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Research on the Teaching Mode of Robotics Courses in Application-Oriented Universities

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***Abstract*—For application-oriented universities, robotics course is a course that requires the combination of theoretical research and practice. The theoretical part includes not only the application of various dynamic equations and kinematic equations, but also the use, derivation and stability proof of various algorithms, which students often find cumbersome and difficult to understand. Therefore, the new mode of robot teaching based on simulation will become an effective measure for colleges and universities to solve the above problems, and it is also an inevitable trend of teaching reform in colleges and universities in the future. The simulation teaching of robotics course can improve students' learning enthusiasm, deepen students' understanding of robotics theory, and realize the combination of theory and practice.**

***Index Terms*—Application-Oriented Universities; Robotics; Curriculum; Teaching Reform; Simulation**

I. Introduction

Education in the new era should be people-oriented, oriented to intelligent, efficient, and practical development, and truly realize the informatization of education. Robotics is a popular research field today, and its teaching methods and teaching structure should also meet the needs of the rapid development of the new era, meet the needs of combining theory and practice, and promote the improvement of students' theoretical level and practical ability.

With the development of science and technology, the simulation of robots is no longer a problem, and its simulation technology has become mature, which is a great help for us to implement simulation teaching. In order to meet the demand of the job market for students about robotics, it is necessary to deepen students' understanding of basic theories through simulation learning on the basis of students' completion of basic theoretical learning, and enable students to have the ability to analyze complex robot problems. It enables students to solve multi-faceted and multi-level practical problems such as the specific hardware structure, system operation, technology development, and physical operation of robots, as well as the problems that have a low learning threshold but are difficult to master. In the original robot control course, the way students receive knowledge is relatively simple and boring, lacks the opportunity to consolidate and understand knowledge, and it is also difficult to apply it in practice. This status quo can be changed through simulation teaching, which can enable students to master the theoretical knowledge, and promote the improvement of the practical level to a certain extent, and let students feel the charm of robot control, and achieve multiple birds with one stone in the real sense.

Robot theory is cumbersome and complex, through the implementation of the combination of theory and practical simulation, can effectively promote students' understanding and application of control theory, improve students' own comprehensive ability, reduce the difficulty of teachers' teaching, therefore, the implementation of robot control course simulation teaching is in line with the common needs of students and teachers, but also in line with the development requirements of the new era.

II. Existing Problems

Robot control technology is a multidisciplinary comprehensive discipline, the course not only emphasizes the understanding of theoretical knowledge but also pays attention to the play of practical ability, and its main content involves many aspects such as kinematics and dynamic modeling, position control, force control, nonlinear control, mechanical design, robot programming language and system, etc., the content is more complex, easy to learn and difficult for students to master. At present, there are many problems in the teaching of robot control courses, among which the four more serious aspects are:

1) The teaching content is out of touch with reality. At present, the content taught in the curriculum is too old, and the times and technology are developing rapidly and advancing every day, but the knowledge taught by teachers in the classroom and the content in textbooks are stuck in a few years ago or even more than ten years ago, and there is no update and reform at all. Even if there is a little robot hardware and software in the school laboratory, its technology is lagging behind, which also limits the students' innovation ability to a certain extent.

2) Teachers are too rigid in teaching. Due to the limited teaching resources, the teacher's teaching is often based on the teacher's narration and the student's listening, the teacher directly copies the content of the narration, forcibly instills knowledge to the students, and the students cannot digest and understand the content of the teacher's lecture in real time, and cannot form their own knowledge system, resulting in students rarely taking the initiative to learn after class and are not interested in robot control.

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3) Students' lack of practical experience. Laboratory equipment does not provide all students with the opportunity to operate it themselves, as some of them are fragile and expensive. At the same time, some robot experimental equipment has a certain degree of danger, and students will have certain safety hazards when they directly start to operate. All of this ultimately leads to a disconnect between the student's ability to combine theory and practice. [10] discussed that A robot is a machine that can automatically do a task or a series of tasks based on its programming and environment. They are artificially built machines or devices that can perform activities with utmost accuracy and precision minimizing time constraints. Service robots are technologically advanced machines deployed to service and maintain certain activities. Research findings convey the essential fact that serving robots are now being deployed worldwide. Social robotics is one such field that heavily involves an interaction between humans and an artificially built machine. These man-built machines interact with humans and can also understand social terms and words. Modernization has bought changes in design and mechanisms due to this ever-lasting growth in technology and innovation. Therefore, food industries are also dynamically adapting to the new changes in the field of automation to reduce human workload and increase the quality of service.

4) The teaching content is more theoretical. The robot control theory course contains the application of various dynamic equations and kinematic equations, and also includes the use, derivation and stability proof of various algorithms, the teacher only simply explains the formula in the teaching process, and students often feel that the calculation is cumbersome and difficult to understand in the process of learning, and cannot have an in-depth understanding of the various performance and parameters of the robot and the lack of real feelings for the physical parts of the robot, and it is difficult to have an in-depth understanding of the specific structure.

