In the context of mechanical engineering education Research on the application of intelligent manufacturing technology in experimental teaching

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Abstract. In the era of Industry 4.0, customer needs are developing towards personalization, requiring short timeliness of products, and smart factories need to flexibly adjust production factors and be able to meet the customized production of multiple batches. In order to cultivate students with solid basic knowledge and innovation consciousness, with strong practical ability, for the whole process of intelligent manufacturing technology in the whole process of product design and manufacturing, a comprehensive experimental platform integrating experimental teaching, skill training and scientific research has been built, simulating the actual production situation of enterprises, taking the intelligent manufacturing cycle of products as the main line, building a guarantee mechanism for serving experimental teaching and talent training, forming a comprehensive quality training as the main line, serving the local economy as the core, intelligent, digital, The multi-level new experimental teaching system solves the problem of students participating in product manufacturing and intelligent innovation, and improves the quality of experimental teaching and the level of practical education.

Keywords: Mechanical Engineering, Intelligent Manufacturing, Experimental Teaching, Talent Training.

1 Introduction

Manufacturing is the foundation of China's industrial system, intelligent manufacturing is an important way for the transformation and upgrading of China's industrial manufacturing system, is the deep integration of the Internet, Internet of Things, artificial intelligence, big data and other information technology and manufacturing technology, is an important driving force to promote China's industrial development. With the support of the Internet and information technology, machinery manufacturing technology can be used in intelligent manufacturing from design, production, procurement, management and service, and throughout the entire manufacturing cycle of products [1]. Intelligent manufacturing has changed the traditional production mode, gradually changing from serialization and standardization to personalized customization to meet

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the personalized needs of different consumers, and standardized production has gradually changed to service-oriented, and intelligent manufacturing has been integrated into all aspects of the product to meet the personalized needs of the new era. In order to meet the development needs of intelligent manufacturing industry, the society urgently needs more professionals who master the knowledge of intelligent manufacturing, and the role of intelligent manufacturing in experimental teaching is extremely extensive [2].

2 The Importance of Smart Manufacturing

In the world, with the vigorous development and wide application of artificial intelligence technologies such as industrial Internet, big data, cloud computing, regional chain, and 5G in the manufacturing industry, the fourth industrial revolution marked by digitalization, networking, and intelligence of production has arrived [3]. As a model of artificial intelligence technology in the industry, the realization process of intelligent manufacturing not only requires a large number of complex high-tech talents such as advanced manufacturing technology, manufacturing automation technology, Internet of Things technology, machine vision, and big data, but also requires a large number of interdisciplinary talents with compound knowledge. In particular, there is a huge demand for system integration and digital talent with a holistic view and the ability to lead technology development, implementation, and innovation [4].

In order to promote the transformation of economic structure and industrial upgrading, intelligent manufacturing is an important way of China's economic development. Intelligent manufacturing integrates machine intelligence into various manufacturing activities, integrates traditional manufacturing technology with emerging information technology, and forms a new industrial revolution. In this context, a large number of professional and skilled talents who can meet the needs of new industrial development are needed, which puts forward higher requirements for the talent training of application-oriented undergraduate colleges. Carry out innovation and reform in the concept, goal and other aspects of talent training, and deeply understand the ability requirements of the development of intelligent manufacturing industry for new skilled talents; make adjustments in curriculum design, teaching methods, experimental teaching, etc., so that students have the macro thinking of the mechanical manufacturing system, can use the knowledge and skills learned to solve practical production problems, have high innovation ability, practical operation ability and independent learning ability, and quickly adapt to the job in the context of the development of the intelligent manufacturing industry. Application-oriented undergraduate colleges and universities are always paying attention to the market development situation, constantly optimizing and adjusting the talent training model, cultivating more craftsmen who meet the needs of social development, and continuously delivering high-quality talents to promote China's economic development [5].

