

# Home Network Monitoring System Based on Internet of Things

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**Abstract.** With the rapid development of urbanization and the continuous improvement of the quality of life, people pay more and more attention to the monitoring of the home environment to the home environment and life safety. In view of the problems and user needs that are easy to exist in the indoor environment, this paper has carried out Design of home environment monitoring system based on Internet of Things. The system is based on the Internet of Things, with remote viewing and remote alarms, making the monitoring system more comprehensive, networked and remote, ensuring the safety, comfort and health of home life. This paper refers to GB/T18883-2002 indoor air quality standards, based on the basic idea of comfortable home, healthy home, and safe home, designed the overall architecture, and completed the hardware circuit design with this framework, and introduced the overall comfort evaluation method of indoor environment. . The main design has completed the monitoring of parameters such as methane, water flow, temperature, humidity, air pressure, dust and formaldehyde. The test results show that the Internet-based home environment monitoring system designed in this paper can realize the monitoring of various environmental parameters and basically meet the design index requirements.

## 1. Introduction

In recent years, with the acceleration of urbanization, people are paying more and more attention to the home environment. The home environment is mainly divided into three aspects: on the one hand, it is a safe environment, with the heating and heating, the popularity of natural gas, bringing convenience to life. At the same time, it also increases the safety risks, especially the empty nest elderly are more likely to have security problems. At present, Chinese society has entered an accelerated period of population aging, and the number of empty-nest elderly families in China is also rising. According to the "Tracking Survey on the Status of Urban and Rural Elderly in China" issued by the Office of the National Working Committee on Aging, in 2006, the number of empty nesters in urban areas accounted for 49.7%. However, the elderly are old and weak, easy to forget, and often forget to close natural gas valves or faucets, causing natural gas to leak or flooding the room, causing unimaginable consequences. Therefore, safety issues such as fireproof, explosion-proof and waterproof have become the primary issues for caring for the elderly in the empty nest, and thus the construction of a harmonious society can be realized. The second aspect is the comfortable environment. Because of the indoor heating in the north, it is easy to dry. In the south, it is rainy and rainy. The home is often wet. If you live in a humid environment for a long time, it will cause diseases such as rheumatism. If the temperature is too



high or too low, it will affect the body. Too high can cause people to have heatstroke, and too low can cause a cold [1, 2, 3].

The quality of indoor air and the safety of the home environment are closely related to people's lives. Therefore, there are some home detectors on the market for indoor air quality testing. However, these instruments are relatively single-one, lacking the basics. Monitoring of environmental parameters. There are also some products about the indoor environment monitoring system of wireless sensor networks, but the technology is not mature enough, and most of them use Zigbee for networking. Today, when WiFi is so popular, re-networking will undoubtedly increase costs and waste resources. . In summary, in view of the problems and user needs that are likely to exist in the indoor environment, the comprehensive, networked, and remoteness of the home environment monitoring system is an inevitable trend of development, with low development cost, low power consumption, comprehensive functions, and convenient use. Monitoring systems for real-time, dynamic, all-weather monitoring are not considered to be imminent. Different from the products on the market, the home environment monitoring system carried out in this paper integrates the monitoring of domestic gas and water flow, and increases the indoor health environment multiple test items. The system access to the Internet of Things is more convenient for people in daily life. Continuously monitor the safety hazards and various types of pollution in the indoor environment to ensure the safety of life and improve the health quality of the whole people. The monitoring system is also applicable to confined spaces such as automobiles, basements, warehouses, etc., laying the foundation for the progressive development of smart home systems in the era of big data.

## **2. Hardware design of home environment information acquisition system**

This chapter mainly carries on the selection of the transponder and the system circuit design, specifically including the signal acquisition circuit, the water flow switch control circuit, the formaldehyde signal acquisition and amplification circuit, the dust signal acquisition circuit, the temperature, humidity, pressure sensor acquisition circuit and the basic system. Design of peripheral circuits [4] [5] [6] [7], etc.

