Development and Design of Teaching Experiment Platform Based on Intelligent Manufacturing

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Abstract

In order to meet the needs of intelligent manufacturing and intelligent production in automobile industry, an experimental platform for intelligent manufacturing Teaching of automobile is designed and built. The teaching experiment platform is composed of a movable workbench, which makes use of Industrial Ethernet to realize direct communication between control and equipment. At the same time, the cloud network is integrated into the master control terminal. The experimental platform can realize remote data monitoring and process control, and complete the production process links such as remote control, CNC machining, industrial robots, and intelligent detection. The development of the teaching experiment platform is of great significance to the cultivation of professional compound high-end technical talents.

Keywords: *Hub, Intelligent manufacturing, PLC, WinCC*

1 INTRODUCTION

Manufacturing industry is a pillar industry of the national economy. In recent years, China's manufacturing industry has developed continuously and rapidly. The team of technical and skilled talents is the main force supporting the development of manufacturing industry. Application-oriented Education is the main channel for training and transporting technical and skilled talents for manufacturing industry. Therefore, a good intelligent manufacturing experimental platform is established, It is of great significance to improve the comprehensive technical skill level of technical talents in applied education.[1-3]

Aiming at the practical problems in the upgrading and transformation of traditional production and manufacturing systems,[4] relying on the application of intelligent manufacturing technology and taking the production and processing of auto parts as the project background, this experimental platform completes the complete project cycle of students from function analysis, integrated design, layout planning to installation and deployment, programming and debugging, optimization and improvement, and cultivates students' technical application Technological innovation and coordination ability.

Through the study of the experimental platform, students can systematically learn and master the knowledge of robots, CNC machining, PLC, industrial configuration, etc. at the same time, through group teaching, students can improve their teamwork ability and enhance their sense of responsibility, which is of great significance to the improvement of students' overall knowledge level.

2 OVERALL DESIGN OF INTELLIGENT MANUFACTURING TEACHING EXPERIMENT PLATFORM

The intelligent manufacturing teaching experiment platform adopts an integrated application platform. The core of the platform is to flatten the control structure of the original equipment layer, field layer and application layer by using industrial Ethernet, so as to realize one network to the end, direct communication between control and equipment, information compatibility between multiple types of equipment, big data exchange between systems, and integrate cloud network into the main control end, Realize data remote monitoring and process control.

The platform adopts project-based modules, takes the wheel hub of the automobile industry as the product object, integrates modules such as intelligent warehousing and logistics, industrial robot, CNC

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machining and intelligent detection, realizes production process links such as warehousing and logistics, CNC machining and intelligent detection, realizes information interconnection by using the Internet of things and industrial Ethernet, and completes rapid data exchange and process control, PLC is used to realize the flexible field control structure and general control design logic, relying on the MES system to realize data acquisition and visualization, integrating big data to realize the implementation deployment and intelligent control of the process, connecting to the cloud, realizing integrated joint control with the help of data services, meeting the customized production and manufacturing of wheel hub and realizing visual management. Figure 1 shows the overall framework of the experimental platform, and Figure 2 shows the control system of the experimental platform.

