

# The Design of Material Conveying and Automatic Sorting Control System Based on PLC

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## Abstract

The automatic sorting technology is widely used in all walks of life, such as logistics distribution centers, post offices, mining, port, etc. It can replace humans to do a lot of monotonous reciprocating or high-precision work. In order to liberate people's hands to do more challenging and innovative work and greatly improve work efficiency. This design uses programmable logic controller PLC and configuration software to design an automatic sorting control system. The PLC and MCGS present a friendly man-machine interface and powerful data management functions. The simulation results show that the system has high sorting efficiency and stable performance.

*Keywords:* automatic sorting, PLC, MCGS

## 1. Introduction

Before the emergence of automatic material sorting control system, the traditional logistics transportation basically relies on manual labor to carry goods. The traditional logistics transport of goods is slow, costs a lot of labor, and the accuracy of sorting goods is very low, but also brings huge labor costs to the enterprise. Now, with the advent of a variety of conveyor equipment, the entire conveyor system requires only a few people to ensure the normal operation of the entire system, which reduces the impact of manual sorting operations and effectively improves the sorting accuracy, so that enterprises reduce a lot of extra costs.

In this paper, a kind of automatic material sorting control system controlled by PLC is proposed. The automatic sorting control system uses Siemens PLC as the control device. A motor is used to drive the conveyor belt to rotate as a conveying device. Sensors are used to detect the material or color of the object, and send out signals. Receiving these signals, PLC controls the whole system based on those signals, then the system accomplishes the sorting of different materials or different colors of the

block. Through running the system several times to detect objects of different materials, the results show that the automatic sorting system has the characteristics of high accuracy, high stability and high practicability. This system can also be replaced with corresponding sensors to sort objects of different colors.

## 2. System design

### 2.1. Hardware selection

The Siemens minicomputer S7-200CPU226 contains 2,048 storage units, 24 inputs and 16 outputs. In addition, it can be connected to 7 expansion modules, which can be extended to 248 digital I/O points or 35 analog I/O points.

The control requirements of the system include four sensors (one inductive proximity sensor, two photosensitive sensors and one color sensor), four in-place signals (materials 1, materials 2, materials 5, materials 6) and four switching signals, altogether 12 signals. The output signals include the movement of two conveyor belts, the movement of four pushrods, and a total of 18 signals are input and output. According to the I/O points, selecting

a general minicomputer can meet the control requirements of the system, so the PLC of the system is S7-200CPU226. The address distribution table of PLC input and output in material sorting system is shown in Table 1 and Table 2.

Table 1 PLC input address distribution table

	address	function
input	I0.0	start
	I0.1	stop
	I0.2	inductive proximity sensor
	I0.3	light-sensitive sensor
	I0.4	material 5
	I0.5	material 6
	I2.0	start 1
	I2.1	stop 1
	I2.2	color sensor
	I2.3	light-sensitive sensor 1
	I2.4	material 1
	I2.5	material 2

Table 2 PLC output address distribution table

	address	function
output	Q0.1	pushrod 1
	Q0.2	pushrod 2
	Q0.0	belt
	Q0.3	pushrod 3
	Q0.4	pushrod 4
	Q0.5	belt 1

### 2.2. Introduction to MCGS

MCGS<sup>1</sup> is a kind of configuration software system that can quickly construct and generate upper computer monitoring system, which mainly completes field data collection and monitoring, front-end data processing and control. It can be run on a variety of platforms, and then presented to the user in a variety of ways (way: animation display, report display, etc.) by collection and processing of field data, to facilitate users clearly know where the problem is, timely treatment of the problem. It is widely used in the field of industrial control.

In this paper, PLC and MCGS are combined and communicated, and the configuration screen of automatic sorting system is simulated, so that users can understand the control process of the system more easily.

### 2.3. The overall structure of the system

The material sorting control system consists of two production lines, each of which includes a conveying module, a feeding module and a sorting module<sup>2,3</sup>. Production line 1 sorts objects according to their materials.

The transmission module is composed of a linear conveyor belt driven by a DC motor. The blanking module is composed of a blanking trough. The sorting module consists of a push rod, a light-sensitive sensor, and an inductive proximity sensor. Production line 2 is to sort objects according to color, and the conveying module is composed of a straight conveyor belt driven by a DC motor. The blanking module is composed of a blanking trough. The sorting module consists of a push rod, a photosensitive sensor, and a color sensor. The structure diagram of the material sorting system is shown in Fig.1 and Fig.2.

The process of production line 1 in material conveying and automatic sorting system is as follows. The first step is to put objects of different materials into the hopper, and the conveyor belt motor drives the conveyor belt to rotate. The second step, the object is successively pushed onto the conveyor belt. When the object approaches sensor 1, the inductive proximity sensor quickly detects whether the material of the object block is iron. The third step, after the detection is completed, the conveyor belt carries the object to the corresponding position of the push rod. Finally, the corresponding putter moves quickly to push the block out of the conveyor belt. After the conveyor belt idles for 1min, the conveyor belt motor stops running. The flow chart of production line 1 is shown in Fig.3.

The process of production line 2 is as follows. The first step is to put objects of different colors into the hopper, and the conveyor belt motor drives the conveyor belt to rotate. In the second step, the objects are pushed onto the conveyor belt in turn. When the object approaches sensor 3, the color sensor quickly detects whether the block of color is red or not. The third step, after the detection is completed, the conveyor belt carries the object to the corresponding position of the push rod. Finally, the corresponding putter moves quickly to push the block out of the conveyor belt. After the conveyor belt idles for 1min, the conveyor belt motor stops running.

