ISSN: 2688-8653

Design of Monitoring System for Breeding Environment based on Microcontroller

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Abstract

The monitoring of the breeding environment is of great significance for improving the efficiency of the breeding farm. Aiming at small and medium-sized farms, this paper designs an intelligent environmental monitoring system with STC89C51 as the control core, LCD1602, DHT11 sensor, independent keyboard and alarm system. This system can collect the temperature and humidity of the breeding environment, and compare the measured value with the set threshold to determine whether to adjust the breeding environment, so as to realize the automatic monitoring of the breeding environment parameters. After software and hardware debugging, the basic requirements of the design are finally realized.

Keywords

Microcontroller, temperature and humidity monitoring, DHT11 sensor, liquid crystal display, software simulation.

1. Introduction

Through production practice and scientific experimental research, it is found that the breeding environment will have a greater impact on the reproductive capacity, health status, and feed utilization rate of the laying hens during the growth process [1] [2]. Temperature and humidity have the greatest impact on the breeding environment. How to monitor the environment in real time and remind the staff to adjust the environmental temperature and humidity in time is of great significance for improving the efficiency of the breeding industry [3] [4].

This article designs a breeding environment monitoring system with a microcontroller as the control core. The second part introduces the overall design of the system, the third part introduces the hardware circuit design of the system, the fourth part introduces the software simulation and hardware test results, and the fifth part gives conclusions.

2. System Overall Design

2.1. Design Specifications

We will design a layer hen breeding environment monitoring system, which can accurately and quickly collect the temperature and humidity in the chicken house and display it on the LCD1602 liquid crystal display, and compare it with the set upper and lower thresholds. If the measurement data exceeds the threshold range, the buzzer will alarm, and the corresponding indicator will light up to remind the staff to adjust the temperature and humidity. The design indicators are as follows,

(1) Temperature measurement accuracy: ±2℃;

(2) Temperature measurement range: 0~+50℃;

(3) Humidity measurement accuracy: ±5%RH;

(4) Humidity measurement range: 0~90%RH;

ISSN: 2688-8653

(5) The upper and lower thresholds of temperature and humidity can be modified by keys;
(6) Alarm can be given when temperature and humidity exceed the threshold.

2.2. Overall Design

The block diagram of the overall design is shown in Figure 1. The system uses STC89C51 as the main control circuit module, including DHT11 temperature and humidity sensor acquisition circuit, LCD1602 liquid crystal display circuit, button circuit, alarm module, etc. The STC89C51 microcontroller is the central control part. DHT11 is used to collect temperature and humidity in real time, and display the collected temperature and humidity on the LCD1602 display. The button circuit is used to set the temperature and humidity threshold. When the real-time temperature and humidity exceed the threshold, an alarm signal is issued.

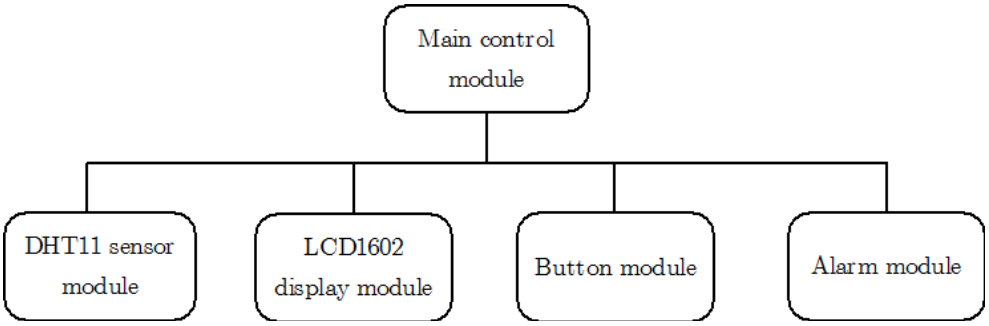

Figure 1: Block diagram of the overall design scheme

3. Hardware Design

3.1. Main Control Circuit Design

The main control circuit is composed of the minimum system of the single-chip microcomputer [5] [6], including clock circuit, single-chip microcomputer, reset circuit, etc., as shown in Figure 2. The clock circuit sends out a signal, and the single-chip microcomputer continuously sends out instructions for receiving the data collected by the sensor, analyzing and processing, and passing it to the display module for display.

