CE201

Group Project and Industrial Practice Group Report

Dormitory intelligent assistant based on STM32

Team Number:05

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Contents

Dormitory intelligent assistant based on STM32

Abstract

The STM32-based product includes three modes: Intelligent voice control which can be awakened by specific wake-up words, and specific instructions can be given to achieve corresponding functions after waking up, normal mode which can display real-time humidity, temperature, air quality, and whether there are people staying outside the door on the OLED and APP by Bluetooth, and defense mode which can use camera take a picture every 20 seconds and when the pressure sensor captures someone at the door then sends a notification to the APP, then upload pictures to the cloud platform and APP by WIFI.

Key Words: STM32, Speech Recognition, Bluetooth, WIFI

1.Project brief

1.1 Application background

The rapid development of the smart home industry in China in recent years shows that people's pursuit of quality of life is increasing day by day, especially the generation of young people who are constantly pursuing the convenience of dormitory life. At present, more and more college students need a kind of intelligent household product which can improve the quality of life and bring allround convenience. This product came into being. The physical drawing of the product is displayed in Figure 1.

Figure 1. Physical drawing of product

1.2 Main functions

(1) Intelligent voice control: Intelligent voice assistants can be awakened by specific wake-up words, and specific instructions can be given to achieve corresponding functions after waking up. The functions that can be realized are: turn on & off the light, open & close the door, turn on & off the fan, turn on & off the curtain, and turn on & off defense modes.

(2) Normal mode: the OLED screen can real-time display humidity, temperature, air quality, and whether there are people staying outside the door, and this basic information of dormitory can be received and viewed in the mobile APP in real-time.

(3) Defense mode: On the basis of the normal mode, you can also turn on the defense mode through the intelligent voice assistant. After the mode is turned on, in addition to the basic functions of the normal mode, the camera and pressure sensor will be activated. The camera can take a picture outside the door every 20 seconds and upload it to the cloud platform, allowing you to know the real-time situation outside the door through the APP anytime, anywhere. When someone is outside the door, the pressure sensor installed on the ground can quickly capture it, the camera intercepts a short video and sends a notification through the APP, and the user can take pictures of the person outside the door through the APP.

2. Introduction to speech recognition and control module

2.1 Detailed function

Speech recognition includes first-level command and second-level command. The first-level command is "Xiao Bei". After successfully recognizing the first-level command, the voice assistant will wake up and respond to "Wo zai". The second-level commands include ten commands such as "Da kai deng" and "Guan bi deng". When the voice assistant receives and recognizes the second-level commands, it replies with statements such as "deng yi da kai". In addition, if there is no second-level command within 20 seconds after waking up the voice assistant, the voice assistant will automatically shut down. If users want to shut down the voice assistant in advance, they can use the entry of "tui xia ba xiao bei" to operate.

2.2 Chip introduction

The speech recognition and control module is based on LD3320 speech recognition chip and SYN6288 speech synthesis chip to achieve its functions [1].

LD3320 shown in figure 1 has a speech recognition function that separates Chinese characters into pinyin letters. It is a speech recognition chip based on non-specific voice recognition technology, that is, it can realize speech recognition without the user's recording training.

SYN6288 Chinese speech synthesis chip shown in Figure 1 converts received text data to Chinese speech through text analysis and processing algorithm.

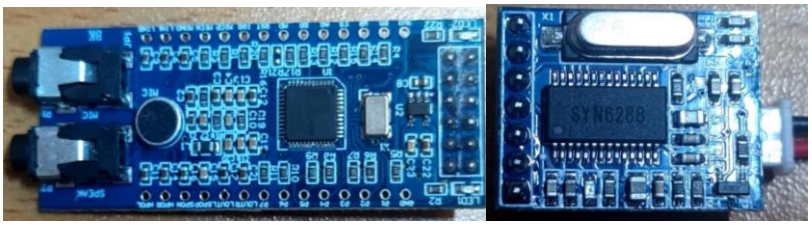

Figure 2. LD3320 module(light) and SYN6288 module(right)

2.3 Circuit design and welding

Through consulting the LD3320 and SYN6288 chip manual, on the basis of the typical application circuit, according to the actual circuit calculation and selection of component models, through Altium Designer to draw the LD3320 module schematic diagram shown in Figure 2 and SYN6288 module schematic diagram shown in Figure 3 and the corresponding PCB diagram. LCD3320 module and STYN6288 module are completed by welding components on PCB board.

