Journal of Applied Science and Engineering Innovation, Vol.6, No.1, 2019, pp.9-13
ISSN (Print): 2331-9062
ISSN (Online): 2331-9070

# Design of Environment Temperature and Humidity Acquisition System of Internet of Things Based on Cloud Platform

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**Abstract:** With the rapid development of science and technology, the collection of temperature and humidity has been widely used in various industries. The transportation and storage of special medical supplies, seafood products and dairy products are strict to the temperature and humidity. This paper introduces a cloud platform based on STM32 microcontroller to control chip acquisition system design scheme, the data of temperature and humidity temperature and humidity acquisition system is described in detail design, hardware design, software design. Paper the temperature and humidity acquisition system development present situation, through to the existing collection system was studied, and identify the feasibility scheme to ensure data accuracy, real-time detection system of collecting the data of temperature and humidity, easy to check. The alarm function of the acquisition system is designed according to the research requirements and practical analysis. Finally, the design requirements are achieved through systematic testing and multiple optimization.

**Keywords** temperature and humidity; cloud platform;STM32 MCU; alarm function

## INTRODUCTION

Nowadays, industrial and agricultural production, transportation, reserve and other industries have very strict requirements for temperature and humidity measurement and control. However, temperature and humidity are the most difficult data indices to detect and control. Once temperature and humidity can not be accurately monitored, it will cause very serious consequences[Jiarong Mo 2016]. Generally speaking, the most commonly used way of temperature and humidity monitoring is wired monitoring and control. However, there are some shortcomings in this way, which is not only complicated in operation but also inconvenient in maintenance. And the cost is higher. Therefore, the most important thing at present is to develop a temperature and humidity acquisition system which can be real-time monitoring, simple to use and low cost[Rui Kong 2013].At present, compared with the advanced level of the United States and Western Europe, China's transportation and warehousing environmental monitoring system is still in a backward stage[Wenqi Yang, et. al., 2017].

The widely used systems in various industries are only traditional technologies, and the gap is too big. Nowadays, with the rapid rise of Internet technology, more and more devices involve network technology more or less. However, the monitoring technology in our country has been exposed to network technology for a short time, and the experience is insufficient, so that the newly developed intelligent monitoring system can not be fully applied in various industries. The technology is not easy to be accepted by the public because of its high price and short promotion time. Most warehousing and transportation enterprises in China still use the traditional environmental monitoring system, but the cost is higher than the budget of most enterprises[Jiankai Gao 2017] . At the same time, there is a serious problem of resource depletion. Therefore, the development trend of temperature and humidity monitoring system should be the application of information technology in the monitoring system to achieve real-time monitoring of temperature and humidity, over-limit alarm and other functions. The design purpose of this system is to ensure the safety of transportation and storage environment.

The main control chip of this design uses STM32 chip to develop a temperature and humidity acquisition system of Internet of Things based on cloud platform. The wireless communication module serves as a bridge for information transmission. The collected data can be uploaded to the monitoring center through this module. At the same time, the acquisition center can upload the data to the cloud platform through wireless network. Users can view the collected data through micro-mail.

### System Overall Design

The whole system is powered on, the modules work normally and initialize. STM32 MCU controls the whole monitoring system. Firstly, it receives data collected by DHT11 sensor; then it controls SIM800A module to transmit data and upload data to cloud platform; finally, the monitoring center monitors whether the data exceeds the upper limit[Dan Wu,, et. al.,2014], and if it exceeds the upper limit, it alerts the

user. Cloud platforms are associated with Wechat public numbers, so users can view them on their mobile phones.

Temperature and humidity acquisition system mainly uses STM32 module, DHT11 module, SIM800A module and other devices. The main controller receives the data collected by DHT11 and uploads the data to the cloud platform through SIM800A module. The monitoring center detects whether the data exceeds the upper limit, and if the data exceeds the upper limit, the alarm prompt will be given. Users can view the results by Wechat. The overall design scheme is shown in Figure 1.

