

Design of Automatic Packaging and Palletizing Line Control System for Shoes Products Based on PLC

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Abstract

In order to improve the footwear products packaging, transportation and warehouse stacking efficiency, enterprise production efficiency, and reduce labor intensity, according to the process of automatic packaging palletizing production line and the characteristics of simple operation, stable operation and convenient maintenance of automatic production line, we design a control system of automatic packing and palletizing line based on PLC. SIEMENS PLC S7-300 CPU315-2DP and digital input SM321, digital output SM322 and other modules are adopted as the control system core to realize the automatic control of the packaging production line. The upper computer adopts MT8150iE touch screen to monitor and control the running state of the whole packaging production line. On the basis of the hardware selection, the main program and man-machine interface of the control system is programmed to successfully realize the high-speed and stable operation of the production line. The results show that the control system has the advantages of strong stability, low cost and programmable ability, which greatly improves the efficiency of packaging, transportation and palletizing, and significantly improves the degree of enterprise automation.

Keywords

Automatic packaging palletizing production line; PLC; touch screen; PC.

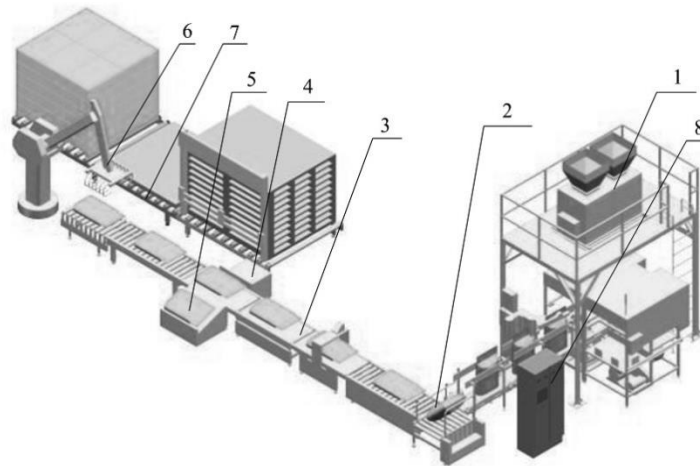
1. Introduction

With the continuous development of modern industrial automation technology, the production equipment in enterprises has gradually become a collection of machines, electricity, instruments, etc. Manual work has gradually been replaced by highly automated control. Packaging, transportation and palletizing of footwear products can not be separated from automated packaging machinery. At present, the advanced technology of the automatic packaging is mainly in the hands of a few developed countries, and domestic automatic packing and palletizing equipment mainly rely on imports of foreign equipment. Because of high cost, difficult maintenance, all kinds of advanced technology monopolized in domestic, therefore, the domestic demand for fully automatic packaging production line is urgent. With the continuous development of China's economy, the study of automatic palletizing line has great economic significance and practical significance. Automatic packing and palletizing line is a high-tech equipment, that integrates mechanical and electrical technology. It is mainly to realize automation of packaging in the process of unpacking, loading, conveying, elimination, sealing, coding, printing, product testing, product transfer, palletizing, pallet and palletizing, etc...

The programmable controller (PLC) has the advantages of strong anti-interference ability, high scalability, high reliability, programmable ability, so it is widely used in the field of industrial control in a relatively harsh environment. This paper proposes a control system of PLC automatic packing and palletizing line, adopted SIEMENS S7-300 and MT8150iE touch screen as the core of the control system, which complete the automatic control and monitoring of the whole production line.

2. Hardware design of control system

The basic composition of automatic packaging palletizing line is shown in Figure 1. Automatic packaging palletizing production line can automatically complete the work tasks of unpacking, loading, conveying, elimination, sealing, coding, printing, product testing, product transfer, palletizing, pallet and palletizing. The main mechanical systems in packaging palletizing production line include automatic unpacking system, automatic loading system, conveying system, elimination system, automatic sealing system, palletizing system, pallet conveying system, etc.



