

Research and Analysis on Project-based Teaching of Sensor and Detection Technology

Zheng Tan

Lanzhou Petrochemical Vocational and Technical University, Lanzhou 730000, China

Keywords: Sensor and Detection Technology; Project-based Teaching; Research and Analysis

Abstract: The development of the course "Sensor and Detection Technology" is a course based on intelligent information technology. In the teaching process of the course "Sensor and Detection Technology" in higher vocational colleges, the combination of theory and practice is emphasized, the development of integrated courses is emphasized, and systematic teaching practice is carried out. Based on this, this paper takes the project-based teaching of "sensor and detection technology" as the teaching method, guided by projects, to develop students' independent exploration ability, cultivate students' innovation awareness, mobilize students' subjective initiative and innovation creativity in the project process, and vigorously promote the integration and development of "sensor and detection technology" classroom teaching.

The development of the curriculum content of "Sensor and Detection Technology" will create a foundation for promoting China's supply side structural reform, promoting the competitive advantage of manufacturing industry and cultivating excellent comprehensive talents for the development of sensor and detection technology. In the current national development, sensor and vision system technology is the focus of current project research, and also the new direction of future development. In the teaching process of "Sensor and Detection Technology", vocational colleges and universities emphasize that the content of teaching technology should conform to the actual development and meet the market demand. They should also take practical projects as the starting point to cultivate students' ability to find and solve problems and improve their innovative practical awareness.

1. Project based teaching of sensor and detection technology

The teaching of the course "Sensor and Detection Technology" is roughly divided into three parts in the project-based teaching. The first part is the usual single theory learning and practice. In the process of single theory learning and practice, guide students to consult relevant teaching materials, understand and understand the basic principles of sensors and visual systems, and understand their applications in all aspects and the test selection of each sensor, It will lay a good foundation for students' theory.[1] After that, through the detailed explanation of teachers, students will actively participate in the activities related to sensors, as well as guide students to carry out practical training, visit learning and other activities, so as to help students further consolidate their theoretical knowledge, further understand and master the movement form of vision system and sensors, and

understand their relevant working characteristics.

Second, carry out practical training. In the process of practical training, we can focus on cultivating students' comprehensive application ability, guide students to fully apply the relevant knowledge learned in the first part, to actually solve the foundation of testing problems in the testing process, and help students to discover problems, research and analyze problems, and finally solve problems through practical practice. The ultimate goal of talent training in higher vocational colleges is to truly implement "learning for application". By taking problems as the guidance of teaching development and solving problems as the driving force, we will develop the application and integration of students' comprehensive abilities in sensor and visual system research. At the same time, in the daily routine project training, teachers can help students form project research groups freely, so that students can train their skills in intelligent sensor and visual system research. In addition, teachers can provide guidance and assistance to improve students' innovation and enthusiasm in this field [2].

Third, take the initiative to participate in training projects related to intelligent sensors and visual systems, and participate in relevant skill competitions to exercise their professional level. The study of the first and second parts provides students with theoretical basis and practical skills, while the third part focuses on the development of students' application and practice level. Through the in-depth excavation and knowledge accumulation of the first two parts, students are fully familiar with the corresponding professional knowledge, master certain technical and professional abilities, and exercise and comprehensively use these knowledge and abilities through skill competitions, Translate relevant sensor knowledge and skills into your own practical experience. By actively participating in the training program, students can further improve their practical ability and working ability, constantly find, analyze and solve problems in practice, and provide space and resources for the training of technical comprehensive talents [3].

2. Application strategy of project-based teaching

2.1. Actively encourage and guide students to explore and learn independently

The project-based teaching itself has a strong exploration of independent learning. It changes the single traditional "imparting" teaching method in the past, takes projects and problems as the guidance, and carries out teaching through inspiration, group discussion, online resource integration, etc. At the same time, actively guide and answer the problems that students encounter in the process of autonomous learning. When inspiring students to carry out projects and find problems, students' thinking can be diffused through practical problems with typical significance and value, such as project teaching of sensors in robots, Put forward questions: "How to effectively improve the robot's repeated positioning function to ensure the robot's track accuracy" or "How to improve the engineering identification and monitor the machining allowance and surface defects of the workpiece during the processing". It can enlighten students through practical engineering training, promote their divergent thinking, trigger their innovation and creativity, enable students to find and think about problems in the actual case analysis, and conduct regular knowledge and learning in the existing knowledge reserve, ultimately sublimate the perceptual cognition to the theoretical level.

