

Industrial Robot Digital Twin Application Technology

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Abstract: This paper mainly discusses the core position of the course "Industrial robot Application Technology" in the national double high construction professional group and the innovation of teaching methods. The "task-driven, process" of production-teaching collaboration built through digital twin technology aims to cultivate students' design development. The importance of the course "Industrial Robot Application Technology" is introduced. Teachers' teaching innovation team, national production training base and national science and technology innovation service platform support the digital development of this technology in intelligent manufacturing to create a digital twin teaching platform. In the course material content-based teaching design and the docking of industrial needs, including and industrial robot operation certification. In addition, the action-oriented teaching concept, ideological and political materials are integrated into the teaching design, and the paper emphasizes the teaching material compilation method and three-dimensional teaching material design. At the same time, it also has a potential impact on the expected model innovation of the application and promotion of teaching materials and continuing education.

Keywords: Digital twin technology, production-teaching collaboration, industrial robot application technology, teaching innovation.

1. Introduction

1.1. Background

"Industrial Robot Application Technology" is the core course of mechatronics technology, the backbone of the national double high construction professional group[1]. Guided by the national teacher teaching innovation team, the national production training base as the carrier, the national science and technology innovation service platform as the support, relying on the national advanced manufacturing cluster (regional pillar industry) production-education alliance, through digital twin technology to build a "ubiquitous" teaching ecology, the implementation of "task-driven, results-oriented" teaching process[2]. Train students to serve the robot application industry, help its digital design development, and support the intelligent upgrading of regional industries. Through the study of this course, students will become technical talents with the characteristics of "precise control, pragmatic and effective" in the field of robot control integration, who can accurately design control schemes, accurately configure peripheral parameters, carefully develop control programs, fine debug robot workstations, and lean help enterprises reduce costs and increase efficiency.

1.2. The purpose and content of the teaching reform paper are summarized

In the case that the physical equipment is not yet in place, the digital twin technology of industrial robots can repeatedly modify and verify the product and production process through the combination of "virtual and virtual" and "virtual and real", which is one of the new directions for the digital development of intelligent manufacturing. This book combines virtual universe pro software with industrial robot offline programming software, modeling software, Vision software Visionmaster and Siemens Botu software to create a digital twin teaching platform, which is oriented to the actual needs of industrial robot industry and takes typical application

projects of industrial robots as the carrier. The integration method of industrial robots under digital twin is systematically introduced. There are five projects in this book, which are the creation of basic digital twin workstations, the creation of industrial robot digital twin workstations, the programming and debugging of industrial robot trajectory digital twin workstations, the programming and debugging of industrial robot sorting digital twin workstations, and the field programming and practical operation of industrial robot visual sorting workstations[3][4]. Among them, the first three projects focus on the integrated design of industrial robot digital twin application, which can carry out specific learning activities in the industrial robot twin platform; The latter two projects focus on the integration implementation of industrial robots, which can carry out virtual and real learning activities in the digital twin platform and real industrial robot system. In this book, digital resources such as twin virtual workstation resource package, video, animation, courseware and pictures, especially the content that cannot be clearly described by "picture + text" in the textbook, are embedded in the form of two-dimensional code beside relevant knowledge points, readers can scan the two-dimensional code to download and obtain, and can watch the operation video explanation[5], demonstration and animation demonstration at any time and train and verify in the twin platform. It can also supplement the online and offline blended teaching model. This book is suitable for teaching materials of industrial robot application technology, mechatronics technology and electrical automation technology in undergraduate colleges and higher vocational colleges, and can also be used as reference materials for vocational skills training and self-study of engineering and technical personnel.

excellence; When explaining the "Electrical control system simulation and experiment" module, we can integrate the creative spirit of "enterprising and innovative", encourage students to explore and innovate boldly, and contribute to the development of electrical control technology.

Through this three-dimensional implementation of the "trinity" of ideological and political integration paradigm teaching method, the three ideological and political elements throughout the entire teaching process, imperceptibly carry out ideological and political education for students, cultivate students' social responsibility, innovative spirit and professional ethics, and lay a solid foundation for cultivating socialist builders and successors with all-round development of morality, intelligence, physical beauty and labor.

3. Characteristics and Innovation of Teaching Materials

3.1. Digital training, integration of enterprise production

By constructing the digital twin training platform and restoring the typical work tasks of enterprises, the industrial robot course teaching is limited by practical training teaching and difficult to connect with the actual production pain points. This teaching material project applies digital twin technology to restore the enterprise robot production line through modeling, and continuously and rapidly update and optimize the teaching project for the innovation of industry technology and process, so that students can also adapt to the actual production process of enterprises in on-campus practical training.

