Design of Intelligent WiFi Trash Bin Control System

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Abstract: In this graduation project, STM32 microprocessor developed by Italian French semiconductor company is selected as the main control, and an intelligent WiFi garbage can system with various intelligent functions is studied, which can realize the automatic opening and closing of garbage can cover, and can realize the automatic work according to whether someone is in front of the garbage can. This "design of intelligent WiFi trash bin control system based on STM32" is proposed. In order to reduce the R & D cost of relevant intelligent WiFi trash bin system in the market today, a large number of high cost-effective STM32 microprocessor main control core, LCD1602 lattice screen, 28byj stepper, stepper motor driver, WiFi wireless communication sensor, pyroelectric infrared sensor and other devices are selected, Through the construction of hardware circuit, the framework of this system is realized. In this paper, the intelligent WiFi trash bin control system is tested from many angles, and abundant test data are obtained according to its running phenomenon. According to the test results, it is modified and optimized continuously. Finally, it can make the intelligent WiFi trash bin system show the best working state.

Keywords: Smart trash bin, WiFi wireless communication, Remote control.

1. Introduction

The development of intelligent WiFi trash bin control system is dominated by Electronic Science and technology. Until now, the intelligent WiFi trash bin at this stage is still in the state of continuous optimization and upgrading. After embedding a large number of new technologies such as intelligent sensors and micro controllers into the software and hardware, the intelligent WiFi trash bin can be controlled by the target code, To achieve different intelligent performance from simple to complex, technicians can update and maintain the system function by modifying program code, which completely changes the previous system form. This graduation project plans to design this type of intelligent WiFi trash bin system is an internal STM32 type microprocessor

as the main control, through powerful programming code as the main control Control means, combined with a highly integrated hardware system and the realization of an intelligent electronic control system, through extensive access to information, we can see that the intelligent WiFi trash bin has a long history of development. Before the advent of microprocessor driven technology, it has been a more classic system, but in the past, electronic science and technology was dominated by analog electronics After years of development and progress, all intelligent WiFi trash bins on the market have been fully digitized, which can realize the rapid processing of data and perform various functions. After collecting and summarizing relevant information, we can know that the general development direction of intelligent WiFi garbage bin in recent years is towards miniaturization and intellectualization[1-7]. These concepts have been paid special attention because in today's technological background, people are generally satisfied with the existing functions of the intelligent WiFi trash bin. However, for its higher operation effect, such as human-computer experience, high-speed, and more flexible working performance, these performance are endless, and with the increasing number of users, These requirements are constantly put forward. This kind of intelligent WiFi trash bin control system which will be designed in this graduation project will be based on the development background of the project. Through the analysis of a large number of design cases, some excellent design points and common defects are integrated, and the design core points are extracted and embedded into the intelligent WiFi trash bin control system However, for the widespread shortcomings, this paper will try to eliminate these unavoidable design defects through circuit optimization and software program optimization, so as to finally design the system with high performance and competitive advantage.

In the current market, domestic and foreign intelligent WiFi trash bin have their own different users. Looking at the current domestic and foreign product development status, although some foreign research and development institutions for the intelligent WiFi trash bin started earlier, and the domestic research and development time of this system is relatively short, through the current market often used several intelligent WiFi trash bin for literature After consulting the quantity, it can be concluded that the medium and high-end intelligent WiFi trash bin is constantly seizing more market share. Compared with the low-end intelligent WiFi trash bin which has more competitive strength in the past, due to the continuous reduction of the R & D cost of medium and high-end products, the low-end products are less and more advantageous in terms of price. At the same time, with the continuous improvement of technical level, the low-end products are becoming more and more difficult Users are increasingly unable to satisfy the lack of functions of low-grade products. This paper presents an intelligent WiFi trash bin control system, which can display the system parameters, rotate the

stepper motor, amplify the electric pulse signal, WiFi communication and human body signal capture. The development background of the system and the current development status at home and abroad have been described. The implementation scheme, hardware circuit and software system of this system will be mainly described This paper will use STM32 microprocessor as the control core, combined with LCD1602 LCD screen, four phase stepping motor, stepper motor driver, WiFi module and infrared tube infrared sensor and other devices, through reasonable hardware and software system design, to achieve the initial functional requirements.

