PLC Control System of Pneumatic Manipulator Automatic Assembly Line Based on Cloud Computing Platform

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Abstract: With the development of science and technology, cloud computing, big data and artificial intelligence and other new technologies have been applied in all aspects of life. The traditional manual tracking and processing production process has many defects. The application of computer technology to the production line to realize automatic production has the characteristics of high efficiency and integration. This paper studies the PLC control system of pneumatic robot automatic assembly line based on cloud computing platform system. In the research, we use PCL system to scan the data of automatic assembly of pneumatic manipulator processed by cloud computing platform, and write the program into the memory of PCL. At the same time, we connect the field input signal and the controlled actuator to the input end of the input module and the output end of the output module. The user can realize the automatic assembly by running the program. Compared with the number of Pneumatic Manipulators produced by manual production line, the system in this paper has high efficiency and superior performance. Thus, the PLC control system of pneumatic manipulator automatic assembly line based on cloud computing platform can improve the production efficiency.

Keywords: Cloud Computing Platform, Pneumatic Machinery, PLC Control, Automatic Assembly Line

1. Introduction

In recent years, the continuous development of cloud computing technology in the IT industry has laid the foundation for the existing foundation. The specialization of the framework level has been increasing, especially with the proliferation of the global network put forward higher requirements on the network [1]. The use of virtualization technology for virtual data centers that are virtualized through servers has also affected data centers and put forward new requirements. Virtualization
technology is a good way to solve this problem. Storage virtualizes physical resources and improves server and resource revenue. Through network virtualization technology, the horizontal integration of all layers of the network is realized, and a unified switching architecture is formed, so that the data center has a very large data exchange and transmission capacity [2]. The combination of virtualization technology and cloud computing achieves high availability of network transmission, seamless access, scalability, high security and other functions.

Automated production line refers to the computer program. The design and application mode replaces the traditional manual tracking and processing production process, and has the characteristics of high efficiency and integration. The organic combination of PLC technology and network technology can meet the reliability, real-time and visualization requirements of the system, and designing an automated production line control system is an important means for enterprises to improve production efficiency and an inevitable choice to ensure quality and economic benefits. The combination of traditional assembly and manual control is based on a single mechanical operation control. This control method is stable, qualitative and reliable [3-5]. In order to replace the traditional manual and mechanical operation control methods and improve the work efficiency and quality of workpiece assembly, it is necessary to design an automatic control system.

This paper introduces the concept of "cloud computing" into the new generation of control systems, makes full use of the internal network of the system to establish a cloud platform, and integrates the existing computing processing capabilities and storage resources to the utmost extent through the cloud platform to provide "super computing" for the new generation of control systems. "ability. The programmable logic controller (PLC) combines the versatility and flexibility of computers with cloud computing to optimize production control capabilities. Combine cloud computing with automated production lines to improve the production efficiency of robotic hands.

2. Methods

2.1 Automatic Assembly Production Line

According to the work requirements of general workpieces, the main part of the Palestine vertical storage system is mainly composed of three-dimensional warehouses, separators and bottom plates. The three-dimensional warehouse is composed of an assembly composed of a beam frame main body and a columnar frame main body. Each frame main body is set in a modular form to store soft and finished products. The palette assembly line is mainly composed of a work block docking station, a work block palette visual inspection buffer station, a visual inspection station, a work waste sorting assembly buffer, and a work piece holding station. The three-phase asynchronous motor drives the conveyor belt to rotate back and forth to transport the palette to the designated station [6]. The input end, detection station and output station of the pallet assembly line are equipped with sensors for detecting pallets with the workbench. The check station and the grabbing station are equipped with trays respectively, and there are air blocks blocking the trays at the front buffer station. The AGV Toronto unit consists of a lower frame and an upper conveying device. The central drawer is equipped with an electronic control panel. There are three cargo spaces. The AGV trawl realizes the docking with the assembly line conveyor belt to transport goods. Up to 3 pallets can be shipped at a time. In order to record the number of pallets on the conveyor belt, there are sensors at the input and output ends [7].

