**Software Requirements Specification (SRS)**

Revision History:

|  |  |  |
| --- | --- | --- |
| Date | Author | Description |
| 2019.3.17 | Rui Xing | Editing system capabilities |
| 2019.3.18 | Shuihan Zhang | Editing system context |
| 2019.3.19 | Yuru Wang | Editing quality requirements (non-functional requirements) |
| 2019.3.19 | Zheng Chen | Introduction/Concept of Operation |
| 2019.3.20 | Rui Zhu | Editing fundamental assumptions |
| 2019.3.20 | Rui Xing | Editing expected subsets |
| 2019.3.21 | Rui Xing, Shuihan Zhang, Yuru Wang, Rui Zhu, Shijie Wen | Editing use cases |
| 2019.3.21 | Zheng Chen | Quality Requirements/Expected subsets |
| 2019.3.21 | Zhi Zhou | Overall block diagram |
| 2019.3.21 | Zimu Hu | Edit functional documentation |
| 2019.3.22 | Rui Xing, Shuihan Zhang, Yuru Wang, Rui Zhu, Shijie Wen | Editing use cases |
| 2019.3.22 | Zheng Chen | Behavioral Requirements |
| 2019.3.23 | Zhi Zhou | Modify functional documentation |
| 2019.3.23 | Zheng Chen | Use Cases/Behavioral Requirements |
| 2019.3.23 | Zheng Chen | Fundamental Assumption/Appendices |
| 2019.3.23 | Rui Xing, Shuihan Zhang, Yuru Wang, Rui Zhu, Shijie Wen | Adding use case |
| 2019.3.23 | Shijie Wen | Editing detailed requirements |
| 2019.3.23 | Rui Zhu | Editing expected changes |
| 2019.3.23 | Yuru Wang | Editing appendices |
| 2019.3.24 | Shijie Wen | Modifying detailed requirements |
| 2019.3.24 | Rui Xing | Editing introduction |
| 2019.3.25 | Zhi Zhou | Add Server System Context |
| 2019.3.25 | Zhi Zhou | Add System Input & Output |
| 2019.3.25 | Renxiang Zhu | Add Quality Requirements |
| 2019.3.25 | Renxiang Zhu | Integrate documents |
| 2019.3.25 | Yuanjin Li | Editing Software Requirements Specification |
| 2019.3.26 | Yifan Zhang | Editing the Detailed Requirments |
| 2019.3.26 | Zhongyu Wang | Editing the Quality Requirments |
| 2019.3.26 | Zheng Chen | Revise Use Cases and System Inputs and Outputs |
| 2019.3.26 | Qingzhong Chen | Revise Use Cases |
| 2019.3.27 | Zheng Chen | Revise Use Cases and Fundamental Assumption |
| 2019.3.28 | Zhi Zhou | Combine Learning Ducks’ Document |
| 2019.3.31 | Zhi Zhou | Combine Revision History |
| 2019.4.1 | Zheng Chen | Remove some parts of administrator’s adding and moving functions and use cases. |
| 2019.4.1 | Yuanjin Li | Modify the Output |
| 2019.4.1 | Yifan Zhang | Modify the Input |
| 2019.4.1 | Yifan Zhang | Add the Definitions |
| 2019.4.1 | Yuanjin Li | Modify the use cases |
| 2019.4.1 | Rui Xing, Shuihan Zhang, Yuru Wang, Rui Zhu, Shijie Wen | Editing use cases |
| 2019.4.2 | Zimu Hu | Combine Double Bloom’s Document |
| 2019.4.2 | Zhi Zhou | Combine Apostle’ s Document |

**1.  Introduction**

**1.1    Intended Audience and Purpose**

This document is intended to provided information guiding development process, ensuring that all system requirements are met. The following entities may find the document useful:

* Customer - This page will detail all of the web app requirements as understood by the production team. The customer should be able to determine that their requirements will be correctly reflected in the final product through the information found on this page.
* Development Team - Details of specific requirements that the final software build must include will be located here. Developers can use this document to ensure the software addresses each of these requirements.
* QA Team - By developing testing procedures founded in the system requirements, the QA Team can create a comprehensive testing regimen that will guarantee requirements are met.

**1.2    How to use the document**

Table of Contents:

1. Introduction

2. Concept of Operations - broad description of the purpose of the application

2.1 System Context - details any specific system requirements the application will require to run

2.2 System Capabilities - description in prose of all capabilities available to the user in the address book

2.3 Use cases - A detailed look at each functional requirement, describing the application context both before and after an action is taken

3. Behavioral Requirements - How the application will interact with a user

3.1 Input and output requirements - A description of allowed inputs and generated outputs

3.1.1 Input - Describes any restrictions that will be placed on allowed input

3.1.2 Output - Describes the range of outputs that can be generated

3.2 Detailed Output Behavior - Output descriptions in prose

4. Quality Requirements - Requirements not pertaining to the function of the application will be listed here

5. Expected Subsets - Expected levels of functionality at checkpoints during development

6. Fundamental Assumptions - Some specifics about input, output, or behavior upon which other requirements are founded will be listed here

7. Expected Changes - Future features and directions the project is expected to take

8. Appendices - Details aiding the understanding of this document

8.1 Definitions and acronyms - Any technical terms or abbreviations will be spelled out here for ease of use of the document

8.1 Definitions - Definitions of technical or unusual terminology

8.1.2 Acronyms and Abbreviations - Any abbreviated terms will be expanded here

8.2 References - any external references necessary or helpful to understanding this document will be listed here

**2. System Capabilities**

**2.1. System Context**

Requires a system with a GUI display and browser because all of the operations are performed through a GUI and a browser.

Windows:

* Windows 10 (8u51 and above)
* Windows 8.x (Desktop)
* Windows 7 SP1
* Windows Vista SP2
* Windows Server 2008 R2 SP1 (64-bit)
* Windows Server 2012 and 2012 R2 (64-bit)

Mac OS X:

* Intel-based Mac running Mac OS X 10.8.3+, 10.9+

Linux:

* Red Hat Enterprise Linux 5.5+1, 6.x (32-bit), 6.x (64-bit)2
* Red Hat Enterprise Linux 7.x (64-bit)2 (8u20 and above)
* Ubuntu Linux 12.04 LTS, 13.x
* Ubuntu Linux 14.x (8u25 and above)
* Ubuntu Linux 15.04 (8u45 and above)
* Ubuntu Linux 15.10 (8u65 and above)

**2.2. System capabilities**

Intelligent light control system Web APP is a web program that supports user interaction. On the web page, the user logins the account according to his personal ID and password, and then carries on the concrete operation to the intelligent light control system. Different kinds of users have different rights to intelligent light control system. There are three different permissions: students, teachers and administrators. The system functions are as follows:

1.User login. Users must be students, teachers or administrators of some schools.

2.Check the state of the light. All users have this permission.

3.Check whether a room is occupied. All three users have this permission.

4.Check the state of the light sensor. In this function, users can see the situation of ambient light.