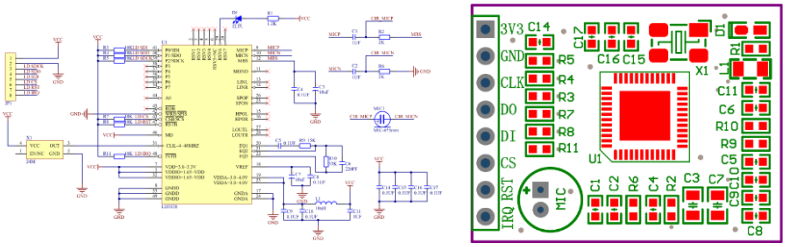

Figure3. LD3320 module schematic diagram and PCB diagram

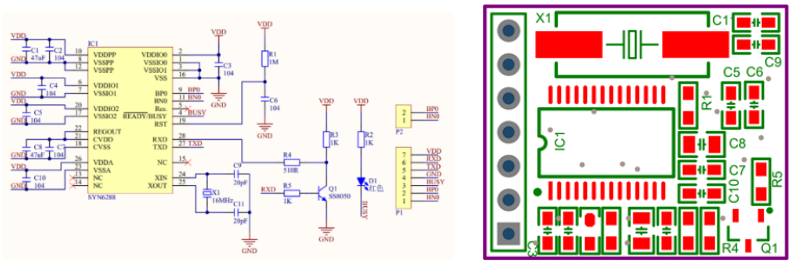

Figure 4. SYN6288 module schematic diagram and PCB diagram

Finally, draw the power board PCB, weld the two modules together with STM32, that is, complete the production of the voice module shown in Figure 4.

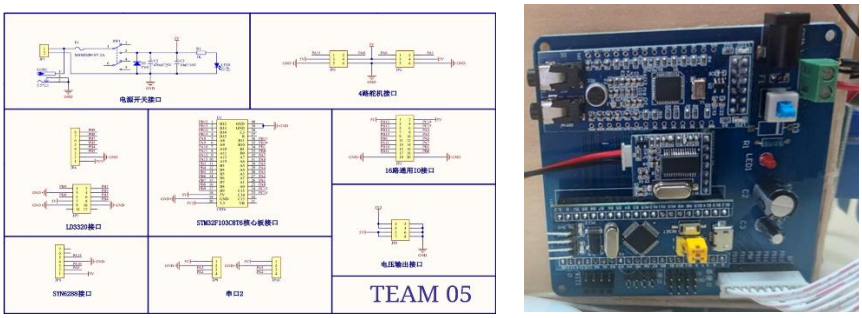

Figure5. power board PCB and real product

3.Introduction to bluetooth module and the APP

3.1 The bluetooth module

In this module we use two HC-05, DuPont lines and USB to TTL to realize transmitted the sensor signal via a terminal with the same Bluetooth function.

First pair the Bluetooth module. USART2 on STM32 is selected to communicate with Bluetooth to know the connection mode through the STM32 schematic diagram. Wired way is shown in Figure 6.