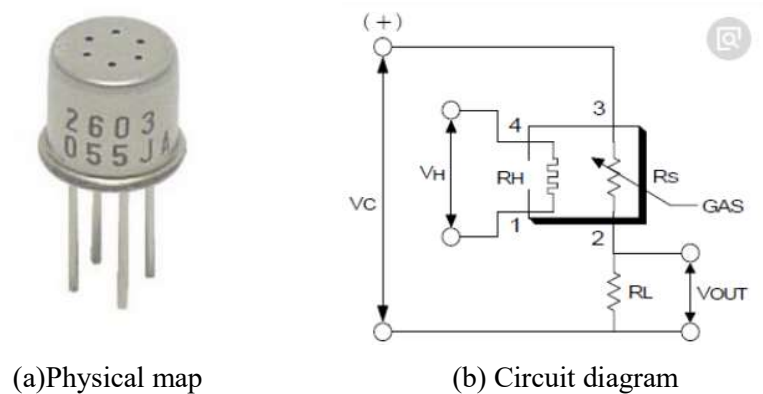
### *2.1. Home environment information acquisition unit selection*

The environmental information acquisition unit, that is, the transmission unit is the core of the entire indoor environment monitoring unit. It converts the collected environmental signals into digital signals or analog electrical signals, and then the micro-control processor performs related processing. Therefore, the choice of sensor plays a crucial role. Determine the accuracy of the entire system measurement, choose a high sensitivity. Good selectivity. The high stability of the sensor is the primary key network, the sensor selection requirements are mainly the following [8]

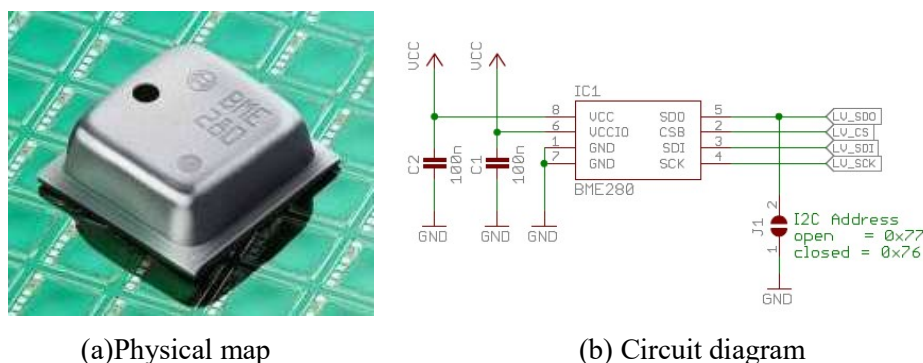
- (1) Select according to the type of gas to be measured;
- (2) The range of the sensor and the range of environmental concentrations;
- (3) Sensor selectivity and sensitivity;
- (4) Linearity and stability of the sensor.
- (5) Sensor response time and corrosion resistance.

Refer to the sensor selection requirements of the above five aspects, and each sensor module will be described in detail below.

*2.1.1. Methane gas sensor selection.* The sensitive material of TGS2611 is SnO<sub>2</sub>. The physicochemical reaction of SnO<sub>2</sub> is reversible. Its adsorption time and recovery time are short and can be used continuously. Because the sensitivity factor is very small, the heating current only needs 56mA. The appearance structure is shown in Figure 1. . The outer casing is added with activated carbon filter material, which can eliminate the interference of ethanol and water vapor, so it has good anti-interference, long-term stability, corrosion resistance and high sensitivity. It is an ideal household methane gas detection sensor, which meets the system design requirements.