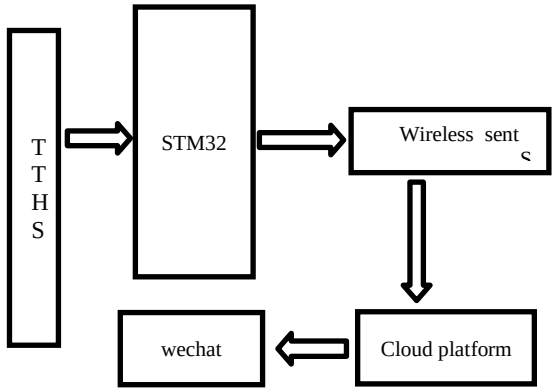


Figure. 1 Overall scheme design

## System Hardware Design

The main components of the hardware design of the system are: main control circuit, wireless module circuit, temperature and humidity sensor circuit, power supply circuit and cloud platform. In this system, STM32 single chip computer is the main control hub, its role is to control and command peripheral equipment, to achieve specific functions of the system. When building hardware, modular design is adopted[Xiuwen Liu,2014]. Firstly, each module is programmed one by one, and then it is continuously improved to achieve specific functions. After the successful debugging of each module, it is the building of the module, which combines each module into a whole, so as to realize the monitoring function of the system. This design method is simple and easy to operate, thus reducing the complexity of the system design.

### Design of Main Controller

The main control circuit is composed of reset circuit, crystal oscillator circuit and power supply circuit. In the reset circuit part, the reset pin NRST is connected to the power supply VCC on one side, but not directly. A 10K pull-up resistor is connected between the two sides, and a 100nF capacitor is connected to GND on the other side to form a reset circuit. In the crystal oscillator circuit part, an 8 MHz crystal oscillator is connected in parallel between the pins of OSC_IN and QSC_OUT, and 22 pF capacitor is connected to GND at both ends of the crystal oscillator, thus forming an external oscillator circuit.

### Temperature and Humidity Sensor Module

DHT11 sensor is a composite sensor whose output signal is digital signal. The so-called composite sensor can measure temperature and humidity at the same time. This measurement method of the sensor is due to the special internal structure, in which one resistance humidity sensor is used to measure humidity, and another NTC element is used to measure temperature[Yonghui Yu, et. al., 2013]. Both can be seen as a whole, fast response, affordable and durable. DHT11 sensor has calibration coefficient, which ensures the accuracy of data. When the system works, the module calls these calibration coefficients constantly to make the output signal accept calibration and ensure its stability[Jinkuang Wang, et. al., 2015].

In this design, DHT11 sensor connects to the PA11 pin of STM32 chip. The connection is very simple, only one pin of single chip is needed. The connection is shown in Figure 2. In addition, if the length of the connecting wire is less than 20m, a 5K pull-up resistor can be connected.

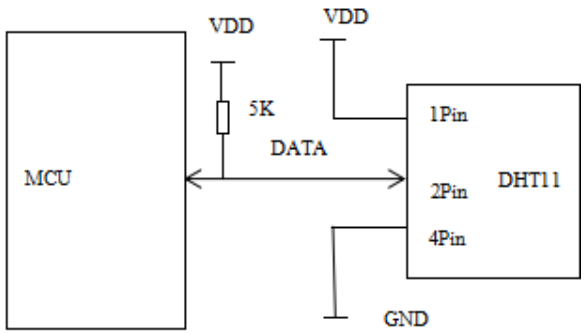


Figure 2 Typical interface connection diagram

### Wireless Module

The development of wireless module originated from digital radio. In order to build a data transmission station with higher performance, researchers decided to apply DSP and other technologies to digital radio, thus having the wireless module now. The origin of digital radio is relatively early, from the original form of telegraph to the present form of digital radio. Accordingly, the form of the transmitted signal changes correspondingly, from the original code form to the high-speed data form. The transmission speed has also been greatly improved.

