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Implementation of temperature and humidity control sensor system

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Abstract:

This article designs a novel environmental temperature and humidity control system by 89C51. For effective application in the greenhouse, we can precisely regulate the temperature and humidity in the greenhouse in a more labor-saving way.

Keywords

Temperature, humidity, greenhouse

1. Introduction

Taiwan's main agricultural type is leisure agriculture. Among the various crops produced in Taiwan, orchids are very important leisure agricultural crops. Orchid is a kind of greenhouse flowers. Thus, Taiwan has become a big country in the production of orchids. The five major factors of plant growth are sunlight, temperature, humidity, nutrients, and soil. In order to increase the chances of survival of greenhouse plants, these five factors are indispensable.

This article uses the characteristics of the 89C51 single chip to sense temperature and humidity. When the temperature and humidity are too high or too low, the temperature and humidity are balanced by controlling the fan, the water sprayer, the heating bulb and the dimming bulb. Automatic control technology is applied in the hardware. These technology includes the power processing circuit, single chip control, temperature sensor, comparator circuit, relay action, and program multitasking logical judgment.

The 89C51 single chip is widely used in microprocessors. Especially in engineering, it is very popular. Because the 89C51 single-chip microprocessor has many advantages: Such as strong command function, large memory capacity, serial communication, and Boolean algebra etc. It allows us to design as we like, develop new products and improve product.

We have taken the environmental temperature and humidity control system as the research content of this hardware. In order to be effectively applied to the greenhouse, adjust the temperature and humidity in the greenhouse at high labor-saving and high precise way [1-4].

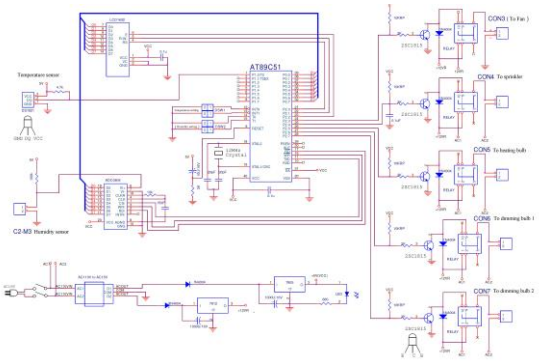

Figure 1. Block diagram of the hardware architecture.

2. The Basic Principles

This hardware is based on the characteristics of the 89C51 single chip to detect temperature and humidity and analog-to-digital (ADC) conversion. When the temperature and humidity are too high or too low, the temperature and humidity are balanced by controlling the fan, the water sprayer, the heating bulb and the dimming bulb. Automatic control technology is applied in the hardware. These technology includes the power processing circuit, single chip control, temperature sensor, comparator circuit, relay action, and program multitasking logical judgment.

Figure 1 is a block diagram of the hardware architecture. Its functions are depicted in the following.

1. A set of 89C51 single-chip circuits is responsible for program control and temperature and humidity sensing.
2. A set of humidity sensors and analog-to-digital (ADC) circuits.

3. A set of temperature sensor circuits.
4. A set of two-digit Dip Switch can set the 4-stage humidity setting value. A set of two-digit Dip Switch can set 4 temperature settings.
5. A set of LCD displays humidity set-point, humidity measurement, temperature set-point, and temperature measurement.
6. Five sets of relays control fans, water sprayers, heating bulbs and dimming bulbs.
7. A set of power processing circuits produces +12V, and 5V power.
8. When the temperature and humidity are too high or too low, the temperature and humidity are balanced by controlling the fan, the water sprayer, the heating bulb and the dimming bulb. Switch the dimming bulb 1 and the dimming bulb 2 every 5 seconds. In order is: Step 1. Dimming bulb 1 is ON, dimming bulb 2 is OFF, switch 5 seconds. Step 2: The dimming bulb 1 is ON. the dimming bulb 2 is ON, switch every 5 seconds. Step 3: The dimming bulb 1 is OFF. the dimming bulb 2 is ON, switch every 5 seconds. Step 4: The dimming bulb 1is ON, the dimming bulb 2 is ON, switch every 5 seconds. Repeat steps 1 through 4 in this way, representing the morning, noon, evening, etc.

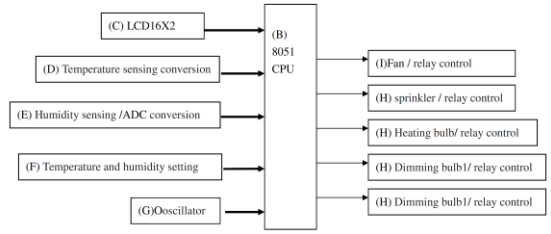

Figure 2. Block diagram of the hardware.

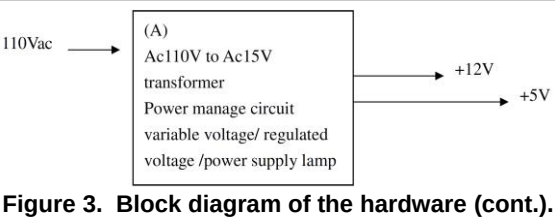

Figure 3. Block diagram of the hardware (cont.).

