

# Design of Smart Home System Based on Voice Control and Bluetooth Communication

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**Keywords:** smart home; microcontroller; voice control; bluetooth; stepper motor

**Abstract:** With the development of electronic information technology, home environment is becoming more and more intelligent. Smart home system based on voice control and Bluetooth communication can control illumination, color and curtain rise and fall of color lights in intelligent home through voice dialogue or mobile phone APP. Smart night lights are added, which provides convenience for people's life. The system adopts the form of slave computer and host computer, and achieves wireless communication between slave computer and host computer through C2540F256 Bluetooth chip. The slave computer uses STM32F103 chip as microprocessor and LD3320 chip as voice dialogue function or Bluetooth APP of mobile phone to send instructions. The host computer uses STC89C52 as microprocessor to realize intelligent control of lights and curtains.

## 1. Introduction

With the continuous development of science and technology, people's demand for home life is no longer limited to simple material needs, but more concerned about the intelligent home. For users, the real intelligent home life is to make the machine in the induction environment, can make its own judgment, and according to the actual environment to make changes. Real smart home should be truly insensitive, can directly "dialogue" with it, to achieve the control of household appliances, and truly create a senseless smart home system. The smart home system based on voice control and Bluetooth communication controls the illumination, color and curtain status of color lights through voice and mobile phone APP.

## 2. System Design

Intelligent voice control system uses wireless Bluetooth communication, which is divided into two parts: host and slave. The slave transmits signals to the host through voice module or mobile phone. The master MCU feedback signals to control the light's turn on and off and the color change. At the same time, it controls the motor's operation, simulates the curtain's rise and fall, and detects the indoor environment with built-in photosensitive resistor, and controls the turn-on and turn-off of the indoor night lamp.

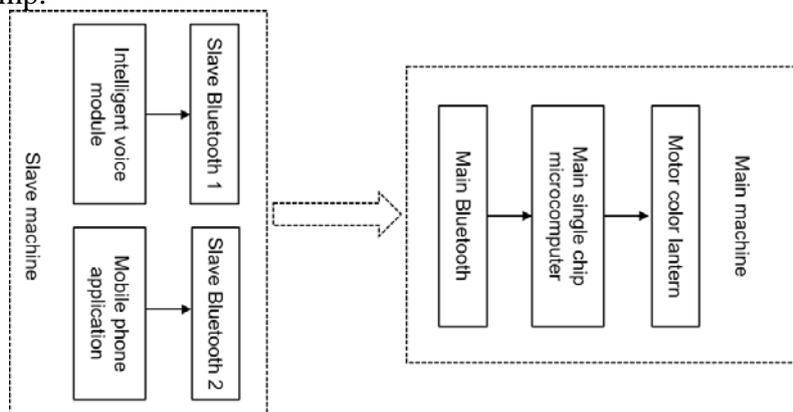


Fig. 1 System schematic diagram

There are two forms of slave machine:

- (1) Human voice signal is collected by intelligent voice module and sent to Bluetooth 1;
- (2) The instructions are sent to the built-in Bluetooth 2 of the mobile phone through Bluetooth APP of the smart phone.

The main Bluetooth receives the control signal from Bluetooth signal and sends it to the single chip computer, which controls the light of the color lamp, the color of the color lamp and the rise and fall of the curtain.

### **3. Hardware Circuit Design**

#### **3.1 Design of Intelligent Voice Module**

The intelligent voice module uses LDV5 speech recognition module, which mainly includes voice chip and microprocessor. The voice chip adopts LD3320 chip and the microprocessor adopts STM32F103 chip. LD3320 chip is a speech recognition/voice control chip based on speaker-independent speech recognition technology. The chip integrates high-precision A/D interface, and can realize speech recognition/voice control/man-machine conversation function without external auxiliary FLASH and RAM, and the list of identified keywords can be dynamically edited. STM32F103 chip is a 32-bit RISC processor. The high performance of its ARM core is greatly reflected in the storage space of 8-bit and 16-bit systems. In addition, it integrates FLASH storage, SRAM, rich I/O interface and advanced interrupt response system.

- (1) LDV5 module has the function of USB interface and TF card reading U disk;
- (2) It has a low-speed TF card with maximum 4G Mini support;
- (3) It can realize man-machine dialogue, play MP3 function, play songs, dialogue and other functions.
- (4) It has the function of serial port output identification code and supports 1-12 bytes custom 16-bit output.
- (5) Support password recognition (for example, if the module is defined as "smart home", only after each "smart home" is said, the module can receive other operations);
- (6) Support common recognition mode and key trigger mode to adapt to different application environments;
- (7) With the watchdog reset function, the system is more stable and durable.

