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Research and Practice of Engineering Training Intelligent Manufacturing Practice Teaching Platform Based on the Cultivation of New Engineering Innovative Talents

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Abstract: *In order to meet the requirements of the "Made in China 2025" national strategy, "train and create an international, compound, and high-quality professional and technical personnel team with advanced manufacturing technology", strive to improve college students' innovative and practical capabilities, and build comprehensive, advanced, and comprehensive The open and integrated engineering training intelligent manufacturing practice teaching platform provides detailed introductions from the five aspects of hardware construction, software construction, curriculum system, evaluation system and assessment system, providing a reference for the construction of intelligent manufacturing practice teaching in other colleges and universities .*

Keywords: *Engineering Training, Smart Manufacturing, Practical Teaching*

1. Introduction

With the development of industries in the new era such as Made in China 2025, Internet+, Internet of Things, Industry 4.0, and artificial intelligence, new engineering and technological talents are required to have solid engineering practice capabilities, outstanding innovation capabilities, broad international perspectives, and the ability to discover and solve problems. Ability to complex engineering problems. However, the shortage of this type of talent has become a key factor restricting the development of my country's manufacturing, aerospace and other industries. The Ministry of Education launched the "New Engineering" plan in 2017, approved new engineering majors such as intelligent manufacturing engineering, big data management and application, and advocated new ideas, new models, new methods, new content, and new quality of engineering education as new colleges and universities. The basic content of engineering construction and education reform is to build new engineering majors or transform existing majors, and cultivate new engineering and technical talents that meet the needs of the new economy and industry.[1]

In order to complete the "Made in China 2025 national strategy" required to "train and create an international, compound, and high-quality professional and technical personnel team with advanced manufacturing technology", striving to improve college students' innovative and practical ability has become the main goal of training students in colleges and universities. [2]Engineering training As a compulsory course for colleges and universities to carry out engineering practice teaching, it plays an important supporting role in cultivating college students' engineering practice ability and innovation ability. Therefore, the construction of a training and teaching platform based on engineering training courses with the goal of cultivating new engineering innovative talents has important application value.

Guided by the concept of new engineering construction, with the goal of cultivating new engineering intelligent manufacturing innovative talents with strong engineering practice ability, innovation ability and innovation consciousness, build a comprehensive, advanced and open engineering training intelligent manufacturing training teaching platform , To create a professional group of engineering training intelligent manufacturing technology; update the practical teaching content of engineering training intelligent manufacturing through new concepts, new models, and new methods, improve practical teaching methods, build high-quality intelligent manufacturing traditional

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teaching resources and digital teaching resources, and strengthen school-enterprise cooperation , Explore the new era of engineering training and intelligent manufacturing practice teaching system, establish a hierarchical, modular, online and offline mixed teaching practice teaching system and mode with engineering practice ability training as the main line, and realize the personalized education of engineering training in intelligent manufacturing.[3]

2. Hardware Construction of Intelligent Manufacturing Practice Teaching Platform

Through multiple surveys of enterprises and institutions, combined with the engineering training practice syllabus and the overall development plan of the engineering training center, independently build an intelligent manufacturing system, integrate central equipment resources, and build a modern manufacturing system with "automation + digitalization" as the core. Matching integrated intelligent design/processing/assembly/testing/operation and maintenance integrated intelligent manufacturing practice teaching platform.

The platform combines the advanced digital control system and connects with the existing production equipment of the center, such as replacing the original CNC lathe and machining center CNC system of the center, connecting the communication protocol of the CNC system, and integrating typical processing and manufacturing equipment such as CNC lathes and machining centers. Integrate into the "hardware" system of the intelligent manufacturing unit, realizing the rational use of central equipment. [4]

The intelligent manufacturing practice teaching platform is product-centric, including intelligent design, intelligent processing, intelligent assembly, intelligent visual inspection, and intelligent management.

