DLIM-412 Industrial 4.0 technology application system

Fig 1 For reference only

I. Overview.

"Industry 4.0" (the "fourth industrial revolution"), also known as "smart production" , is the interpretation of information physical integration, which completes the whole process of perception,

communication, implementation and decision-making, including five categories: resource elements, interconnection, system integration, information integration and emerging business types, and guides enterprises to use digital, networked and intelligent technologies to develop towards model innovation. Through the introduction of information and communication technology (ICT) , collect, share and use production data information in different ways, realize the diversification and personalization of products and services, shorten the response time of production process, reduce production time and cost, so as to continuously improve industrial productivity.

The system is closely related to the latest technology development trend of "industry 4", and integrates advanced technologies such as "Internet plus", "smart sensor", "PLC control technology", "intelligent electrical and mechanical equipment", "digital twin simulation", "logistics technology", "IT technology and safety", so that students can learn and master the latest 4 knowledge and skills in industry.

The hardware platform of DLIM-412 industrial 4.0 technology application system includes bottom box feeding station, bookmark feeding station, box cover assembly station and storage station. The software platform is composed of MES production execution system and digital twin system. The system can complete the personalized customization of bookmarks and learn and master the professional skills of industrial 4.0.

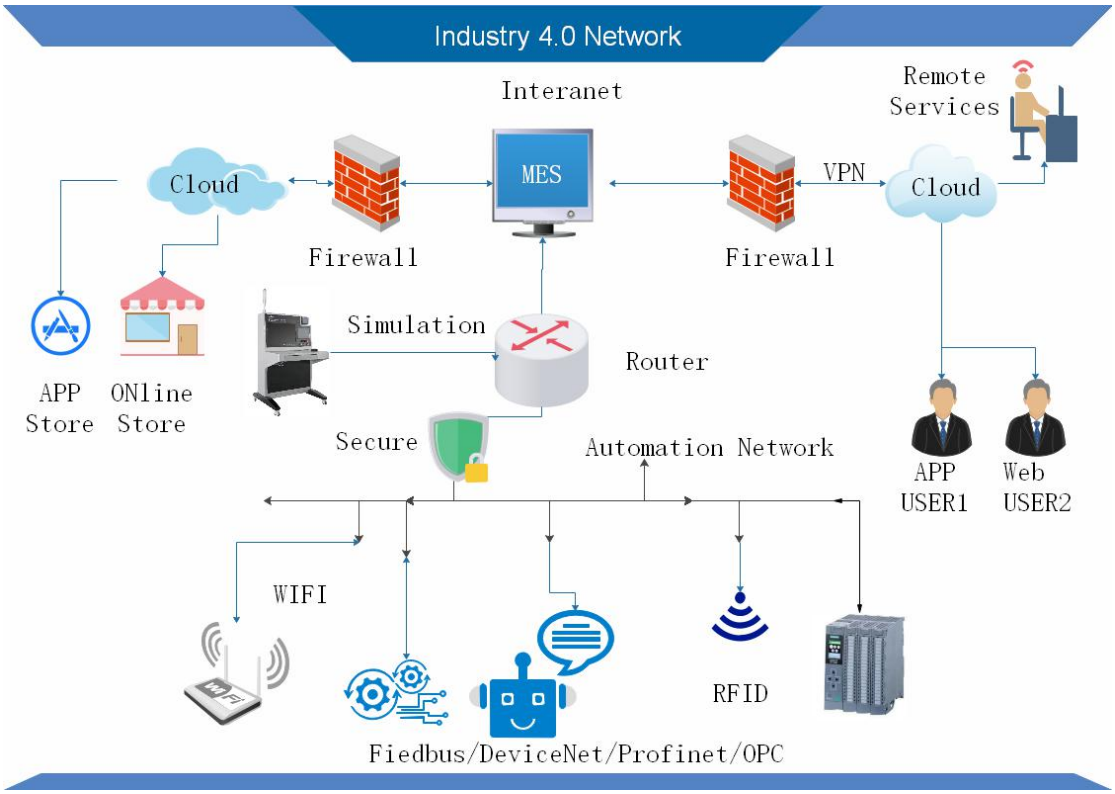

Fig 1.1 Network topology

Using this system, students can learn and master the following skills:

1) Sensor detection technology: including optical fiber sensors, photoelectric sensors and inductive sensors commonly used in industrial automation. Students can know each sensor on the equipment and master the use method of each sensor.

2) Electrical control system: the electrical drawings are designed according to industrial standards. Students can learn circuit principle analysis, PLC I / O address check and equipment circuit analysis methods on this equipment.

3) Motor driving technology: including servo motor, stepping motor, AC motor and driver. Students can understand and master the use methods of each motor on this equipment.

4) Siemens PLC technology: students can practice PLC wiring, programming and debugging on this equipment.

5) RFID Technology: installation and debugging of RFID.

6) Internet of things technology: installation and testing of industrial Internet perception layer equipment, connection and configuration of Internet of things network transmission layer, deployment of industrial Internet application layer, and joint commissioning of industrial Internet collaborative manufacturing system.

7) Configuration technology: students can practice the programming of Siemens configuration software and the communication between configuration software and PLC on this equipment.

8) System maintenance and fault detection technology: this part focuses on the contents and methods of daily maintenance of mechatronics equipment, as well as common fault analysis and troubleshooting methods.

9) Digital twin Technology: digital 3D model building and layout, virtual PLC debugging, virtual production line beat optimization, etc.

10) MES technology and application: users place orders through the MES system, and select the demand information at the same time (the demand information is provided in the form of multiple options, and users can select bookmarks of different colors). The order information is released to the manufacturing production line for production through the MES system.

11) Logistics technology: not only transfer, handling, assembly and storage technology, but also

identification, data transmission and tracking technology.

12) It technology: mainly including network planning, network cabling, firewall, VPN, gateway, router setting, etc.

13) Information security: the two LANs are mainly interconnected. The network firewall is configured, and the gateway provides filtering and security functions.

Equipment workflow:

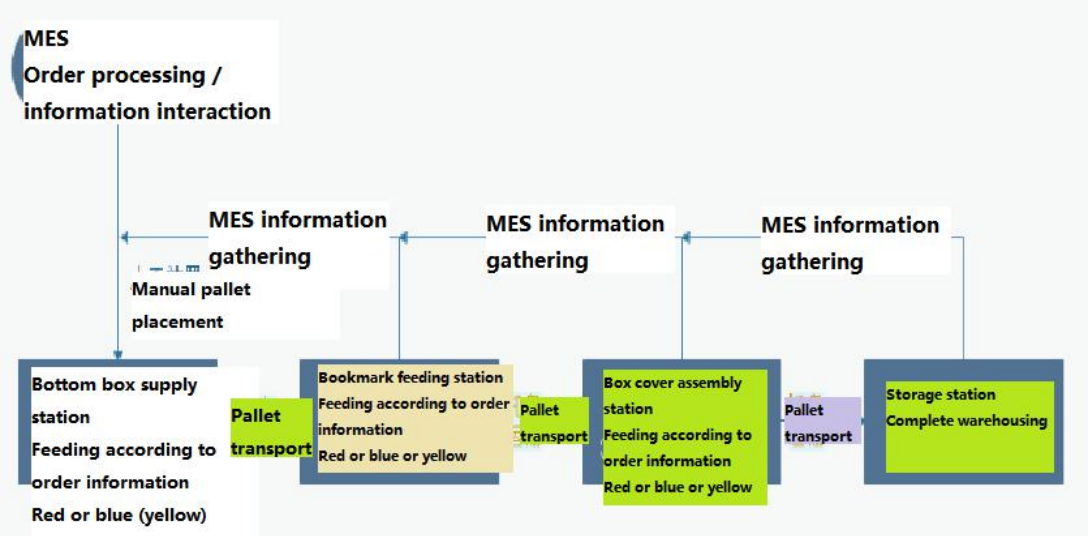

Fig 1.2 flow chart

1) Bottom box feeding station: when the customer orders, MES issues the production task, and the bottom box feeding module launches the bottom box of corresponding color to the tray. The product information is written into the chip through RFID.

2) Bookmark feeding station: after the pallet arrives at the bookmark feeding station, the corresponding stop mechanism acts, the pallet accurately stops at the station set by the program, and the bookmark is transported to the box slot by the handling module. And update product information through RFID. The stop mechanism is reset and the tray enters the next workstation.

3) Box cover assembly station: after the tray arrives at the box cover assembly station, the corresponding stop mechanism acts, and the tray accurately stops at the station set by the program. The box cover feeding module pushes out the box cover of corresponding color to the middle turntable, and the box cover is transported to the bottom box by the handling assembly module to complete the assembly. And update product information through RFID. The stop mechanism is reset and the tray enters the next workstation.

