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# Design of an Intelligent medication box system

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**Abstract:** In the context of todays intelligent development, in order to help improve the living experience of the elderly, convenient and intelligent "smart medicine boxes" have begun to enter their lives. The intelligent medication box system designed in this article aims to assist elderly people in taking medication, while monitoring and providing feedback on daily medication usage information. Using microcontroller technology and Bluetooth wireless communication technology, when Bluetooth is in contact with a mobile phone, the indicator light of the smart medicine box will light up, the LCD1602 display screen will prompt medication, and the buzzer will sound an alarm, thereby reminding the elderly to take medication at the appropriate time. When the switch of the smart medicine box fluctuates, the mobile app will provide feedback on the switch status of the medicine box, thereby providing specific information on the medication taking of the elderly. The future application prospects of this system are extremely broad.

**Keywords:** STM32; LCD1602; Bluetooth communication; APP.

## 1. Introduction

As they grow older, many elderly people become forgetful. These elderly people find it difficult to take medication on time in their daily lives, and further timely, quantitative, and planned medication intake is even more demanding and difficult for the elderly population. At the same time, based on the current design of intelligent medication boxes, the specific requirements of current market products cannot be met, and the control system of medication boxes is relatively cumbersome. In the specific application process, it will actually bring troubles to the daily life of the elderly. Therefore, in this context, adopting the system design concept of "integrated design" to simplify and optimize the application and development of intelligent medicine boxes can obviously meet the market demand and promote the effective development of the entire industry. The concept of this design is to assist the elderly in achieving "planned medication", designed to help them with their daily lives. It is a convenient storage container for these people to take medication on time. It can better assist elderly people who cannot take medication on time by providing necessary medication reminders according to the medication frequency, type, and specific medication schedule set in the app, helping them follow medical advice and take medication on time.

## 2. System scheme design

In the design process of this system scheme, STM32 microcontroller was mainly selected as the core, which also includes 3 LED light circuits, 3 switch detection circuits, 1 alarm circuit, 1 LCD display circuit, 1 Bluetooth module control circuit, and power supply circuit.

In the specific system design process, this intelligent medicine box adopts an embedded system design approach. We have chosen a circuit design approach with a "microcontroller" as the core system and various functional circuits as peripheral assistants, forming a centralized and diversified system integration mode that constitutes the entire intelligent medicine box design system. In this systematic design, the microcontroller is responsible for the "brain" function of the entire system. The minimum system composed of clock and reset circuit is the "output bridge" in the entire system design system.

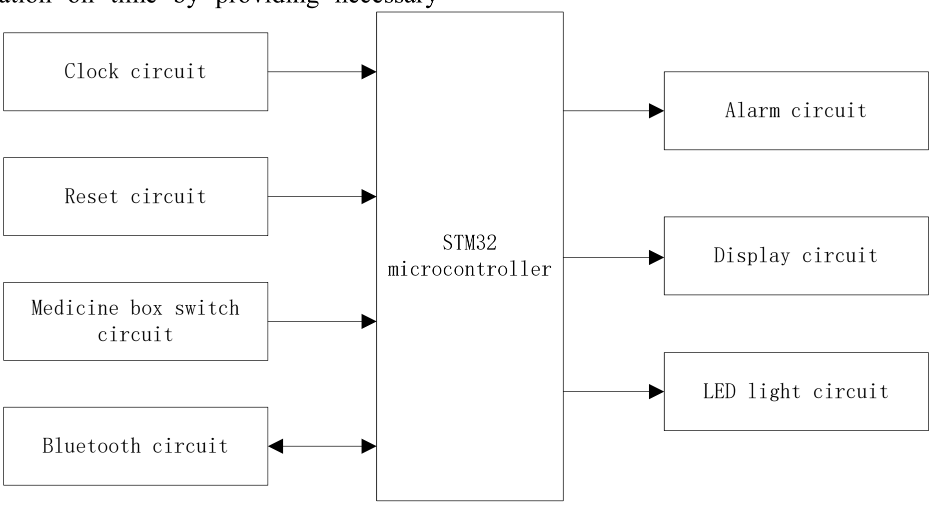


**Figure 1.** System block diagram

The design block diagram of the system is shown in Figure 1, and the functions of each part are as follows:

1). Use Bluetooth connection to connect the terminal device to the mobile app.

2). The LCD screen displays real-time time and displays specific medication plans on the APP terminal. When the design time is up, the indicator light of the smart medicine box will light up, and a "buzzer reminder" will be used to remind the elderly to take medication in a timely manner. The display screen prompts to take medicine. At this time, you can open the medicine box to take the medicine, and then close the medicine box after taking it out.

3). During the process of opening and closing the medication box, the specific opening and closing actions will generate data reminders, which will be transmitted to the mobile APP terminal, allowing daily medication status to be viewed through the APP.