As a data communication device, SIM800A module has a full-function serial port for data transmission and AT command transmission. The main chip is TXD and RXD data lines, which are responsible for data transmission. The core of wireless module is data transmission. The standard voltage of serial port is 2.8V. There are two ways to connect serial port, one is full-function serial port connection,

that is, all the signal lines must be connected; the other is non-full-function serial port. In this mode, only two transmission lines RXD and TXD are connected, and other interfaces are suspended.

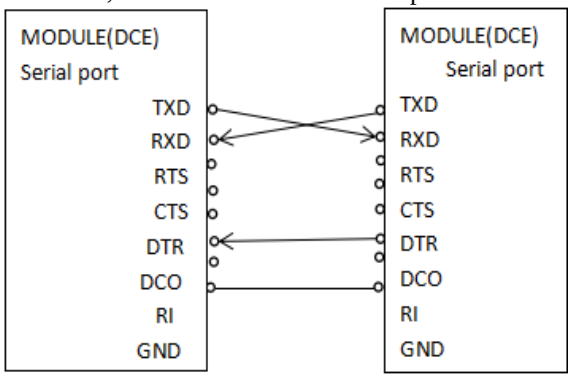


Figure 3 Non-Full Function Serial Port Mode

### Tlink Internet of Things Platform

The Internet of Things (IOT) originates from Internet technology, and its function is to enable communication between things. This design combines the Internet of Things network platform with the monitoring system, realizes the real-time monitoring function of the system, and is a major breakthrough in monitoring technology. The open platform of the Internet of Things (IOT) is characterized by supporting multiple connection protocols[Xiang Bian, et. al.,2015], because it can connect various types of sensors, thus establishing a real-time remote control system, providing a platform for the rapid implementation of the application of the Internet of Things.

Log on to the official website, register the account and log on.

First of all, add devices, you can enter the "monitoring center" on the home page, select the "add devices" option, click enter, you can also add devices through other ways;

Then, create the device, users can name the device according to their own wishes, choose the corresponding connection protocol according to the device used, and the reporting cycle also needs to be set by themselves.

The device has two states of "connected" and "unconnected", which are related to the reporting period. If data is uploaded to the platform within this time range, the device connection status shows "connected". Therefore, this time should be set to be larger than the actual data transmission interval, so that in the normal working process will not appear "disconnected" state;

Finally, click "Save Device" to save.

Wechat is one of the most commonly used chat software nowadays. The cloud platform designed in this paper is related to the Wechat Public Number, which can obtain and save data uploaded locally from the cloud platform. It can also receive alarm information sent by the monitoring center. Users can observe the monitoring environment anytime and anywhere with their mobile phones.

## Software Design

This design is hardware physical design, but the hardware needs matching software to complete the requirements, so the software design occupies an extremely important position in the temperature and humidity system of this design. In this design, the following software parts will be designed: main program, acquisition program, sending and receiving program and so on. Structured programs have been used for a long time. Structured design can reduce the occurrence of errors in the design, but also reduce the confusion and complexity of the program[Zhiliang Wang, et. al.,2015].

### Main Programming

First of all, the system is powered on and works normally. STM32 MCU controls the collection terminal and transmission center to send the data to the cloud platform. The monitoring center judges whether the uploaded data exceeds the upper limit. If the upper limit is exceeded, the alarm notification will be given, and the user can query the results by mobile micro-mail. As shown in Figure 4.