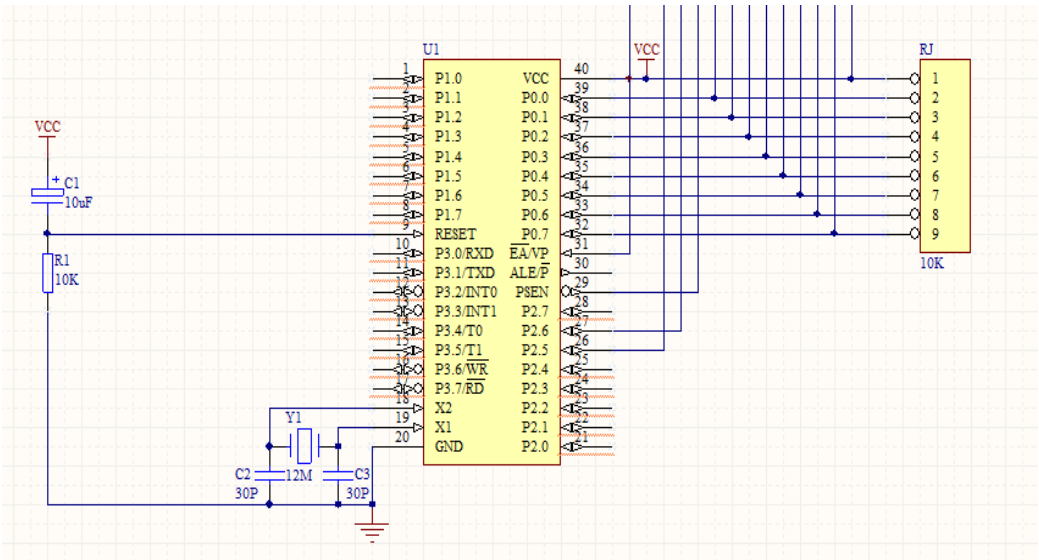

Figure 2: Main control circuit design

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3.2. Sensor Module Design

The DHT11 type digital temperature and humidity sensor [7] can monitor the temperature and humidity in the environment in a very short time and convert it into a signal that the single-chip microcomputer can receive. The sensor circuit diagram is shown in Figure 3.

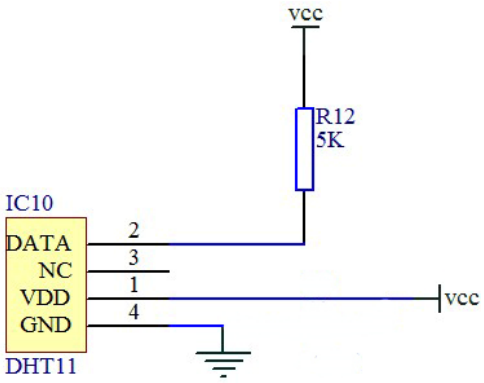

Figure 3: Sensor circuit

3.3. Display Module Design

The display module adopts LCD1602 liquid crystal display to realize, use voltage to control the area that needs to display content. The sensor transmits the collected current temperature and humidity data to the single-chip microcomputer. After the single-chip uses the internal program analysis, it is displayed on the LCD screen, and the upper and lower thresholds of the required temperature and humidity can be set on the display screen. The circuit diagram is shown as in Figure 4.

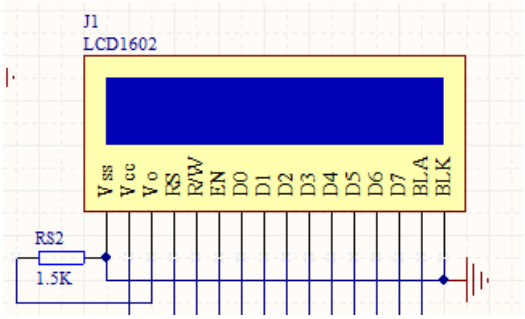

Figure 4: LCD1602 circuit

3.4. Alarm Module

The alarm module adopts buzzer to realize, the circuit diagram is shown as in Figure 5. When the temperature and humidity data received by the microcontroller exceeds the set threshold, the buzzer will be activated and an alarm signal will be issued.

