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Design of an Intelligent Dehumidifier

Haimei Hang

School of Suzhou Institute of Industrial Technology, Suzhou 215104, China.

Abstract

In response to the problems of low intelligence and insufficient interactivity of traditional dehumidification equipment, this paper designs an intelligent dehumidification system based on STM32 microprocessor. The system uses STM32 as the control core, collects real-time environmental humidity data through DHT11 sensors, and combines Bluetooth communication and mechanical button control on a mobile app to achieve flexible setting and dynamic adjustment of target humidity. Compared to traditional solutions, this design can meet the intelligent humidity control needs of scenarios such as homes and warehouses.

Keywords

Intelligent dehumidification, STM32 microprocessor, Bluetooth communication.

1. Introduction

With the rapid development of modern industrial technology and the continuous improvement of living standards, the application of environmental humidity control technology in industrial production, agricultural storage, home life and other fields is becoming increasingly widespread. This article proposes an intelligent dehumidifier system based on STM32 microprocessor. Real time environmental data is collected through DHT11 temperature and humidity sensors, and STM32's fast computing capability is used for threshold judgment. When the environmental humidity is detected to be lower than the user set value, the high-power dehumidification fan is automatically started to achieve fast dehumidification; Users can flexibly set target parameters through mobile apps or mechanical buttons, balancing convenience and reliability of operation. In addition, the system is equipped with a high-definition LCD display screen, which can display the current humidity, target threshold, and device operating status in real time, significantly improving the human-computer interaction experience.

2. Overall scheme design

The system consists of STM32 microprocessor, button circuit, fan module, LCD screen, humidity detection module, Bluetooth module, and power circuit. The STM32 microprocessor uses various interfaces composed of GPIO pins to perform unidirectional or bidirectional data communication with external functional modules, and configure initialization and other functions. The LCD screen displays and outputs data, providing it to the user. Connect the DC fan driver circuit to the STM32 microprocessor pin to achieve power gain on PWM waves, thereby driving the DC fan. The humidity detection module achieves stable acquisition of temperature and humidity parameters. Bluetooth communication circuit enables wireless data communication with mobile apps. The overall system diagram is shown in Figure 1.

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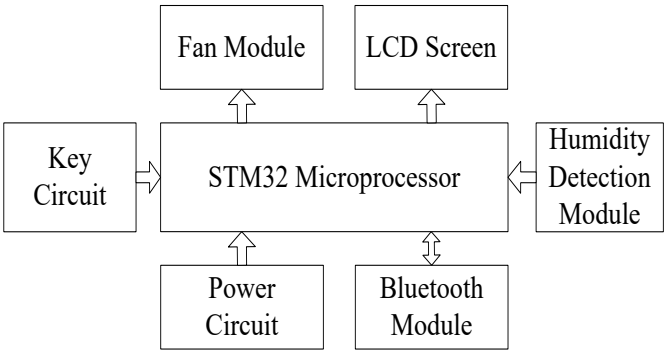

Figure 1 Overall System Design

3. System hardware design

3.1. System hardware design

This design uses STM32 microprocessor as the main control chip. The operation of STM32 microprocessor requires a stable clock signal, which will affect the stability of timer and other modules. This project uses an 8MHz passive crystal oscillator to construct a clock circuit. Reset circuit, using button reset. In this circuit structure, when the reset button is pressed, the VCC high level is immediately short circuited to the RST pin of the STM32 microprocessor through the button, thus triggering the reset function immediately.

3.2. Design of LCD Display Circuit

The system selects LCD1602 display, which can achieve pagination display of 32 characters in terms of performance indicators, and has a relatively simple driving circuit structure, which can ensure the overall stability of the intelligent dehumidifier control system to a certain extent. Configure the eight pins of the PA port as output mode and connect them to the eight pins DB0~DB7 of the LCD1602 LCD screen, so that the character codes generated by the STM32 microprocessor can be fed into the interior of the LCD1602 LCD screen.

3.3. Design of Temperature and Humidity Collection Circuit

The internal controller of the DHT11 temperature and humidity sensor stores the collected temperature and humidity data in registers at predetermined addresses. Users need to read the registers according to the address requirements to obtain the temperature and humidity collection results. This design uses the PB11 pin of STM32 microprocessor to construct the acquisition port at the hardware level, and connects the PB11 pin to the 0UT pin of DHT11 temperature and humidity sensor.

3.4. Design of Bluetooth Wireless Communication Circuit

The HC-05 Bluetooth module belongs to low-power wireless communication devices. This design considers the power parameter configuration of the control system and uses+5V voltage as the power supply voltage for HC-05 Bluetooth. The data transmission interfaces are respectively serial data transmission and serial data reception. The TXD pin is used to output internal data of HC-05 Bluetooth, and the RXD pin transmits data to the HC-05 Bluetooth internal controller. The PA10 pin of STM32 microcontroller is used as the serial data receiving channel of the main control end, connected to the TXD pin, and the PA9 pin is used as the serial data output channel of the main control end, connected to the RXD pin. At this time, high-speed data communication can be carried out between the microcontroller and Bluetooth.

