Research and Discussion on Flexible Automatic Production Line Upgrade System

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Abstract: Modular flexible automatic production line training system consists of six units. They are respectively: loading detection unit, handling unit, processing and testing unit, installation unit, installation handling unit and classification unit. The control system can be controlled by Siemens, Mitsubishi or Omron PLC, which are all have good flexibility, namely each station has a set of independent control of PLC control system. After the completion of the training in the basic unit module, and the adjacent of two station, three stops can be... up to six stations are connected together to learn the control, programming, assembly and debugging techniques of complex systems. The practical training system contains a variety of control technologies such as pneumatic, motor drive and control, PLC, sensor and so on, which is suitable for engineering practice, course design and training of engineering and technical personnel at the beginning of the post. It is an ideal equipment for training mechatronics talents.

1 RESEARCH AND DEVELOPMENT STATUS AT HOME AND ABROAD

1.1 Research Status of Flexible Manufacturing System Abroad

FMS is still developing rapidly in Japan, the United States and Germany. As early as the middle of last century, MIT developed CNC milling machine, which is not only the first flexible automation equipment in the world [1]. More importantly, it ushered in an era of flexible production, from which small batches and multiple varieties would not be a production problem. In the early 1960s, in the American Melrose company, CNC automatic production line came into being, which also created a precedent in related fields [2]. In the late 1960s, two American companies developed and designed related automatic production lines, and from then on, flexible manufacturing system in its true sense began to come into people's vision [3].

1.2 Domestic Research Status of Flexible Manufacturing System

At home, flexible manufacturing is much later than abroad for many years. Under this huge gap of nearly 20 years, we can only import relevant systems from abroad at a high price. Until the end of the last century, with the strong support of the state, China was able to develop relevant flexible systems independently [4]. Through the practice, although our country starts late, but the development speed is not slow; many related systems emerge at the historic moment in our country. More delightedly, the gap between China's flexible manufacturing level and that of foreign countries is narrowing [5]. However, this development is doomed to be short-lived, because there is no future for this kind of imitation related system, and the number of relevant scientific research institutions in China is too small, most products do not have independent intellectual property rights, so it seems that domestic flexible system development is a long way to go.

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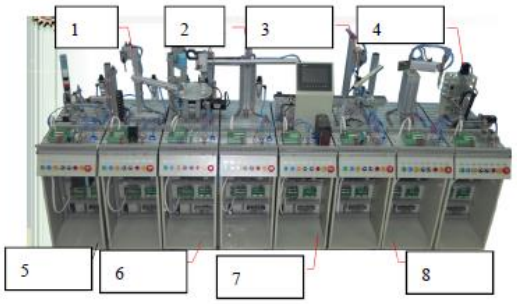
1.3 Domestic and International Status of Teaching Flexible Manufacturing System

The flexible teaching system in our country lags behind many foreign countries. Universities such as those in Japan, Singapore, the UK and Germany are far ahead of us in the relevant allocation [6]. In universities in these countries, flexible systems range from simple to complex, allowing students to experience operating platforms themselves. In the process, students can also research, debug and program on these advanced flexible systems. In China, many of the country's top universities also provide students with teaching systems, but most of them are imported from Britain or Germany, and needed a lot of money. Although some universities are trying to develop relevant systems independently, most of them still lack relevant teaching systems and cannot provide relevant practical links.

2 RESEARCH CONTENT, KEY TECHNOLOGIES AND RESEARCH OBJECTIVE

2.1 Research Content

Modular flexible automatic production line training system is one of the most typical mechatronics and automation products. It is for vocational colleges, technical schools, education training institutions and developed, such as it is suitable for automation and machinery manufacturing, mechanical and electrical integration, electrical engineering and automation, automation engineering, control engineering, measurement and control technology, computer control, automatic control, mechanical and electrical engineering, mechanical design and theory and other related professional teaching and training. It not only specially designed for teaching, but also strengthened various control technology and engineering practice ability. The original system is shown in figure 1.



1-detecting unit; 2-handling unit; 3-Extract installation unit; 4-Ster; eo storage unit; 5-feeding unit; 6-processing unit; 7-Sorting and conveying unit; 8-Operator unit

Fig 1. Schematic diagram of the original automatic production line.

2.2 Key Technologies

(1) The system organically integrates mechanical, pneumatic, electrical control, motor transmission, sensing and testing, PLC and industrial network control technology, with modular structure and easy combination. Can complete all kinds of individual skills training and comprehensive project training, can also carry out mechanical parts installation and debugging, pneumatic system installation and debugging, electrical control circuit installation and PLC programming, mechanical and electrical equipment installation and debugging, automatic control system installation and debugging, industrial network control system installation and debugging in one. It can meet the needs of practical teaching and engineering training.