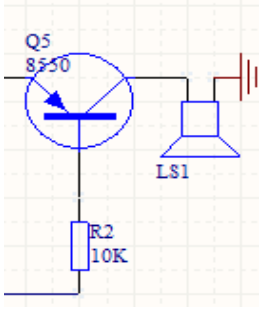

Figure 5: Alarm circuit

ISSN: 2688-8653

3.5. Button Module

The button module circuit is shown in Figure 6, using 3 buttons to change the temperature and humidity threshold. The keyboard in this design only works when the voltage is extremely low. The circuit is connected with a pull-up resistor, so that the keyboard will not start randomly; as long as you press a key, it can work normally.

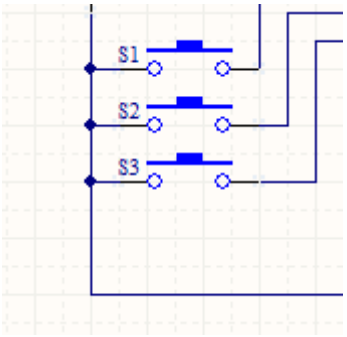

Figure 6: Button circuit

4. Simulation and Hardware Test

4.1. Software Simulation Results

Use Proteus ISIS software for circuit simulation, and build a simulation circuit based on the system design block diagram. The simulation result is shown in Figure 7. It can be seen that at this time the temperature is displayed as 26℃, the humidity is 60%, the upper and lower limits of the temperature are 5℃~30℃, and the upper and lower limits of the humidity are 30%~65%.

4.2. Hardware Test Results

According to the overall design of the system, the hardware circuit obtained by welding is shown in Figure 8. Before energizing, check the power supply and grounding for short circuits. Connect the power supply and grounding contacts of the single-chip microcomputer through a multimeter. If there is no alarm and a large resistance value is displayed, there is no short circuit; then check all the power supply and grounding parts. Make sure the connection is correct.

Set the upper limit of temperature to 26℃, and the lower limit to 21℃; the upper limit of humidity is 88%, and the lower limit is 40%. As shown in Figure 9, the measured temperature is 21℃, which is lower than the set threshold, and the buzzer sends out an alarm signal. If a cup full of hot water is placed on the edge of the DHT11 sensor, as time increases, the temperature rises steadily to 26°C and reaches the upper limit of the temperature setting, the alarm system responds, the buzzer and the indicator light work, as shown in Figure 10.