The design of the manipulator needs to consider the load of the manipulator. When selecting the hydraulic cylinder of the manipulator, the diameter of the hydraulic cylinder should be larger, so that the overall strength of the arm is relatively high. The check of the hydraulic cylinder can be checked by the following formula:

The formula for checking the diameter of the piston rod:
\[
d \geq \sqrt[4]{\frac{4F}{\pi \sigma}} \\
\]  

Checking formula for cylinder wall thickness:

\[
\delta \geq \frac{D}{2} \left( \frac{\left[ \frac{\sigma}{\sigma} + 0.4P \right]}{\left[ \sigma \right] - 1.3P} - 1 \right) \\
\]

2.2 PLC Control System

At present, the control system of the pneumatic manipulator is based on PLC control. There are five working modes, with different opening methods and proximity control. One is the manual method [8]. According to production, when manual operation is required, the pneumatic manipulator can realize individual control of each action, and by manual operation, the pneumatic manipulator can be used pneumatically when the pneumatic manipulator is placed on the way to a remote location. The maintenance of the manipulator is convenient, which ensures that the pneumatic manipulator can be operated quickly and resume normal operation quickly. The second is to return to the origin. After the start button, you can leave the position of the pneumatic manipulator, withdraw and continue unfinished operations under other circumstances. The third is single-cycle work. When the start button is clicked, the pneumatic manipulator can start operation from the first work program until the last operation specified in the program is completed. This process is a cycle. The fourth is the single-step method. Pneumatic manipulators strictly follow the steps of the work cycle. If you want to operate, click the start button to complete. After the last operation, stop and continue to the next operation [9-10]. The fifth is to continue working. When the start button is pressed, the pneumatic machinery will stop working, and the hand can always complete all operations according to the set procedure and repeat until the stop button is pressed.

3. Experiment

3.1 Pneumatic Manipulator Control System Based on PLC Control

From the overall situation of the pneumatic manipulator control system based on PLC control, first of all, the main functions of the above three control programs are public programs, which need to be switched between various operating methods. If there are two programs at the same time, for example, if the open contacts of the left limit sensor X10 and the upper limit sensor X14 in the common program are interlocked in the serial electrical path, the origin condition M5 will become ON. In other words, the air pointer is circulating to its original position. In this case, if the system is only in manual mode, in order to execute the user program, the position of S0 corresponding to the initial step and the accuracy of single cycle, single step, continuous operation methods, etc. must be changed. Second, the manual program consists of single-step control and electrical control. Currently, the manual program mainly contains 7 manual buttons. One controls the leftward movement of the pneumatic arm, and the other controls the upward movement of the pneumatic arm. The third is the control of the movement of the pneumatic arm to the left, the next is the movement control of the pneumatic manipulator to the initial position, the sixth is the movement control of the pneumatic manipulator to the side, and the seventh is the movement control of the pneumatic manipulator closing and tightening. The manipulator must be installed with a certain chain to show its functions, and it can ensure that all control systems of the manipulator controlled by PCL can operate safely. Finally, in the actual design process, in order to realize the running function of the whole system, SFC can be used to complete the actual design program.

The working dynamics of the pneumatic manipulator. When the workpiece needs to be clamped, the piston rod 201 of the cylinder 2 extends forward, the piston rod 201 of the cylinder 2 pushes the
slider 3 to move forward, and the slider 3 drives the connecting plate 5 to move synchronously. The movement of the plate 5 makes the two first drive arms 6 open to each other, and the two first drive arms 6 drive the ends of the two second drive arms 7 to open to each other. Because the corners of the two second drive arms 7 are both connected on the connecting plate 1, the other ends of the two second driving arms 7 are closed to each other, so that the two rubber clamps 8 are closed to each other to clamp the workpiece; when the workpiece needs to be put down, the cylinder 2 returns and the two rubber clamps The heads 8 move away from each other to put down the workpiece.

