Application of MOTOMAN Robot in MPS

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Abstract

This paper presents Yaskawa MOTOMAN industrial robots used in auto production and processing system. The handling mission of the MOTOMAN robot, the I/O communications settings, the robot programming and debugging are outlined. The system has been at a comprehensive university engineering training center to the application of advanced technology plays a cultivate the function of application-oriented talents.

Keywords

Industrial Robot; MOTOMAN; MPS; Demonstration; Interference Zone.

1. Introduction

Robot technology is a kind of high-tech which integrates computer, mechanism, cybernetics, information and sensing technology, artificial intelligence, bionics and other disciplines. It is a very active field of contemporary research and application. Robot application is an important symbol of the level of industrial automation in a country. Robot is not a simple way to replace manual labor, but a humanoid electronic and mechanical device which combines the advantages of human and machine. It not only has the ability of rapid response and analysis and judgment of human environment, but also has the ability of long-time continuous work, high precision and anti-harsh environment. In a sense, it is also the product of the evolution process of machines, not only an important production and service equipment in industry, but also an indispensable automation equipment in the field of advanced manufacturing technology.

MPS (Modular Production System) is an open teaching and training system designed and developed for students who can not train on the actual production line and simulate the actual industrial production process. This kind of system is a miniature model of industrial automation production line, which can provide a simulation teaching environment close to the actual automatic control and processing production line. Automatic production teaching system is a set of practical experimental equipment designed and produced to improve students' practical ability and practical skills. MOTOMAN industrial robot is introduced to complete the task of installation and transportation. The system includes a variety of technologies such as motor drive, pneumatic, PLC (programmable logic controller), robot control, sensor and so on, which provides a typical comprehensive technology application environment for students, and enables students to have a comprehensive understanding, comprehensive training and mutual promotion of many single subject professional knowledge. Therefore, this set of device is very suitable for the training of students and engineering and technical personnel, and it is an ideal equipment for training mechatronics and automatic control talents.

2. MPS system

The MPS system consists of six independent and closely connected workstations. The six stations are: loading inspection station, handling station, processing station, installation station, robot (installation and handling station) and sorting station. A significant feature of the experimental device is that it has good flexibility, that is, each station is controlled by a set of PLC system independently. If the six workstations are trained separately, more students can learn at the same time. After the basic unit module training is completed, two or even six adjacent stations can be connected together to learn the control, programming, assembly and debugging technology of complex systems.

