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Original Article

NEXT-LEVEL EFFICIENCY: DEVELOPING ADVANCED CONTROL SYSTEMS FOR AUTOMOBILE CONNECTOR ASSEMBLY

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Abstract: Automobile connector plays a very important role in the safe operation of the automobile. This paper, on the basis of the automatic assembly device of the automobile connector, analyzes and discusses the program control and interface design of the automatic assembly device, so that the automatic assembly device can be better operated. Close collaboration often requires a wide variety of parts, in which car connectors play an important role. Whether it is traditional cars or new energy vehicles, in the analysis of traffic accidents, we have found that many traffic accidents are caused by poor connector contact. Therefore, an automatic assembly device of the automobile connector is designed. The detailed design of the assembly device is introduced in other papers, and the program control and interface design of the device are introduced.

Keywords: automotive connector; automatic assembly device; program control and interface design

1. Introduction

The program design of automatic control system of automobile power connector assembly device will be able to solve the low level of automation and the low efficiency of fault detection mechanism. Through the application of intelligent control and monitoring system, manual labor can be freed from heavy and repetitive physical labor. The use of highly automated assembly equipment can not only improve production efficiency, but also greatly improve product quality. This article mainly from the program design, proposed the automobile connector design plan, the automatic assembly greatly enhances the production efficiency.

2. Overview of the automatic assembly device of the automobile connection

It is understood that part of the modern enterprises still use manual workpiece assembly and plug method for detection, this way is long and may because of the fatigue of the human body test is not accurate, low production efficiency, product quality is not guaranteed, so according to the requirements of the enterprise manufacturing corresponding automation equipment has become the of The Times.

High-level automated assembly lines originated from foreign countries that developed earlier and accumulated a large number of mechanical and electrical control technology. A typical example is German Benz, whose automatic production line has a very high technical level and a very high degree automation. Mercedes-Benz has implemented modern control and design in every important assembly process, using advanced sensing technology and industrial aesthetics. Mercedes-Benz's long accumulation and continuous research and development have made it a world leading position in the of automation.

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However, such large production lines similar to automobile assembly lines are very different from automated assembly of small parts. Especially in recent years, with the rise of the information and electrical industry in the world, various small industrial products have entered people's vision. The consumption and update speed of this product are very fast, so the use of automatic assembly to improve the consumer field is an important direction. And only the efficiency improvement is not enough, small industrial consumer goods are generally composed of more small parts, how to assemble these small parts together is a big difficulty. Unlike large production lines, such miniaturized assembly equipment needs to consider many practical factors. For example, a professor at the of Tokyo in Japan has developed an automated assembly technology for small parts, which combines many small parts together for [1] by using the "self-organization" of the parts.

Now all countries are aware of the importance of automated assembly lines for the development of national manufacturing industries, and they invest a lot of resources in the development and application of new technologies every year. For China, because our industrial research is relatively late compared with the developed countries, in the field of automatic assembly line and precision processing are in the exploratory stage. At present, although China started relatively late, but driven by the rapid development of China's economy, China's automatic assembly technology has also made a great improvement, and in recent years, the development speed has gradually accelerated. For example, in the production process of Shenlong Fukang car in China, automatic production and automatic assembly lines have been used a lot of use. Many scientific research institutes have also made a lot of research on robot flexible automation. For these technologies, we introduce more, really designed and developed by ourselves, and have few things with independent intellectual property rights. At present, the automatic assembly technology has been developing rapidly in the field of large equipment assembly in China, but the assembly process and technology of small products and small equipment are very lacking. Therefore, we should accelerate the research and application of related technologies, and promote the common development of [2] of automatic assembly in multiple fields.

3. Design of the PLC control program

PLC is short for programmable controller and is widely used in the industrial control field of [3]. In order to standardize the control language and basic elements of programmable controllers, the International Electrotechnical Commission (IEC) has issued the international standard IEC61131-3 [4]. This standard proposes five charts of functional block diagram, ladder chart, instruction sheet, structured text and sequential functional diagram for developers. The program control of the automatic assembly device involved in this paper belongs to motion control, which is that the control process is divided into several steps, each step works in order, and one step is working [5]. The PLC needs to allocate the I / O, divide a line from the main circuit to power the PLC, 24VDC to supply power to the input point, and connect the input point R000-R011 with the emergency stop signal. The equipment is powered by air pressure transmission. Access the pressure switch to detect the air pressure. Two alternate selectors are used for hand / automatic switching. Access the PBL4 automatic button and run the machine automatically when the debugging is completed. Other access to stop button, reset button and material cleaning button respectively.

