

Design of Belt Cutting Machine Based on Motion Controller

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Abstract. Aiming at the present problems existing in the manual belt cutting, a belt cutting machine is designed based on the motion controller. The hardware and software are designed. The belt cutting machine can realize the automation of the whole process of feeding, sizing, cutting and counting. The cutting test has been conducted, the result proves that the system is feasible, it can improve production efficiency, and reduce production cost. It has a certain practical value.

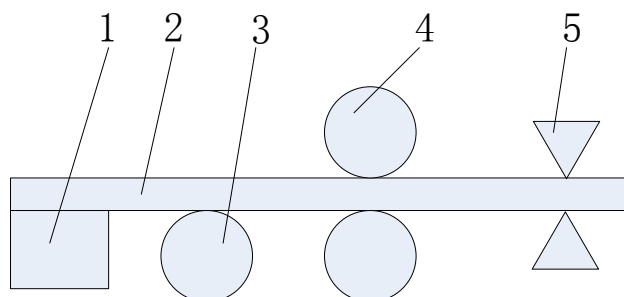
Keywords: Belt cutting machine; Control system; Motion controller

Introduction

Belt cutting machine has a wide range of applications in light industry, machinery industry and packaging industry [1]. Belt cutting machine can be used to cut off the heat-sensitive material into the lifting belt or shroud belt etc. The braided belt fixed length management and cutting are completed in the belt cutting machine, after cutting off, the woven belt can be used for subsequent processing, which can be processed into a variety of packaging bag [2]. The fixed ruler and measurement work of traditional belt cutting machine is generally done by man, the cutting includes artificial cutting and mechanical cutting. The mode of production has low efficiency and high cost, at the same time, it is difficult to guarantee the quality, and often in the presence of burr [3]. Therefore, the realization of belt cutting machine automatic feeding, measurement management and cutting machine, improving production efficiency and accuracy, which has the vital significance to the development of light industry, machinery industry and packaging industry [4]. Foreign countries have started the research of automatic belt cutting machine, domestic research on belt cutting machine is mainly about host drive control [5]. The control system for belt cutting machine is mainly to achieve the control of speed and accuracy, parameter setting etc. In recent years, the motion controller with high control precision, fast response speed has been widely applied [6]. The control system of belt cutting machine is designed with motion controller as the core.

Hardware design

The overall design. As shown in Figure 1, the automatic belt cutting machine is mainly composed of three parts of a control system, an automatic feeding mechanism, and a cutting mechanism. Control system is used for a variety of parameter settings, receiving the feedback signal, and coordinating motion of institutions according to the procedures and feedback information instruction, which will achieve the control of the automatic belt cutting machine. Automatic feed mechanism is used for belt cutting machine automatic feeding, which comprises a belt feeding mechanism and the belt transporting mechanism, the belt feeding mechanism is composed of a fixing bracket and a servo motor, fixed bracket is used for fixing the disc woven belt, woven belt is driven by a servo motor to complete action of the belt feeding mechanism; the belt transporting mechanism brings woven belt to the cutter position to be cut off, the belt transporting mechanism is composed of two rubber rollers, one of which is active roller, another is the driven roller. The driven roller can rotate freely, and it is fixed on a bracket, the bracket position can be adjusted to meet different needs of the pressure between the two rubber roller. The active roller is fixed on the frame, the rotation is driven by the servo motor. The woven belt is driven forward by the friction force between the two rubber roller, and belt transporting is completed. Cutting mechanism is used for cutting the woven belt, which is composed of two cutters, one cutter is fixed, another cutter is driven by servo motor through the crank mechanism, at the same time, counting work is realized through the cutting mechanism.



1. Control system 2. Frame 3. Feeding mechanism
 4. Transporting mechanism 5. Cutting mechanism
 Figure 1. The automatic belt cutting machine

Motion controller. Motion controller is the core of the control system, motion controller is used for coordinating the motion among each mechanism, receiving the feedback signals from automatic belt cutting machine, and doing real time adjustment according to the feedback signal and the setting program. In order to improve the machining efficiency and ensure the belt cutting precision, requirements of motion controller of the system must process and feedback the received signal quickly, and it also must have high control precision. In this paper, the motion controller of the belt cutting control system adopts the British Trio multi axis motion controller, the controller supports a variety of signal, it can receive and process various feedback signal accurately, response time is short. At the same time, the controller also has the function of PLC, it can be very convenient to use the program language to realize logic control. The controller set up various forms of exercise, they can be used directly. The Trio controller also provides many kinds of expansion module, the user can select and configure flexibly according to their own needs. The integration of motion controller and other hardware is shown in figure 2.

