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Design of Control System for Industrial Defective Product Sorting Station Based on IOT2050

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Abstract: *Aiming at the problems of many types of abnormal states in industrial defective sorting stations, long time consuming analysis of abnormal causes, and untimely equipment monitoring, the control system of industrial defective sorting stations based on IOT2050 is designed. With Siemens PLC-1200 as the main body, combined with TIA Portal and IOT2050, it realizes the design of software and hardware configuration, programming, WinCC screen and industrial cloud platform of industrial defective sorting station control system. The simulation results show that the system runs stably, realizes automatic production operation and data monitoring, and is of great significance to ensure the reliable operation of equipment.*

Keywords: *TIA portal; IOT2050; WinCC; Industrial cloud platform; Sorting stations*

1. Introduction

With the "German industry 4.0" concept and the "Made in China 2025" plan, intelligent manufacturing has become a major trend in the development of the world's manufacturing industry, artificial intelligence, industrial cloud platform, big data analysis, intelligent gateway computing and other technologies are increasingly mature [1]. At this stage, the factory equipment is inefficient, the work is unstable, and the maintenance system time is long, the maintenance equipment cost is high and other problems are becoming increasingly obvious, so it is necessary to upgrade the equipment intelligently [2]. In order to improve the performance development of the control system and realize the intelligent application of the control system, the control system is simulated and debugged with the help of the virtual simulation environment, and the simulation results are verified.

2. Design of control system function

After the feeding point sensor of the industrial defective sorting station system detects the material, the motor rotates forward, and the synchronous belt conveying component moves from the initial position to the right position, and when the height detection point detects the material, the motor stops and detects the height of the material. After the detection is completed, the motor continues to rotate forward, the material continues to move to the right side of the handling, and when it reaches the right position of handling, the motor stops. In this case, different operations are performed according to the test results. If the material is unqualified, the discharge cylinder action discharges the material; If it is a qualified material, push the material to the next station cylinder action to complete the pushing. After the ejection action is completed, the system performs a zeroing operation.

System modes include auto-run mode, step-in mode, and zero-back mode. When the system selects the auto-run mode, the system will automatically perform the sorting of defective goods. When the system selects the step operation mode, the system performs a step-in sorting operation each time the step run button is pressed. When the system is started for the first time or the system has completed a round of defective sorting, the system will enter zero-back mode, at which point all components of the system will return to the initial handling position.

3. Design of control hardware function

The control system hardware includes power supply, PC (host computer), I/O signal board, IOT2050 intelligent gateway, PLC controller SIMATIC S7 1200, communication module and various product

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components of the defective sorting station, of which the PLC controller adopts Siemens SIMATIC S7 1200—CPU1214C DC/DC/DC—6ES7-214-1AG40-0XB0—version number V4.2, the device has powerful command and system control functions; the communication system design uses intelligent gateway IOT2050, the model is selected as 6ES7647-0BA00-1YA2, the gateway has a display port, an SD card slot, two USB 2.0 sockets and two GB Ethernet ports, is a new generation of industrial Internet of Things intelligent gateway [3]. Figure 1 shows the control system diagram.

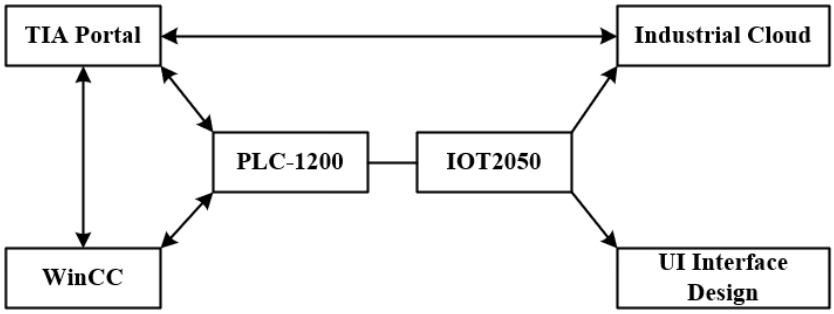

Figure 1. Control system

4. Design of control software function

4.1 I/O Address assignment

The control system adopts the mode of I/O communication [4], and the distribution of I/O points is as follows: 14 I points (input points), which are I0.0~I1.3, and the input point allocation table is shown in Table 1. There are 7 Q points (output points), which are Q0.0~Q0.6, and the output point allocation table is shown in Table 2.

