Research on Optimization Design of Multi-motor Intelligent Dispensing System

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Abstract: *Through the research on the intelligent dispensing system of Chinese and Western medicine at home and abroad, the advantages and disadvantages of the finished products of each intelligent dispensing system are analyzed, so as to design an intelligent dispensing system with certain advantages and only for Chinese medicine. Based on the designed system structure, the system is modeled in three dimensions to determine whether the designed system is feasible. In addition, a rough study of the selection, working principle and implementation basis of the system motion controller is carried out.*

Keyword- *Intelligent dispensing system; Path optimization; Integrated design; Operation control system*

I. Introduction

Traditional Chinese medicine has a long history and is an important part of the Chinese national civilization. At present, there are as many as 10,000 kinds of botanicals known, and there are more than 10,000 kinds of commonly used ones. The reserves are very rich [1]. Compared with western medicine, traditional Chinese medicine has the advantages of all-natural, small side effects, and treating both the symptoms and the root causes [2]. However, the old-fashioned dispensing and drug-carrying methods that have been used for thousands of years have long been unable to adapt to today's fast-paced, efficient modern society [3]. Therefore, the research on the intelligent dispensing system of traditional Chinese medicine has urgent practical significance.

At present, most of the smart dispensing systems for Chinese medicine production in the country follow the Western intelligent dispensing system for western medicine. Under the guidance of the theory of traditional Chinese medicine, using modern preparation technology, the traditional Chinese medicine decoction pieces are made into granular drugs according to the steps of extraction, concentration, drying and granulation to promote the development of intelligent dispensing of traditional Chinese medicine [4].

What this paper is to study is the design of the intelligent drug-dispensing structure for the original medicinal materials of traditional Chinese medicine. The object is a traditional Chinese medicine reel that has been packaged in a quantitative manner and connected by small bags.

II. The development status of automated pharmacies

Since the end of the last century, based on modern drug management ideas, Germany, the United States, Japan and other developed countries have carried out research on pharmacy intelligence and automation, and developed a series of automation products supporting the hospital wards. These smart pharmacies mainly use the following four technical methods:

1. Robotic:

The key technology of this type of automated pharmacy is the control of the robotic vacuum adsorption and mechanical clamping coordinated action, which automatically operates in accordance with the instructions of the management software in a three-dimensional space platform. Specifically, the following example is shown in Figure 1.

Fig1. Robotic automated pharmacy

2. Storage tank type:

In order to allow the kit to be dispensed smoothly from the reservoir, the key technology is the design of the reservoir.

First of all, the principle of gravity blanking is used to discharge the medicine, and the discharge opening of the storage tank must have a certain inclination angle with the horizontal plane. This design can make the medicine box get a certain buffering effect when it falls, and will not be damaged. In addition, the size of the medicine storage tank is related to the storage amount of the medicine in the pharmacy, and it needs to be designed according to the actual situation. Specifically, there are examples in Figure 2 below.

Fig2. Drug storage tank automatic pharmacy

3.Rotary cabinet

This type of automatic pharmacy is driven by a motor to drive a rotary drive chain. The hopper link hinge is arranged at a fixed distance on the drive chain, and is driven by the drive chain during operation. Specifically, the following examples are shown in Figures 3.
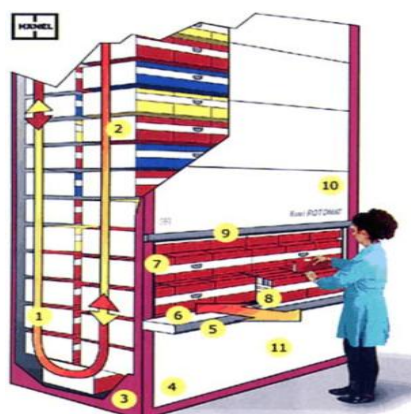

Fig3. Rotary cabinet automatic pharmacy

4. Bulk drugs

The workflow of such pharmacies is relatively simple, and the medicines are stored in bulk in the pharmacy. When the medicine is stored, all actions are directly performed by the robot. Specifically, the following examples are shown in Figures 4.

Fig4. Bulk drug automated pharmacy

5.Pill preparations

The dispensing of the pill preparation by the automatic counting medicine box is the most suitable control system for realizing the intelligent dispensing of the Chinese medicine formula particles.

III. Research on 3D Modeling and Path Optimization

The intelligent dispensing system studied in this paper is an integrated structure control system. Integrated design and control is a complex and integrated design approach that integrates systematic analysis of plant dynamics into process control to find a proper approach at the control and economic levels [5].

In this paper, the design of traditional Chinese medicine dispensing system is based on the integrated design method. Each Chinese medicine corresponds to a set of Chinese medicine tray unwinding device, Chinese medicine delivery counting and cutting device, Chinese medicine dispensing device and Chinese medicine centralized device, and these devices are reasonably integrated to ensure that the space occupied by the system is reduced without affecting the working efficiency of the system.