4). Regardless of whether the time is up or not, there will be a record of the elderly person opening the medicine box, making it convenient for their family to check the usage of the medicine box.

5). The opening and closing of the medicine box require manual operation.

# 3. Hardware design of the system

## 3.1. Wireless Bluetooth Module Communication Circuit Design

This article uses the HC-06 Bluetooth module and also adopts the "command communication" mode in the design process to achieve effective matching with mobile terminals. The Bluetooth circuit module design of this system mainly focuses on the following aspects:

1). The mobile terminal APP encodes relevant instructions into information data, transmits it to the Bluetooth module through the Bluetooth communication channel, and re encodes the relevant data instructions. Finally, it inputs them into the control center of the chip through the serial port to achieve effective execution of the instructions.

2). After receiving the relevant processing data, the control center packages and sends the specific data to the chips Bluetooth module, and uploads the command data using AT commands. Finally, with the help of Bluetooth communication channels, the specific command operations are transmitted to the mobile terminal APP. The Bluetooth circuit of this design is shown in Figure 2.

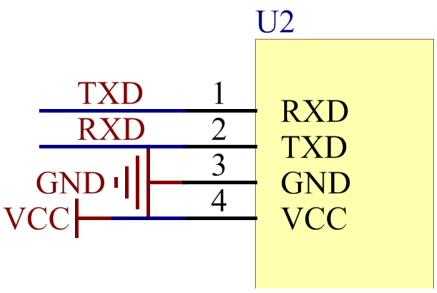


**Figure 2.** Bluetooth circuit

The HC-06 module has four external pins, VCC, GND, TXD, and RXD. The Bluetooth power supply voltage range is 5V ± 0.3V, and the rated voltage is 5V. The input voltage of this system is 5V, so there is no need to add an additional power conversion circuit. TXD and RXD pins are cross connected to the TXD and RXD of the control center, otherwise communication cannot be achieved.

## 3.2. LCD Display Circuit Design

In order to enable the intelligent medication box system to display real-time time and prompt medication on the arrival time display screen, this project designs the hardware driver circuit structure of the LCD1602 LCD screen based on the previous design, as shown in Figure 3, There are a total of 11 software pin ports for the LCD1602 LCD screen, and each pin can be docked according to the circuit connection relationship. According to research, the best contrast can be achieved when a DC voltage of about+1V is applied to the third pin V0. Therefore, in this project, two resistors with resistance values of 1k and 10k are connected in series to divide the+5V DC voltage and generate a+1V DC voltage. Then, it is connected to the VO pin of the LCD screen, followed by the connection of the data input and output pins DB0-DB7, which have a total of 8 pins. This design allocates the PB port of the microcontroller with a total of 8 pins for connection, that is, DB0-DB7 are respectively connected to PA8-PA15, thus forming the two components. The parallel interface docking between them, and finally the instruction control pin E The connection of the RW and RS pins is allocated in this design, with the PB5-PB7 pins of the microcontroller connected to the E, RW, and RS pins of the LCD screen.