Intelligent design includes product 3D model design, product process design, and product functional performance optimization. Combine the digital twin practice platform to complete virtual ordering, process simulation, virtual logistics operation, production and processing simulation, assembly simulation, inspection simulation, and finished product warehousing simulation.

Intelligent processing includes storage units and processing units. It includes raw material warehouse, finished product warehouse, AGV trolley system, CNC lathe, machining center, ABB1410 robot and other main components. The overall process of the intelligent processing link is: After receiving the Internet order, the control center calls the storage area through the control system, and the AGV takes the blanks from the raw material warehouse and sends them to the conveyor belt and sends them to the loading table. The robot is responsible for loading and unloading materials by clamping and picking. , And then the semi-finished product is taken from the unloading table by the AGV and sent to the CNC lathe and machining center for processing. [5]

Intelligent assembly includes assembly units, including ABB1410 robots, bearing pressing mechanisms, screwing mechanisms and other mechanisms. The overall process of the intelligent assembly link is: After the semi-finished products are processed sequentially, they are sent to the assembly area and the robot completes the bearing press-fitting and screw fastening work to complete the assembly work.

Intelligent visual inspection includes visual inspection system, marking system, etc., including robots, industrial cameras, and laser marking machines. The overall process of the intelligent visual inspection link is as follows: the wheel hub that has been clamped and assembled by the robot is displayed in front of the industrial camera in three poses, and the camera performs image collection work, and the control center inputs the collected images to the computer, and then through the computer The internal visual inspection program recognizes the image, and the computer inputs the inspection results into the control center, and the control center will control the AGV to send the products to the finished product area or the waste area according to the results.

Intelligent management includes configuration data server, video monitoring system, console and other hardware equipment, as well as MES/ERP system relational database system, configuration software control system, etc. [6]The intelligent management link is responsible for coordinating external orders externally, and internally for the deployment of various production areas, so as to realize order management, production schedule supervision, process monitoring, real-time production schedule query, quality monitoring, order completion query, report query, etc.

Through the learning of the intelligent manufacturing practice teaching platform, students can

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master the following skills: ①Master the basic methods of product design, and be familiar with the production process of the product; ②Familiar with the wiring methods in each production unit; ③ Familiar with Siemens S7-1500F series PLC configuration , Familiar with Siemens S7-1511T motion controller programming, familiar with Siemens TIA Portal V15 software system; ④ Familiar with HMI interface design work; ⑤ Master ABB robots for teaching and programming, and various instructions of ABB robots. ⑥Master the use of the control center to control the camera to take pictures; ⑦Master the use of OpenCV platform to perform feature extraction and feature recognition on the collected images; ⑧Require students to apply simulation software and data processing tools to complete the optimization and improvement of the production workshop, and use simulation analysis Methods Perform simulation analysis on production, and perform production scheduling according to order requirements, and learn the development process and use method of MES system at the same time.[7]

3. Intelligent Manufacturing Digital Twin Software Construction

The construction of the intelligent manufacturing digital twin practice teaching platform takes "comprehensive perception, equipment interconnection, intelligent control, and intelligent prediction" as the core, and takes product lifecycle management (PLM) as the goal. The intelligent manufacturing digital twin practice teaching platform simulates the entire process of products from user needs to actual products, from customer orders to product delivery, and finds the most suitable optimized simulation results to control the actual production process through PLC to avoid unnecessary loss of work.[8]

The platform can realize the virtual training and teaching of intelligent production line Internet ordering, system data splitting, automatic material storage, automatic material transportation, CNC lathe robot loading and unloading, machining center robot loading and unloading, finished product assembly and testing. At the same time, in each training module, realize the cognition and simulation operation of mechanical structure design, electrical system design, system operation training, and system operation tasks. Finally, students can perform operations and verifications in the actual intelligent manufacturing production line. The combination of virtual and real fully realizes the application of advanced technologies such as Internet of Things technology, automation technology, and network technology in teaching, and organically integrates knowledge and skills in intelligent manufacturing, industrial engineering, production management and other links, and virtual operation learning is in line with actual operation verification. Combined, the teaching process is intuitive and vivid, which is convenient to help students gain a comprehensive perceptual and rational understanding of intelligent manufacturing and processing, and the teaching effect is remarkable.