There is a TF card on the module. When using the voice module, the module can be operated only by modifying the content of the TF card. For example, 78 I/O ports of PA0-PA are reserved, and I/O ports can be used by simply setting the corresponding serial number of menu text in TF card. Each port has the functions of high level, low level, high level 0.5 s and high level 1 s. When using I/O port output, only the serial number is associated, but not related to others. If the keywords corresponding to the serial number are recognized correctly, the port will have the corresponding state output, which is not affected by the identification code.

#### **3.2 Bluetooth Module Design**

HC-08 Bluetooth serial module uses CC2540F256 chip. It is a data transmission module based on Bluetooth Specification V4.0 BLE Bluetooth protocol. It has 2.4 GHz ISM working frequency band and GFSK modulation mode. The maximum transmission power of Bluetooth is 4 dBm, - 93 dBm, which can realize long-distance transmission up to 80 M.

There are two ways of Bluetooth connection: one is the connection between Bluetooth and Bluetooth, the other is the connection between Bluetooth and mobile phone.

- (1) Connection between Bluetooth and Bluetooth

The connection between Bluetooth and Bluetooth will be connected from Bluetooth to main Bluetooth through Bluetooth module, as shown in Figure 3.

Instructions are sent by voice module and transmitted to MCU through Bluetooth. After receiving signals, MCU takes corresponding measures to control the light on or off and the color change, as well as to drive the motor to change the curtain state.

When using the connection between module and module, bluetooth, voice module and single-chip computer need to be connected according to the way shown in Figure 2. The first is voice module LDV5, and the second is host single-chip computer STC89C52. Because HC-08 defaults to slave Bluetooth, Bluetooth needs to be set up. As long as the Bluetooth is connected with the serial port transfer TTL module and the serial debugging assistant sends "AT+ROLE=0" through the AT command, when Bluetooth power off and power on again, it can become the main Bluetooth mode. After the power on from Bluetooth, the master and slave Bluetooth will automatically connect to realize the transfer function.

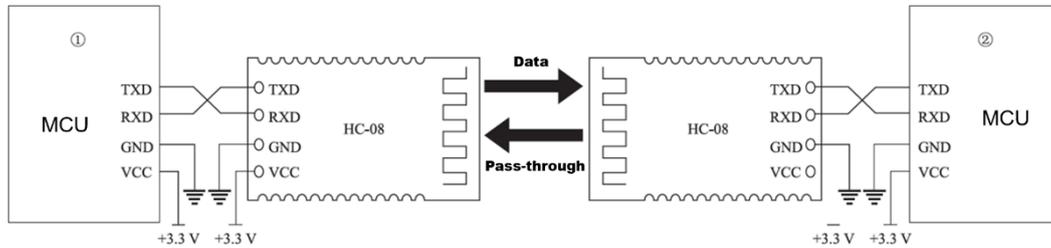


Fig. 2 Bluetooth module

### (2) Connection between Bluetooth and Mobile Phone

The connection mode realizes wireless transmission of mobile phones and microcontrollers through Bluetooth module, as shown in Figure 3. Mobile phone sends instructions to MCU through Bluetooth, MCU receives signals, and takes corresponding measures to control the lighting and color change of color lights, as well as to drive the motor to change the curtain state.

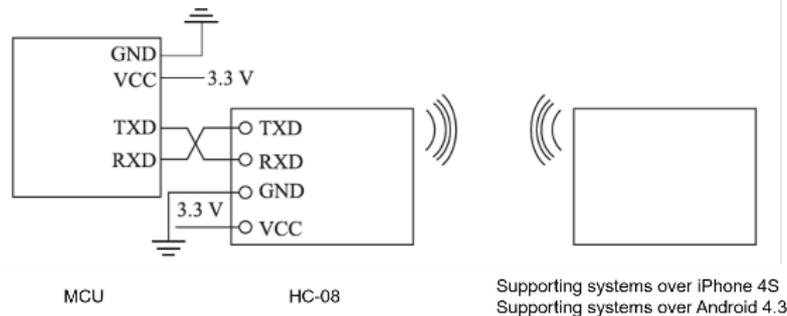


Fig. 3 Communication module

When using mobile phone to connect with Bluetooth, choose Bluetooth in mobile phone. Mobile phone downloads Bluetooth Assistant APP and connects to the main Bluetooth via Bluetooth Assistant, as shown in Figure 5. Because Bluetooth assistant defaults to 16-bit, when writing instructions such as "f8" and "ff", the instructions will be sent to MCU to realize home control.