3.5. Alarm circuit design

This design uses a+5V DC voltage as the operating voltage for the active buzzer. The PB8 pin of the STM32 microprocessor is used as the output port for the driving signal. The working mode

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of this port is high and low level pulse output. Due to the weak power of this pulse, it cannot be directly input into the active buzzer for driving. Therefore, MOSFET is connected to the active buzzer and PB8 pin. Its working principle is to turn on the MOSFET when PB8 outputs a high level, thereby supplying power to the active buzzer and emitting a buzzing sound.

3.6. Circuit design of fan module

This design uses a small DC fan. By using the SI2302 driver architecture buffer module, the pulses output by the STM32 microprocessor pins receive sufficient power gain, enabling stable control of the DC fan. The STM32 microprocessor uses the PB7 pin, which is directly connected to the four signal input channels of the SI2302 driver module to input weak PWM waves. After fast power gain, high-power signals are output through the drain pin.

3.7. Key Circuit Design

The system has four mechanical buttons, which are respectively connected to the input pins PB10, PB12, PB13, and PB15 of the STM32 microcontroller. They are used to increase, decrease, switch the cursor, and switch the display interface of the parameters to be set.

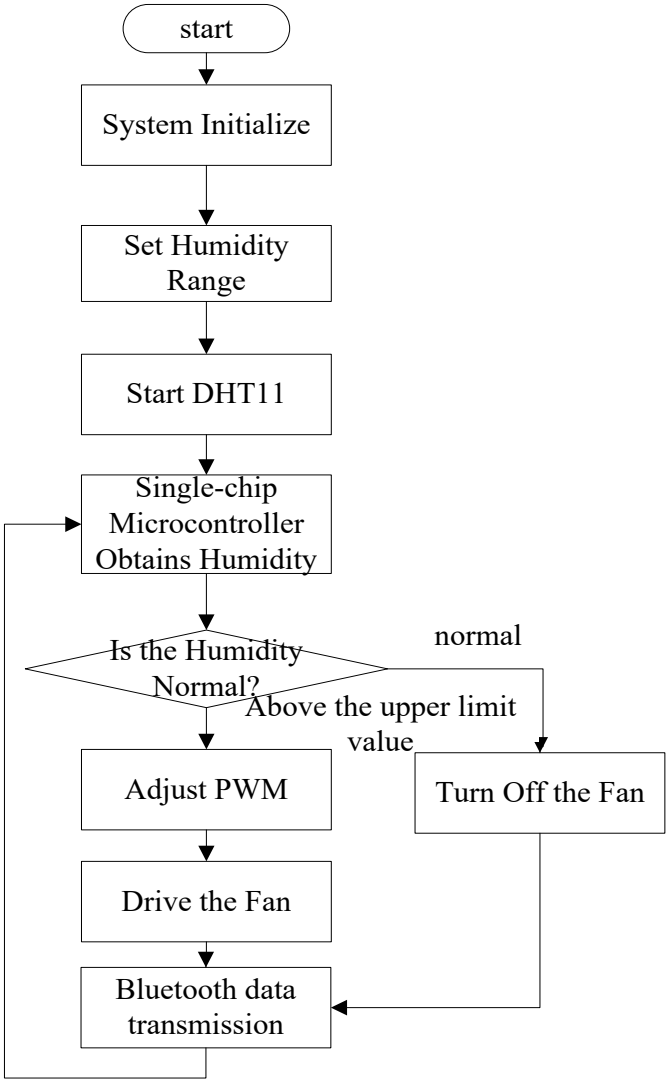

Figure2 Main flowchart of intelligent dehumidifier

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4. System software design

4.1. Main program flow design

At the software level, a software development platform for the intelligent dehumidifier system will be built using KEIL software. By writing C language program code, driver programs for various hardware circuit modules will be generated, and under the control of STM32 microprocessor, various functional indicators will be achieved. The main process is shown in Figure 2.

4.2. System functional testing

After power on, the system immediately enters the working state through a fast initialization process, and the STM32 microcontroller drives and controls the functional modules through various interfaces. As shown in Figure 3, by driving the DHT11 temperature and humidity sensor, the current temperature value is 21.8 °C and the humidity value is 66% RH. Due to being higher than the target humidity of 61% RH, the left fan in the figure is started for automatic dehumidification. Subsequently, the STM32 microcontroller drives the LCD1602 LCD screen to display the current temperature and humidity values.