Table 1. Allocation of system input point

Input	Explanation
I0.0	Auto-run/Step-in
I0.1	Auto-run
I0.2	Step-in
I0.3	Emergency stop
I0.4	the initial state
I0.5	the right state
I0.6	Feeding available
I0.7	Height detection available
I0.8	Discharge cylinder in
I0.9	Discharge cylinder out
I1.0	Lifting cylinder up
I1.1	Lifting cylinder down
I1.2	Transport cylinder in
I1.3	Transport cylinder out

Table 2. Allocation of system output point

Output	Explanation
Q0.0	Autorun indication
Q0.1	Drive motor energy
Q0.2	Drive motor direction
Q0.3	Discharge cylinder
Q0.4	Lifting cylinder
Q0.5	Transport coil in
Q0.6	Transport coil out

ISSN 2522-3488 Vol. 7, Issue 4: 17-22, DOI: 10.25236/IJNDES.2023.070404

4.2 Main program flow

The control system program is designed according to the sequential logic structure, and the logic control is carried out by executing the MOVE program block. Figure 2 shows the main program flow chart of the control system.

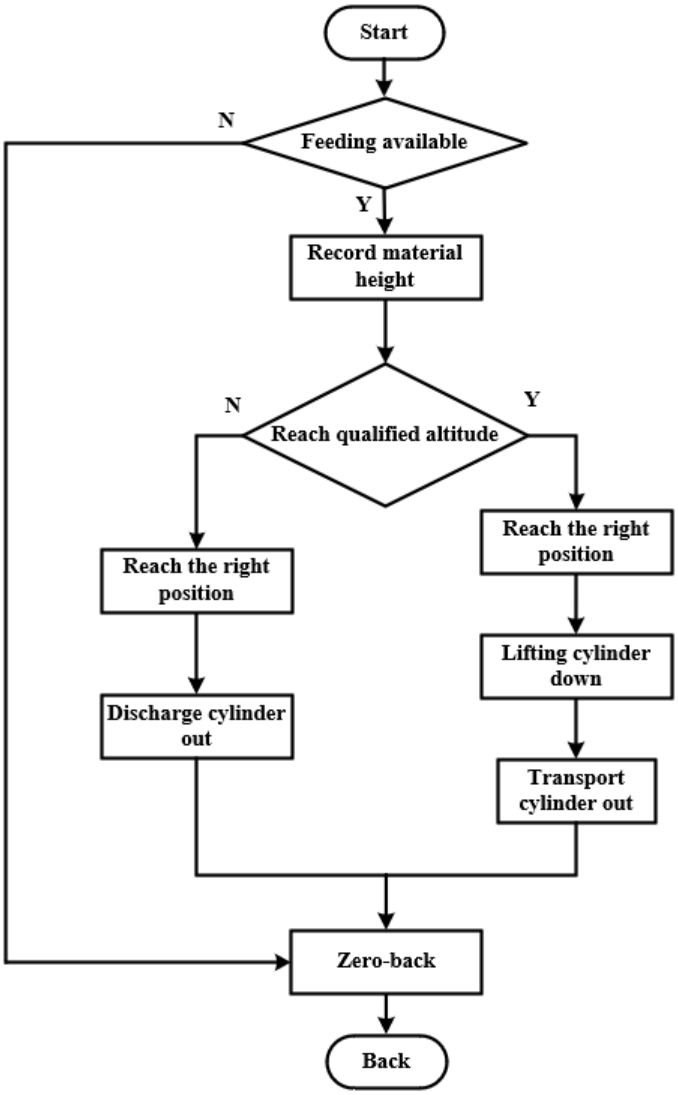

Figure 2. Main program flow

4.3 WinCC design

This design uses Protal WinCC Advanced V15.1 to draw the system model and various signal indicators. At the same time, the input window of the standard height value of the material is set and the total quantity of the current work, the number of qualified products, the number of non-conforming products and the measured height value are displayed. Figure 3 is the system WinCC monitoring screen design, at this time the system is in the initial state, set the material standard height to 10mm.

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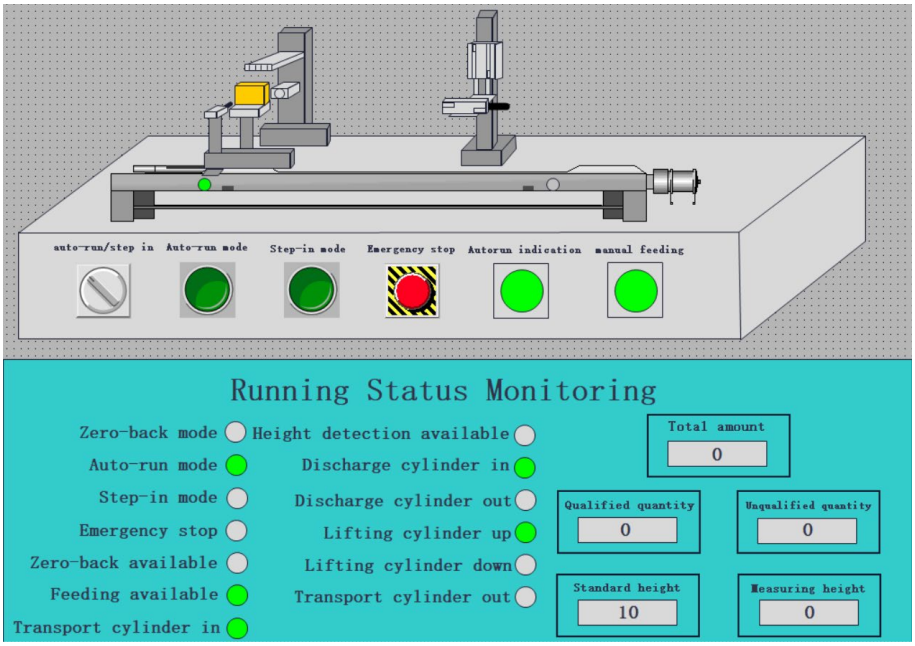