4) Finished product warehousing: after the pallet arrives at the warehousing station, the corresponding stop mechanism acts, the pallet accurately stops at the station set by the program, and the manipulator carries the

finished product box to the warehouse designated by MES to complete the finished product warehousing process. And update product information through RFID.

II, Features.

1. Device selection: the main devices used in the platform are selected from international and domestic well-known brands with advanced technology and high market share.

2. Standardization: the platform shall be developed and tested in accordance with relevant national safety standards and specifications for mechanical and electrical equipment.

3. Modular design conforms to the teaching law and students' cognitive law. Teachers and students can choose different module combinations for practice according to the needs of teaching and competition.

4. Personalized Customization: customers can place personalized orders through the industrial Internet cloud platform or app, and select the required product type and product appearance (box cover and bookmark color)

5. Annular layout: the whole equipment is arranged in the form of annular conveyor belt. Four pallets are arranged on the conveyor belt. The pallets can be recycled as material transportation carriers. Through the arrangement and combination of four proximity switches and the specific structural design of the tray, the recognition of 15 tray features can be realized.

6. Fieldbus: the field control equipment has communication function and constitutes the bottom control network of the plant. The equipment has interoperability and interchangeability. The automatic control equipment and system are connected to the information network to provide more flexible system integration and data processing mode.

7. Industry 4.0 intelligent manufacturing technology: apply information and communication technology to the production and manufacturing process, practice the application of industrial Internet technology, and realize the digitization and data sharing of system information. Practice the application of data encryption, firewall setting, authority control and other technologies to protect the security of production network, office network and computer system from unauthorized modification, destruction or disclosure, and meet the needs of emergency data processing. Select and apply sensor technology, automatic identification technology (RFID, RFID, etc.), PLC technology, digital twin technology, MES and data processing, optimize the process and parameters of the production system,

improve efficiency, reduce cost, obtain equipment operation parameters, monitor equipment operation status, and realize predictive intelligent maintenance.

III, Technical parameters.

1. Working power supply: AC220V ± 10%, 50Hz,

2. Rated power: 2KW

3. Floor area size: overall layout size: about 2100 * 2100 * 1780mm (L) × W × H)

4. Working environment: temperature 5 ℃ - + 40 ℃, relative humidity < 85% (25 ℃)

5. Safety protection: it has multiple protections of short circuit, overload, audible and visual alarm light and emergency stop

6. PLC: Siemens series

IV, Composition and function.

4.1 Bottom box feeding station

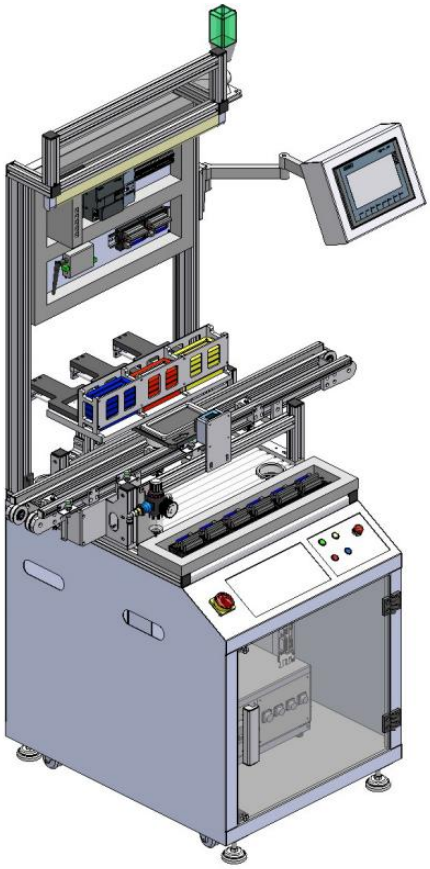

Fig 4.1 Bottom box feeding station

Composition: it is composed of table body, annular conveyor belt, bottom box feeding module,

cylinder solenoid valve assembly, PLC, touch screen, RFID assembly, stop mechanism, cylinder, solenoid valve group, air source processing element, sensor assembly, industrial Internet and network security, etc.

Workflow: MES places orders, program starts and equipment runs; The tray circulates along the annular conveyor belt. When the tray reaches the corresponding station specified in the MES order (the bottom box color specified in the MES order), the sensor detects the tray, the stop mechanism corresponding to the bottom box position of the specific color acts, the tray stops accurately, and the feeding module loads the bottom box of the color specified by the MES into the tray. When the bottom box is loaded, the stop mechanism is reset, the tray continues to run along the annular conveying line to reach the RFID read-write position, the stop mechanism acts, the tray accurately stops at the RFID read-write position and writes the product information. After the stop mechanism is reset, the tray continues to run along the annular conveying line and enters the next station. Through the arrangement and combination of four proximity switches and the specific structural design of the tray, the tray feature recognition is realized.

Main technical parameters:

Input power supply: single phase three wire AC220V ± 10%, 50Hz.

Output power supply: DC regulated power supply: 24V, 5A

Overall dimension: 1100 (600) × seven hundred and fifty × 1780mm (L × W × H)

Working pressure: 0.35-0.6mpa

Safety protection function: emergency stop button, short circuit, overload, etc.

4.1.1 bottom box feeding module

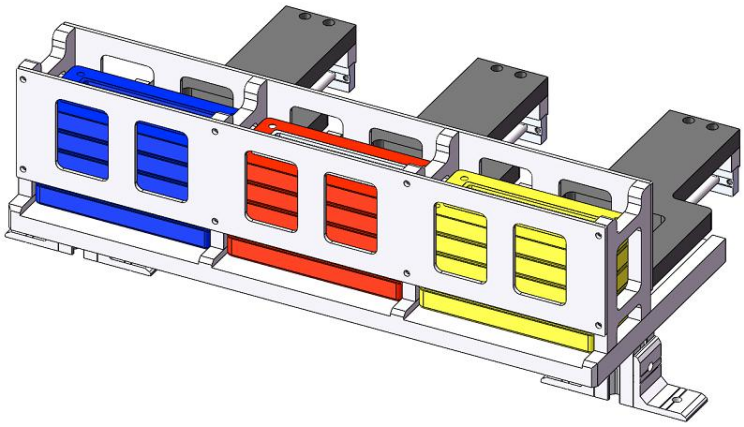

Fig 4.2 Effect drawing of bottom box feeding module

The bottom box feeding module is a mechanism for storing and supplying the bottom of the box. The bottom boxes of blue, red and yellow are placed in the corresponding silos respectively.

4.2 Bookmark feeding station

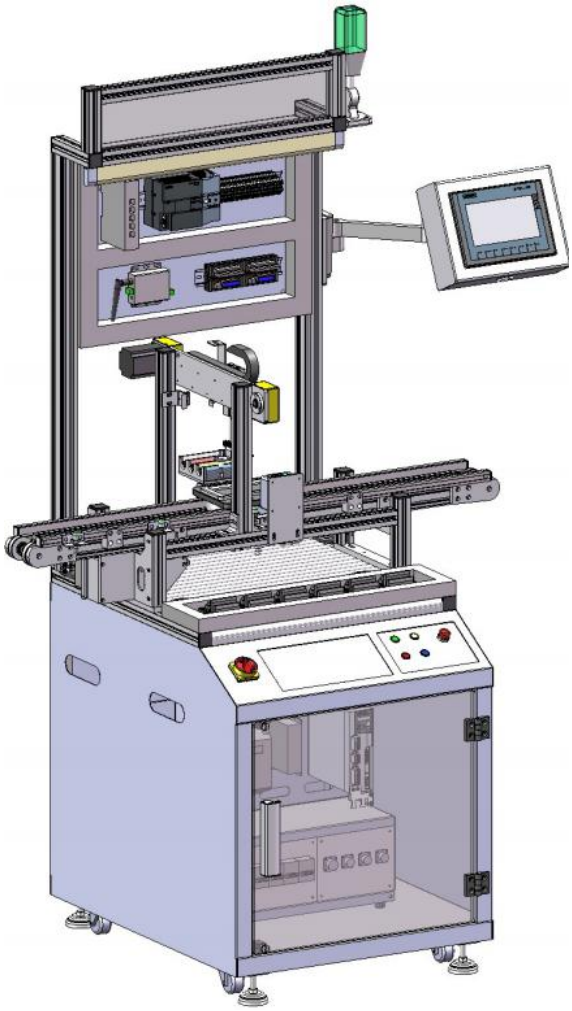

Fig 4.3 Effect drawing of bookmark feeding station

Composition: it is composed of platform, annular conveyor belt, handling mechanism, bookmark storage, PLC, RFID component, stop mechanism, sensor component, vacuum suction cup component, cylinder, solenoid valve group, industrial Internet and network security, etc.

