



Welcome Smart Home

Welcome Smart Home

< BUPT Smart Home Report >

Group: < DB21-65 >

DESIGN & BUILD PROJECT [SUMMER 2021]

Group Members:

Table of Contents

Table of Contents.....	2
1. Introduction	5
2. General Design Process	6
3. Product Design.....	7
3.1. Circuit Components	7
3.2. Function Design	9
3.2.1. Fundamental function of the smart home Hardware Model.....	9
3.2.2. Humidity and Temperature	9
3.2.3. Doors and Windows	9
3.2.4. Brightness of the Light.....	9
3.2.5. Ability to Communicate with Data Access Software	10
3.2.6. Raindrop Feeling Function.....	10
3.2.7. Smoke Alarm and Flame Alarm	10
3.2.8. Fan Function.....	10
3.2.9. Access Control System.....	10
3.3. Appearance Design.....	10
3.4. Software Design.....	11
3.4.1. Example 1: WIFI module.....	12
3.4.2. Example2: different kinds of models of RGB light.....	17
3.5. Technical Advantages and Innovation.....	19
4. Data Management.....	20
4.1. Database Design	20
4.1.1. ER model.....	20
4.1.2. Database table.....	21
4.2. Relationship Design	22
4.3. Cloud Database Deployment.....	22
5. Website Design	24
5.1. Appearance design	24
5.2. Logic design.....	26

5.3.	Function design.....	26
5.3.1.	Login	26
5.3.2.	Registration and Password Retrieval.....	28
5.3.3.	Change password and modify user information	29
5.3.4.	User functions.....	29
5.3.5.	Manufacturer functions	31
5.3.6.	Admin functions	32
6.	Web cloud deployment and management.....	35
6.1.	Amazon web services EC2	35
6.2.	DNS and CDN services.....	36
6.3.	SSL Certificates and HTTPS	37
6.4.	Visual server monitoring panel.....	38
7.	Project structure and techniques used.....	38
7.1.	MVC design framework	38
7.2.	Project details	39
7.2.1.	Config module	39
7.2.2.	Controller module	40
7.2.3.	JavaBean module.....	40
7.2.4.	Database operation module.....	41
7.2.5.	View Module	41
8.	Business outlook.....	42
9.	Planning and Management.....	43
9.1.	Labor Division	43
9.1.1.	Telecommunications Engineering and Management.....	43
9.1.2.	E-Commerce and Law	43
9.1.3.	Internet of Things Engineering	43
9.2.	Process Schedule	44
9.3.	Minutes of Group Meeting	44
9.3.1.	Minutes of the First group meeting	44
9.3.2.	Minutes of the Second group meeting.....	44

9.3.3.	Minutes of the Third group meeting	45
9.3.4.	Minutes of the Fourth Group Meeting.....	45
9.3.5.	Minutes of the Fifth Group Meeting	46
9.3.6.	Minutes of the Sixth Group Meeting.....	46
9.3.7.	Minutes of the Seventh Group Meeting	46
9.4.	Exceptional situation statement.....	48
10.	Conclusion.....	49
11.	Acknowledgement.....	49

1. Introduction

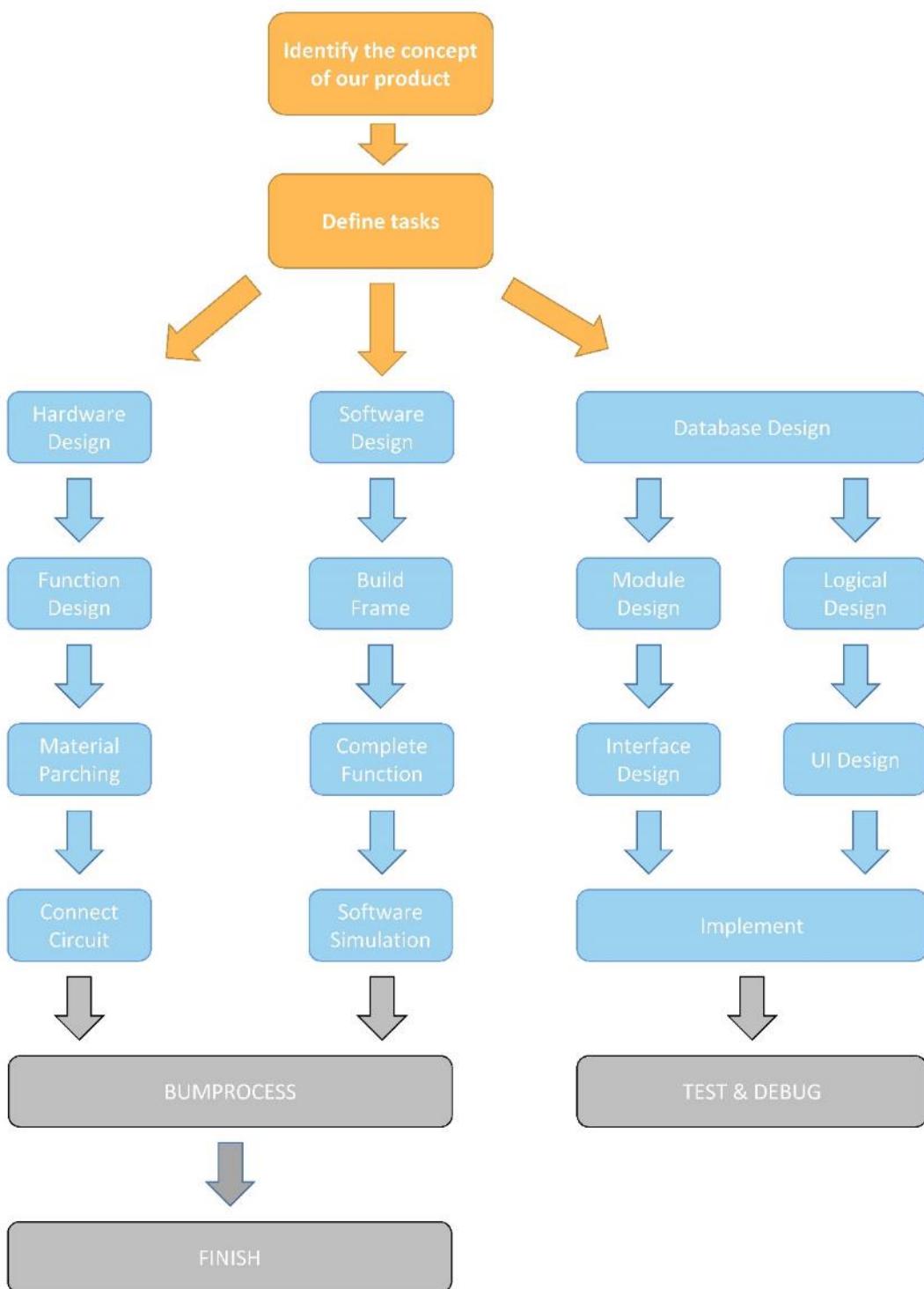
The smart IoT home has always been one of the most advanced and popular concepts of the new age and is sought after by countless people. To date, there are several smart device companies on the market offering their full range of smart IoT home product solutions, providing a new way of living in the home for people around the world who love technology and IoT convenience.

Based on the concept of providing a simple, convenient and user-friendly smart home, BUPT Home has combined the best of what is already available in the market and introduced a new smart home product platform solution for users. It is a comprehensive solution consisting of a user side, a management side and hardware facilities.

In our smart homes, the comfort of the user is always at the forefront of the experience. Therefore, our Smart Home Management System has a user-friendly login and management interface. It also has simple, accurate and easy-to-use electronic hardware. We currently offer our customers a smart home with four devices: doors, lights, fans and sensors. Each device is connected to the internet, allowing users to view and control their smart devices from a remote location. This is a great example of how intelligent the Smart House is. Of course, as the device manufacturers update the platform, more devices will be added to the platform to create more possibilities for the users' smart life.

We sincerely hope that our Smart House will bring convenience and safety to everyone who uses it, and that everyone will feel the charm of a modern Smart House.

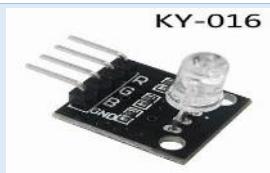
2. General Design Process



3. Product Design

3.1. Circuit Components

No	Components	Image	Comments
1	Arduino UNO R3		Serve as main board In charge of part which need to be connected to server.
2	Arduino Uno		Serve as assistant board in charge of part which do not need to be connected to server
3.	ESP8266(ESP-12F)		WIFI model. In charge of Data interaction.
4.	LCD 1602*A		16-pin 1602A LCD Display the Temperature and humidity
5.	DHT11		Detect outside temperature and humidity
6.	Breadboard*2		installed for netter layout of the wires
7.	MH-RD		Raindrop module,
8.	Light sensor		Detect the lightness.

9.	Fan		A module which represents the electric fan.
10.	Collision sensor		Responsible for detecting window closure.
11.	Infrared sensor		Simulate person enter the room.
12.	Buzzer		An alarm device warns the safety.
13.	RGB light		Control the light indoors.
14.	Flame sensor		Detect infrared light emitted by flame
15.	Smoke sensor		Detect the smoke
16.	RFID		Access control system

3.2. Function Design

3.2.1. Fundamental function of the smart home Hardware Model

This is a house with a built-in smart home system, by observing the situation of the electronic components inside the house and the Internet of Things server, users can visually observe the various conditions of the house

Because many components are connected to the IOT, users can not only quickly find these changes on the Internet by changing the external environment of the components, but also by operating on the IOT or using Bluetooth to control the status of the original, such as the brightness of the light bulb.

In order to make the smart home system more intelligent, we designed many functions based on the original requirements. Among them, the basic functions include requirements.

3.2.2. Humidity and Temperature

Measure and display indoor humidity and temperature. Use DHT11 component to receive the situation of humidity and temperature. User could observe the real-time data(or 5ms later) on the screen of both LCD1602A component and website. instead of simply transferring data, visualization icon is more exciting and users could detect a period of time.

3.2.3. Doors and Windows

Check whether the doors and windows are open or closed and display the status on the display. Use an infrared sensor to sense whether the door is open and close, and use a collision sensor to sense whether the window is closed. All information about the closing of doors and windows can be observed on the IOT platform

3.2.4. Brightness of the Light

Control the brightness of the lights and display the brightness of the lights on the screen. The lighting of the smart home system is designed with various modes, including away-from-home alarm mode, automatic light switch mode, light off mode and brightness adjustment mode. Users switch to the away-from-home alarm mode and a buzzer will sound an alarm when someone is detected and the lights are switched on. Switching to auto-adjust mode, the light will automatically adjust its brightness according to the brightness of the environment. Switch to Off mode and the lights will simply go out. Switching to Adjust mode allows the user to control the brightness of the light themselves (either from IoT mode or Bluetooth mode).

This is designed to meet the lighting needs of the user in a variety of different scenarios.

3.2.5. Ability to Communicate with Data Access Software

Both Bluetooth and IoT can be used for data access software. IoT is more recommended because it is designed with many visual parts. Data transfer in IoT is not only suitable for many situations, but is also more suitable for modern needs. When using EMQX and MQTT for auxiliary transmission, the json format is used instead of plaintext mode because JSON allows for more versatile data transmission and JSON can meet the requirements for sending data from the IoT side to the hardware port.

More sensors and components are being used to better meet the needs of the smart home. Users can experience the complex functionality and wide range of applications of this system from the use of these components.

3.2.6. Raindrop Feeling Function

The raindrop sensor is realized by the raindrop sensor, and the user can feel whether it is raining outside without leaving the house, which is used to help the user decide whether to carry an umbrella to prevent rain.

