Home-style smart medicine box for the elderly

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Abstract. With the intensification of the aging of our country’s population, the health care of the elderly has become a social problem that must be solved in my country. Elderly people often suffer from chronic diseases and need long-term medication. However, it is difficult for the elderly to take medicines on time and in doses due to deterioration of their physical functions. Based on the above background, the project team researched and designed a smart medicine box that can intelligently remind and automatically dispense medicine. The device is mainly divided into four functional modules: medicine dispensing module, medicine taking module, medicine dispensing module, and control module. It realizes the five basic functions of medicine addition, temporary storage and sealing, medicine absorption, automatic medicine dispensing, and timing reminder and Additional features such as data sharing.

1. Research background and significance

1.1. Research background
Due to the increase of age, the physical and physiological functions of the elderly are degraded, which makes the elderly vulnerable to chronic diseases and need to take long-term medication. However, the memory of the elderly is relatively weak, and it is difficult to remember the dosage and frequency of various medicines correctly. Based on this background, the project team plans to start by reminding the elderly to take medicine, and design a new generation of smart medicine box. The medicine box has the functions of automatically reminding the elderly to take medicine, improving the elderly’s medication habits, and automatically taking, dispensing and dispensing medicine for the elderly. The medicine box can also feed back the elderly’s physical feelings and record the effects of medication.

1.2. Research significance
Currently, the existing smart pill boxes on the market have a single function or are too complicated to be used by the elderly. Therefore, it is of great significance and use value to design a household smart medicine box that is easy to operate, has multiple functions, and can realize reminding and dispensing medicine.
2. Overall design
The household smart medicine box is a mechatronic device integrating mechanical structure and circuit control technology. In order to realize the functions of adding, temporarily storing, sealing medicines, drawing medicines and automatically dispensing medicines in the smart medicine box, the whole mechanism is divided into four modules for design.

2.1. Design ideas of medicine taking device
The medicine taking device mainly has the following requirements: first, it must ensure the stability of storage conditions, second, it is necessary to achieve selective grasping of tablets of different sizes, weights and shapes, and third, it is necessary to consider the space and space occupied by the medicine taking device itself. For its space utilization, we decided to adopt the structural design combining the screw slide table and the scissor mechanism, and through the connection of the spring, realized the demand of a power source to provide power for the two-way movement of the medicine taking device, and the air pump provides suction. The suction cup on the head of the medicine taking device can accurately grasp the tablets.

2.2. The design ideas of the medicine bottle sealing and opening and closing device
Common medicine bottles often adopt the design of separating the body and cap of the medicine bottle, but the operation of this kind of bottle cap is more complicated. Therefore, the project team used the design of the capless water cup for reference, and used the rubber film to seal the medicine bottle. While ensuring the sealing effect, it also facilitates the combination with other mechanisms to realize the operation of the medicine bottle to the open and close lid.

2.3. Design Ideas of Rotary Medicine Storage Device
Considering that there are many types of medicines that are commonly used and the storage volume has certain requirements, the space utilization rate should be maximized, and at the same time, it should be able to control the medicine bottle to accurately move to the preset position, so it was decided to use six points The groove wheel mechanism can maximize the use of space and ensure the accuracy of operation.

2.4. Design Ideas of Dispensing and Dispensing Device
This work plans to realize two ways to take medicine, one is to automatically pour the pills into the hand through the turntable after the taking port senses the human hand, and the other is to introduce the pills into a portable small pill box, which has a timer reminder The vibration function makes it convenient for users to take medicine on time when they are out.

3. Module design

3.1. Medicine taking module
The medicine taking module is composed of a screw sliding table, a spring, a scissor mechanism and an air pump, which converts the single-stage linear movement of the sliding table into a double-stage curvilinear movement of the medicine taking head with a clever trajectory. The design results of the mechanism are shown in Figure 1.

![Figure 1](image-url)
the scissor mechanism is 35mm, and the number of connecting rod pairs is 5 pairs

3.2. Seal and switch cover module
The sealing and opening module can be subdivided into two parts, the sealing part of the vial and the opening and closing part.

3.2.1. The design of the vial
The vial is sealed with a rubber film. The rubber film is cylindrical and placed inside the middle of the vial. Its diameter is similar to the inner diameter of the vial. Its upper and lower ends are connected to the center of the vial and the vial chuck. The middle part of the medicine bottle and the mouth of the bottle can rotate mutually to realize the twisting of the rubber film.

3.2.2. Design of switch cover module
The switch cover module consists of two parts: the switch cover device and the lifting device. Due to space constraints, this mechanism uses a combination of a motor and a chuck, and the lifting device uses a double cam mechanism. The synchronous rotation of the two cams allows the switch cover mechanism to be raised and lowered. The design results of the mechanism are shown in Figure 2.

![Figure 2. Schematic diagram of switch cover module](image)

3.3. Rotating medicine storage module
The rotating medicine storage module distributes six small medicine bottles on six corners. The six small medicine bottles are fixed on the disc by linear guide rails. At the same time, they can be slid out through the linear guide rail to facilitate taking out the small medicine bottles. The design results of the mechanism are shown in Figure 3.

![Figure 3. Rotating medicine storage module](image)

In order to ensure that the rotating mechanism can accurately position the vial and improve the fault-tolerant performance of the mechanism, through many experiments, it was decided to adopt a six-index sheave mechanism to achieve the control of the vial.
3.4. Dispensing medicine module

The main function of the medicine dispensing module is to collect the medicine taken out by the medicine taking module and store it in the corresponding module for easy taking out. The elderly can choose two ways to dispense medicine according to their needs, which is more humane. The design results of the mechanism are shown in Figure 4.

The overall design of the Home-style smart medicine box is shown in Figure 5.

4. Project innovation points

(1) The medicine taking module adopts a structure that combines a screw rod and a scissor mechanism. Only by controlling the rotation of the screw, the back and forth and up and down movement of the medicine taking module can be controlled. At the same time, the use of the scissor mechanism is also reduced. The length in the vertical direction improves the space utilization rate.

(2) The rotating medicine storage module adopts an intermittent mechanism, which has high rotation accuracy and also improves the fault tolerance of the mechanism.

(3) Two different ways of dispensing medicine, which can not only meet the needs of users at home, but also meet the needs of taking medicine when going out.

5. Application prospects

The current pill box products on the market only have the function of timed reminders. They still need to be manually dispensed and cannot meet the needs of elderly people living alone. Therefore, there is an urgent need for a product that can fill the gap in this area. This product, on the premise of both intelligence, the use needs of the elderly are fully considered, so that the elderly can take medicines correctly and on time even when living alone, which has a high market application prospect.
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