Work flow: the pallet runs along the annular conveying line. When the pallet reaches the bookmark feeding station, the sensor detects the pallet, the stop mechanism acts, and the pallet stops accurately. The pneumatic suction cup of the end actuator of the two-axis handling mechanism absorbs the bookmarks of the color specified by MES in the bookmark storage, and then transfers the bookmarks to the pallet. After bookmark loading, RFID writes product information. Then, the stop mechanism is

reset, and the tray continues to run along the annular conveying line and enters the next station.

Main technical parameters

Input power supply: single phase three wire AC220V ± 10%, 50Hz

Output power supply: DC regulated power supply: 24V

Overall dimension: 1100 (600) × seven hundred and fifty × 1780mm (L × W × H)

Working pressure: 0.35-0.6mpa

Safety protection function: emergency stop button, short circuit, overload, etc.

4.2.1 handling mechanism

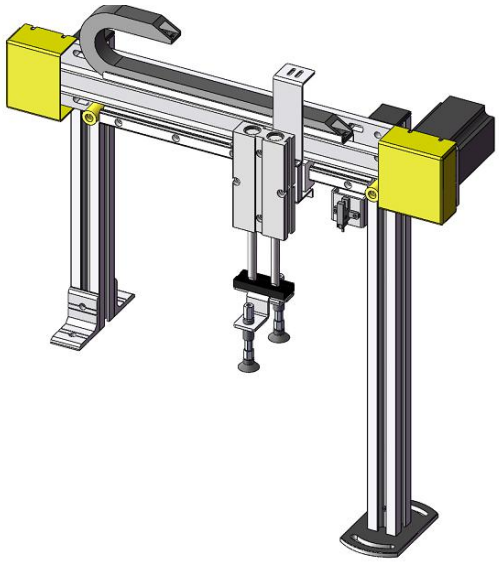

Fig 4.4 Effect drawing of handling mechanism

The two axis handling mechanism is composed of x-axis, Z-axis and vacuum suction cup assembly. The two axis handling mechanism realizes the functions of suction and handling bookmarks. The x-axis is composed of stepping motor, synchronous belt drive, linear guide rail assembly and connector, and the z-axis is mainly composed of double axis cylinder, speed regulating valve and detection sensor. The vacuum suction cup is composed of suction cup, vacuum generator, pneumatic joint and air source.

4.2.1 bookmark storage

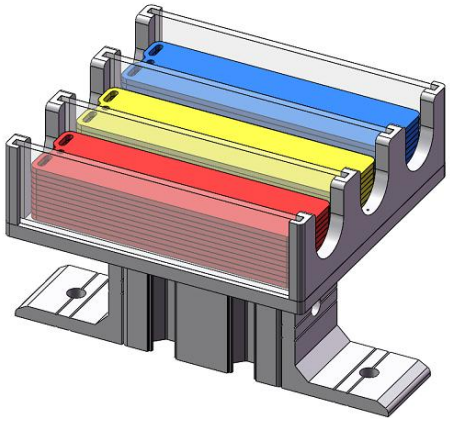

Fig 4.5 Effect drawing of bookmark silo

Three color bookmarks are placed in the bookmark warehouse.

4.3 box cover assembly station

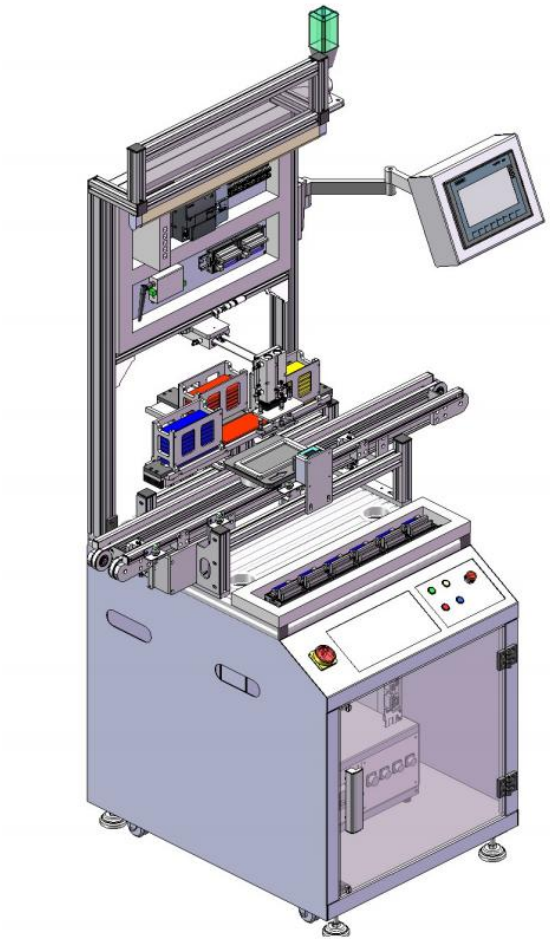

Figure 4.6 effect drawing of box cover assembly station

Composition: it is composed of platform, annular conveyor belt, box cover storage mechanism, handling and assembly mechanism, PLC, RFID component, stop mechanism, sensor component, vacuum suction cup component, cylinder, solenoid valve group, industrial Internet and network security, etc.

Work flow: the tray runs along the annular conveying line. When the tray reaches the box cover feeding station, the sensor detects the tray, the stop mechanism acts, and the tray stops accurately. The box cover storage mechanism transports the box cover in the color specified by MES to the transfer platform. The pneumatic suction cup of the end actuator of the two-axis handling and assembly mechanism absorbs the box cover of the transfer platform in the box cover storage, and then the two-axis handling mechanism operates, Assemble the box cover with the box bottom in the tray. After the box cover is assembled, the RFID writes the product information. Then, the stop mechanism is reset, and the tray continues to run along the annular conveying line and enters the next station.

Main technical parameters

Input power supply: single phase three wire AC220V ± 10%, 50Hz

Output power supply: DC24V

Working pressure: 0.35-0.6mpa

Overall dimension: 1100 (600) × seven hundred and fifty × 1780mm (L × W × H)

Safety protection function: emergency stop button, short circuit, overload, etc.

4.3.1 box cover storage mechanism

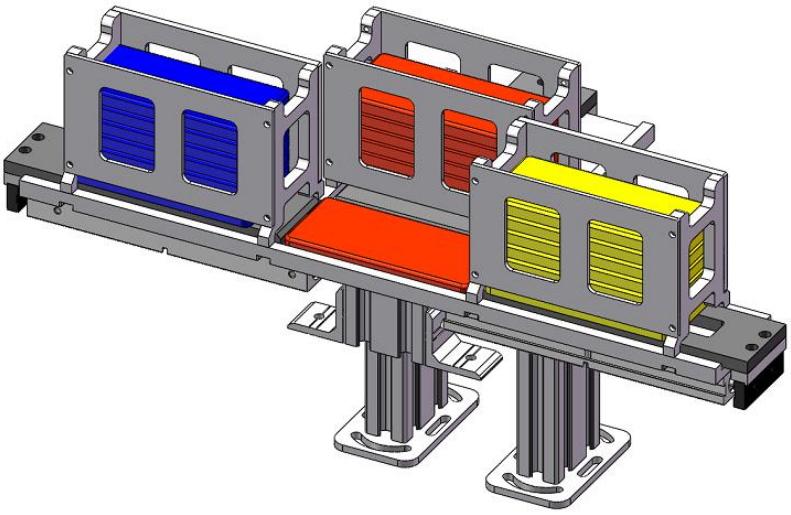

Figure 4.7 effect drawing of box cover storage mechanism

The box cover storage mechanism is a device for storing the box cover and pushing the box cover to the transfer platform. The box covers of the three colors are respectively placed in the material barrel of the corresponding color. The three drums share a middle turntable, and the box cover is temporarily stored on the transfer table after being pushed out.

