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RESEARCH ARTICLE

CONTROL SYSTEM DESIGN OF THREE-SERVO PACKING MACHINE

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ABSTRACT

Aiming at the shortcomings of packaging machine, such as slow packing speed, limited packing precision and low intelligent level, a three-servo intelligent high-speed packaging machine was designed and developed. Three-servo packaging machine is one of the most important equipment in food and material packaging industry. Its control effect and reliability have a key impact on the efficient completion of packaging process. Aiming at the control requirements of the transmission system of three-servo packaging machine, the object control condition based on DSP device is adopted to establish the specific control scheme of the lower computer, including anti-interference design, main circulation process design, working state control and parking control, so as to realize the precise control of each working link of the packaging machine.

INTRODUCTION

With the development and application of mechanical production and electronic technology, packaging machine industry at home and abroad is developing rapidly. The improvement of intelligent control level makes packaging machine usher in a very good development opportunity. At present, the three-servo packaging machine with excellent performance has been widely used in various industries and fields. It combines new transmission technology and new control means. It can not only ensure the efficient work of the packaging machine, but also achieve a substantial increase in the cost-performance ratio of processing equipment. The rapid development of domestic three-servo packaging machine mainly originated from the introduction of foreign technology, which has obviously narrowed the gap between domestic and foreign packaging industry in automation control. However, because the core technology is still mastered abroad and the cost of the introduction of new technology is very high, the control technology of some domestic small and medium-sized enterprises has been at a low level for a long time. Therefore, breaking the current situation of this problem is a problem that the development of domestic market economy must face. Otherwise, it will lead to the loss of market dominant position and dominant control ability of domestic core technology. Under the long-term influence of economic globalization in China, computer, communication, automation and other control technologies are integrated in various industries and fields, which can effectively promote the development of domestic packaging machine control technology. In view of the complex control content of the transmission parts of the

three-servo packaging machine, the paper adopts DSP56800 to control and design each link, and finally realizes the efficient and reliable working ability of the packaging machine, and promotes the development and progress of the packaging industry.

Overall design of control system

Application of core controller: According to the application characteristics and controlled contents of DSP control in various fields, the control schemes can be divided into three kinds. The control scheme based on data flow and structure has good real-time performance and high operational efficiency for multi-task processing. The later stage of program maintenance is concise and clear, but the control object of complex work is difficult to achieve by standardized and standardized program. The Physical drawing of electric control system is shown in Fig.1. The control scheme based on finite state machine is easy to realize the developer's modeling intention, and has high development efficiency under the control condition of high structure level. Under the condition of finite state machine development, the requirement of program design for new technicians is relatively low, and the program of control program is simple to write. However, it is difficult to implement under specific conditions, such as multiple concurrency control conditions. Object-based control schemes tend to be visualized, which can directly model controlled objectives in software, and realize the standardization, reliability and practicability of the program in accordance with industry standards. Object-oriented control schemes have good application prospects, but the implementation of real-time systems needs to be developed or expanded. The transmission system of three-servo packaging machine requires higher control system and more strict control scheme selection.

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When the three-servo packaging machine is working, the user sets the working requirements and working conditions of the packaging. The process is realized by the upper computer control terminal. The transmission parts of the packaging machine work, such as the triaxial coordinated motion of the transverse seal shaft, the plastic composite film shaft and the material groove shaft. Each packaging link has good synchronization, which is realized by the lower computer. This is also the core part of the whole control system, and the process has strict standardization. According to the control requirements of the transmission system of the three-servo packaging machine, the object-based control scheme is adopted in this paper.



Fig. 1. Physical drawing of electric control system

Determination of control scheme and process: The transmission system of the three-servo packaging machine has specific specifications, of which working principle diagram and physical drawing are separately shown in Fig.2 and Fig.3. When designing the control steps, it is necessary to follow the functional requirements and the nature of the control scheme. Aiming at the working principle of the three-servo drive system, the functions and specific control tasks of the whole control system are studied, and the main functions of the host computer and the slave computer are defined. The control model is established and described by using UML through object-based control method. When the control scheme is established, the motion characteristics of three servo motors need to be considered comprehensively, so that the overall control scheme of the lower computer can be given, and the partition control can be realized according to the specific action. In order to ensure the feasibility and validity of program control under long working conditions, it is necessary to consider comprehensively the difficulty and realizability of programming. In the system, the serial communication program is programmed by VB, and the communication process is realized by MSCComm serial control. MSCComm works in two ways in the system: event-driven and query. Among them, event-driven method is mainly used in the design process of the program, adding its own relevant code in the event processing function according to the user's

requirements, the program can automatically respond, and the reliability is very high; query method is mainly used to verify the correctness of the program by checking various attribute values, which is widely used in simple programs.