1. Unpacking equipment 2. Loading equipment 3. Transfer device 4. Sealing device
5. Rejecting device 6. Robot Palletizer 7. Pallet conveyor 8. Control cabinet

Figure 1 Basic composition of automatic packaging palletizing line

In the process of automatic palletizing and packaging, the operations are more complex, and the working environment is also bad. The automatic palletizing and palletizing production line control system based on PLC has many advantages, for example simple structure, fast running speed, high stability and strong expansibility, etc.. According to the technological process of the production line, the control system should meet the following requirements:

Each process can coordinate the whole control system, so that the automatic production line can run stably, reliably and at high speed.

The program is flexible, and can adjust the running program at any time according to different operation requirements.

The control system has the high real-time performance and good dynamic response, and can collect all kinds of sensor signals at any time, then can timely feedback.

High reliability, safety and stability.

The user-friendly man-machine interface is convenient for workers to operate and monitor.

The hardware structure is compact, and has late scalability.

According to the packaging process, this paper adopts the "HMI+PLC" control mode, the overall block diagram of the control system as shown in figure 2. PLC controller is used as the bridge between touch screen and signal sensors, and the touch screen is connected with each signal closely. Therefore, the touch screen, PLC, I/O input and output modules are combined together to form the automatic packaging palletizing production line control system.

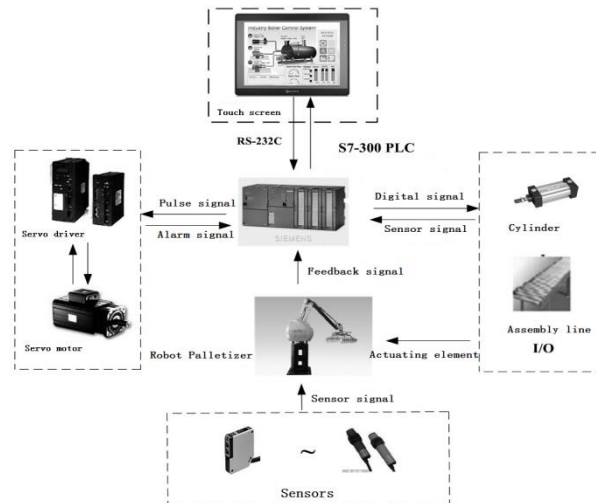


Figure 2 Hardware block diagram of control system based on S7-300

2.1 Touch Screen

Touch screen, referred to as HMI, is the direct medium to control the packaging machine. Because the working environment of the production line is complex and harsh, in order to ensure the equipment can be stable and reliable operation in complex working environment, the host computer selects the MT8150iE series touch screen in the control system. Through the touch screen, the packaging speed, conveyor speed and other parameters can be realized to input into the control system, and the production status of the production line can be displayed in real time. MT8150iE series touch screen has multiple serial ports (RS-232/RS-485), which can communicate with the different lower machines at the same time. They have 400 MHz-32 bit RISC processing speed, 24VDC input power, to achieve 1 minutes of 500VAC ultra high voltage.

2.2 PLC

According to the main functions of the control system, the modular PLC is selected. The main components are CPU module, power module and basic I/O module. When the control system need be extended, the corresponding functional modules are only added on the original system to realize the added function. The design cost is low and the efficiency is high.

PLC is the core of the whole control system. The packaging production line has many complex actions, and there are more I/O points in the production line. After comprehensive analysis, the system selects SIEMENS PLC S7-300 series. The PLC has many functions and fast operation speed, and can be configured according to different requirements of the production line. On the basis of analyzing the process flow of the whole packing palletizing line, the CPU315-2DP in S7-300 series is selected. The production line mainly includes two parts: automatic packaging system and automatic palletizing system. According to the action analysis of the packaging process, the packaging and palletizing parts need about 60 input points and 50 output points. So the input module SM321 and the digital output module SM322 are selected.