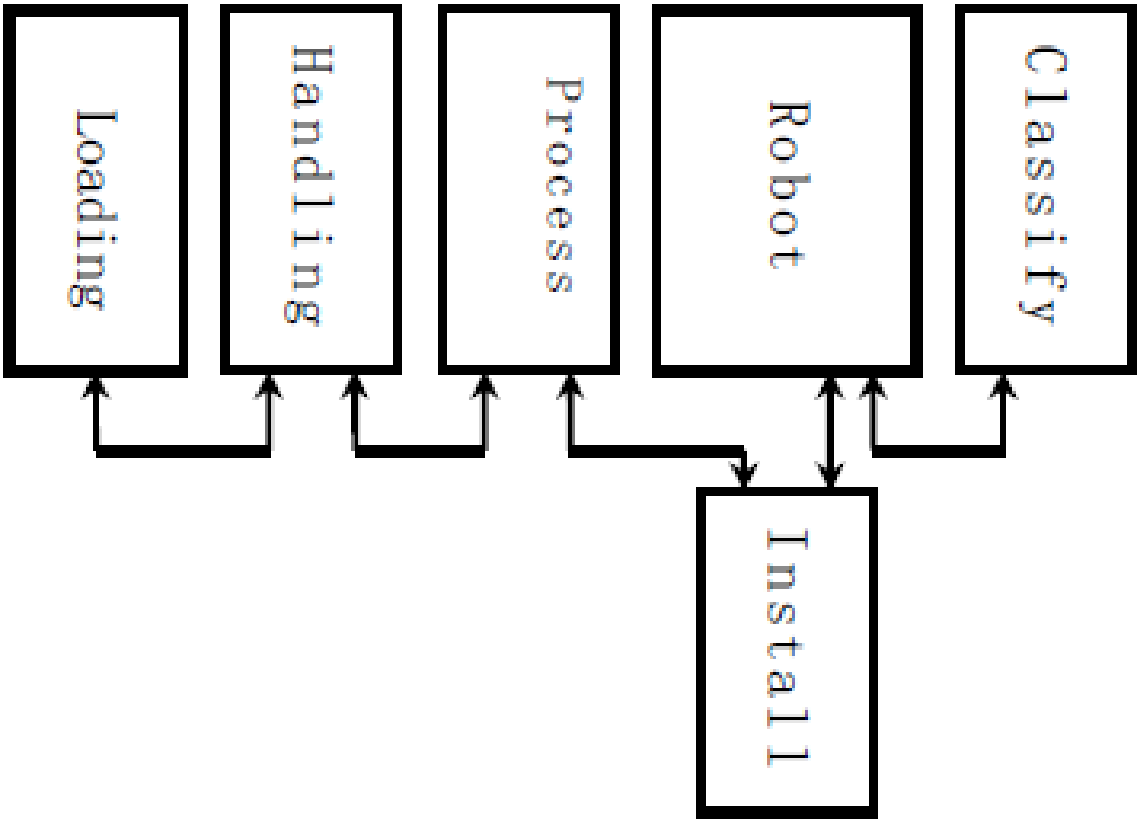

Fig.1 block diagram of MPS system

2.1 Loading inspection station

(1) Return the feeding table to send the work piece to the detection station in turn.

(2) The lifting device lifts the work piece and detects the color of the work piece.

2.2 Handling station

Transfer the work piece from the loading inspection station to the processing station.

2.3 Processing station

The work pieces are transformed between four stations by using the rotary table. The four stations are connected to the work piece position, drilling position, detection position and work piece output position in turn. The last station places the work piece in the position of connecting the work piece; the rotary table turns 90 degrees, and the work piece goes to the drilling unit for drilling; then turn 90 degrees to the depth of the detection work piece and the detection hole; turn 90 degrees to the work output position and wait for the robot to carry.

2.4 Installation station

(1) Select the raw material warehouse where the work piece is to be installed.

(2) Push the work piece out of the warehouse.

(3) Install the work piece in place.

2.5 Robot

(1) Pick up the work piece in the processing station and put it into the installation station.

(2) Pick up the loaded work piece and put in the sorting station.

2.6 Sorting station

(1) Sort by work piece type.

(2) Push work piece into warehouse.

3. Motoman robot

Industrial robot is composed of manipulator (mechanical body), controller, servo drive system and detection sensor device. It is a kind of Mechatronics automatic production equipment which can simulate human operation, automatic control, repeatable programming and can complete various operations in three-dimensional space. It is especially suitable for flexible production of various varieties and variable batches. It plays a very important role in stabilizing and improving product quality, improving production efficiency, improving working conditions and rapid updating of products. XRC MOTOMAN industrial robot system is composed of manipulator, manipulator controller (XRC), servo motor drive system, angle encoder and related auxiliary equipment. It is an advanced equipment applied in industrial automation production. XRC control cabinet is a very mature control cabinet. It has good versatility and can be used in other robots with different functions.

Fig.2 figure of MPS system

Fig.3 Yaskawa YR-SV3-J00 robot body

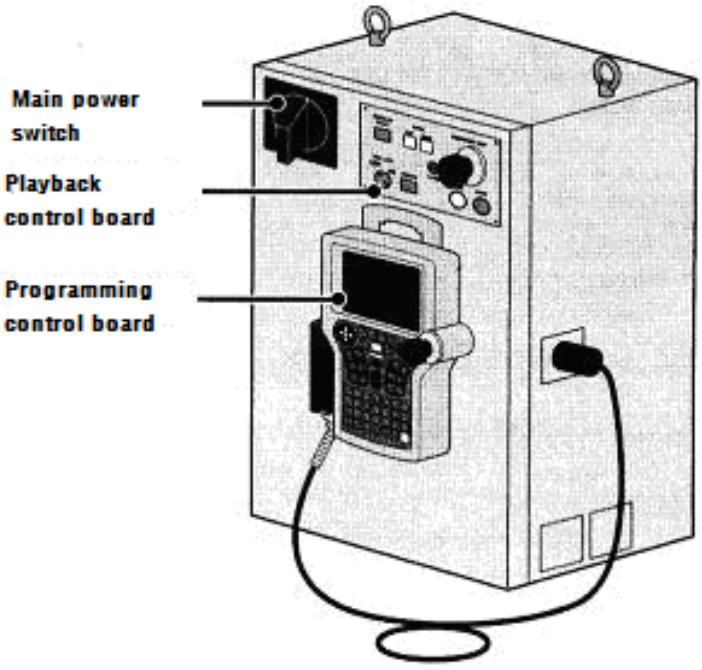

Fig.4 XR robot controller

3.1 Robot parameter setting

Enter the management mode to set the following parameters, in which the interference zone tracks the setting of relevant program points in the teaching programming process.