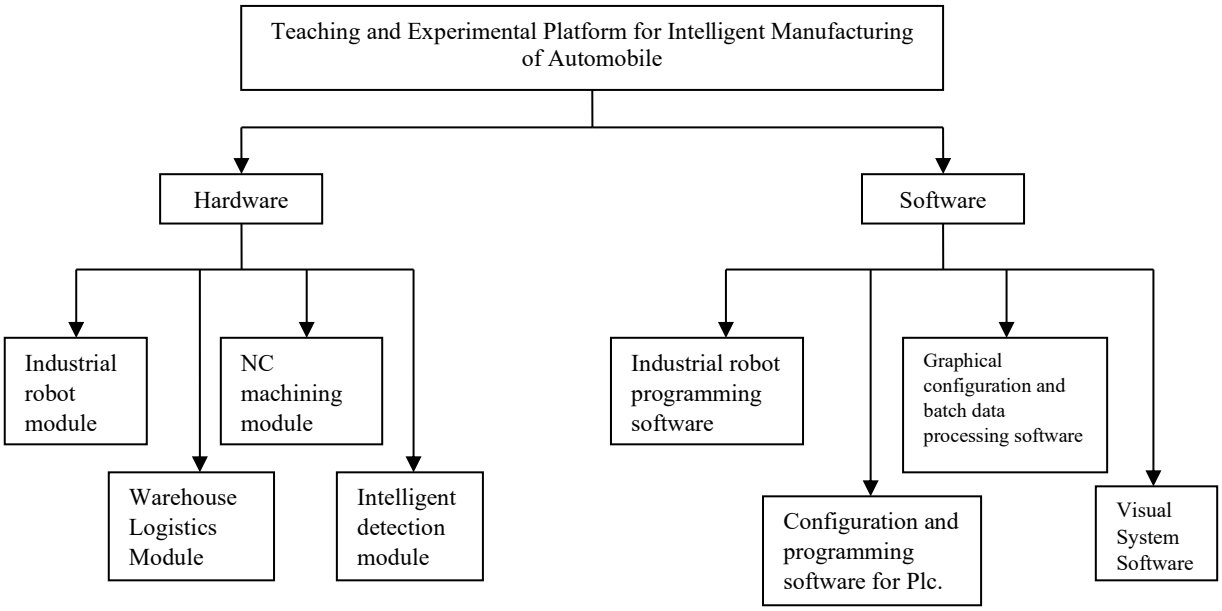

Fig. 1 Overall framework diagram of experimental platform

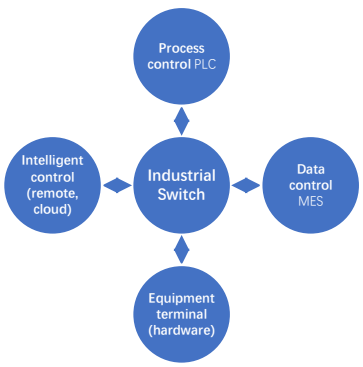

Fig. 2 Control System of Experimental Platform

3 DESIGN OF AUTOMOBILE WHEEL HUB EXPERIMENTAL PLATFORM

Based on the principle of modular design, relying on remote IO module, the intelligent manufacturing teaching experiment platform realizes signal monitoring and control coordination through industrial Ethernet to meet different process requirements and function realization, and fully reflects the power consumption, efficiency and cost characteristics of system integration. Each unit of the experimental platform is installed on a freely movable independent bench. The four sides of each unit can be spliced with other units. According to the process sequence, it can be freely combined into a layout form suitable for different functional requirements to meet the learning needs of students at different stages. Figure 3 shows the work flow chart of intelligent manufacturing teaching experiment platform.

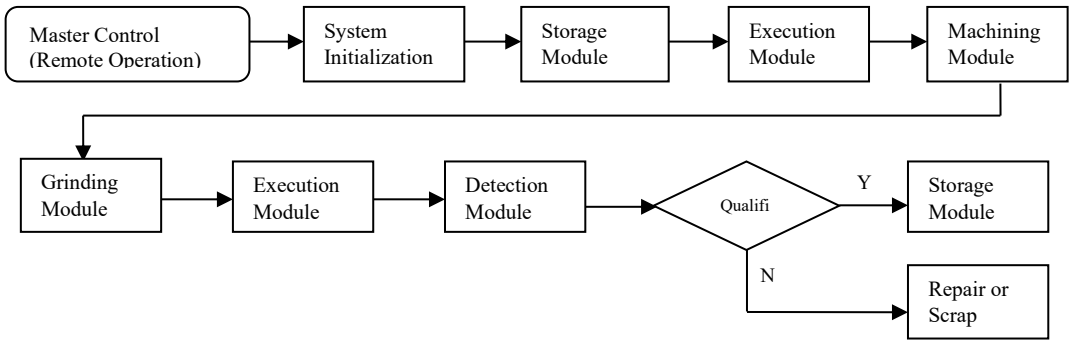

Fig. 3 Workflow of Intelligent Manufacturing Teaching Experiment Platform

3.1 *Industrial Robot Module*

The industrial robot module uses a sliding platform. The industrial robot chooses the small-sized six-degree-of-freedom industrial robot, which can move freely in the working space to complete different forms of picking or machining parts. The process control signal of the execution system is interacted with the main control unit by the remote IO module through industrial Ethernet. As the extension axis of industrial robot, the sliding platform expands the workspace of industrial robot, so that industrial robot can finish the more complicated process. At the same time, the motion parameter information (such as speed, position, etc.) of the sliding platform is transmitted to PLC by the industrial robot controller through the on-the-spot IO signal, so as to control the servo motor to realize linear motion. The industrial robot can install or release tools at the specified position through program control. In order to make the industrial robot to automatically and quickly change tools, a flange is installed on the end flange of the industrial robot, which can be matched with the tool end of the quick change module.

3.2 *Warehousing and Logistics Module*

The warehousing and logistics module can accomplish the storage and retrieval of the goods automatically according to the instruction, and manage the goods automatically, which makes the material handling and storage more reasonable. The warehousing and logistics module is used for temporary storage of parts and is composed of workbench, three-dimensional warehouse, remote IO module and other components. The three-dimensional warehouse is a double-layer structures with six bins, and each bin can store one part; The pallet of the bin can be pushed out, which is convenient for the robot to store and pick up parts in an unnecessary way; Each bin is equipped with sensors and indicators, which can detect whether there are parts stored in the current bin and display the status; All cylinder actions and sensor signals in the storage unit are transmitted to the main control unit by the remote IO module through industrial Ethernet.