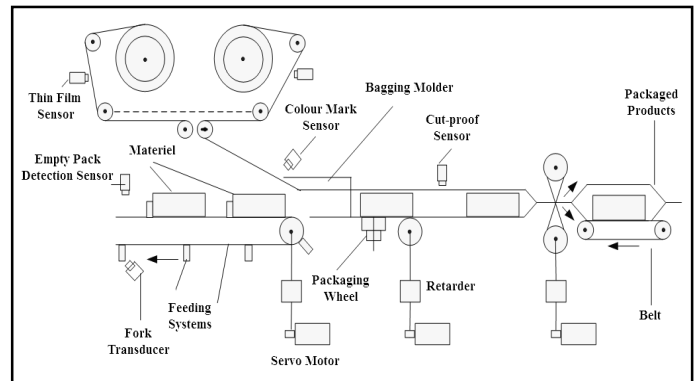


Fig. 2. Working principle diagram of packing machine



Fig. 3. Physical drawing of packing machine

Design of control function: The key component of the control system is the cooperation between the upper computer control terminal and the lower computer processor. According to the structural characteristics of the packaged parts, the staff set the relevant process sizes on the upper computer, such as initial process parameters, later parameter modification, working status display, fault information warning, packaging quality detection data, etc. When the control system works, it is necessary to check the existence of each sensor, that is, initialization. After initialization, the instruction of skipping ROM is sent, then the instruction of reading register is sent, and the reset pulse is sent to DSP56800. After receiving the signal, the DSP begins to record the parameter values, and finally gets the final accurate measurement data through CRC verification. The system sets parameters such as communication port, baud rate and stop bit length at the communication port to control the closing and closing attributes of the serial port.

Design of Control System for Lower Computer

Software design scheme: The software of the lower computer runs on the DSP56F807. The design and implementation of the software are mainly embodied in the software compilation of the DSP chip. This design uses CodeWarrior, an integrated development environment for Motorola's DSP series chips, to develop the DSP program.

