Design of Smart Mirror Based on Raspberry Pi

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***Abstract*—Intelligent systems are not only used on mobile phones and tablet computers, but also more and more intelligent products are coming into being. At present, 3D mirrors and hair salon smart mirrors are expensive, and are limited to use in public places. In this paper, an intelligent mirror based on raspberry pi is designed for the home of Internet of things. The intelligent mirror is made of raspberry pi as the host controller, and STM32F030C8T6 microcontroller as the core control chip. In working condition, the system by raspberry pi is connected to the network through WIFI, and obtain information about the weather forecast from the API network interface specified dressing index, time, date and other information, and then through the information displayed on the plasma display. The user can interact with the mobile phone through the APP mirror, SYN6288 mirror through speech synthesis module make sounds, such as asking the mirror the weather, news, time, the mirror can automatically obtain the corresponding information network and broadcast. The designed intelligent mirror has the advantages of small size, simple operation, low cost, and is suitable for families, and has broad application prospects.**

Keywords- Raspberry pi; STM32; intelligent mirror; Linux

I. INTRODUCTION

At present, more and more close to the life of intelligent products are emerging, smart TV, smart watches to now appear again intelligent mirror. There are smart mirrors in 3D somatosensory fitting mirrors and hair salons in foreign countries, which are limited to use in public places[1]. The main reason is that the cost is high, and the imaging effect is not good, and there is the phenomenon of picture delay. According to the survey, we spend 20 minutes or so on washing, makeup and wearing after getting up, and these 20 minutes are also the time for us to look in the mirror. In order to make full use of this time, in the mirror at the same time, can effectively access the relevant information of the day, this project designed a kind of intelligent mirror can be used in the home of things. The intelligent mirror is the principle of one-way perspective, the actual picture in the form of specular reflection transmitted to our vision. The picture displayed behind the mirror can also be transmitted to us through the mirror, so as to achieve the effect of showing the pattern on the mirror. Compared with the method of collecting pictures by the camera used in the 3D somatosensory fitting mirror, the picture is smoother and the cost is reduced. The main chip is raspberry pi, and the operating system is Linux[2]. When an smart mirror opens, it is equivalent to an intelligent interactive center to help people understand relevant information in a timely manner. Smart mirror equipped with intelligent voice control, from any cast music, dialogue, broadcast can achieve full voice control. In the mirror on hot news, weather conditions, road conditions, schedule and other clear, it also shows the clothing index according to real-time weather conditions and reminders out of attention. At the same time, users can also control the brightness of the mirror lights through the mobile phone APP, in my spare time, through the mobile phone APP can chat with the mirror.

II. SYSTEM DESIGN

The smart mirror is composed of a controller, a display module, a wireless transceiver module, a clock module, a Bluetooth module, a speech synthesis module and an auxiliary function module[3]. The system block diagram is shown in figure 1.

Controller module: the controller is the "brain" of the smart mirror, which ensures the normal operation of the mirror parts. This topic chooses raspberry pi as the host of the system, and STM32F030C8T6 microcontroller as the core control chip.

Display module: in order to achieve the design of functional effects, the use of one-way perspective mirror and 24 inch PHILPS display combined with the display module.

Clock module: in order to achieve accurate time display of smart mirror, low power CMOS real-time clock chip PCF8563 is selected.

The wireless transceiver module: using the XL02-232AP1 module, half duplex wireless transmission function with UART interface, not only can work in the public frequency of 433MHz, but also in the original cable connection on the basis of upgrading wireless connectivity, and does not require additional programming, can be completely compatible with the cable of the serial communication protocol.

Bluetooth module: combined with the actual needs of the mirror, the current market is more powerful HC-05 serial port Bluetooth module, support master-slave mode, support hardware / software settings master-slave mode.

III. THE DESIGN OF SYSTEM HARDWARE CIRCUIT

A. The Host -Raspberry Pi

Raspberry pi known as card type computer is a microcomputer main board based on ARM. In this topic, the smart mirror chooses 3B raspberry pi for display function. The interface circuit between raspberry pi and STM32 single chip microcomputer is shown in figure 2.

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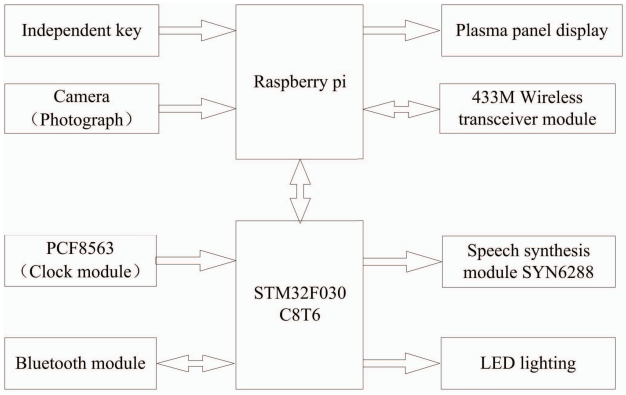