3.2. A task-driven and result-oriented teaching material compilation method for industrial robots

This textbook adopts the "task-driven, result-oriented" compilation method, so that the process of teachers' teaching and students' learning can be synchronized with the typical working process. With "project + task + knowledge + evaluation" as the carrier, clear teaching methods and teaching processes are designed for teachers, and clear learning methods and learning paths are designed for students. Under the guidance of the task set in the textbook, the teachers and students completed the project smoothly according to the "six-step method".

At the same time, the textbook uses the twin technology to restore the real technical reform project of the enterprise, so that students can transform the knowledge and skills learned in the task process to the practical application of production. This immersive learning experience greatly stimulates students' learning interest and innovative consciousness, and enhances the logic and effectiveness of teaching.

3.2.1. Two-dimensional code technology enables three-dimensional teaching material design and realizes "Internet +" information teaching

Both static text content and dynamic teaching resources are embedded, demonstrating the new three-dimensional design of "Internet +" information technology. The book will be a rich variety of supporting teaching resources in the form of two-dimensional code embedded in the textbook page, through scanning two-dimensional code downloaded operation video explanation, animation demonstration, can be visually displayed, not only can make abstract, profound,

boring knowledge become image, intuitive, vivid, and combined with the digital twin training platform, It can effectively support the development of "online and offline mixed" teaching mode.

3.3. Three-dimensional teaching material design based on "dual" cooperation

In terms of organization and arrangement, the book designs a total of 5 projects from easy to difficult, each project is set up with a series of related typical tasks and required knowledge modules; Each task can be used as an independent teaching unit; Finally, the book is presented in the structure of "project + task + knowledge + evaluation", which is very suitable for the teaching method of "learning by doing and learning by doing". According to the characteristics of teaching links and tasks, ideological and political elements are organically integrated into teaching projects from the aspects of technology, standards, norms and cooperation, so as to promote students' ideological and political literacy and internalize values.

This book is developed by the "double teachers" type teachers and the "double" engineers of the thinking Department and Yalong company, which is the result of deep integration and long-term cooperation between schools and enterprises, and also an important construction result of the high-level professional group of "double universities".

4. Expected Analysis of Textbook Application and Promotion

4.1. Innovation of teaching and training mode of industrial robots based on digital twin technology

The textbook has been written since 2018, and has been used as a practical training textbook in our school for students majoring in mechatronics, electrical automation technology, industrial robot technology and students of industry-education alliance, and has achieved remarkable results and been well received. The supporting digital twin training platform is suitable for online teaching and training without limitation of time and space, which solves the problem of industrial robot application technology course teaching relying on practical training equipment, thus greatly enhancing the popularization of teaching materials. This textbook is a school-enterprise cooperative development, fully integrated into the actual work content of industrial robot application engineers in enterprises, and perfectly docking with the "1+X" system of "Industrial robot application programming" vocational skill level certificate, has successfully guided more than 300 students inside and outside the school, the pass rate is as high as 95%, will continue to meet the growing demand for certificate training. It has a high degree of applicability. Project 5 restores the real project of the enterprise through digital twin technology, which can train students to carry out practical projects of the enterprise and improve the practical innovation ability of docking production. At the same time, it can provide online continuous training and learning for industrial alliance engineers, which is expected to serve more than 1,000 engineers and more than 200 enterprises. To sum up, this textbook is not only suitable for students majoring in electrical automation in higher vocational colleges, but also as an important reference book for electrical technicians. It is

a very practical textbook and worthy of further promotion.

5. Construction of Supporting Resources

5.1. Research and practice of student center teaching model innovation based on digital twin technology

Following the student-centered teaching concept, relying on the three national platforms of industry-education alliance, innovation platform and training base, using the new form of leaf-type tasks as guidance, using digital twin technology to integrate the practical training platform and real cases of enterprises, updating digital course teaching resources, and creating a new "ubiquitous" teaching ecology. Enterprise mentors and teachers of the Alliance pair education, jointly prepare lessons, cooperate in teaching, cooperate to develop more than 500 resources such as twin teaching materials, videos, animations, and model workers' ideological and political cases, enrich teaching, ideological and political resources, and embed them on the textbook page in the form of two-dimensional code. By scanning the QR code, readers can intuitively watch the operation video explanation, demonstration and animation demonstration, and realize the mixed teaching mode of online and offline.

Digital twin technology is used to build the same digital training platform as the real training platform, and connect with digital teaching resources such as videos and animations on the online course platform. Through the task guidance of this textbook and the link of two-dimensional code, students can conduct independent exploration, cooperation and communication, and online practical training, and supplement the mixed teaching mode of online and offline, and carry out real and digital dual-platform operation training.

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