The application of motion controller in the control system of chamfering machine

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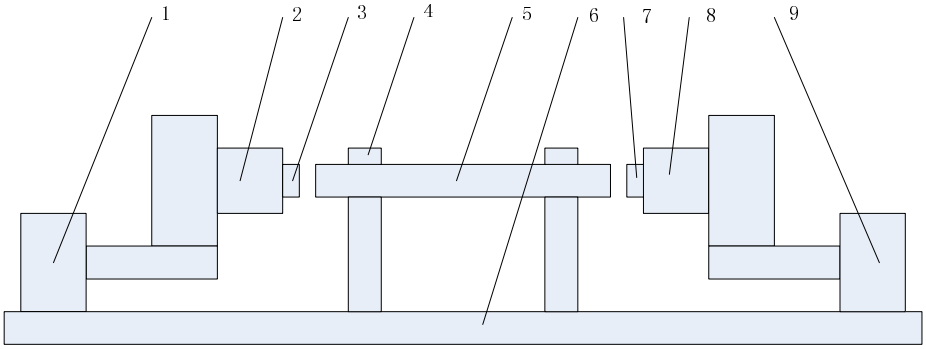
Abstract. With the development of the industry, the bar has been widely used in various fields. Due to the processing, the bar often need treatment before they can be put into the market, the traditional bar end treatment has the shortcomings of high labor intensity, low precision, high cost, and there are also security risks. In this paper, the motion controller is applied to the chamfering machine control system, control system uses motion controller as the core, the touch screen can communicate directly with the motion controller. The bar end processing problem can be solved, and it can improve the work environment, reduce labor intensity, reduce security risks, improve production efficiency. It has a certain practical significance.

Introduction

With the rapid development of industrial automation, the bar has a wide range of applications in various industries [1]. In the bar the process, the cut size needs to be determined, which resulted in the end of the bar is prone to defects such as burr, bump [2]. In order to be able to put the bar products into the market, and meet the market demand, the bar end must be dealt with. Bar processing industry contains a lot of bar end grinding method, and chamfering including portable grinding wheel, fixed grinding wheel. But these methods have the shortcomings of high labor intensity, low processing efficiency, it cannot quickly complete the end processing, resulting in accumulation of bar [3]; at the same time the chamfering quality cannot be guaranteed, the end of the bar swing will cause a certain impact on the grinding wheel, the grinding wheel is easy to fly, there are security risks [4]. The CNC technology provides a new way for the bar to bar chamfering, it can effectively avoid the above problems, using the chamfering machine can improve production efficiency and reduce production costs. Especially in recent years, the motion controller with high control precision, fast response and so on has been widely used [5]. An automatic chamfering machine is designed based on the of motion controller, it can effectively improve the existing working conditions, and it has a certain practical significance.

Chamfering machine working principle and the system hardware design

Chamfering machine working principle. Chamfering machine is mainly composed of two parts, one part is the loading and unloading mechanism, the other part is the chamfering part. As shown in Figure 1, the chamfering part has left and right two chamfering mechanism and intermediate clamping mechanism. Chamfering mechanism is driven by a servo motor to rotate and move, a cutter is put on the front of tool motor, moving motor is connected with the ball screw, when it works, bar is clamped by clamping mechanism, motor drives tool motor forward through ball screw, tool cutter motor rotates to do the bar chamfering, a photoelectric sensor is arranged in the front of the tool end, it is used to detect the relative position of the tool and the bar, to avoid angle error caused by the location error of bar. The feeding mechanism diagram is shown in Figure 2, when the system detects that there is no bar on the chamfering mechanism, the signal will be sent, the bar will roll to the specified location for chamfering through the movement of the cylinder.



