

Control System Design of Welding Workstation based on Industrial Robot

Zhelu Wang^{1, a}

¹Wenzhou Polytechnic, Wenzhou 325035, China.

^a382211678@qq.com

Abstract

In the context of made in China 2025, manufacturing industry in China and Zhejiang Province is moving towards intelligent development, so industrial robots can be seen in various industrial fields. This paper takes the welding robot workstation as the research object, Siemens PLC as the control core, ABB Robot irb1410 is selected, equipped with welding gun, welding workbench, electrical control cabinet and welding equipment. The control system of the welding robot system is well designed, stable and has a high level of automation.

Keywords

Welding, control system, Industrial Robot.

1. Introduction

Welding technology is the operation method of connecting two or more base metals into a whole by using welding materials under high temperature or high pressure. Modern welding technology has been able to weld the weld without internal and external defects, with mechanical properties equal to or even higher than the connected body. The mutual position of the welded body in the space is called the welded joint. The strength of the joint is not only affected by the weld quality, but also related to its geometry, size, stress and working conditions. The basic forms of joint include butt joint, lap joint, T-joint (positive joint) and angle joint, etc[1]. With the development of computer technology, electrical control technology and robot technology, since the automatic welding equipment was used in production, its technology has become increasingly mature, mainly with stable and improved welding quality; improve labor productivity, improve labor intensity of workers, can work in harmful environment, shorten the preparation period of product transformation, reduce the operation technology of workers Therefore, it has been widely used in all walks of life[2-3].

Industrial robot is a kind of high-end intelligent equipment that can imitate manual operation, programmable and automatic control, with high automation and flexibility. This paper takes ABB industrial robot irb1410 as the core, introduces Siemens PLC controller, builds the control system of welding robot, studies the control connection between PLC and industrial robot, and ensures the stability and practicability of the control system.

2. System Composition and Selection of Welding Robot Workstation

2.1. Composition and Working Principle of Welding Robot Workstation

The system of welding robot workstation consists of industrial robot, welding platform, welding gun, control cabinet and fence. As shown in Figure 1, with the industrial robot as the core, the industrial robot technology, 3D modeling technology and virtual simulation technology are used to design the welding workstation, so as to achieve the goal of "machine replacement" by replacing manual welding machine automation.

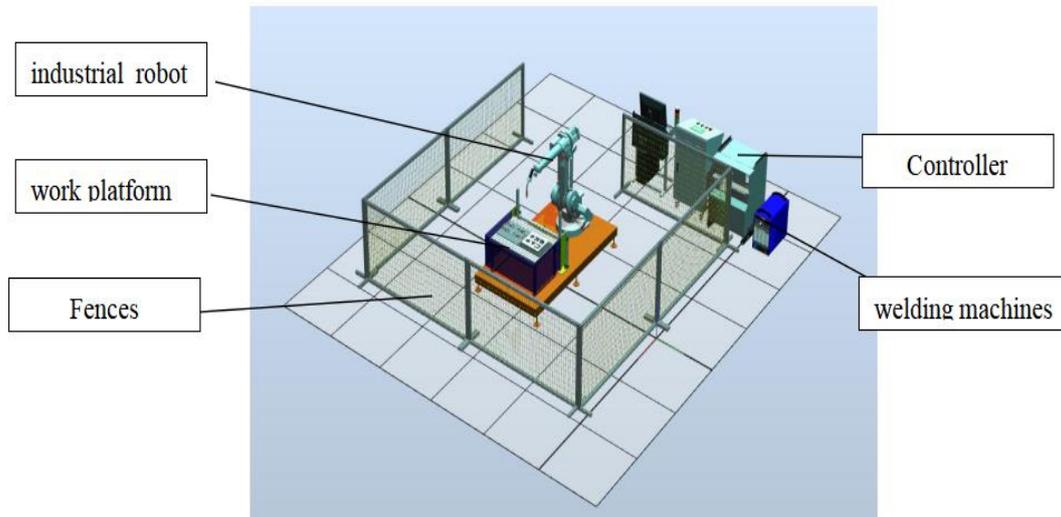


Figure 1. Layout and composition of welding robot workstation

2.2. Selection of Workstation Robot

There are many choices of industrial robots, such as freedom, maximum load, positioning accuracy, workspace, working speed and so on. The robot selection of welding robot workstation designed in this paper mainly considers the following important indicators:

The degree of freedom index, which is a parameter to measure the flexibility of robot movement, is an important index to measure the robot. The more degrees of freedom, the more flexible the robot is. Generally, the degree of freedom of industrial robot is 3-6.