Based on the above example diagram, the three-dimensional software is used to present the design results in three dimensions. The details are shown in Figure 5 below.
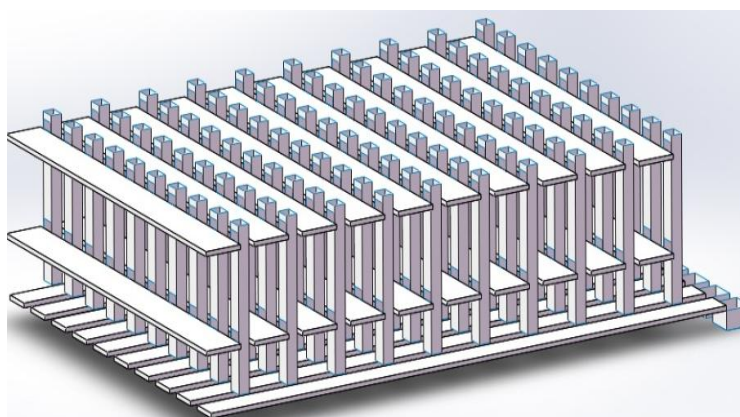

Fig5. Intelligent Chinese medicine dispensing system structure diagram

In the intelligent dispensing system of traditional Chinese medicine, after the traditional Chinese medicine belt is coiled according to different regulations, it will be transported to different storage tanks through the upper medicine tray conveyor belt. In order to improve the dispensing efficiency, the allocation of the tank position must also comply with certain criteria [6]:

1. The principle of distance priority

Drugs with high frequency of use are stored in a place with low storage and close to the prescription tank of traditional Chinese medicine. At the same time, the integrated dispensing system close to the storage tank is preferred.

2. Principles of drug relevance

Extracting the law of drug use from a large amount of prescription information, storing related drugs in adjacent storage places, and also arranging the layout of the drug boxes in the storage tank according to the seasonal information of the disease and different prescriptions and other useful information. .

IV.Basic theory and hardware construction of motion control system

4.1Concept of motion control system

As one of the branches of the automatic control system, the motion control system mainly controls various moving equipment and devices. In simple terms, the motion control will present the expected mechanical motion of the position and velocity of the mechanical moving parts under complex conditions, which are represented by the expected motion trajectory and the specified motion parameters. The motion control system has certain dynamic and real-time performance, generally with the motor as the control object, and is carried out for its speed, attitude and displacement [7]. The motion control system usually has a controller as its core, and the actuator is a power electronics and power conversion device. Motion control is now widely used in industry, such as packaging, textiles, printing and assembly.

4.2Basic composition of motion control system

A complete motion control system is like a complete human body, and no component can be lacked. It is roughly divided into hardware and control software as shown in Figure 6. Subdivided, there are many types of complete motion control systems. The components of a typical motion control system are shown below.
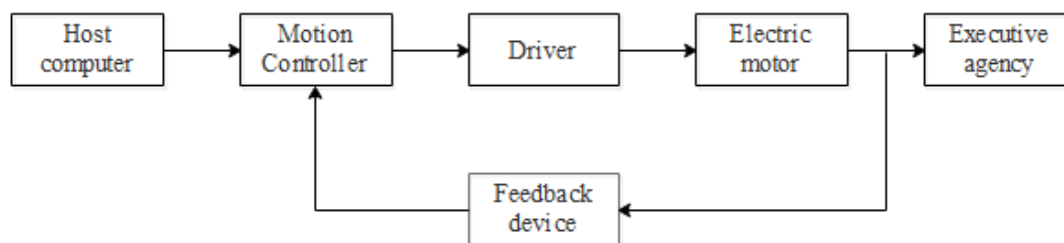

Fig6. Typical motion control system composition diagram

4.3Principle of motion control

Motion control refers to the conversion of predetermined control schemes and control commands into desired mechanical motions to achieve precise position control, speed control and acceleration control of the actuator [8]. Positioning accuracy is one of the key indicators to measure the quality of a motion control system, and there are many factors affecting the positioning accuracy, such as load, friction, disturbance, etc. Therefore, in order to achieve high-precision positioning control, the positioning selected by the control system must be selected. The device has high requirements, and the accuracy of the positioning device largely determines the positioning accuracy of the system [9].