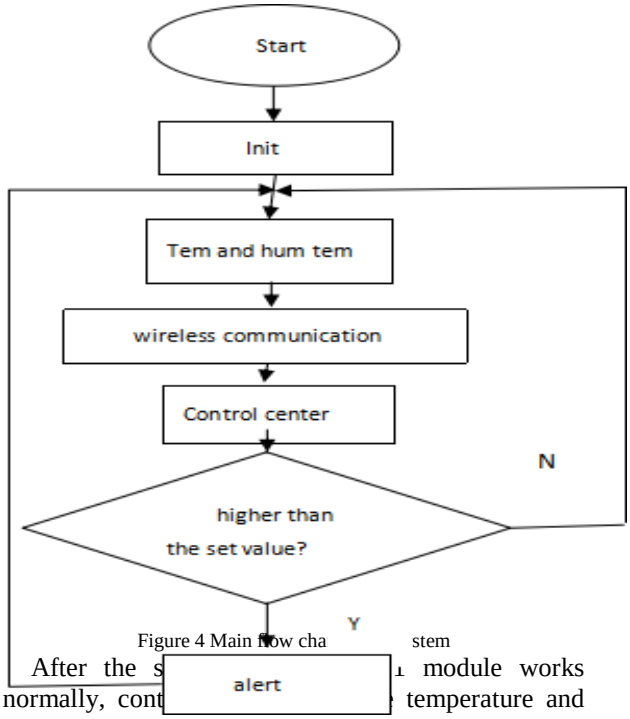


Figure 4 Main flow cha stem

After the s module works normally, cont temperature and humidity data in the environment, and sends the collected data to the STM CPU for processing. Because the monitoring environment is not strict with the data requirements, the data collected in this design only need to read the integer part, and the decimal part can be used after the system upgrade.

After the system is powered on, the modules are initialized and the system works normally after several seconds delay.

(1)Temperature and Humidity Sensors

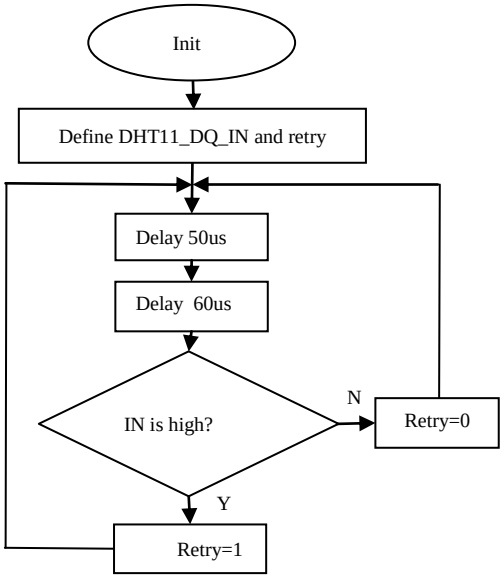


Figure 5 Read data flow chart

**Wireless Module Work**

As shown in Figure 6, the wireless module is controlled by the main controller STM32. According to its requirements, the collected data is received first, and then uploaded to the cloud platform. The function of wireless module is to receive and transmit data, and it is an important bridge of the system. This module also needs the function of wireless network.

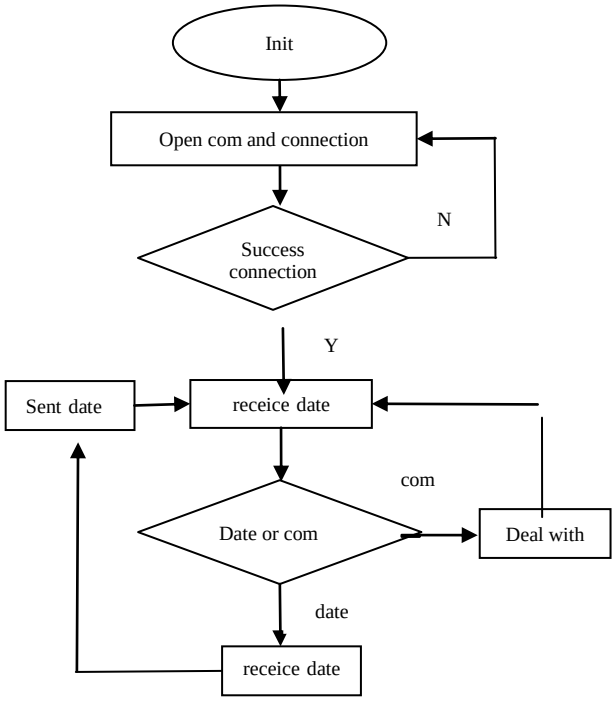


Figure 6 Transfer data flow chart

**Data Upload**

The data is uploaded to the cloud platform, and the monitoring center compares the data with the set upper limit. If the upper limit is exceeded, the alarm will be given. If not, the system will continue to monitor, real-time monitoring, reliable and stable. Because the collected data is uploaded to the cloud platform, the cloud platform can be connected with Wechat. So users can use mobile phones to observe data and record it in real time, which is convenient and cost-saving.

