Application of Intelligent Manufacturing Technology in Experimental Teaching in Colleges and Universities

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Abstract. Intelligent manufacturing represents the development direction of advanced technologies in the field of engineering in the future. The intelligent manufacturing comprehensive training and teaching platform combines the virtual simulation teaching software with the actual production line of intelligent manufacturing, and puts forward a new curriculum implementation plan in the aspects of experimental teaching content, teaching methods and teaching methods in colleges and universities through the teaching mode of "combination of virtual and real", which fully meets the target needs of colleges and universities to cultivate high-quality engineering and technical talents in the context of new engineering construction.

Keywords: Intelligent manufacturing; experimental teaching; talent training

1 Preface

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[1]. In this context, a large number of professional and skilled talents who can meet the needs of the development of new industries are needed, which puts forward higher requirements for the talent training of colleges and universities. As a compulsory course for engineering practice teaching in colleges and universities, experimental teaching plays a huge role in cultivating college students' engineering practice ability and innovation ability[2].

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2 Introduction of Intelligent Manufacturing Comprehensive Training Platform

The intelligent manufacturing comprehensive training platform combines the intelligent manufacturing production line with the virtual simulation teaching software, develops and designs the "virtual and real" intelligent manufacturing virtual simulation training and teaching platform, and has achieved good implementation results in the teaching practice activities. It is equipped with ABB robots, CNC lathes, CNC milling machines, AGV intelligent mobile vehicles, intelligent visual inspection platforms, SCARA robot intelligent assembly platforms and other equipment, as well as supporting FMS, ERP, MES and other management software. Experimental training projects such as intelligent production, intelligent manufacturing, and intelligent logistics can be carried out, so that students can experience the effect of factory practice. By allowing students to participate in practice, they can truly experience the operation mode of Industry 4.0 and "Internet +" in manufacturing enterprises, enhance students' practical ability, and improve their employment competitiveness (see Figure. 1).

Fig. 1. Intelligent manufacturing production line.

2.1 Introduction to the Production Process

The production process of the intelligent manufacturing comprehensive training platform realizes the information interconnection and integration between high-end CNC machine tools and industrial robots, intelligent sensing and control equipment, intelligent detection, intelligent logistics and warehousing equipment and other key technical equipment[3]. The process realizes the management functions of planning, scheduling, quality, equipment, production, energy efficiency and other functions through the establishment of workshop manufacturing execution system (MES), the establishment of enterprise resource planning system (ERP) to realize the operation and management functions of supply chain, logistics and cost, and the establishment of internal communication network architecture of the factory to realize the information interconnection between the manufacturing process and the manufacturing execution system (MES) and the enterprise resource planning system (ERP).

2.2 Introduction to the Main Units of the Intelligent Production Line

2.2.1 Intelligent Storage Unit. The intelligent storage unit is composed of a stacker, a shelf, an inbound and outbound platform, a conveyor line and a reader. The shelves consist of 4 rows of 5 rows of front shelves and 4 rows of 7 rows of rear shelves. The control system of the storage unit is controlled by PLC controller and equipped with a touch screen, which can easily realize the operation of material in and out/in, transfer, transfer and inventory operations. The intelligent storage unit can not only complete the teaching demonstration alone, but also realize the overall scheduling control through the general console(see Figure. 2).

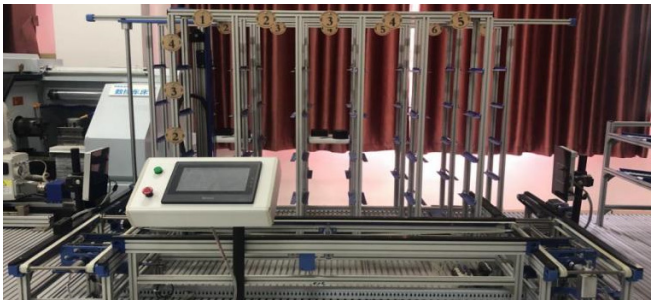

Fig. 2. Physical diagram of intelligent warehousing system.

2.2.2 Intelligent Manufacturing Units. The intelligent manufacturing unit is mainly used to complete the task of intelligent processing of materials. Multiple RFID readers. The flexible conveyor line control system is controlled by PLC controller and equipped with touch screen, and CNC milling machine, CNC lathe, and robot are remotely controlled through Ethernet. Each module in the intelligent manufacturing unit can operate independently, and the intelligent manufacturing scheduling and control software can also be used to realize the intelligent scheduling of each unit(see Figure. 3).