2.2. Project design highlights key points

"Sensor and Detection Technology" is a professional basic course for automation specialty. The principle of project teaching focuses on the understanding of project content and the practical application of professional basic knowledge. In addition, project design and development should be closely combined with practical problems and should not be divorced from reality. In the process of project design and production, if only a simple explanation of principles, formula application and

calculation drills, students will lose their enthusiasm and enthusiasm for learning, it will make it difficult for students to grasp the key points of project development, and it will make students acquire little knowledge and skills after the end of the final project.

Therefore, in the process of carrying out project-based teaching, first, students should actively cooperate with teachers in the course of classroom learning. Teachers also need to change certain teaching strategies in the course of teaching, pay attention to the prominence and emphasis of the center, and provide students with searchable reading professional materials and resources after class. Second, provide students with conditions for practice, and open professional laboratories for practice, Help students use the conditions of the laboratory to complete the design of related projects, including project production, debugging and final problem solving. With the help of a series of virtual software systems developed by software, students can be provided with plug and play, online adjustment and other functions of software modules. For example, in the project "Application of visual system in robot integrated system", Guide students to complete the project of "conducting appearance defect detection: guiding and positioning, improving the flexibility and automation of production, highly integrating algorithm processing, logic control, image acquisition and communication functions, and building a simplified system" and "completing the programming controller used to control the actions of actuators such as motor robots, and sorting out the detection signals and workflow of each unit." Through the actual project practice, the students not only master the relevant theoretical knowledge of sensors, but also improve their professional skills to learn to find, analyze and solve problems. By clarifying the focus of the project and emphasizing, the students can grasp the relevant professional knowledge of sensors more thoroughly.

3. Project based teaching design

3.1. Project determination

The current social development is in the high-speed development period of information and intelligence. A new generation of information communication technology based on intelligent manufacturing has emerged as the times require and pointed out the direction for future scientific and technological development. The application of sensors and visual systems in intelligent manufacturing is particularly critical, especially in the current application of intelligent automation. Therefore, in the current and future development, we should focus on the application and research of sensor and vision system. In addition, as an automation major, it should aim to develop students' ability to think and solve problems, and improve students' innovative practical ability.

Based on this, the following projects are created to promote students' development: "Project I: Application of sensors in mechatronics", "Project II: Application of sensors in robots", "Project III: Application of sensors in intelligent manufacturing", "Project IV: Application of visual systems in robot integrated systems", "Project V: Application of visual systems in intelligent manufacturing" "Item 6: Application of traditional camera system".

3.2. Establish tasks

In the process of project-based teaching of "sensor and detection technology", according to the requirements of talent training program, sensor and detection technology syllabus, professional standards, industry and enterprise implementation standards and other contents, the project formulation and task establishment are carried out. The tasks of each project are as follows:

[Item 1: Application of sensors in mechatronics]

Task 1: drive system of CNC machine tool, monitoring and control of various environmental factors such as temperature, safety, etc., surface roughness of machined parts, machine tool status,

etc.

Task 2: Measure the state change of a specific object and convert it into information in the form of signals that can be stored, transmitted and processed.

[Item 2: Application of sensors in robots]

Task 1: It is realized through external sensors to transmit the perception of the operating object and external environment in terms of the position and speed of the monitoring robot in real time.

Task 2: Work piece identification and installation monitoring. Process identification shall be carried out during processing, and machining allowance and surface defects of workpiece shall be monitored.

Task 3: Detection of zero displacement and limit position in each joint sensing device of the industrial robot to improve the repetitive positioning function and track accuracy.

[Item 3: Application of sensors in intelligent manufacturing]

Task 1: Predict equipment failures and trigger maintenance protocols.

Task 2: Automatically record data.

Task 3: Accept the notification of abnormal processes and quality standards.