5.Turn on/off the lights. Student users can only turn on the light when it is off and the classroom is occupied, and turn off the light when it is on and the classroom is empty. When the relevant operation cannot be carried out, a window will pop up to show the reasons: For example, *There are people in the classroom, so you cannot turn off the lights*. Teachers and administrators directly force the lights to be on/off. Students, teachers and administrators can operate the switch of a light or the main switch of all lights.

6.Add/delete new rooms. Administrators have this permission.

7.Add/delete sensors. Administrators have this permission. There are three kinds of sensors: switch sensor, light sensor and Presence sensor.

8.Add/delete actuators (lights). Administrators have this permission.

**2.3. Use cases for Customers**

#### 2.3.1 User login

|  |  |  |  |
| --- | --- | --- | --- |
| Use Case | user login | | |
| Version | 1.0 | Created | 3-23-19 |
| Author | Zheng Chen | | |
| Source | User stories | | |
| Purpose | User Login and go into the light system | | |
| Goals | User Go into the light system | | |
| Summary | Login by inputting account number, password and press login button. | | |
| Actors | user | | |
| Trigger | Inputting account number, password and press login button. | | |
| Precondition | None | | |
| Basic Flow | Actor | | System |
| 1 | User(student, teacher and administrator)input account number and password. | |  |
| 2 | User press login button | |  |
| 2 |  | | Login part of UI gets the account number and password. |
|  |  | | Login part of UI sends command, account number and password to server |
| 3 | user get the result of login. If login succeed, the homepage of user will be displayed. If login fails, a window will be poped out, “account or password is wrong" . | |  |
| Frequency |  | | |
| Type | Primary | | |
| Postconditions | The web page is displayed. | | |
| Chart |  | | |
| Alternate Flow | *Actor* | | System |
| 1 | User(student, teacher and administrator)  Register account | | Login part of UI will let you input account number, email and password and save it. |
| 2 | User forget password | | Login part of UI will let you input email and account number. And it will send a link to your email and let you change your password. |
| 3 |  | |  |

#### 2.3.2 Verify login

|  |  |  |  |
| --- | --- | --- | --- |
| Use Case | verify login | | |
| Version | 1.0 | Created | 3-23-19 |
| Author | Zheng Chen | | |
| Source | User stories | | |
| Purpose | verify login | | |
| Goals | server get login information, verify it and then go into the light system | | |
| Summary | Server get information and verify it. | | |
| Actors | server | | |
| Trigger | user press login button. | | |
| Precondition | None | | |
| Basic Flow | Actor | | System |
| 1 | command, account number and password to server | |  |
| 2 | Server returns back result of login. | |  |
| 3 |  | | UI displays the result of login. If login succeed, the homepage of user will be displayed. If login fails, a window will be poped out, “account or password is wrong" . |
| Frequency |  | | |
| Type | Primary | | |
| Postconditions | The web page is displayed. | | |
| Chart |  | | |
| Alternate Flow | *Actor* | | System |
| 1 | User(student, teacher and administrator)  Register account | | Login part of UI will let you input account number, email and password and save it. |
| 2 | User forget password | | Login part of UI will let you input email and account number. And it will send a link to your email and let you change your password. |
| 3 |  | |  |

#### 2.3.3 Check the state of lights or light sensors or check whether someone is in room

|  |  |  |  |
| --- | --- | --- | --- |
| Use Case | check the state of lights or light sensors or check whether someone is in room | | |
| Version | 1.0 | Created | 3-23-19 |
| Author | Zheng Chen | | |
| Source | User stories | | |
| Purpose | check the state of lights or light sensors or check whether someone is in room | | |
| Goals | check the state of lights or light sensors or check whether someone is in room | | |
| Summary | Check all states of lights and sensors and whether someone is in room by inputting room number and choosing teaching building. | | |
| Actors | user | | |
| Trigger | inputting room number and choosing teaching building | | |
| Precondition | Login and press “lights and sensors” | | |
| Basic Flow | Actor | | System |
| 1 | User inputs teaching building name and room number and press enter button. | |  |
| 2 |  | | To server: UI part will send account number, room number, teaching building and user’s current right. |
| 3 | The user check results. | |  |
| 4 |  | | If the user is an ordinary user(student or teacher), the server will return lights' and light sensors' information and whether someone is in room. If the user is an administrator, the server return lights' and light sensors' information, other sensors’ information and whether someone is in room. |
| Frequency |  | | |
| Type | Primary | | |
| Postconditions | The state of light are displayed. | | |
| Chart |  | | |
| Alternate Flow | *Actor* | | System |
| 1 |  | |  |

#### 2.3.4 Server checks

|  |  |  |  |
| --- | --- | --- | --- |
| Use Case | Server checks | | |
| Version | 1.0 | Created | 3-23-19 |
| Author | Zheng Chen | | |
| Source | User stories | | |
| Purpose | Server checks. | | |
| Goals | Server checks the state of lights or light sensors or check whether someone is in room | | |
| Summary | Server checks all states of lights and sensors and whether someone is in room | | |
| Actors | server | | |
| Trigger | UI sends check command to server | | |
| Precondition | Login and press “lights and sensors” | | |
| Basic Flow | Actor | | System |
| 1 | From UI : server gets account number, room number, teaching building and user’s current right. | |  |
| 2 |  | | Server return information for checking |
| 3 | If the user is an ordinary user(student or teacher), the server will return lights' and light sensors' information and whether someone is in room. If the user is an administrator, the server return lights' and light sensors' information, other sensors’ information and whether someone is in room | |  |
| Frequency |  | | |
| Type | Primary | | |
| Postconditions | The state of light are displayed. | | |
| Chart |  | | |
| Alternate Flow | *Actor* | | System |
| 1 |  | |  |

#### 2.3.5 User turns on/off

|  |  |  |  |
| --- | --- | --- | --- |
| Use Case | User Turn on/off | | |
| Version | 1.0 | Created | 3-23-19 |
| Author | Zheng Chen | | |
| Source | User stories | | |
| Purpose | User turns on/off the lights | | |
| Goals | User turns on/off the lights | | |
| Summary | User turns on/off the lights | | |
| Actors | user | | |
| Trigger | Choose room number and choose teaching building and choose lights. Finally press the  turn on/off button. | | |
| Precondition | Login and check | | |
| Basic Flow | Actor | | System |
| 1 | User presses turn on/off button | |  |
| 2 |  | | UI part will send teaching building name, room number, light name and command to server. |
| 3 |  | | Server return operation result |
| 4 | UI will display that the operation succeeded or failed . After that, UI will renew light state. | |  |
| Frequency |  | | |
| Type | Primary | | |
| Postconditions | The result is displayed. | | |
| Chart |  | | |
| Alternate Flow | *Actor* | | System |
| 1 |  | |  |