3.3 *CNC Machining Module*

With the development of computer technology, digital control technology has been widely used in various fields of industrial control, and it is becoming more and more important in manufacturing industry. The CNC machining module is composed of worktable, CNC machine tool, tool magazine, CNC system, remote IO module and other components. The module adopts the CNC machine tool with typical three-axis milling machine structure. The machining action is controlled by the CNC system. The structure adopts lightweight design. The CNC machine tool can realize small-scale high-precision machining. In this experimental platform the Siemens 828D numerical control system, which integrates CNC, PLC, operation interface and shaft control functions, supports the application of turning and milling processes, and supports various programming methods. It can satisfy the programming requirement from the mass production to the single workpiece, and its calculation precision can fully guarantee the accuracy of the control. It can significantly shorten the programming time and ensure the best workpiece accuracy; The CNC machine tool adopts virtual tool library, and uses the screen display to simulate the tool change action and the current tool information. The tool library control signal is provided by the CNC system, which is exactly the same as the real tool library. The control signal of the whole CNC machining module is transmitted to the main control unit by the remote IO module through industrial Ethernet.

3.4 *Intelligent Detection Module*

The intelligent detection module can detect and identify parts according to different needs. It is composed of worktable, intelligent vision, light source, display and other components. The intelligent vision device can realize bar code recognition, shape matching, color detection, size measurement and other functions according to different program settings. The operation process and results are displayed through the display; Then the industrial Ethernet will transmit the program selection, detection execution and result output of the detection module to the industrial robot, and the result

information will be transmitted to the general control unit to determine the subsequent work flow.

4 DESIGN OF VISUAL MANAGEMENT INTERACTIVE INTERFACE SYSTEM

This experiment platform uses WinCC to carry on the visualization management. WinCC is the upper computer configuration software developed by Siemens, which is mainly used to monitor the production process. Its lower computer programming software mainly adopts STEP7 of Siemens. It provides functional templates for industrial graphic display, messages and reports. High performance process coupling, fast picture updating and reliable data make it highly practical. Moreover, WinCC also provides an open interface as a user solution.

By compiling the WinCC project, upload data to the cloud to achieve remote control and monitoring. Using VB script for data upload process as shown in figure 4.

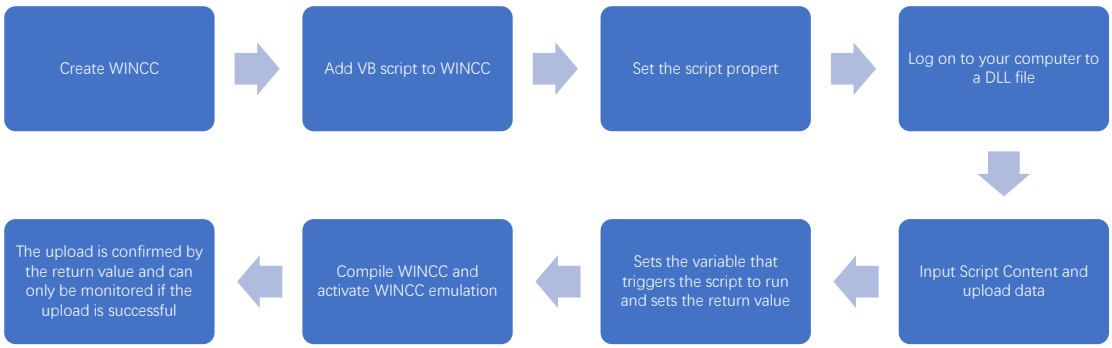

Fig. 4 Data Upload Process

5 CONCLUSION

With the continuous development of manufacturing industry, the establishment of teaching experiment platform based on intelligent manufacturing and the introduction of advanced technology and equipment into teaching will help broaden students' vision, arouse students' interest in learning and improve teaching effect.

Aiming at the need of curriculum reform and innovation of automobile specialty, this paper designs an integrated teaching platform of intelligent manufacturing. The platform is based on the background of auto parts processing, grinding and testing procedure, and is guided by complete projects such as functional analysis, integrated design, layout planning, installation and deployment, programming and debugging, optimization and improvement. It allows students to complete the learning of auto parts processing technology, grinding technology, monitoring technology, operation of industrial robots, visual management interactive system, etc. through practice. It has cultivated students' ability of technology application, technology innovation and coordination. It is of great significance to the current curriculum reform of vocational education.

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