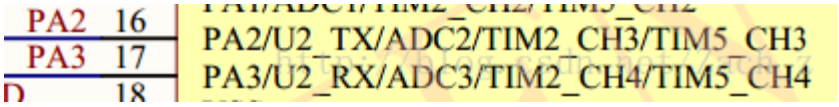

Figure 6. Wired way

Next, initialize the Bluetooth module. Steps for initializing Bluetooth [2]: (1) Set PIO11 to high. (2) Open the module, and the module will enter the AT command response state. (3) Use serial port tool to set the baud rate to 38400, data bit to 8, stop bit to 1, and parity bit to none. (4) The serial port sends the character "AT+ROLE=1\r\n", and returns "OK\r\n" on success, where \r\n is a carriage return character. (5) PIO set to low, re-POIR, module master module, automatic search slave

module, establish connections.

3.2 The APP framework

To search bluetooth devices and connect them with mobile phones for data transmission we use Wechat developer tools develop a Wechat mini program. The Wechat mini program include three contents: initialize bluetooth, search for Bluetooth devices, monitor bluetooth data.

3.2.1 Initialize bluetooth

When the user need to initialize the Bluetooth module with wx.openBluetoothAdapter so that the host/slave (peripheral device) mode on iOS then the user can invoke the command once and specify the corresponding mode.

3.2.2 Search for Bluetooth devices

With wx.StartBluetoothDevicesDiscover started to search for nearby Bluetooth peripheral devices shown in Figure 7.

参数

Object object

属性	类型	默认值	必填	说明
services	Array.<string>		否	要搜索的蓝牙设备主服务的 UUID 列表（支持 16/32/128 位 UUID）。某些蓝牙设备会广播自己的主 service 的 UUID。如果设置此参数，则只搜索广播包有对应 UUID 的主服务的蓝牙设备。建议通过该参数过滤掉周边不需要处理的其他蓝牙设备。
allowDuplicatesKey	boolean	false	否	是否允许重复上报同一设备。如果允许重复上报，则 wx.onBlueToothDeviceFound 方法会多次上报同一设备，但是 RSSI 值会有不同。
interval	number	0	否	上报设备的间隔，单位 ms。0 表示找到新设备立即上报，其他数值根据传入的间隔上报。
powerLevel	string	medium	否	扫描模式，越高扫描越快，也越耗电。仅安卓微信客户端 7.0.12 及以上支持。
success	function		否	接口调用成功的回调函数
fail	function		否	接口调用失败的回调函数
complete	function		否	接口调用结束的回调函数（调用成功、失败都会执行）

Figure 7. Pattern parameter

3.2.3 Monitor bluetooth data

With wx. NotifyBLECharacteristicValueChange to monitor bluetooth data.Enable the notify function when the feature values of Bluetooth low-power devices change.

4. Introduction to dot matrix screen and OLED screen

4.1 Dot matrix screen

In this module we use MAX7219 and Dupont lines to realize time display.

4.1.1 Data interpretation

Max7219 and STM32 communication mode shown in Figure 8: MAX7219 communication mode is SPI, 16bit data format, high preposition.

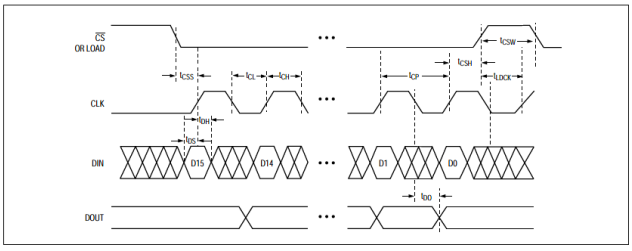

Figure 8. Communication mode

Max7219 control mode: SPI sends 16bit at a time, that is, 2 bytes = address + data. Addresses represent different functions, and data represents parameters you want to set. According to the need to directly to the address table, and then according to the address function set data.