#### 2.3.6 Server turns on/off

|  |  |  |  |
| --- | --- | --- | --- |
| Use Case | Server turn on/off | | |
| Version | 1.0 | Created | 3-23-19 |
| Author | Zheng Chen | | |
| Source | User stories | | |
| Purpose | Server turns on/off the lights | | |
| Goals | Server turns on/off the lights | | |
| Summary | Server turns on/off the lights | | |
| Actors | user | | |
| Trigger | User presses the turn on/off button. | | |
| Precondition | Login and check | | |
| Basic Flow | Actor | | System |
| 1 | server gets teaching building name, room number, light name and command to server. | |  |
| 2 | Server return operation result | |  |
| 3 |  | | UI will display that the operation succeeded or failed . After that, UI will renew light state. |
| Frequency |  | | |
| Type | Primary | | |
| Postconditions | The result is displayed. | | |
| Chart |  | | |
| Alternate Flow | *Actor* | | System |
| 1 |  | |  |

#### 2.3.7 Hardware sends signals and gets command

|  |  |  |  |
| --- | --- | --- | --- |
| Use Case | hardware sends signals and gets command | | |
| Version | 1.0 | Created | 3-23-19 |
| Author | Zheng Chen | | |
| Source | User stories | | |
| Purpose | hardware sends signals and gets command | | |
| Goals | hardware sends signals and gets command | | |
| Summary | hardware sends signals and gets command | | |
| Actors | user | | |
| Trigger | Sensors send their data to communication module. | | |
| Precondition |  | | |
| Basic Flow | Actor | | System |
| 1 | Communication module verify connection to the server | |  |
| 2 |  | | Server will accept the connection and  tell communication module. |
| 3 | 3.1 Switch sensor tells communication module whether light was operated  or not.  3.2 Presence sensor send a picture to raspberry pi to communication module.  3.3 Light sensor send its state to communication module.  3.4 Light send its state to communication module. | |  |
| 4 |  | | 4.1 Communication module sends the switch sensor’s information and 0(not operated)/1(operated)signals toserver.  4.2 Communication module uses image recognition algorithm to judge whether someone is in room. And then it send 0(nobody) or 1(someone) signal and presence sensor's information to server.  4.3 Communication module send 0(bright) or 1(dark) signal and light sensor's information to server.  4.4 Communication module send 0(not bright) and 1 (bright) signal and light name to server. |
| 5 | light gets command from server. | |  |
|  |  | |  |
| Frequency |  | | |
| Type | Primary | | |
| Postconditions |  | | |
| Chart |  | | |
| Alternate Flow | *Actor* | | System |
| 1 |  | |  |

#### 2.3.8 Server gets signals from hardware

|  |  |  |  |
| --- | --- | --- | --- |
| Use Case | Server gets signals from hardware | | |
| Version | 1.0 | Created | 3-23-19 |
| Author | Zheng Chen | | |
| Source | User stories | | |
| Purpose | Server gets signals from hardware | | |
| Goals | Server gets signals from hardware | | |
| Summary | Server gets signals from hardware | | |
| Actors | user | | |
| Trigger | Sensors send their data to communication module. | | |
| Precondition |  | | |
| Basic Flow | Actor | | System |
| 1 | server verifies connection from hardware. | |  |
| 2 | 2.1 server gets the switch sensor’s information and 0(not operated)/1(operated)signals.  2.2 server gets send 0(nobody) or 1(someone) signal and presence sensor's information.  2.3 server gets 0(bright) or 1(dark) signal and light sensor's information.  2.4 Server gets 0(not bright) and 1 (bright) signal and light name. | |  |
| 3 | The Server decides whether the light should be on or not. | |  |
| 4 |  | | Communicatioin module sends command to lights. |
| Frequency |  | | |
| Type | Primary | | |
| Postconditions |  | | |
| Chart |  | | |
| Alternate Flow | *Actor* | | System |
| 1 |  | |  |

#### 2.3.9 User Wants to Quit the Application

|  |  |  |
| --- | --- | --- |
| Use Case | User Wants to Quit the Application | |
| Version | 1.0 | |
| Author | Rui Raposo, Hongfan Zhang | |
| Source | Directly from Portuguese teacher | |
| Purpose | Quit | |
| Goals | Close the application and save the username and password | |
| Summary | Save the username and password, and terminate the application | |
| Actors | User | |
| Trigger | User presses “back” twice in two seconds. | |
| Precondition | The application is open and running. | |
| Basic Flow | User | System |
| 1 | Press “back” twice in two seconds. |  |
| 2 |  | Save username and password. |
| 3 |  | Terminates itself. |
| Exception Flows |  |  |
| 2.2 | Forces the termination (by shutting down their machine, using Android's Force Quit, etc.). |  |
| 3.2 |  | Do nothing. |
| Postconditions | If a user explored a room, app should save this room for “rooms” interface. | |
| User case diagram |  | |

#### 2.3.10 User Wants to Look the List of Rooms

|  |  |  |
| --- | --- | --- |
| Use Case | User Wants to Look the List of Rooms | |
| Version | 1.0 | |
| Author | Rui Raposo, Hongfan Zhang | |
| Source | Directly from Portuguese teacher | |
| Purpose | Display the list of rooms in specific buildings. | |
| Goals | Show the list of rooms on application. | |
| Summary | Ask servers for information about rooms, and show the list of rooms on application. | |
| Actors | User | |
| Trigger | User click specific building in “buildings” tab. | |
| Precondition | The application is open and running. User is logged. | |
| Basic Flow | User | System |
| 1 | The user clicks specific rooms in “buildings” tab. |  |
| 2 |  | The application asks the server for a list of rooms. |
| 3 |  | The application displays the response of server in “rooms” tab. |
| Exception Flows |  |  |
| 2.2 | If application cannot get the list, a dialog prompts that “Cannot get the list of rooms in chosen building”. |  |
| 3.2 |  | Go to 1 |
| Postconditions | None | |
| User case diagram |  | |

#### 2.3.11 User Wants to Look the List of Sensors and Lights

|  |  |  |
| --- | --- | --- |
| Use Case | User Wants to Look the List of Sensors and Lights | |
| Version | 1.0 | |
| Author | Rui Raposo, Hongfan Zhang | |
| Source | Directly from Portuguese teacher | |
| Purpose | Display the list of sensors and lights in specific rooms. | |
| Goals | Show the list of sensors and lights on application. | |
| Summary | Ask servers for information about sensors and lights, and show the list of sensors and lights on application. | |
| Actors | User | |
| Trigger | User click specific rooms in “buildings” tab. | |
| Precondition | The application is open and running. User is logged. User has chosen a building. | |
| Basic Flow | User | System |
| 1 | The user clicks specific rooms in “rooms” tab. |  |
| 2 |  | The application asks the server for a list of sensors and lights. |
| 3 |  | The application displays the response of server. |
| Exception Flows |  |  |
| 2.2 | If application cannot get the list, a dialog prompts that “Cannot get the list of sensors and lights in chosen room”. |  |
| 3.2 |  | Go to 1 |
| Postconditions | None | |
| User case diagram |  | |