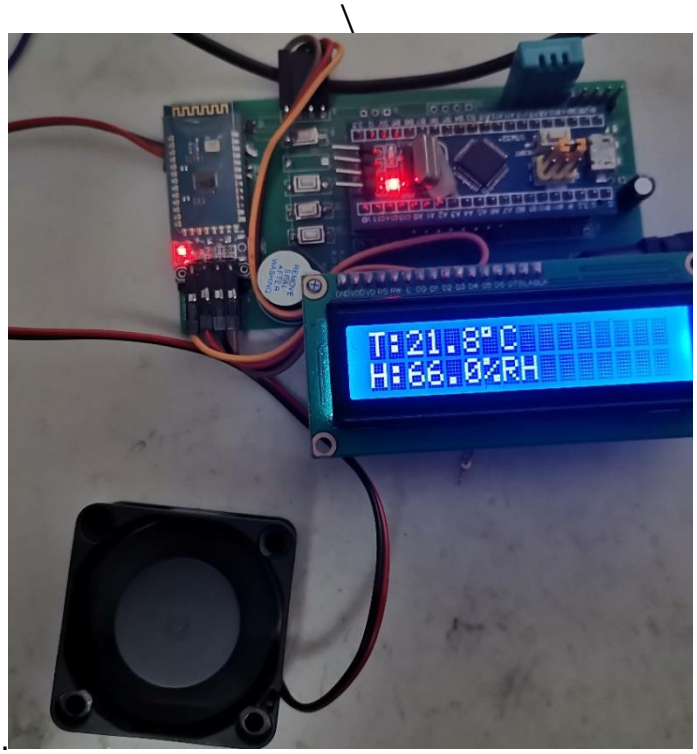

Figure 3 Start automatic dehumidification

As shown in Figure 4, after opening the mobile Bluetooth app, connect it to the Bluetooth account on the physical device. At this time, the system can send various data information to the mobile app through the HC-05 Bluetooth module. The displayed temperature value is 21.8 degrees Celsius, the temperature alarm upper and lower limits are 23-40 degrees Celsius, the humidity is 56% RH, and the physical alarm upper and lower limits are 39-61 degrees Celsius.

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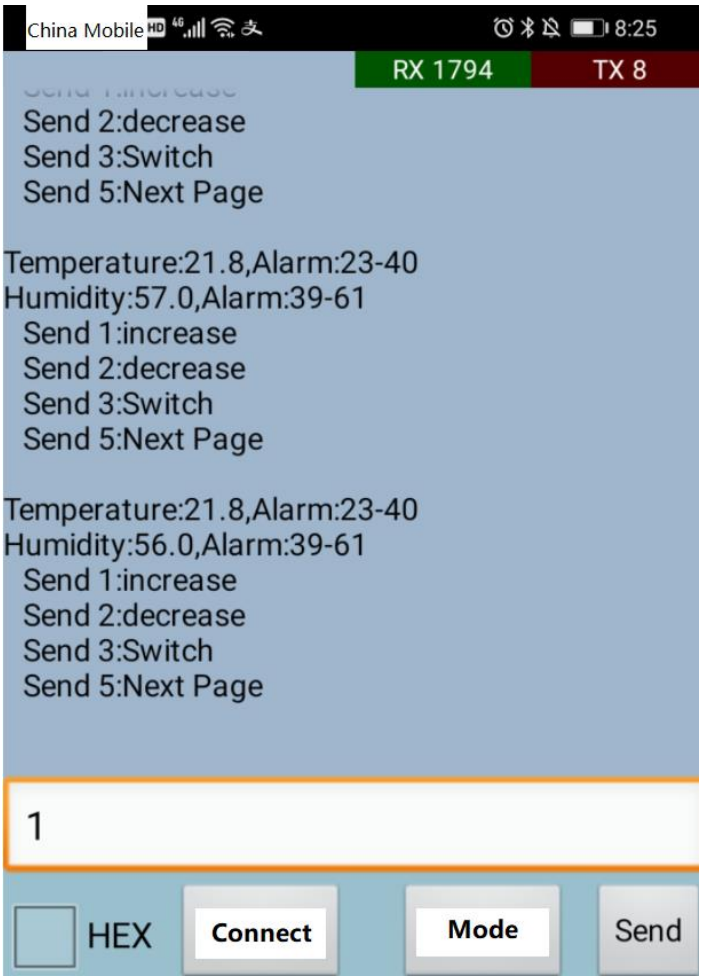

Figure 4 Bluetooth APP display

5. Conclusion

This project has successfully implemented an intelligent dehumidifier system, which has been tested and verified in multiple aspects. It can demonstrate long-term stable operation. Users can set the target humidity value through buttons. When the humidity parameter is lower than the target value, the system will automatically start the dehumidification fan to produce a large air volume effect, thereby achieving automatic dehumidification function. At the same time, the system can also display various parameters through a high-definition LCD display.

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