

Design of Stacking Machine Based on Motion Controller

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Abstract: With the development of science and technology, industrial automation degree is become higher and higher, stacking machine also has been widely applied. In this paper, a stacking machine is designed by using the motion controller as the core, the machine structure and the part of the software are designed, the control system adopts the "double CPU structure of "PC+ motion controller", it greatly improves the efficiency of program development and implementation. The stacking machine has the advantages of high precision, fast response speed, and good openness, which can satisfy the actual application, it has a certain practical significance.

Keywords Stacking machine; Control system; Motion controller

INTRODUCTION

Stacking machine plays an important role in the automation processing workshop, which is mainly used to transport the workpiece [1]. In the processing, stacking machine removes the workpiece from the shelves, then transports it to the machine tool feeding platform, manipulator will take the workpiece from platform to the machine tool for processing; after processing, the manipulator will take the workpiece from the machine, place into the feeding platform, stacking machine will remove the workpiece in the platform, then transport back to the shelf [2]. Now most of the stacking machine is using a PLC or SCM to control [3]. Some input and output signal processing ability of PLC is weak, it need to increase the expansion module in the actual application, which will be more complex. Because the monolithic integrated circuit plate making process, SCM will appear problem problems such as poor anti-interference, scalability and portability of PLC and MCU are relatively poor [4]. In recent years, the motion controller because of its high reliability, good openness, and good portability, in the field of automatic control has a wide range of applications [5]. This paper describes the design of a stacking machine using the motion controller as the core, the design process is introduced, aiming to make a contribution to the development of the stacking machine.

THE OVERALL DESIGN OF STACKING MACHINE

Mechanical structure design of the stacking machine

Stacking machine is mainly responsible for the completion of loading and unloading from shelf and machine. Stacking machine body has four degrees of freedom, as shown in Figure 1, stacking machine is driven by four servo motors at four direction, they are

moving along the direction of the guide way of stacking machine, called the Z direction; fork vertical movement, known as the Y direction; fork horizontal telescopic movement, called X direction; and the rotation direction of the fork along the vertical direction (Y direction), called B direction. The arrangement direction of the guide rail is the direction of movement of the stacking machine, stacking machine is driven by servo motor and moves along the guide rail. The rest of the movement is driven by servo motor and other agencies to complete.

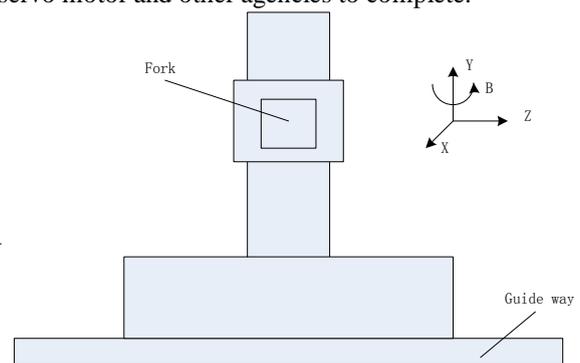


Figure 1. The design of structure of stacking machine

Control system design of the stacking machine

As shown in Figure 2, the stacking machine control system is mainly composed of PC, motion controller, servo drives, sensors and other signal device. The control system adopts the double CPU structure of "PC+ motion controller", the motion controller is the core of the whole control system, the written programming will be transmitted to the motion controller through the PC, motion controller is responsible for the execution of the moving program and processing for each feedback signal. Servo drivers are respectively connected with the motion controller and servo motor, servo driver

receives the signal from the motion controller, then drives servo motor to execute the corresponding motion. The detecting device includes various sensors and limit switches, they are used to detect and feedback of the motion state of the stacking machine. Other signal device comprises an indicating lights, which are used to indicate the running state of the stacking machine.

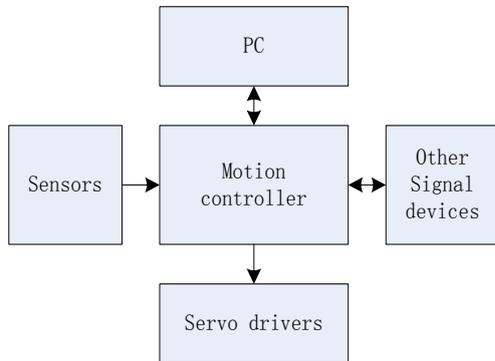


Figure2. The design of control system

SOFTWARE DESIGN

Software structure design

In order to improve the stacking machine control system scalability and portability, stacker control system software design uses the modular design method. Motion controller and PC is the relationship of upper and lower computer, motion controller only has operating environment, it does not have the development environment, so it need to use a PC as a development environment for software development and debugging. The modular design of the system in this paper is shown in figure 3. PC as upper computer is management module, doing overall planning and management for the program; motion controller as lower computer is the execution module. Program development is done in the upper computer, and then the developed motion control program is transmitted to the motion controller, motion controller will perform motion control.

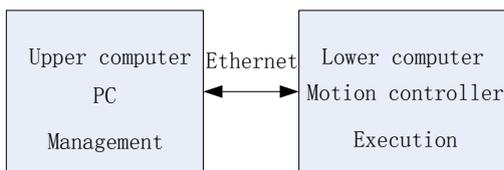


Figure3. The modular design of system

Software function design

1) The function of communication: there needs fast and accurate communication between the upper and lower computer, and between the feedback signal and the motion controller. System communication between upper and lower computer uses standard Ethernet, the feedback signal and the motion controller is directly connected, this can reduce the

interference to the system, and can guarantee the communication speed and accuracy.

2) The function of signal detection: control system detects output signal through the various motor encoder, then judges the actual state of motion of each axis of the stacking machine. A limit switch is arranged in each shaft, if the system detects the limit switch signal, the system will stop the current movement, so as to ensure the safe operation of the system.

3) The function of stacking: after stacking program is programmed, stacking machine automatically moves to shelves, and detects the workpiece, when it detects the signal of workpiece, manipulator comes out, the workpiece is clamped, stacking machine moves to the machine tool edge, the workpiece is placed in the designated position of the machine. When the workpiece is processed, the system continues to carry on the detection of the workpiece. When detecting the workpiece, the workpiece is clamped and placed on the platform transport.

I/O design

Detection device of control system and other devices communicate with control system through I/O interface of motion controller. The system design of I/O is shown in table 1.

Table1.System I/O design

Input		Output	
IN0	Position signal 1	OUT0	Indicated light 1
IN1	Position signal 2	OUT1	Indicated light 2
IN2	Position signal 3	OUT2	Indicated light 3
IN3	Position signal 4	OUT3	Indicated light 4
IN4	Limit signal 1	OUT4	Indicated light 5
IN5	Limit signal 2	OUT5	Indicated light 6
IN6	Limit signal 3		
IN7	Limit signal 4		
IN8	Limit signal 5		
IN9	Limit signal 6		

CONCLUSION

The improvement of degree of automation causes the increasingly widespread use of stacking machine in the application, stacking machine in automation workshop greatly improves the production efficiency. Stacking machine traditional control system adopts

MCU or is the PLC as the core to build, but the MCU or PLC have certain defects. In this paper, a stacking machine is designed with the motion controller as control core, by using the double CPU structure of "PC+ motion controller", the stacking machine has high openness and fast response speed, which has a certain practical significance to the practical application of the stacking machine.

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