Multi-point infrared temperature measurement system based on STM32

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Abstract

This topic is about the design of multi-point infrared temperature measurement system based on STM32. It requires that STM32 chip be used as the core processor of the system, and through the use of several non-contact infrared temperature sensors, the temperature of multiple objects or different surfaces of the same object can be measured at the same time. At the same time, the upper computer interface and the host computer program are provided to analyze the temperature acquired by the system.

Keywords

Temperature Measurement, Infrared Temperature Measurement, Non-contact, Multi-point.

1. Introduction

Temperature measurement is widely used in people's daily life, as well as in industry, medical treatment, scientific research and other fields. It is everywhere in our life and work today. However, with the improvement of science and technology, people have more and more high requirements for temperature measurement. The non-contact thermometer has better reaction speed, measurement range and accuracy than the contact thermometer. At the same time, its greatest advantage is that it can measure temperature without touching the measured object. This advantage can improve the safety of temperature measurement in some dangerous areas such as industry and medical treatment. For example, in medical treatment, virus infection can be avoided when patient's body temperature is measured. In industrial production, when measuring high temperature objects, the surveyor can be kept away from the high temperature objects while protecting the measurement. Instrument. Because there is no need to contact with the measured object, the non-contact thermometer will not exchange heat with the measured object in the measurement, so it can reduce the influence of the thermometer on the actual temperature of the measured object, reduce the error, and play a great role in scientific research.

2. Topics and requirements

According to the requirements of the project, the main functions of the temperature measuring equipment are as follows:

(1) Get the temperature measured by one of the sensors and display it to the monitor.

(2) Set the time interval, each sensor automatically measures the temperature at the corresponding time, and save the temperature data to the memory.

(3) Adjust the emissivity of the sensor. Because different objects have different emissivity, it is necessary to adjust the emissivity of sensors according to the measured objects in order to get accurate data.

(4) Check the temperature data measured by the sensors in the memory, and the data are displayed on the monitor.

(5) Erase the memory. Because flash memory is used in the system, it is necessary to erase the original data of the memory before storing new data into the memory.

(6) Upload data to host computer through serial port.

3. General layout of system design

In this design, the system is divided into six modules: display module, power module, infrared sensor module, host computer data transmission module, memory module and STM32 processor module.

The display module is 5110 LCD, which is responsible for displaying instructions, data and status information; the power module is composed of 9V carbon battery and AMS1117 voltage regulator chip, and powers the other modules; the infrared sensor module is composed of several MLX90615 sensors with SMBus bus structure and connected with STM32; the upper computer data transmission module is composed of CH340 USB. The serial port of STM32 is converted from CH340 to USB and connected with PC. The memory module is responsible for storing the temperature data measured by sensors and waiting for transmission to PC. Finally, the STM32 processor module is composed of the smallest system and control keys with STM32F103RET6 chip as the core, and leads to the connection with each module. Mouth.