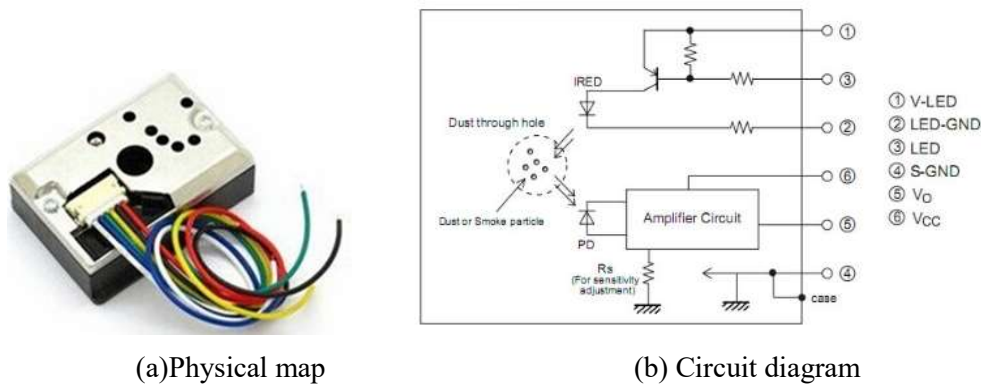
**Fig.1** Sensor TGS2611

**2.1.2. Temperature, humidity, pressure sensor selection.** In order to improve the system integration and increase the measurement accuracy [9], this design selects a high-precision, high-performance combined digital temperature, humidity and air pressure sensor BME280 from Germany BOSCH. The specific appearance is shown in Figure 2.

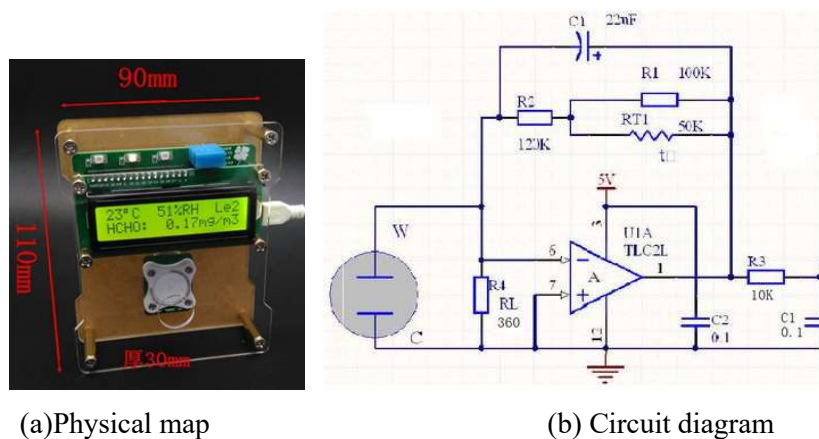
**Fig.2** Sensor BME280

The BME280 supports three modes: sleep mode, cast mode, and normal mode. Switching between modes can be set by a software program. After the power-on reset, the sleep mode is first entered. In the sleep mode, no measurement is performed, and the power consumption is the lowest, and all registers can be accessed. In the forced mode, a single measurement is performed according to the selected measurement and filter, and then back. Go to sleep mode; in normal mode, you can perform fixed cycle four measurements. The BME280 measurement cycle consists of temperature, air pressure, and humidity. After the measurement cycle, the pressure and temperature data can be used to eliminate short-term pressure fluctuations through the IR filter [10].

**2.1.3. Dust sensor selection.** At present, there are two types of mainstream sensors for dust concentration detection on the market, namely the Japanese SHARP dust sensor GP2Y1010AU0F and the Hanwei Syhitech dust sensor DSM501A. Both sensors can sense the smoke generated by pollen and tobacco, house dust, etc. However, the SHARP dust sensor GP2Y1010AU0F has an advantage in measuring tiny particles. It can measure PM2.5 and fine particles above 0.8 microns, with high sensitivity and volume. Small, lightweight and easy to install, therefore, the design uses SHARP's new dust sensor GP2Y1010AU0F, as shown in Figure 3.