3 Introduction to the Intelligent Manufacturing Experimental Platform

This intelligent manufacturing experimental project combines the teaching and experimental syllabus of management disciplines, information management and information systems, industrial engineering, machinery manufacturing and other majors, and learns to understand the relevant business processes, production methods, operation models, business models and other existing principles of intelligent manufacturing through the platform, cash concepts, and mastering the planning, design, modeling and comprehensive application of digital factories and other professional skills, so as to meet the needs of interdisciplinary, cross-professional and cross-field comprehensive experiments or practical teaching, as shown in Figure 1 Intelligent Manufacturing Laboratory. This experimental system can realize 5 modules, including 97 experiments, covering intelligent manufacturing system operation management experiments, logistics management experiments, PLC automation program design and control engineering foundation, mechanical design and manufacturing and automation, robot engineering professional experiments and other experiments.

Fig. 1. Intelligent Manufacturing Laboratory.

3.1 Process Introduction

The production process of the intelligent manufacturing comprehensive experimental platform realizes the information interconnection and integration between high-end

CNC machine tools and industrial robots, intelligent sensing and control equipment, intelligent detection and assembly equipment, intelligent logistics and warehousing equipment and other key technical equipment.

3.2 Process Characteristics

Based on the Internet of Things information platform, a unified logistics and distribution system is formed. Using high-frequency RFID technology, it can carry out intelligent functions such as cargo scanning, warehousing cargo monitoring, and automatic judgment of warehousing information to improve warehousing speed and strengthen warehousing accuracy. Customization of production process. According to the order demand, the production process is flexibly matched, and the mixed flow production is unchanged to respond to all changes. Whole process quality control. Machine vision technology is introduced into the production process, and intelligent quality control of the whole production process is formed through the detection of defects, colors, shapes, etc. of products.

4 Experimental Examples, Operation Methods of Intelligent Manufacturing Comprehensive Experimental Equipment

Cognitive experiments on intelligent manufacturing systems. Experimental hours: 2 hours. Experiment type: demonstration, validation. Experimental Requirements: Compulsory.

Purpose of the experiment: Familiar with the composition of the intelligent manufacturing comprehensive training platform, master the operation steps of the automatic operation of the intelligent manufacturing comprehensive training platform, and master the production process of the intelligent manufacturing comprehensive training platform. **Experimental equipment and tools:** 1 set of intelligent warehousing system, 1 set of AGV intelligent handling system, 1 set of intelligent manufacturing system, 1 set of production assembly system, 1 set of intelligent assembly system, 1 set of intelligent detection system, 1 set of electronic label picking system, 1 set of automatic sorting system, 1 set of network control system, 1 set of production monitoring system, 1 set of control special system, 1 set of MES production and manufacturing execution system, 1 set of SPC statistical process quality management system, and 1 set of ERP enterprise resource management system. **Experimental content:** Power on the device. Close the circuit breaker in the electric control cabinet, power on a single module (when the emergency stop is pressed, the whole system is powered off), power on the air pump, open the air path, turn on the server in the network cabinet, power on the robot, rotate the button in automatic mode, press the green button. The button light is on, and the automatic mode switch is successful. Click PP to move to main, and press the Run button. The meter is powered on, the main unit of the meter is powered on, and the software is opened to select the test program. Click on the server connection button and it will turn red. Press the Back to Origin button to move the table to the waiting position.

AGV placement. From left to right, there are AGVs No. 1, No. 2, and No. 3. The placement direction is in accordance with the direction indicated by the icon on the AGV walking table. Detect whether there are residual parts in the lathe milling machine and whether the robot is safe in the zero position. Open the Server.rdp system and run MES and MCS respectively. Start the ERP system. Turn on and run the MES manufacturing system to observe whether the equipment is normal. Open the visual inspection software, click "Yes" in the pop-up dialog box, and click the start menu. After each equipment returns to zero, the corresponding order is issued in ERP, and the production order of the MES system can be executed. **Precautions for experiments:** After the preparation for operation of the equipment is completed. Always check whether there are any products left over from the last time on the production line. If so, clear the task manually before you can continue to deliver the task. Whether the position of the robot can be directly returned to zero. If there is a possibility of a product collision when returning to zero, please manually move to a safe location before running the scheduling software. Check whether the tray is positioned correctly. If there is an error, please correct it promptly. When the AGV trolley is placed, the grayscale sensor needs to be on the black tape, otherwise the AGV will have a site error when moving. Write an experimental report, and submit relevant results information, analysis and summary.