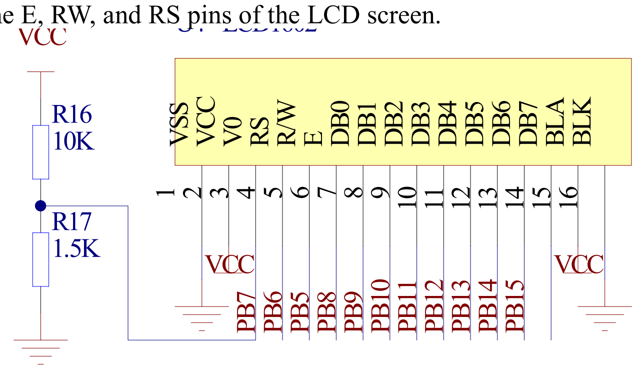


**Figure 3.** LCD1602 LCD screen circuit

## 3.3. Circuit design of luminous LED lights

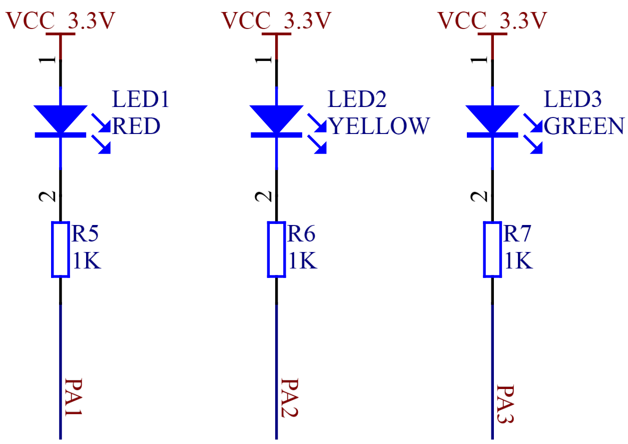


**Figure 4.** LED indicator circuit

In the design process of this system, common LED tubes in the market were selected as the indicator lights for the medicine box. At the same time, the LED indicator lights used in this system are made of light-emitting diodes as components, and the "one-way conductivity" of diodes is utilized to control and implement the entire LED light display function. In the design process of this system, the selected LED lamp is a 5mm specification tube, and the conduction current is 3mA. Since the input voltage of the system has been rectified by the power circuit to meet the input requirements of the LED lighting circuit, the system does not require a separate power conversion circuit. Of course, it should be pointed out that in the design process of this system, a "current limiting resistor" component was also added to effectively protect the entire LED tube system. Figure 4 shows the LED indicator circuit.

## 3.4. Alarm Circuit Design

In the design process of this system, a "buzzer" was selected as the alarm device component for the medicine box in the selection of the alarm system. Considering the low sound of passive buzzers and the relatively weak hearing ability of the elderly population, there may be situations where they cannot hear sound. Therefore, this system uses an active buzzer as the alarm device. However, the active buzzer also requires power connection, so this system has also designed the alarm circuit specifically.

The voltage range of the active buzzer selected for this system is 5V ± 0.5V, and the input voltage is the same as the input voltage of the entire system. There is a difference in the startup power consumption between the buzzer and the microcontroller. Therefore, in the system design process, the author selected a transistor as the driver to effectively improve the load capacity of the entire system. The 8050 model transistor is used, with a default amplification factor of 100. Figure 5 shows the alarm circuit.

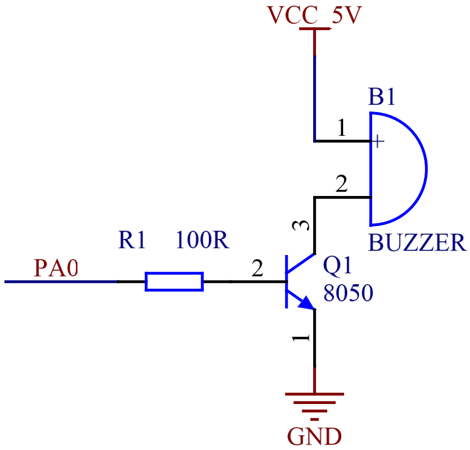


**Figure 5.** Alarm Circuit

According to the above figure, when the transistor 8050 is in the disconnected state, the power supply of the buzzer is in the cut-off state, effectively achieving control of the buzzer. As long as the transistor 8050 is conducting, it indicates that the power supply of the entire medication box system is normal, and the buzzer of the system is also in operation. The resistor R1 in the figure is a current limiting resistor, mainly used to ensure the stability of the operation of the microcontroller and prevent the occurrence of excessive current burning the microcontroller. In addition, during the design process of this system, there is no need to control the volume of the buzzer, so it is only necessary to ensure that the driving duty cycle of the buzzer remains in a simple state of "1" or "0".

## 3.5. Design of Medicine Box Switch Circuit

In the design process of the medicine box switch circuit, the commonly used "triangle physical in place switch" controller in the market was selected, and its specific circuit design is shown in the following figure.

It should also be pointed out that there is a certain delay in the use of physical switches, and this delay is mainly due to the state of the switch, which is manually controlled for operation. Therefore, in order to ensure the correctness of system operation instructions and the accuracy of the entire instruction action, the delay of switch instructions was controlled at the level of 500ms.

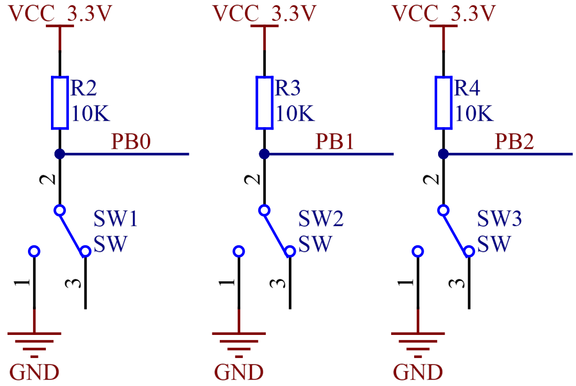


**Figure 6.** Medicine box switch circuit

## 3.6. APP Program Design

The APP needs to connect to the Bluetooth module, set the medication time and send it to the STM32 microcontroller via Bluetooth, and send the opening status of the medication box to the APP to view the daily medication status. During the development process of the mobile app, JAVA language was chosen for the language design of the entire app. The specific design work includes the following steps.

### 3.6.1. Design Bluetooth interface

In the process of programming the Bluetooth interface, startDiscover() was chosen to implement the calling of the microcontroller Bluetooth module, and relevant instruction data propagation was carried out after the docking was completed. The Bluetooth docking process took about 13 seconds during the experiment, and a connection fault alarm was added.