**Fig. 3** New dust sensor GP2Y1010AU0F

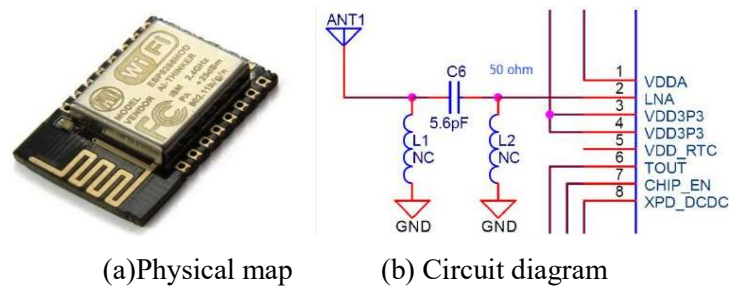
**2.1.4. Formaldehyde gas sensor selection.** At present, the determination methods of formaldehyde are commonly used in chemical measurement and electrochemical sensor measurement, wherein the chemical methods mainly include phenol reagent colorimetry, liquid chromatography, acetylacetone method, gas chromatography, AHMT method, chromotropic acid method, etc. [11]. However, if the above method is used for real-time monitoring on site, there are shortcomings such as long measurement period and cumbersome measurement operation. Therefore, the determination of formaldehyde concentration in indoor air generally uses an electrochemical sensor method. In summary, the formaldehyde sensor of this subject uses the electrochemical sensor of Dart Company of the United Kingdom, and Figure 4 shows the physical map of Dart formaldehyde sensor.

**Fig.4** Dart formaldehyde sensor

### 3. wireless data transmission communication

This article selects Lexin Information Technology's ESP8266 WiFi module, which is small in size, low in power consumption, low in price, and has the characteristics of universal USART interface. ESP8266 module is mainly used in home automation, industrial wireless control, sensor network, wearable device, wireless location. Sensing devices, wireless positioning system signals, etc., are very suitable for the development of preliminary functional modules of the product. The physical form of the module is shown in Figure 5 [12].

ESP8266 supports three power-saving modes, namely Modem-Sleep, Light-Sleep and Deep Sleep. In order to reduce system power consumption, according to system technical indicators, the collected data is updated every 5 minutes = times, so ESP8266 is set to fixed time. Wake up at intervals, automatically connect after waking up, and send data on the AP. It takes about 0.3~1s, and the overall current is much smaller than 1mA, which reduces the system power consumption.



**Figure 5.** ESP8266 physical map

An important function of the system is to access the results of the results to the cloud platform via the Internet. Let the home environment monitoring system realize the network function, open the Internet of Things application, and realize remote supervision and control. Therefore, wireless data transmission is an important part of the system to achieve the Internet of Things.

### 3.1. ESP8266 access IoT link model

The ESP8266 WiFi module has three working modes, which are SotAP mode. The Stuation mode and the SofAP+Station mode enable flexible networking by selecting different modes. The SoftAP mode refers to the module itself as a hot spot. Mobile phones, PDAs, and other user devices can be used as Stalion to access hotspots to form a local area network. Station mode means that ESP8266 can connect to Internet to upload and download data to the server in the network through AR. Users can monitor the status of ESP8266 through the Internet on the terminal device and send control commands to the platform [12].

This article is a home environment monitoring system that implements environmental methane, temperature and humidity, and formaldehyde. After the information such as dust is collected. Then, the collected data is transmitted to the Internet of Things cloud platform through the WiFi module, and the Internet of Things is selected as the server.

Le Network is an open cloud platform designed to take advantage of wireless networks, hardware and software systems, and smartphones. The computer web page and Ap work together to create a home intelligence center. Users can log in to the Le network flat fr server web page. Register your own user account, the user generates a dedicated Userkey belonging to the user when applying for the account, and adds a URL (Uniform Rsource Locator) request, and then you can add your own device and sensor. All of its own measurement equipment can be accessed for centralized monitoring and management.