4.4Classification of motion control systems

1. Classification according to servo control mode: open loop control system, semi-closed loop control system and full closed loop control system.
2. Classification by structure: Concentrated Control System (CCS), Distributed Control System (DCS) and Fieldbus Control System (FCS).
3. Classified by profession: mechanical system, hardware system and software system.
The research in this paper is a full-closed-loop control distributed intelligent dispensing system. The specific structure has the following 7 schematic diagram.
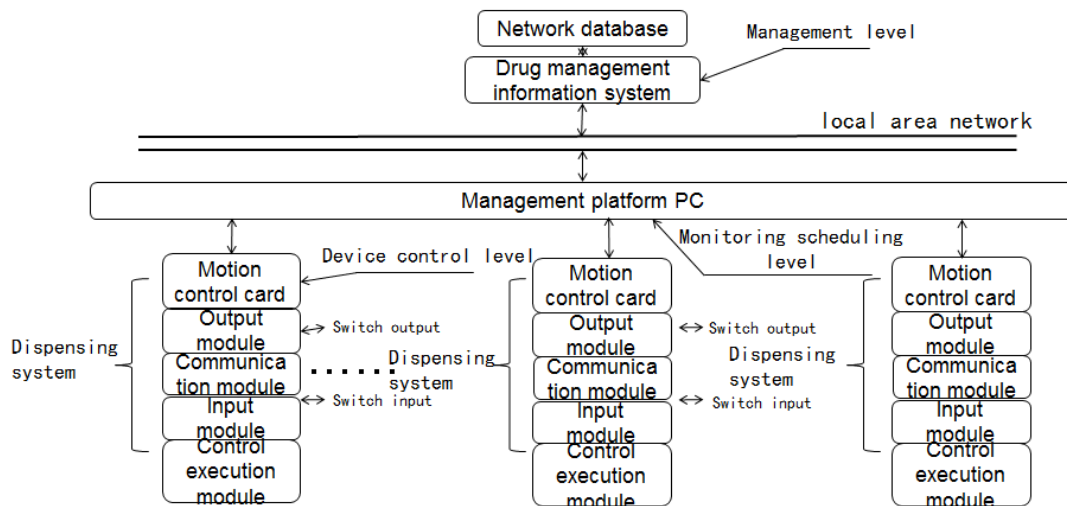
Fig7. Intelligent Chinese medicine dispensing system structure block diagram

4.5Selection of intelligent dispensing system controller
　　Common motion controllers are: PLC (programmable logic controller), independent motion controller, motion control card, dedicated motion controller, etc. Their characteristics are as follows.
1. PLC
　　Although the motion control function of the PLC is relatively simple, its reliable operation and simple programming are awkward, and its controller can now provide software tools, which greatly simplify programming, log and alarm management, in order to reduce The size and cost of the system can also be increased by adding motion modules directly to existing PLCs.

2.Independent motion controller
　　Stand-alone motion controllers are also powerful in providing application solutions, whether they are small single-axis machines or large machines built over distributed networks.

3. PCI bus type motion control card
　　Each type of motion controller has its own unique features, and the motion control card is no exception. It has two remarkable features. One of them is very powerful for writing the program mentioned above, and the other is the use of motion control card. The number of axes of the motion controller is expanded. The motion control card has its own characteristics, but also has the disadvantages of stable operation and poor reliability.

4.Dedicated motion controller
　　The dedicated motion controller is usually designed with the chip of MCU and ARM as the core. It has high integration, low price and convenient use. The software is specially designed for special equipment and can be used directly by customers. Its hardware and software design fully consider the process requirements of special equipment [10].
　　As can be seen from the above description, the "PC + motion control card" constitutes a multi-axis motion controller control scheme has more advantages, so the system uses the "PC + motion control card" control mode to design a multi-axis motion control system.
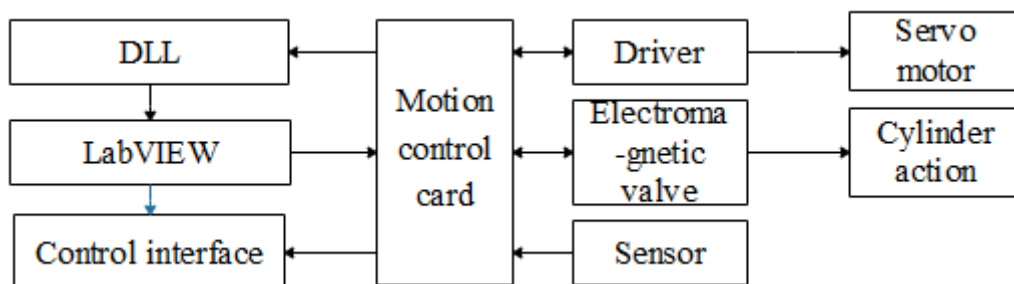The specific hardware is built as follows picture 8.

Fig8. Overall structure of the system

V.Conclusion

This paper firstly gave a preliminary understanding of the development process of the intelligent dispensing system of traditional Chinese medicine. Later, based on past experience, the three-dimensional structure of the intelligent dispensing system of traditional Chinese medicine was initially modeled. Finally, from the control of the system to the whole system.A comprehensive understanding of the hardware and software, and finally put forward rationalization ideas.

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