Design for New wardrobe with Temperature and Humidity Control Based on STC89C52 Single Chip Microcomputer

Xiaohui Wang [a], Kai Gong [b]

School of mechanical Electrical and Mechanical Engineering, Lingnan Normal University, Zhanjiang 524048, China;

[a] wangxh@lingnan.edu.cn, [b] xiaohuilyy@163.com

Abstract

In view of the consumption characteristics of floating population in wet southern cities, a new type of automatic dry closet based on STC89C52 single chip microcomputer was designed and manufactured. The connector was modeled by PRO-E and printed out by 3D printing, then used the connector to connect the telescopic column and baffle. This design allows the closet to have new practical features such as easy disassembly and partitioning. Temperature and humidity sensor (DHT11) was used to detect the humidity and temperature of the closet, the detection signal was input to the STC89C52 MCU, in order to control the air dryer for achieving effective control of the humidity and temperature here. After successful debugging of circuit and program with software such as proteus and keil, products was built in kind and experimental tests was conducted , the results show that the function and stability of the system meet the requirements of the temperature and humidity controlled drying function.

Keywords

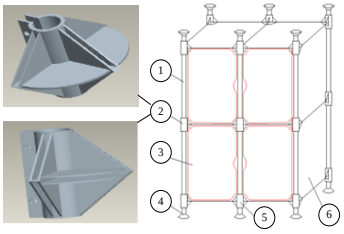
temperature and humidity sensor, innovative design, dry closet, STC89C52, Proteus, control, MCU.

1. Introduction

With the development of science and technology, the structure and function design of the wardrobe has become more diverse, humanized and intelligent. Especially as the most popular custom-made wardrobes at present, domestic and foreign scholars carry out various functional optimization designs based on their full advantage of space. Liu Wenjin of Zhongnan Forestry University and other ergonomic regional intelligent design for the whole wardrobe, using advanced technologies such as embedded systems and sensors, make it easy for different people (especially children and people with disabilities) to take out clothes [1] . Sun Keliang of Northeastern Forestry University determined the functional design of the whole wardrobe from two aspects: the scale of the person and the scale of the object [2]. In recent years, single-chip technology has been widely used in the fields of temperature, humidity and position control [3-7]. The development and application of intelligent equipment has given new life to traditional furniture. The intelligent products based on single-chip sensors have Occupy the vast market because of it's stable performance and low price. The overall wardrobe has entered the Chinese family about ten years, but it has been favored by many domestic families. However, the above-mentioned high-intelligent overall wardrobe costs are very high, requiring large space for storage, only suitable for high-end decoration. Based on the control principle of single-chip microcomputer, software such as Pro-E and Proteus, this paper strives to design a low-cost multi-functional assembled whole wardrobe, and realizes the functions of automatically identifying wet weather, temperature and humidity control drying clothes.

2. Structural scheme

The overall structure of the wardrobe designed in this paper is shown in Figure 1. The support structure is a plurality of top-standing vertical columns (Part No. 1), which are retractable stainless steel rods with vacuum suction cups at both ends. The length of the columns can be adjusted to the height of the building space. It is freely adjusted and fastened with screws. The two ends of the column are fixed to the ceiling and the floor by suction cups. As shown in Figure 1, six telescopic columns are used to form the wardrobe main body, panels are arranged on the side, the top and the bottom of the main body, and the door panel is installed on the front side. The difference between the door panel and the panel is that only the two ends of the same side of the door panel are fastened in the connecting part, and the other side is provided with a small opening for easy opening and closing, the four corners of the panel are fixed in the connecting member and cannot be rotated. Attachment (part2 and 5in Figure 1) can be installed on the column. The No. 5 part with the telescopic rod can expand the locker in four directions: up, down, left and right. The panel is fixed on the connecting piece to separate a large storage space into a small storage space, which is convenient for placing and isolating the same kind of articles and clothes. Users can assemble a solid wardrobe with a high space utilization rate according to their preferences.



1 Retractable stainless-steel column 2 A-connector 3 Rotatable door panel 4 bottom suction cup 5 B-connector 6 panel (non-rotatable)

Figure 1. Overall structure

3. Design for control system

The purpose of design for control system is mainly to realize the automatic humidity control and temperature display function of the wardrobe. Considering the wet weather in the south, the clothes in the closet are prone to moisture and mildew; common household dryers and large disinfection dryers used in hotels can help us solve this problem, but the domestic dryers commonly used in the market can only be artificially dried at regular intervals. This paper attempts to place the temperature and humidity sensor in the closet. When the sensor detects the humidity inside the wardrobe increases to the design value, the drying device at the bottom of the wardrobe automatically recognizes the temperature and humidity and switches the drying function by its control chip.

3.1 Hardware design and simulation

Common dryers are classified into venting type (low cost), and dehumidification type (requires condensing device, high cost but no impact on external environment). According to heating method, it is divided into gas, electric heating, microwave type, heat pump, etc. This article uses low-cost heating and moisture removal methods, namely electric heating vented clothes.