ESP8266 is connected to the Le network server through the network. After uploading the local monitoring data, the user can access the device data through the PC or mobile phone supporting APP. At this time, the ESP8266 works in the Station mode.

### 3.2. Data frame structure

According to the data transmission link model. When the hardware device and the remote server are connected for data interaction, the underlying hardware system starts the TCP Client service, and the remote server is in the TCP server mode, and the two establish a connection. After the handshake is successful, the data transmission starts.

In wireless data transmission, a frame of data usually consists of the following parts: frame header, data, and frame tail. The header indicates the start of data, the data is the main transmission content, and the end of the frame marks the end of one frame of data. Correspondingly, the system-frame data is also composed of the three parts, namely: Request Line, HcaderKey-valur, Body.

(l) Request Line: The format is `Smethord $url HTTP/1.1`irin, where.

a) \$method is the request method. Can be GET, PUT, POST, etc., when performing uplink data transmission. Request method is POST

b) \$url is the request path, where the corresponding device number and sensor number of the sensor to be uploaded must be declared;

c) HTTP/1.1 is the version of the HTTP collaboration. Fixed Yufu:

d) \r is a newline, meaning the end of the request line;

(2) Header Key-value; format is \$key: \$value\r\n, where:

a) \$key stands for the key. There are two keys in this association, the host name key Host and the request body length key Content-Length, and the Content-Length must be the total number of bytes of the request body.

b) \$value stands for "value", such as hostname :

c) \r\n. Here represents the junction of a header, after the end of the header, you must add a newline \r\n;

(3) Request body (Body): The request body contains the data and the check code, and the blank line of the header is the request body.

### 3.3. WIFI data transmission specific process

According to the introduction of ESP8266, the wireless transmission module is a serial port type, and a connection needs to be established. The main parameters include three aspects:

(1) Serial port parameters: baud rate, data bit, parity bit, stop bit, hardware flow control, the specific configuration is as follows:

Baud rate, 115200;

Serial port transmission word length: 8 bits;

Stop bit: 1 bit;

The hardware stream is controlled by the software for the WiFi data transmission of this system, so the hardware stream is not used.

2) Wireless network parameters: network name (SSID), security mode. The key name and the secret key are the name and key of the wireless route that the WiFi module is about to access.

(3) TCP connection parameters: protocol type, connection type. Destination IP address, destination port, as follows: Connection type:

TCP; protocol type: HTTP

Protocol; destination port and IP address: Le is the IoT port and IP address;

After all the above-mentioned three aspects of the dispersion are determined, it can be seen from the data transmission flowchart 33. WiFi wireless data transmission mainly completes the following three aspects:

(1) Complete the startup test and parameter configuration of ESP8266 and access the AP router:

First, enable the WiFi module to determine whether it can work normally. If the number of startup failures exceeds the threshold, it is considered that the module itself is faulty. The startup self-test procedure is as follows:

```
woid ESP8266 AT Test (void)
```

```
{
```

```
ESP8266_RST_HIGH_LEVEL ();
```

```
Delay_ms( 1000 );
```

```
while ! ESP8266 Cmd ( "AT" *OK", NULL, 200 )) ESP8266 Rst ();
```

Second, configure the working mode. From the previous data link model, the ESP8266 should work in Station mode,

```
ESP8266_Net_Mode_Choose (ENUM_Net_MODETypeDef enumMode)
```

```
switch ( enumMode )
```

```
{
```

```
case STA:
```

```
return ESP8266 Cmd ( "AT+CWMODE=", "OK", "no change", 2500 );
```

```
case AP:
```

```
return ESP8266 Cmd ( "AT+CWMODE=2", "OK", "no change", 2500 );
```

```
return ESP8266 Cmd ( "AT+CWMODE=3", "OK", "no change", 2500 );
```

```

return false;
}
}

```

After the mode is selected successfully, it can be connected to the nearby AP router according to the user's input. Send AT command \* AT + CWLAP = <SSID> <PSW>", where SSID and PSW are the name and key of the currently accessing AP, write it to the EEPROM, and basically complete the transmission configuration [3].