3.2.7. Smoke Alarm and Flame Alarm

Users can observe smoke and flames on the IOT side. These functions meet the room's requirements for fire safety and indoor smoking bans.

3.2.8. Fan Function

Through the relay and battery, a small fan is designed, and the user can control the fan to cool down.

3.2.9. Access Control System

An access control system is designed. The user can add an electronic card for the access control by himself. When the electronic card is not stored in the system, the system will not respond. Only when the registered electronic card touches the RFID access control system, the system responds.

3.3. Appearance Design

In order to make users pay more attention to the function rather than the electronic components used, we try to hide the components and wiring behind the house, or use other materials to cover them. We don't want to show an industrial-style house. The unity of color and the beauty of the house are the primary factors in the exterior design.



We used two breadboard designs, one of which is responsible for components that do not require data transmission, and the other is connected to the esp8266wifi module. Using two breadboards makes the wiring look less confusing. Some simple sensors, such as raindrop sensors and buzzers, can appear outside the house more easily.

Our top cover of house can be easily removed so that the user can observe the current situation of the component from above, not from the gap between the door or window. If the user dropped the house and unfortunately some parts of the circuit failed to operate, we can repair the it without tearing it apart.

3.4. Software Design

The code below shows the program running on the Arduino uno board. However, as the code is complex and some of the components have almost identical code. We have chosen to show the code for the WIFI module and the lighting module as their code is typical and representative.

3.4.1. Example 1: WIFI module.

Step 1: Include the libraries used. Define the interface and pins for the display LCD and connect them to the component.

```
#include <DHT.h>
#include <Wire.h>
#include <SoftwareSerial.h>
#include <LiquidCrystal_I2C.h>
#include <"aliyun_mqtt.h">
#include <PubSubClient.h>
#include <ArduinoJson.h>
#include <WiFi.h>
```

Step 2: Define interface and pin to display LCD and connect to the components.

```
const int bluePin= 3;
const int redPin=6;
const int greenPin= 9;
const int peoplePin= 4;
const int knockPin = 12;
const int buzzerPin=8;  //
const int photocellPin =A0;
int outputvalue = 0;
int val=0;
int incomestate = 0;
int relayPin = 7; //
char X;
DHT dht(DHTPIN, DHTTYPE);
SoftwareSerial BT(10,11); // Pin10 is RX, connect HC06的TXD
                           // Pin11 is TX, connect HX06的RXD
LiquidCrystal_I2C lcd(0X27,16,2);
```

Step 3: User should replace their own WIFI name and password, rename the topic of MQTT and register their MQTT username and password.

```
// WiFi
const char *ssid = "Group65"; // Enter your WiFi name
const char *password = "12345678"; // Enter WiFi password

// MQTT Broker
const char *mqtt_broker = "broker.emqx.io";
const char *topic = "humidity and temperature";
const char *mqtt_username = "Group65";
const char *mqtt_password = "123456";
const int mqtt_port = 1883;

#define ALINK_BODY_FORMAT      "{\"id\":\"123\", \"version\": \"1.0\", \"method\": \"%s\", \"params\": %s}"
#define ALINK_TOPIC_PROP_POST  "/sys/" PRODUCT_KEY "/" DEVICE_NAME "/thing/event/property/post"
#define ALINK_TOPIC_PROP_POSTRSP "/sys/" PRODUCT_KEY "/" DEVICE_NAME "/thing/event/property/post_reply"
#define ALINK_TOPIC_PROP_SET    "/sys/" PRODUCT_KEY "/" DEVICE_NAME "/thing/service/property/set"
#define ALINK_METHOD_PROP_POST  "thing.event.property.post"
#define ALINK_TOPIC_DEV_INFO    "/ota/device/inform/" PRODUCT_KEY "/" DEVICE_NAME ""
#define ALINK_VERSION_FROMMA   "{\"id\": 123, \"params\": {\"version\": \"$s\"}}"
unsigned long lastMs = 0;
```

Step 4: Void init_wifi and void mqtt_callback is to verify connection.

```
void init_wifi(const char *ssid, const char *password)
{
    WiFi.mode(WIFI_STA);
    WiFi.begin(ssid, password);
    while (WiFi.status() != WL_CONNECTED)
    {
        Serial.println("WiFi does not connect, try again ...");
        delay(500);
    }

    Serial.println("Wifi is connected.");
    Serial.println("IP address: ");
    Serial.println(WiFi.localIP());
}
```

```

void init_wifi(const char *ssid, const char *password)
{
    WiFi.mode(WIFI_STA);
    WiFi.begin(ssid, password);
    while (WiFi.status() != WL_CONNECTED)
    {
        Serial.println("WiFi does not connect, try again ...");
        delay(500);
    }

    Serial.println("Wifi is connected.");
    Serial.println("IP address: ");
    Serial.println(WiFi.localIP());
}

void mqtt_callback(char *topic, byte *payload, unsigned int length)
{
    Serial.print("Message arrived [");
    Serial.print(topic);
    Serial.print("] ");
    payload[length] = '\0';
    Serial.println((char *)payload);

    if (strstr(topic, ALINK_TOPIC_PROP_SET))
    {
        StaticJsonBuffer<100> jsonBuffer;
        JsonObject &root = jsonBuffer.parseObject(payload);
        if (!root.success())
        {
            Serial.println("parseObject() failed");
            return;
        }
    }
}

```

Step 5: Void mqtt_version_post, void mqtt_check_connect and void mqtt_interval_post is to define the style of json, transfer the json to server.

```

void mqtt_version_post()
{
    char param[512];
    char jsonBuf[1024];

    //sprintf(param, "{\"MotionAlarmState\":%d}", digitalRead(13));
    sprintf(param, "{\"id\": 123,\"params\": {\"version\": \"%s\"}}", DEV_VERSION);
    // sprintf(jsonBuf, ALINK_BODY_FORMAT, ALINK_METHOD_PROP_POST, param);
    Serial.println(param);
    mqttClient.publish(ALINK_TOPIC_DEV_INFO, param);
}

```

```
void mqtt_check_connect()
{
    while (!mqttClient.connected())//
    {
        while (connect_aliyun_mqtt(mqttClient, PRODUCT_KEY, DEVICE_NAME, DEVICE_SECRET))
        {
            Serial.println("MQTT connect succeed!");
            //client.subscribe(ALINK_TOPIC_PROP_POSTRSP);
            mqttClient.subscribe(ALINK_TOPIC_PROP_SET);

            Serial.println("subscribe done");
            mqtt_version_post();
        }
    }

void mqtt_interval_post()
{
    char param[512];
    char jsonBuf[1024];

    //sprintf(param, "{\"MotionAlarmState\":%d}", digitalRead(13));
    sprintf(param, "{\"CurrentHumidity\":%d,\"CurrentTemperature\":18,\"GeoLocation\":{\"CoordinateSystem\":2,\"Latitude\":2,'
    sprintf(jsonBuf, ALINK_BODY_FORMAT, ALINK_METHOD_PROP_POST, param);
    Serial.println(jsonBuf);
    mqttClient.publish(ALINK_TOPIC_PROP_POST, jsonBuf);
}
```

Step 6: The loop function runs over and over until forever

```
void loop()
{
    if (millis() - lastMs >= 20000)
    {
        lastMs = millis();
        mqtt_check_connect();
        /* Post */
        mqtt_interval_post();
    }

    mqttClient.loop();

    unsigned int WAIT_MS = 2000;
    if (digitalRead(SENSOR_PIN) == HIGH)
    {
        Serial.println("Motion detected!");
    }
    else
    {
        Serial.println("Motion absent!");
    }
    delay(WAIT_MS); // ms
    Serial.println(millis() / WAIT_MS);
}
```

3.4.2. Example2: different kinds of models of RGB light.

Case1: Enter the leaving home alarm mode.

```
switch(x) {
    case 'o'://leaving home alarm mode
    {
        digitalWrite(redPin,LOW);
        digitalWrite(greenPin,LOW);
        digitalWrite(bluePin,LOW);//灯关闭

        int people = digitalRead(peoplePin);
        boolean knockVal = digitalRead(knockPin);
        if(knockVal == LOW)
        {
            digitalWrite(13,LOW);
        }else{
            if(people==1){
                tone(buzzerPin,200,100);
                digitalWrite(13,HIGH);//people exits and the light is open, the buzzer will work
            }
        }
        break;
    }
}
```

Case 2: Enter the automatic adjustment mode

```
case 'p'://Enter the automatic adjustment mode
{
    outputvalue=analogRead(photocellPin);
    if(outputvalue<=100){//dark, open the light
        val=60;
        color(225,225,225,val);
    }else if(outputvalue<=200){
        val=30;
        color(225,225,225,val);
    }else if(outputvalue<=350){
        val=20;
        color(225,225,225,val);
    }else if(outputvalue<500){
        val=2;
        color(225,225,225,val);
    }else{//亮, 关灯
        digitalWrite(redPin,LOW);
        digitalWrite(greenPin,LOW);
        digitalWrite(bluePin,LOW);
    }
}
break;
```

Case 3: Enter the light off mode

```
case 'a'://Enter the light off mode
{
    digitalWrite(redPin,LOW);
    digitalWrite(greenPin,LOW);
    digitalWrite(bluePin,LOW);
    lcd.setCursor(0,2);
    lcd.print("system close");
}
break;
```

Case 4: Enter the adjustment mode

```
case 'b'://Enter the adjustment mode
{
    val=10;
    color(250,235,215,val);
    Serial.println(val);
    lcd.setCursor(0,2);
    lcd.print("system close");
}
break;
```

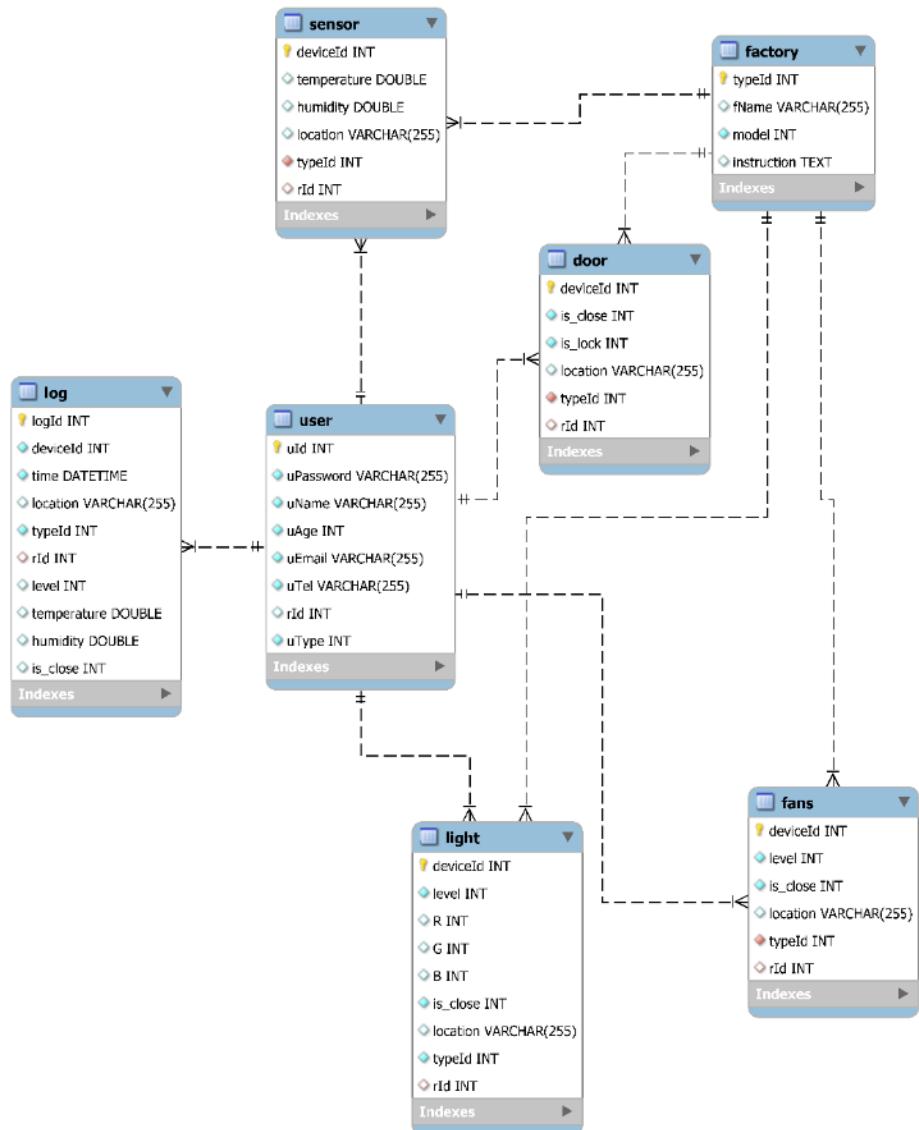
3.5. Technical Advantages and Innovation

Compared with traditional home design, this product (smart home system) frees people from complex activities, and simply and intuitively displays the situation of each home and external environment. Users no longer need to detect whether there is rainy weather by watching TV or querying the Internet. Even if the user is not in the house, the dynamics of the house are very clear to him. This greatly expands the safety and comfort of life.

