Module II Test Project

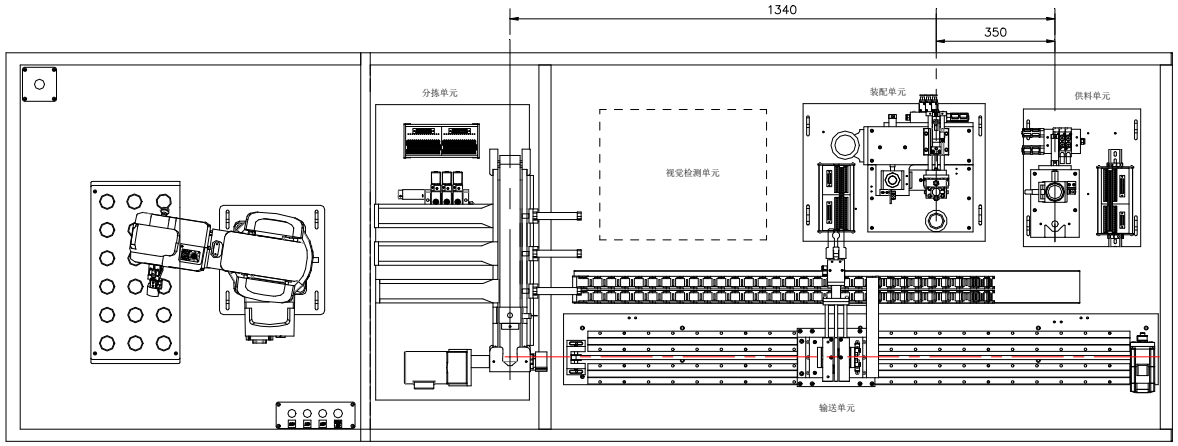
Reconstruction and optimization of intelligent production line

Score (point): 100

Time (minute): 180

Background:

The technological process of production of a company's existing production line is backward. In the context of intelligent manufacturing, visual inspection and robot units should be added in this production line according to the requirements of new processes and new tasks, with the aim to meet the current and future production requirements. As the company's technicians, you are required to complete equipment programming and debugging to realize automatic operation of this production line in accordance with the relevant technical documents.



	Sorting unit
	Visual inspection unit
	Assembly unit
	Feed unit
	Conveying unit

Production line layout

Main tasks:

Based on the task requirements, place the feed unit, assembly unit and visual inspection unit which have been properly assembled on the production line surface.

Based on the task requirements, complete the writing and debugging of the visual

inspection unit program.

The on-line program of HMI, feed unit, conveying unit, assembly unit, sorting unit and robot unit has been given and stored in the Skill Competition folder under the D drive of the computer.

Check the I0 signals of various units by competitors, and according to the control requirements, transform and optimize the HMI, conveying unit and sorting unit programs to realize automatic production and operation of this production line.

The preconditions for completion of tasks are as follows:

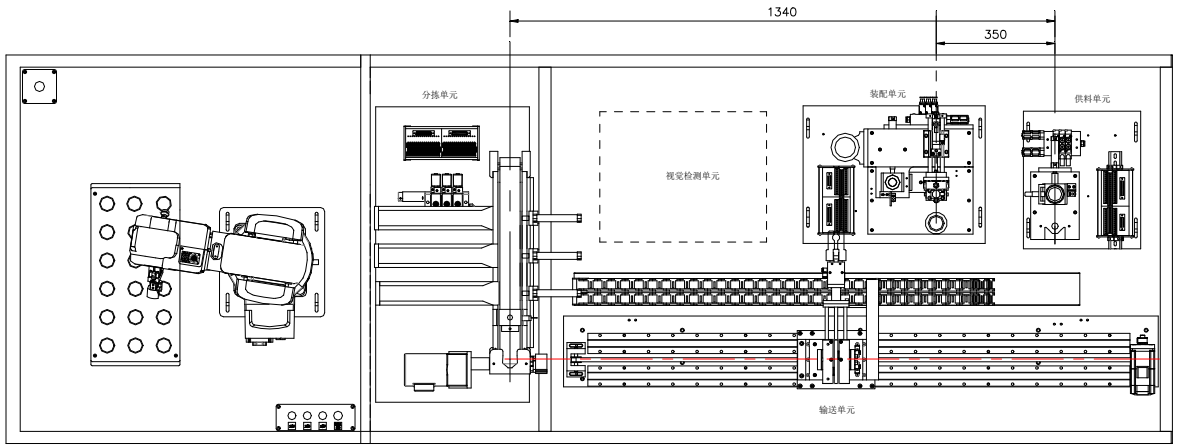
1. PLC can be used to correctly execute the program controlling the production line.