2. System hardware design

The intelligent WiFi trash bin control system designed in this paper will choose the system structure in Fig. 1, through which the hardware framework of the intelligent WiFi trash bin system can be built. The STM32 microprocessor will be the main control core. All the index requirements of this type of intelligent WiFi trash bin system will be completed under the control of STM32 microprocessor, and the parameter display circuit and steps will be completed According to the signal flow relationship in the figure, the circuit modules such as stepper motor driving circuit, ULN2003 stepping motor driving circuit, esp8266 WiFi communication circuit and infrared tube sensor circuit are driven with STM32 microprocessor according to the signal flow relationship in the figure, and provide external signals for STM32 microprocessor. The human body sensor module is configured to monitor whether there is someone in front of the garbage can in real time through the human body detection sensor, and the detection results are sent to the single chip microcomputer in the form of high and low level signals; the garbage bin cover is dragged by the stepper motor and its driver to realize the automatic opening and closing; the LCD1602 LCD display is configured to display the working state of the intelligent garbage can; The mechanical key circuit is configured to set the working mode of the intelligent garbage can system. The memory performance of STM32 microprocessor is mainly divided into two types of memory: flash and ram. The space used to store software code is 512KB Byte, users can add more flash capacity, and the RAM storage space for data temporary storage is 64K. Its internal CPU uses Cortex-M3 core, which is the most famous model in microcomputer system.

Figure 1 microprocessor chip

The structure of the reset circuit is relatively simple. It can be realized only through

the three basic components in Figure 2. According to the line connection relationship in Figure 2, the resistance and capacitance constitute the voltage divider circuit. When the key in Figure 2 is not pressed, the capacitance impedance is infinite, so the circuit outputs high level to RST pin of STM32 microprocessor, and the rst pin can keep positive at this level Regular work. When the key is pressed, the 10uF capacitor will be short circuited to make the output level of the circuit change from high to low. When the rst pin is in this state, the reset action will occur immediately.
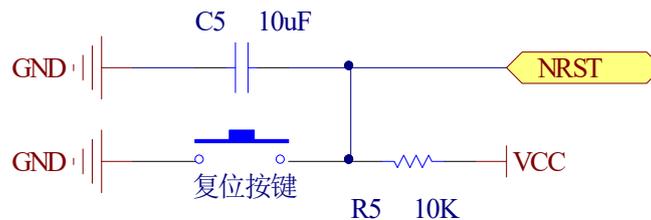
Figure 2 design of reset circuit

The design of clock circuit mainly refers to the design and development data of STM32 microprocessor. The circuit structure in many excellent cases is shown in Fig. 3. This paper uses a 30pf capacitor and a 12m crystal oscillator to form a resonant circuit. The two ends of the crystal oscillator are connected to the xtal1 and xtal2 pins of the STM32 microprocessor, so that the STM32 microprocessor can receive the clock signal with high stability after power supply, Make it execute the instructions normally.
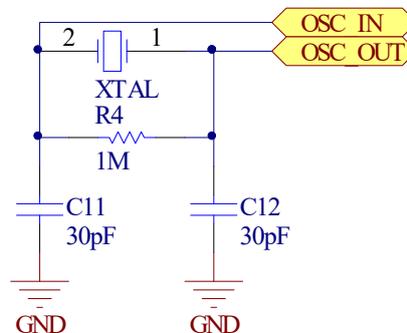
Figure 3 crystal oscillator circuit design

According to the content of the official data of the esp8266 WiFi module, users can use + 3.3V to apply power to it, and use a single power supply to apply the power supply. This device has low power consumption. It mainly uses the esp8266 core processor as the key, and is surrounded by power circuit, onboard antenna, amplifier and serial bus. Through reasonable line connection, the overall power supply is realized In order to ensure the design progress of this project, this design also selects this esp8266 WiFi module to receive and transmit WiFi wireless communication data, as shown in Figure 6.