When each part of the device reaches the origin and moving point, the sensor sends the input signal to the PLC, and the PLC controls the on and break of the solenoid valve to control the cylinder to move the equipment. The specific I / O assignments of the PLC are shown in Table 1, 2 below.

Table 1: The PLC Input

	input		
address	annotation	address	annotation
R110	HSGDislocated origin	R1000	S/RClaw origin

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R111	HSGDislocated dynamic point	R1001	S/RClaw moving point
R112	HSGClaw origin	R1002	S/RLift origin
R113	HSGClaw moving point	R1003	S/RLift moving point
R114	HSGClaw origin	R1004	S/RTransitional origin
R115	HSGPony moving point	R1005	S/RHorizontal moving point
R200	S/RDislocated origin	R1006	S/RPress into the origin
R201	S/RDislocated dynamic point	R1007	S/RPush into the moving point

Table 2: The PLC Outputs

	output		
address	annotation	address	annotation
R5000	HSGDislocated forward valve(A)	R5009	S/RDislocated back valve(B)
R5001	HSGDislocated back valve(B)	R5010	S/RClaw valve
R5002	Claw extension valve	R5011	S/RLift valve
R5004	Cradle forward valve(A)	R5012	S/RTranslational forward valve(A)
R5005	Cradle back valve(B)	R5013	S/RTransstatic back valve(B)
R5008	S/RDislocated forward valve(A)	R5101	S/RPressure into the valve

4. Circular action design

In order to prevent the unstable machine operation caused by the instantaneous jitter of the cylinder sensor, the expression of the cylinder position must be determined by the coil of the solenoid valve and the input point of the sensor, increasing the delay and later expression. At the same time, in order to prevent the sensor failure of the origin and the moving point sensor of the cylinder in the running of the machine, the constant closing point of the moving point should be written in at the same time. The same reason goes for the expression of dynamic points. For the cylinder using a double-head valve, the expression of the position should be written in both the constant opening point of the electric coil and the constant closing point of the lost coil.

This action uses a single head valve, this solenoid valve is generally used in the cylinder retracted after the coil power off process, without interference with any other mechanism. When the claw is at the origin, the origin signal R112 closes, the claw cylinder closes, the timer starts, 0.2s after the paw moves to the action position, the moving point signal R113 closed solenoid valve action controls the cylinder signal closes, and the paw after 0.2s returns to the origin from the action position. S / R clip claw clip action, S / R lifting action, HSG positioning action, S / R pressing action and the same.The Claw stretch action procedure is shown in Figure 1.

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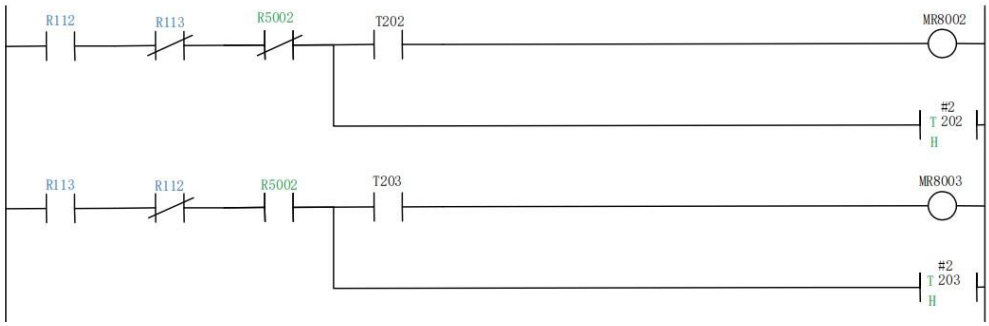

Figure 1: Claw extension action

For the cylinder using the double-head valve, the position expression should be written in both the constant opening point of the electric coil and the constant closing point of the lost coil. This solenoid valve is generally used in after the loss of power, may have interference with other institutions, such as dislocation, transverse movement, rotation, launch, material separation, etc. The main guarantee is that after the power loss, the cylinder can not move. Prevent the institutions from bumping in with each other.

When the claw is at the origin, the claw origin signal R114 closes, the solenoid valve electrical control cylinder B signal R5005 closing timer starts, when the 0.2s back claw action reaches the action position, the moving point signal R115 closes the solenoid valve action control cylinder A signal R5004 closes, after the 0.2s claw back to the origin. HSG dislocation action, S / R dislocation action, S / R horizontal movement for the same reason.The Claw Dialing Motion program is shown in Figure 2.

