Design of teaching robot based on motion controller

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Abstract. Robot technology is an advanced technology, electronic electrical, mechanical design, information technology, network technology, artificial intelligence all combine in robot. Robot teaching is widely used in universities. Using robot teaching platform can do lots of experiments in a variety of courses. This paper introduces a teaching robot of five freedom degree, robotic system uses motion controller as the control core and the robot control system adopts the upper and lower machine form of "PC+ motion controller". It provides a new tool in universities for the purpose of robot teaching and scientific research.

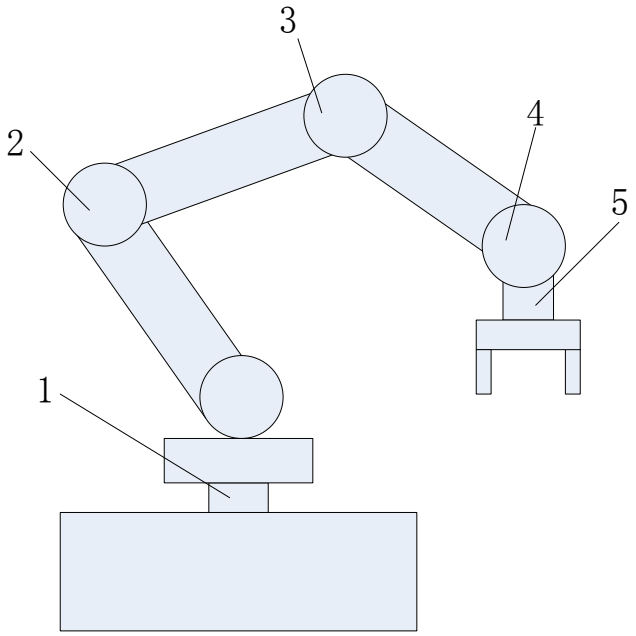
Keywords: Teaching; robot; motion controller.

1. Introduction

With the development of science and technology, robot has been applied widely in industry, agriculture and many other fields [1]. At the same time, people realize that culturing robot design and operating personnel is a necessary link in the course of further development of robot. The robot is a kind of comprehensive high and new technology, it relates to the advanced technology of mechanical design, motion control, computer systems, software, information engineering and other fields [2]. Teaching robot is a kind of comprehensive and open experimental platform, the teaching robot platform can realize experiments in electrical, mechanical design, testing technology, electromechanical control, signal processing and other courses [3]. Teaching robot is mainly used for the display of the mechanical structure and movement characteristics, so it has a certain gap with the industrial robot [4]. Firstly, the motion performance should be better, functions should be diversified; secondly, the volume should not be too large [5]. This paper describes the design of a teaching robot based on motion controller, it has high precision, good reliability. It has a certain practical significance.

2. Teaching robot body

The mechanical structure. Many industrial robot applies for five joint structure, application areas includes welding, handling and spraying [6]. As shown in Figure 1, the robot designed in this paper is also a five joint robot. Mainly they are the waist joint, shoulder joint, elbow joint, wrist joint, wrist rotation, at the end of the wrist joint is a finger, driven by pneumatic mechanism , it can realize the material clamping etc. The robot waist joint is responsible for the overall rotation, determining the overall position of the robot; shoulder joint and elbow joint can do pitching motion, determining the robot finger position; wrist swing and rotation determines finger gesture. Using the joint type design can has more space in the same condition than non-joint type design. Five degrees of freedom robot are: the waist turning motion, rotary motion of shoulder, rotary motion of elbow, wrist pitch motion and rotary motion. The five degree of freedom robot can play a very good role in teaching.



1. Waist joint 2. Shoulder joint 3. Elbow joint 4. Wrist joint
5. Wrist rotation
Figure 1.Teaching robot

Control system hardware. Teaching robot control system block diagram is shown in figure 2. Motion control takes the form of the realization of "PC+ motion controller", communication between motion controller and PC uses Ethernet. Motion controller is connected with the driver, motion controller sends an instruction to driver, driver sends pulses to the corresponding motor and motor will do corresponding motion. The input and output module of motion controller is used to connect peripherals and indicating lamp.

