Greenhouse Intelligent Monitoring System Based on MCU

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Abstract. Modern greenhouse cultivation of crops yield and quality is affected by temperature and humidity is very big, this paper designed a greenhouse intelligent monitoring system based on single chip microcomputer, STC89C52 as control core, using composite was carried out on the temperature and humidity sensor DHT11 real-time monitor and record, use buzzer and LED lights to alert users to temperature and humidity changes and respond in a timely manner.

1. Introduction
Greenhouse crops have relatively high requirements for temperature and humidity, but the price of existing temperature and humidity monitoring equipment is relatively high, operation is complicated, and it is relatively difficult for some greenhouse growers [1]. This paper designed a monitoring system with relatively low price, simple operation and full function, can monitor changes of indoor temperature and atmospheric water vapor contents in the greenhouse in real time, remind growers that the temperature and humidity changes are out of range, ensure that the crops are in a suitable growth environment and reduce unnecessary losses.

2. Design Scheme of Greenhouse Intelligent Monitoring System
Because the numerical values of temperature and humidity in the greenhouse and their variation range have a critical influence on the quality of the crops in the greenhouse, measuring indoor numerical changes and controlling them in time is the key to improve the quality of crops [2].

This design takes the STC89C52 digital processor as the core, adopts DHT11 composite sensor device to collect the temperature and atmospheric water vapor content data in the greenhouse, and sends corresponding instructions to the buzzer, LED lights, and display devices via the MCU processing, the user can use the independent physical buttons on the system to understand the recorded temperature and humidity data and set the required temperature and humidity range. Fig.1 is the system block diagram, the functions that can be realized are:

(1) The temperature and humidity can be detected at the same time, and the temperature detection range is 0-60℃, its error range is plus or minus 2℃, the humidity detection range is 20%-100%RH, and its error range is plus or minus 5%.
(2) Use LCD1602 display device display the moisture content and temperature of the current indoor atmosphere.
(3) The normal area of these two variables can be set independently.
(4) When these two variables exceed the normal area, the buzzer will work.
(5) There is a corresponding LED light indicating the corresponding variable is out of range.
(6) The change of temperature and humidity can be recorded, and the record can be viewed.

![System block diagram](image1)

**Fig. 1** system block diagram

3. Program Design of Greenhouse Intelligent Monitoring System

![Flow chart of main program](image2)

**Fig. 2** flow chart of main program

The program design of system is mainly composed of the LCD initialization procedure, alarm value initializer, DHT11 sensing program [3], temperature judgment program, 1602 LCD program, button program, main program flow chart, as shown in Fig.2, open power, device enters into the working state, first, the LCD screen and the alarm value are initialized, then read the DHT11S data and display on the LCD, since then, the device starts monitoring the numerical variation of the temperature and humidity, when the temperature or humidity exceeds the set range, sound-light alarm occurs, when the time is more than three minutes, modify the time based on the actual situation, the device records the data, when the record key is pressed, the recorded data will be displayed, continuously press 12 times to exit record interface, when the design key is pressed, enter the temperature and humidity range adjustment, when the above procedures are completed, the device will cycle the main program [4].

4. Applications of Greenhouse Intelligent Monitoring System

I visited the local greenhouse farmers who plant tropical bananas; learn about the living features of tropical bananas, such as temperature and atmospheric water vapor content in the day and night. The following materials are used to test, as shown in Fig.3, the reasonable range of the following
greenhouse temperature and humidity has been made to ensure that the tropical bananas in the greenhouse are in a suitable growth environment [5].

4.1. Temperature and humidity setting
Press the "setting" button to enter into the temperature setting state, use the "rise" and "lower" button to set the temperature limit, and the lower limit setting of temperature normal range is shown in Fig.4.

Press the "setting" button to enter into the temperature setting state, use the "rise" and "lower" button to set the temperature limit, upper limit setting of temperature normal range as shown in Fig.5.
Press "setting" buttons twice, enter into the humidity setting state, use "rise" and "lower" button to set the humidity lower limit, the lower limit setting of atmospheric relative moisture content, and the lower limit setting of the temperature normal range is shown in Fig.6.

**Fig. 6** Atmospheric relative moisture content lower limit setting
Press twice "Settings" button twice, enter the humidity setting state, use "rise" and "lower" buttons to set the humidity lower limit, the atmosphere relative moisture content is set as shown in Fig.7.

**Fig. 7** Atmospheric relative moisture content upper limit setting

4.2. **Working light display**
When the atmospheric relative moisture content is lower than the normal lower limit of the moisture set by the program, the corresponding light prompting device will operate, and the real-time situation of the atmospheric relative value is displayed, Fig8 shows the operation of the corresponding lighting device in low humidity.

**Fig. 8** corresponding lighting device in low humidity
When the atmospheric relative moisture content is lower than the normal upper limit of the humidity set by the program, the corresponding light prompting device will work, show the real-time
situation of the atmospheric relative content value in the room, and Fig.9 shows corresponding lighting device in high humidity.

![Fig. 9 corresponding lighting device in high humidity](image1)

When the temperature in the greenhouse is lower than the normal upper limit value of the temperature setting, the corresponding light attention device will work; show the real-time situation of the indoor temperature value, and Fig.10 shows the corresponding lighting when temperature is too high.

![Fig. 10 corresponding lighting when temperature is too high](image2)

When the temperature in the greenhouse is lower than the normal upper limit of the temperature set, the corresponding light prompting device operates, and the real time of the indoor temperature
value is displayed, corresponding lighting when temperature is too low as shown in Fig.11, the temperature corresponds to the lighting device.

![Fig. 11 corresponding lighting when temperature is too low](image)

4.3. Function button
Due to most farmers' usage habits, this system sets the first button to "setting", the second button is "rise", the third button is "lower", the fourth button is "record", as shown in function buttons of Fig.12, the corresponding function buttons are set, rise, lower, recorded in turn.

![Fig. 12 material picture of function buttons](image)

4.4. Device operation
The important function of this temperature and humidity monitoring system is to be able to detect and display the actual temperature and moisture content in the greenhouse at the time, when the actual temperature and the atmospheric relative moisture content are higher or lower than the setting range, the sounding device will work, make sound, prompt staff. When connecting an external DC power, the display device will display "DHT11 System", namely the temperature and humidity monitoring system of the DHT11 perceived device, and then display the current temperature and atmospheric water vapor content in the second line, Fig.13 is the power-up display.
Fig. 13 power-up display

4 LED work lights show 4 different states, respectively, users can adjust the standard range of temperature and humidity by independent buttons. The system records a data every three minutes, a total of 13 times, the user can use the button to view, when the record and detection program run, return to the starting point to conduct the next loop judgment, Fig.14 is a record display.

Fig. 14 record display

5. Conclusion

This paper expounds the design of greenhouse intelligent monitoring system based on MCU, including hardware circuitry and software programs, the system obtains external data via the DHT11 sensor, uses MCU STC89C52 process data, send information on the LCD screen, records related data and sends corresponding instructions, and it is applied to the actual planting environment to meet the requirements. This system is low price, simple operation, and high practical.

References

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