4. Data Management

4.1. Database Design

4.1.1. ER model



4.1.2. Database table

User	uld	*Primary key	Light	deviceId	*Primary key
	uPassword			R	
	uName			G	
	uAge			B	
	uEmail			is_close	
	uTel			typeid	
	rId			rId	
	uType1			location	
Factory	typeid	*Primary key	Log	logId	*Primary key
	fName			deviceId	
	Model			time	
	instruction			location	
Door	deviceId	*primary key		typeid	
	is_close			level	
	is_lock			temperature	
	location			humidity	
	rId			is_close	
	typeid			rId	
Fans	deviceId	*Primary key	Sensor	deviceId	*Primary key
	level			temperature	
	is_close			humidity	
	location			location	
	typeid			typeid	
	rId			rId	

The User table is used to record account information, which is used to represent users, administrators and device manufacturers. The permissions of these three accounts are distinguished by the value of the uType field. The passwords for the accounts are encrypted with md5 calculations and stored for the security of the user.

The Factory table records the equipment model information issued by the equipment manufacturer and is used to record the categories and descriptions of the different equipment.

The Door, Light, Fans and Sensor tables are then the corresponding device tables. The different types of devices are stored in the corresponding table with a unique record corresponding to their current status information and the family information they belong to.

The Log table is used to store information about the logs generated by the device.

4.2. Relationship Design

1. The relationship between users and devices is that each user family can have multiple devices, but each device corresponds to a unique user family, and these two tables are linked by the user room ID.
2. The relationship between logs and each device is that each device can generate a series of records that are recorded in the log table. However, each log record corresponds to only one device, and the two tables are linked by the device ID. log ID is used as the primary key for the log table, allowing unique records to be located.
3. The relationship between users and logs is that each user household can generate many device operation logs, but each log can only occur in one household.
4. The relationship between manufacturers and devices is that each manufacturer can have multiple devices, but each device corresponds to a unique manufacturer, and these two tables are linked by the device ID. In addition, the model of the device allows us to uniquely identify which type of device a device belongs to, i.e. the device model.

4.3. Cloud Database Deployment

We deploy our databases on Amazon Web Services (AWS), Amazon's cloud computing IaaS and PaaS platform, which provides a full suite of cloud computing services, including elastic computing, storage, databases and applications, to help companies reduce IT investment and maintenance costs. We use EC2 (Elastic Compute Cloud) we use is an elastic cloud computing service that provides users with elastic and variable computing capacity, usually allowing them to create and manage multiple virtual machines on which they can deploy their business, and the computing power (CPU, memory, etc.) of the virtual machines can be adjusted at any time according to business needs. This also facilitates the subsequent deployment of our management system, as all our data and services can be shared online.

The screenshot shows the AWS EC2 Instances page. On the left, there's a navigation sidebar with links like 'EC2 Dashboard', 'Events', 'Tags', 'Limits', 'Instances', 'Images', 'Amazon Machine Images (AMIs)', 'Elastic Block Store', 'Volumes', 'Snapshots', 'Lifecycle Manager', 'Network & Security', 'Security Groups', 'AWS Lambda', 'Placement Groups', and 'Key Pairs'. The main content area has a header 'Instances (1 / 1) Info' with a search bar. Below it is a table with columns: Name, Instance ID, Instance state, Status check, Alarm status, Availability Zone, Public IPv4 DNS, Public IPv4 IP, and Elastic IP. A single row is selected for the instance named 'Web' with the ID 'i-029d86928a1f49282'. At the bottom of the page, there's a detailed view for this instance with tabs for 'Details', 'Security', 'Networking', 'Storage', 'Status checks', 'Monitoring', and 'Tags'. The 'Details' tab is active, showing sections for 'Instance summary', 'Public IPv4 address' (35.176.65.30), 'Private IPv4 address' (172.31.20.67), 'Instance state' (Running), 'Instance type' (t2.micro), and 'AWS Compute Optimizer findings'.

```

ubuntu@ip-172-31-20-67: ~
Using username "ubuntu".
Authenticating with public key "imported-openssh-key"
Welcome to Ubuntu 20.04.3 LTS (GNU/Linux 5.11.0-1019-aws x86_64)

 * Documentation: https://help.ubuntu.com
 * Management: https://landscape.canonical.com
 * Support: https://ubuntu.com/advantage

System information as of Thu Oct 14 04:32:18 UTC 2021

System load: 0.06      Processes:          122
Usage of /: 34.6% of 27.08GB  Users logged in:      0
Memory usage: 69%           IPv4 address for eth0: 172.31.20.67
Swap usage: 37%

=> There is 1 zombie process.

* Ubuntu Pro delivers the most comprehensive open source security and
  compliance features.

https://ubuntu.com/aws/pro

5 updates can be applied immediately.
To see these additional updates run: apt list --upgradable

Last login: Sat Oct  9 08:54:01 2021 from 127.0.0.1
ubuntu@ip-172-31-20-67:~$ 

```

In addition, Amazon EC2 can be used in conjunction with Amazon VPC to provide secure and robust networking capabilities for our computing resources. Our compute instances are located in the Virtual Private Cloud (VPC) and have a specified IP range. We can decide which instances are public to the Internet and which ones remain private. This makes our service absolutely secure for users' personal information and privacy.

The screenshot shows the phpMyAdmin interface with the following sections:

- General settings:** Shows the current connection is via UNIX socket, server type MySQL, and version 8.0.26 - Source distribution.
- Database server:** Shows the server is Localhost via UNIX socket, using MySQL 8.0.26.
- Web server:** Shows the server is nginx/1.21.0, using libmysql - mysqlnd 7.4.24, PHP extension mysqli, curl, mbstring, and PHP version 7.4.24.
- phpMyAdmin:** Shows the version is 5.1.0, latest stable version 5.1.1, and links to documentation, official homepage, contribute, get support, list of changes, and licence.

At the bottom, there are notices about an available update to version 5.1.1 and about configuration storage being incomplete.

Table	Action	Rows	Type	Collation	Size	Overhead
door	Browse Structure Search Insert Empty Drop	21	InnoDB	utf8mb4_general_ci	32.0 KIB	-
factory	Browse Structure Search Insert Empty Drop	4	InnoDB	utf8mb4_general_ci	32.0 KIB	-
fans	Browse Structure Search Insert Empty Drop	8	InnoDB	utf8mb4_general_ci	32.0 KIB	-
light	Browse Structure Search Insert Empty Drop	50	InnoDB	utf8mb4_general_ci	32.0 KIB	-
log	Browse Structure Search Insert Empty Drop	114	InnoDB	utf8_general_ci	16.0 KIB	-
sensor	Browse Structure Search Insert Empty Drop	21	InnoDB	utf8mb4_general_ci	32.0 KIB	-
user	Browse Structure Search Insert Empty Drop	10	InnoDB	utf8mb4_general_ci	48.0 KIB	-
7 tables	Sum	208	InnoDB	utf8mb4_general_ci	224.0 KIB	0 B

We configured an Ubuntu 20.04 virtual machine on AWS and deployed a MySQL 8.0 server on it. The database is managed and synchronized remotely using phpMyAdmin and Navicat.

5. Website Design

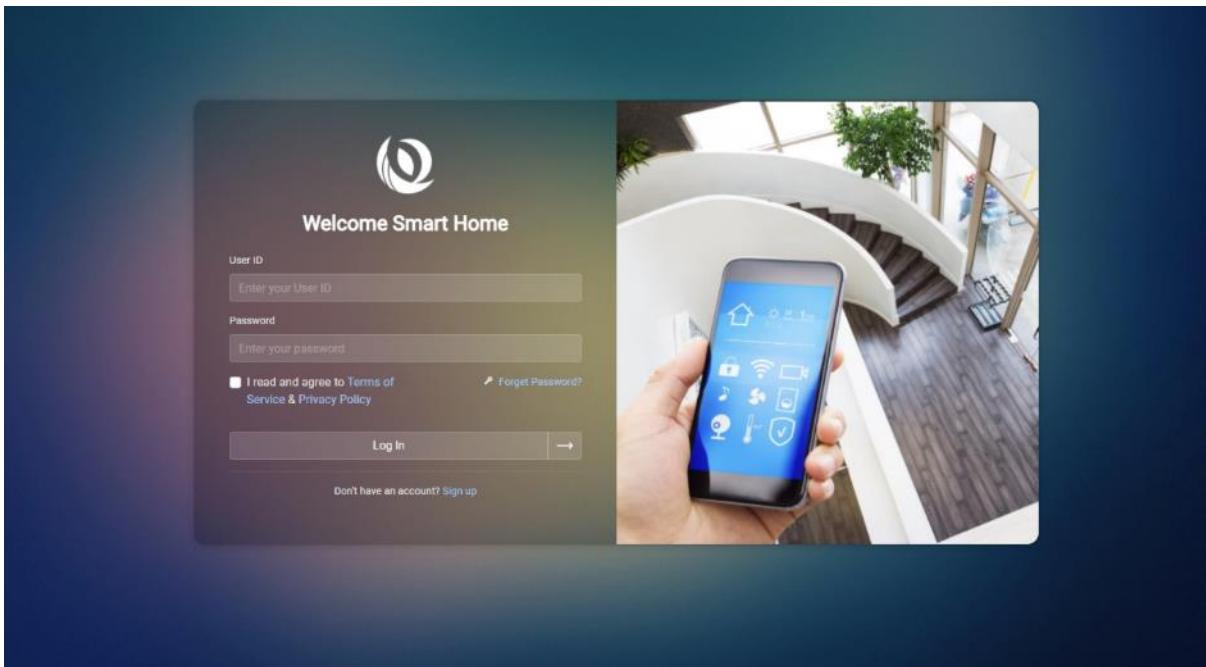
This is because with the increasing popularity and development of smart devices, users have more smartphones, smart tablets and laptops. Therefore web-based applications have the following huge advantages over client software and APPs.

- 1) The web application is not affected by the platform used.
- 2) Web applications do not require any additional applications to be installed.
- 3) Users can access web apps as long as they have an access address.

It is because of these three main advantages that countless software or games are trending towards web-based. We have therefore decided to port our products, which are aimed at all three user groups, to the web for development. Users can easily access our services via a browser wherever they have an internet connection, regardless of the device they are using. This will make our products more viable and popular for a longer period of time.

