

# Advancing Home Safety and Comfort: The Future of Intelligent Environmental Monitoring in Smart Homes

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## Abstract:

The intelligent monitoring of the home environment is a sophisticated smart home environment monitoring system integrating housing, network, environmental monitoring, and information transmission technologies. This system encompasses environmental monitoring, circuit communication, and information notifications. The present design employs a GSM module to transmit real-time data signals pertaining to the home environment. Specifically, the GSM module is networked to detect and provide feedback on the home environment via the STC single-chip microcontroller. Core components utilized in this research include the DHT temperature and humidity sensor, the MQ smoke sensor, and the GSM module. The design is primarily segmented into four sections: single-chip circuit design, sensor circuit design, GSM signal circuit design, and software debugging for the overall system.

## Keywords:

Smart Home, Environmental Monitoring, Sensors, GSM.

## 1. Introduction

Intelligent monitoring of home environment is an intellectualized home environment which integrates housing, network, environment monitoring and information collection<sup>[1-3]</sup>. Today, with the development of modern society, we can know that the bitter days of the past are gone forever. We can see that people's lives are getting better and better, so we have higher and higher requirements for the quality of life. With the development of science and technology, people know that the future home environment will be intelligent, controlled by a mobile phone through wireless network. In the future, people's living environment will become more and more intelligent. We can real-time understand the changes of the home environment through a terminal control and then change the living environment according to the detected data to improve living standards. With the network composed of GSM module as the core, we can collect the temperature and humidity data at home by using temperature and humidity detector. According to the gas concentration in the air, we can detect whether there is gas leakage in the home. We can collect the smoke data in the air by smoke sensor, and convert it into digital two by AD0832. According to the value beyond our set, the buzzer will make a sound, the alarm light will start to flicker, and finally through the GSM module to the residents set the number to send test information<sup>[4]</sup>.

China began to develop smart home technology in 1994. Today, our home environment has changed a lot, becoming more and more intelligent, and life is more convenient. As technology matures, technical difficulties are overcome, so I can predict that the development of smart home technology in my country will soon catch up with western developed countries and surpass them. From the current development of our country, the future of smart home will be great. Compared with China, the intellectualization of home in foreign countries started earlier, and the technology is more mature and perfect. Especially in the developed countries such as the United States and Europe, the development of smart home is very fast. The development of smart home technology makes life more convenient, safe and comfortable. Since 1984, western countries such as Singapore have successively developed

home intelligent technology, and now their home intelligent technology has been quite mature<sup>[5,6]</sup>The use of fire is widely used in daily life, but people are also accompanied by danger in the process of convenient use. These accidents often make people feel very sad. Every year, many families are grieved by the fire. So we need to monitor fire in daily life. It is necessary to produce smoke and other substances during fire. Therefore, we use the designed items to detect the gas in the air and alarm when it exceeds the standard. Home environment monitoring is connected with the household's mobile phone through the network, so that the household can understand and monitor the environment of their own home in real time. When the home environment is abnormal, the household can receive the information hints of smart home for the first time. Therefore, the intelligent monitoring of home environment is the pursuit and aspiration of people nowadays. Therefore, it is necessary to study this topic. Although the development of smart home in China has been nearly 20 years, since 1994, there are still a lot of technical problems in the smart home in our country, which make it not widely used. So far, the smart home environment monitoring in our country still has a long way to go. Intelligent monitoring of household environment can improve people's living safety environment, and provide a safe living environment for people is what people yearn for now.