4.3.2 box cover assembly mechanism

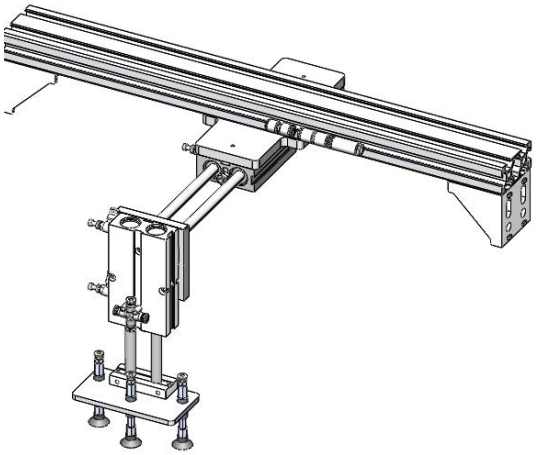

Figure 4.8 effect drawing of handling and assembly mechanism

The box cover assembly mechanism is composed of x-axis, Z-axis and vacuum suction cup assembly. The box cover assembly mechanism realizes the functions of absorbing, transporting and assembling the box cover. X axis is composed of double axis cylinder, speed regulating valve and detection sensor, and Z axis is composed of double axis cylinder, speed regulating valve and detection sensor. The vacuum suction cup is composed of suction cup, vacuum generator, pneumatic joint and air source.

4.4 storage station

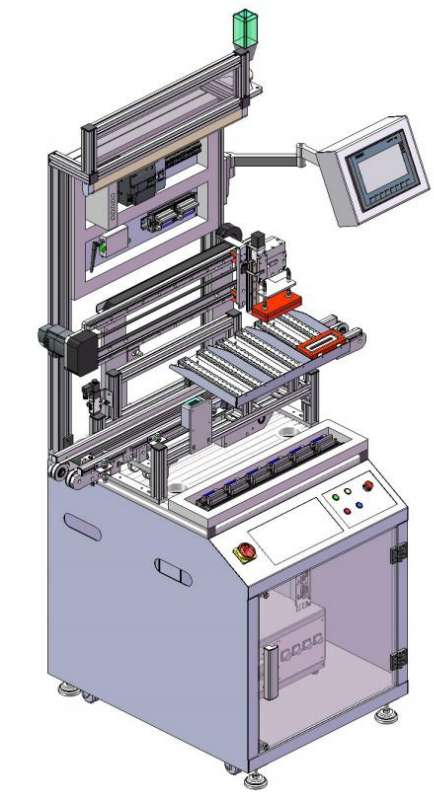

Figure 4.9 effect drawing of storage station

Composition: it is composed of table body, annular conveyor belt, loading and unloading manipulator, slide storage, PLC, RFID component, stop mechanism, sensor component, vacuum suction cup component, cylinder, solenoid valve group, industrial Internet and network security, etc.

Work flow: the tray runs along the annular conveying line. When the tray reaches the storage station of the bookmark box, the sensor detects the tray, the stop mechanism acts, the tray stops accurately, the vacuum suction cup assembly at the end of the loading and unloading manipulator moves to the stop position of the bookmark box, and the pneumatic suction cup of the end actuator grabs the bookmark box, Then the loading and unloading manipulator transfers the bookmark box to the chute storage location specified by MES instruction. An optical fiber sensor is arranged in the chute storage. When a bookmark box is detected at the feeding position in the chute storage, the loading and unloading manipulator will stop and wait until the warehousing conditions are met. After bookmark warehousing is completed, RFID writes product information. Then, the stop mechanism is reset, and the tray continues to run along the annular conveying line and enters the start station for recycling.

Main technical parameters

Input power supply: single phase three wire AC220V ± 10%, 50Hz

Working environment: temperature 5 ℃ - + 40 ℃, relative humidity < 85% (25 ℃), no water droplet condensation, altitude < 4000m

Output power supply: DC24V

Working pressure: 0.35-0.6mpa

Overall dimension: 1100 (600) × seven hundred and fifty × 1780mm (L × W × H)

4.4.1 loading and unloading manipulator

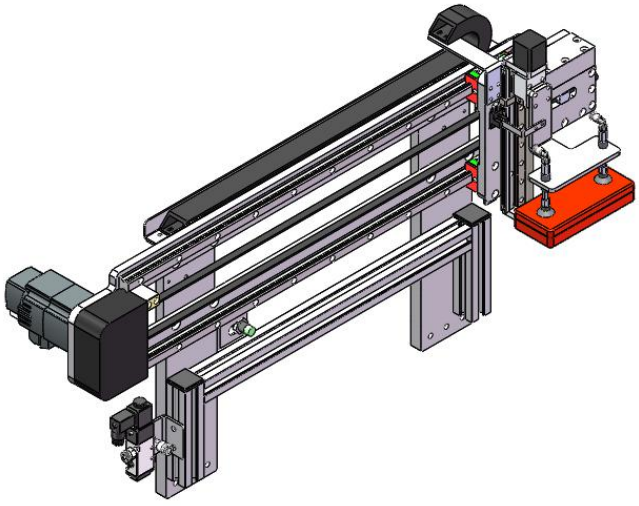

Fig. 4.10 effect drawing of loading and unloading manipulator

The loading and unloading manipulator is composed of x-axis, Z-axis and vacuum suction cup assembly. The loading and unloading manipulator realizes the functions of suction, handling and storage of Bookmark Box. Axis X is composed of servo motor, synchronous belt drive, linear guide rail assembly, sliding plate, connector and origin sensor. Axis Z adopts electric sliding table, which is mainly composed of screw stepping motor, sliding plate, linear guide rail and origin sensor. The vacuum suction cup is composed of suction cup, vacuum generator, pneumatic connector, solenoid valve group, etc.

4.4.2 slideway storage

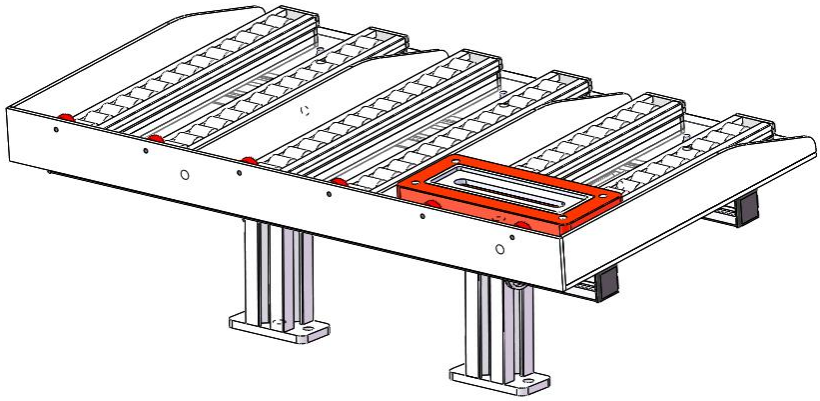

Figure 4.11 slide way storage effect

Slide storage is used to store bookmark boxes of different colors. The slide way storage is composed of a storage strip, a storage body and an optical fiber sensor.

4.5 energy management module (optional)

The energy management module is mainly composed of power management module and gas source management module.

The power management module adopts single-phase guide rail electricity meter, which can realize the collection and display of system electricity, and the collected data can also be transmitted to PLC through communication.

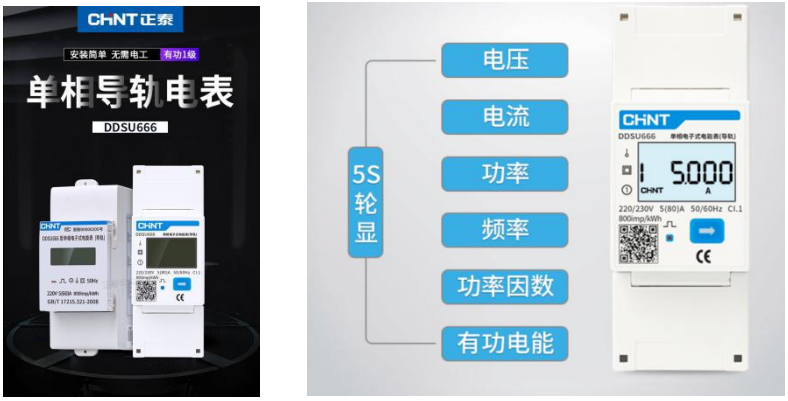

Figure 4.12 power management module

The air source management module can detect the air source flow, measure the flow of 0-200l / min, and display the instantaneous flow and cumulative flow. With RS485 interface, the maximum supporting working pressure is 0.8MPa, the display resolution is 0.1l/min, and it has alarm function.

Figure 4.13 air source management module

4.6 network technology

Based on the new generation technology provided by OPC foundation, OPC UA provides secure, reliable and independent of manufacturers, and realizes the transmission of raw data and preprocessed information from manufacturing level to production planning or ERP level. Through OPC UA, all required information is available to each authorized application and authorized personnel at any time and anywhere. This function is independent of the manufacturer's original application, programming language and operating system. OPC UA is a supplement to the OPC industrial standard that has been used at present. It provides some important features, including platform independence, scalability, high reliability and the ability to connect to the Internet. OPC UA no longer relies on DCOM, but is based on Service-Oriented Architecture (SOA). OPC UA is easier to use. Now, OPC UA has become a bridge between enterprise layer and embedded automatic formation independent of Microsoft, UNIX or other operating systems.