4. Construction of Intelligent Manufacturing Course System

4.1. Establish a Hierarchical, Staged, and Progressive "Intelligent Manufacturing Engineering Training" Curriculum System Structure of "Engineering Cognitive Training-Basic Engineering Training-Comprehensive Innovation Training-Innovation and Entrepreneurship Practice Training", and a Hierarchical and Stepped Practical Teaching System in the Content and Level are Rising Step by Step, which Cultivates Students' Ability to Manage Knowledge Flexibly.

The first layer: Engineering cognitive training aimed at on-site observation, mainly embodied in cognitive level internship courses and introduction courses. The instructor mainly adopts the teaching organization form of on-site visits and demonstrations to allow students to initially establish the concept of engineering, To stimulate students' interest in participating in engineering practice.[9]

The second layer: basic industrial training with hands-on practice as the goal. The instructor mainly adopts the teaching organization form combining group teaching and virtual simulation to strengthen the understanding of the teaching content of intelligent manufacturing training and cultivate the ability of comprehensive application and hands-on operation.

The third layer: Comprehensive innovation training aimed at in-class comprehensive training, project-based comprehensive training, and competition project training, including intelligent manufacturing competitions, mechanical innovation design competitions, engineering training competitions, robotics competitions, Internet + competitions, etc. The main theme is It is to cultivate

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students' engineering awareness, engineering quality and engineering ability.

The fourth layer: innovation and entrepreneurship practice training with innovation and entrepreneurship as the goal, cultivate and improve students' engineering practice ability, innovative thinking and entrepreneurial ability.

4.2. Individualized and Modular Teaching Mode

Using the intelligent manufacturing virtual simulation practice teaching platform, in the teaching process, the instructor comprehensively considers the characteristics of different grades and different professional experimental objects, and selects the corresponding teaching focus. For example, for students majoring in mechanical engineering, key professors have a comprehensive understanding of the composition, principle, and process methods of each functional module of an industrial intelligent production line, and perform operations and verifications in the actual production line. For students majoring in automation, in addition to the cognitive and virtual operation of each module of the intelligent manufacturing production line, in-depth learning of industrial robot control and the electrical system of each module can also be added. Modular teaching realizes the development of personalized teaching content for different student groups, fully meets the needs of talent training goals for different majors, and better implements the teaching concept of "teaching in accordance with their aptitude".

4.3. Online and Offline Hybrid Teaching Mode

The "online + offline" hybrid teaching method makes full use of the digital media resources in the comprehensive training to achieve the learning process of "teaching, learning and doing", and strengthen the training of comprehensive knowledge and skill points. "Offline" conducts practical operations in the training room, focusing on the combination of theoretical teaching and practical teaching to ensure the effect of comprehensive project training.

4.4. Strengthen the Integration of Production and Education in Intelligent Manufacturing, and School-Enterprise Cooperation

In order to achieve the organic combination and optimal allocation of school-enterprise resources, and jointly cultivate talents needed for industrial development in the new era, through school-enterprise cooperation and strong alliances, the two sides build together, explore the intelligent manufacturing practice teaching system under the new situation, and serve the engineering training practice teaching And scientific research.[10]

5. Conclusions

The construction of the intelligent manufacturing practice teaching platform allows students to understand the development of advanced manufacturing technology, understand the basic knowledge, principles and applications of advanced manufacturing technology, thereby improving the quality of practical teaching. This article introduces the construction plan of the intelligent manufacturing practice teaching platform in detail, and provides a reference for the construction of intelligent manufacturing practice teaching for engineering training in other colleges.

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