Shown as Figure 2 and Figure 3, the principle of each circuit block is depicted in the following.

(A) Power manage circuit/ variable voltage/ regulated voltage /power supply lamp

AC110V input provided by the mains electricity, by way of the switch, after the 110Vac To 15Vac transformer, and after 2 sets of rectification and voltage regulation,

7805 regulator IC gets DC5V (VCC) electricity. Another 7812 regulator IC has DC 12V electricity. DC5V (VCC) is used by ICs and LCDs. DC12V is used for relay. In addition, the LED power light is on during the DC5V powered.

(B) 89C51 CPU circuit

The 89C51 is a 40 pin CPU with 32 pin on its I/O pin.

1. The 40th pin is the VCC power input and the 20th pin is the ground pin.
2. The 18th, 19th pin is the quartz oscillator pin, which provides the required oscillation pulse for program execution.
3. RST pin (9th pin), connected to a 10uF/16V capacitor and 2kΩ resistor.
4. We can get the reset time of $10\mu \times 2k = 20ms$. This time period can avoid the situation that program is not stable during the power not stable at turning on.
5. The 29th, 30th, and 31st pin is the external memory control pin. This paper uses 89C51 internal memory. Therefore, these three pins are not used. Connect the 31st pin to 5V.
6. The 1st pin is the temperature sensor output/input pin.
7. The 11th, 16th, 17th pin is the ADC0804 control output pin.
8. The 32nd-39th pin is the ADC0804 and the LCD data bus pin.
9. The 20th, 21st, 22nd pin is the LCD control output pin.
10. The 12th-15th pin is the temperature and humidity setting pin.
11. The 27th, 28th pin is the dimming bulb relay control pin.
12. The 26th pin is the heating bulb relay control pin.
13. The 25th pin is the sprinkler relay control pin.
14. The 24th pin is the fan relay control pin.

(C) LCD circuit

The 89C51 program displays control commands for the LCD. It displays each set value and measured value.

(D) Temperature sensing conversion circuit

The circuit detects temperature by way of the DS1821 temperature sensor. After the serial digit value, provides to the 89C51 calculation.

(E) Humidity sensing circuit

The circuit detects the temperature by way of the C2-M30 humidity sensor. It converts to a digital value by way of ADC0804, provides to the 89C51 calculation.

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(F) Temperature and humidity setting

A set of two-digit dip switch can set the 4-stage humidity setting value. A set of two-digit dip switch can set 4 temperature settings.

(G) Crystal oscillator

Quartz oscillator provides the required oscillating pulse for program execution. This circuit adopts a 12MHz frequency.

(H) Dimming bulb / sprinkler relay control circuit

89C51 controls a transistor. When transistor is ON (High), the relay is turned on. At this time, the terminal block outputs AC110V. When transistor is OFF (Low), the relay turns off, and the terminal block has no output voltage. The terminal block can be connected to an external light bulb.

(I) Fan / Relay Control Circuit

89C51 controls a transistor. When transistor is ON (High), the relay is turned on. At this time, the terminal block outputs DC12V. When transistor is OFF (Low), the relay turns off, and the terminal block has no output voltage. The terminal block can be connected to an external fan.

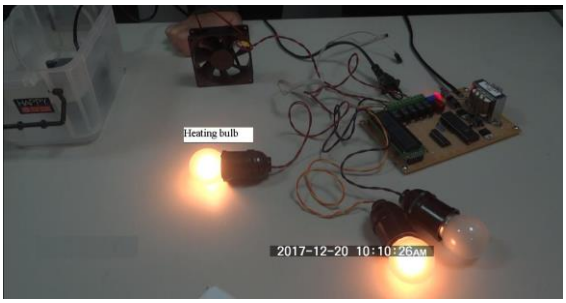


Figure 4. The photo of hardware result.

3. The Production Results

We set the temperature and humidity in advance. If the indoor temperature is now 22 ° C, when we set it to 28 °C, the heating bulb will light up. Shown as Fig. 4, heating is performed. Shown as Figure 5, when heated to 28 ° C, the heating bulb will not turn on, and drive the fan to cool down.

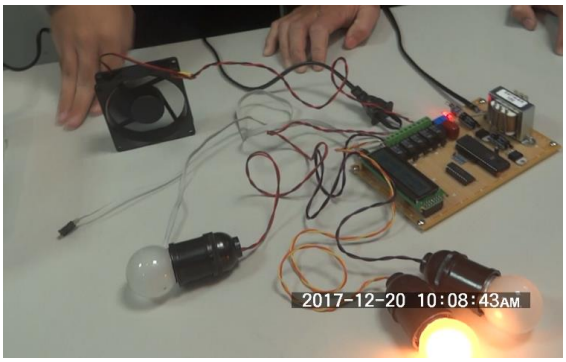


Figure 5. The photo of hardware result (cont.).