Firewall / NAT: firewall policy controls network traffic between different trust zones, while network address translation (NAT) protects the internal LAN from unauthorized activities from external hosts.

VPN: virtual private network (VPN) provides a secure communication tunnel when users access the private network through the public Internet. VPN uses IPSec (IP Security) server or client mode to encrypt and authenticate the network

Network layer IP packets to ensure confidentiality and sender authentication.

4.7 electric control and communication system

Figure 4.14 electric control system

There are 4 sets of electrical control systems installed in each station. It is mainly composed of PLC module, touch screen, switching power supply, frequency converter, remote I / O module, circuit breaker, wiring terminal block, IO switching module, industrial switch, etc.

4.7.1 power supply

Power supply: input power supply, the power supply specification is AC single-phase 220V; DC power supply adopts DC24V switching power supply; The electric control system is equipped with a power socket for power supply of each module.

The electrical control box is used to install the centralized electric control system, including input and output power supply, PLC and expansion module, servo driver, air switch, wiring module, etc.

4.7.2 PLC and expansion module

Fig. 4.15 PLC

Bottom box feeding station, bookmark feeding station, box cover assembly station, storage station adopts Siemens

PLC S7-1200 series, CPU digital input 14/output 10, 100 KB working memory; 24VDC power supply. Onboard DI14×24VDC leakage type/ Prototype DQ10 x24VDC and AI2: onboard 6 high-speed counters and 4 pulse outputs; signal board expansion onboard I/O, up to 3 communication modules for serial communication, up to 8 for I/O expansion Signal module: 0.04ms/1000 instructions; PROFINET interface for programming, HMI and data communication between PLCs.

4.7.3 Operation panel

Fig. 4.16 Effect diagram of operation panel

As the operation panel of the workstation, it includes the power switch, start, stop, reset, manual automatic and emergency stop buttons.

4.7.4 Touch screen

SIMATIC HMI KTP700 Basic version

SIMATIC HMI, KTP700 basic version, compact panel, key/touch operation, 7" TFT display, 65536 colors, PROFINET interface, the lowest version that can be configured for the project WinCC Basic V13/ STEP 7 Basic V13

4.8 Pneumatic system

Fig. 4.17 Air compressor

4.8.1 Air compressor

Equipped with 1 set of air compressor, which is used to supply air to the pneumatic actuator system of the workstation.

The main parameters are as follows:

Rated pressure: 0.6Mpa;

Flow rate: 0.1m³/min;

Gas storage tank capacity: 24L;

Compressor power supply and power: 220V/50Hz, 1.5Kw.

4.8.2 Pressure regulating filter

It consists of an air filter (water filter) and a pressure reducing valve (pressure regulating valve). Among them, the main function of the pressure reducing valve is to stabilize the pressure of the air source, make the air source reach a constant state, and reduce the damage to the hardware such as the valve and the actuator caused by the sudden change of the air pressure.

Fig. 4.18 Pressure regulating filter

4.9 Software

4.9.1 PLC Programming software (education version)

TIA Portal is the abbreviation of TIA Portal, which is a brand-new fully integrated automation software released by Siemens Industrial Automation Group. It is the first automation software in the industry to adopt a unified engineering configuration and software project environment, which is suitable for almost all automation tasks. With this new engineering technology software platform, users can quickly and intuitively develop and debug automation systems.

TIA Portal software (TIA Portal) is a new generation of Siemens framework software, and Siemens control and

monitoring software is integrated in this software. TIA Portal software has the same database and platform, and data can be shared among various devices without the user having to do any extra work. TIA Portal software S7-1200, S7-1500, S7-300, S7-400 PLC programming software, and can also program WinAC and ET200 intelligent distributed I/O stations.

It integrates the functions of modern office software, and is equipped with a graphical configuration method similar to the original appearance of the equipment, which enables users to complete automation control design tasks flexibly, easily and quickly.

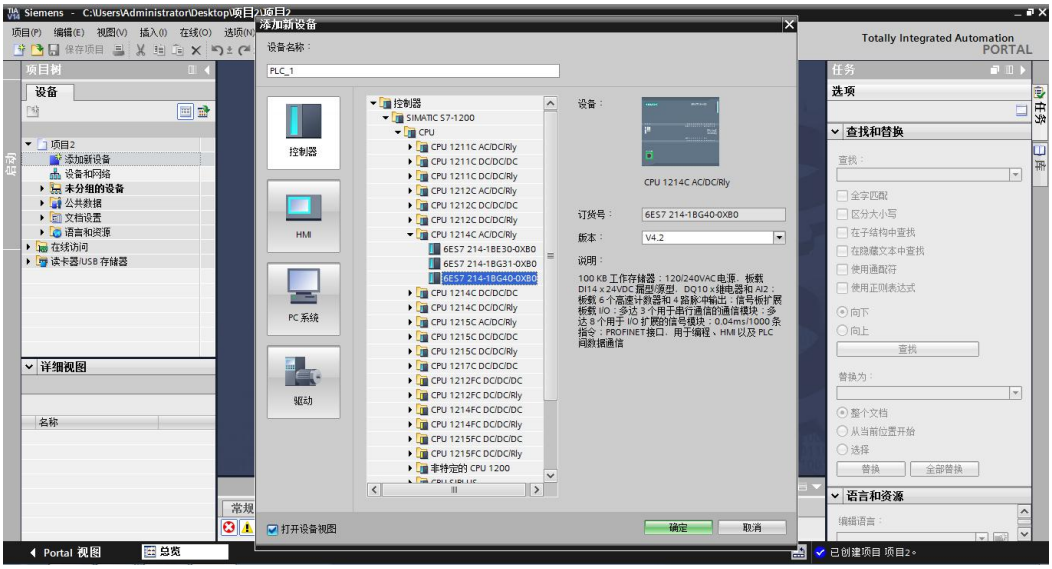

Fig. 4.19 TIA Portal software

4.9.2 MES System

Fig. 4.20 MES System

This unit coordinates the action flow of the overall system and feeds back the working status of the system at the same time. Including system settings, basic management, network order management, production management, equipment management, warehouse management modules.

1) System settings: user management, role management, menu management, button management, data dictionary, log management settings can be performed.

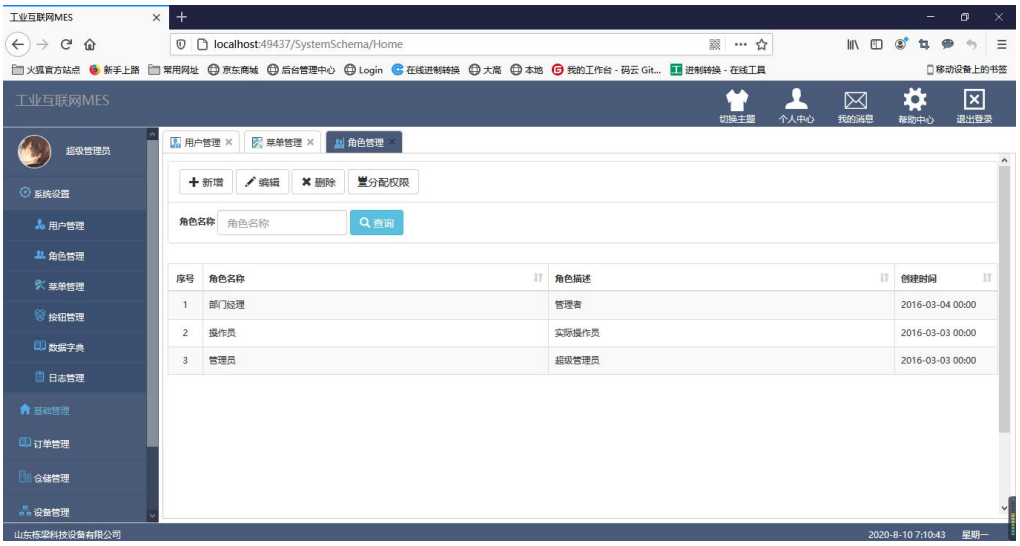

Fig. 4.21 System setting interface

2) User management module: User information can be edited, including creating or deleting users, setting names, passwords, permissions, etc.