## 2. Design Scheme

First, the MCU circuit is designed to enable the MCU to write and reset. Then the display circuit design, through the display screen to intuitively understand the test data. The third step is to design the sensor circuits and collect the parameters of the living environment. Finally, GSM module circuit and alarm circuit design, through alarm and information transmission to detect and prompt the living environment. Software design: In the first step, we design the circuit of LCD to restore the initial state. In the second step, we design the circuit of each sensor, such as the concentration of dust in the air, temperature and humidity, smoke concentration and other test items. The indices of the test are displayed on the display screen. Finally, the design of sending collection information through GSM module is presented. For temperature and humidity detection in the environment, we choose DHT11 sensor to do experiments. It is widely used in digital module acquisition and detection of temperature sensor technology. It has many advantages, such as reliability and stability. It works in a range of voltage from 3.5 volts to 5.5 volts, current is 0.5 mA, temperature and humidity have a measurement range, temperature is between 0 and 50 degrees Celsius, humidity is between 20 and 90% RH, sampling period is 1 second, compatible with TTL, single bus structure. The system uses 89C52 as the control chip. For environmental monitoring data, such as temperature and humidity data, DHT is used to collect. Finally, the detected data information is sent to the mobile phone set by the household to let the household know the real-time situation of the household environment. This step is realized by GSM. DHT11 is used for data communication and synchronous microprocessor. This format is a data format using bus. It has a data format that can be divided into decimal and integer parts when communicating. The current decimal part is used later and read out to zero.

When the user sends the signal through the MCU, the DHT11 changes from the low power mode to the high power mode. When the host's start signal ends, the response signal is sent to the 40bit data to send. Then, it can trigger the signal acquisition, and when we read the data, we can read it. In this mode, DHT11 can collect temperature and humidity data because it receives start signal instructions. Without this start limit, DTH11 will not receive instructions, so it will not actively collect temperature and humidity data. The final data will be converted to low speed mode when the data are collected. In idle state, the bus level is displayed as high level. At this time, the bus is pulled down by the host and begins to wait for the response of DHT. The time when the bus is pulled down by the host must be longer than 18 milliseconds. This ensures that DHT can receive the signal. We can know that when DHT receives a start signal from the host, we will follow. The thing is to wait slowly for the start signal from the host to end, and finally we can see that it will send a low level of 80us to respond to the start signal from the host. When the start signal from the host is finished, wait about 20-30us, and then you can read the DHT response signal data. When the host sends the start signal. When the signal is in input mode, we can change it to input mode, or we can output a high level, the bus pulls up

and the resistance increases. When the bus is set by a single operation, it will show a low level. At this time, we can know that DHT11 will be in the state of sending a response signal, and when the signal is sent, the total will be The line will be pulled up, 80 us higher, and then it will start to prepare to send some of the data we gave. You can see that the starting signal shows a low level of 50 US for each bit of data. The data of 0 or 1 tells us the length of the high level at this time, which is determined by it. The state is shown below. When the read signal is high, DHT11 is in no response state. At this time, we have to check whether the connecting lines in the design line are normal.

In the MQ-7 gas sensor I used in this paper, the material used is tin dioxide, which has a low conductivity. The method of high-low temperature cycle detection is used, in which low temperature is used to detect carbon monoxide in air. The reason of conductivity of MQ-7 gas sensor increases with the increase of carbon monoxide concentration in air. We only need to use the method of high-low temperature cycle detection, in which low temperature is used to detect carbon monoxide in air. Simple circuit design can be used to change the conductivity of MQ-7 gas sensitive material into output signal corresponding to air gas concentration. GSM module can be connected with STC89C52 single chip computer. When successfully connected, monitoring data can be sent to the household's mobile phone through short message prompting. The single chip computer can recognize the data information received by the GSM module, and then feedback it to the sensors to achieve the function of monitoring the home environment. When the user goes out, he can also control the situation at home, such as temperature and humidity, smoke and dust concentration. When the measured value exceeds the standard, this module will automatically send the corresponding alarm message to the set mobile phone. The GSM module has the function of sending SMS, and it can be connected with the single chip microcomputer. Install a real-time monitoring device in the family to monitor the environment at home, so that the household can also know the monitoring of the home environment when they go out.