Operation origin: the operation origin is the reference point related to the robot operation, which is the precondition for the robot not to interfere with the surrounding equipment and start the production line, so that the robot can be determined within the set range. Through the teaching programmer operation to set the operation origin position. When the robot enters the origin point (on), as long as the robot enters the origin point, the control signal is set to the operation position immediately. This signal is used as the robot ready signal.

Cube interference area: if the robot's control point is in the interference area, the interference signal will be turned on. The interference area 1 is set at program point 0012 and interference area 2 is set at program point 0022. XRC can judge whether the robot control point is in the interference area or outside the interference area, and output the judgment by signal. The robot control point is in the cube interference area 1, the interference signal (logic symbol 30020) has output; in the cube interference area 2, the interference signal (logic symbol 30021) has output.

3.2 Robot teaching programming

Robot input and output allocation is shown in the table below: [1][2]

Table 1 Robot I/O allocation

Input			Output		
Name	logic symbol	Function	Name	logic symbol	Function
Front station ready	20030	Robot receives this signal and goes to the processing station to grasp the work piece	Operation origin	30022	Inform installation station that robot ready
			In cube 1	30020	Inform installation station ready to assemble
Installed	20031	With these two signals, robot can put the work piece from the installation to the sorting station	In cube 2	30021	Inform sorting station to store the work piece
Rear station ready	20032		grasp the work piece	30030	Control solenoid valve to grasp the work piece

The robot first moves to the operation origin. When it is near the operation origin, the robot generates a ready signal to tell the previous station (i.e. the installation station) - the robot is ready. When the installation station is ready, a ready signal will be given to the robot, and the robot can go to the processing station to grab the work piece, put the work piece in the installation position, and then the robot will give the installation station a signal of "can be installed". When the installation station is ready, the installation station will give the operator a "installation" signal. After the robot gets this signal, it will go to the installation station to grab it in the sorting station. Before the robot is ready to put down the work piece, check whether the receiving station is in the waiting state.

