Innovative Experimental Design of Modular Robot Platform

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Abstract: In the current process of innovation education and practical teaching in universities, robot teaching and innovation experiments are important research topics. And with the continuous development and improvement of artificial intelligence, in the current process of innovative research on robots, more attention has been paid to the design of robotic automation and intelligent systems. It has significant meaning to the design and analysis of robot motion control and the improvement of robot research. The introduction of the modular robot platform into the teaching and research process can improve students' ability to independently design and develop robots, and it also can expand students' knowledge of robot-related knowledge. In addition, the use of modular robot platforms can introduce task schemes as teaching cases and carry out hierarchical teaching modes, which is of great help in guiding students to carry out robot innovation research. When using the modular robot platform to carry out innovative research and design, it is necessary to pay attention to constructing an innovation experiment group. In this research, the writing robot developed by students is used as an object to design and study an automated system for robots to control writing brushes. The use of this experimental innovative design method can greatly enhance students' enthusiasm for innovation, stimulate students' interest in robots, and is of great help in cultivating students' creative thinking and ability.

1. Introduction
With the continuous improvement of the socio-economic level, people's living standards have also been greatly improved. In the current social development process, people have more advocated convenient and efficient living concepts. With the continuous development of artificial intelligence technology, the current artificial intelligence robot has become one of the important trends in the development of science and technology in the world. Robot is one of the important application types of artificial intelligence. It is a comprehensive research result based on intelligent control technology, sensor technology, image processing technology and machine learning technology. Robots have high autonomy and practicability and are widely used in many industries. For example, the automotive industry, service industry, foundry industry, and chemical industry. The use of robots to build innovative experimental design platforms can help students to integrate professional knowledge. In the current domestic universities, especially engineering majors, modular robot innovation and practical teaching is the focus of the current teaching reform. There are still some problems in the current robot platform teaching experiments, such as the relatively simple function of the robot platform and the problem of program solidification. Therefore, based on the modular robot platform, an innovative experimental design scheme is constructed, and hierarchical project objectives are used as the main teaching tasks to ensure the independence and connection between teaching tasks. This can form a complete practical engineering project.
2. Basic Overview of Robots
Robots mainly rely on their own control capabilities to implement various functions. The robot has a high level of automation, has a high degree of flexibility, and can be programmed and multifunctionally operated. Robots generally have similar intelligence capabilities as humans, mainly including motion capabilities, planning capabilities, collaboration capabilities, and perception capabilities. In the process of researching robots, it is necessary to carry out systematic research on robots according to the composition of human systems, because robots are also relatively complex systems engineering complete machines, mainly including four major mechanisms such as actuators, drive devices, control systems, and artificial intelligence devices. In the process of designing a robot system, it is important to realize that the robot does not need to breathe and circulate blood. Therefore, the robot's motion system cannot match the human motion system. In the four major systems of the robot, the actuator mainly includes a robot arm, a wrist, an arm, and a steering gear, which can imitate human arm movements for various tasks. The automatic device is mainly composed of a driver, a reducer and detection software, which can convert electrical energy into mechanical energy to drive the robot's operation process. The driving means such as electric drive, hydraulic drive or pneumatic drive can provide power for the actuator. The control system generally includes sensors and electronic computers. In the process of detecting the motion parameters of the robot, it is necessary to perform feedback control on the robot and then complete the prescribed actions. Artificial intelligence system is an important part of robot, mainly including sensor system, decision planning, expert system, artificial intelligence system can ensure that the robot has logical judgment ability, pattern recognition ability and planning operation procedures and other functions [1].

3. Modular Robot Platform
In order to ensure that students in the field of measurement and control technology and instrumentation can learn robot effectively, it is necessary to carry out education on robot innovation and practice. The introduction of a modular robot platform and the construction of a robot experimental training platform can not only carry out modular teaching tasks based on engineering innovation practices, but also integrate diverse robot technologies in the teaching process, and also make full use of advanced sensor network technologies enable students to develop their imagination. At the same time, students can design various engineering models, based on their own creativity, and use simple graphics and visual programming methods to generate C language code, which can control the robot in real time. This modular and hierarchical teaching method is conducive to giving full play to students' imagination, cultivating students' creative thinking, and at the same time, improving students' creative practice ability. Because in the process of designing robot models of various structures by themselves, students can have a deeper understanding and mastery of what they have learned.

In the process of robot teaching, the main problem is that there are large differences in students' learning ability and knowledge level, and there are also some differences in understanding different problems. The innovative experimental design teaching process based on the modular robot platform is mainly based on the characteristics and personality characteristics of students. It can make full use of the hierarchical teaching method to ensure that each student is based on what he has learned. Robots are innovatively designed. This teaching mode breaks through the constraints and rigidity of traditional teaching, can form a training course of modular robot platform, and then build a hierarchical experimental system based on practical teaching. In the process of using the modular robot practice platform, because it is based on modularity, each experimental system is independent and also has a certain degree of connectivity on engineering literacy for effective cultivation. The modular robot platform mainly includes three levels: First, all students carry out joint learning. This is the basic stage of the course. The main goal is to allow students to understand robot technology, master certain disciplines such as C language, single chip microcomputer, and automatic control. Then, use the controller, sensors, and engineering on the modular robot platform to learn the configuration
and construction of the robot. This method can stimulate students' interest and enthusiasm for learning robots, and let students understand simple flowchart programming methods [2]. Second, it belongs to the stage of expansion and improvement. In this stage of teaching, each student can choose a specific direction as his or her own research area. This method can focus the students' energy and attention, and let the students go deeper. Grasp the field of robotics research that interests them, and allow students to deeply understand the relevant principles and use methods of microcontrollers, controllers, servos, and sensors, so that students can better master various aspects of digital circuits, analog circuits, digital signals, and computers, principle. In the process of developing teaching activities, teaching is mainly based on teaching tasks. Various teaching tasks can be used to allow students to integrate the knowledge of the subjects they have learned, and to allow students to learn to apply knowledge in various disciplines. Third, it is mainly the application stage of knowledge. In this stage, capable students can use some complex and complete engineering projects to carry out the ability of students to use knowledge of various disciplines based on their knowledge and based on teaching goals. Exercise can use project display and project defense to summarize the knowledge learned during the project, so that students can master the application points of subject knowledge, and at the same time, they can use some in-depth projects and competitions to cultivate students' engineering and technical level and practical literacy. The third stage is the difficult content of robot teaching. It is also a key content, which is important knowledge consistent with current innovation and entrepreneurship education. Using these three gradual stages, it is possible to give full play to the innovative experimental functions of the modular robot platform, allowing students to improve their ability to innovate and practice on the basis of mastering basic subject knowledge [3].