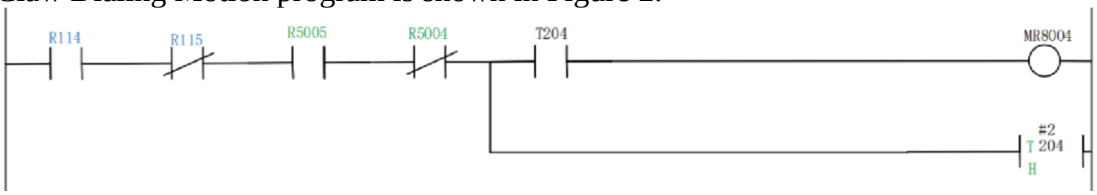

Figure 2: Claw dialing movement

5. Design of the cylinder drive

The MR4502 and the MR4503 are the mechanism interlock conditions for the cylinder to move forward and backward, which can be driven only when the conditions are met. This is the drive design of a single-head solenoid valve. The order of the machine boot requirements, need to power first, and then press the "run ready" button, and finally on the gas. The reason why the "operation preparation" button is to prevent the suction of the cylinder solenoid valve coil is unknown, resulting in the movement of the cylinder mechanism, resulting in mechanism collision or personal injury. And the first "run preparation" button, through the "run preparation" pulse MR001, the cylinder in the forward end, trigger the hold MR4003, the cylinder in the backward end, trigger the hold MR4002, so that the solenoid valve coil to maintain suction or maintain release. In this way, the cylinder mechanism will not move again. And one of the moving point and the origin of the next work station should have a signal to meet the operation conditions of the work station, and allow the work station to act. Other actions are all the same.The cylinder retraction procedure is shown in Figure 3. The cylinder extension program is shown in Figure 4.

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Figure 3: Pull back

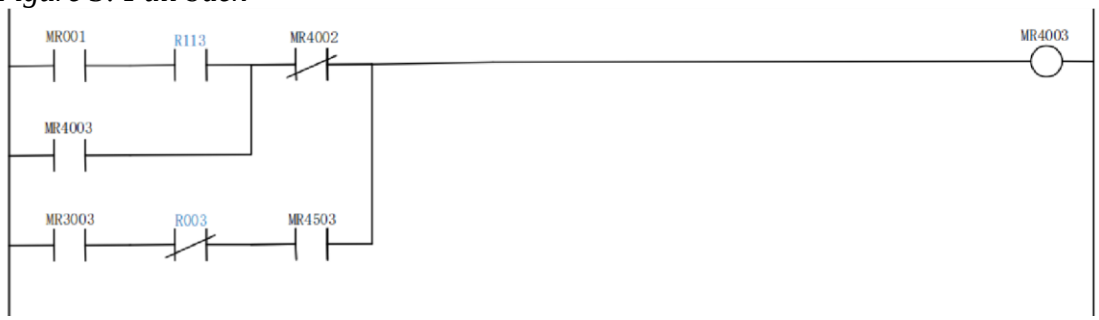

Figure 4: Claw forward

6. Automatic step and incoming material induction self-inspection of the single work Station

Take the pressure into the station as an example, other stations and the same. The start of each single work station requires some necessary conditions, such as "before processing", the mechanical origin of the work station, and the automatic step BIT0, etc. After starting, in addition to the failure of the station, it is necessary to complete the action of the station. Take the press entry station as an example, when the machine is in the running condition, the mechanical origin condition is satisfied, and the automatic step BIT0 is satisfied. The OK products of the current work station (ST3) are transported to the work station (ST4), and the MR2103 conditions are met, and the DM707 is placed in 4. Through the decoding of the DECO instructions, the MR31800 is closed to drive the pressure into the cylinder forward, and all the actuator actions behind it are in the same thing. When the product processing is completed, put 5 in the status word (DM1004) of the press station product, so that the status of the press station station product changes from "before processing" to "processing OK". Then according to the time sequence mechanism all back to the original, the action of the station is all completed.

DECO is a decoding instruction, through the application of this decoding instruction, you can achieve the value of DM707, then the corresponding first bit at the beginning of the MR31800 will be often closed. But the DECO instruction can decode 256 bits at a maximum, so the maximum value of the DM31800 is 255 (0-255).