**2.4. Use cases of Server**

#### 2.4.1 Hardware connects to server

|  |  |  |  |
| --- | --- | --- | --- |
| Use Case  Case | Hardware connects to server. | | |
| Version | V1.0 | Created | *2019.3.25* |
| Author | Zhi Zhou | | |
| Source | Hardware | | |
| Purpose | Build connects between server and hardware. | | |
| Goals | Authenticate hardware’s identification and build connections. | | |
| Summary | Hardware raise a connecting request. After authenticating hardware’s identification, server will build the connection. | | |
| Actors | Hardware | | |
| Trigger | Hardware boot. | | |
| Precondition | Server is running | | |
| Basic Flow | *Actor* | | System |
| 1 | Raise a connecting request. | |  |
| 2 |  | | Authenticate hardware’s key. (Move to alternate flow 1 when error) |
| 3 |  | | Authenticate whether hardware is registered in the database. (Move to alternate flow 1 when error) |
| 4 |  | | Build connection with Hardware. |
| Frequency |  | | |
| Type | Primary | | |
| Postconditions | Connection is built. | | |
| Chart | /Users/wnjxyk/Desktop/2.4.1.png2.4.1 | | |
| Alternate Flow | *Actor* | | System |
| 1 |  | | Reject the connecting request. |

#### 2.4.2 Hardware reports data

|  |  |  |  |
| --- | --- | --- | --- |
| Use Case  Case | Hardware reports data | | |
| Version | V1.0 | Created | *2019.3.25* |
| Author | Zhi Zhou | | |
| Source | Hardware | | |
| Purpose | Report sensors’ data to server | | |
| Goals | Send data and live package to server. | | |
| Summary | Report sensors’ data to server. | | |
| Actors | Hardware | | |
| Trigger | Sensors’ data changed.  sS | | |
| Precondition | Connection is built. | | |
| Basic Flow | *Actor* | | System |
| 1 | Send sensors’ data to server through socket. (Move to alternate flow 1 when failed.) | |  |
| 2 |  | | Record the data in memory. |
| Frequency |  | | |
| Type | Primary | | |
| Postconditions | Data is sent. | | |
| Chart | /Users/wnjxyk/Desktop/2.4.2.png2.4.2 | | |
| Alternate Flow | *Actor* | | System |
| 1 | Try to reconnect. | |  |

#### 2.4.3 Client sends command

|  |  |  |  |
| --- | --- | --- | --- |
| Use Case  Case | Client sends command | | |
| Version | V1.0 | Created | *2019.3.25* |
| Author | Zhi Zhou | | |
| Source | Client | | |
| Purpose | Give hardware the command after handled by intelligence controller. | | |
| Goals | Gather necessary data for IC, send data to IC, get command from IC and send command to hardware. | | |
| Summary | Server give intelligence controller the command submitted by the client. And then send the result generated by the intelligence controller to hardware. | | |
| Actors | Client | | |
| Trigger | Client sends command | | |
| Precondition | Server and hardware is running | | |
| Basic Flow | *Actor* | | System |
| 1 | Send command to server. | |  |
| 2 |  | | Check user’s authority. (Move to alternate flow 1 when failed.) |
| 3 |  | | Check whether the target is online. (Move to alternate flow 2 when target is offline) |
| 4 |  | | Pack necessary and related data, and send them to intelligence controller with command. |
| 5 | Generate the command and return it to the server. | |  |
| 6 |  | | Send command to hardware. |
| Frequency |  | | |
| Type | Primary | | |
| Postconditions | Hardware executed the command. | | |
| Chart |  | | |
| Alternate Flow | *Actor* | | System |
| 1 |  | | Reject the command |
| 2 |  | | Tell client that the target is offline. |

#### 2.4.4 Client queries hardware’s information

|  |  |  |  |
| --- | --- | --- | --- |
| Use Case  Case | Client queries hardware’s information | | |
| Version | V1.0 | Created | *2019.3.25* |
| Author | Zhi Zhou | | |
| Source | Client | | |
| Purpose | Client got the hardware’s information. | | |
| Goals | Authenticate client’s identification and then client got the hardware’s information. | | |
| Summary | Client raises a query request. After authenticating user’s authority, server give client what it wants. | | |
| Actors | Client | | |
| Trigger | Client raises a request. | | |
| Precondition | Server is running | | |
| Basic Flow | *Actor* | | System |
| 1 | Raise a query request. | |  |
| 2 |  | | Authenticate user’s authority. (Move to alternate flow 1 when error) |
| 3 |  | | Report the data. |
| Frequency |  | | |
| Type | Primary | | |
| Postconditions | Client got the information. | | |
| Chart | /Users/wnjxyk/Desktop/2.4.4.png2.4.4 | | |
| Alternate Flow | *Actor* | | System |
| 1 |  | | Reject the query request. |

#### 2.4.5 Sensors’ data affect the hardware

|  |  |  |  |
| --- | --- | --- | --- |
| Use Case  Case | Sensors’ data affect the hardware | | |
| Version | V1.0 | Created | *2019.3.25* |
| Author | Zhi Zhou | | |
| Source | Intelligence Controller | | |
| Purpose | Hardware got the command. | | |
| Goals | Hardware got the command. | | |
| Summary | Server send intelligence controller’s command to hardware. | | |
| Actors | Server | | |
| Trigger | Service received hardware’s data. | | |
| Precondition | Server is running and hardware just reported its data. | | |
| Basic Flow | *Actor* | | System |
| 1 |  | | Pack necessary and related data, and send them to intelligence controller with command. |
| 2 | Generate the command and return it to the server. | |  |
| 3 |  | | Send command to hardware. |
| Frequency |  | | |
| Type | Primary | | |
| Postconditions | Hardware executed the command. | | |
| Chart | /Users/wnjxyk/Desktop/未命名文件.png未命名文件 | | |
| Alternate Flow | *Actor* | | System |

**2.5. Use cases of Intelligence Controller**

#### 2.5.1 Initialize the system

|  |  |  |  |
| --- | --- | --- | --- |
| Use Case | Initialize the system | | |
| Version | 1.0 | Created | *2019-4-1* |
| Author | Li Yuanjin | | |
| Source | Requirement | | |
| Purpose | Initialize the system | | |
| Goals | Make the system start to work | | |
| Summary | Server give a signal to make the system initialized. | | |
| Actors | Server | | |
| Trigger | Customer start the system | | |
| Precondition | None | | |
| Basic Flow | *Actor* | | System |
| 1 | Server give a package of the data to initialize the system | |  |
| 2 |  | | Initialization and give a reply |
| Frequency | Once. | | |  |
| Type | Primary | | |
| Postconditions | The project assignment is created | | |
| Chart |  | | |
| Alternate Flow | *Actor* | | System |

#### 2.5.2 Automatic mode

|  |  |  |  |
| --- | --- | --- | --- |
| Use Case | Automatic mode | | |
| Version | 2.0 | Created | *2019-4-1* |
| Author | Li Yuanjin | | |
| Source | Requirement | | |
| Purpose | Power saving intelligently | | |
| Goals | Control the status of the light | | |
| Summary | Automatically sets the state of the light. | | |
| Actors | Server | | |
| Trigger | None | | |
| Precondition | Automatic mode | | |
| Basic Flow | *Actor* | | System |
| 1 | Server give a package of the data | |  |
| 2 |  | | Judge the situation, check the priority and instruction and give the command |
| Frequency | 1 time in a minute | | |  |
| Type | Primary | | |
| Postconditions | The project assignment is created | | |
| Chart |  | | |
| Alternate Flow | *Actor* | | System |