5 The Effect of Intelligent Manufacturing Experimental Teaching

According to the teaching arrangement, the Intelligent Manufacturing Experimental Center provides students with experimental extracurricular activities, and also provides a platform for professional competitions such as students' graduation design, scientific and technological production, and skill competitions. In recent years, the experimental teaching of intelligent manufacturing has been carried out for 10 majors in the university, such as intelligent manufacturing, mechanical design, mechatronics, robotics engineering, vehicle engineering, logistics services, electrical engineering and automation. The experimental platform can independently develop 10 experimental courses such as production operation management, logistics management, PLC automation program design and control engineering, mechanical design, mechanical manufacturing, robot engineering, etc., with 30 experimental projects and an average of about 25,000 experimental hours per year. The Intelligent Manufacturing Experimental Teaching Center is open to the whole school all day after school, and students can apply to select experiments according to the arrangement of the experimental center. In the past two years, students have won more than 30 national and provincial awards through the training and guidance of the center, and students have applied for 3 patents. In recent years, the survey results show that the time for students trained by the intelligent manufacturing center to adapt to the requirements of the job in the enterprise technology center or production workshop has been significantly shortened, and the professional work ability has been significantly improved, which has been highly praised by the enterprise.

6 Characteristic Innovation and Prospects

The main feature of the intelligent manufacturing experiment is to simulate the actual needs of the enterprise and realize the intelligent manufacturing process of the product. The experimental system can realize the intelligent manufacturing real experimental project based on the cultivation of students' design ability, comprehensive ability and innovation ability, integrate and apply multiple technologies such as the Internet, digital multimedia, human-computer interaction, database, digital design, programming design and network communication, realize the integration of in-class and extra-curricular, on-campus and out-of-school, online and offline, simulation and the actual needs of enterprises, and continuously carry out traditional experiments and experimental teaching methods combined with the actual needs of enterprises. Through the training of the intelligent manufacturing center laboratory, students can master the professional skills of product design, editing programs, computer-aided process analysis, intelligent manufacturing, assembly, warehouse management, logistics operation and distribution for the whole cycle of intelligent manufacturing of traditional advantageous industries such as general mechanical products, stainless steel, light metals, molds and other traditional advantageous industries. The construction of intelligent manufacturing laboratories provides students with safe, reliable and front-level training oriented to the actual needs of the society, which can effectively shorten the distance between students and enterprises, and fundamentally solve the problem of disconnection between local undergraduate education and industry development.

7 Concluding Remarks

In the context of the development of intelligent manufacturing industry, the talent training model of China's application-oriented undergraduate colleges is facing new challenges, especially the talent training of mechanical manufacturing majors, which needs to be reconstructed to meet market demand-oriented talent training target model. The intelligent manufacturing industry pays more attention to the cultivation of high-quality compound talents, and students must not only have solid and comprehensive professional knowledge, but also have strong innovation ability and the ability to solve practical engineering problems, so as to promote the transformation of China's traditional industries to intelligent, high-end, and green environmental protection development, and promote China's transformation from a manufacturing country to a manufacturing power. In order to cultivate compound talents suitable for industrial development, application-oriented undergraduate colleges need to conduct an in-depth analysis of the comprehensive quality required by the corresponding positions of mechanical manufacturing students, and then reconstruct the curriculum system, upgrade the experimental equipment, optimize the teaching content, reform the teaching methods, create a high-level and professional teaching team, and build a new talent training model, which can not only deliver human resources for industrial upgrading, but also improve the employment competitiveness of students.

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References

1. Tian Y, Wang Xingbo, Fu Guiwu, et al.Construction of intelligent manufacturing virtual simulation experiment teaching platform under the background of engineering education[J].China Equipment Engineering,2021(07):214-215.
2. Zhang Kangyi. Application analysis of VR technology in environmental art design teaching under the background of Internet intelligent manufacturing[J].Forest Area Teaching, 2020 (09):49-51.
3. Zhang Zhiting. Application of virtual simulation experiment in computer network technology teaching[J]. Academic Weekly,2024,(11):29-31.
4. Domanski A P, Yashar D. Optimization of finned-tube condensers using an intelligent system[J].International Journal of Refrigeration,2006,30(3):482-488.
5. S. O F, S. H E, G. M E. High mobility transmission system under intelligent reflecting surface[J].Transactions on Emerging Telecommunications Technologies,2022,33(7).

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