Figure 3. Monitoring screen of System WinCC

4.4 Communication between the PLC and WinCC

Complete the system communication settings through the S7-ONLINE node, select the application access point (A) as S7-ONLINE (STEP 7) in the "Control Panel—Setting PG/PC Interface", and select Realtek PCIe GBE Family Controller. TCPIP.1 in the interface allocation parameter (P). Select "DB block → properties→ deselect optimized block access" in the system program, and check "Allow PUT/GET communication access from remote objects" on the PLC properties page, Figure 4 is the network configuration diagram of the control system.

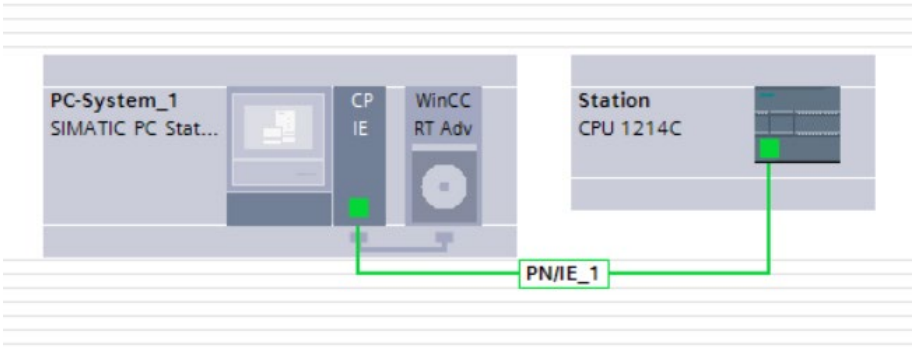

Figure 4. Control system network configuration

5. Design of control software function

5.1 Requirements analysis

The control system needs to be connected with the IOT2050 intelligent gateway, collect key data of the system, upload it to the industrial cloud platform in real time, and design relevant UI pages to visually present the important data of the system. By displaying the system operation status in real time, users can understand whether the current data of the system is normal. If the data is abnormal, users need to analyze the problem to see if there is a problem with the production module or with the network configuration. By locating error data, the cause of problems could be found out and the industrial productivity could also be improved.

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5.2 Construction of industrial cloud platform

The industrial cloud platform includes cloud servers, various types of equipment on site, IOT2050 intelligent gateways, various clients [5]. And data transmission between them. IOT2050 collects data from the field PLC and actively sends it to the configured cloud server, and can also obtain instructions from the cloud server and send them to field devices such as PLCs. Through the Node-RED design UI page in IOT2050, the device operation status and operation data can be monitored in real time. Figure 5 shows the Node-RED data flow of the system industrial cloud platform.

