Design of a Type of Spray‑Painting Manipulator

Zelun Li [1, a], Jie meng [1, b] and Zhicheng Huang [2, c]

¹College of Mechanical and Dynamic Engineering, Chongqing University of Science and Technology, Chongqing 401331, China

²School of Mechanical and Electronic Engineering, Jingdezhen Ceramic Institute, Jingdezhen 333403, China

[a]instru@163.com, [b]mj8101@163.com, [c]huangwu555@sina.com

Abstract

Spray-painting manipulator is the special equipment using to spray paint on parts automatically in industrial production. It has been used in cars industry in recent years. It's very important to maintain the stability and accuracy of the equipment. So this paper taking an automatic spray-painting manipulator as the research subject, has designed whose structure and control system. In this design, steering engine is adopted to control the joints and to realize the paint spraying in every angle through the design of controlling system. And it has certain effects.

Keywords

Spray-painting, manipulator, SCM.

1. Introduction

In manufacturing industry, paint spraying on surface is a very important procedure, which can effectively avoid being eroded, increase life of workpiece, and beautify the surface of workpiece. It is wildly used in almost all producing of mechanical and electrical products. A large amount of aldehyde, benzene, amine and other hazardous materials are produced in the procedure of spraying. Those hazardous materials absolutely harm the workers, having negative influence on their working mood. Because manual paint spraying is limited by the workers' skills and moods, the rate of repeated spraying in traditional way is high, restricting the productivity largely. However, with the development of industrial technology, those problems are solved by paint spraying manipulator [1-2]. Nowadays, the competition in large scale manufacture is fierce, making the improvement of production rate and guarantee of production quality be an important point of a company. So in order to make the producing line deeply automatic become the beneficial measurement at present, as an important member of automatic production, spray-painting manipulator has gradually been used by companies.

The current study about spray-painting manipulator mainly focuses on modeling analysis of airbrush and research of trajectory optimization. In 1986, the offline programming technology of paint spraying manipulator was put forward by Klein. Interactive design, airbrush simulation and trajectory analysis of manipulator got result in his offline programming system of paint spraying. Use model to analyze and improve the painting materials accumulated in paint spraying by manipulator, and prove it by the result of experiment [3]. In 1989, Duelen brought in robot offline programming technology in electrostatic spraying. Offline programming started being wildly used [4]. In order to decrease the waste of painting materials and avoid overloading of electrical machine, in 2000, Veljko and other people studied on that, and optimized relative parameters, not influencing the quality of paint spraying at the same time [5]. In 2002, Chen and other people found and put forward the problem of coating interference caused by combining the trajectory of airbrush on complicated curved face, and discussed the solution by using statistics from simulation [6-7]. In 2008, Girma respectively used genetic algorithm and ant colony algorithm to solve the optimizing and combining problems of trajectory of airbrush after separating complicated curved surface. And he compared the advantages

and disadvantages of the two algorithms [8]. This paper has designed an automatic paint spraying manipulator based on the current research state of spray-painting manipulator.

2.   Design of mechanical system

Spray-painting manipulator consists of three parts, executive system, control system, and driving system. Executive system is an indispensable mechanical part for manipulator to realize all actions, including wrists, arms, a foundation, and spraying pipelines. A wrist connects hand and arm, the function of which is to adjust or change the work direction of hand. An arm supports wrist, bearing workload of workpiece and transmitting it to the expected place. The foundation supports the whole arm, like a pallet, bringing mechanical arm to revolve a certain angle. Spraying pipelines spray paint, transmitting paint. Fig.1 shows the brief mechanical structure of spray-painting manipulator.
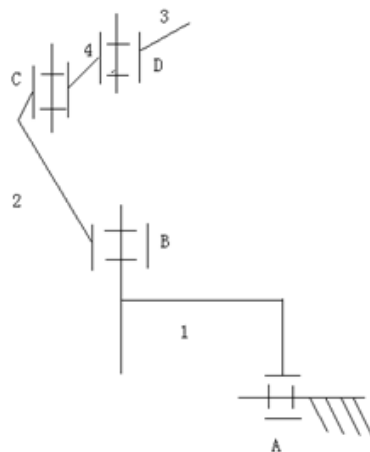
1-waist 2-arm 3-wrist 4-forearm A-rotate device, B-revolve device, C -revolve device, D-revolve device

Fig.1 The total system block diagram

3.   Design of the control system

The control system of spray-painting manipulator is to keep stability of mechanical arm, ensuring the stability of action speed and acceleration of robot. It adopts building block design method, including single chip control block, power block, voltage regulator block, servo motor, servo-control block and other blocks, realizing the automatic function of painting.
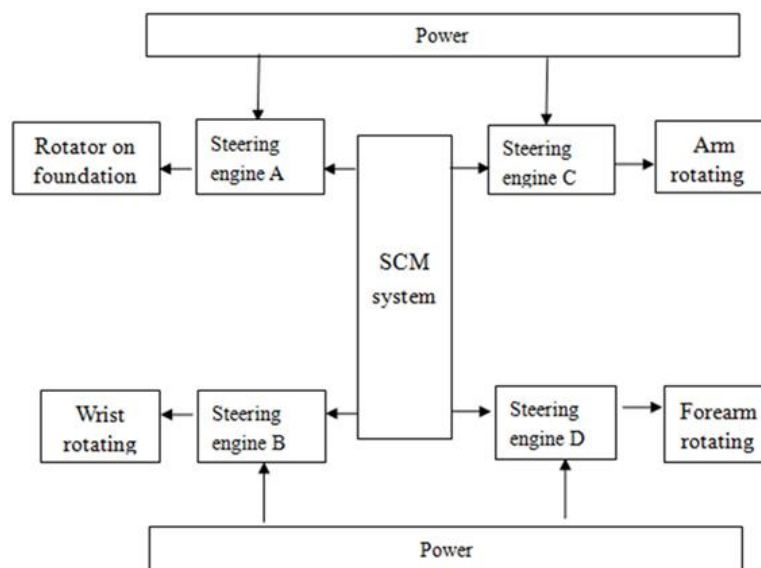

Fig.2 The structure of the universal wheel

4. Conclusion

Spray-painting manipulator is the equipment to paint in industry. Now it's wildly used in the paint lines such as cars, spaceflights and electrical productions. But the degree of automation of painting robot is not high, mainly using in large industrial production lines, little using in daily life. And the workload is large, the environment is terrible and the stability of painting quality is low. With the development of industrial technology and the improved awareness of protecting environment, it's more and more important to start a kind of robot that is safe, stable and usable.

The whole system of spray-painting manipulator consists of single-chip control block, power block, servo motor, servo-control block and other blocks. Fig.3 shows the three dimension structure of the designed spray-painting manipulator. This design has realized the paint spraying manipulator's function to automatically paint.

Fig.3   The structure of spray-painting manipulator

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