Figure 1. System block diagram

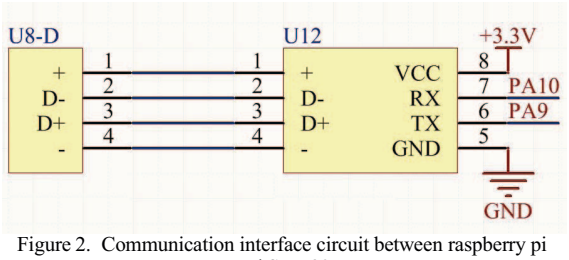

Figure 2. Communication interface circuit between raspberry pi and STM32

B. Controller -Stm32 Single Chip Microcomputer

Smart mirror comprises a wireless transceiver, clock, Bluetooth and other functions, these functions are achieved by microcontroller. The system uses STM32F030C8T6 microcontroller as controller for smart mirrors. The STM32F030C8T6 chip is 32 bit embedded processor ARM Cortex -M0 kernel architecture based on random access memory program memory contains 64KB and 8KB, 48MHz is CPU, the maximum operating speed, with 1 12Bit ADC and 6 general 16 bit timer, 1 available PWM control timer, 39 I/O export[4,5]. Figure 3 is the STM32 minimum system.

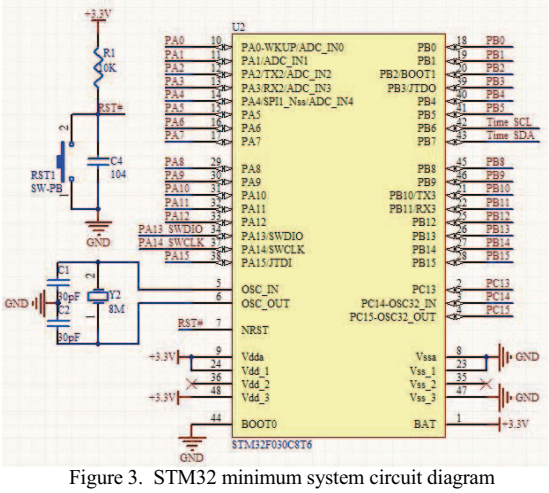

Figure 3. STM32 minimum system circuit diagram

C. Display Interface Circuit

The display function of the smart mirror is that the raspberry pi is connected to the VGA port of the display to drive the display through the HDMI to VGA transfer line, and the circuit connection diagram is shown in figure 4.

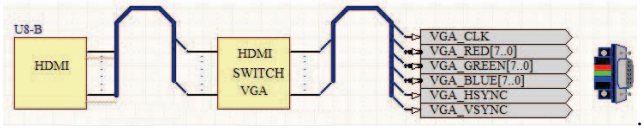

Figure 4. Display interface circuit diagram

D. Speech Synthesis Module Interface Circuit

Smart Mirror speech synthesis module using the SYN6288 speech synthesis chip, the chip through the asynchronous serial communication mode (UART), to be related to the text data synthesis received from the implementation of the text to speech (speech or TTS) conversion circuit principle diagram as shown in figure 5.

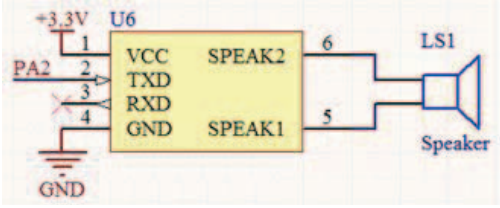

Figure 5. Circuit diagram of speech synthesis module

E. Wireless Transceiver Circuit

The wireless transceiver module is composed of the sending module and the receiving module. The transmitting module is controlled by the external STM32 single chip microcomputer, and the receiving module is controlled by the STM32 microcontroller inside the mirror. The transmitting module is the same as that of the receiving module, and the interface circuit is shown in figure 6.

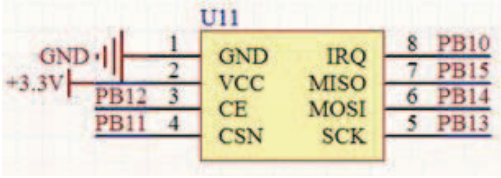

Figure 6. Receiving module circuit diagram

F. The Data Acquisition Module Circuit

The data acquisition module uses smoke sensor, carbon monoxide sensor, pyroelectric sensor to detect the environment, and transmits the collected information to the microcontroller. Figure 7 is the circuit design of the data acquisition module.

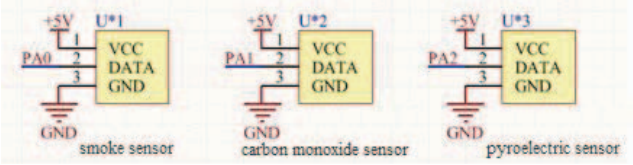

Figure 7. Circuit diagram of data acquisition module

G. Bluetooth Interface Circuit

The system uses HC-05 Bluetooth module, and the circuit diagram is shown in figure 8. HC-05 Bluetooth

module uses Blue2.0, supports up to 29 AT commands, provides a powerful Bluetooth serial solution.