4. Discussion

4.1 The Structure and Control Requirements of the Manipulator

According to the working conditions of the pneumatic equipment, it was found that it is necessary to install 21 input terminals and 7 output electronics reasonably to meet operating requirements and ensure operating accuracy. Because the controller used in this article is the 48 MR of Mitsubishi FX 2 N, 24 input points and 24 output points are set according to the conditions of use, so it is necessary to truly meet the control requirements of the pneumatic hand. Therefore, PLC I/O ports will be allocated specifically: X0 is manual, X1 is reset to zero, X2 is single step, X3 is single cycle, X4 is continuous, and X6 is activated X7 is stopped, X10 is limit sensor rotation, X11 is normal, right limit sensor X12 rotates arm extension sensor, X15 usually refers to the lower limit sensor, X20 turns left, X21 will turn right, X23 is indent, X24 is indent, X25 is down, X26 is fixture, X27 is released, Y0 is turned left, Y2 is expanded, Y3 is indent, Y4 is raised, Y5 drops, Y6 is at a critical juncture. As shown in Table 1.

Table 1. Manipulator PCL input/output component address allocation table

| Import                                      | Output                                      |
|---------------------------------------------|---------------------------------------------|
| Pneumatic button SB1                        | X0 Extend drive electric control coil Y0    |
| Stop button SB2                             | X1 Retract the drive electric control coil Y1|
| Front limit sensor of cantilever cylinder   | X2 Arm control valve                        |
| Cantilever cylinder rear limit sensor       | X3 Rise drive electric control coil Y3      |

4.2 Automatic Configuration of Pneumatic Manipulator Efficiency

According to the production time and the number of pneumatic manipulators, Figure 1 is made. It is found that the automatic production line is basically proportional to a certain coefficient of time. The comparison with the number of pneumatic manipulators produced by manual production lines shows that the PLC control system of the pneumatic manipulator automatic assembly line based on the cloud computing platform can improve production efficiency.

Pneumatic manipulator, which includes a mounting plate, a cylinder, a sliding block, a sliding rail, a connecting plate, two first driving arms and two second driving arms, the cylinder is arranged on a surface of the mounting plate, the sliding block is fixed on the piston rod of the cylinder, the sliding block is slidably arranged on the sliding rail, the sliding rail extends along the length of the piston rod of the cylinder, the connecting plate is fixed with the sliding block, and one end of the two first driving arms is connected with The two second drive arms are both L-shaped. One end of the two second drive arms is connected to the other end of the two first drive arms. The corners of the two second drive arms are connected with each other. The mounting plates are connected, the other ends of the two second drive arms all extend outside the mounting plate and are fixed with a rubber chuck. The two first drive arms and the two second drive arms are symmetrical with respect to the slide rail. Set up.
The internal operation method of PLC usually adopts cyclic scanning, and its internal work has been added to large and medium-sized PLCs. After the user debugs the user program, when writing the program into the PLC memory in the programming box, connect the input signal and controlled actuator of the field to the input terminal of the input module and the output terminal of the output module, and set the PLC operation method. Select the operating mode, and then follow-up operations will be completed in the PLC according to the user program. In work, PLC mainly completes the processing of six modules. According to the internal working mode of PCL, the automatic configuration production system of the pneumatic manipulator is researched. Production time and number of pneumatic manipulators is shown in Figure 1.

![Figure 1. Production time and number of pneumatic manipulators](image)

5. Conclusions
The development of computer technology can introduce new development directions for each industry. The introduction of computer technology into the power system and the continuous improvement of the computer technology in my country's machinery, as well as the perfect integration of computer technology into the automation technology of the mechanical automatic production system, will enable our automatic production system to be further developed. This significantly reduces labor costs and improves power and system efficiency. This will provide effective technical support for the lives of our people and the development of enterprises, and will also realize the development of our country's modernization. The pneumatic manipulator control system based on PCL control has the characteristics of simple operation, convenience and efficiency, which has a great effect on reducing the workload of production personnel. Therefore, making good use of cloud computing platform technology and combining it with the automatic configuration production system of pneumatic manipulators will further accelerate the production of pneumatic manipulators and reduce the burden on production personnel. The control system of the pneumatic manipulator is based on PLC control. Combining PCL technology with cloud computing technology will make the automatic production configuration system more stable and efficient.

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