#### 2.5.3 Command-light mode

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Use Case | | Command-light mode | | | | |
| Version | | 2.0 | | Created | *2019-3-31* | |
| Author | | Zhang Yifan | | | | |
| Source | | Requirement | | | | |
| Purpose | | Turn the light on or off correctly by instruction | | | | |
| Goals | | Change the status of the light or give the error report | | | | |
| Summary | | A user issues an instruction to change the light through the server, then the Intelligent Control System (our system) make a judgement and return the result. | | | | |
| Actors | | Server | | | | |
| Trigger | | Someone gives an instruction to change the status of the light. | | | | |
| Precondition | | None | | | | |
| Basic Flow | | *Actor* | | | System | |
| 1 | | Server: Send instruction to change the state  of the light | | |  | |
| 2 | |  | | | Check the priority and instruction and make a decision back to the server | |
| Frequency | | 2s | | | | |
| Type | | Primary | | | | |
| Postconditions | | The project assignment is created | | | | |
| Chart | |  | | | | |
| Alternate Flow | | *Actor* | | | System | |

#### 2.5.4 Time setting mode

|  |  |  |  |
| --- | --- | --- | --- |
| Use Case | Time setting mode | | |
| Version | 2.0 | Created | *2019-3-31* |
| Author | Zhang Yifan | | |
| Source | *Requirement* | | |
| Purpose | (The administrator) Set the time period that during these time slots our system will keep the light on or off all the time, until a teacher’s or administrator’s command change the state. | | |
| Goals | Set the time period | | |
| Summary | An administrator issues a command to change the time periods through the Server,  then the Intelligent Control System (our system) make a judgement and return the results or the reason why he can’t do it. | | |
| Actors | Server | | |
| Trigger | A command to change the time periods | | |
| Precondition | The command came from an administrator. | | |
| Basic Flow | *Actor* | | System |
| 1 | Server sends data to Intelligent Control | |  |
| 2 |  | | By checking the priority and instruction system make a decision and send it to Server |
| Frequency | 2s | | |
| Type | Primary | | |
| Postconditions | The project assignment is created | | |
| Chart |  | | |
| Alternate Flow | *Actor* | | System |

#### 2.5.5 Rules setting mode

|  |  |  |  |
| --- | --- | --- | --- |
| Use Case | Rules setting mode | | |
| Version | 2.0 | Created | *2019-3-31* |
| Author | Zhang Yifan | | |
| Source | Requirement | | |
| Purpose | (The administrator) Set the rules of our system, including priority and orders | | |
| Goals | Set the rules | | |
| Summary | A user issues a command to change the rules through the Server, then the  Intelligent Control System (our system) make a judgement and return the results or the reason why he can’t do it. | | |
| Actors | Server | | |
| Trigger | A command to set the rules. | | |
| Precondition | The command came from an administrator. | | |
| Basic Flow | *Actor* | | System |
| 1 | Server sends data to Intelligent Control System | |  |
| 2 |  | | By checking the priority and instruction system make a decision and send it to Server |
| Frequency | 2s | | |
| Type | Primary | | |
| Postconditions | The project assignment is created | | |
| Chart |  | | |
| Alternate Flow | *Actor* | | System |

**2.6 Use Cases of Database**

#### 2.6.1 Server Wants to Register an Account for End Users

|  |  |  |  |
| --- | --- | --- | --- |
| Use Case | *Server Wants to Register an Account for End Users* | | |
| Version | 1.0 | Created | *4-1-19* |
| Author | Rui Xing, Yuru Wang | | |
| Source | Customer | | |
| Goals | The server wants to register a non-existent account before. | | |
| Summary | The server wants to register a non-existent account before. And then the server calls the add account function. | | |
| Actors | Server | | |
| Trigger | The server calls the add account function. | | |
| Precondition | This account does not exist before registration; the application is open and running with a client book open. | | |
| Basic Flow | Actor | | System |
| 1 | The server calls the add account function, which provides the user's ID, name, identity, and new password. | |  |
| 2 |  | | The database adds personal information to the client table. |
| 3 |  | | Update other tables. |
| 4 |  | | Return the flag of success. |
| Frequency |  | | |
| Type | Primary | | |
| Postconditions | There is a new user in the client table. It is marked to be saved at the next save point. The user book is aware that it has been altered. | | |
| Chart |  | | |
| Alternate Flow | Actor | | System |
| 1 | The user decides to "cancel" the workflow. | |  |
| 1 |  | | The application returns to its initial state. |

#### 2.6.2 Server Wants to Delete a User Account

|  |  |  |  |
| --- | --- | --- | --- |
| Use Case | *Server Wants to Delete a User Account* | | |
| Version | 1.0 | Created | *4-1-19* |
| Author | Rui Xing, Yuru Wang | | |
| Source | Customer | | |
| Goals | The end user wants to register a new account and fill in his/her personal information. This information should be added to the database. | | |
| Summary | The end user wants to register a new account and fill in his/her personal information. This information should be added to the database. And the server calls the delete account function. | | |
| Actors | Server | | |
| Trigger | The server calls the delete account function. | | |
| Precondition | The server wants to delete an existing user account. The information should be deleted from the database. | | |
| Basic Flow | Actor | | System |
| 1 | The server calls the delete account function, which provides the user's ID. | |  |
| 2 |  | | Retrieve the database by ID number and find the corresponding table items. |
| 3 |  | | Delete the target table entry. |
| 4 |  | | Update other tables. |
| 5 |  | | Return the flag of success. |
| Frequency |  | | |
| Type | Primary | | |
| Postconditions | The database removes the user's information and the account no longer exists. | | |
| Chart |  | | |
| Alternate Flow | Actor | | System |
| 1 | The user chooses to "cancel" the process. | |  |
| 1 |  | | The user's personal information will not be removed from the database. |
| 2 | The user that be searched does not exist. | |  |
| 2 |  | | Return the flag of not exist. |

#### 2.6.3 Server Wants to Change a User’s Password

|  |  |  |  |
| --- | --- | --- | --- |
| Use Case | *Server Wants to Change a User’s Password* | | |
| Version | 1.0 | Created | *4-1-19* |
| Author | Rui Xing, Yuru Wang | | |
| Source | Customer | | |
| Goals | The server would like to change user’s password. | | |
| Summary | The server would like to change user’s password. And the server calls the change password function. | | |
| Actors | Server | | |
| Trigger | The server calls the change password function. | | |
| Precondition | The user has registered, that is, personal information and password already exist. | | |
| Basic Flow | Actor | | System |
| 1 | The server calls the change password function, which provides the user's ID and a new password. | |  |
| 2 |  | | The database looks up the corresponding table item according to the ID. |
| 3 |  | | The database saves the encrypted password into the password property. |
| 4 |  | | Update other tables. |
| 5 |  | | Return the flag of success. |
| Frequency |  | | |
| Type | Primary | | |
| Postconditions | If the user saves the change, the password will be changed and the next time the server searches his/her password, it will get a new password. | | |
| Chart |  | | |
| Alternate Flow | Actor | | System |
| 1 | The user chooses to "cancel" the process. | |  |
| 1 |  | | The database will keep the original password of current user. |
| 2 | The user that be searched does not exist. | |  |
| 2 |  | | Return the flag of not exist. |