Figure 4 actual WiFi module

It can be seen that the design of this kind of smart VCD, wixch can be divided into 5 types, such as wirsd and wirsd, which can be used to control the system_ PD, gpio0 and gpio2, the UART interface is used to construct the data bus interface between STM32 microprocessor and esp8266 WiFi wireless communication module. Since the data receiving bus and data sending bus in UART interface are mapped to PB8 and PB9 of STM32 microprocessor, PB8 is connected to TXD pin of esp8266 WiFi wireless communication module, and PB9 is connected to RXD pin In terms of power supply circuit, the wireless communication module uses + 3.3V DC voltage to supply power to connect it to the VCC pin of the module. The RXD and TXD pins of esp8266 WiFi module are used to transmit signals to the external controller. In this project, STM32 microprocessor will be directly connected with it through the input and output interface to form UART interface. Then, the connection between esp8266 WiFi module and STM32 micro processor is realized at the software level.
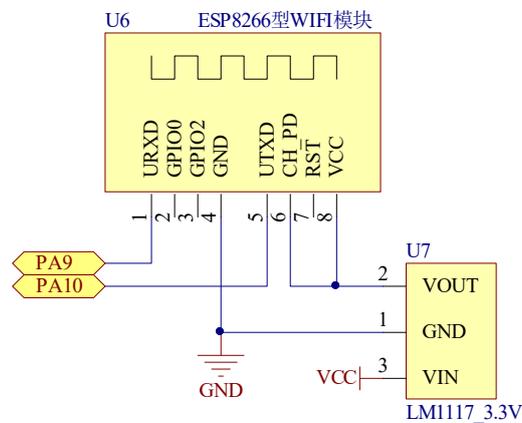

Figure 5 WiFi communication circuit design

In order to realize the performance parameters of the display part, this graduation project selects a LCD1602 LCD screen which is used frequently in the micro controller system. As shown in 6, the modules often used to achieve similar performance in today's market include digital tube, etc. in contrast, LCD1602 liquid crystal screen has the best cost-effective parameters and is also the most suitable for this intelligent WiFi garbage can system Its low power consumption meets the expected target of this type of intelligent WiFi trash bin control system. Through simple hardware and software configuration, users can easily use this LCD1602 LCD screen.

Figure 6 LCD1602 LCD module

After the design of the minimum system of this intelligent WiFi trash bin system, we will start to research and develop the hardware control circuit of LCD1602 LCD screen. Referring to some excellent designs, we can simply modify the individual details, and then transplant it to the intelligent WiFi trash bin system to make it work efficiently and flexibly The normal power supply voltage is in the range of 3.3 ~ 5V, and the design content is the data pins RS, RW, en and db0 ~ DB7 of LCD1602 LCD screen. As shown in Fig. 7, the pc13 ~ PC15 of the microprocessor is connected with en, RW and RS respectively, and db0 ~ DB7 is connected with PA0 ~ PA7, which makes the STM32 microprocessor and LCD1602 LCD module form a parallel interface at the hardware level The LCD1602 LCD screen can be manipulated to achieve the effect of LCD display.
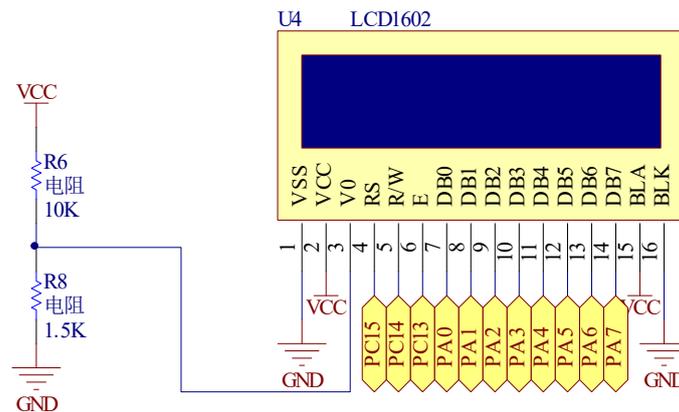