3. Software design of control system

3.1 Software design of upper computer

The touch screen program in Upper computer can realize the communication between operator and PLC, realize the switch between different man-machine interface, and different operations can control different programs in PLC. The touch screen can display the operation information, alarm information and control signals in the form of text or image to the users of the palletizing and palletizing line. The program structure design of touch screen not only affects the beauty of human-computer interface, but also has an important impact on the stable and reliable operation of the whole system. The MT8150iE series touch screens are simulated off-line and online by EasyBuilder8000 programming software, which greatly facilitates the debugging of the program. The touch screen

software program mainly includes three parts: main control interface, parameter setting interface and monitoring. The main control interface mainly includes start button, stop button, automatic mode and manual mode, the main control interface as shown in Figure 3. The parameter setting interface is shown in Figure 4.



Figure 3 Main control interface



Figure 4 Parameter setting interface

The alarm screen mainly displays the alarm information in the production line. In combination with the alarm information in the screen, the workers of the production line can find faults and eliminate the faults in time, so as to ensure the normal production of the production line.

3.2 Program design of lower computer

The logic control program of automatic packaging palletizing production line mainly includes the following modules: automatic feeding-box procedures, automatic taking-box procedures, automatic opening-box procedures, automatic loading procedures, automatic sealing procedures, automatic labeling procedures and procedures for stratified stacking, etc.. The flow chart of automatic taking-box program is introduced here. The box is transmitted to the pallet by the transmission device. When the sensor detects the box, the box will be clamped by the fixture. The transverse transmission device is in taking-box position of the production line. When the limit switch detects the position signal, then the transverse transmission device stops dropping. At the same time, the kowtow device will tilt, then the vacuum solenoid valve starts and the box is clamped, then the kowtow device erects. The oblique pallet is lifted to complete the taking-box operation, then the system repeats the same action again. The flow chart of automatic taking-box is shown in figure 5.

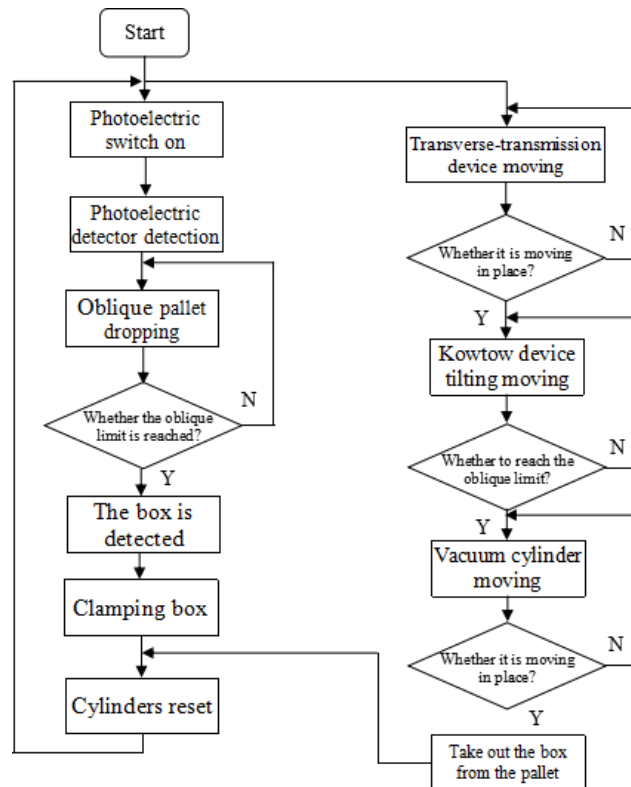


Figure 5 Automatic box drawing flow chart

4. Conclusion

In order to improve the automation level of packaging palletizing production line, improve the production efficiency and reduce the labor intensity of workers, a control system of automatic palletizing and palletizing production line based on PLC is put forward. The upper computer adopts S7-300 series CPU315-2DP and digital input SM321, digital output SM322 and other modules to realize the automatic control of the packaging production line. The upper computer adopts MT8150iE touch screen to monitor and control the running state of the whole packaging production line. On the basis of hardware selection, the main program of the control system and the human-computer interaction interface are programmed. The control system has strong stability, low cost and strong programmable ability, which greatly improves the efficiency of packaging, transportation and palletizing, and significantly improves the degree of automation of enterprises.

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