#### 2.6.4 Server Wants Authentication of the User ID and Password

|  |  |  |  |
| --- | --- | --- | --- |
| Use Case | *Server Wants Authentication of the User ID and Password* | | |
| Version | 1.0 | Created | *4-1-19* |
| Author | Rui Xing, Yuru Wang | | |
| Source | Customer | | |
| Goals | The server would like to search for username and password. | | |
| Summary | The server would like to search for username and password. And the server calls the login authentication function. | | |
| Actors | Server | | |
| Trigger | The server calls the login authentication function | | |
| Precondition | The server transfers the user ID and password. | | |
| Basic Flow | *Actor* | | System |
| 1 | The server calls the login authentication function, which gives the user ID and password. | |  |
| 2 |  | | According to the user ID, database finds out corresponding user item. |
| 3 |  | | Determine whether the password is the same.  property. |
| 4 |  | | If the user ID and password are correct, return the flag of success. |
| Frequency |  | | |
| Type | Primary | | |
| Postconditions | The server receives the authentication result. | | |
| Chart |  | | |
| Alternate Flow | Actor | | System |
| 1 | The user that be searched does not exist. | |  |
| 1 |  | | Return the flag of not exist |
| 2 |  | | If the user ID and password are not correct, return the flag of error. |

#### 2.6.5 Server Wants to Add New Lights

|  |  |  |  |
| --- | --- | --- | --- |
| Use Case | *Server Wants to add new lights* | | |
| Version | 1.0 | Created | *4-1-19* |
| Author | Rui Zhu, Yuru Wang | | |
| Source | Customer | | |
| Goals | The server wants to add new lights to the list of lights he or she can control. | | |
| Summary | The server calls the corresponding add function and transmits the information about the bulb that needs to be added. The database service program adds the light bulb to the data. | | |
| Actors | Server | | |
| Trigger | The server calls the add light function. | | |
| Precondition | User is an administrator; the application is open and running with a light book open. | | |
| Basic Flow | Actor | | System |
| 1 | The server calls the add light function, which provides the light's ID, roomID, settime, and Life. | |  |
| 2 |  | | The database adds light information to the light table. |
| 3 |  | | Update other tables. |
| 4 |  | | Return the flag of success. |
| Frequency |  | | |
| Type | Primary | | |
| Postconditions | There is a new light in the light list. It is marked to be saved at the next save point. The light book is aware that it has been altered. | | |
| Chart |  | | |
| Alternate Flow | Actor | | System |
| 1 | The user decides to "cancel" the workflow. | |  |
| 1 |  | | The light book he or she controls return to the initial state. |

#### 2.6.6 Server Wants to Remove Lights from a Room

|  |  |  |  |
| --- | --- | --- | --- |
| Use Case | Server Wants to Remove Lights from a Room | | |
| Version | 1.0 | Created | *4-1-19* |
| Author | Rui Zhu, Yuru Wang | | |
| Source | Customer | | |
| Goals | The server would like to delete some lights from light table. | | |
| Summary | The server calls the corresponding delete function and transmits the information about the bulb that needs to be deleted. The database service program deletes the light bulb to the data. | | |
| Actors | Server | | |
| Trigger | The server calls the delete light function. | | |
| Precondition | User is an administrator; the application is open and running with a light book open. | | |
| Basic Flow | Actor | | System |
| 1 | The server calls the delete light function, which gives the light ID, room ID and user ID. | |  |
| 2 |  | | According to the user ID, database determines the current user’s attribute and judge whether he has the permission. |
| 3 |  | | According to the light ID and room ID, database finds out target light. |
| 4 |  | | Remove the target light. |
| 5 |  | | Update the other table. |
| 6 |  | | Return the flag of success. |
| Frequency |  | | |
| Type | Primary | | |
| Postconditions | The database removes the target light and return the flag of result. | | |
| Chart |  | | |
| Alternate Flow | Actor | | System |
| 1 | The current user has no authority to delete the light. | |  |
| 1 |  | | Return the flag of no permission. |
| 2 | The light that be searched does not exist. | |  |
| 2 |  | | Return the flag of not exist. |

#### 2.6.7 Server Wants to Add New Sensors

|  |  |  |  |
| --- | --- | --- | --- |
| Use Case | *Server Wants to add new sensors* | | |
| Version | 1.0 | Created | *4-1-19* |
| Author | Shijie Wen, Yuru Wang | | |
| Source | Customer | | |
| Goals | The server wants to add new sensors to the list of sensors he or she can control. | | |
| Summary | The server calls the add sensor function and transmits the information about the sensors that needs to be added. The database service program adds the sensor to the sensor-list in database. | | |
| Actors | Server | | |
| Trigger | The server calls the add sensor function. | | |
| Precondition | User is an administrator; the application is open and running with a sensor book open. | | |
| Basic Flow | Actor | | System |
| 1 | Server calls add sensor functions, which provide the light's ID, roomID, and type. | |  |
| 2 |  | | The database adds sensor information to the light table. |
| 3 |  | | Update other forms. |
| 4 |  | | Return the flag of success. |
| Frequency |  | | |
| Type | Primary | | |
| Postconditions | There is a new sensor in the sensor list. It is marked to be saved at the next save point. The sensor book is aware that it has been altered. | | |
| Chart |  | | |
| Alternate Flow | Actor | | System |
| 1 | The user decides to "cancel" the workflow. | |  |
| 1 |  | | The sensor books he or she controls return to the initial state. |

#### 2.6.8 Server Wants to Remove Sensors from a Room

|  |  |  |  |
| --- | --- | --- | --- |
| Use Case | *Server Wants to Remove Sensors from a Room* | | |
| Version | 1.0 | Created | *4-1-19* |
| Author | Shijie Wen, Yuru Wang | | |
| Source | Customer | | |
| Goals | The server would like to delete some sensors from sensor table. | | |
| Summary | The server calls the delete sensors function and transmits the information about the bulb that needs to be deleted. The database service program deletes the sensor bulb to the data. | | |
| Actors | Server | | |
| Trigger | The server calls the delete sensor function. | | |
| Precondition | User is an administrator; the application is open and running with a sensor book open. | | |
| Basic Flow | Actor | | System |
| 1 | The server calls the delete sensor function, which gives the sensor ID, room ID and user ID. | |  |
| 2 |  | | According to the user ID, database determines the current user’s attribute and judge whether he has the permission. |
| 3 |  | | According to the sensor ID and room ID, database finds out target sensor. |
| 4 |  | | Remove the target sensor. |
| 5 |  | | Update the other table. |
| 6 |  | | Return the flag of success. |
| Frequency |  | | |
| Type | Primary | | |
| Postconditions | The database removes the target sensor and return the flag of result. | | |
| Chart |  | | |
| Alternate Flow | Actor | | System |
| 1 | The current user has no authority to delete the sensor. | |  |
| 1 |  | | Return the flag of no permission. |
| 2 | The sensor that be searched does not exist. | |  |
| 2 |  | | Return the flag of not exist. |