(Use PLC control equipment for marking)

2. The system should comply with the specification requirements.

(Consistent with the professional technical specification)

Schematic diagram of production line layout:



	Sorting unit
	Visual inspection unit
	Assembly unit
	Feed unit
	Conveying unit

Schematic Diagram of Production Line Layout

Initial position of the production line

Initial position of the feed unit:	**Initial position of the sorting unit:**
1. The ejection cylinder is in the position of extension	1. Push-rod 1 cylinder is in the position of retraction

2. The pushing cylinder is in the position of retraction	2. Push-rod 2 cylinder is in the position of retraction
	3. Push-rod 3 cylinder is in the position of retraction
	4. The frequency converter stops operating

Description of unit installation and positioning:

1. The sorting unit is the reference for positioning of various units, and movement is not allowed.

2. The positioning of the feed unit is determined by the position of the sorting unit.

3. The conveying unit in this task is the coordination unit. It is mainly used to grab, convey and place the workpieces from the discharging platform of the feed unit to the inlet of the sorting unit so as to coordinate with the completion of the automatic operation function of the production line.

Status of workpiece:

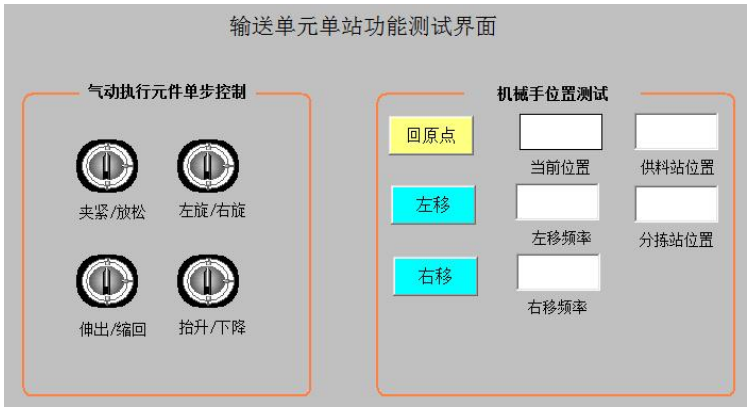
Workpieces are conveyed to storage chutes 1-3# (sorting cylinders 1-3# correspond to storage chutes 1-3#) by type.

Type of workpiece		Storage chute 1#	Storage chute 2#	Storage chute 3#
Black workpiece + black core		X		
Black workpiece + metal core			X	
Black workpiece + white core				X

Control program of production line:

Requirements:

Correctly write the program compliant with the operational function of production line according to the following control procedure description.

<table>
<tr><th>Control procedure description</th><th>Score</th><th>Max. score</th></tr>
<tr><td>Use PLC to inspect the control procedure</td><td></td><td></td></tr>
<tr><td>Preparation: Turn off the power of PLC, turn off the air supply, disconnect PLC from the programming equipment, remove all workpieces from the production line, put various unit modules in any position, and put all auto-manual switches of the production line in the manual position (anticlockwise). Start PLC, turn on the air pressure valve, and set the pressure of duplex part to be 5bar.</td><td></td><td></td></tr>
<tr><td>I. Single-station test function (if the production line jams during the process, manual assistance is not allowed)</td><td></td><td></td></tr>
<tr><td>1. Conveying unit</td><td></td><td></td></tr>
<tr><td>Touch screen interface
 

<table>
<tr><td></td><td>Single-station Function Test Interface of the Conveying Unit</td></tr>
<tr><td></td><td>One-step control of pneumatic actuating element</td></tr>
<tr><td></td><td>Clamp/Release</td></tr>
<tr><td></td><td>Anticlockwise/Clockwise</td></tr>
<tr><td></td><td>Extend/Retract</td></tr>
<tr><td></td><td>Lift/Lower</td></tr>
<tr><td></td><td>Manipulator position test</td></tr>
<tr><td></td><td>Back to Origin</td></tr>
<tr><td></td><td>Move left</td></tr>
<tr><td></td><td>Move Right</td></tr>
<tr><td></td><td>Current Position</td></tr>
</table>
</td><td></td><td></td></tr>
</table>