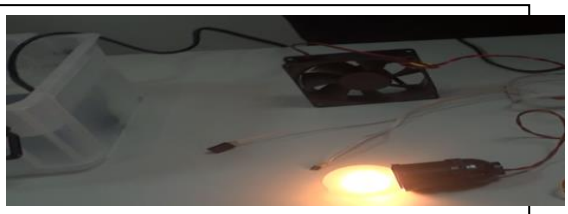
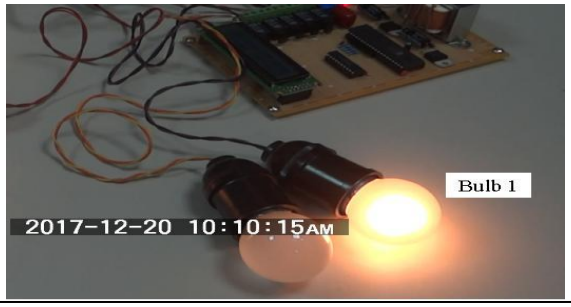


Figure 6. The photo of hardware result (cont.)



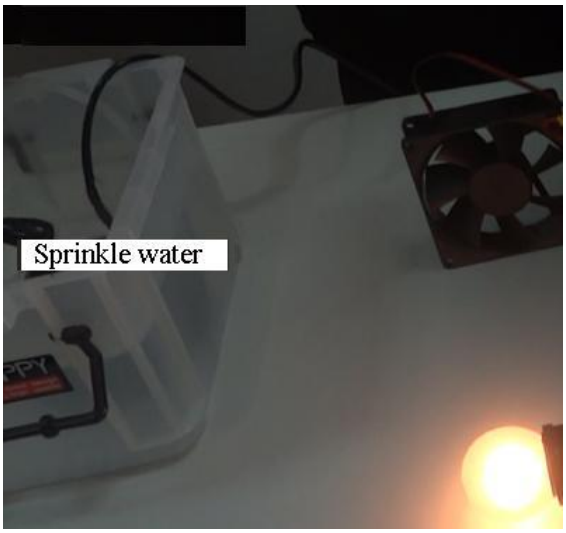


Figure 7. The photo of hardware result (cont.)

We use a humidity sensor to measure humidity. We use the mouth to blow the air. Shown as Figure 6, the humidity is too wet, it dose not be sprinkled. Shown as Figure 7, the humidity is not too wet, it will sprinkle water.

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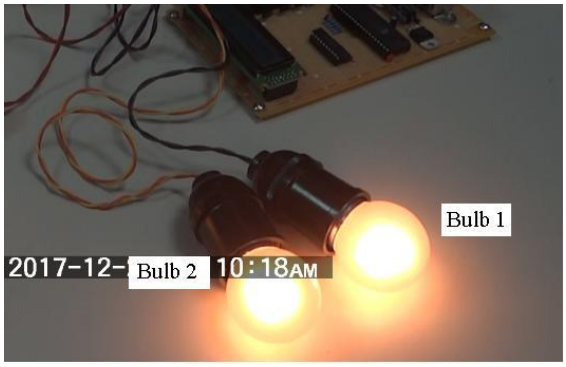

Figure 9. The photo of hardware result (cont.)

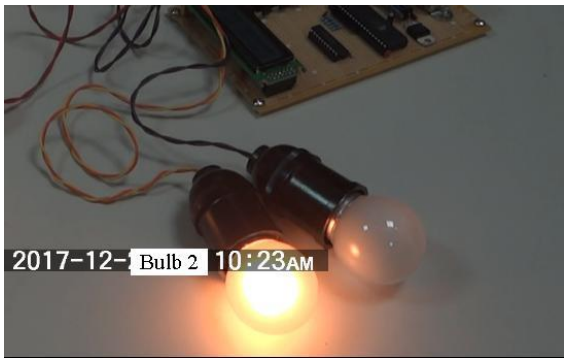

Figure 10. The photo of hardware result (cont.)

Figure 11. The photo of hardware result (cont.)

The operation of the dimming bulb is depicted in the follows. Switch the dimming bulb 1 and the dimming bulb 2 every 5 seconds. In order is: Step 1: Dimming bulb 1 ON, dimming bulb 2 OFF, switch every 5 seconds in Figure 8. Step 2: The dimming bulb 1 ON, the dimming bulb 2 ON, switch every 5 seconds in Figure 9. Step 3: Dimming bulb 1 OFF, dimming bulb 2 ON, switch every 5 seconds in Figure 10. Step 4: The dimming bulb 1 ON, the dimming bulb 2 ON, switch every 5 seconds in Figure 11. Repeat steps 1 through 4 in this way, representing the morning, noon, and evening, etc.

4. Conclusion

Figure 4 to Figure 11 are the photos of the hardware results of this paper. In the future, the agricultural environment will gradually move toward the development of "smart greenhouses". The temperature and humidity control sensing system made by us is providing a reference.

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