[Item 4: Application of vision system in robot integrated system]

Task 1: Guide and position appearance defect detection, identify and improve the flexibility and automation of production, highly integrate image acquisition, communication functions, etc., and build a simplified system.

Task 2: Programming controller, which is used to control the actions of robots, motors and other actuators, process the detection signals of each unit, manage the workflow, data transmission and other tasks.

[Item 5: Application of vision system in intelligent manufacturing]

Task 1: Detect or track images of a given size, color mode, etc. or similar image ranges.

Task 2: precision detection of product surface, including target direction and position detection, detection of product surface crushing, damage and other problems.

Task 3: Make high-precision measurement of product dimensions under non-contact conditions to determine whether there is any error in the size of product appearance.

[Item 6: Application of traditional camera system]

Task 1: Measure the distance image with multi vision and distance measuring device.

Task 2: Use the time sequence image to calculate the operation status of each pixel in the image; Temporal images detect moving objects and track them.

Task 3: According to the results of image processing, change the parameters and direction of the camera, move the overall position of the camera, or improve the lighting conditions.

4. The specific implementation process of project-based teaching

4.1. Sub groups

According to the site and experimental equipment of the experimental engineering base and the total number of students in the class, reasonable groups can be formed, or freely combined according to the personal wishes of the students in the class to form groups. Each group should have 4-6 members. Each group should elect a team leader, who is responsible for making overall plans for the project progress of the whole group, and also doing a good job of interfacing with teachers. At the same time, when the project selected by each group is determined, it is also necessary to select a teacher in the specialty as the instructor, so that students can find information resources during the project development process, and guide and answer questions for students.

4.2. Intra group task allocation

After the list of groups is confirmed, the instructor will assign the project tasks, hold group meetings, discuss the specific tasks corresponding to the project, explain the theoretical knowledge behind the project and the current application background, introduce the difficulties and problems in the current technology development and enterprise application, and help students to understand the story behind the project. Then let the students express their understanding and views on the project one by one. Finally, the teachers and students will discuss and determine the specific tasks of the project, and the teachers will carry out some specific content requirements and precautions in the design process. After the division of tasks within the group is clear, the members will further discuss the initial design and solution of the project, and finally form a final and effective implementation plan. The teachers will put forward their opinions. After the teachers' opinions are put forward, the formal plan will be formed. The members will divide the work among themselves, and actively carry out their own work and tasks.

4.3. Practice of Production Education Integration Base

The implementation of the project is to better promote the improvement of students' practical ability, promote the comprehensive application of students' theoretical knowledge and practice, and help them improve their perceptual cognition of sensors and monitoring technologies to a rational level. At this time, the role of the industrial robot training center, the integration base of production and teaching, is obvious. After the division of labor is completed, students will integrate all the modules to form a complete project design process. After that, real practice is required. The industrial robot training base is the key to practice. In the industrial robot training base, new technologies, standards and processes of enterprises in the industry are fully incorporated into the training scope in a timely manner to help students' project design more adapt to the actual production of enterprises. Through various project supporting software, various offline simulation and programming are used to practice the contents of the project, so that each student has the opportunity to practice and enhance students' awareness of intelligent sensing Understand the application of visual system and other contents.

5. Conclusion

To sum up, "Sensor and Detection Technology" is a compulsory basic course for automation majors in higher vocational colleges. It helps students improve their practical opportunities through project-based teaching methods, gives full play to students' independent exploration ability in learning, and constantly improves students' comprehensive practical ability through teachers' side guidance, so as to achieve the ultimate teaching goal of this course.

Acknowledgement

Fund: University student innovation entrepreneurship training program 2022.

References

- [1] Li Y, Liu M. *Teaching reform and research on "sensor and detection technology" based on flipped classroom* [J] *Science, Education and Culture*, 2021.
- [2] Zhao G, Xu J, Xu G. *Research on project-based teaching method of sensor and detection technology course* [J] *China Modern Education Equipment*, 2021, (11): 3.
- [3] Li J, Ai Z, Yang C, et al. *Exploration and practice of teaching mode of sensor and detection technology under the background of new engineering* [J]. *Education Observation*, 2020, (6): 3.