	Frequency When Moving Left		
	Frequency When Moving Right		
	Feed Station Position		
	Sorting Station Position		
● It should include the switches of pneumatic actuating element: Clamp/Release, Anticlockwise/Clockwise, Extend/Retract, and Lift/Lower. ● The manipulator position test should include: Back to Origin, Move Left and Move Right buttons; display box of current position of the manipulator; input boxes of Frequency When Moving Left, Frequency When Moving Right, Feed Station Position and Sorting Station Position.			
Power the conveying unit off, manually move the manipulator to any position in the middle, and energize it.			
Switch the auto-manual switch of the conveying unit to the manual position to enable the cylinder to return to its initial position.			
Click the Back to Origin Button on the touch screen, so that the manipulator returns to the original sensor position and the display box of Current Position displays 0 on the touch screen.			
Input the frequency values when moving left and moving right on the touch screen (e.g. moving left: 10000, moving right: -10000), and click Move Left button and Move Right button to operate the manipulator.			
Move the manipulator to the discharging platform of the feed unit, control the switches of Clamp/Release, Anticlockwise/Clockwise, Extend/Retract, and Lift/Lower on the touch screen, adjust the accuracy of the manipulator grabbing workpieces, and input the current position in the feed station position.			
Move the manipulator to the discharging platform position of the sorting unit, control the switches of Clamp/Release, Anticlockwise/Clockwise, Extend/Retract, and Lift/Lower on the touch screen, adjust the accuracy of the manipulator grabbing workpieces, and input the current position in the sorting station position.			
On the touch screen, the feed station position and the sorting station position have the function of storing data in case of power failure.			
2. Visual inspection unit			
Place black workpiece + black core on the inspection platform, press SB1 to enable the yellow indicator light to be normally on, and press SB2 to enable the yellow indicator light to be off, and then remove workpieces.			
Place black workpiece + white core on the inspection platform, press SB1 to enable the green indicator light to be normally on, and press SB2 to enable the green indicator light to be off, and then remove workpieces.			
Place black workpiece + metal core on the inspection platform, press SB1 to enable the yellow and red indicator lights to be normally on, and			

press SB2 to enable the red indicator light to be off, and then remove workpieces.		
II. On-line test function (if the production line jams during the process, manual assistance is not allowed)		
Preparation: Switch all auto-manual switches of the production line to the automatic position (clockwise), power the conveying unit off, manually move the manipulator to any position in the middle, and energize it.		
Press the reset button on the touch screen. Then the yellow indicator light on the signal post flashes at 1Hz, and the manipulator of the conveying unit returns to the origin. After resetting, the yellow indicator light of the signal post is normally on.		
Press the start button on the touch screen. Then the green indicator light on the signal post is normally on.		
A: The feed unit pushes workpieces to the feed platform.		
The manipulator of the conveying unit grabs workpieces from the feed platform.		
The servo motor runs to the assembly platform of the assembly station at 300mm/s and sends an assembly request signal.		
The assembly station starts the workpiece assembly procedure after receiving this signal. After receiving the signal of assembly completion, the manipulator grabs the assembled workpiece.		
The servo motor runs to the inspection platform of the visual inspection station at 300mm/s and sends an inspection request signal.		
The visual inspection station starts the visual inspection procedure of workpieces after receiving this signal. After receiving the signal of visual inspection completion, the manipulator grabs the inspected workpiece and turn it anticlockwise in place.		
The servo motor runs to the inlet position of the sorting station at 300mm/s and sends a sorting request signal.		
The sorting station starts the sorting procedure after receiving the sorting request signal, while the manipulator of conveying unit returns to the feed platform of the feed unit, and then return to Step A.		
Sorting procedure		
According to the data detected by the visual inspection unit, the motor runs to the pushing chute at 25Hz, and then the motor stops and pushes workpieces into the pushing chute.		
The sorting rules are as follows: Black workpiece + black core push them in storage chute 1# and then convey them by the robot to the first column of pallets. Black workpiece + metal core push them in storage chute 2# and then convey them by the robot to the second column of pallets. Black workpiece + white core push them in storage chute 3# and then convey them by the robot to the third column of pallets.		