5) The physical equipment for course teaching is expensive. The teaching of robot control course is expensive, especially the complete set of industrial robot equipment is very expensive, cheap tens of thousands, expensive at least hundreds of thousands, due to the limited funds of domestic ordinary undergraduate universities, so only a few sets of industrial machinery and equipment can be purchased in small quantities for demonstration and explanation, resulting in limited teaching resources for teachers.

III. Reform of Teaching Mode

Traditional robotics courses have many problems, and this is where the simulation-based teaching model comes into play.

(1) Simulation teaching mode

There are many benefits to be gained by introducing robotics simulation teaching, which are as follows:

1) Adapt to the development of the times. The teaching of robot control is close to the practical application, conforms to the trend of the development of the times, and understands the demand for technology in today's industrial development, so that students can independently improve their technical level and understand their own shortcomings. [11] discussed about Intelligent Sensor Network for Vehicle Maintenance System. Modern automobiles are no longer mere mechanical devices; they are pervasively monitored through various sensor networks & using integrated circuits and microprocessor based design and control techniques while this transformation has driven major advancements in efficiency and safety. In the existing system the stress was given on the safety of the vehicle, modification in the physical structure of the vehicle but the proposed system introduces essential concept in the field of automobile industry. It is an interfacing of the advanced technologies like Embedded Systems and the Automobile world. This “Intelligent Sensor Network for Vehicle Maintenance System” is best suitable for vehicle security as well as for vehicle’s maintenance. Further it also supports advanced feature of GSM module interfacing. Through this concept in case of any emergency or accident the system will automatically sense and records the different parameters like LPG gas level, Engine Temperature, present speed and etc. so that at the time of investigation this parameters may play important role to find out the possible reasons of the accident. Further, in case of accident & in case of stealing of vehicle GSM module will send SMS to the Police, insurance company as well as to the family members.

2) Enhance students' practical ability, promote students' understanding and absorption of knowledge, and expand students' horizons. For the robot control course, it is far from enough to teach theoretical knowledge, and we must pay attention to the students' own practical ability. Based on the simulation platform, it can improve students' hands-on ability, and then promote students' self-innovation ability. The combination of teaching theory and practical simulation can promote students' understanding of kinematic equations, dynamic models, motion trajectories, force control and related control algorithms, improve students' interest in learning, and promote students' active learning because of flexible learning methods. Teachers can also pay attention to students' learning progress in real time, grasp the real-time situation of students, and adjust their class rhythm in time to ensure that students can basically complete the absorption of knowledge. The hardware structure of the robot is shown through simulation, so that students can feel the robot more intuitively, and the simulation platform can enrich the teaching content and let students open up their knowledge. Based on simulation teaching, students can broaden their horizons and understand cutting-edge knowledge.

3) Maximize the use of limited resources. The cost of the simulation platform is lower than that of physical teaching, which can maximize the use of limited teaching resources, and eliminates the problem that students are overly careful about the operation procedures and affects the experimental effect due to the high cost of some experimental equipment,

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and encourages students to innovate and try boldly. Based on the simulation platform, students can experience the differences between different types, different uses, and different brands of robots, experience their advantages and disadvantages, and feel the design ideas based on the design purpose. By building a virtual experimental environment and different experimental environments, the students' sense of substitution is enhanced and the students' experience is enriched.

4) Reduce potential safety hazards. In today's environment of high personal safety, the safety of students is the most important, and some robotic equipment is dangerous and confidential, making it difficult to teach them physically. Based on the simulation platform, it can be displayed more intuitively, more three-dimensionally, and more clearly, so that students can have an in-depth understanding.

The above content verifies the importance and feasibility of simulation teaching, which will promote students' understanding of relevant theoretical knowledge and formula derivation proof, and improve students' comprehensive ability to combine theory and practical experience. Through simulation teaching, the combination of theoretical teaching and practice is truly achieved.

However, after all, simulated robots are not as realistic as real robots, so we must pay attention to the importance of creating situations in the process of teaching implementation. With the development of a large number of simulation robot software in recent years, such as the emergence of Tencent Dingding virtual robot and whale virtual robot, the pace of simulation robot is getting bigger and bigger, opening up a broader world for the future teaching of simulation robots.

(2) Cases of combining theory and practice

Taking the knowledge of robot coordinate system space description and transformation as an example, the students' understanding of robot coordinate system space description and transformation knowledge is realized through the concretization of theoretical description and simulation examples.

(1) Visualization of simulation examples: Using the relevant simulation platform, the teacher can show students the transformation of the coordinate system and the control of the simple robot, and also let the students experience the parameter changes, the translation and rotation of the pose, the transformation between coordinate systems and vectors, deepen the students' interest in the robot control course, and experience the charm of the robot course.

(2) Concretization of theoretical description: Through the explanation of robot system diagram and mathematical description, students have a clear understanding of the translation and rotation of posture and the transformation between coordinate systems. The display based on teaching animation can make students' perception of relevant theoretical knowledge concrete and systematic. At the same time, the materials of the relevant courses can be sent to students for self-review after class.

IV. Conclusion

The robotics course was created to meet the demand for such talent in today's industrial development. Robot simulation teaching should be based on satisfying students' application skills, and encourage students to innovate boldly and pioneer. The teaching of robotics courses should combine theory and practice to improve the teaching level and promote students' learning and understanding.

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