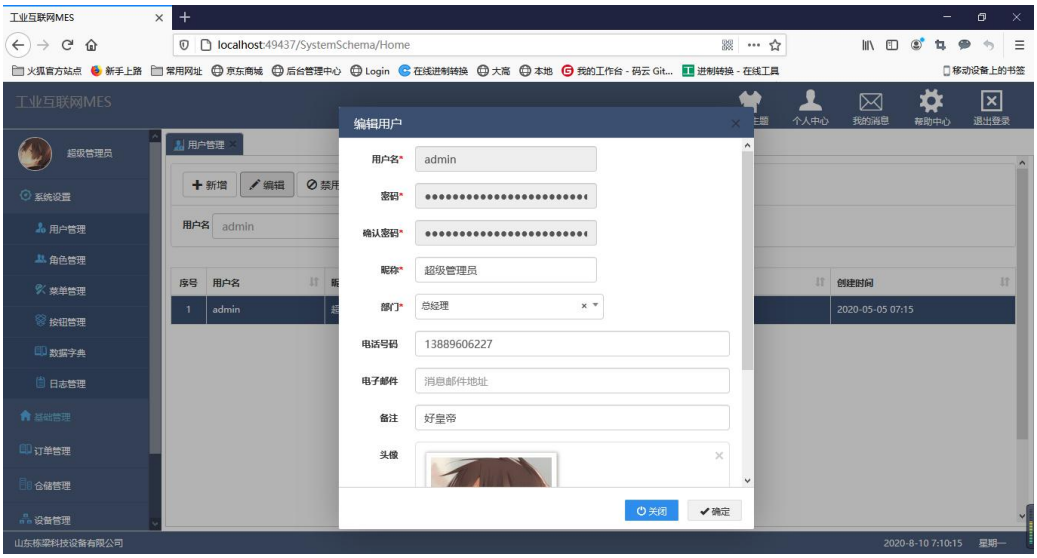

Fig. 4.22 User Management Module

3) Order management module: Receive orders from the Internet, generate customer QR codes to feed back to

the client according to customer customization requirements, and schedule the order of orders at the same time, allowing orders to be inserted.

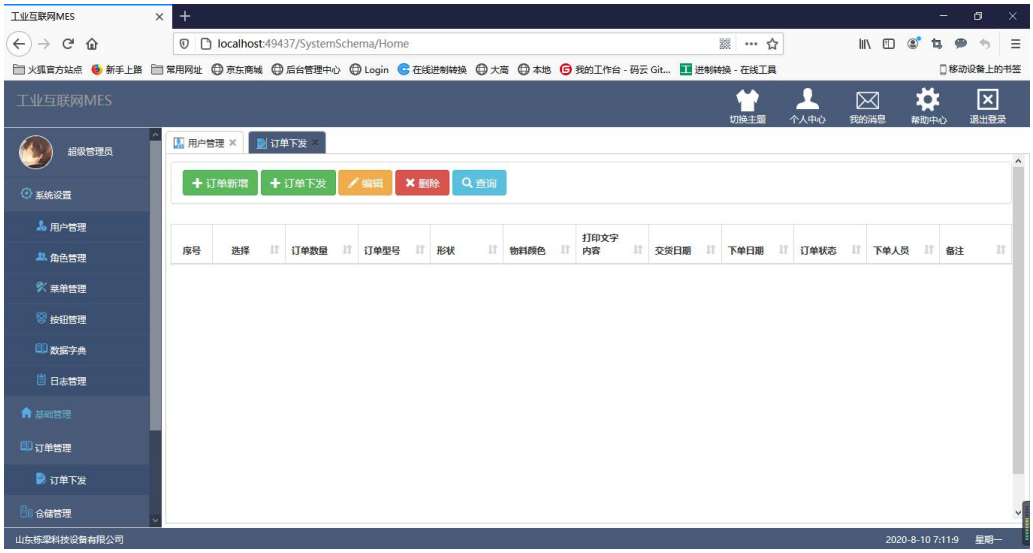

Fig. 4.23 Order management module

Personalized customization: feedback the customer's customized information to the feeding station, and launch the bookmark of the selected color for processing.

4) Equipment management module: It can manage equipment type and maintenance information.

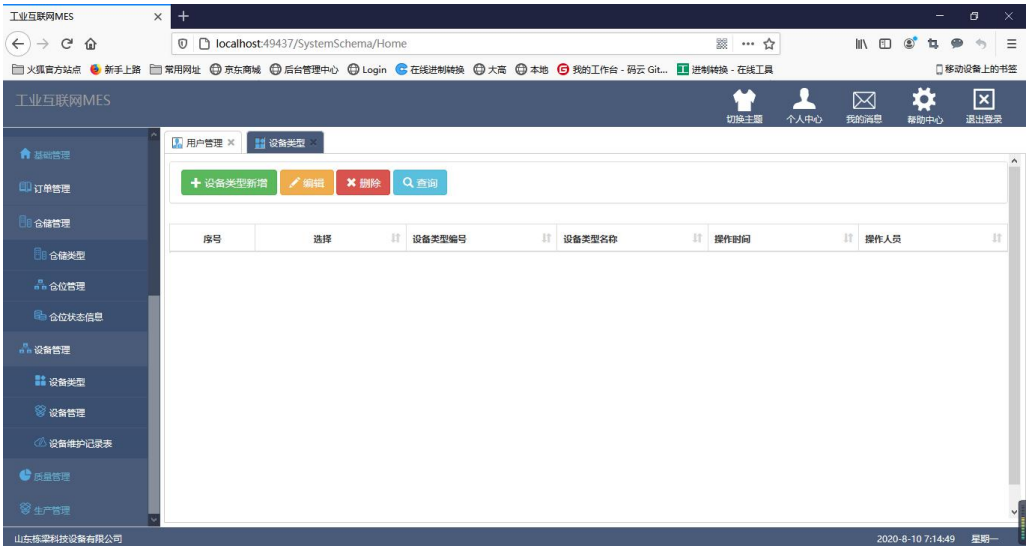

Fig. 4.24 Device management module

5) Warehousing management module: Receive warehouse information from the lower level, and manage warehousing type and position status.

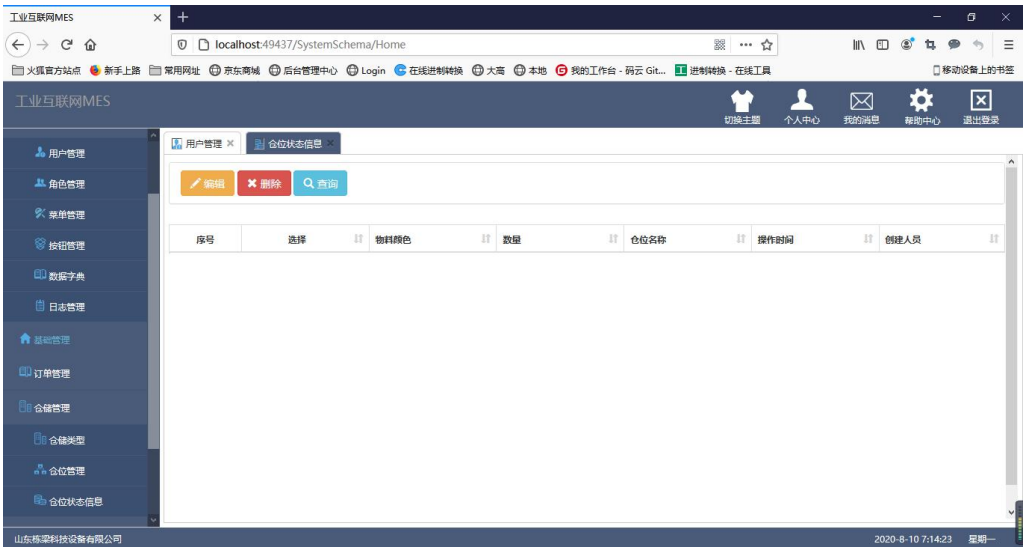

Fig. 4.25 Warehouse Management Module

4.9.3 Digital twin

Digital twin technology is a new digital simulation solution suitable for the R&D and design of automation equipment. With the help of this software platform, 3D modeling and simulation of concepts including multi-physics and automation-related behaviors that usually exist in automation equipment can be carried out. And virtual debugging. Simulate the motion and working status of automation equipment through digital models, realize the linkage virtual debugging of machinery and electricity, through the virtual and real connection of twins, continuous iteration of data, continuous optimization of models, and then obtain the optimal automation equipment solution.

At the same time, the virtual simulation software can receive data from real PLC controllers, drive virtual robots, belts, roadway manipulators and other mechanisms to realize applications such as handling, assembly, and transmission.