Abnormality handling		
If there are insufficient workpieces in the silos of feed unit and assembly unit, the red indicator light on the signal post will flash at 1Hz.		
If there is no workpiece in the silos of feed unit and assembly unit, the red indicator light on the signal post will flash on for 1s and off for 0.5s.		
If the last workpiece is pushed from the silo of the feed unit, the equipment will continue to operate until the whole procedure ends, and all indicator lights on the signal post will be off.		
When the manipulator of the conveying unit operates, the manipulator will stop immediately if the emergency stop button of the conveying unit is pressed.		
After the emergency stop button of the conveying unit is reset, the manipulator will continue to operate.		

Operating procedure for preset programs of the robot unit

(I) Manual operation of robot palletizing unit

1. Work preparation of robot palletizing unit

Control procedure description
(1) Set the robot in the state of automatic operation.
(2) Switch the rotary switch on the button indicator light unit in the drawer to the state of manual operation.
(3) Robot reset of robot palletizing unit: After the green button on the button indicator light module is pressed, the robot reset starts, and meanwhile, the yellow indicator light flashes. After resetting is completed, the yellow indicator light is normally on (the initial position has been calibrated in the robot, so robot teaching is not required).
(4) After the robot is successfully reset, the green indicator light is normally on.

2. Robot palletizing

Control procedure description
(1) After the robot is ready and the sorting unit completes the sorting of individual workpieces, the robot will start working according to the button signal.
(2) Three buttons in the button box correspond to three different sorting workstation signals. After the corresponding button is pressed, the robot will automatically place the materials in the sorting unit to the corresponding positions on the material pallet according to different workstation slots (robot teaching has been completed), i.e. place the materials from Storage Chute 1 to the first column of material pallets, place the materials from Storage Chute 2 to the second column of material pallets, and place the materials from Storage Chute 3 to the third column of material pallets, and all columns arranged in order.

After all columns of material pallets are full, the robot will automatically place surplus workpieces in the waste stacking area (the action of placing waste has been completed in the robot program, so no additional program is to be written).
(3) When the robot grabs materials from any workstation slot, it will send a signal of empty storage chute, and this signal is ON and lasts for 1s.
(4) After the palletizing of individual workpieces is completed, the robot will return to the initial position.

3. Emergency handling of robot palletizing unit

Control procedure description
(1) In an emergency, press the emergency stop button on the desktop to stop the robot immediately.
(2) Press the red button on the button indicator light to stop the robot.

(II) On-line operation of robot palletizing unit

1. Work preparation of robot palletizing unit

Control procedure description
(1) Set the robot in the state of automatic operation.
(2) Switch the rotary switch on the button indicator light unit in the drawer to the on-line state.
(3) Robot reset of robot palletizing unit: After the green button on the button indicator light module is pressed, the robot reset starts, and meanwhile, the yellow indicator light flashes. After resetting is completed, the yellow indicator light is normally on (the initial position has been calibrated in the robot, so robot teaching is not required).
(4) After the robot is successfully reset, the green indicator light is normally on.

2. Robot palletizing

Control procedure description
(1) After the robot is ready and receives the signal of completing the sorting of individual workpieces sent from the sorting unit, the robot will start working.
(2) The robot will automatically place the materials in the sorting unit to the corresponding positions on the material pallet according to different workstation slots (robot teaching has been completed), i.e. place the materials from Storage Chute 1 to the first row of material pallets, place the materials from Storage Chute 2 to the second row of material pallets, and place the materials from Storage Chute 3 to the third row of material pallets, and all rows arranged in order. After all columns of material pallets are full, the robot will automatically place surplus workpieces in the waste stacking area (the action of placing waste has been completed in the robot program, so no additional program is to be

written).
(3) When the robot grabs materials from any workstation slot, it will send a signal of empty storage chute, and this signal is ON and lasts for 1s.
(4) After the palletizing of individual workpieces is completed, the robot will return to the initial position.

3. Emergency handling of robot palletizing unit

Control procedure description
(1) In an emergency, press the emergency stop button on the desktop to stop the robot immediately.
(2) Press the red button on the button indicator light to stop the robot.