5.1. Appearance design

For the appearance of the website, we do not pursue too many attractive decorative styles, but rather focus on its clear layout, intuitiveness and practicality, which can help customers to easily find what they want, but also to avoid visual fatigue after a long time browsing the website. However, this does not mean that our website is spartan, as we offer users a choice of background colors, allowing them to choose their own style, thus making the user experience better.

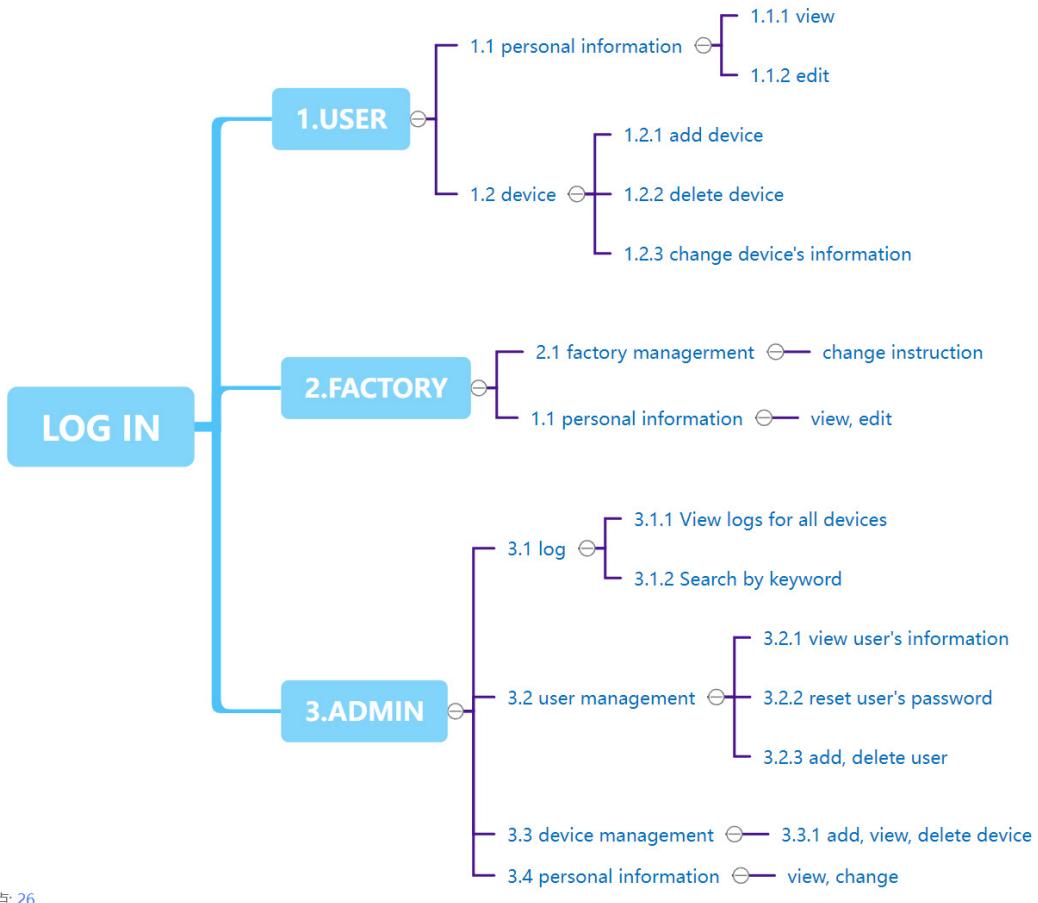


In order to display the data more visually, we have used data visualization to present the data in the form of statistical charts for a better user experience. (The image below shows an example of the main user side interface)



The right-hand side of our website is the menu interface, which allows users to jump directly to the relevant interface by clicking on it, and to visually observe the information they want. In addition, by clicking on the gear icon on the right-hand side of the page, we can change the theme of the page to meet the needs of each user.

5.2. Logic design

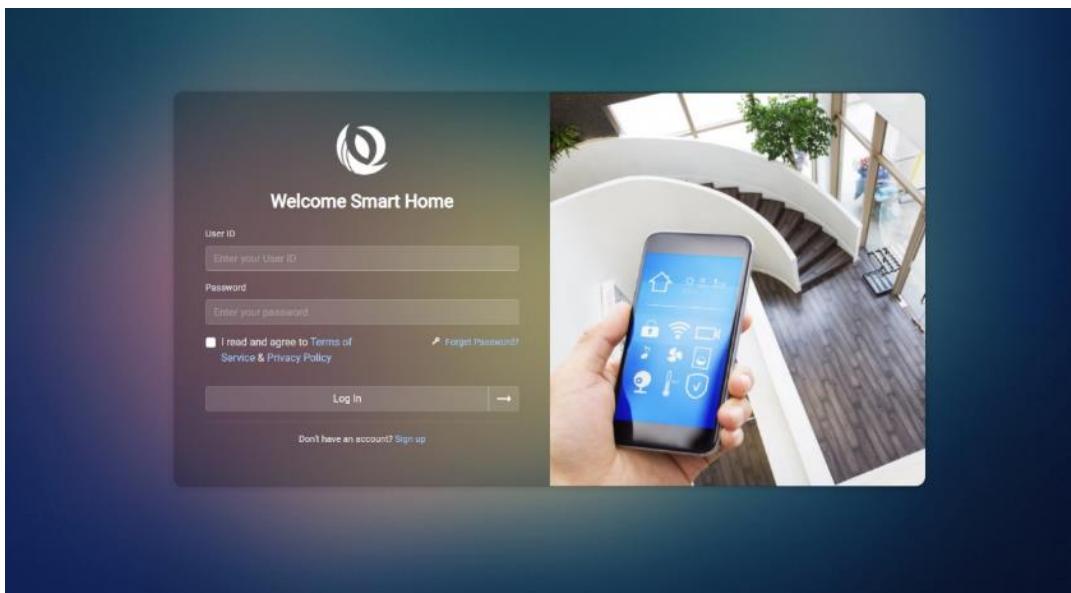


节点: 26

5.3. Function design

5.3.1. Login

Our login screen is fully functional. Firstly, if you wish to access our site, you must enter the correct password. If you enter an incorrect account or password, you will be prompted with a password mismatch. Of course, users must read and agree to our Terms of Service and User Privacy Policy in order to access the site, which is necessary to better protect the rights of our users and to provide them with a better service.



BUPT Smart Home Terms of Service

This version update time: October 1st, 2021

I. Conditions of Use

Welcome to BUPT Smart Home, which is offered to you by the production team under the following conditions. If you visit or spend money at BUPT Smart Home, you will have to accept these conditions. Please read them carefully. In addition, when you use a current or future service agreement or visit or purchase from an affiliate of BUPT Smart Home, whether or not included in the BUPT Smart Home web site, you are subject to the conditions and guidelines that apply to those services or business practices.

II. Privacy

In order to understand our situation, please read our Privacy Notice, which also governs your visit to BUPT Smart Home.

III. Copyright

All content included on this site, such as text, graphics, logos, button icons, images, audio clips, digital downloads, data compilations and software is copyrighted by BUPT Smart Home and its content providers and is protected by U.S. and International copyright laws. The content compiled on this site is copyrighted exclusively by BUPT Smart Home and is protected by International copyright laws. The software used on this site is copyrighted by BUPT Smart Home or its software providers and is protected by International copyright laws.

IV. License and Site Access

BUPT Smart Home grants you a limited license to access and make personal use of the site and not to download (other than page caching) or modify it, even in part, without the express written consent of BUPT Smart Home. This license does not include the following: resale and commercial use of the site, use and collection of any descriptions of products and prices and their listings, derivative use of this site and its contents, downloading and copying of billing information for the benefit of another wholesaler, use of tools for the development, automation and collection and extraction of data and similar information. The Site and any part thereof may not be reproduced, duplicated, copied, sold, resold, accessed or otherwise exploited for commercial purposes without the express written consent of BUPT Smart Home. The site's design techniques may not be used to imitate the design of trademarks, logos, and other proprietary information (including images, text, page designs, and forms) without the express written consent of BUPT Smart Home and its affiliates. You may not use the Site or any other "hidden text" utilizing the Site's name and trademarks without the express written consent of BUPT Smart Home and its affiliates. Any use not authorized or endorsed by the site will result in termination of the license. You are permitted to make limited hyperlinks to the pages of this website as long as the link is not false, misleading, derogatory or otherwise offensive to the website or its affiliates, and the right to link is non-exclusive and may be revoked at any time. Without the express written consent of the website, you may not use the logo or other graphics and trademarks owned by the website in the link.

V. Accounts

If you use this site, you are responsible for maintaining the confidentiality of your account and password and for restricting access to your computer by others, and you agree to be responsible for all actions that occur under your account and password. BUPT Smart Home does not sell products to children, but does sell to adults who are able to use credit cards. If you are under 18 years of age, you may use the BUPT Smart Home website only with a parent or guardian BUPT Smart Home and its affiliates have the right to refuse service, close accounts, cancel or edit content, or cancel orders at their sole discretion.

VI. Copyright Disputes

The BUPT Smart Home website respects the intellectual property rights of others. If you believe that we have violated your copyright, please follow our notice and procedures for copyright infringement here.

BUPT Smart Home Privacy Policy

This version update time: October 1st, 2021

Commitment to protect privacy

BUPT Smart Home ("we" or "us") understands the importance of personal privacy and we will do our best to keep your personal information secure and under control by taking appropriate security measures as required by law and regulation. Through the BUPT Smart Home Privacy Policy (this "Privacy Policy"), we want to explain to you how we collect, use, store, share and transfer this information when you use our products and/or services, and how we provide you with access to, update, delete and protect this information.

This Privacy Policy will help you understand the following:

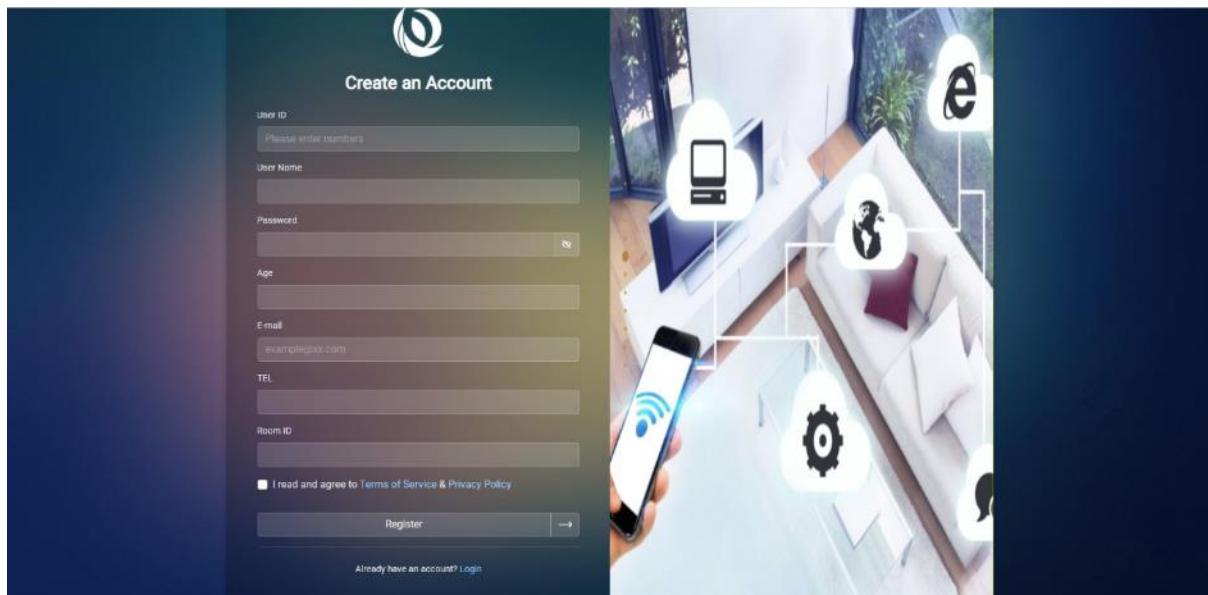
1. how we collect and use your personal information
2. how we use cookies and similar technologies
3. how we share, transfer, and publicly disclose your personal information
4. how we protect and store your personal information
5. your rights
6. the protection of minors' information
7. how your personal information is transferred globally
8. how to update this policy
9. how to contact us

This Privacy Policy applies to products or services provided to you by BUPT Smart Home. In particular, this policy does not apply to services provided to you by other third parties.