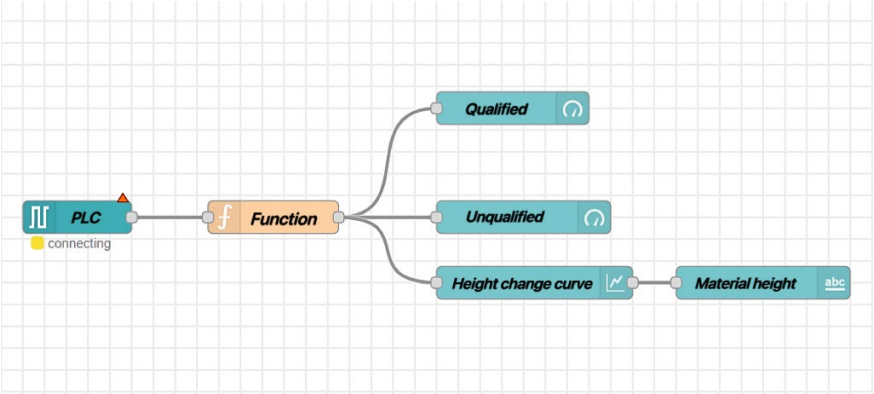

Figure 5. Node-RED data flow

6. Debugging and analysis of the control system

Before the system starts, the standard height is set to 10mm. After the system is initialized, the zero mode indicator lights up and the motor is spinning. After initialization is complete, the automatic mode indicator lights up and the system starts running automatically. The system motor carries the animal material to the height detection point, and the material indicator lights up at the height detection point. The system detects the height of the material, the WinCC screen shows that the current material height is 10mm, judged to be a qualified product, at this time the material continues to advance to the right position, the lifting cylinder drives the pusher to the next station cylinder down and completes the pushing, at this time the lifting cylinder falls indicator and pushes to the next station cylinder extension status indicator light up. After the ejection is completed, the system enters the zero return mode, pushes to the next station the cylinder retraction status indicator and the lifting cylinder rise indicator light up at the same time, each component returns to the initial position, and the system completes a running cycle. Figure 6 shows the WinCC screen after the system pushes the material.

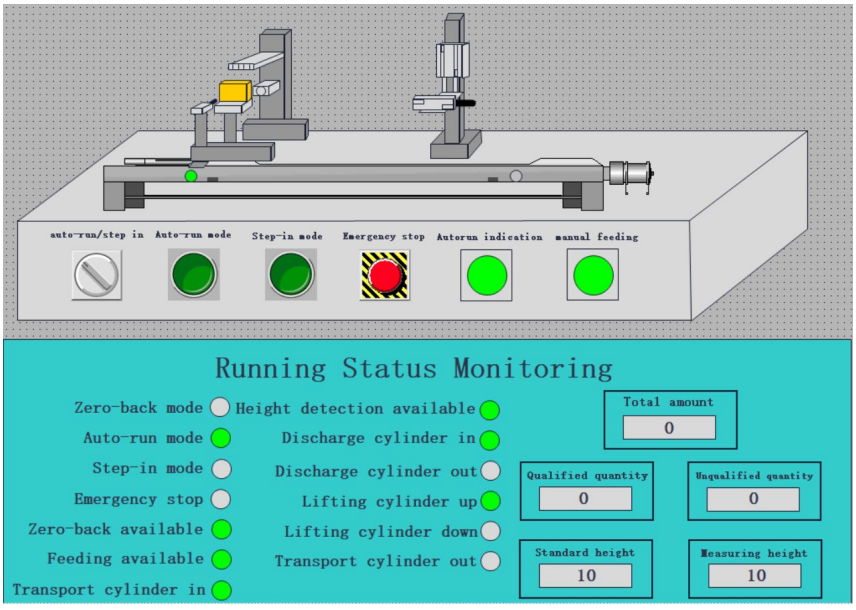

Figure 6. Monitoring screen of WinCC running status

ISSN 2522-3488 Vol. 7, Issue 4: 17-22, DOI: 10.25236/IJNDES.2023.070404

During system operation, the IOT2050 intelligent gateway uploads the collected PLC data to the industrial cloud platform, and displays the system operation trend in real time through the UI interface [6]. Engineers can calculate the operating efficiency of the system more accurately through the information of the UI interface, so as to debug and upgrade the system. Figure 7 shows the UI interface of the total number of qualified/unqualified materials in the system, at this time, the number of qualified materials handled by the system is 38, and the number of unqualified materials is 2.

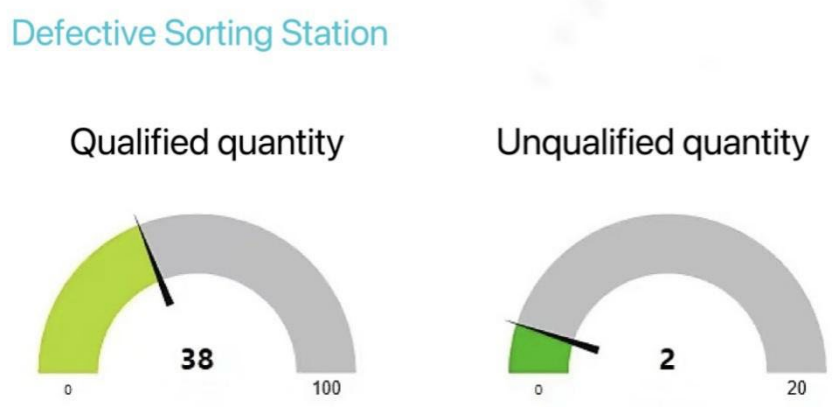

Figure 7. UI interface of the control system

7. Conclusion

This design adopts Siemens PLC-1200 and IOT2050 to realize the simulation of industrial defective sorting station system, through Siemens PLC-1200 connected to IOT2050 intelligent gateway, upload system data to the industrial cloud platform, apply WinCC and Node-RED visual development advantages, realize the visual management of the control system, can reduce the probability of major failures in the system, improve industrial production efficiency, the control system has guiding significance in practical applications.

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