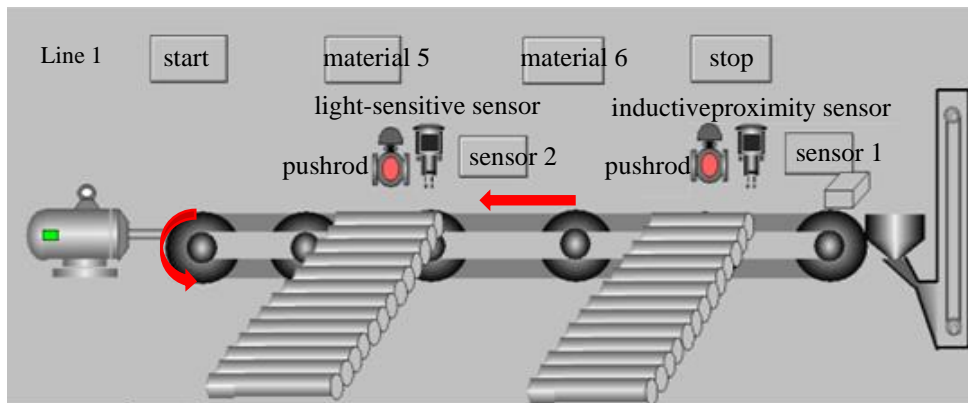


Fig.1. Simulation of sorting objects by material

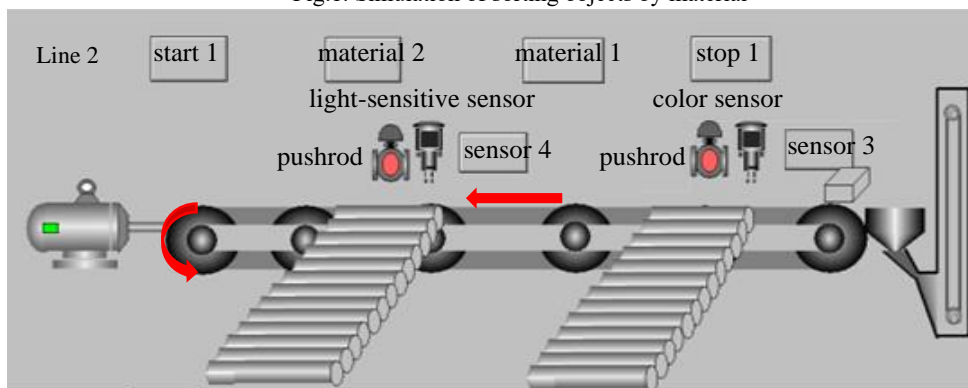


Fig.2. Simulation of sorting objects by colors

### 3. Results

To reflect the state change of simulation through the graphics in the monitoring screen, PLC and MCGS need to establish a communication interface through the device window. MCGS relies on the device window to establish a connection channel with the PLC, which can read external data and send data to the outside, and realize system monitoring. The following are the steps to design the connection between PLC and MCGS. The first step is to add "Siemens S7-200-PPI Universal Serial Port Parent Device" in the device toolbox. The second step is to edit the device properties under the universal serial port parent device. Acquisition optimization is 0-no optimization. The device name is device 0. The device annotation is Siemens\_S7200PPI. The initial working state is 1-start. The minimum acquisition period is 1000ms. The device address is 2. The communication waiting time is 500ms. The number of fast acquisitions is 0. The data collection method is 0-block collection. The third step, by increasing

the equipment channels of PLC and MCGS, and connecting the channels, the data between PLC and MCGS can be connected correspondingly.

In this paper, PLC is used to complete the control of the whole system module, and the MCGS software is used as the input control tool, to realize the automatic sorting of objects of different materials or different colors. The simulation results show that the system has high sorting accuracy, stable operation and high sorting efficiency.

### 4. Conclusion

The automatic material sorting system is based on Siemens S7-200CPU226 PLC as the control device, the system is mainly composed of a transmission module, a feeding module, and a sorting module. Each module is a small electromechanical system based on pneumatic devices as the execution unit, and a variety of sensors are installed throughout the system to provide signals such as the location, material and color of the objects. However, the automatic material sorting system has certain requirements

on material packaging and material color, which is also a problem to be solved in future research work.

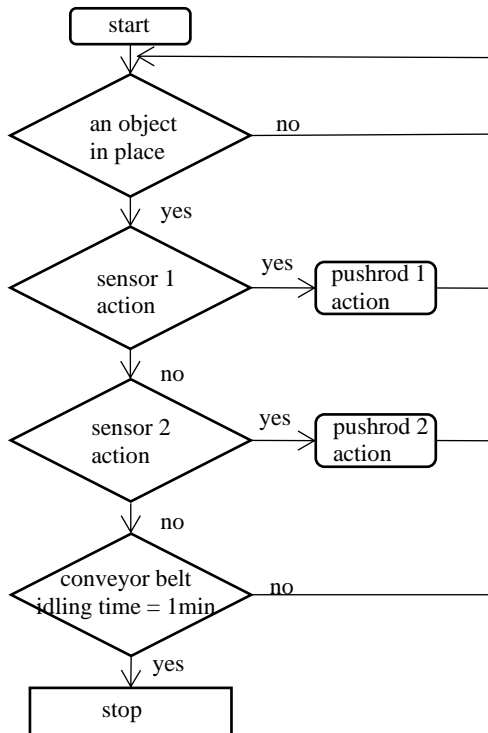


Fig.3. The flow chart of production line 1

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