ISSN: 2688-8653

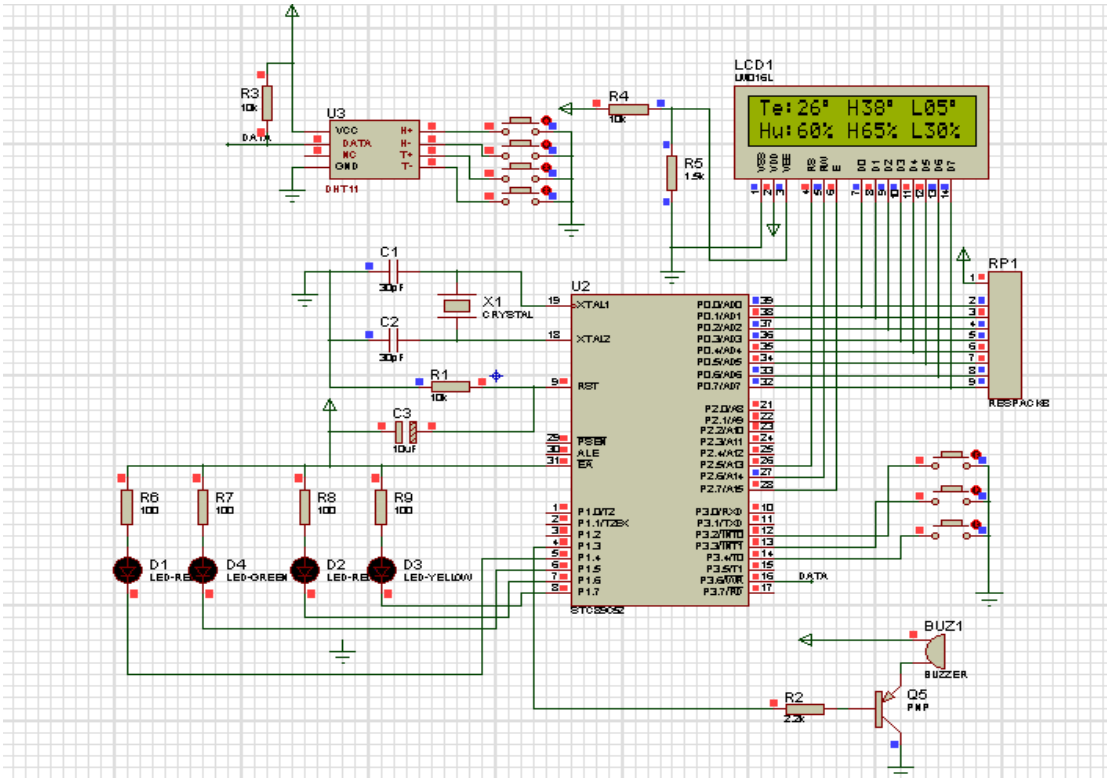

Figure 7: System simulation diagram

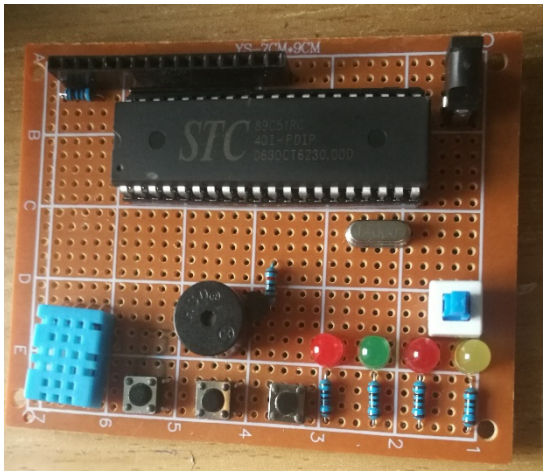

Figure 8: Hardware circuit diagram

5. Conclusion

This paper designs a breeding environment monitoring system based on STC89C51 single-chip microcomputer. The system mainly includes STC89C51 single-chip microcomputer, DHT11 sensor module, LCD1602 liquid crystal display module, alarm module and button module. Both software simulation and hardware test results show that the system can measure the ambient temperature and humidity in real time, and when the temperature and humidity exceed the threshold range, an alarm signal will be issued to meet the design requirements.

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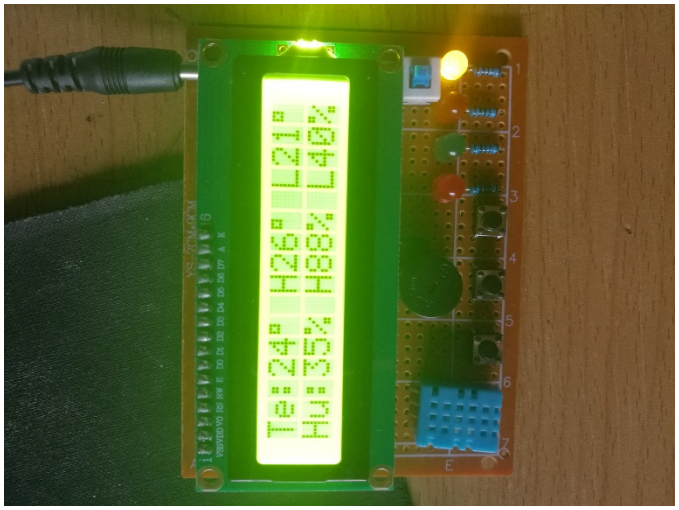

Figure 9: Humidity lower limit alarm diagram

Figure 10: Temperature upper limit alarm diagram

Acknowledgements

This paper was supported by the National Natural Science Foundation of China (grant number 61901350); and Science Research Fund of Xi'an Aeronautics University (grant number 2019KY0208).

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