The hardware mainly includes the control module of the single chip microcomputer, the data acquisition device, the data display device and the drying circuit. The wiring diagram of the main components is shown in Figure 2. The model of the one used is STC89C52, which has its own register and digital-to-analog conversion circuit compared to AT89C52. The chip STC89C52 in Figure 3 is connected with DHT11 temperature and humidity sensor, LCD1602 liquid crystal display and relay respectively. The voltage of the single-chip power supply module is DC 5V. the main function of the control circuit of the automatic drying program is to control the closing of the relay contact switch in the main circuit.

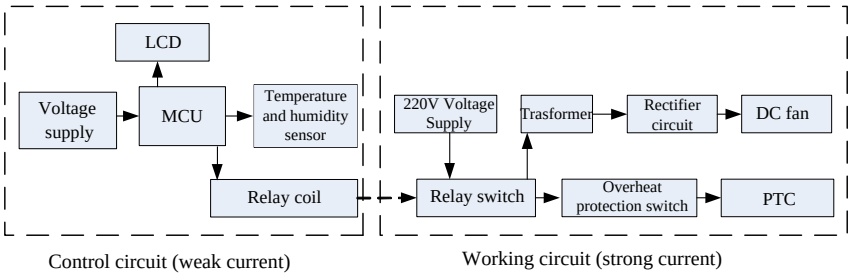


Figure2. Circuit diagram

When the power is open, the dryer in the wardrobe starts the automatic detection program. The DHT11 temperature and humidity sensor performs real-time detection and timing sampling on the humidity inside the wardrobe, and inputs this signal into STC89C52 which can compare the measured signal with the set signal in Single chip microcomputer. When the air humidity of the closet exceeds the upper limit and the temperature is lower than the upper limit, the relay coil is energized, the relay switch that triggers the drying circuit is closed.

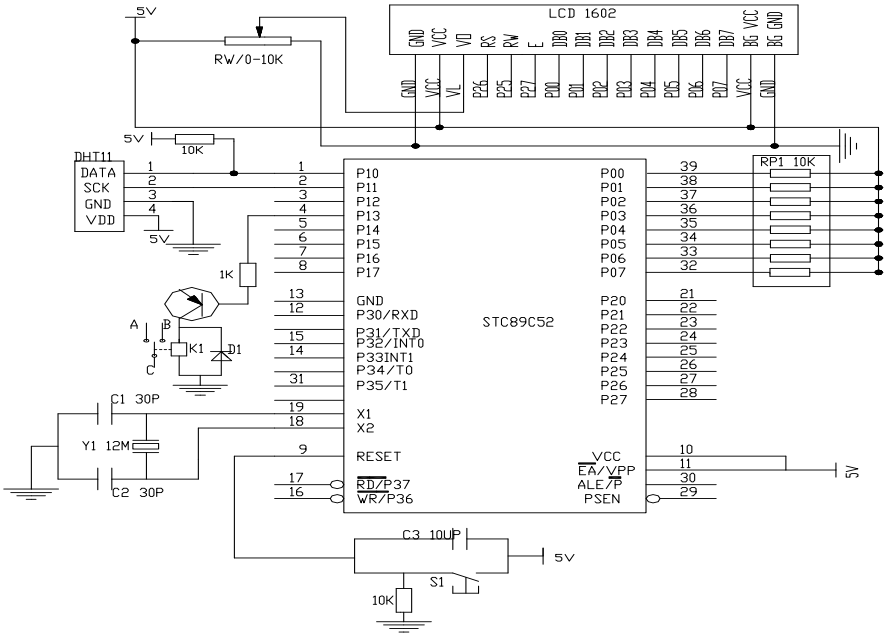


Figure3. Wiring Diagram for Control Circuit

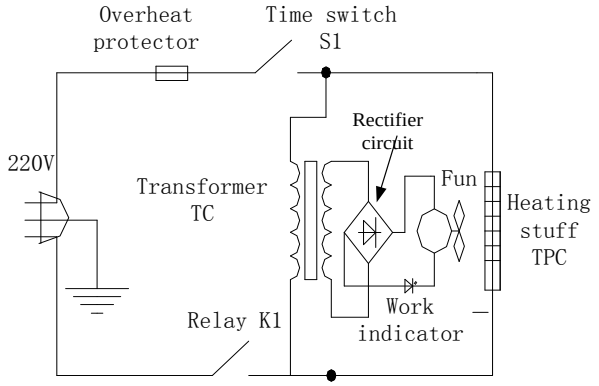


Figure 4. Wiring Diagram for Working Circuit

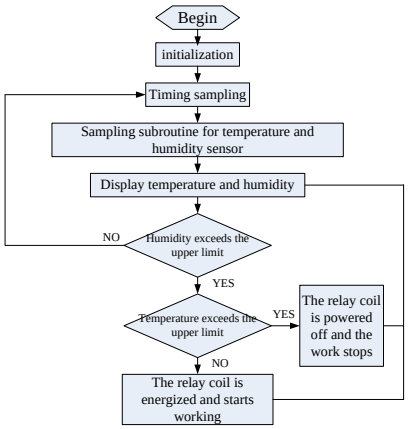


Figure5. Flow chart for control program

The 220V power supply passes through the transformer and then turns on the heater heating plate and the dryer fan, the drying function is activated. During the drying process, the temperature and humidity sensor is still detected in real time. Once the air humidity inside the wardrobe is detected to fall below the upper limit or the temperature is higher than the upper limit, the relay coil is

de-energized, and the relay contact switch is turned off. In this way, the relatively constant temperature drying function is realized, and the clothing is prevented from being damaged by excessive temperature (the silk drying cannot exceed 50 ° C). The Wiring Diagram for Control Circuit and Working Circuit are shown in figure 3 and figure 4.