Workspace index, which refers to the working range of the robot, the maximum range that the robot wrist or end actuator can reach, the larger the working space is, the larger the moving range of the robot is. In motion control, we should pay attention to the limit position of robot, and consider the welding position and limit position.

Positioning and repetitive accuracy index, deviation between the actual position and the ideal position of the robot, and the repetitive positioning accuracy is to test the scattered deviation value of a robot in the same environment and condition for several times. The smaller the deviation of the robot repeated to the same position for many times, the higher the repetitive positioning value of the robot and the human.

Through these indicators, the welding robot workstation can choose ABB irb1410 as the machine body of robot work, design the corresponding installation base, and design the welding platform with it as the center. At the same time, the 6-DOF robot has high flexibility, which can complete the welding work of multiple angles and realize the trajectory planning of complex path.

3. Control System Design of Welding Robot Workstation

The main functions of electric control system of welding robot workstation include: 1) teaching, debugging, programming and automatic operation of industrial robot; 2) welding parameter setting, cylinder lifting of working platform, and welding control with welding gun; 3) interface interaction and parameter setting of industrial machine, PLC and human computer; 4) realization of the whole welding workstation.

3.1. Hardware Design of Welding Workstation Control System

The control system of welding workstation includes: 1) Siemens PLC control system, 2) robot control system, 3) robot teaching device. The main system adopts Siemens PLC as the control core, and integrates the robot control cabinet, sensor system and human-machine interface.

The realization of the whole transportation system mainly depends on the debugging and Realization of PLC logic control. The I / O signal module of robot controller and PLC communication module can communicate directly or indirectly for signal transmission. When working, the welding robot operates normally according to the manual teaching program and is controlled by PLC.

According to the functional requirements of the welding robot workstation, set the signal with Siemens smart PLC. Table 1 below defines the contact signal of the welding robot PLC and robot, and then conduct the hardware wiring, parameter setting and communication test of the PLC and robot according to the corresponding address.

Table 1. Welding robot PLC and robot contact signal definition

Robot system correlation signal	Robot signal name	PLC address	PLC Symbol
Auto On	DO10_1	I0.4	Automatic status
<u>MotoOnState</u>	DO10_2	I0.5	Motor enabled
	DO10_4	I0.7	Welding completed
		I1.0	Robot emergency stop input
<u>MotoOn</u>	DI10_1	Q0.3	Robot motor enable
Start	DI10_3	Q0.4	Robot start
Stop	DI10_4	Q0.6	Robot pause
<u>ResetEstop</u>	DI10_6	Q1.0	Robot emergency stop reset
		Q1.3	Robot emergency stop

3.2. Software Design of Control System

The welding work can be done not only by local operation of robot teaching device, but also by remote control of PLC. Under the remote control mode, the following conditions shall be met before the equipment is started: the robot selects the automatic mode. There is no light curtain alarm, no robot emergency stop alarm, etc. When the device is ready, press the start button, the system runs, and the robot program starts to run.

During the operation of the robot, if the stop button is pressed, the robot shall be suspended. If the start button is pressed again, the robot will continue to run. During the operation of the robot, if the safety light curtain acts, the robot shall be suspended. Press the reset button to clear the safety light curtain alarm signal. At this time, press the start button, and the robot will continue to run.

During the operation of the robot, if the emergency stop button acts, the system shall stop immediately. Press the reset button to clear the robot emergency stop signal. For safety reasons, after the emergency stop signal is cleared, operate the robot teaching device to make the robot return to the working origin. After the robot returns to the working origin, the system can be started again.

The control flow of industrial robot is shown in Figure 2.

4. Conclusion

The control system of welding robot workstation designed in this paper takes Siemens PLC as the control core, uses electrical control technology, industrial robot technology, through the design of software and hardware of the whole system, and finally completes the welding function. The control system of the welding workstation of the industrial robot is reasonable in design, easy to operate and stable in operation, so that the automatic welding function can be realized instead of manual operation, and the working efficiency can be greatly improved.

Acknowledgements

This work was supported by The teaching research project of Zhejiang Education Department No.jg20190734,the research project of Chinese Vocational Education in Zhejiang Province No.ZJCVB19,the major teaching reform research project of Wenzhou Polytechnic No. WZYZD201907.

References

- [1] Q.H.Wang.Discussion on the application of welding and cutting equipment in efficient welding of construction machinery manufacturing.[J] Internal Combustion Engine & Parts,2020,9:100-101.
- [2] H.Y. Sun. Research on the application of industrial robot in intelligent manufacturing.[J] Electronic Test, 2020, 12: 129-130.
- [3] C.F.Wang. [1] H.Y. Sun. Research on the application of industrial robot in intelligent manufacturing. [J] MW Metal Forming, 2020, 06: 3-6.