### 3.6.2. Broadcasting and Data Processing

In the design process of this section, considering the need to call the bluedapter. startDiscovery() function to achieve the transmission and docking of Bluetooth broadcast search, a delay was added in the design process, that is, Bluetooth broadcast data will only be matched between the mobile terminal and the smart medicine box after a period of search. After the matching is completed, information transmission will be carried out between the mobile terminal APP and the smart medicine box, and the relevant medicine box information and time design will be written into the storage chip, thus realizing the control connection between the mobile terminal APP and the hardware.

### 3.6.3. Design of Timing Function

In the system design process, the connection between the microcontroller and the mobile phone needs to be achieved through Bluetooth transmission, so the interface data of the application program needs to be set with a data preprocessing program. It is necessary to achieve device docking in order to achieve communication, and data sharing can be achieved without obtaining output through threads.

After writing the above program, connect the APP to Bluetooth, set the medication time, and check the opening status of the medicine box.

# 4. Software design of the system

After the overall software of the system is started, a system reset operation will be performed first, which will reset the variables of the entire operation data and enter the initialization state of the system module. Subsequently, the instruction data of the entire system is received and analyzed, and the relevant control instructions are issued to the relevant system modules through data encoding, and implemented using various control units of the microcontroller. At the same time, after the relevant data instructions are issued, the system will transfer the data to the storage to effectively save the called data. Figure 7 is the main program flowchart.

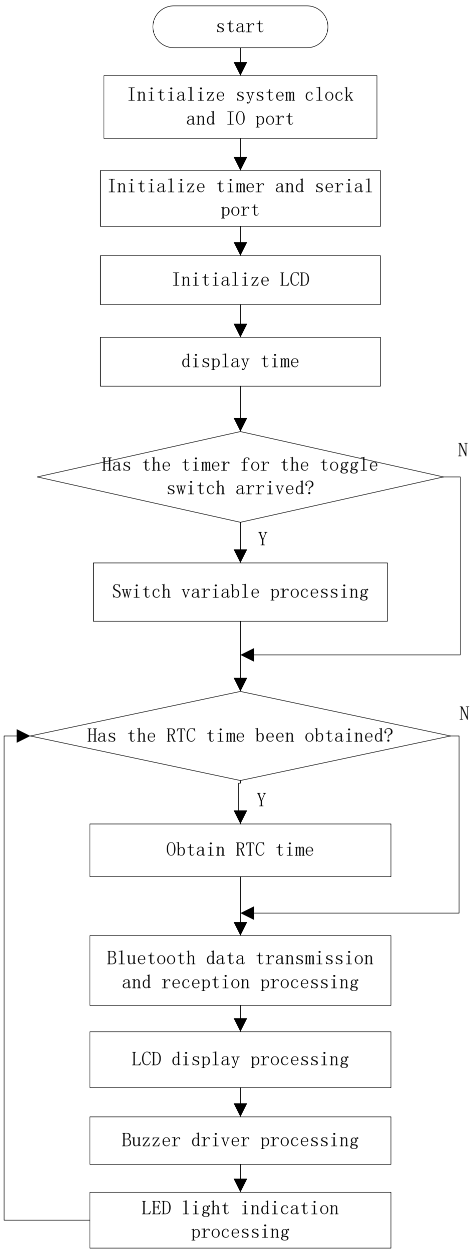


**Figure 7.** Main program flowchart

# 5. Conclusion

This design enters the perspective of the elderly and is fully portable and intelligent. Its highly automated dispensing system, reminders, and real-time monitoring functions prevent medication accidents before they occur. The medication information setting system, which can be managed by a third party, is not only remote and convenient, but also completely separates elderly people with poor self-control ability from drug selection, and only requires the most basic and simple operations to complete medication. Provided a healthy and safe life for the elderly, prevented medication accidents, and relieved the worries of guardians. With the rapid increase of the elderly population in our country, medication boxes will inevitably become a necessary equipment for home medication management. At the same time, this design minimizes the impact of medication on daily life through intelligent management, providing users with the most caring medication care.

# Acknowledgment

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# References

[1] Wu Zhenlei, Gu Chuchu. Intelligent Medicine Box Design Based on STM32 Embedded Technology [J]. Gansu Science and Technology Zongheng, 2020.

[2] Lan Xinyue, Yang Jing, Dong Xinjun et al. Exploration of Elderly Medicine Box Design [J]. Western Leather, 2020.

[3] Huo Kaikai Design and Research of "Guardian" Intelligent Medicine Box [J]. Green Packaging, 2023.

[4] Dong Hongyu. Intelligent Medicine Box Design Based on STM32 and IoT Technology [J]. IoT Technology, 2023.