Coming sensing self-inspection, its mechanism is the incoming induction fiber motionless, in the dislocation cylinder moving point, the incoming induction signal is often closed, in the dislocation cylinder wrong, in the incoming induction fiber dug a hole, so that the optical fiber perforated. Normally, at this time the material induction signal because there is no object occlusion, should be often open state. However, if the incoming sensor signal is normally closed, that means the sensor is abnormal and alarm.

Cylinder may occur a certain failure, in order to prevent the occurrence of failure, the need to carry out a certain alarm, the PLC system should have an alarm programming. Take the claw alarm as an example, other fault alarm and the same. When the solenoid coil R5002 is driven, the moving point sensor R113 is not sense, that is, the

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R113 has no signal input, or when the solenoid coil R5002 loses power, the origin sensor R112 has no signal input; or when the moving point origin sensor is on at the same time. In any one of these cases, the delay of a certain time, the specific time is subject to the stroke of the cylinder.

When the delay arrives, the machine alarm MR40114 action and self-lock. When the fault disappears, the MR41114 action is used to drive the reset button light flashing, prompting the operator to click the reset button and click the reset button, the MR42114 connects to disconnect the alarm MR40114, so that the alarm is lifted. It should be noted that the MR014 is converted from the input signal of the reset button and the constant closed point of the automatic run, because the failure must be reset after the automatic run disappears. For the cylinder driven by the double-head valve, it is necessary to add two constant closing points of the drive coil and the delay of the OFF, so as to prevent the failure of not driving the solenoid valve coil on the machine caused by the inaccurate position of the induction device.

7. Human-machine interface design

An interface is designed through the configuration software that can be operated directly on the touch screen. Can realize counting, electrical equipment start and stop, machine debugging, equipment alarm, screen switching and other functions. In the design of the configuration software, the PLC uses the KV-N60AT model as an example, and the VT STUDIO ver.6G configuration software matching with the PLC can be selected for the system design. Open VT STUDIO ver.6G software on the PC end, open a new project, and select VT models. Here we choose VT5 series, VT5-W07 model. After selecting VT models, select PLC models. We selected the KVNano series [KV-N *] species, determined after completion. Create the required screen after entering the main interface. Set the number, count the OK numbers and the NG numbers, and monitor the operation state. If the equipment is wrong to alarm, the alarm information. Whether each station has products is also clear at a glance. In addition, the machine has to debug the machine and monitor the production situation, so the design switch to switch the screen.The main screen is shown in figure 5.

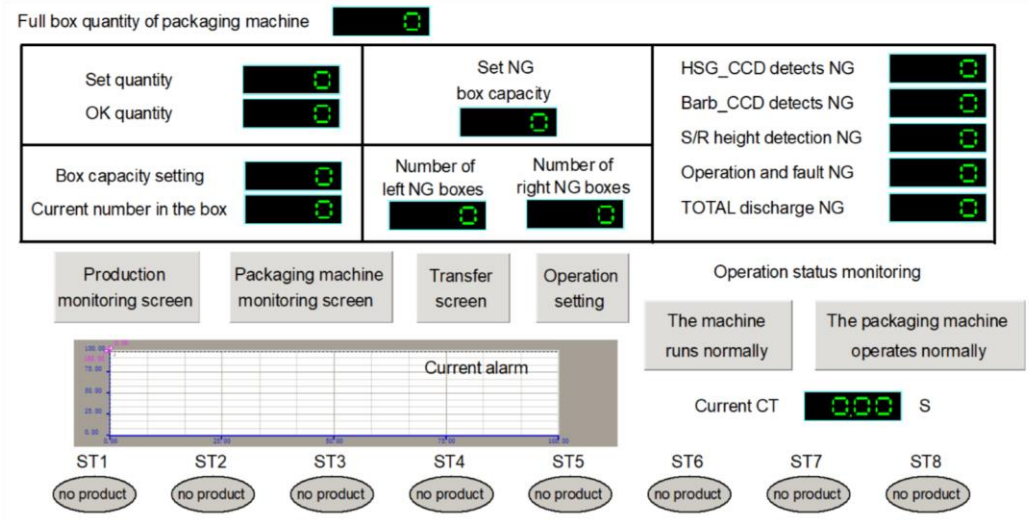

Figure 5: Main picture

Drag out the production monitoring screen switch, packaging machine monitoring screen switch, adjustment machine screen switch, operation setting switch from the software, the switch function is selected as the page switch, that is, click and jump to the interface. Corresponding ses the page number to the switched screen. The number setting of the main screen, box capacity setting and NG box number setting should associate the reference

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word soft original with the variables in the PLC program. Other values show that they all need to be linked together.

