operate. The commonly used manipulator structures are generally divided into five types: cylindrical coordinate manipulator, joint manipulator, planar joint manipulator, rectangular coordinate manipulator and spherical coordinate manipulator. The motion form of cylindrical coordinate manipulator is a three degree of freedom motion system with one rotation and two movements. If it is driven by a motor, at least three motors are needed to operate normally. If the manipulator wrist also needs to rotate, it needs to be equipped with a motor gripper, so the axis numerical control system should be selected. The arm of the articulated manipulator is similar to the upper limb of human. The first three joints can rotate. The shoulder joint is usually formed by the column and the big arm, and the joint between the small arm and the big arm is formed by the shooting joint. Since each joint needs motor drive, the axis numerical control system should be selected. There is no wrist device for the face joint manipulator, and a motor needs to be placed at the bottom to control the lifting of the manipulator. Two joints need a motor respectively, and the gripper is driven by the pneumatic system, so there are three motors in total, and the general CNC of the shaft can meet the requirements. The moving part of the rectangular coordinate manipulator is composed of three movable straight lines, which is similar to the cylindrical coordinate manipulator. If the motor drive mode is adopted, plus the motor required for wrist rotation, and the gripper is driven by the motor, a total of 5 motors are needed, and the axis numerical control system should be selected. The spherical coordinate manipulator consists of two rotations and a straight-line movement. Its working range is a sphere, and it is also a motion system composed of three degrees of freedom. Plus the motor required for wrist rotation and gripper, there are five parts in total, so the axis numerical control system should be selected.

3. Development Status of Cnc System

In the late 1950s, the CNC system was just started in China. Because of the blockade of the

export of CNC technology, the country introduced and digested a lot of CNC technology from 1981 to 1995. By the year 2000, China's CNC technology has been developing rapidly. China's CNC technology has begun to enter industrialization and marketization. The utilization rate of domestic CNC products has reached about 50%, and the domestic CNC system basically covers about 10%. At present, the scale of CNC industry in China has basically taken shape. CNC technology has become a compulsory course for mechanical students in Colleges and universities, and a large number of CNC senior talents have been trained for the country. After more than 50 years of efforts, China's CNC system has a certain scale in the market. Because of the low price, good quality and full function of CNC products in China, they are welcomed by users. At present, the most influential companies in China are Huazhong CNC, aerospace CNC, etc. The successful development of Huazhong 8-type system by Huazhong CNC and the successful application of high-precision five axis linkage casnuc 3000mc developed by aerospace CNC in the machining center show that China's current high-end CNC field has broken the blockade of foreign CNC technology. Because the development of China's high-end CNC system is still in the primary stage, it is still occupied by foreign products in the field of high-end CNC, and the domestic CNC system is still in the field of low-end CNC.

4. Method Analysis

4.1 Pneumatic Circuit of Manipulator in Assembly Line

Assembly line manipulator is widely used in workshop automation production, which is usually realized by pneumatic system. From the perspective of the production process of the manipulator, the bottom application logic of the pneumatic manipulator should be column lowering, extending the boom, tightening the workpiece, shrinking the boom, rotating the column clockwise, lifting the column, lowering the workpiece, and rotating the column anticlockwise back to the starting point. From the point of view of control method, it is controlled by PLC. In terms of pneumatic mechanical structure, there are three cylinders and a pneumatic motor.

4.2 Program Design of Manipulator Control System in Assembly Line

As the core control program of the manipulator in the assembly line, PLC is usually based on the manipulator and pneumatic system, so as to understand the nodes (18), output points (8), input points (9) and output input voltage (DC24V) of the electrical control system. Therefore, PLC control module suitable for manipulator of assembly line should be selected. From the perspective of operation principle, electric control is mainly responsible for the start and stop of equipment work, and input the relevant address to the corresponding port, and then through the corresponding output port, complete action can be carried out. It should be noted that when the equipment is in or out of work, the initial state of the equipment should be restored (as shown in Figure 1).

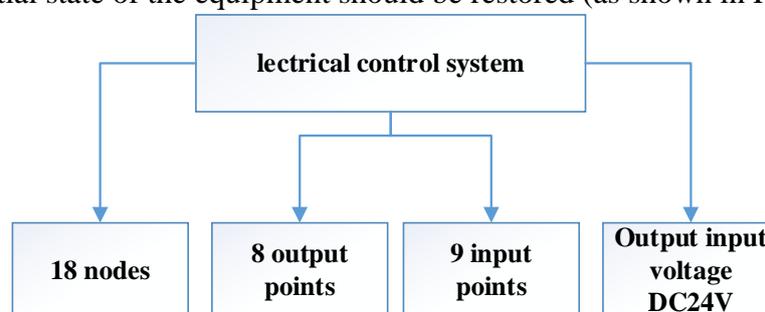


Fig.1 Example of Electrical Control System

4.3 Software Design

Firstly, the electric hybrid control of manipulator in assembly line based on PLC is taken as the main body, and the pneumatic control program is designed first, then the PLC control program is designed. Secondly, by using the record select mode, the relationship between the cylinder

displacement and the input program state is selected, and then the pneumatic servo program is written. Finally, in the selection of PLC control program, through a complete set of procedures of column lowering, extending the boom, tightening the workpiece, shrinking the boom, rotating the column clockwise, lifting the column, lowering the workpiece, and rotating the column anticlockwise, a comprehensive data integration is carried out. In the process of data integration, coding system and simple control system can be used to fill in the parameters, so as to realize the software design.

4.4 Possibility of Simulation Experiment

On the one hand, in the design of the assumed specific assembly line manipulator electrical hybrid control method, because of the poor relevance, it fails to meet the standard, or in the simple experimental environment, according to the above principles, through the design of computer related software, the experimental model is constructed to realize the virtual aggregation of data. On the other hand, if the design is completed, it can also be saved or trial run according to the idea of virtual design, so as to do a good job of test and inspection for the application of real theory to practice, so as to ensure the effective connection between theory and practice, reduce the repeated work and improve work efficiency.

References

- [1] Ma M.L. (2019). Application Analysis of PLC-based Industrial Manipulators in Automated Production Lines, *Modern Industrial Economy and Informatization*, 9(02), 69-70.
- [2] Zhao W., Chen B. (2019). Research and Analysis of Pneumatic Manipulator Control System Based on PLC, *Southern Agricultural Machinery*, 50(6), 105+107.
- [3] Zhang Y.X., Wang D.F. (2014). Research on Visual/Force Hybrid Control Scheme for Industrial Manipulators, *Mechanical Engineer*, 51(11), 13-15.
- [4] Guo X.Y., Wang H.H., Zhang C.L., et al. (2017). PLC-based Teaching Pneumatic Manipulator Control System Design, *China New Technology and New Products*, 27(16), 11-12.
- [5] He H.S. (2017). Teaching Research on Robot Control Project Based on PLC, *Wireless Interconnect Technology*, 16(22), 98-99+111.
- [6] Dong L.B., Zhang H.C. (2016). Discussion on Robot Design Based on PLC Control, *Construction Engineering Technology and Design*, 7(1), 1-1
- [7] Du L.X., Yao C.G., Lin W.Q. (2019). Industrial Manipulator Design Based on PLC Control, *Internal Combustion Engine and Accessories*, 40(07), 225-227.