#### 2) ESP8266 access to the TCP server

ESP8266 transmits data to the cloud. First, you need to set the target IP and port to set the target network server and access the external server. Determine whether to wait for successful access. After access, ESP8266 begins to enter the sneak mode. The ESP8266 data sending function is given below:

```

Bool ESP8266 SendString (FunctionalState enumEnUnvamishTx, char * pSt, 132ulstrLength,
ENUM. D NO TypeDef uld)

```

Among them, enumEnUnvamishTx declares whether to enter the transparent mode, pStr is the string to be sent, ulStrLength is the number of bytes to send the string, and ucl indicates which D is sent. The sensor collection information is transmitted according to the transmission protocol. The data content and length of the sender and the receiver are exactly the same, and the transmission process is as transparent. - After the transfer is completed, then repeat the data process, while waiting for the next transfer, ESP8266 will automatically detect whether the network connection is successful. If the connection fails, it will reconnect.

#### (3) Reconfirm whether the connection is successful

When the data is transmitted again, the ESP8266 will wake up and automatically detect if the network connection is successful. If the connection is compromised, it will reconnect. After the data is uploaded to the server for processing, in the process of data transmission, an important aspect is that the data transmission protocol must be formatted for uploading, and the server responds to the ruling to establish a corresponding processing mechanism according to the request. Because the system needs to submit data to the specified server for processing requests. Therefore, the POST request is selected, and the uploaded data needs to be included in the request body. The amount of data that a POST request can transfer is large. Generally, the default is unrestricted, and the security is high. Confirm that the specific part of reconnecting is as follows [14].[15]

```

If ( uTepClosedFlag )
{
ESP8266_ExitUJnvamishSend();
do ucStatus = ESP8266 Oet LinkStaus ();
While (I ucStatus);
If (ucStatus-4)
{
USART1 printfUSART3 "PS32 (01325, 70, Join the AP again; 15) rn")
While (ESP8266 JoainAP (macUser_ ESP8266 ApSsid, macUser_ ESP8266 ApPwd)
While (! ESP8266 Link. ServertenumTC,macUJser ESP8266 TepServer. PmacUser_ ESP8266
TepServer Port, Single. ID 0));
USART1 prinfUSART3, PS32 (1, 325, 70, Link the server suecsfollyI5yrfn";
}
While (! ESP8266 UnwanishSend 0);
}

```

## 4. Conclusion

This paper investigates the status quo of domestic indoor environmental monitoring and the development trend of related monitoring receivers. Based on the current indoor safety and the severity of indoor environmental pollution, the application of sensor technology and modern mobile



communication technology has designed a multi-purpose design. Most indoor environmental monitors. The main work and research results of the thesis are as follows:

(1) Analyze the system function indicators and technical indicators, and determine the overall design plan of the system. The functions and functions of each module are analyzed, the software design is planned, and the indoor environment comfort evaluation model is introduced to balance the comprehensive effects of thermal comfort and indoor air quality on the indoor environment. .

(2) Based on the selection of the relevant sensors, the hardware circuit design, including the sensing 2 pre-processing circuit design, the liquid crystal display circuit, the amplifying circuit, the wireless module circuit and other basic peripheral circuits, gives the corresponding specific Design the scheme and explain the working principle of the circuit.

(3) Explain in detail the software program design of the system's overall software program and each sub-module, and elaborate the principle and design process of wireless transmission.

(4) Explain in detail the test process of the indoor environmental monitoring system, mainly for the functional test of the environmental parameter detection of dust and nail, and the functional test of the ESP8266 wireless communication module. The well was tested on the overall function of the monitoring system, and the actual test results achieved the expected test results.

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