Figure 7 circuit design of LCD1602 LCD screen

According to the outline drawing of the device in Figure 8, the electronic component of 28byj stepping motor has five interface pins in total, and the user can control it through a simple interface. In the working process, it has the performance of 10W load capacity. It mainly realizes the function of electric drive under the control of the four wire serial interface of the controller chip, and in the following system hardware In the design process, the underlying driving circuit of this type of 28byj stepping motor will be researched and developed. According to the records in the data, it can be clearly seen that the core structure of the stepping motor is mainly composed of conversion circuit, control bus, amplifier and filter.

Figure 8 physical diagram of four phase stepping motor

As shown in Figure 9, the ULN2003 driver chip has a efficiency of up to 98% under working conditions. Compared with other devices with similar functions, the ULN2003 stepping motor driver chip integrates up to seven Darlington transistors. The power gain effect of the motor pulse signal is perfect. Users can use the DC voltage of 5V to control this type of motor The driver can share the same power supply with STM32 microprocessor. The ULN2003 driver chip is the most commonly used motor driver in the market today. Like a4988 stepping motor driver, it can be seen in STM32 microprocessor system.
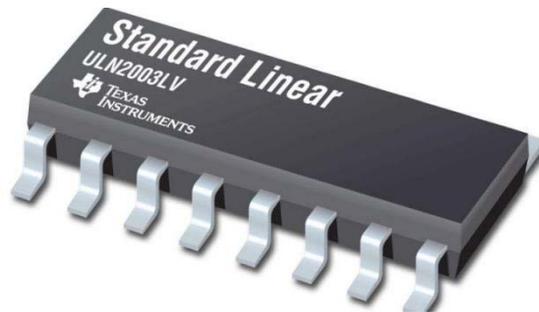

Figure 9 stepper motor driver module

Through the relative module of the motor drag part of the intelligent WiFi trash bin control system, this topic will use the 28byj stepper motor to realize the function of dragging and dragging the garbage bin cover. The 28byj stepper motor selected in this paper uses the in-line package form, as shown in the circuit schematic diagram in Figure 10, it is necessary to connect its five pins in circuit, which needs to be in turn In this paper, the hardware circuit of the signal and power pins of 28byj stepper motor is designed. Among them, the connection between in1, in2, in3 and in4 data pins and the control chip is the key research and development content of this intelligent WiFi trash bin system. In order to make the small stepper motor run in different ways, it is necessary to fully design the hardware circuit, Since the input signal of this small stepping motor is divided into four phases, four channels of pulse signals with different time sequence are received through four pins a ~ d. in this project, these four pins need to be designed separately and connected to the four pins of out1 ~ out4 of the upper level ULN2003 driver chip, and the GND pin can be directly grounded. In terms of circuit configuration of ULN2003 driver chip, it uses + 5V DC voltage to supply power. Four GPIO pins (pb0 ~ PB3) of STM32 microprocessor are selected to form four phase pulse signal output, which are respectively connected to in1 ~ in4 pins of
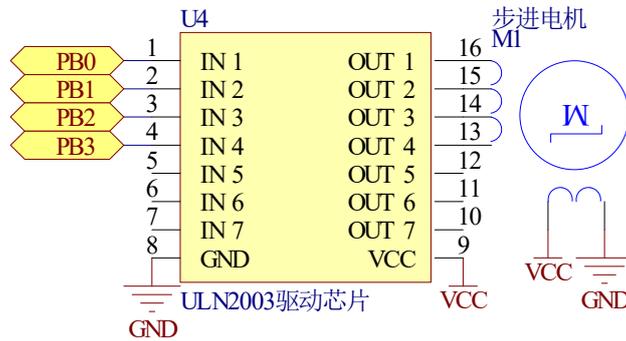
ULN2003 chip.