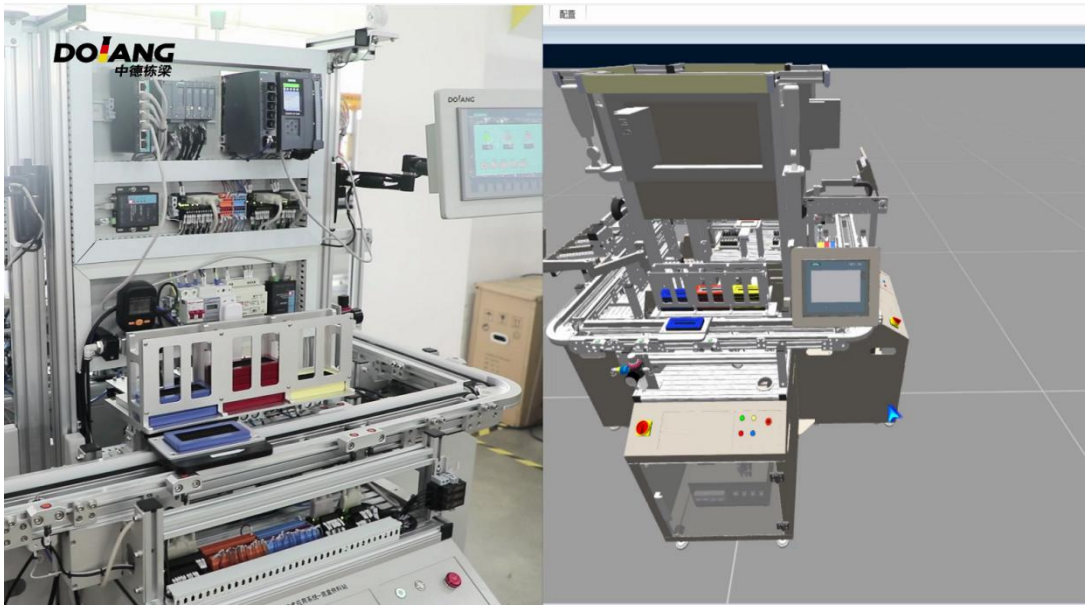

Fig. 4.26 Digital Twin System

Software functions include:

Network component library: Contains more than 2,300 common factory application components: Comprehensive coverage: In the electronic component library, there are a wealth of robots, tooling fixtures and production line equipment components from major brands. Including ABB, KUKA, Fanuc, Comau, Kawasaki, Yaskawa, Staubli, Siasun, Habot, Eft and other brands, in addition to robots, the library also provides a large number of commonly used automation components, such as: conveyor belts, processing machine tools, gantry, variable Position machine, ground rail, human-machine collaboration elements, etc.

Self-built component library: fast self-built non-standard equipment component library: support 58 formats to drag and import: such as 3Dmax, AutoCAD, CATIA, Pro/E, SolidWorks, UG/NX and other software models, and support all mainstream intermediate formats, such as IGES, JT, Parasolid (x_t), STEP/STP, etc.

Lightweight model, component logic definition: Quickly add static attributes such as parameterized size and color in one minute, and define dynamic attributes such as running logic and motion rules.

Self-built digital factory/knowledge base: Public cloud/private cloud/localized component library can be established as needed, and project team members can access according to authority; iteratively update step by step to establish the company's own digital factory and knowledge base.

Rapid production line layout: Trinity: The Trinity of Product, Process, and Plant will fully restore the production status of the factory.

PnP plug-and-play: It is as easy to build a layout as Lego bricks, and a complex production line can be quickly built from scratch in one minute. Intelligent path planning: The shortest logistics route is automatically generated and updated when the component location is changed.

Flow production logic: Quickly define production and logistics operation logic, pull through all states from entering the factory to leaving the factory, support factory-level simulation, and have powerful and rapid program realization capabilities.

Python-based open platform: Python-based logic editor, no need to learn unpopular programming languages. Open 2000+API supports in-depth personalized development (.net) to create your own simulation platform.

Equipment online and virtual debugging: support OPC-UA, SiemensS7-PLC, Modbus and other protocols, use equipment data to drive the motion of the simulation environment, and reflect the status of equipment and production lines in real time; customized big data alarm system, display the alarm effect of the original chart type It is transformed into a 3D real-time simulation event system, which greatly improves the response speed of alarm events and the 3D visualization effect.

Assembly process simulation: product production and assembly process detailed simulation; with component interference analysis highlighting check; interference analysis detailed report output one-click setting of the motion signal logic between assembly components, simplifying the assembly simulation process. Graphical teaching position of the assembly process is simple and efficient.

Ergonomics simulation: human body grasping, production operation and other teaching functions, restore the whole process of man-machine operation; man-machine simulation has precise assembly function, can assemble one-handed/two-handed multi-scene operations and human body according to component size and constraint relationship The walking path planning function RULA analyzes and restores the human body's stress and fatigue state.

Physical simulation of flexible wiring harness simulation: With physical simulation behavior, it is supported by NVIDIA physics engine. If necessary, you can add physical effects in the simulation, such as inertia, collision, gravity, friction and other physical elements; support wire harness and cable simulation, simulate the movement of the cable according to the front and rear forces, and check its dynamic interference with other components in real time.

Display output: output 4K high-definition pictures and animation videos up to 2160P. Support Blender rendering plug-in for poster-level high-end rendering; interactive VR virtual production line interaction, operating production

line equipment and controlling factory operation like a game. Directly generate 2D-CAD drawings based on 3D and embed 2D drawing editing functions.

4.10 Monitoring system (optional)

In order to monitor the production process and equipment operation at any time, this system is equipped with 1 set of surveillance cameras, the camera adopts 2 million starlight 1/2.7" CMOS high-definition network cameras, POE power supply, RJ45 interface, supporting bracket; 1 set of video recorder (4 channels); The capacity of the hard disk is ≥2T, and the real-time running video can be accessed at any time by connecting to a computer or monitor.

Fig. 4.27 surveillance system

4.11 Visual terminal (optional)

Fig. 4.28 Visual terminal

Function: Real-time presentation of the running status of the production line, MES information, etc.;

Display terminal: a well-known domestic brand, 40 inches, 4K resolution, can be used as an extended display for desktop computers (industrial computers) through HDMI.

4.12 Others

1） Workpiece tray

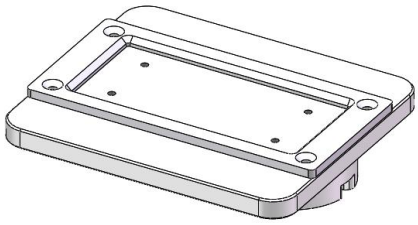

Fig. 4.29 Workpiece tray

This production line is equipped with 4 sets of workpiece pallets. The pallets are mainly composed of plastic and aluminum alloy parts. The pallets are equipped with RFID chips and are installed on the fixed plate through bolts.

2） Toolkit

Tools include Allen wrench, slotted screwdriver, Phillips screwdriver, etc

3） Teaching resources

Teaching resources include teaching resources related to practical training instructions and sample programs.

4） Materials

This system is equipped with 5 sets of red, yellow, and blue boxes and 15 bookmark workpieces.

5） Network

This system is equipped with network cables and wireless communication modules, and cooperates with industrial switches and remote IO modules to build a complete network construction.

V. Main Configurations List

SN	Station	Module	Name	Model	Brand	Qty.	Unit
1	Feeding station	Workbench	Table body sheet metal	600mm*750mm*750mm	Dolang	1	set
			Substrate profile	Aluminum profile	Dolang	1	set
			Load-bearing casters	2 inches	Chinese	4	pc
			Foot	M12	Chinese	4	pc
		Belt conveyor module	Conveyor module bracket	Aluminum profile	Dolang	1	set

			Geared motor	3IK15GN-S/3GN10K	Zhongda	1	set
			Flat belt and pulley assembly	PVC flat belt	Dolang	1	set
			Proximity sensor	PR12-4DP	Chinese	5	pc
		Stop	Stop device	Pneumatic stop	Dolang	4	set
		RFID	RFID	DLRF-7075A	Dolang	1	set
		Feeding module	Bottom storage body	Well type silo	Dolang	1	set
			Cylinder assembly	TN16*100S	AirTAC	3	set
			Fiber Optic Sensor	E32-DC200-6	Chinese	3	set
		Air source	Solenoid valve group	4V110-06	AirTAC	2	set
			Air source treatment	AFR2000	AirTAC	1	set
		Electronic control and communication system	PLC	S7-1200	Siemens	1	set
			touch screen	KTP700	Siemens	1	set
			I/O module	RF8210	Smartlink	1	set
			Gateway	ECU1251	Advantech	1	pc
			Industrial Switch	8 口	Chinese	1	set
			Operation button	Including start, stop, reset, network emergency stop	Chinese	1	set
			Three-color light	DC24V	Chinese	1	set
2	Bookmark feeding unit	Workbench	Table body sheet metal	600mm*750mm*750mm	Dolang	1	set
			Substrate profile	Aluminum profile	Dolang	1	set
			Load-bearing casters	2 inches	Chinese	4	pc
			Foot	M12	Chinese	4	pc
		Belt conveyor module	Conveyor module bracket	Aluminum profile	Dolang	1	set
			Geared motor	3IK15GN-S/3GN10K	Zhongda	1	set
			Flat belt and pulley assembly	PVC flat belt	Dolang	1	set
			Proximity sensor	PR12-4DP	Chinese	5	pc
		Stop	Stop device	Pneumatic stop	Dolang	2	set