#### 2.6.9 Server Wants to Add New Rooms

|  |  |  |  |
| --- | --- | --- | --- |
| Use Case | *Server Wants to add new rooms* | | |
| Version | 1.0 | Created | *4-1-19* |
| Author | Shijie Wen, Yuru Wang | | |
| Source | Customer | | |
| Goals | The server wants to add new rooms to the list of rooms he or she can control. | | |
| Summary | The server calls the add room function and transmits the information about the rooms that needs to be added. The database service program adds the room to the room-list in database. | | |
| Actors | Server | | |
| Trigger | The server calls the add room function. | | |
| Precondition | User is an administrator; the application is open and running with a room book open. | | |
| Basic Flow | Actor | | System |
| 1 | The server call adds the room function, which provides the roomID, Lightnum, and Sensornum. | |  |
| 2 |  | | The database adds the room information to the room table. |
| 3 |  | | Update other forms. |
| 4 |  | | Return the flag of success. |
| Frequency |  | | |
| Type | Primary | | |
| Postconditions | There is a new room in the room list. It is marked to be saved at the next save point. The room book is aware that it has been altered. | | |
| Chart |  | | |
| Alternate Flow | Actor | | System |
| 1 | The user decides to "cancel" the workflow. | |  |
| 1 |  | | The room books he or she controls return to the initial state. |

#### 2.6.10 Server Wants to Remove Existing Rooms

|  |  |  |  |
| --- | --- | --- | --- |
| Use Case | *Server Wants to Remove Existing Rooms* | | |
| Version | 1.0 | Created | *4-1-19* |
| Author | Shuihan Zhang, Yuru Wang | | |
| Source | Customer | | |
| Goals | The server would like to delete some rooms from room table. | | |
| Summary | The server wants to delete some rooms from room table. And then the server calls the delete room function. | | |
| Actors | Server | | |
| Trigger | The server calls the delete account function. | | |
| Precondition | The operator’s attribute is the administrator. | | |
| Basic Flow | Actor | | System |
| 1 | The server calls the delete room function, which gives the room ID and user ID. | |  |
| 2 |  | | The database determines the current user’s attribute and judge whether it can be deleted. |
| 3 |  | | Find out target room. |
| 4 |  | | Remove the target room. |
| 5 |  | | Update the other table. |
| 6 |  | | Return the flag of success. |
| Frequency |  | | |
| Type | Primary | | |
| Postconditions | The database removes the target room and return the flag of result. | | |
| Chart |  | | |
| Alternate Flow | Actor | | System |
| 1 | The user decides to "cancel" the process after deciding to remove the room. | |  |
| 1 |  | | The database terminates the current operation. |

#### 2.6.11 Server Wants to Change the User's Permissions

|  |  |  |  |
| --- | --- | --- | --- |
| Use Case | *Server Wants to Change the User's Permissions* | | |
| Version | 1.0 | Created | *4-1-19* |
| Author | Shuihan Zhang, YuruWang | | |
| Source | Customer | | |
| Goals | The server changes the user permissions. | | |
| Summary | The server wants to changes the user permissions. And then the server calls the change user identity function | | |
| Actors | Server | | |
| Trigger | The server calls the change user identity function | | |
| Precondition | Server makes a request to change the user's permissions. | | |
| Basic Flow | Actor | | System |
| 1 | The server calls the change user identity function, which provides the user ID and the modified identity. | |  |
| 2 |  | | Based on the user ID, the user is found in the client table. |
| 3 |  | | Modify the label attribute for this user. |
| 4 |  | | Return the flag of success. |
| Frequency |  | | |
| Type | Primary | | |
| Postconditions | The user is modified to specify permissions. | | |
| Chart |  | | |
| Alternate Flow | Actor | | System |
| 1 | The user decides to "cancel" the process after deciding to the operation of checking the number of people in the room. | |  |
| 1 |  | | The database terminates the current operation. |

#### 2.6.12 Server Wants to Add New Actuators

|  |  |  |  |
| --- | --- | --- | --- |
| Use Case | *Server Wants to Change the User's Permissions* | | |
| Version | 1.0 | Created | *4-1-19* |
| Author | Shuihan Zhang, YuruWang | | |
| Source | Customer | | |
| Goals | The server changes the user permissions. | | |
| Summary | The server wants to changes the user permissions. And then the server calls the change user identity function | | |
| Actors | Server | | |
| Trigger | The server calls the change user identity function | | |
| Precondition | Server makes a request to change the user's permissions. | | |
| Basic Flow | Actor | | System |
| 1 | The server calls the change user identity function, which provides the user ID and the modified identity. | |  |
| 2 |  | | Based on the user ID, the user is found in the client table. |
| 3 |  | | Modify the label attribute for this user. |
| 4 |  | | Return the flag of success. |
| Frequency |  | | |
| Type | Primary | | |
| Postconditions | The user is modified to specify permissions. | | |
| Chart |  | | |
| Alternate Flow | Actor | | System |
| 1 | The user decides to "cancel" the process after deciding to the operation of checking the number of people in the room. | |  |
| 1 |  | | The database terminates the current operation. |

#### 2.6.13 Server Wants to Remove Actuators from a Room

|  |  |  |  |
| --- | --- | --- | --- |
| Use Case | *Server Wants to Remove Existing Rooms* | | |
| Version | 1.0 | Created | *4-1-19* |
| Author | Shuihan Zhang, Yuru Wang | | |
| Source | Customer | | |
| Goals | The server would like to delete some actuators from actuator table. | | |
| Summary | The server wants to delete some actuators from actuator table. And then the server calls the delete actuator function. | | |
| Actors | Server | | |
| Trigger | The server calls the delete actuator function. | | |
| Precondition | The operator’s attribute is the administrator. | | |
| Basic Flow | Actor | | System |
| 1 | The server calls the delete actuator function, which gives the actuator ID, room ID and user ID. | |  |
| 2 |  | | The database determines the current user’s attribute and judge whether it can be deleted. |
| 3 |  | | Find out target actuator. |
| 4 |  | | Remove the target actuator. |
| 5 |  | | Update the other table. |
| 6 |  | | Return the flag of success. |
| Frequency |  | | |
| Type | Primary | | |
| Postconditions | The database removes the target actuator and return the flag of result. | | |
| Chart |  | | |
| Alternate Flow | Actor | | System |
| 1 | The current user has no authority to delete the actuator. | |  |
| 1 |  | | Return the flag of no permission. |
| 2 | The actuator that be searched does not exist. | | . |
| 2 |  | | Return the flag of not exist. |
| 3 | The user decides to "cancel" the process after deciding to remove the actuator. | | . |
| 3 |  | | The database terminates the current operation |

**2.7 Use Cases of Hardware**

#### 2.7.1 Sensors & Lights Wants to Send the Status

|  |  |  |
| --- | --- | --- |
| Use Case | Sensors & Lights Wants to Send the Status | |
| Version | 1.0 | |
| Author | Rui Raposo, Hongfan Zhang | |
| Source | Directly from Portuguese teacher | |
| Purpose | Send the Status | |
| Goals | Sensors & Lights send the status to client. | |
| Summary | Sensors & Lights send the status to client. | |
| Actors | Sensors & Lights | |
| Trigger | Sensors & Lights send the status to client per minute. | |
| Precondition | Sensors & Lights is connected with client. | |
| Basic Flow | Sensors & Lights | Client |
| 1 | Send status to client |  |
| 2 |  | Receive status. |
| Exception Flows |  |  |
| Postconditions | None | |
| User case diagram |  | |

**3.    Detailed Requirements**

**3.1 System Inputs and Outputs for Customers**

**3.1.1****Inputs for Web**

The input of the application comes from the user.