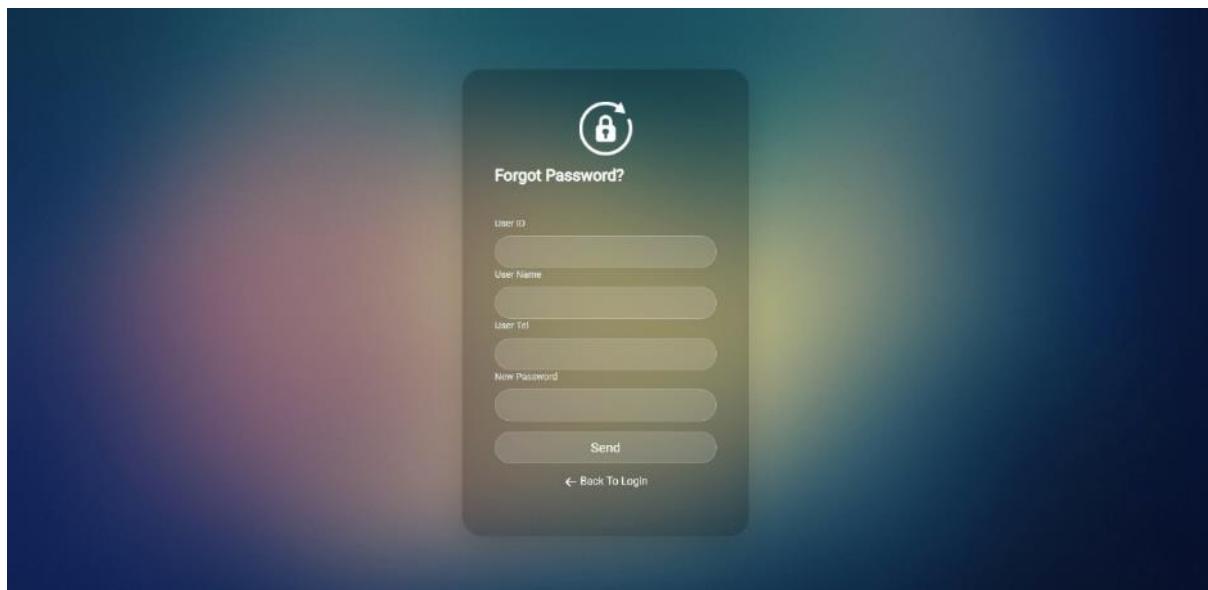
Please read and thoroughly understand this policy before using any BUPT Smart Home product or service, and use the product or service only after you have confirmed that you fully understand and agree to it. By using BUPT Smart Home products or services, you acknowledge that you fully understand and agree to this policy. If you have any questions, comments or suggestions regarding the content of this policy, you may contact BUPT Smart Home's customer service at BUPT-Smart-Home@bupt.edu.com.

5.3.2. Registration and Password Retrieval

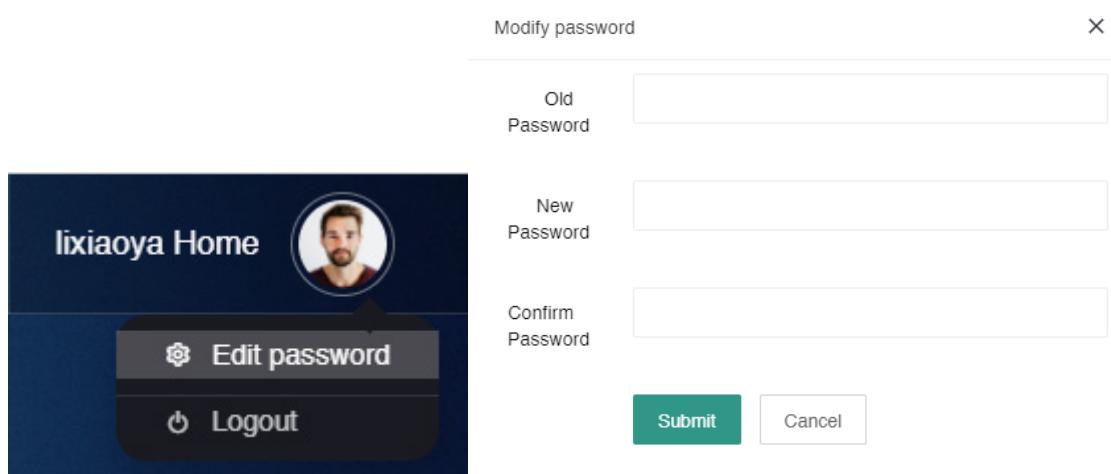
Our login screen also provides users with the ability to register and retrieve their password. If you need to register as a user, all you need to do is fill in the relevant information and read and agree to the terms and conditions and we will create an account for you.



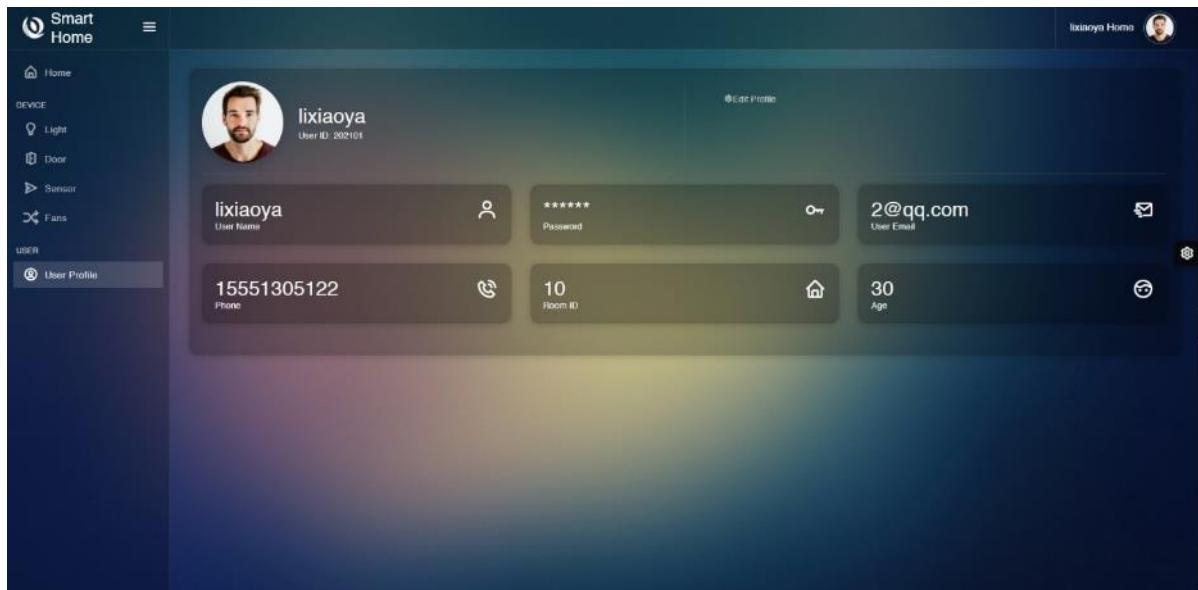
If you have accidentally forgotten your account password, we offer you two ways to retrieve your password. The first is to reset your password by clicking on the Forgotten Password message on the login screen and entering your personal details correctly. If you have forgotten the personal details, you have entered then you can only reset your account password by contacting your administrator.



5.3.3. Change password and modify user information



Whether you are a user, equipment manufacturer or administrator, you can easily change your password and user information. To change your password you simply click on your avatar, select change password, repeat the current account password as well as the new password and you can easily change your account password.



Modifying personal information is just as easy and convenient, all you have to do is click on edit in the user information screen and you can modify them (User interface as an example, administrators and equipment manufacturers have the same function as users).

5.3.4. User functions

Once you have logged into our user interface, you will find that we have a comprehensive range of functions. The menu bar on the left side allows you to select different functions according to your

needs. By clicking on it, you can access the corresponding module. In the middle of the page, you will find the statistics of all the devices you have used and the number of devices that have accessed the site in the last week, presented in a visual graph. We also give the user real-time weather conditions in the top right-hand corner of the website so that the user is more aware of the current environment and can control their smart devices more easily. The next step is to introduce the specific device interface (in the case of lights), where the user can view the real-time data detected by the current device and also edit their own device. Specially, you can modify the brightness of the lights, the colour combinations, the position information, etc. As soon as you modify them, the corresponding icons will change accordingly.

The screenshot shows a web-based smart home management system. On the left, there's a sidebar with navigation links: Home, DEVICE (selected), Light, Door, Sensor, Fans, and User Profile. The main content area has a title 'Add' and a table with columns: Device ID, Level, RGB, Status, Location, and Operation (with buttons for Edit, Delete, and Instruction). There are seven rows of data, each representing a device with its details and operation buttons. At the bottom, there are navigation buttons for '1-50', '1-100', and '1-200'.

Device ID	Level	RGB	Status	Location	Operation
12	70	💡 230,200,50	Open	second bedroom	<button>Edit</button> <button>Delete</button> <button>Instruction</button>
11	0	💡 255,255,255	Close	study room	<button>Edit</button> <button>Delete</button> <button>Instruction</button>
8	50	💡 255,255,255	Open	toilet	<button>Edit</button> <button>Delete</button> <button>Instruction</button>
7	1	💡 255,1,1	Open	second bedroom	<button>Edit</button> <button>Delete</button> <button>Instruction</button>
6	1	💡 1,255,1	Open	main bedroom	<button>Edit</button> <button>Delete</button> <button>Instruction</button>
5	90	💡 255,255,255	Open	second bedroom	<button>Edit</button> <button>Delete</button> <button>Instruction</button>
4	80	💡 0,0,0	Close	main bedroom	<button>Edit</button> <button>Delete</button> <button>Instruction</button>

This screenshot shows a modal window titled 'Edit' over a table of device data. The table columns are RGB, Status, Location, and Operation. The modal contains fields for Level (70), R (230), G (200), B (50), Location (second bedroom), and Status (radio buttons for Close and Open, with Open selected). At the bottom are 'Submit' and 'Cancel' buttons.

RGB	Status	Location	Operation
💡 230,200,50	Open	second bedroom	<button>Edit</button>
💡 255,255,255			<button>Edit</button>
💡 255,255,255			<button>Edit</button>
💡 255,1,1			<button>Edit</button>
💡 1,255,1			<button>Edit</button>
💡 255,255,255			<button>Edit</button>
💡 0,0,0			<button>Edit</button>

You can also delete or add as many devices as you like, it's all so easy. In addition, if you are unsure about the use of the device, click on the instructions button and you will see the user guide provided by the manufacturer.