		RFID	RFID		DLRF-7075A	Dolang	1	set
		Bookmark feeding module	Flat belt and pulley assembly		Flat belt and pulley assembly	Dolang	1	set
			Transport mechanism	Stepper motor	57A2	Rtelligent	1	pc
				Stepper drive	R60	Rtelligent	1	pc
				Linear Guides	HGH15CA	Chinese	1	set
				Synchronous belt drive	Synchronous belt	Chinese	1	set
				Cylinder assembly	TN16*50-S	AirTAC	1	set
				Vacuum suction cup assembly	Double suction cup	Chinese	1	set
		Air source	Solenoid valve group		4V110-06	AirTAC	2	set
			Vacuum generator		X-KZU07S	AirTAC	1	pc
		Electronic control and communication system	PLC		S7-1200	Siemens	1	set
			touch screen		KTP700	Siemens	1	set
			I/O module		RF8210	Smartlink	1	set
			Industrial Switch		8 口	Chinese	1	set
			Operation button		Including start, stop, reset, network emergency stop	Chinese	1	set
			Stepper drive		R60	Rtelligent	1	台
			Three-color light		DC24V	Chinese	1	set
3	Cover assembly unit	Workbench	Table body sheet metal		600mm*750mm*750mm	Dolang	1	set
			Substrate profile		Aluminum profile	Dolang	1	set
			Load-bearing casters		2 inches	Chinese	4	pc
			Foot		M12	Chinese	4	pc
		Belt conveyor module	Conveyor module bracket		Aluminum profile	Dolang	1	set
			Geared motor		3IK15GN-S/3GN10K	Zhongda	1	set
			Flat belt and pulley assembly		PVC flat belt	Dolang	1	set
			Proximity sensor		PR12-4DP	Chinese	5	pc

		Stop	Stop device		Pneumatic stop	Dolang	2	set
		RFID	RFID		DLRF-7075A	Dolang	1	set
		Handling the assembly module	Lid storage	Lid storage body	Well type silo	Dolang	1	set
				Cylinder assembly	TN16*150-S	AirTAC	2	set
				Cylinder assembly	TN16*100-S	AirTAC	1	set
				Fiber Optic Sensor	E32-DC200-6	Branded	3	set
			Material fetching Assembly mechanism	Cylinder assembly	TN20*50-S	AirTAC	1	set
				Cylinder assembly	TN20*125-S	AirTAC	1	set
				Vacuum suction cup assembly	Three suction cup heads	Branded	1	set
		Air source	Solenoid valve group		4V110-06	AirTAC	2	set
			Vacuum generator		X-KZU07S	AirTAC	1	pc
		Electronic control and communication system	PLC		S7-1200	Siemens	1	set
			touch screen		KTP700	Siemens	1	set
			I/O module		RF8210	Smartlink	1	set
			Industrial Switch		8 口	Chinese	1	set
			Operation button		Including start, stop, reset, network emergency stop	Chinese	1	set
			Three-color light		DC24V	Chinese	1	set
4	Storage unit	Workbench	Table body sheet metal		600mm*750mm*750mm	Dolang	1	set
			Substrate profile		Aluminum profile	Dolang	1	set
			Load-bearing casters		2 inches	Chinese	4	pc
			Foot		M12	Chinese	4	pc
		Belt conveyor module	Conveyor module bracket		Aluminum profile	Dolang	1	set
			Geared motor		3IK15GN-S/3GN10K	Zhongda	1	set
			Flat belt and pulley assembly		PVC	Dolang	1	set
			Proximity sensor		PR12-4DP	Branded	5	pc

		Stop	Stop device		Pneumatic stop	Dolang	1	set
		RFID	RFID		DLRF-7075A	Dolang	1	set
		Warehouse module	Loading and unloading robot	servo motor	1FL6034-2AF21-1AA1	Siemens	1	set
				Synchronous belt drive	Synchronous belt	Dolang	1	set
				Linear Guides	HGW15CA	Branded	2	set
				Proximity sensor	PR12-4DP	Branded	1	pc
				Electric sliding table	Stepping screw motor, linear guide, origin detection sensor	Branded	1	set
				Vacuum suction cup assembly	Double suction cup	Branded	1	set
				Bracket	Aluminum alloy bracket	Dolang	1	set
			Warehouse	Warehouse ontology	Three positions	Dolang	1	set
				Fiber Optic Sensor	E32-DC200-6	Branded	6	set
		Air source	The electromagnetic valve		4V110-06	AirTAC	2	set
			Vacuum generator		X-KZU07S	AirTAC	1	pc
		Electronic control and communication system	PLC		S7-1200	Siemens	1	set
			touch screen		KTP700	Siemens	1	set
			I/O module		RF8210	Smartlink	1	set
			Industrial Switch		8 mouth	Chinese	1	set
			Operation button		Including start, stop, reset, network emergency stop	Chinese	1	set
			Stepper drive		R60	Rtelligent	1	台
			server Driver		V90	Siemens	1	set
			Three-color light		DC24	Chinese	1	set
5	Air source		air pump		Air storage tank 24L, flow rate 0.1m3/min	Branded	1	台

6	Software pc	MES	System scheduling, production order monitoring, warehouse management, etc.		Dolang	1	set
		PLC	PLC programming software	TIA Portal Education Edition	Siemens	1	set
		HMI	Touch screen programming software			1	set
		Digital twin simulation software pc	1:1 digital real production line (running version)		Dolang	1	set
		Network software pc	SQL Server (Education Edition) HeidiSQL (Education Edition) Wireshark software C# or Java, Javascript			1	set
7	Computer		MES system Set computer	7080MT/I7/10700/8G/1T+256G nvme high-speed solid state/730 4G/21.5 display/dual network card	Dell	1	set
			Virtual simulation set computer	i7-9700/16G/256G solid state/GTX1660S/6G	Dell	1	set
8	Others	Toolkit		Inner hexagon, slotted, Phillips screwdriver, etc.	Dolang	1	set
		Computer Desk	Steel-wood structure		Dolang	2	pcs
		materials	Box, red		Dolang	5	set
			Box, yellow		Dolang	5	set
			Packing box, blue		Dolang	5	set
			Bookmarks (red, yellow, blue)		Dolang	15	pc
		tray		POM material	Dolang	4	set
		Wireless Router	TL-WAR308		Chinese	1	pc
		education resources	user's manual	Backup to U Disk	Dolang	1	pc
			Sample program	Backup to U Disk	Dolang	1	set
9	Optional parts	surveillance system	Camera	2 million starlight	HIKVision	1	set

			hard disk	2T	HIKVision	1	set
			VCR		HIKVision	1	set
		Visualization terminal	Display screen	40 inch	Branded	1	pc
			TV stand		Branded	1	pc
			HD line	5M	Branded	1	pc
		Energy monitoring	Energy Management Module	Air source + power supply	Branded	1	set

VI. Training projects

1. MOUDLEBUS communication between PLC and RFID;

2. Profinet communication between PLC and PLC;

3. Communication between MES and PLC;

4. Application of HMI and stepping;

5. Application of bus communication technology;

6. Application of industrial automation network;

7. Application of PLC technology;

8. Application of motor drive technology;

9. Application of motion control system;

10. Digital 3D model construction and layout;

11. PLC virtual debugging;

12. 3D digital production line layout;

13. Mechatronics collaborative simulation: mechanical interference, mechanism kinematics verification, mechanism dynamics verification;

14. Application of MES system.

15.SQL database application

16.Heidi SQL data application

17. Wireshark software technology application

18. RFID application technology

19. Network security technology: network planning, network wiring, firewall, gateway settings, etc.

20. Logistics Technology

21. Internet of Things Technology

22. APP development and application technology

23. Web Development and Application

24. C# or Java, Javascript software application