4. Design and Analysis of Robot Control System

In the process of innovative experimental design of the modular robot platform, it is necessary to realize that the robot's motion control system is the key operation system to ensure that the robot can smoothly perform automated operations. And can't get any work done. The motion control system includes three phases: centralized control, master-slave control and hierarchical control, which centrally controls the CPU to practice all the control functions. The master-slave control mainly uses the master CPU to calculate coordinate changes and then generate a trajectory, and the slave CPU mainly controls the robot's manipulator motion. Hierarchical control is developed based on master-slave control. The upper-level master computer manages the entire system of the robot, coordinates changes, and generates trajectories, while several lower-level microprocessors can control the joint coordinates of the robot processing [4].

When designing and innovating a writing robot, the main hardware facility is a steering gear. The steering gear is like the joint of a robot, and it is the execution unit of a writing robot. Only by flexibly controlling the joints can the writing robot control the movement of the writing brush and realize the purpose of writing the writing brush characters using an automatic control program. The writing robot is shown in Figure 1.

![Figure 1 Writing Robot](image)
5. Design Effect of Writing Robot

At this stage, when printing brush characters on various items, it is mainly formed by software scanning for printing or inkjet printing, and because the speed of artificial writing is relatively slow, the printing efficiency is relatively low. In the process of using the modular robot platform, the innovation practice group intelligently controls the writing brush by designing intelligent programs, which can automatically write the writing characters on various items, which can reduce the amount of human labor, increase the writing speed, and achieve intelligence Integrated production methods. In the process of designing a writing robot, according to the relevant experimental instructions and literature, from "the user controls the steering gear according to his own needs, so that the brush at the end can move to a specific position with a certain attitude" as the basis to analyze the movements and then build a mathematical model of running movements. In the design process, a CDS robot steering gear is used as the power system, and then a brush is used to connect the brush, so that a complete six-axis winding structure can be formed. The schematic diagram of the designed mechanism is shown in Figure 2.

![Fig. 2 Motion Mechanism of Writing Robot Steering Gear](image)

The positions of the fishing line are on the 1st to 3rd servos, and the 4th to 6th servos are the three fishing lines below. During the design of this mechanism, the positions of the support points Q1-Q6 of the 6 fishing lines are fixed Yes, this represents known coordinates. However, the relative positions of the two control points P1 and P2 of the writing brush and the pen point P3 of the writing brush are in a stable state. When the three fishing lines above and the three fishing lines below are extended, the direction of rotation of the servo is opposite. When controlling a writing robot, the main steps are as follows: determine the target position of the end brush → find the length corresponding to 6 ropes → compare the length of the 6 ropes with the initial length to obtain the elongation of each rope and shorten the amount → calculate the operating angle of each servo → obtain the angle after the servo turns, use the computer to send control instructions → turn the servo to control the movement of the writing brush. During the design process, the innovation experiment team used the components of the modular robot platform to build a two-layer chassis, and the lower components mainly fixed the writing robot. The upper component mainly builds the steering gear and the paper feed wheel, so that the paper can be automatically fed. The bottom plate and the mechanism can be connected using countersunk bolts through the through holes. Finally, the multi-function debugger is used to connect the servos in series and then connect with the computer. The control system is connected to the line, which can effectively control the movement of the writing brush and the automatic paper feed function [5].

6. Conclusion

In summary, in the process of innovating the modular robot platform, it is necessary to improve and innovate the traditional robot motion control system. So we need to pay attention to the design of the hardware system of the robot, and ensure the modular robot innovation experimental platform to adapt the actual ability of the students. Only in this way can the students carry out effective practical
operations, and ensure that students acquire the relevant basic skills and improve their innovative and practical ability. In the process of designing innovative experiments for the modular robot platform, there are innovative teams that use writing robots as their main research, mainly researching the joints of the robot, among which the power unit is a digital servo. During the design process, an automatic system capable of controlling the writing of kanji characters by writing brushes was built. Through the final robotic practice, it was found that the performance of the students could achieve the expected purpose of the experiment. And using the layered teaching mode, it can effectively integrate the innovative experiments of modular robots and innovation education. In the process of designing and implementing innovative experiments, it guides students to formulate robot design plans, and at the same time, carries out hierarchical teaching according to the specific conditions of students. It is conducive to students' independent design and realization of functions. In practice, it is of great help to train students' innovative design ability, team collaboration ability and judgment analysis ability. Making full use of the innovative experimental design of the modular robot platform can improve students' innovative consciousness and innovative ability, enable students to apply the theoretical knowledge they have learned to actual engineering practice, and allow students to improve their students' innovative practical ability skill after they acquiring basic skills.

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