This screenshot shows the 'Door' management section of the Smart Home Management System. The sidebar on the left lists 'Home', 'DEVICE' (Light, Door, Sensor, Fans), and 'USER' (User Profile). The main area has a header 'Add' and a table with columns: Device ID, Locked, Status, Location, Anomalies, and Operation. Three rows are listed:

Device ID	Locked	Status	Location	Anomalies	Operation
4	Unlocked	Open	living room	None	Edit Delete Instruction
3	Unlocked	Open	main bedroom	None	Edit Delete Instruction
1	Locked	Close	bookroom	None	Edit Delete Instruction

This screenshot shows the 'Sensor' management section. The sidebar includes 'Home', 'DEVICE' (Light, Door, Sensor, Fans), and 'USER' (User Profile). The main area features an 'Add' button and a table with columns: Device ID, Temperature, Humidity, Location, and Operation. Four rows of sensor data are displayed:

Device ID	Temperature	Humidity	Location	Operation
4	12.0 °C	12.00 %	Living room	Edit Delete Instruction
3	10.5 °C	10.80 %	Living room	Edit Delete Instruction
2	37.5 °C	25.40 %	master bedroom	Edit Delete Instruction
1	12.9 °C	32.89 %	room	Edit Delete Instruction

This screenshot shows the 'Fans' management section. The sidebar lists 'Home', 'DEVICE' (Light, Door, Sensor, Fans), and 'USER' (User Profile). The main area has an 'Add' button and a table with columns: Device ID, Level, Status, Location, and Operation. One row of fan status is shown:

Device ID	Level	Status	Location	Operation
1	10	Close	main bedroom	Edit Delete Instruction

5.3.5. Manufacturer functions

Manufacturers, as a type of user, have separate accounts and passwords. However, manufacturers cannot register their own accounts, they need to be added by the administrator to create an account with the legal and compliant manufacturer information. Manufacturers can add different types of equipment. They can modify the information of the equipment they produce in the following way.

Type ID	Name	Model	Instruction	Operation
4	Fans		Edit Name: Fans Instruction: This is fans Model: 3	<button>Edit</button>
3	Sensor			<button>Edit</button>
2	Door			<button>Edit</button>
1	Light			<button>Edit</button>

5.3.6. Admin functions

As the third and most important part of our website, the administrator's side is also relevant to IoT engineering students. First, the main interface of the administrator's side is different from the other two users. After logging into the site, the first thing the administrator sees is all the rooms and the number of devices in them. The menu bar on the left has many additional functions, including viewing the records of each device, user management, manufacturer management, etc.

Room ID	Count
10	7
1	4
12	4
15	4
11	3
14	3
13	2
17	2
16	2
1	1
16	1

Room ID	Count
10	3
11	3
12	3
13	3
17	3
14	2
15	2
1	1
16	1

Room ID	Count
10	4
11	3
12	3
13	3
19	3
14	2
17	2
16	1

Room ID	Count
10	1
11	1
12	1
13	1
14	1
15	1
16	1
17	1

The following describes the administrator's interface for managing each device specifically (using lights as an example).

The screenshot shows a table titled 'Device' with columns: Device ID, Level, RGB, Status, Location, Room ID, and Operation. The 'Operation' column contains three buttons: Edit, Delete, and Instruction. A search bar at the top right allows filtering by Room ID. The table lists 10 devices, each with unique parameters and location details. The interface has a dark blue header and sidebar.

Device						
Device ID	Level	RGB	Status	Location	Room ID	Operation
11	0	255,255,255	Close	study room	10	<button>Edit</button> <button>Delete</button> <button>Instruction</button>
10	1	1,1,1	Open	餐厅	1	<button>Edit</button> <button>Delete</button> <button>Instruction</button>
9	1	1,1,1	Open	主卧	1	<button>Edit</button> <button>Delete</button> <button>Instruction</button>
8	50	255,255,255	Open	toilet	10	<button>Edit</button> <button>Delete</button> <button>Instruction</button>
7	1	255,1,1	Open	second bedroom	10	<button>Edit</button> <button>Delete</button> <button>Instruction</button>
6	1	1,255,1	Open	main bedroom	10	<button>Edit</button> <button>Delete</button> <button>Instruction</button>
5	90	255,255,255	Open	second bedroom	10	<button>Edit</button> <button>Delete</button> <button>Instruction</button>
4	80	0,0,0	Close	main bedroom	10	<button>Edit</button> <button>Delete</button> <button>Instruction</button>
3	1	1,1,1	Open	老人房	1	<button>Edit</button> <button>Delete</button> <button>Instruction</button>
2	1	1,1,1	Open	书房	1	<button>Edit</button> <button>Delete</button> <button>Instruction</button>

The administrator can view all the current devices in a visual format and observe all the parameters of the device at the moment and can add, modify and delete all devices. We also offer a search function, where the administrator can enter the keywords of the room ID and search for them, after which the devices containing the keywords will be displayed on the web page in order.

The screenshot shows a table titled 'Log' with columns: Log ID, Time, Device ID, Level, Location, and Room ID. A search bar at the top right allows filtering by Start Time, End Time, Room ID, and Device ID. The table lists 10 log entries, each with a timestamp and device details. The interface has a dark blue header and sidebar.

Log						
Log ID	Time	Device ID	Level	Location	Room ID	
552	2021-10-14 01:40:32	12	70	second bedroom	10	
551	2021-10-14 01:40:26	12	70	second bedroom	10	
550	2021-10-14 01:40:15	6	1	main bedroom	10	
549	2021-10-14 01:40:09	7	1	second bedroom	10	
503	2021-10-13 06:18:38	12	70	second bedroom	10	
495	2021-10-13 05:22:25	0	3	kitchen	17	
494	2021-10-13 05:22:14	0	1	study	17	
492	2021-10-13 05:21:09	0	3	study	16	
491	2021-10-13 05:15:24	0	2	study	15	
488	2021-10-13 05:07:09	0	1	kitchen	15	



The screenshot shows the 'Log' section of the Smart Home Management System. On the left, there's a sidebar with icons for Home, Device (Light, Door, Sensor, Fans), Log (Light, Door, Sensor), and User (User Manage, Manufacturer Manage, User Profile). The main area has a search bar at the top with fields for Start Time (yyyy-MM-dd) and End Time (yyyy-MM-dd), and dropdowns for Room ID and Device ID. A 'Search' button is on the right. Below is a table with columns: Log ID, Time, Device ID, Temperature, Humidity, Location, and Room ID. The data shows several log entries for different devices over a few days. At the bottom, there's a navigation bar with page numbers (1, 2, 3, 4, 5, ..., 7, Next).

Log ID	Time	Device ID	Temperature	Humidity	Location	Room ID
546	2021-10-14 01:30:00	1	12.9 °C	32.89 %	room	10
547	2021-10-14 01:00:00	1	16.1 °C	33.26 %	room	10
546	2021-10-14 00:30:00	1	18.7 °C	31.46 %	room	10
545	2021-10-14 00:00:00	1	13.9 °C	40.26 %	room	10
544	2021-10-13 23:30:00	1	13.0 °C	47.20 %	room	10
543	2021-10-13 23:00:00	1	14.1 °C	51.19 %	room	10
536	2021-10-13 22:30:00	1	15.7 °C	53.88 %	room	10
535	2021-10-13 22:00:00	1	16.0 °C	43.72 %	room	10
534	2021-10-13 21:30:00	1	12.4 °C	51.32 %	room	10
533	2021-10-13 21:00:00	1	17.3 °C	60.58 %	room	10

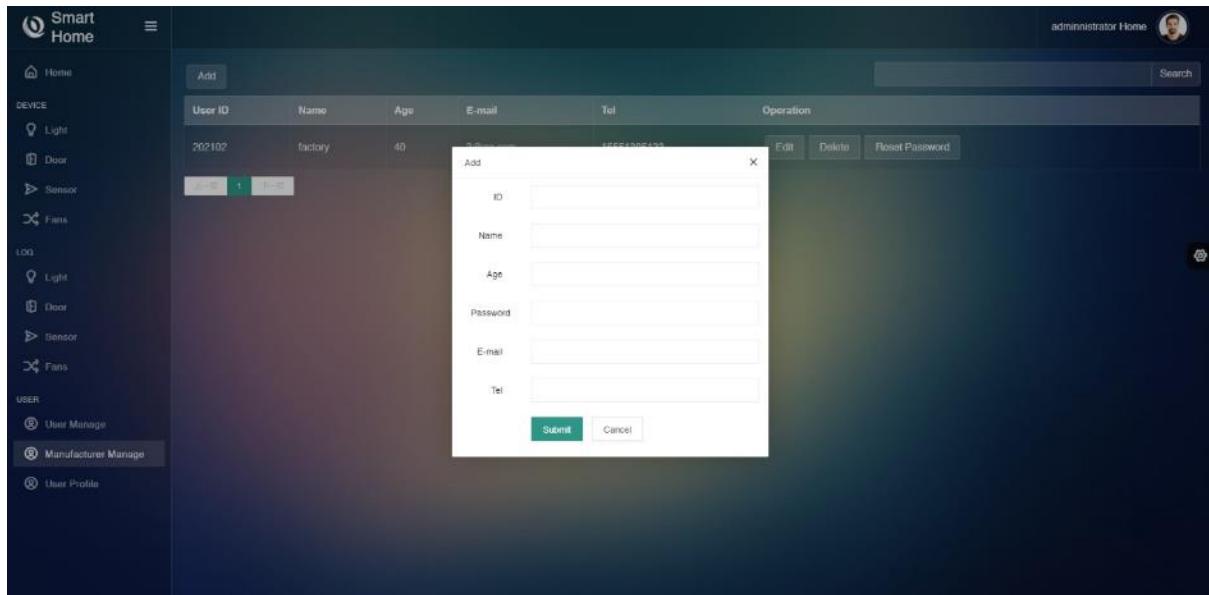
After this, the log screen displays all records for all devices and provides a search function that allows the user to search by different keywords. The administrator can also manipulate this data, adding or deleting it.



The screenshot shows the 'User Management' section. The sidebar includes icons for Home, Device, Log, and User (User Manage, Manufacturer Manage, User Profile). The main area has a search bar at the top with a 'Add' button. Below is a table with columns: User ID, Name, Age, E-mail, Tel, Room ID, and Operation. The data lists several users with their details and edit/delete/reset password buttons. At the bottom, there's a navigation bar with page numbers (1, 2, 3, 4, 5, ..., 7, Next).

User ID	Name	Age	E-mail	Tel	Room ID	Operation
2019213457	Huo Dongze	22	7@bupt.edu.cn	15776072897	17	<button>Edit</button> <button>Delete</button> <button>Reset Password</button>
2019213456	Gou Ning	22	6@bupt.edu.cn	15776072896	16	<button>Edit</button> <button>Delete</button> <button>Reset Password</button>
2019213455	Wang Xiaomei	21	5@bupt.edu.cn	15776072895	15	<button>Edit</button> <button>Delete</button> <button>Reset Password</button>
2019213454	Du Han	21	4@bupt.edu.cn	15776072894	14	<button>Edit</button> <button>Delete</button> <button>Reset Password</button>
2019213453	Li Menghan	21	3@bupt.edu.cn	15776072893	13	<button>Edit</button> <button>Delete</button> <button>Reset Password</button>
2019213452	Xu Changming	21	2@bupt.edu.cn	15776072892	12	<button>Edit</button> <button>Delete</button> <button>Reset Password</button>
2019213451	Yan Song	21	1@bupt.edu.cn	15776072891	11	<button>Edit</button> <button>Delete</button> <button>Reset Password</button>
202101	Ixiaoya	30	2@qq.com	15551305122	10	<button>Edit</button> <button>Delete</button> <button>Reset Password</button>

The function of the user management interface is attributed to the administrator's authority, allowing the administrator to manage the users, the administrator can reset the user password, add users, search according to keywords, and delete users. The functions of the factory management interface are similar.