The production process needs to be monitored, so we also need to design the images used for the production monitoring screen, and the production monitoring screen can be set to jump through the switch. Jump to the production monitoring screen by switch to monitor the equipment running time, OK product quantity and NG product quantity, HSG input quantity, S / R input quantity, and CCD camera conditions. The settings for the value display is shown in the figure above to variable associate with the soft original in the PLC. The production monitor screen is shown in Figure 6.

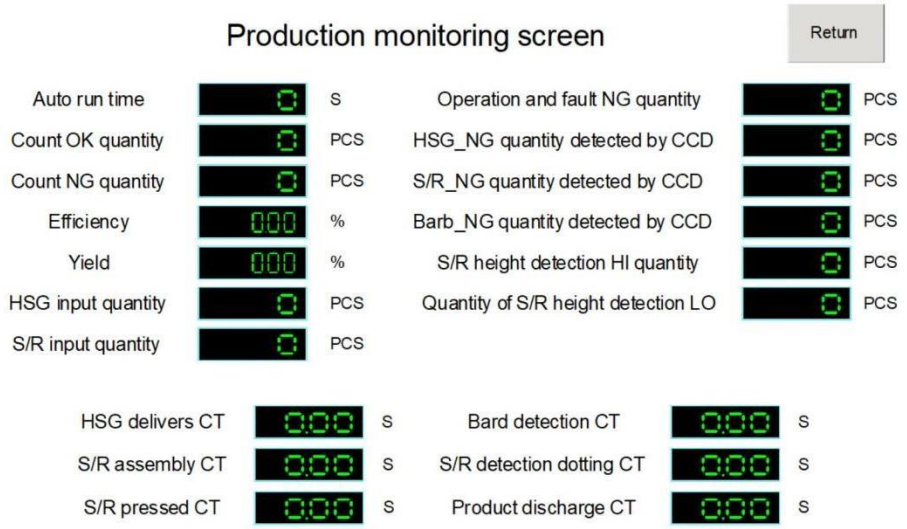

Figure 6: Production monitoring screen

In addition to carry on the monitoring of the production, the packaging machine should also undertake the necessary monitoring, jump to the monitoring screen of the packaging machine through the switch, in the six barrels there are fully charged sensors, the green light button light will flash after the material is full. Press the switch after replacing the material bag, and the sensor is reset, so to extinguish the light after the reset, and normally set it to stop when the capacity reaches 600 (do not need to press the reset switch of the packing machine). In the touch screen monitoring screen, we set three styles of material cylinder, empty material, half material and full material. Set the color discrimination on the touch screen to facilitate the operator monitoring. Set component properties, and soft components associate variables with the PLC. The display image is set so that it has color differences for easy monitoring.

After the equipment assembly, each station should be debugged to move the machine according to our requirements. Any problems occurring during debugging will appear in the current alarm. Set the circular start button and flat start button to control the start and stop of the vibration plate, and set the forward and back button to adjust the assembly part until the requirements.

Take the HSG flat vibration start button as an example, find the component attribute setting from the editor, set the button and associate the soft original with the PLC. The switch mode is changed to bit reverse, that is, press start and press close again. Open the switch on. The same is true for other flat and circular vibration start buttons. For example, the forward and back button is used to set the assembly part of the device. Take the HSG dislocation forward button as an example, find the component attribute setting from the editor, set the button and associate the soft original with the PLC, and change the switch mode to instantaneous reset, that is, click the move, release

the stop. These buttons are adjustments to the mechanical assembly, such as stretching the claw forward, moving him to the working position, and the maximum movement never exceeds the limit of the device. Other buttons are all the same.

When the machine debugging is almost similar, we need the equipment to be in the state of air transfer, through the air transfer to understand the operation of each component of the equipment, whether there will be a collision between the components.

8. Conclusion

At present, automobile is a very important means of transportation in human society, which plays an important role in both transportation and social development. Cars are mainly composed of different parts, and the assembly of car parts becomes very important, and many manufacturers still use the manual assembly method, which will undoubtedly greatly increase the production costs. And limited energy may lead to reduced production efficiency, and the quality of assembly products will be discounted. To achieve the automatic production, on the one hand, it is necessary to set up the automatic production equipment, and on the other hand, it is necessary to carry out the necessary programming and interface design for the automatic production equipment.

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