1.Left moving motor 2.Left rotating motor 3.Left cutter 4.Clamping mechanism 5.Bar 6.Frame 7. Right cutter 8. Right rotating motor 9. Right moving motor

Figure 1.The diagram of chamfering machine

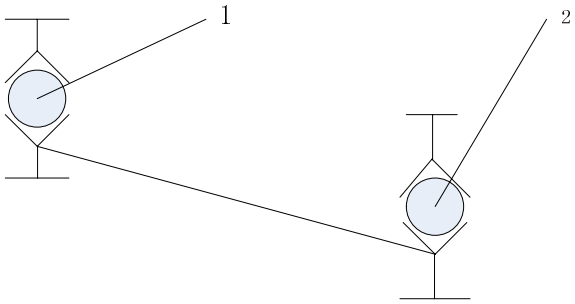


Figure 2.The diagram of feeding mechanism

Chamfering machine system hardware design. Chamfering machine control system has advantages of fast response speed, high control accuracy, and good reliability. The motion controller is used as the hardware core of the system in this paper. The motion control system also has servo driving part, man-machine interaction part etc. Figure 3 is a diagram of the hardware system of chamfering machine. The motion controller is used to realize logic control and motion control, servo driver communicates with motion controller directly, motion controller sends a control signal to the servo driver according to the procedure, the servo driver controls servo motor to carry out the corresponding movement. Communication between touch screen and motion controller through RS485, it is used for parameter setting and display. The sensors are used to detect the state of the chamfering machine; operation status indicator lights are used to indicate the chamfering machine.

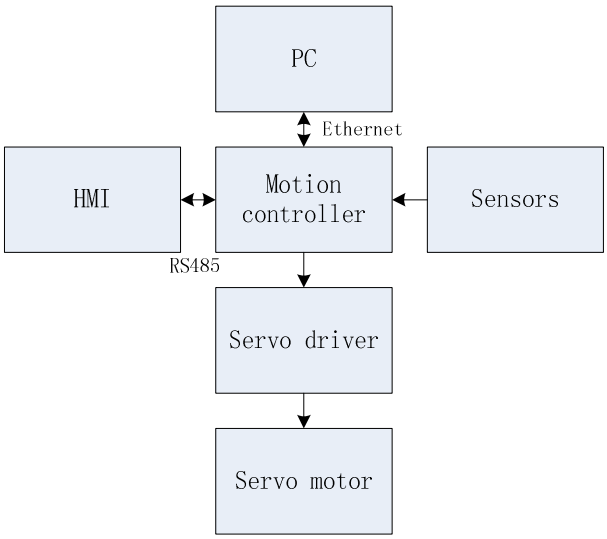


Figure 3.The hardware integration

Software design

The overall scheme of the software. In order to ensure the system real-time and scalability, chamfering machine control system adopts the modular design way. As shown in Figure 4, the software is divided into management module, motion module, parameter setting module and display module. The motion controller is a control device based on the PC, it only the operation environment, and does not have the development environment, so the development and management of the program has to be done by computer. The management module runs in Upper computer. The movement execution module is in motion controller, development and debugging program in on the upper computer, the program will directly transmitted to the motion controller, motion controller is processed according to the procedures. Parameter setting and display module is running on the touch screen. Different modules are responsible for different functions, it can guarantee the response speed and control accuracy of the system in this way, and ensure the quality of the bar chamfering.

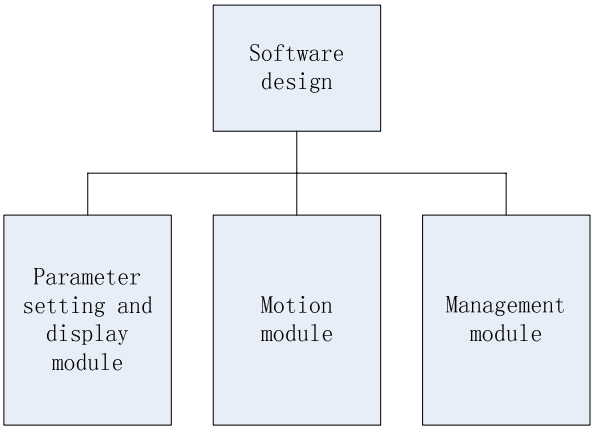


Figure4. The modular design of software

I/O design. Chamfering machine system uses sensor to detect the state of the system, the indicator light on the system indicates the operation state, these signals are received and sent through I/O interface controller, including position signal and indication signal etc. I/O system design is shown in table 1.