### 3.3 Main Microprocessor Design

The processor of the host computer chooses STC series STC89C52 chip . It is a low-power but high-performance chip with 8-bit CMOS microcontroller and 8 kB programmable FLASH memory. It supports ISP download and is often used to control circuit detection. In addition, when debugging the circuit, if you need to reload the program, you can directly burn the program through the software to avoid multiple unplugging chips, so it will not cause damage to the chip. STC89C52 has a total of 40 pins. It has 4 kB FLASH memory, 128B RAM, 32 external bidirectional I/O ports, 5 interrupt priority, 2 16-bit programmable timing counters and 2 full duplex serial communication intra-chip clock oscillators. It has idle mode, normal mode and power failure mode, and different modes cooperate with different situations in order to rationally allocate internal resources.

### 3.4 Motor Module Design

Because the stepper motor is easy to operate, has small error and is not limited by weight without overload, it can be used in the fields related to speed and position that need to be controlled.

Therefore, the stepper motor is used in the motor module of this paper. It converts the electric pulse signal into an open-loop control element of angular displacement or linear displacement. The driving board of stepping motor adopts ULN2003. ULN2003 is a high-voltage, high-current Darlington array consisting of seven silicon NPN Darlington tubes. Every pair of Darlington in ULN2003 is connected with a 2.7 k<sub>base</sub> resistance in series, which can be directly connected with TTL and CMOS circuits at 5 V working voltage to process data previously required to be processed by standard logical buffers. The motor module circuit is shown in Figure 4.

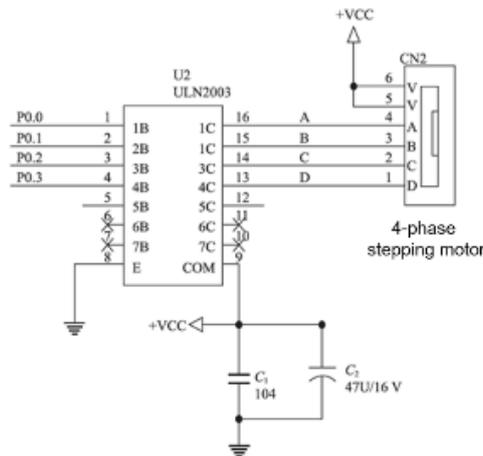


Fig. 4 Motor module

The motor module is driven by ULN2003. The driving ports are P 0.0 (A), P 0.1 (B), P 0.2 (C), P 0.3 (C). The positive order was: AB group - BC group - CD group - DA group; the reverse order was: AB group - AD group - CD group - CB group. "-" is a pulse, both positive and reverse are 5.625 degrees. Four-phase and five-wire stepper motors are connected with ports P 0.0, P 0.1, P 0.2 and P 0.3, corresponding to four phases A, B, C and D of stepper motors respectively.

#### 4. Software Program Design

According to the idea of hardware design, intelligent voice control system has two operation modes. the control of smart home adopts two ways: one is voice control, the flow chart is shown in Figure 7; the other is mobile phone control, the flow chart is shown in Figure 8.

Speech control is to send voice instructions to voice module, and transmit them to MCU through Bluetooth, so as to control lights and curtains. When the voice module is opened, the singlechip initializes. When people issue instructions to the voice module, the voice module detects the matching degree of instructions, transmits data to the singlechip, and calls the voice feedback of MP3 to the user to form a man-machine dialogue mode. Mobile phone control sends instructions through Bluetooth assistant, and Bluetooth is transmitted to MCU to control lights and curtains. Both of these methods can realize the control of the light on and off, the color change and the operation of the control motor to simulate the curtain rising and falling. At the same time, the built-in photoresistor detects the indoor environment and controls the lighting of the indoor night lamp.

The program flow of the single chip computer in the host computer is shown in Figure 9. When MCU serial port receives the signal, the signal is detected. If the signal is needed, the corresponding operation is carried out according to the signal indication. If not, the serial port signal is re-monitored.

#### 5. Conclusion

Furniture control system based on intelligent voice can control the lighting and extinguishing of color lights, the color of color lights and the rising and falling of curtains through two modes of voice dialogue and mobile phone APP. The function of intelligent night lights can be realized by

real-time measuring the intensity of light through photosensitive sensors, which can provide convenience for people's life.

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