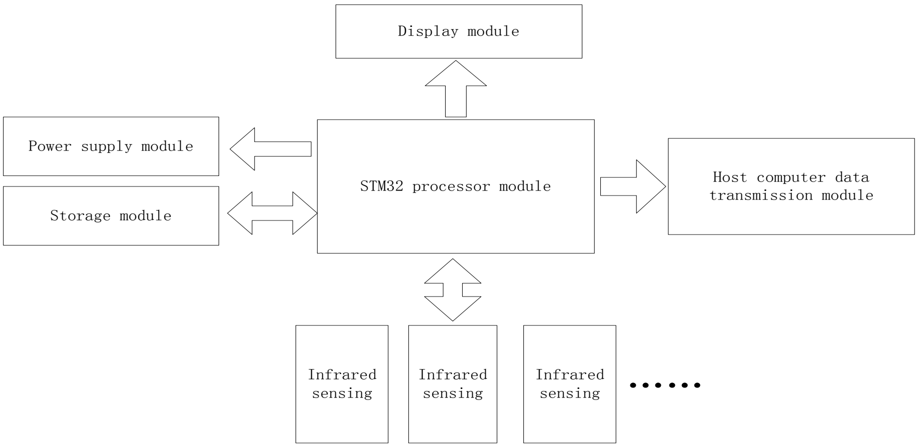

Fig. 1 System block diagram

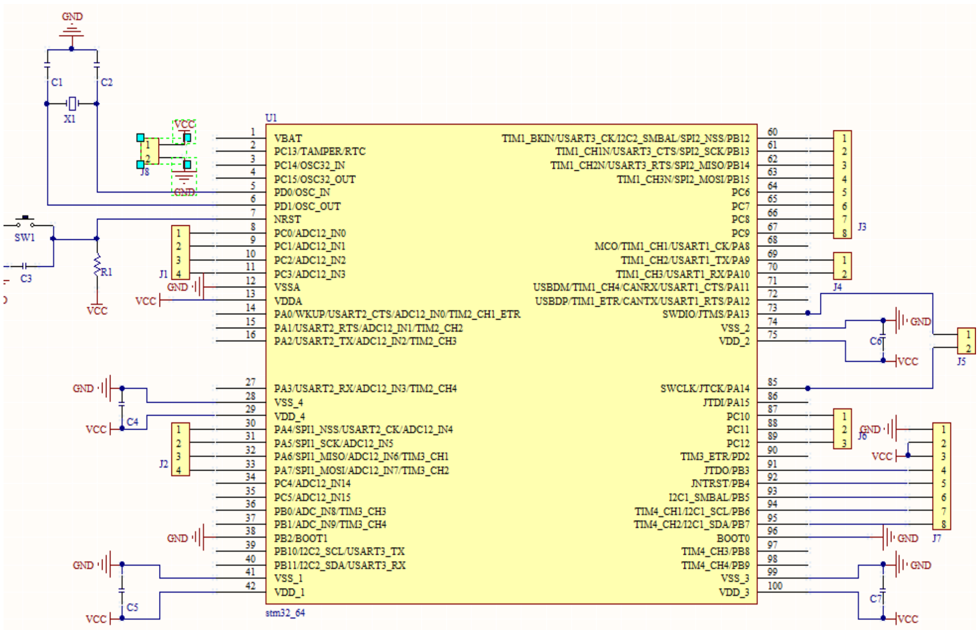

Fig. 2 STM32 system

4. Circuit Design

4.1 Introduction of STM32F103RET6 Chip.

According to the minimum system of STM32, the system consisting of STM32F103RET6 chip is shown in Fig. 2. It leads out the necessary pins for the system and connects the 8 MHz crystal oscillator and reset circuit. Because the STM32 real-time clock is not used in this design, 3 or 4 pins are left out, and no external oscillator of 32.768 kHz is needed. J2 serves as SPI interface and connects with memory chip by multiplexing STM32 I/O port; I/O port PC1 and PC2 are connected to SMBus bus to control infrared temperature sensor; J4 is a hardware serial port of STM32 using I/O multiplexing function, which is connected with CH340 chip; J5 is connected with PA13 and PA14, which are STM32's ST-L by default. INK interface, STM32 can be downloaded and debugged through ST-LINK. Finally, J7 is the 5110LCD ground interface, which connects PB4 to PB7 using I/O port, and data transmission is carried out through software simulation SPI interface.

4.2 Design of Infrared Temperature Sensor.

The MLX90615 digital infrared temperature sensor used in the device will be connected by SMBus bus. The sensors will be used as slave devices, while the STM32 processor will be used as the main device to control the sensors. The configuration of SMBus bus is shown in Fig. 3. SDA pins are data pins and SCL pins are responsible for transmitting clock signals. They are connected with 4.7K resistance pull-up.