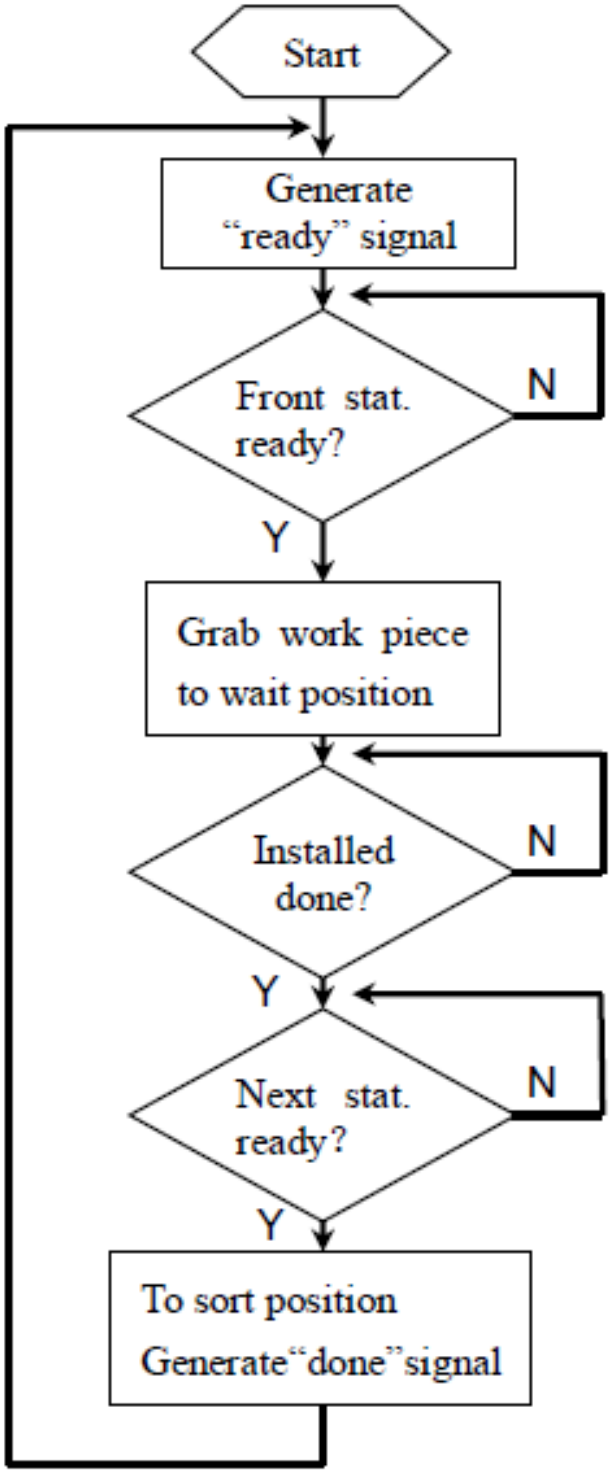

Fig.5 flow chart of robot handling program (output of robot grabbing work piece is logic symbol 30030)

The robot teaching program is as follows, prgam1 is a subroutine.

```
0000 NOP
0001 *start
0002 MOVJ VJ=40.00; // When the robot runs to the program point, the ready signal is automatically generated.
0003 CALL JOB:PRGAM1 IF IN#(30)=ON; // The current station is ready to call the subroutine.
0004 DOUT OT#(30)ON; //Grasp the work piece.
0005 TIMER T=100; //The grabbing process wait for 1 second.
0006 MOVL V=40 PL=0
0007 MOVJ VJ=10.00
0008 MOVL V=40 PL=0
0009 DOUT OT#(30)OFF; //Place work piece.
0010 TIMER T=100
0011 MOVL V=40 PL=0
0012 MOVJ VJ=10.00; //Return to the waiting position, and set cube interference area 1 at this program point.
0013 WAIT IN# (31)=ON; //Wait for the installation signal of the front station.
0014 MOVJ VJ=40 IF IN#(32)=ON; //Execute If the rear station is ready.
0015 MOVL V=40 PL=0
0016 DOUT OT#(30)ON; //Grasp the work piece.
0017 TIMER T=100
0018 MOVL V=40 PL=0
0019 MOVJ VJ=10.00; //Move to the sorting station to pick up the work piece platform.
0020 DOUT OT#(30)OFF  ;//Place work piece.
0021 TIMER T=300
0022 MOVJ VJ=40; //Set cube interference area 2 at this program point.
0023 JUMP *start
0024 END
```

3.3 Running and debugging of robot

(1) For the off-line debugging of the robot, operator controls the robot from the coordinate origin position to the position where the work piece is taken to grab the large work piece, moves the robot to the installation position with slow manual movement, places the large work piece, moves the robot away from the installation position, and waits for 5 seconds (the purpose is to install the small work piece into the large work piece in the installation station when the network is connected), and moves the robot to the installation position to grasp the large work piece and sends it to the receiving position of the sorting station, controls the robot to return to the coordinate origin position.

Select the appropriate program point position, modify and set the robot's reproduction running speed, and select the appropriate interpolation mode of the reproduction trajectory. All operations with 100% accuracy.

(2) The system joint debugging is to connect the installation station and classification station with the robot according to the input and output table, and carry out the continuous operation and debugging of the program under the cooperation of the front and rear station signals. Until the robot and the whole MPS move safely and smoothly, the speed meets the requirements of the front and rear stations, and can work in coordination with the front and rear stations.

4. Conclusion

The application of MOTOMAN robot in MPS system greatly improves the working speed of the system, and can complete the two-dimensional transportation task timely and accurately, with accurate positioning, coordinated action and reliable work. Robot programming is convenient and fast. Because the robot has a portable teaching device, its friendly user interface can make the programmer flexibly and quickly realize various actions of the robot. In addition, the biggest characteristic of the robot is flexibility. It can move in single axis or six axis linkage to complete all kinds of complex space motion. Its trajectory can be straight line and circle in various spatial directions, and can be various regular or irregular space curves. Any structure of the production line, the robot can easily feed, take material. The performance of the whole teaching system of automatic production and processing has been effectively improved. The training content is increased.

References

[1] YASNAC XRC Instruction manual, Shougang MOTOMAN robot Co., Ltd. 2002.

[2] YASNAC XRC Operation essentials, Shougang MOTOMAN robot Co., Ltd. 2002.

[3] Yingchen Xue. Industrial computer and configuration control principle. China Electric Power Press.