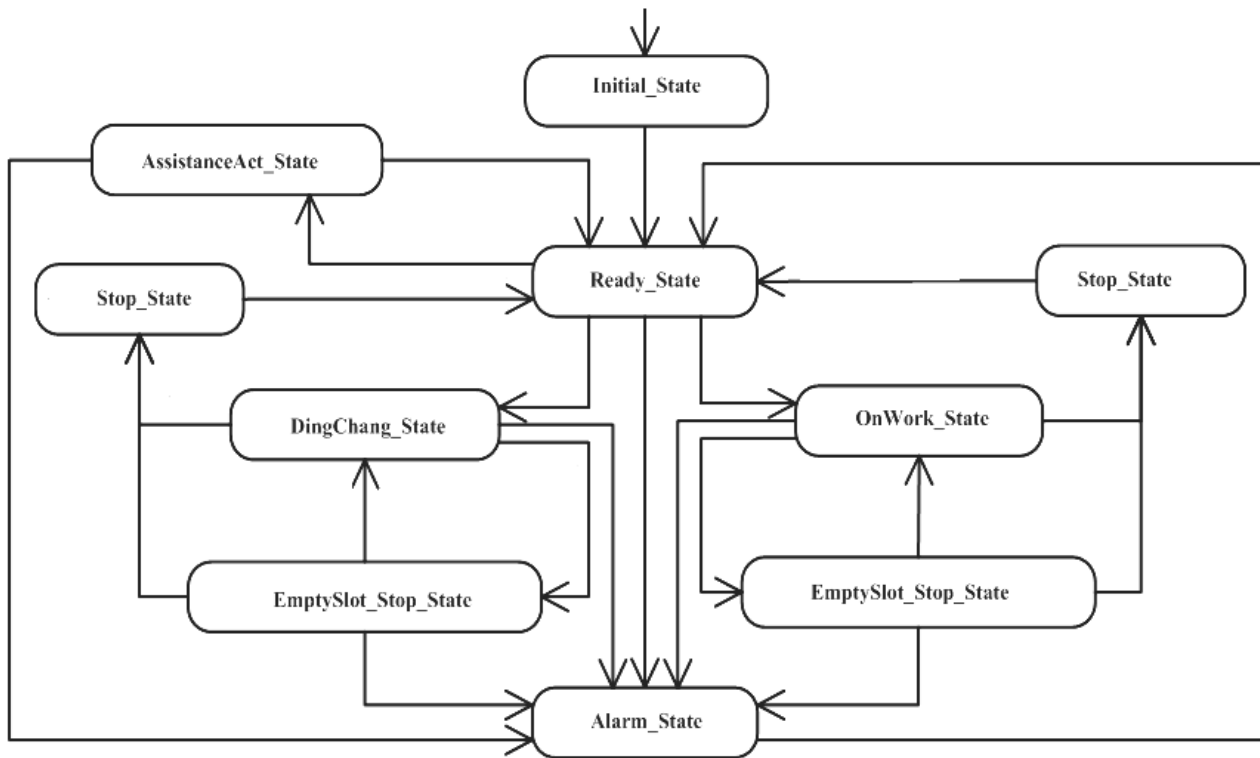


Fig. 4. Control flow of packing machine

The development environment can automatically check the obvious errors in the code. It scans the code through an integrated debugger and editor to find out the errors. And reduce the obvious errors, then compile and link the program so that the computer can understand and execute the program. The development environment enables users to make full use of the chip's functions and quickly and easily establish and set up a complex DSP system. C/C++ programming is allowed in CodeWarrior development environment, and assembly programming is also supported to improve the execution efficiency of embedded programs. The lower computer software not only gives the basic functions of the lower computer software of the automatic packaging machine control system, but also realizes the new functions proposed by users. The software design of the lower computer can be abstracted as a continuous process of dealing with external events and designed as a single task embedded real-time motion control program.

Process design: The control flow of the packing machine is shown in Fig.4. The control system of automatic packaging machine first enters the initialization state to initialize the system and automatically enters the standby state. In standby state, the system cycle for event acquisition and command query. When receiving the auxiliary action instructions of touch screen (such as tracking, fixed length, length measurement, zero clearing, point operation, positioning, slot detection opening, electronic cut-off opening, automatic film opening, calibration, film calibration and cylinder control etc.), the system state is transferred from standby state to auxiliary action state. After the equipment completes the corresponding auxiliary action processing, the system state automatically returns to standby state.

Improvement of software control: Generally, anti-jamming control by software can achieve remarkable results. In order to ensure the accuracy of the parameters obtained after the processing of DSP, in this paper, the anti-jamming design of

the whole system is carried out by software digital filtering in the process of data acquisition, aiming at the signals monitored by the sensors of the whole system. Arithmetic average filtering is used to eliminate the random error of the system. Its disadvantage is that the sensitivity of the system will decrease with the increase of sampling frequency. Therefore, these two factors need to be considered comprehensively, so the sampling coefficients should be selected properly to ensure better filtering effect. Although the arithmetic average filtering method has obvious suppression effect on the interference of random whole signal, its processing ability to the pulse interference is weak, even makes the whole pulse signal farther away from the actual value. Therefore, according to different working conditions, it is necessary to improve the digital filtering effect of the whole software. Pulse interference can be well suppressed by using better filtering method. Before executing the specific servo control subroutine, the packaging machine should calibrate each sensor, determine the instruction sending through the expected response signal, and execute the control command when the inspection is normal, that is, the working state analysis. When the lower computer system receives the data, it will carry out data location, protection and storage.

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Conclusions

In the control scheme of transmission parts of the three-servo packaging machine studied in this paper, the starting, packaging and parking processes of the packaging machine under various working conditions show good stability and controllability, meet the working requirements of the three-servo motor, meet the engineering design targets, and have good economic and social benefits. Under the control condition of DSP56800, the axle of the three parts of the packaging machine can move together and achieve good

synchronization. In summary, the control scheme in this paper has good practicability and feasibility.

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