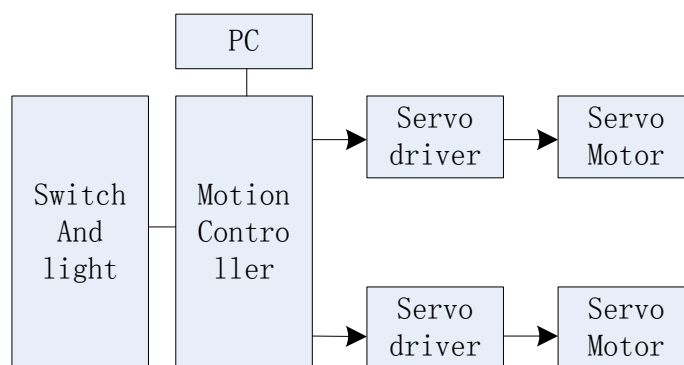


Figure 2. The integration of motion controller and other hardware

Servo system. Servo system is mainly used to drive the feed mechanism and the cutting mechanism, the servo system is required to match Trio controller. Japan YASKAWA servo system is used in this paper. YASKAWA servo system efficiency is high, the lost maximum torque is increased from 300% to 350%, which contributes to the efficient implementation of device; fever is low, inhibiting the loss increase can reduce the rise of temperature. It also has the advantage of small volume, light weight, good vibration resistance etc. And it can be matched with the Trio motion controller perfectly.

Software design

The software structure design. The ability of Trio motion controller does not have separate programming, it is a kind of open controller based on PC. So there need a PC to program and debug. As shown in Figure 3, upper and lower computer form is used in this paper to design program, PC

machine as the upper computer is used to do the overall program planning and management; motion controller as lower computer is used to perform motion control program. Program is done by the upper computer, the written program is transmitted to the motion controller, motion controller will implement related procedure.

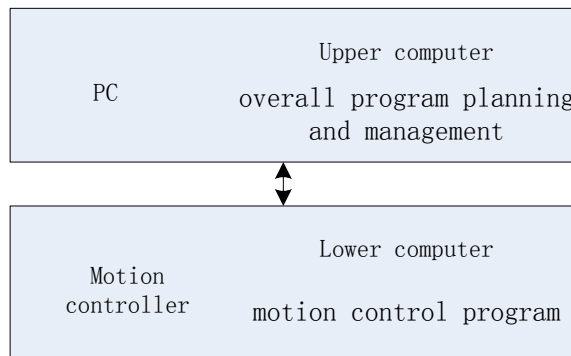


Figure3. The software structure design

The program flow design. According to the control requirements of the automatic belt cutting machine, the program flow of the control system is shown in figure 4. Start the initialization of the program before processing, the system will detect cutting temperature, if the cutter does not reach the specified temperature, it cannot work. Because if the cutter cutting temperature is not enough, it will affect the quality, even the belt cannot be cut off. The system detects that the cutter reaches the specified temperature, then do the processing mode selection, manual or automatic. In the automatic mode, parameters need to be set. After the parameter setting, the processing starts, the system will automatically detect any error. If there is error, system will stop running, and automatically return the initialization program.

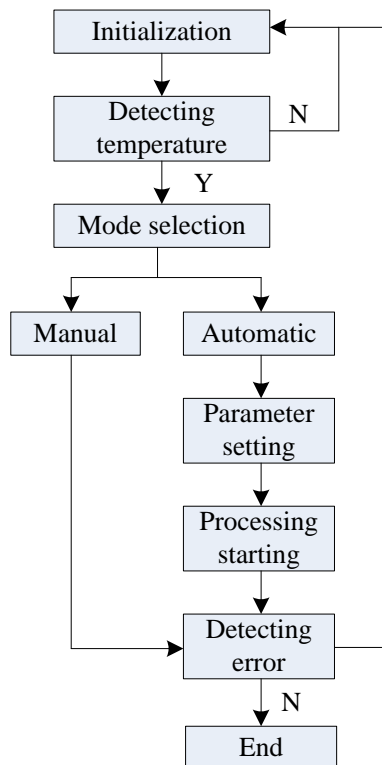


Figure4. The program flow

I/O design. System receives and sends signals through the I/O interface of the controller, the system I/O design is shown in table 1.

Table1. System I/O design

Input		Output	
IN0	Feeding photoelectric switch	OUT0	Indicator light 1
IN1	Counting sensor	OUT1	Indicator light 2
IN2	Error signal sensor	OUT2	Indicator light 3
		OUT3	Indicator light 4

Cut test

The test of woven belt cutting with designed belt cutting machine is done in a factory, results show that the cutting machine can realize the whole process of automatic feeding, sizing, cutting and counting, product quality is good. The use of belt cutting machine can improve production efficiency more than 50%, which has an important significance.

Summary

An automatic belt cutting machine is designed based on the motion controller in this paper, the cutting machine can realize the whole process of automatic feeding, sizing, cutting and counting. Using the motion controller as the motion control core can improve the flexibility of the system. The user can configure the system according to the demand of the system. Test of cutting is done with the automatic belt cutting machine, and the results prove that the system is feasible, it can improve processing efficiency, and reduce the production cost It has an important application value.

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