3.2 Control system program simulatian and debugging.

The software program of this paper is written in C51 language. The modular program method is developed and adopted on platform of the Keil uvsion2ment. The program is written by PZISP ,this is an automatic download software. After the hardware is completed, the debugged program is downloaded to the MCU, then detect the operation of the system.

temperature and humidity sensor (DHT11) detects the humidity inside the wardrobe, The program written includes the initialization procedure for single-chip microcomputer, setting the upper limit of air humidity and upper temperature limit, programming subroutine for DHT11 to collect humidity and temperature data in the environment, LCD1602 display A subroutine of the current chamber temperature and so on.

The flow chart of the general program is shown in Figure5. The timing program uses the interrupt mode to control the sampling frequency. When the power supply switch turned on ,the power of the drying circuit is connected, the system will continue to call the temperature and humidity sensor sampling and display program according to the programmed frequency.

After debugging and burning of the program, the system needs to be tested and demonstrated. The local actual relative humidity during commissioning is 68% RH, the temperature is 30 degrees, the upper limit of humidity is set to 50% RH, and the upper limit of temperature is 51 degrees (as shown in the display of the first and the second picture in Figure 6). After the power is turned on, the relay switch is closed, and the TPC starts heating, the fan is turned on too. That is, the drying function is automatically activated. When the temperature exceeds 51 degrees or the humidity is lower than 50% RH, the drying circuit stop working . This shows the test passed.

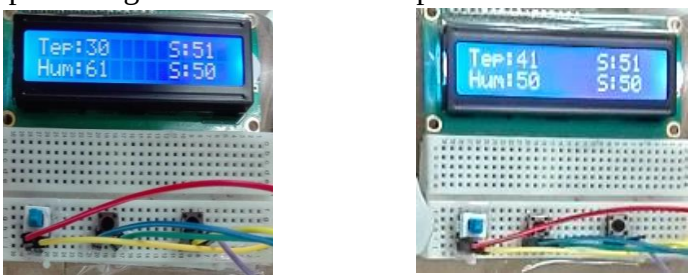


Figure 6. Drying function test for the product

4. Experimental part

The initial temperature in the test cabinet is constant temperature and humidity (25 ° C ± 2 ° C, 65 ± 5% RH), and the drying object is made of silk and cotton. Because the silk clothing is easy to deteriorate at high temperature, the human body senses the air humidity of 65% RH, which is dry. Therefore, the upper limit of the drying temperature is 40 °C, the lower limit of humidity is 62% RH, the tightness of the wardrobe is 95%, and the size of the wardrobe. : 36cm × 36cm × 135cm (double layer)

The experimental steps are as follows:

(1) Washing: Before the start of the experiment, the clothes were washed and recorded it's Initial water content.

(2) Drying: Drying the clothes (the spacing between the clothes is suitable and basically equal during the drying process),Recording the time and end of clothing weight after the experiment.

(3) Perform data calculation to get the clothes drying effect

In order to ensure the reliability and repeatability of the experimental data, the average of five data was taken for each experimental variable data. The experimental results are shown as follows:

Table 1. Experimental measurements

Sample	Nominal weight/g	Initial weight/g	End weight/g	Initialwater content/%	End water content/%	Working time/min	Number of stops
1	50	80	51	60.0	2.0	24.5	2
2	75	200	77	62.5	2.7	28.2	3
3	125	300	128	58.3	2.4	36.3	4

During the experiment, when the humidity is still high and the temperature has reached the upper limit, the drying circuit will be suspended, the pause time is set to 60 seconds, and then continue to open until the humidity detection reaches the standard. The end water content of the three sets of data was between 2% and 3%, and the drying effect was good.

5. Conclusion

This design structure is stable and safe, does not roll over, effectively avoids the bruises caused by climbing due to children; can be repeatedly disassembled and assembled, and has various splicing methods; suitable for a variety of widths and heights, suitable for floating population, Applicable to ordinary families with elderly and children.

Second, it can intelligently identify the weather. Against the humid and rainy weather in the south, this design using the single-chip and temperature and humidity sensors and other components to automatically monitor the air temperature and humidity. It has an intelligent air-drying device, without human intervention, it can be turn on or off automatically, you can freely set the temperature and humidity, achieve low temperature air drying, suitable for silk and other high temperature avoid moisture and mildew clothing storage.

The third, the precision of the connectors used in the design is low. It can be mass-produced by using ordinary injection molds. The cost of selected panels, telescopic rods and electrical components is not high, it's light and easy to disassemble, and the e-commerce transaction prospect is good.

Acknowledgements

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