When the system is connected to the power supply, the system will initially design, and then the sensors start to work. The gas sensor detects the gas concentration in the home. When the gas concentration in the air environment exceeds our fixed value, the buzzer alarm and the alarm lamp flicker. Then the temperature and humidity sensor displays the monitored temperature and humidity data through the display screen to determine whether it exceeds the set standards, such as the sound and light alarm. Finally, the data detected are sent to the set mobile phone through the GSM module. The schematic diagram is shown in Figure 1.

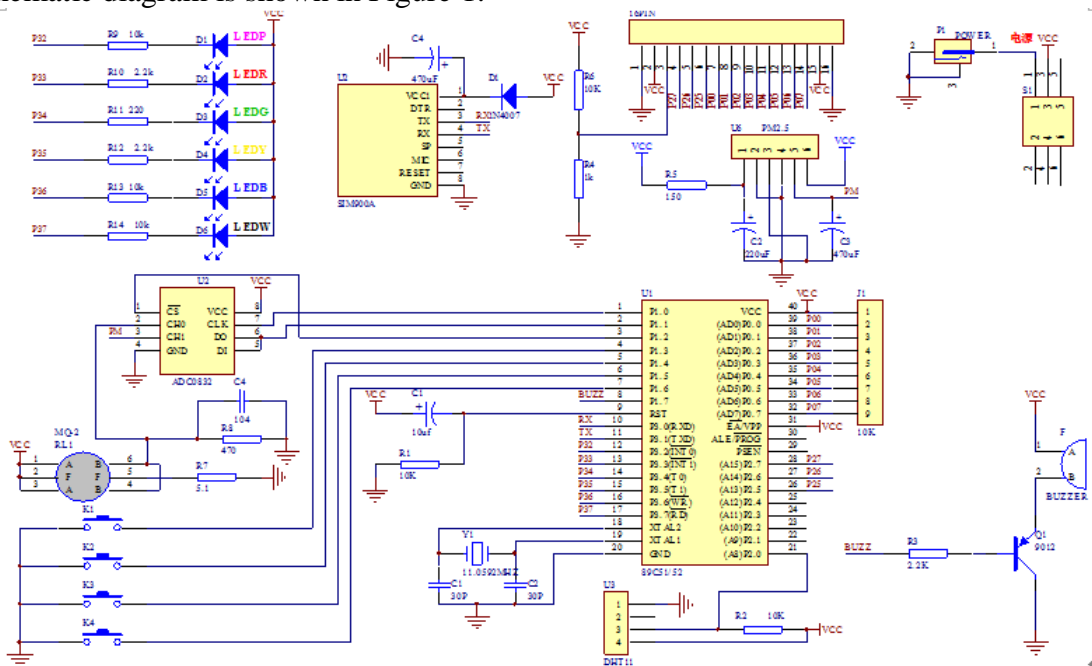


Fig. 1 System schematic diagram

The smoke sensor used in this design can directly detect the concentration of gas in the environment. From the point of view of whether the digital output pin is high or low level, because the sensor used in this paper has the transmission function of analog and digital signals. When the system starts to work, the first step is to prepare each detection unit, such as single-chip computer, display and sensor, for the normal detection in the home environment. The temperature and humidity sensor transforms the detected physical signal into a digital signal which can be recognized by the single chip computer, then displays the monitored data through the display screen, and finally compares the measured data with the data set by us to see if it is within the standard setting, if not within the standard value, by adjusting the control module. So as to achieve the standard value, such as within the set value, then return to continue detection.

### 3. Conclusion

This project centers on a network built around the GSM module, which collects temperature and humidity data at home using a temperature and humidity detector, monitors for gas and natural gas leaks using a gas detector, and gathers smoke data through a smoke sensor. The collected analog data is converted into digital signals using the AD0832. When the collected data indicates anomalies, the system triggers a continuous buzzer alarm, illuminates the LED lights constantly, and ultimately transmits the test data to users via the GSM module.

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