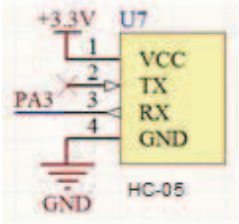

Figure 8. Bluetooth interface circuit diagram

H. Clock Circuit

PCF8563 is used as clock module, MCU and PCF8563 communicate with I2C protocol, read the register data of clock chip or clock chip output time information to SCM, the circuit is shown in figure 9.

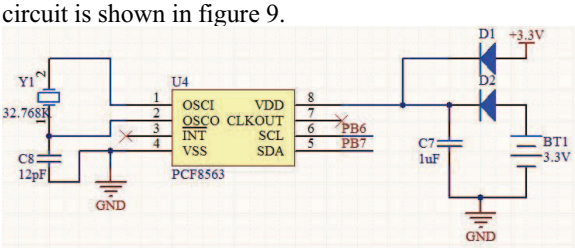

Figure 9. Clock circuit diagram

IV. THE DESIGN OF SYSTEM SOFTWARE

A. Raspberry Pi Program Design

Raspberry pi main program is written using Python language, Python language can invoke various Linux operating system software based on network, can get online sharing. Raspberry pi main program flow diagram as shown in figure 10.

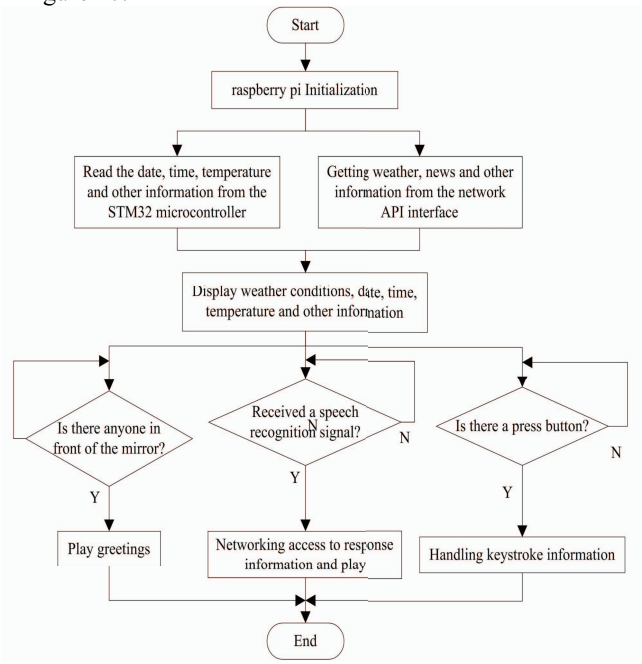

Figure10. Raspberry pi program flow chart

B. Stm32 Program Design

The raspberry pi configuration software, using STM32F030C8T6 microcontroller serial port to read from the date, time and temperature information, and then displayed on the display; when the detected someone close can also play a greeting; when using a mobile phone to send APP voice recognition information to users of raspberry pi, raspberry pi through the WIFI call the SPI network interface, access to respond to information, and then sent to the STM32F030C8T6 microcontroller to control speech synthesis module SYN6288, to make it sound. The flow chart of the STM32 program is shown in figure 11.

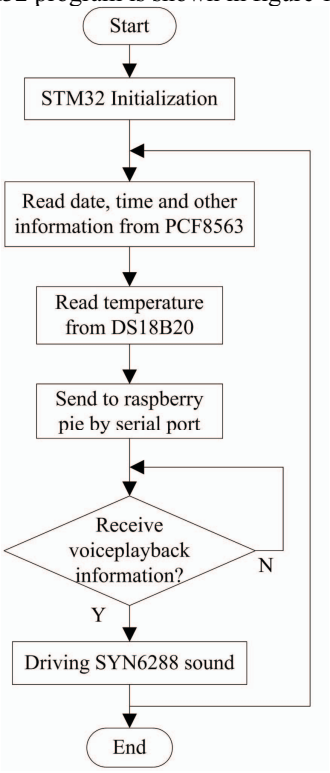

Figure11. STM32 program flow chart

V. . CONCLUSIONS

The smart mirror is developed by raspberry pi as the host controller, and STM32F030C8T6 microcontroller as the core control chip. Raspberry pi is connected to the network via WIFI, and the weather information, clothing index, time, date and other information are obtained by the API interface designated by the extranet. At the same time, the relevant information is displayed on the plasma display. The user can interact with the mirror through the mobile phone APP, and communicate with the mirror through the voice synthesis module SYN6288. The system realizes the functions of face recognition, speech recognition, voice playback, remote control of room lighting brightness and switch status. Smart mirror design has the advantages of

small size, simple operation, low cost, high degree of user-friendly, personalized user interface and other advantages, and is suitable for families, and has broad application prospects.

VI. ACKNOWLEDGEMENT

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