Fig. 3. Physical diagram of intelligent warehousing system.

2.2.3 Intelligent Detection Unit. The intelligent inspection system is mainly used for online rapid measurement of machined workpieces. The system consists of a three-degree-of-freedom Cartesian coordinate robotic arm and a vision measuring instrument[4]. The system can control the robotic arm to automatically move the workpiece

at the detection port position of the conveyor line to the glass table of the measuring instrument through remote command, and the measuring instrument automatically switches to the corresponding detection user program for measurement, and the robotic arm will carry the workpiece back to the original place after the measurement, and complete the online automatic measurement, and the whole process is completed automatically without manual participation(see Figure. 4).

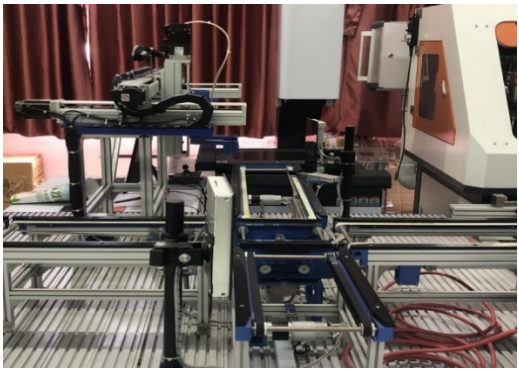

Fig. 4. Intelligent detection system.

2.3 Introduction to the Intelligent Virtual Simulation System

The virtual simulation system includes digital twin virtual simulation system software, LCD splicing screen, electronic computer, console and other equipment for intelligent manufacturing production lines. This system simulates the real intelligent manufacturing production process, students can carry out intelligent manufacturing platform cognition, operation drills, programming simulation, logistics simulation, simulation debugging, etc., the knowledge and skills of intelligent manufacturing, industrial engineering, production management and other links are organically integrated, and the combination of virtual operation learning and actual operation verification is convenient to help students obtain a comprehensive perceptual and rational understanding of intelligent manufacturing processing and production(see Figure. 5).

Fig. 5. Virtual simulation system

3 Experimental Example, MES System Cognition in Smart Factory

Cognition of MES system in smart factory. Experimental hours: 2 hours. Experiment Type: Confirmatory.

3.1 Objectives

Familiar with the functional modules of the smart factory MES system, familiar with the MES system architecture of the smart factory, and familiar with the characteristics of the MES system of the smart factory.

3.2 Experimental Procedure

Use the user name to log in to the intelligent manufacturing information experiment platform system, enter the system address, open the system login page, enter the correct user name and password, and click to log in to complete the system login. After logging in to the system successfully, the page will automatically switch to the entrance page of each subsystem, including MES production and manufacturing execution, ERP enterprise resource management, Features page, data management system, and system help, select MES production and manufacturing execution from the platform entrance, open a new page and automatically jump to the MES production and manufacturing execution home page, the home page displays all the current user's orders, orders to be produced, production error orders, and completed orders, and displays the latest order information of distributors below. Production of the latest order information, the latest completed order information[5]. The left navigation bar displays the MES manufacturing execution function module, click to turn the work on or off.

4 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, we have carried out experimental teaching of intelligent manufacturing for intelligent manufacturing, mechatronics, robotics engineering, electrical engineering and automation[6]. 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 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

5 Conclusions

The intelligent manufacturing comprehensive training platform can ensure that students can participate in simulation and debugging, simulate the real production line environment, and solve the problem of "only watching but not teaching" of the production line, and students dare not get started. 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, organically integrates the knowledge and skills of intelligent manufacturing, industrial engineering, production management, etc., combines virtual operation learning with actual operation verification, and the teaching process is intuitive and vivid, which is convenient for helping students to obtain a comprehensive perceptual and rational understanding of intelligent manufacturing processing and production. Through theoretical learning and multiple rounds of practical training such as lean production, information production, intelligent manufacturing, etc., students have a deep understanding of the knowledge they have learned, which not only makes students deeply understand the major, but also stimulates their love for the major and their confidence and learning direction in future employment.

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