Design of Intelligent Window Closing System

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Abstract. In today's society, windows are mainly used in people's home life in manual switching mode, and with the improvement of the quality of life, the perspective of intelligent home is gradually being realized. It has become a topic that people often talk about. This design is based on the stc series single-chip microcomputer as the main control chip. The rain sensor is used to detect whether the rainwater enters the house. Whether the concentration of inhalable particles in the environment is too large and take corresponding measures, the wind speed sensor detects the strength of the wind, and finally the stepper motor is required to complete the function of the window's active opening and closing itself, so that the window has intelligent functions. Circuit components are relatively practical and reliable, so they have the characteristics of simple circuits, economical and applicable, and easy maintenance.

Key Words: smart window; microcontroller; temperature sensor

1. Introduction
Smart windows generally refer to windows equipped with advanced anti-theft alarm and automatic window closing functions. Smart windows are used in some high-end residences and large shopping malls. Nowadays, we can also see smart windows in ordinary houses. The vast majority of smart window systems are composed of wireless remote control equipment, smart master control equipment, window control equipment, and window drive equipment. However, today's smart window systems have many functions and are widely used by people in modern life\textsuperscript{[1]}. Another type of smart window is composed of glass and other base materials and light-adjusting materials. The light-adjusting materials have the function of dimming. If it is placed in a certain environment, this material can change its own color. In addition, it selectively receives and reflects the external heat radiation and prevents the internal heat from being radiated, thereby achieving the adjustment of light intensity and indoor temperature\textsuperscript{[2]}. The current resource crisis, atmospheric pollution and climate warming are becoming increasingly serious, and the intelligent window control system is rapidly becoming Topics explored by countries.

2. Overall system design
The main modules of the smart window system include: main circuit, sensor control circuit, motor drive circuit, display module and alarm circuit. The overall block diagram of the system is shown in Figure 1. The sensor data acquisition module is mainly applied to sensor technology to perform
non-electrical to electrical conversion. When it is raining outdoors or the indoor temperature and humidity is too high, the temperature and humidity sensor and rainfall sensor will detect the changes in temperature and environmental humidity and rainfall information, and transmit the changes to the signal of the stc microcontroller, the stc microcontroller controls the window at any time. The motor prevents the rainwater from entering the house and destroying the articles and electrical appliances in the house; when the flammable gas and dust in the house exceed a certain concentration, the window will be automatically opened, and the alarm device will alert people that there may be danger and effectively prevent gas poisoning or the occurrence of haze; when the outdoor wind speed exceeds a preset value, the window will be closed automatically to prevent excessive wind, damage the window, and damage the items in the room.

![Figure 1. Block diagram of the overall system design](image1)

3. System hardware design

3.1 Control circuit design

![Figure 2. Minimal system block diagram](image2)

The crystal frequency used in this design is 12MHZ. 51 series microcontrollers can also use an external clock. When using an external clock, the external clock must be input from XTAL1 and
XTAL2 is left floating[2]. When the RST reset pin of the microcontroller generates a high level of 5ms and above, the microcontroller has completed the reset operation, if RST has been continuously high, the microcontroller will always be in the reset state and cannot continue to execute the program. Therefore, after the reset is completed, the microcontroller must be able to leave the reset state. Reset operations usually Power on and switch reset. During the operation of the microcontroller, if a crash occurs, reset the microcontroller with a key switch. The system block diagram is shown in figure 2.

3.2 Temperature sensor design
DHT11 is a sensor with multiple functions, that is, it can measure temperature and humidity, and its output form is a digital signal, which is very stable. There are two main elements in DHT11, one of which is NTC measurement. The original temperature is also the original sensor humidity and it is resistive. They are connected to the 8-bit STC89C52, and the data is calibrated through the DHT11 original. At the same time, their internal program is stored in the OTP in DHT11[3]. When detecting temperature and humidity, DTH11 needs to perform internal calibration of the collected temperature and humidity, and use calibration coefficients at the same time. Their interface method is serial single wire. If the temperature and humidity collection distance is greater than 18 meters, it will Reflects the superior performance of DHT11, such as fast data acquisition and strong anti-interference performance. Its humidity measurement value generally fluctuates between 20% and 90%, and its accuracy is 0.05, while its temperature measurement range is from 0 Degrees Celsius to 50 degrees Celsius, accuracy is around 2 degrees Celsius. After powering on, DHT11 needs to wait for 1s buffer time, because DHT11 is unstable during this time, because of wave interference, so weAn additional capacitor should be added to the VDD and GND terminals, that is, the pins of the power supply, with a size of 100nF, and its pins are single-row 4-pin. A typical application circuit is shown in figure 3.

Figure 3. dht11 typical application circuit

3.3 Dust sensor circuit
Too much dust in the house will affect the air environment in which we live. So we need to install a smoke sensor for the smart window so that it can detect the smoke from the fire in real time, as well as the fine dust in the air, and You can always open a window to create a clean air environment for us.

The GP2Y1010AU0F dust sensor manufactured by Sharp Corporation is an optical air quality sensor. The detection of the sensor contains a deflector externally, and the fan draws air to the suction port of the deflector into the dark room of the detector[4]. Parallel light reception in the dark room The part is rectangular, and the parallel light and the light-receiving part cross to form a sensitive area (slash). Through the dust in the sensitive area, 90 degrees of scattered light needs to be emitted through the slit, and the current is converted by the photomultiplier tube. The photocurrent integration circuit is Electricity and scattered light are proportional to the signal input of the microcontroller through the amplifier and a / d conversion circuit, through the microcontroller to calculate the mass concentration of dust and display and output signals.

3.4 Rain sensor circuit
This design uses a resistive rain sensor. Because this sensor has a simple layout and is easy to manufacture. Its circuit diagram is as follows. It consists of a shape resistance detection board and a comparison circuit. When rain drops drip on the shape resistance, the resistance decreases[5]. The
voltage value of port 3 decreases, and the voltage of port 3 is compared with the voltage of port 2 through a voltage comparator. If the voltage of port 2 is lower than the voltage of port 3, port 1 outputs a low level, otherwise it outputs a high level. The voltage of port 2 can be changed by an adjustable resistor, so the comparison value for determining whether there is rain is accurately adjusted[6]. The principle is shown in figure 4.

Figure 4. Schematic of the resistance rain sensor circuit

4. System software design

4.1 System main program

The software design of the system includes the main program of the system and security anti-theft system, wind speed detection, rain detection, temperature and humidity detection, motor control and display and other procedures. The entire system needs to complete the work of collecting the temperature and humidity of the air, smoke and dust concentration, rainfall and wind. After the system initialization is completed, the single-chip microcomputer detects the signals sent by each sensor, compares them with the values set by the system, and gives the corresponding operations. The flow diagram is shown in figure 5.

Figure 5. System main program
5. Conclusion

In short, in the future, the development form of windows will become more intelligent. With the advancement of technology, there will be a variety of technologies used in smart windows, resulting in more diverse performances of smart windows. Smart windows have become the mainstay of smart home systems. The component will be integrated with the Internet, and we will always report to us the opening and closing of windows and parameters inside and outside the house, so that we can use computers or mobile phones to operate and control. In future life, we do not need to be rainy, windy, weather, security, anti-theft, and other tedious things to open the window in person, these trivial smart windows can help you.

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