(2) Regardless of mechanical structure or control, the system adopts unified standard interface, with high compatibility and expansibility. With the rapid development of industrial field technology, this system can keep pace with the upgrading and expansion of field technology and fully meet the needs of practical training and teaching

(3)This system can exercise learners' innovative thinking and practical ability. Learners can use this system to carry out engineering training in mechanical assembly, electrical design, wiring, PLC programming and debugging, field bus construction and maintenance, etc.

(4) Siemens PLC adopts Siemens PROFIBUS-DP network communication, which enables the real-time exchange of control information and state data between various stations. It is equipped with 10.4-inch, 256-color industrial color touch screen to realize industrial control.

2.3 Research Objectives

In order to satisfy the practical teaching of the teaching class, this paper upgrades the existing set of automatic production line in the laboratory of school of electrical engineering, and the schematic diagram of the upgraded automatic production line is shown in figure 2. The original automatic production line can only be demonstrated for students to watch, after technical upgrading, students can modify the program to complete the change of action. To meet the needs of different teaching practices, students participate in the teaching interaction through the automatic production line teaching system platform, gradually grasp, eventually integrate what they have learned, and improve their comprehensive ability.

Fig 2. Schematic diagram of the upgraded automated production line.

3 TECHNICAL SCHEME, INNOVATION POINT AND ADVANCEMENT

3.1 Technical Solution

Figure 3 shows the logistics transfer process of the work piece from one station to another in the system: The loading detection unit will arrange the large work pieces in order before lifting and sending them out; The transfer station moves the large work pieces from the loading detection unit to the processing station; Processing station will be large pieces of processing after the station; the installation and handling station moves large pieces of work from the transmission station to the installation station and puts them down. Then the installation station will be the corresponding small work piece into the large work piece. After that, the installation and handling station will send the installed work piece to the sorting station, which will send the work piece to the corresponding stock bin.

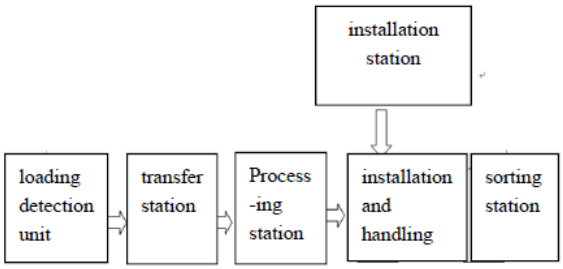


Fig 3. Working process diagram.

(1) Use the instructions learned to complete the programming of each station.

(2) This training is divided into six units. By getting familiar with the composition of control parts and execution parts, some common basic instructions are used to complete routine control in production practice.

(3) By getting familiar with the first station, you can obtain relevant contents of electrical components installation, mechanical disassembly, mechanical design, wiring technology, PLC programming, etc., to prepare for the integration and debugging of the whole six stations.

(4) Cultivate students' interest in learning, apply what they have learned to practice, and cultivate the ability to analyze and solve problems.

(5) Enable students to develop a sense of cooperation and unity in learning.

(6) Strengthen safety education, so that students develop good safe operation habits.

3.2 Innovative Point

Through the practical training and skill training of the intelligent control system of teaching-type automatic production line, students have a clear understanding of the technical process and standard requirements of industrial production, and greatly improve their sense of professional identity and recognition. In addition, after practical training, students have a deeper understanding of basic engineering knowledge; significantly improve their operational ability, teamwork awareness and engineering management ability. Through the practice of training, greatly stimulate students' innovative thinking and innovative ability, for the improvement of the quality of students to play a positive and effective role.

3.3 Advancement

The intelligent control system of flexible automatic production line for teaching is designed, which fused automation professional motion control field of the core technology. Each workstation can be an independent system, and is a mechatronic integrated system, at the same time, the system also has a strong flexibility, convenient for different work tasks configuration, meet the needs of different teaching practice. Through the automated production line teaching system platform, students participate in the teaching interaction, from the shallow to the deep, from the point to the surface, gradually master, and eventually integrate the learned knowledge, improve their comprehensive ability. To ensure the quality of automatic skilled personnel training.

4 APPLICATION PROSPECT ANALYSIS

Flexible automatic production line is a production line composed of several adjustable machine tools and automatic transport devices. It is a production system with complex technology and high automation. It uses computers for management and combines various production modes, which can help enterprises reduce production costs, improve product quality, shorten product replacement time, and finally reflect the improvement of enterprise competitiveness. Based on hardware and supported by software, the flexible automatic production line can achieve the required control by changing the program, so it is flexible and easy to adjust. To realize the flexibility and high efficiency of manufacturing process is the main way to adapt to multi-variety, small and medium batch production. In the process of production line operation, the material transfer system of flexible automatic production line has the ability to bypass the fault machine by itself, with stable production capacity, strong strain capacity, simple structure and flexible assembly. It can be combined freely according to the size of the production workshop, increase or decrease equipment appropriately according to the actual needs, and arrange the system reasonably, so as to solve the problems such as limited enterprise space, no place for new product production line, and too long product replacement time.

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