Control an LED lattice (total cathode), dig0-DIG7 these eight pins need to be connected to the lattice of 8 cathode pins, the general chip DI0 pin is connected to the lattice of the first line of cathode pins, DIG1 is connected to the lattice of the second line of cathode pins...And so on. The SEGDP pin is connected to the first pin (high first) on the left of the lattice anode, and the SEGA-SEGG pin is connected to the lower seven pins on the back. So to make line 3 fully lit, write a number to address Digit2, this number is 0xFF(11111111b), then the DIG2 pin is pulled down, SEGDP, SEGA-SEGG are both high, and line 3 is fully lit. It is worth mentioning that when controlling the dot matrix, you need to set the chip to work in non-decoding mode, so that the data you write to digit0-DIGIT7 address is the LED bit lit in the corresponding position of your corresponding line. For example, if the data part is 0x00, a line is off and a line 0xFF is on.

4.1.2 Configure STM32 parameters

STM32 project is directly generated with STM32CubeMX, configure the RCC clock above, in order to display a variety of characters, so you need a character modeling software to generate the corresponding character logic code, the code is consistent with the logical position and logic level of LED lights. We use PCtoLCD2002 perfect version of the character mold software shown in Figure 9. Copy and paste the resulting character encoding into a static array variable in the program file, passing the variable into the display function as a parameter when used.

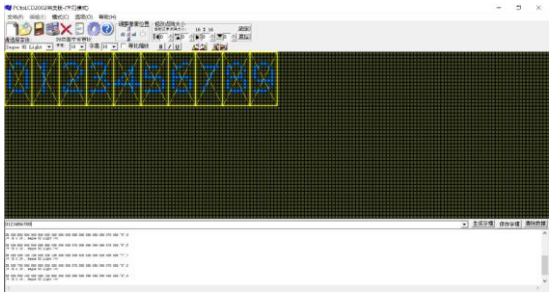

Figure 9. Analog display

4.2 OLED screen

We use SSD1306 to write data.The SSD1306 MCU interface contains 8 data pins and 5 control pins. The following Figure10 summarizes pin assignments for different interface modes. Different MCU modes can be set through the hardware selection on the BS [2:0] pins [3].

Pin Name / Bus Interface	Data/Command Interface								Control Signal				
	D7	D6	D5	D4	D3	D2	D1	D0	E	R/W#	CS#	D/C#	RES#
8-bit 8080	D[7:0]								RD#	WR#	CS#	D/C#	RES#
8-bit 6800	D[7:0]								E	R/W#	CS#	D/C#	RES#
3-wire SPI	Tie LOW					NC	SDIN	SCLK	Tie LOW		CS#	Tie LOW	RES#
4-wire SPI	Tie LOW					NC	SDIN	SCLK	Tie LOW		CS#	D/C#	RES#
I²C	Tie LOW					SDA_{OUT}	SDA_{IN}	SCL	Tie LOW			SA0	RES#

Figure 10. pin assignments

The write mode [4]:

1)The first is the initial state；

2)sent from the machine address: 0 x78 | (W/R), write to 0, read 1;

3)Waiting for a response;

4)Send control code: write data is 0x40, write command is 0x00;

5)Waiting for a response;
6)Send data values or command values;
7)Waiting for a response;
8)End state.

5. Introduction to camera monitoring and cloud platform storage

In this module we realize these functions: real-time monitoring; upload a photo every 20 seconds to the Bava cloud platform for saving; when mobile phone APP1 receives an alert, users can take photos through mobile phone App2; view the pictures saved by Bava Cloud platform on the mobile phone APP3. We use two camera one is connected with FTDI 232 module the other is connected through USB to TTL.

5.1 Camera one: esp32-cam + FTDI 232 module

The functions realized:

1. After connecting with the camera to the same wifi (user name: KKKKKK, password: 12345678901), the dormitory can be monitored in real time through the web page (mobile phone or computer open http://192.168.115.56/).

2. When mobile phone App1 receives a warning of someone approaching, users can press OFF to take a picture through mobile phone App2 (Blynk) (the flash light of camera 1 will be turned on when taking a picture to ensure that the picture can be taken clearly even in the dark), and the picture can be saved and viewed through the website. The above functions are displayed in Figure 11.

