Development and design of on intelligent medicine box

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Abstract. This paper proposes an intelligent medicine box which can be used to provide safe medication to the elderly who are living alone. The design is based on STM32F103 micro-controller and other intelligent control components. The basic working principle is analyzed as well as the hardware structure. The proposed medicine box is full-automation, high-intelligent and multi-functional which can effectively avoid the health and safety risks caused by the memory declination of the old people.

1. Introduction

With the rapid development of society, the living-alone elderly have always been a prominent problem. Medicine is the necessity in their daily lives. Compared with traditional medicine boxes, intelligent medicine boxes are expected to have the characteristic of full-automation, high-intelligent and multi-functional. At present, the most popular product named “AI YiJi”[1] intelligent medicine box has been implemented with some kinds of intelligent control, but it has not yet realized the function of automatic distribution. In this paper, a brand new intelligent box is proposed which could realize automatic distribution, automatic transferring information, heart rate detection as well as the SOS emergency call help.[2] The medicine box also provides voice and display functions which can provide services to the low-educated elderly. It also help to submit the status of the elderly to their children in time. The intelligent medicine box is very easy to operate, which is another important character for elderly. According to the tips of the medicine box, you can operate it skillfully.

This paper discusses the hardware configuration, software control flow, working principle, appearance structure and other related design of the intelligent medicine box. Section 2 introduces the hardware configuration. Section 3 shows the appearance structure. Section 4 analyzes the working principle and Section 5 concludes the paper.

2. System hardware configuration

The Smart medicine box is an intelligent and multifunctional tool under the function of drive control circuit. The composition of the hardware of drive control circuit is as shown in Figure 1. including power circuit, control circuit and other circuits. The power supply circuit converts 12V DC input to 5V DC and 3.3V DC output, which are respectively used as power supply for control circuit and other circuits. The control circuit is STM32F103 type control chip. Other circuits include: The motor drive circuit is to control the operation of vibration motor.

The push rod drive circuit is to control the move of medicine push rod. In the initial state, all the push rods will be at the front. The main purpose is to block the medicine in the upper medicine slot from dropping when a certain medicine slot is shaking. The motor drive circuit
has 8 parallel drive circuits, each of which drives a vibration motor and drive the corresponding medicine slot to deliver the medicine. The push rod drive circuit has 8 parallel drive circuits, each of which is connected with a coil in the push rod mechanism to control the energization of the coil. Then thrust to the push rod is generated under the action of the electric field to push the medicine into the medicine taking box. 8 photoelectric sensors are connected to supervise and control the quantity of drugs taken. The communication module adopts EP8266-12E chip, the control circuit communicates with the following interfaces. 

It is connected with the interface of the display screen for function selection and parameter setting. It is connected with the interface of the camera module (the camera module adopts OV7725 chip, the camera collects the image in the medicine taking box and sends it into the control circuit); the interface will also controls the camera as per the control signal from the control circuit. It is connected with the voice circuit to reminding taking medicine; the voice circuit sends out the voice of taking medicine reminder according to the received signal from the control circuit. It is also connected with the heart rate detection module and SOS button. The heart rate detection module is a MAX3100 model detection chip, it could detect heart rate and displays the measured data on the screen; the user can reach for help by pressing SOS button under emergency.

![Figure 1. Structure of the hardware of drive control circuit](image)

3. Appearance structure

The exterior of the smart medicine box is as shown in Figure 2, Figure 3, Figure 4, and Figure 5. The outer case a) is divided into the upper and the lower layer. The upper layer is set up with medicine supply mechanism that can contain and output different kinds of pills or tablets in different amount. The lower layer is for the drive control mechanism to driving and control the medicine supply mechanism according to the set time, set types and set amounts.

As shown in Figure 4, the drug supply mechanism includes: 8 medicine slots d) arranged at two sides of the interior of upper layer to hold different kinds of drug pills and tablets, as shown in Fig.5 and Fig.3 drug slots d) are arranged on the each side of the medicine box in symmetrical way, and on the side of each medicine slot d) one vibration motor is arranged to drive the drug pills in the slot d) to discharge from the drug outlet at the bottom of the drug slot. The signal input end of the vibration motor e) is connected with the control signal output end of the drive control circuit through a wire, a push rod is arranged under the medicine outlet of each slot d) to push the medicine pills or tablets discharged from the outlet of the medicine box d) into the medicine taking box c) on the top of the medicine box, and the signal input end of the pushing mechanism f) is also connected through a wire to the control signal output end of the drive control circuit. The pushing mechanism f) comprises an outlet channel and a push rod penetrating the channel. When the coil is powered on, it will generate the momentum to the push rod to move towards the outlet of the slot d) so as to push the pills into
the medicine taking box c), when the coil is powered off, the push rod will be retracted.

The exterior is set up with medicine taking box c) to receive the medicine sent by the medicine supplying mechanism and for the user to take medicine. The medicine box c) is arranged in the middle part of the bottom surface of the lower layer of the shell, and the direction of the outer Shell is the moving direction of pulling out and pushing. The front of the exterior case a) is set up with a display screen t), the upper side of the exterior case is arranged with a heart rate detecting port i) for checking the heart rate, and the SOS button j) for emergency help, and the top of each medicine taking box d) is set up with on/off cover h). Heart rate detection port i) has a detection module that can check user’s heart rate by putting one finger on, and the heart rate detection module and the SOS button j) are respectively connected with the driving control circuit with a wire.

A camera b) is arranged in the medicine taking boxes d) to supervise whether the medicine is taken or not. The camera b) covers a surveillance range of the lower layer and the corresponding medicine taking box c). The medicine supply mechanism is provided with one photoelectric sensor g) at each of the 8 medicine outlet for collecting the information of medicine output pieces. The camera b), the photoelectric sensor g) and the display screen t) are respectively connected with the drive control circuit with a wire.

4. Working principle

The working principle and control method of the smart medicine box are as shown in Figure 6. The kit has three main functions.

For the automatic medicine dispensing function, the medicine can be put into the corresponding slots by the user or his relatives or friends according to the instruction on the medicine packing. After putting the drugs into the slots, one can set on the display screen the time and quantity of taking each drugs. After completion of setup, when it is time for take a certain drug, the internal push rod moves backward (initially the push rod is at the front), vibration motor works and slightly shakes the corresponding medicine slot. At this time, the
medicine will fall to the front of the push rod through the medicine outlet, and the push rod move forward to push the medicine into the medicine taking box. The control circuit will send a voice reminder through the voice circuit at the set time of taking medicine to remind of taking medicine. When the medicine is pushed into the medicine taking box, the user can open the taking box for the medicine. That is the whole process of taking medicine. If the camera above the medicine taking box detects that the user has not taken medicine, the medicine box will remind twice and send the reminder information to the family member to ensure that the family member will remind.

If the user wants to measure the heart rate, he can select the heart rate check function on the screen and place his finger on the heart rate detection port to detect. The check result will display on the screen after the detection.[8]

For the button emergency call function, the user can set the emergency call contact first. In the case of an emergency, the user can press the SOS button on the medicine box, and the control circuit will inform the contact person through the communication module for rescue.

Figure 6. Flow chart of drive control of Smart medicine box
5. Conclusion

This paper presents an intelligent medicine box in order to help the elderly to take medicine safely. The basic working principle of the system is analyzed, and the hardware configuration and appearance structure of the system are introduced. The design has the characteristics of automatic dispensing, high intelligence and multi-function, and can effectively avoid the health and safety risks brought by the memory declination of the elderly.

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