Table1. System I/O design

Input		Output	
IN0	Position signal 1	OUT0	Indication light 1
IN1	Position signal 2	OUT1	Indication light 2
IN2	Position signal 3	OUT2	Indication light 3
IN3	Position signal 4	OUT3	Indication light 4
		OUT4	Indication light 5
		OUT5	Indication light 6

Program flow design. In order to ensure the chamfering machine capable of stable operation, avoid the defects of quality and safety problems, program process must be strictly designed. First the system does initialization, it detects the running state of the system, if the system is in normal operation, it will continue to the next step of operation. Chamfering machine has two kinds of mode, automatic and manual operation, it is respectively for processing bar with different requirements, the operation mode is selected before starting work, if a manual operation mode is taken, which side to work can be chosen or on both sides, operation of the completion of the bar is done through the buttons on the touch screen for manual, chamfer. If the automatic operation mode, which side to work can also be chosen or on both sides at the same time, then set parameters, after all parameters setting, the system can automatically according to the set procedures for chamfering.

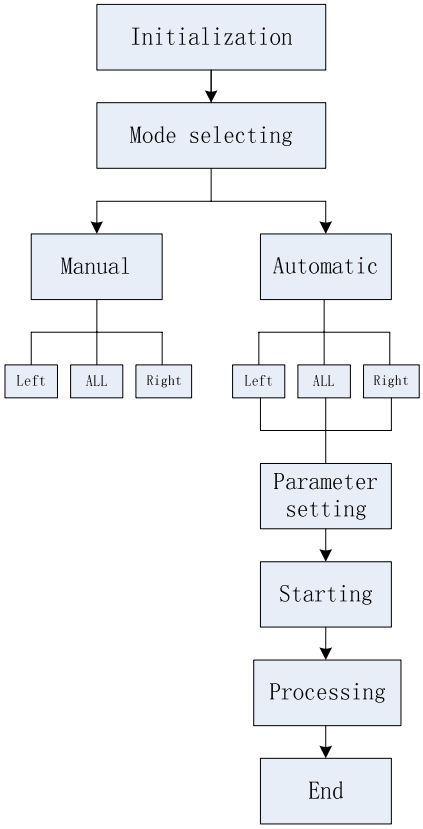


Figure5. Program flow design

Touch screen design. The touch screen is the main part of human-computer interaction, the operator select mode of input processing parameters through the touch screen; it can also observe parameters of each part of the system in operation. Communication between the touch screen and the motion controller through RS485 interface, touch screen design is shown in Figure 5, the interface is the display interface, the running status of the system can be monitored.

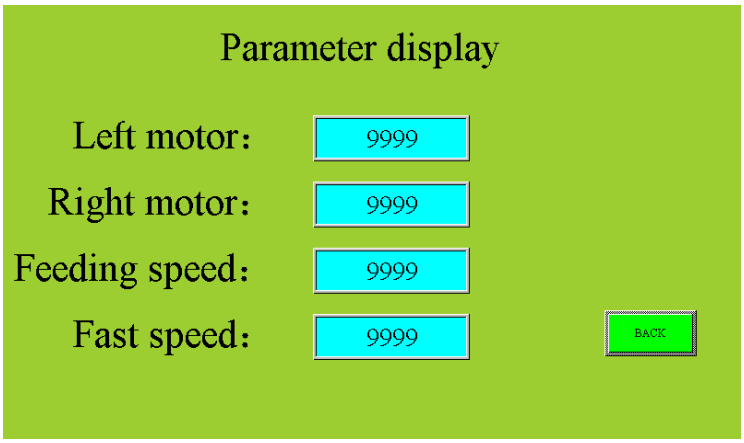


Figure6. Tough screen design

Summary

With the development of automatic control technique, the application of the bar is also increasing, but the post process of bar has become the main factors restricting the development of bar production enterprises, the application of numerical control technology has changed the traditional way of chamfering bar. A kind of chamfering machine is designed based on motion controller in this paper, motion controller has good flexibility, high control precision, good reliability and other advantages.

Chamfering machine has automatic and manual two modes, it can be selected according to different conditions in the practical application, chamfering machine can replace manual labor, improve product quality, and reduce production costs. It can meet the actual demand.

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