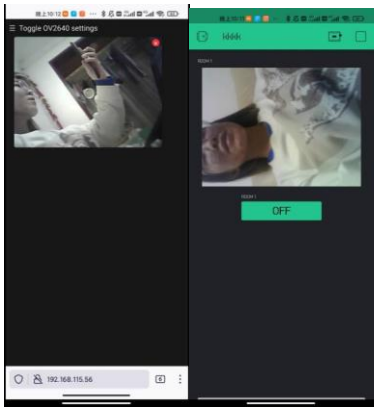

Figure 11.APP1&2 interface

5.2 Camera two: esp32-cam + ch340g-usb to TTL

The functions realized:

1.Upload a photo every 20 seconds to the Bava cloud platform for saving.

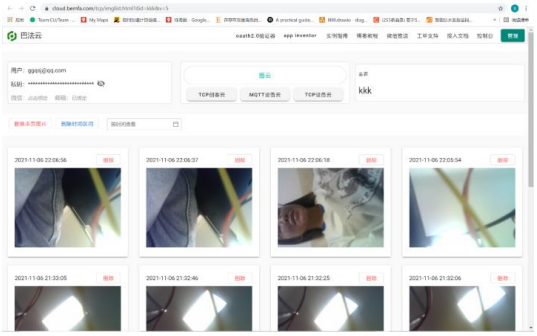

Figure 12. Bava cloud platform

2.View the pictures saved by Bava Cloud platform on the mobile phone APP3.

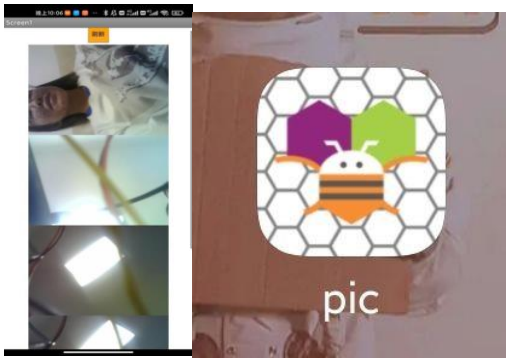

Figure13. APP3 interface

6.Introduction to other modules

6.1Temperature and humidity sensor

The DHT11 sensor is used to display the temperature and humidity. First the host sends the start signal, and returns a corresponding signal from the opportunity to reply. Second pull the signal cable to the host to receive data. Then start receiving 40bit data. The output of 0 and 1 is similar in that they both first output the low level of 50 microseconds if the read signal is high, DHT11 is not responding, but the time of high level is different. Data bit 1 output high level longer than data bit 0[5].

Figure14.DHT11

6.2 Smoke concentration sensor

The smoke detection module uses MQ2 smoke sensor to detect the concentration of harmful gases, which can display real-time smoke concentration on the LCD board. When harmful gases exceed the limit, send out an alarm. Mq-2 can be used in home and factory gas leak monitoring devices, suitable for the detection of liquefied gas, butane, propane, methane, alcohol, smoke, etc.

Figure15.MQ2

6.3 Steering gear

The opening and closing of the door and curtain are controlled by the rotation Angle of the steering gear. The small fan is connected to the relay, and the voice module controls whether the relay is connected or not, and the relay controls whether

the fan is opened or closed. When the steering gear is connected to the relay, turn 90 degrees clockwise to open the door, and turn 90 degrees counterclockwise to close the door. The steering wheel, which rotates 360 degrees, is connected to pulleys and rubber bands to control the opening and closing of curtains.

Figure16. Steering gear

6.4 Pressure sensor

Resistive thin film pressure sensor is used in this experiment. The sensor module is based on a new nano pressure-sensitive material with a comfortable Yang's modulus of ultra-thin film substrate one-time patch, both waterproof and pressure-sensitive. When the sensor senses the external pressure, the resistance value of the sensor changes, and the resistance partial voltage circuit is used to convert the pressure signal of the sensor sensing the pressure change into the electrical signal output of the corresponding change intensity.