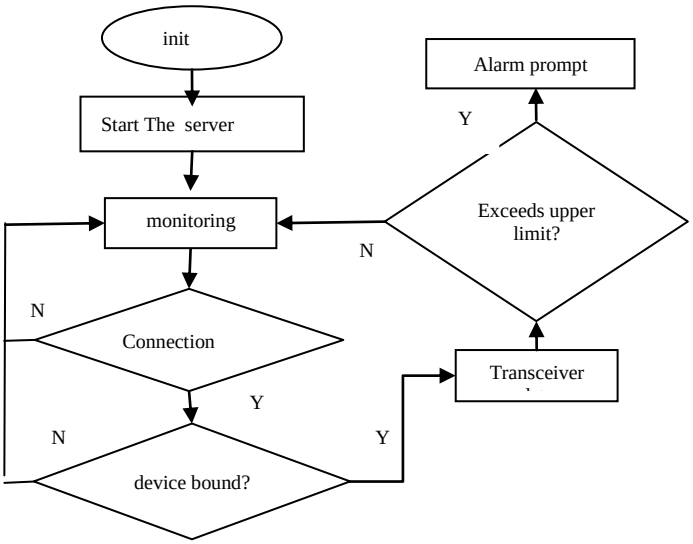


Figure 7 Terminal Workflow Diagram

**EXPERIMENTAL RESULTS**

After the completion of the whole system hardware and the basic framework of the software program, download the program to test the temperature and humidity acquisition system. In order to test the reliability of the whole system, the program needs to be debugged and improved step by step until the monitoring system is stable.

The system can be used to detect indoor temperature and humidity, temperature and humidity in each period of the day. Comparing the data of temperature and humidity acquisition system and temperature and humidity software (more accurate data), the stability of the system is judged comprehensively[E.Gogou, et. al., 2015].

Table 1 Test results

| Detection temperat/°C | Control temperat/°C | Humidity detection/% | Contrast humidity/% |
|---|---|---|---|
| 19 | 20 | 39 | 40 |
| 18 | 20 | 40 | 41 |
| 21 | 20 | 39 | 40 |
| 24 | 25 | 39 | 39 |
| 26 | 25 | 63 | 62 |
| 21 | 22 | 61 | 62 |

According to the test, the data acquisition system is stable and can realize the function of data acquisition. From the data in Table 1, we can see that the temperature error is +2 C and the humidity error is +5%. For the current monitoring environment, the error range is acceptable. If the system is applied to a more precise environment, the decimal part of the data can be expanded accordingly.

## CONCLUSION

A temperature and humidity acquisition system based on cloud platform is successfully designed. The system mainly collects temperature and humidity data and uploads them to the monitoring center. If the data exceeds the upper limit, an alarm is given. In addition, when the data is uploaded to the cloud platform, users can view it by mobile micro-mail, thus ensuring the reliability and stability of the data.

According to the design requirements, the model of temperature and humidity data acquisition device is made with DHT11 sensor as measuring element, STM32 single chip as main control chip, SIM800A module as transmission device and TLink Internet of Things as receiving terminal. In the design process, the module analysis method is mainly used to design the software and hardware of each module separately, and finally assemble as a whole. In addition, using Altium Designer software to complete the design of hardware circuit, the final completion of the physical production, the realization of real-time data acquisition, over-limit alarm function. The function of the system is not comprehensive enough. It can be improved on the original system framework to add other functions, such as adding the function of measuring PH value and oxygen content. The system has some shortcomings in collecting temperature and humidity data. The data uploaded to the cloud platform can be extended to decimal digits, so that the accuracy is higher. This is a problem that needs to be improved. The system is also in the process of perfection, and there are many problems that need to be studied continuously in the future.

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