Figure 10 design of garbage bin lid dragging circuit

As shown in Figure 11, the chip data of this infrared counter tube sensor shows that users can supply power to it through 4.5 ~ 20V voltage. In normal operation state, as long as 0.015w power of the system is consumed, the normal work can be realized. Through the sensor, whether there is anyone before the garbage can can can be detected. This graduation project embeds the module into the intelligent WiFi trash bin control system Medium.

Figure 11 infrared sensor module of infrared tube

This design includes the configuration of detecting human body function in the expected function index. The key component to be used in this index is infrared tube sensor. This device has been briefly described above because it adopts the digital switch interface type, and three data communication pins are opened to the public. The design information of this infrared tube sensor is referred As shown in Figure 12, the pb12 pin of STM32 microprocessor is constructed as the signal acquisition pin of infrared tube sensor at the software level, which makes the internal circuit module work in the appropriate voltage range Pb12 is connected to do pin, which forms the interface connection between STM32 microprocessor and infrared tube sensor.
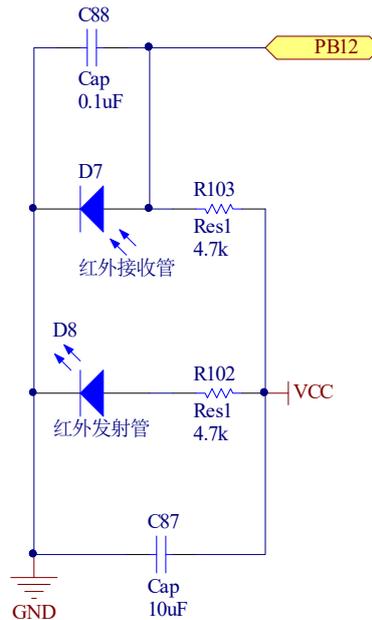
Figure 12 design of human detection circuit in front of garbage bin

This intelligent WiFi trash bin system developed in this paper uses the method of module design to design various functional indicators. The overall system framework of this system has been divided into several circuit modules, and the corresponding circuit modules of each function are designed separately. Next, the software control process will be developed, and the intelligent garbage can control system will enter After the formal working state, the system will first detect whether the user presses the button to set the working mode. Then, the system will send a fixed intensity infrared ray to the front of the garbage bin through the infrared transmitting tube of the infrared tube sensor to detect whether there is anyone in front of the garbage can. If there is someone, the infrared ray will be reflected, and the infrared receiving tube will receive the reflected infrared ray. At this time, the system will The pulse sequence 1 of the stepper motor is taken to make the stepper motor rotate forward and drag the garbage bucket lid to open. After 10 seconds delay, if no person is detected in front of the system, then the system pullback the pulse sequence 2 to cause the stepper motor to reverse rotation and close the garbage bucket lid. When the time is close, the sequence 3 is adjusted to reduce the rotation speed, prevent accidents such as accidental release, and then drive the liquid crystal. The screen displays the working state of the system. The main driver of STM32 microprocessor for LCD1602 LCD screen is to write data and write instructions and other subroutines. Users need to design subprograms in strict accordance with the time sequence specified in the official data of LCD1602 LCD screen, otherwise the LCD1602 LCD screen will not work normally and stably. This intelligent WiFi trash bin control system is no exception, and attention should be paid to the accuracy and stability of the clock in the operation process, Thus, the LCD1602 LCD screen can stably analyze the instructions from STM32

microprocessor.

3. Summary

This design uses tc12c5a60s2 single-chip microcomputer as the main controller of the audio amplification circuit system. The PWM signal is transmitted to apa2604c power amplifier to amplify the small amplitude audio signal. At the same time, it can display the volume in real time through data interaction with LCD1602. The main control circuit has the advantages of operation visualization, integration degree and high cost performance, and it is also the best state for debugging the peripheral circuit of the system. The components and chips used in this design are common components, and the system power supply design also conforms to the current design specifications, so it can be directly embedded into relevant equipment for application. In the design process, it is necessary to debug the hardware (filter, coupling, voltage divider, EMI, etc.) and software (including ADC, PWM, LCD, timer, amp initialization module) frequently to make the system have the optimal sound quality effect.

Acknowledgements

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