6. Web cloud deployment and management

In order to make it easier for all users to access and use our services, we use cloud server technology to guarantee that our platform is freely accessible within the open internet. We have selected a reliable server provider (Amazon) and chosen a domain name that impresses our users - "www.bupthome.com". The following sections provide more technical details and the tireless efforts of our company to maximize the user experience and protect user security.

6.1. Amazon web services EC2

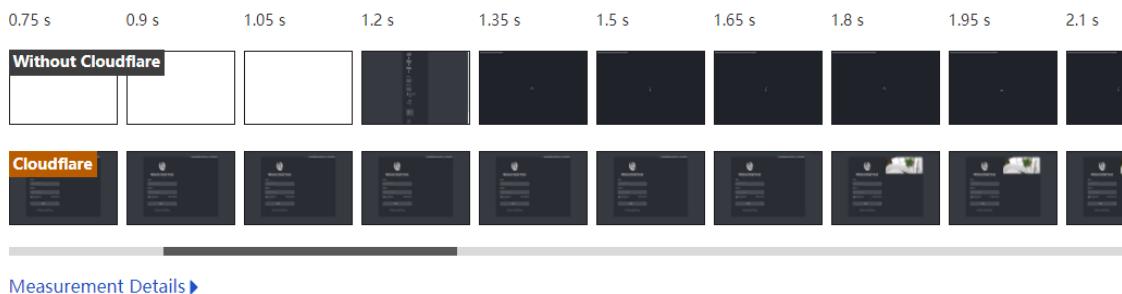
The screenshot shows the AWS CloudWatch Metrics interface. On the left, there's a navigation sidebar with links like 'New EC2 Experience', 'EC2 Dashboard', 'EC2 Global View', 'Events', 'Tags', 'Limits', 'Instances', 'Images', 'Elastic Block Store', 'Network & Security', and 'Feedback'. The main area displays a line graph titled 'CPU Usage (%)' for an instance named 'Web'. The graph shows a sharp peak at the beginning of the month followed by a steady decline. Below the graph, there's a table with metrics such as 'CPU Utilization', 'Memory Utilization', and 'Network In/Out'. At the bottom, there are buttons for 'Edit' and 'Delete'.

We chose the efficient and secure servers of a large company for the deployment of our project. This is because keeping our clients' information secure and providing them with the most convenient service is always our first priority. That is why we chose Amazon web services.

6.2. DNS and CDN services

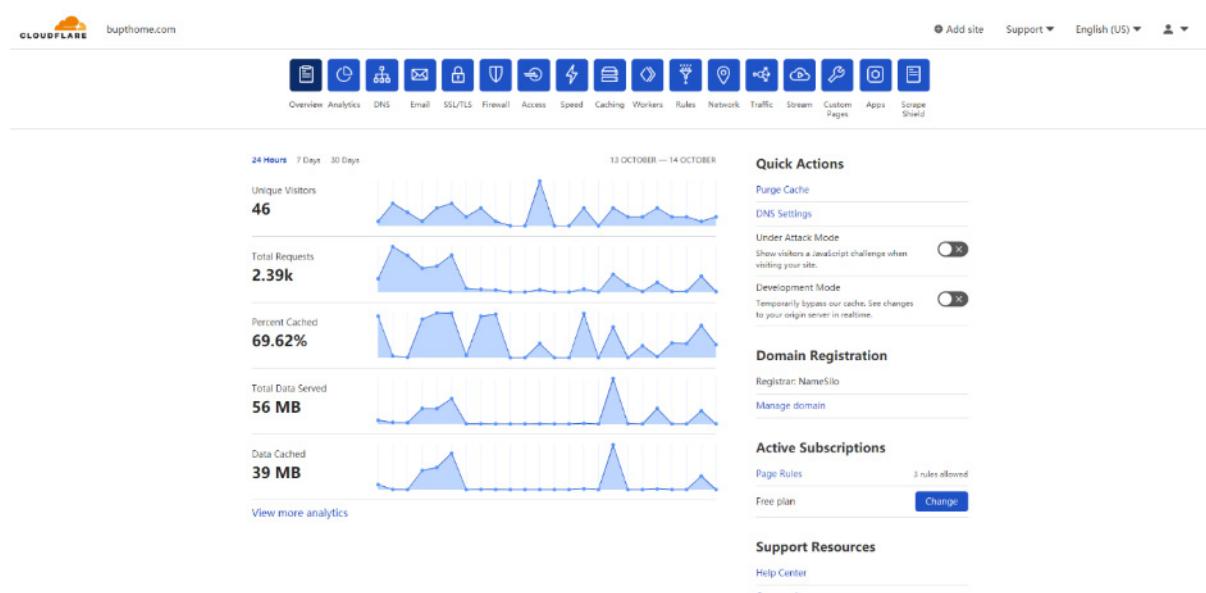
We use Cloudflare as the DNS server provider for our website. In addition, Cloudflare's global network is often faster than the internet. They offer direct connections to all major cloud providers and interconnect with almost every service provider in the world. With data centers in over 250 cities, they offer latency of less than 100 milliseconds to 99% of the world's Internet users.

 **Visitors to your website see content in 0.8 seconds on Cloudflare. That's 32% faster!**



[Measurement Details ▶](#)

Our web application uses the Cloudflare CDN to distribute content such as information about our services, documents and videos, and user guides to end users mainly in Asia, the US and Europe. improve our overall performance and reduce the workload on our raw servers.



We like its security and performance the most, Cloudflare integrates security into every layer so that our site contains a lot of sensitive information securely, Cloudflare performs well, the experience is almost identical for users worldwide and the overall cost of using the right caching algorithm is low.

In addition to this, Cloudflare's network is built with data protection in mind. They are a privacy-first company, offering end-to-end encryption. And they comply with local regulations regarding data localization and storage. Cloudflare does not generate revenue from advertising and therefore does not collect and retain personal data that is processed on your behalf.

6.3. SSL Certificates and HTTPS

Your SSL/TLS encryption mode is **Full (strict)**

This setting was last changed 13 days ago

Off (not secure) ⓘ
 No encryption applied

Flexible
 Encrypts traffic between the browser and Cloudflare

Full
 Encrypts end-to-end, using a self signed certificate on the server

Full (strict)
 Encrypts end-to-end, but requires a trusted CA or Cloudflare Origin CA certificate on the server

[Learn more about End-to-end encryption with Cloudflare](#)

[API ▶](#) [Help ▶](#)

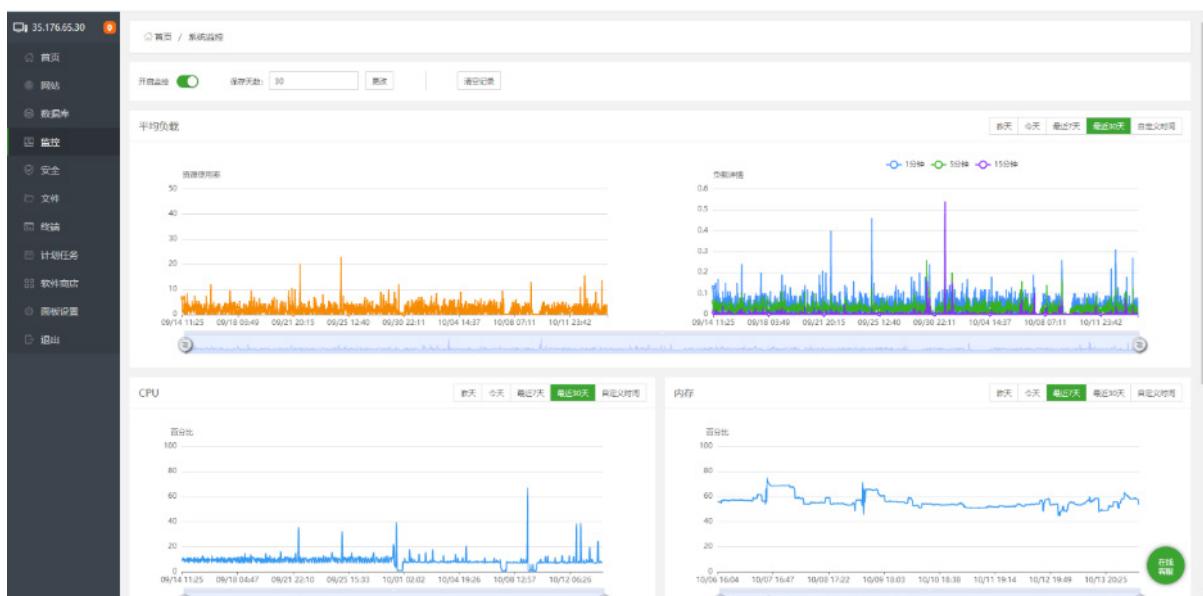
An SSL certificate is a digital certificate issued by a trusted digital certificate authority CA (e.g. Cloudflare CA) after verifying the identity of the server, in compliance with the SSL protocol. By deploying a legitimate SSL certificate on our servers, we can turn on HTTPS services and further protect the security of user privacy information. SSL certificates allow websites to achieve encrypted transmission, which can well prevent user privacy information such as usernames, passwords, records, residence information, etc. from being stolen and compiled.

In addition, SSL certificates can authenticate the real identity of the server, which can effectively distinguish phishing websites from official websites. When a website deploys a globally trusted SSL certificate, the browser has a built-in security mechanism to check the status of the certificate in real time and display the website authentication information to the user through the browser, allowing the user to easily identify the real identity of the website and prevent phishing websites from counterfeiting.

What's more, because a website with an SSL certificate is more trustworthy and secure than one without, it can effectively protect the interests of users from being infringed. Security conscious consumers and business customers find the Internet more reliable with SSL protection in their web services, so there are countless reasons to believe that this is a technology that can be of great benefit to users.

6.4. Visual server monitoring panel

Baota Panel is a server management software that allows you to easily manage your servers via the web side and improve your operation and maintenance efficiency. For example, it creates and manages websites, FTP, databases, has a visual file manager, a visual software manager, visual CPU, memory and traffic monitoring charts, scheduled tasks, and other functions. Overall, Baota Panel is one of the many server management software products that has a user-friendly interactive experience and is fully functional and updated on a weekly basis. Baota Panel is a simple and easy to use server management software. We deploy it on AWS for our daily server maintenance and monitoring.



7. Project structure and techniques used

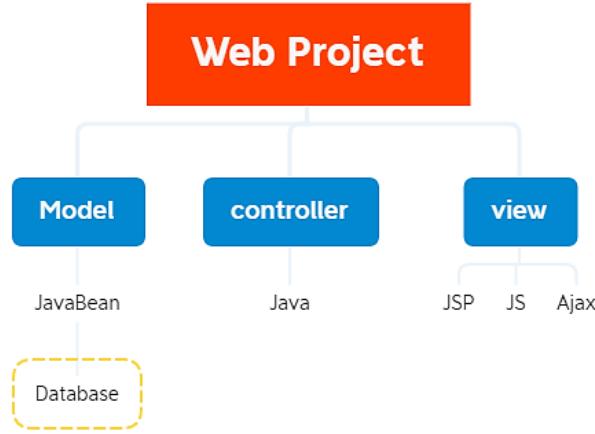
7.1. MVC design framework

The MVC design pattern generally refers to the MVC framework, where M (Model) refers to the data model layer, V (View) refers to the view layer and C (Controller) refers to the control layer. The purpose of using MVC is to separate the implementation code of M and V, so that the same application can have different representations. The View is more clearly defined as the user interface.

In the development of web projects, it is important to be able to respond to user requests in a timely and correct manner. When a user clicks on a URL path on a web page, this is equivalent to a request sent by the user to the web server. It is often the Controller that parses the user's input, executes the processing logic, and jumps to the correct page to display the feedback.

During the request process, the user's information is encapsulated in the User entity class, which is part of the data model layer (Model) in a web project. During the display phase of the request, the resulting web page jumps to the View layer.