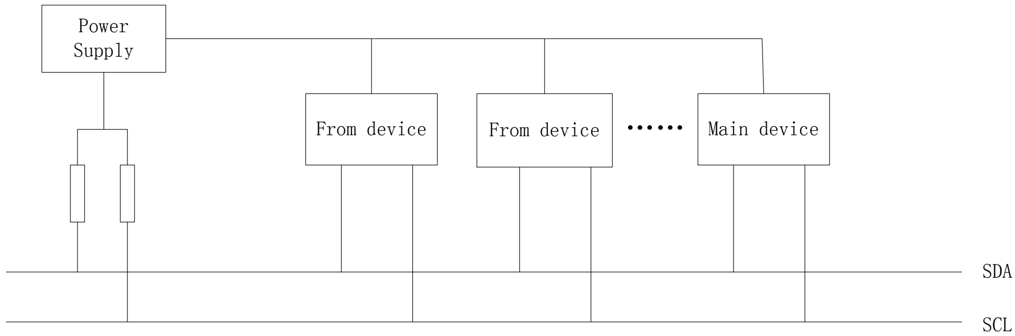

Fig. 3 Circuit design of wireless transmitter system

4.3 Design of Memory System Circuit

The W25X16 flash memory chip used in the design adopts standard SPI communication protocol, so the chip is connected through the SPI interface of STM32 peripheral, and drives it directly by hardware SPI. The circuit of W25X16 is shown in Fig. 4. NSS, SCK, MISO and MOSI interfaces correspond to PA4, PA5, PA6 and PA7 of STM32I/O respectively. When the connection between W25X16 chip and STM32 is too long, the communication will be unstable. Therefore, when the connection distance between W25X16 chip and STM32 is too long, the data pins should be raised to ensure the stability of communication. But the best way is to connect the chip directly to STM32 instead of DuPont line.

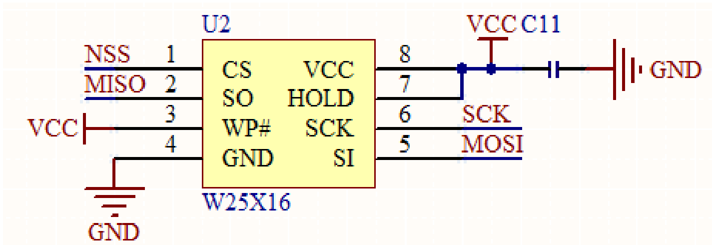

Fig. 4 Circuit diagram of W25X16flash memory chip

5. System programming

The software program adopts modular design. The keyboard scanning function is used to obtain the keyboard values pressed, and then according to the input codes, it enters the function to realize the corresponding functions. When the execution is completed or the cancellation command is received, it returns and continues to scan the keyboard input. The main flow chart is shown in Fig. 5.

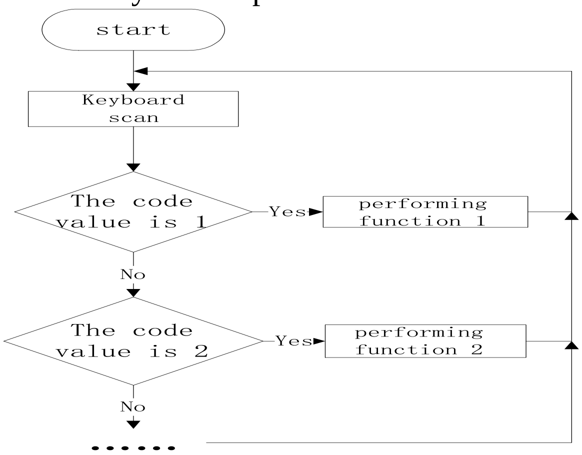

Fig. 5 Main flow chart of program

6. Conclusion

In this design, according to the requirements of the project, a multi-point infrared temperature measurement system based on STM32 is actually completed. Firstly, this paper analyses the requirements of the subject and the development background and research significance of the infrared temperature measurement system, and defines the design scheme and device requirements accordingly. A total of three MLX90615 digital infrared temperature sensors are designed and connected with a STM32 processing chip through SMBus bus. The temperature measurement range is from -40 to 115 degrees C and the resolution is 0.02 degrees C. Moreover, a host computer interface and a matching host computer program are provided to realize the temperature measurement between the device and the host computer. Communication and data transmission.

After testing and adjusting the system to a certain extent, it shows that the designed temperature measuring equipment meets the requirements of the subject. So far, this design has been completed. After the problems encountered in the design process and the knowledge learned from them, some prospects for the design are put forward below.

References

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