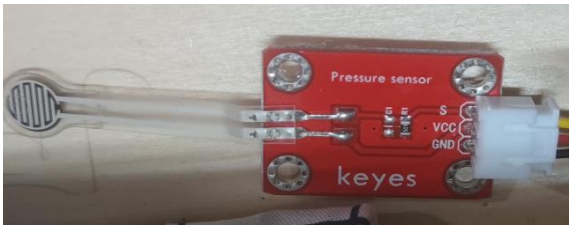

Figure17. Pressure sensor

6.5 Photosensitive sensor

A photosensitive sensor is a sensor that uses a photosensitive element to convert a light signal into an electrical signal. When The higher the light intensity, the greater the current of the photoelectric cell. When the current passes through a resistor, the voltage across the resistor is converted into a 0-5V voltage that can be received by the digital-to-analog converter of the collector, and then collected in an appropriate form The results are saved.

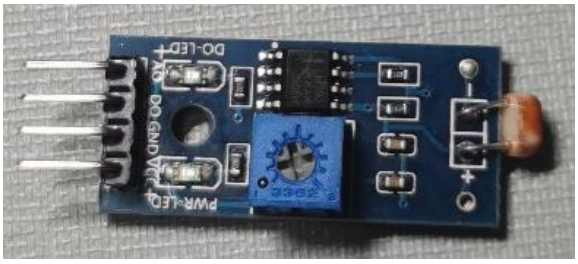

Figure 18. Photosensitive sensor

7.Division of labor

The division of labor of our team is clear and balanced, and everyone has made corresponding contributions no matter in the early or late stage of the project.

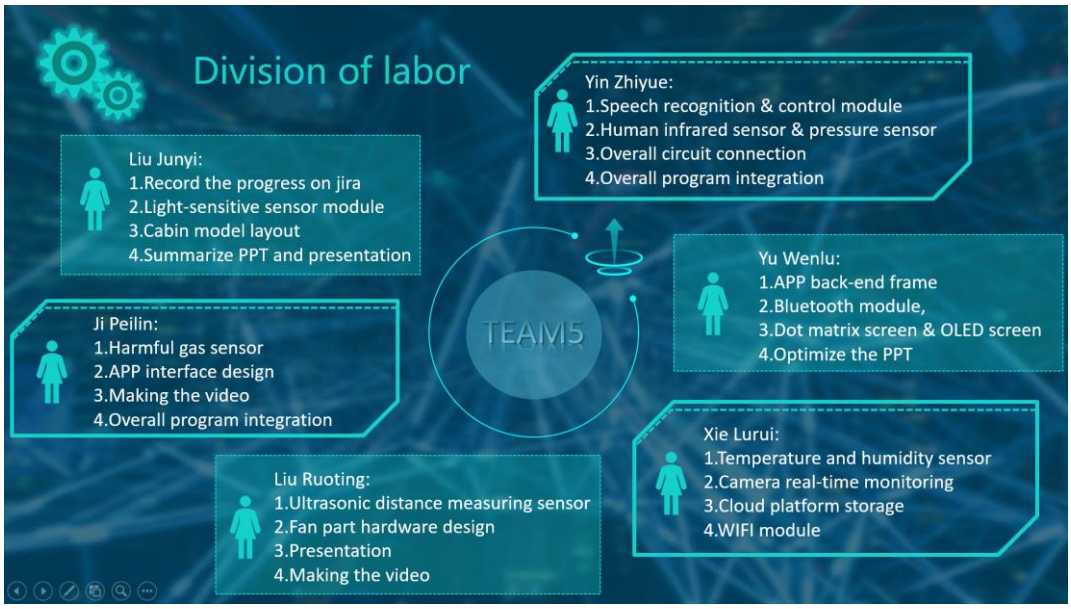

Figure 19. Division of labor

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