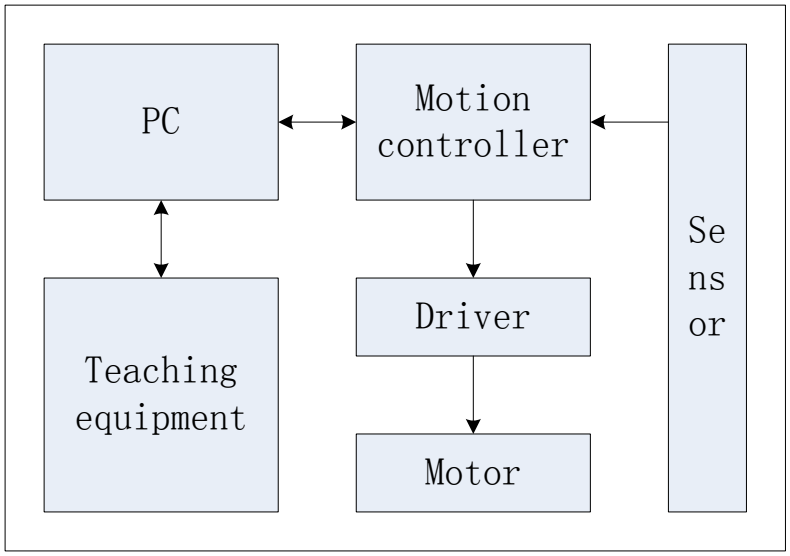


Figure 2.Control system block diagram

3. Software design

The software structure design. The control system needs to realize the real-time control of the movement of each joint, according to the hardware design, hierarchical control mechanism is using. As shown in Figure 3, the PC machine serves as the upper computer, it is used for programming, command receiving and trajectory planning; motion controller serves as lower computer, it is mainly

used to perform motion control. When the system works, sensors perceive the external information, and feedback to control system, the control system will control the robot to carry out various operations.

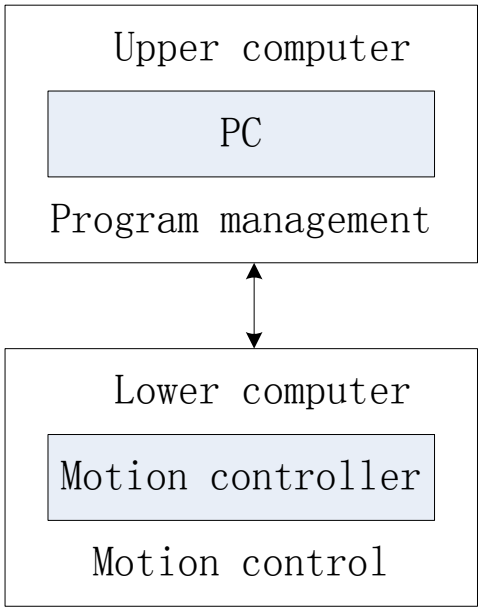


Figure3. Software structure design

Software function design. Parameter setting: the upper computer can carry on the parameters selection and setting, the system can identify the information language that the operator input through the decoding procedure.

Axis control: single axis control choice is done through the parameters, control joint can be chosen on the upper computer, do manual control, in order to check that whether inspection shaft parameters are normal, and whether the limit switch is effective.

Teaching function: through teaching device or teaching interface on a PC for teaching programming. In this process, speed of each joint can be set. The system will record the teaching process, and display in the program window, the operator can use this information to do robot programming.

Other features: other features include indication of the state of each joint, the limiting procedure, error handling.

The I/O design. Input interface of controller is used to receive real time message from sensor in each joint, motion controller is used to control and adjust the movement according to the sensor information and output interface is used to display the state of each joint. I/O design of the system is shown in table 1.

Table1. System I/O design

Input		Output	
IN0	Joint sensor 1	OUT0	Indicator light 1
IN1	Joint sensor 2	OUT1	Indicator light 2
IN2	Joint sensor 3	OUT2	Indicator light 3
IN3	Joint sensor 4	OUT3	Indicator light 4
IN4	Joint sensor 5	OUT4	Indicator light 5

4. Summary

In recent years, robots have been widely applied in all walks of life, the rapid development of robot brings difficulties for robot teaching. In this paper, the structure of the designed robot is similar with industrial robot, so it is more representative. The students can be more intuitive to observe the mechanical and control system, the motion control system is based on "PC+ motion controller", it has high control precision, and good reliability. The robot can apply in the experiment in a number of courses, which has a certain practical significance.

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