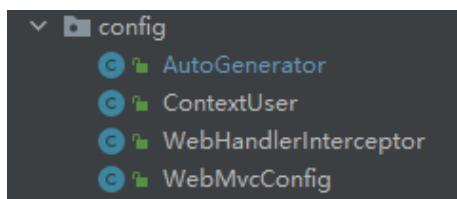
In this way, the control layer is responsible for the interaction between the front-end and back-end, the data model layer encapsulates the user's input/output data, and the view layer selects the appropriate view to display the final execution result.



7.2. Project details

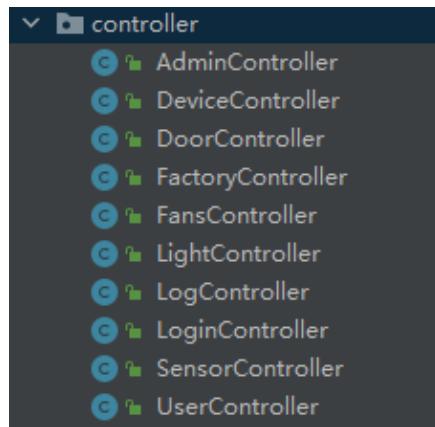
Our smart home website design is divided into front-end and back-end. The front-end mainly includes personal information enquiry system for users and manufacturers and visualization of home equipment information (thermometer showing current temperature, light brightness, door opening and closing status), while the back-end system mainly manages user information for administrators and maintains the normal operation of the website. The front end of the website is developed using JS, JSP, jQuery, Ajax, CSS, Bootstrap and we mainly use JavaScript as the main method of compiling the pages, in order to make the data clearer and more diversified, we learn and use ajax methods for data visualization. In order to make the website more diverse and user-friendly, we added a variety of functions to the page such as editing profiles, pop-up windows, adding devices, etc., so that users can easily observe and modify the status of their homepage through the website. The back-end mainly uses the SpringBoot template engine for data rendering, and connects to the database via MyBatis, with the database built mainly via MySQL 8.0.

7.2.1. Config module



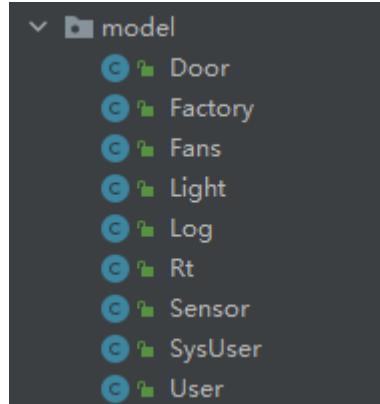
This module is the underlying module for this project, providing data generation, page permission interceptors, and MVC related configuration classes.

7.2.2. Controller module



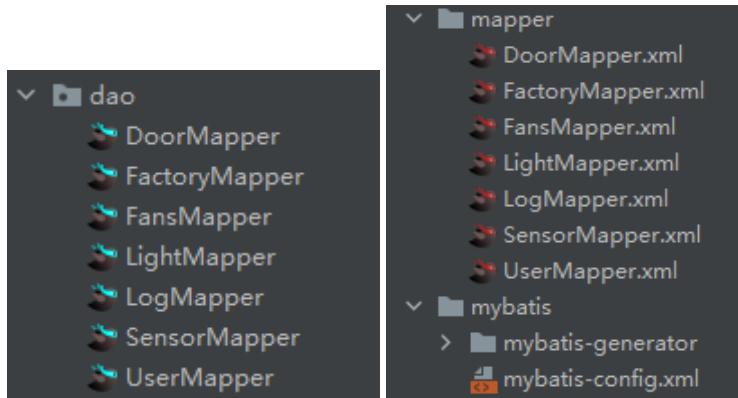
This module is the controller layer of the project and integrates with the service layer. It provides page jump responses for the whole project and mainly handles data requests such as requests for account password verification, requests for information about a particular user, requests for information about a device, requests for statistical information, etc. These classes will provide data call interfaces for the upper view layer to be called.

7.2.3. JavaBean module



This module is a Java entity class that is used to create objects for data persistence.

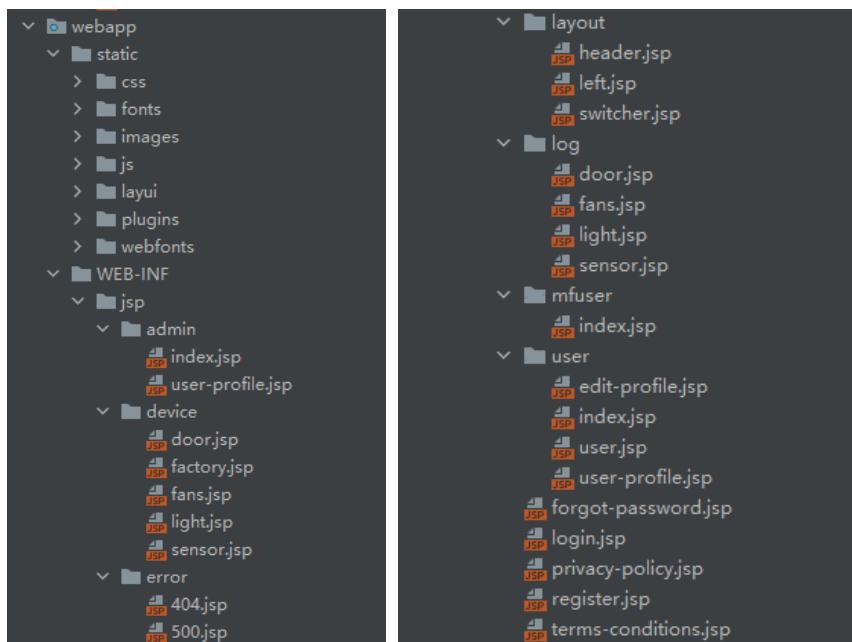
7.2.4. Database operation module



In this module we introduce MyBatis, an excellent persistence framework that supports customized SQL, stored procedures, and advanced mappings. MyBatis avoids almost all the JDBC code and manual setting of parameters and getting result sets. MyBatis can be configured and mapped natively using simple XML or annotations, mapping interfaces and MyBatis does not impose any influence on the existing design of the application or the database. The SQL is written in xml for uniform management and optimization. All the requirements for manipulating the database can be met by SQL statements. Uncoupling SQL from program code: By providing a DAO layer, business logic and data access logic are separated, making the design of the system clearer, easier to maintain and easier to unit test. SQL and code are separated, improving maintainability.

Using MyBatis, we perform all the database operations for this project in this module, including data addition, deletion, checking, etc.

7.2.5. View Module



This module uses Java Server Pages, JavaScript to build the view layer of the project. We also use CSS, Bootstrap and beautiful fonts to ensure that our pages are aesthetically pleasing and friendly to devices of all sizes.

8. Business outlook

After more than 20 years of rapid development in China's household appliance industry, competition is now becoming increasingly fierce, and with the overall macroeconomic downturn in China, demand for traditional household appliances has become weaker in recent years. We should make full use of our own strengths and existing conditions and try to avoid the impact of our own weaknesses and external threats in order to seek the long-term development of our products.

Intelligent systems are one of the most emerging industries and one of the key developments in every country. In China, as the installation of smart homes has the unique charm of being safe, efficient, convenient and intelligent, the market demand for smart homes is also high, which is a good opportunity for our Smart Home to make its mark.

Nowadays, as the global resources continue to decrease and the environment is destroyed, "energy saving and environmental protection" has become the primary requirement for the development of science and technology, and the advantages of "global intelligence" in terms of skills and environmental protection make the Smart Home the mainstream of development, and therefore has a very broad market prospect.

With the advancement of technology, traditional architecture has failed to meet the needs of modern people in terms of comfort, and intelligent systems have unknowingly penetrated into our lives, and it is on this premise that our Smart Home is designed to make every user of our system feel comfortable.

With the rise of advanced technology, the smart home is developing towards networking, information technology and intelligence with powerful functions, and is simple to use and operate, making it extremely convenient for people to use. Along with the development of industry standards for smart homes, it is expected that relevant policies will be introduced soon to further dilute the cost of research and development, improve the cost performance of products, thereby promoting the speed of popularization, it is expected that in the next 3-5 years, smart homes will usher in the peak of development.

The trend of home life towards intelligence is inevitable, therefore, as an emerging project, the future of smart home is immeasurable. With the Internet of Things, cloud computing and other emerging technologies entering the smart home industry one after another, manufacturers have formed their own special products and prices are gradually moving towards the trend of civilization. From wired to wireless, from concept to implementation, smart home after more than ten years of development process, finally the smart home has finally achieved a qualitative leap. The smart home of the future will serve the users better. In this era of Internet of Things, smart home has more potential for development, and I believe I also believe that our products will shine in the future.

9.2. Process Schedule

Process Schedule									
Mission	Duration	Jul-21				Oct-21			Integration
Database Requirement Analysis	1d	7.1							
EER Diagram Design	1d	7.1							
C-S UI Design	2d	7.1-7.2							
C-S Control Part Implement	3d			7.3-7.5					
C-S Panel Implement	2d			7.5-7.6					
Local Database Deployment	1d				7.7				
Cloud Database Deployment	2d					10.8-10.9			
Study Servlet	1d	7.1							
Web Module Design	1d		7.2						
Web Interface Design	3d		7.2-7.4						
Back-end Implement	3d			7.4-7.6					
Cloud Web Deployment	3d						10.10-10.12		
Arduino Learning	1d	7.1							
Arduino Programming	2d		7.2-7.3						
Circuit Building	2d				10.7-10.8				
Body Construction	2d							10.13-10.14	
Video Production	1d								
Paper work	5d							10.10-10.14	

10. Conclusion

With the rapid development of smart homes, various products of smart homes such as smart lighting, smart air conditioning, smart audio and video, smart curtains, smart security and other products have been accepted by the public. How to build out the management relationship of various devices in a smart home is a hot topic of concern for many enterprises nowadays. Therefore, we use Web and MySQL database to build a set of smart home web application to achieve the status monitoring and device management of smart home in the family. Through this set of smart home web application, users can achieve cross-platform, all-weather convenience and efficiency to grasp the status of various appliances in the home and improve the standard and quality of life.

In this Design & Build training, our team consisted of different students from three different disciplines. Therefore, it was a priority for us to work together. Although we were able to make contact and divide up the work in the first instance, the telecoms engineering and management students were unable to meet our initial requirements, resulting in a less than satisfactory outcome. The rest of us who took the task seriously gained a great deal. We learned not only about hardware and software, but also about teamwork, time management, planning and summarizing. The group discussions always inspired us when difficulties arose, which not only improved our problem solving and communication skills, but also developed our sense of responsibility as team members.

Overall, all the students who worked seriously during this primary term benefited greatly. At the same time, we are proud of our website and database. At the same time, we sincerely believe that it is an inevitable trend for home life to move towards intelligence, and therefore, smart home, as an emerging project, has an immeasurable future. The smart home of the future will serve the users better. In this era of Internet of Things, smart home has more potential for development, and I believe I also believe that our products will shine in the future.

11. Acknowledgement

Allow me to start by expressing my heartfelt thanks on behalf of our entire 65 group to all the teachers from BUPT and Queen Mary University of London who organized and taught this course. It was they who led us through the web programming techniques with databases, Java, and other technologies to build this smart home model project. In particular, I would like to thank Professor Jing Li from E-Commerce and Law group. Without their detailed guidance and help, it would not have been an enjoyable experience. We learnt a lot about website and database design, and we were also excited to find out that we were more creative than we thought. Finally, thank you for reading this report and if you have any questions or comments, please contact us at lianjunhong@bupt.edu.cn. Your guidance is very important to us and means a lot to us.