Login interface comes at the beginning. There are two text boxes to be entered, account number and password.

In the navigation bar, there are "home page", "lights", "Sensors", "rooms", "current user identity" and "user personal information". Click on "lights" and there will be two drop-down menus of "building name" and "room number", "enter" and "return to the previous page" buttons on the left side of the interface. After clicking "Enter", there are all the lights in the room on the right side of the interface, as well as the switch of the lights, the check of the lights (full selection, reverse selection), the status of the light sensor and the prompt information box of the room.

Input at login interface:

\* Account: must be made up of numbers. It can only be one of the teaching number, teacher's work number and administrator's ID number.

\* Password: 6-20 characters.

\* Login: Click on this button to enter the next interface with the correct account number and password.

Under "sensors", click on the Add button and enter the following:

\* Sensor types: Only one of three types can be selected from the drop-down menu.

Under "rooms", click the Add button and enter:

\* Room number: Input cannot conflict with an existing room number. And it is less than 5 legal numbers or letters.

Input in basic information:

\* Nickname: less than 20 characters

\* ID number: less than 10 digits

\* School: less than 30 characters

\* Professional: less than 20 characters

\* Class: less than 20 characters

"Modify password" input:

\* Old passwords: 6-20 characters

\* "New password": 6-20 characters.

**3.1.2 Outputs for Web**

Display graphical user interface. Each current interface contains all text boxes or interactive buttons created for users to enter.

Output to the user:

Login interface:

\* If the password or account is incorrect, a pop-up window will prompt "incorrect password or account".

Turn on the lights:

\* If the user is a student and the room is occupied, when the "turn on" button is pressed, a pop-up window will prompt "the room is occupied, the students can not turn off the lights at will". If the room is unoccupied, when the "turn off" button is pressed, a window will pop up to indicate that "the room is unoccupied", and students can not turn on the light at will. If the switch is checked, similar.

**3.1.3 Inputs for APP**

The input of the application comes from the user.

Login interface comes at the beginning. There are two text boxes to be entered, account number and password.

After logging in, the app will display building interface. In the bottom navigation bar, there are "buildings" "rooms", "user profile" and "current user identity". Click on these buttons will change to different interface. In "buildings", there is a list of buildings, including the building name. Click specific building will jump to the “rooms” interface where a list of rooms in this building is, including the building where these rooms are and the room number. After clicking a specific room, there are all the lights’ names/numbers in the room on the left side of the interface, while the switches of the lights display on the right side of the interface (switch shows the status of lights). At the bottom of this list, there are all sensors and their status.

Input at login interface:

* Username: 8-20 characters and cannot contains space.
* Password: 6-20 characters.
* Login button: Click on this button to verify username and password and jump to the next interface with the correct account number and password.

**3.1.4 Outputs for APP**

Android app uses UI interface to interact with user.

Login interface:

If the username and password is not matched, a pop-up window will prompt "Username and password don’t match".

**3.2 Detailed Output Behavior for Customers**

**3.2.1 For Web**

Login interface comes at the beginning. There are two text boxes to be entered, account number and password.

In the navigation bar, there are "home page", "lights", "Sensors", "rooms", "current user identity" and "user personal information". Click on "lights" and there will be two drop-down menus of "building name" and "room number", "enter" and "return to the previous page" buttons on the left side of the interface. After clicking "Enter", there are all the lights in the room on the right side of the interface, as well as the switch of the lights, the check of the lights (full selection, reverse selection), the status of the light sensor and the prompt information box of the room. From the administrator's perspective, there is a red remove button next to each light, and a green new one light button in the right place. The lower right corner of the interface has remove ticks.

Click on "sensors" and there will be two drop-down menus of "building name" and "room number", "enter" and "return to the previous page" buttons on the left side of the interface. Click "Confirm" and all the sensors and their status will appear on the right side of the interface.

Click on "rooms" and there will be a drop-down menu of "teaching building name", "confirmation" and "return to the previous page" buttons on the left side of the interface. Click on the "Confirm" button and all the room numbers in this building will appear on the right side of the interface.

Click on "User Personal Information" and the buttons "Basic Information" and "Modify Password" appear on the left side of the interface. After clicking on the "basic information", there will be "nickname", "ID number", "school", "major" and "class" on the right side of the interface, as well as a "confirm modification" button. Click "Modify Password" and the text box of "New Password" and "Old Password" will appear on the right side of the interface, and the button "Confirm Modification" will appear.

**3.2.2 For APP**

The input of the application comes from the user.

Login interface comes at the beginning. There are two text boxes to be entered, account number and password.

After logging in, the app will display building interface. In the bottom navigation bar, there are "buildings" "rooms", "user profile" and "current user roles". Click on these buttons will change to different interface. In "buildings", there is a list of buildings, including the building name. Click specific building will jump to the “rooms” interface where a list of rooms in this building is, including the building where these rooms are and the room number. After clicking a specific room, there are all the lights’ names/numbers in the room on the left side of the interface, while the switches of the lights display on the right side of the interface (switch shows the status of lights). At the bottom of this list, there are all sensors and their status.

If click “rooms” directly, app will jump to last rooms edited/explored by user previously.

“user profile” interface will display username, nickname, name, a “change password” button and a “log out” button.

“current user roles” is a textbox and should display user’s role. This textbox is disabled.

**3.4 System Inputs and Outputs for Developer**

**3.4.1 Inputs**

The inputs send to the server when client queries hardware’s data should be in the form of json which content is:

uid: The user’s unique identification.

sid: User’s secure ID.

hid: The hardware’s unique identification.

The inputs send to the server when client want to operate a hardware should be in the form of json which content is:

uid: The user’s unique identification.

sid: User’s secure ID.

hid: The hardware’s unique identification.

cmd: The command client sent.

The inputs send to server when hardware want to report their data should be in the form of json which content is:

data: The data which sensor want to report.

The inputs send to server when intelligence controller generated command should be in the form of json which content is:

data: The command that intelligence controller generated.

ROOM{

\*Room\_id: the id of the room

\*Light state{

\*State: it can be a boolean type, whose value is true or false. True means that it is on now, while false means the opposite.

...

}

\*Sensor state{

\*kind: it is a string type, has three values, {motion, light, button}

\*online: it is a boolean type.

\*value: It is a numerical type.

}

};

Instruction{

\*User\_priority: it is a numerical type and means user’s priority

\*Instruction\_type: the instruction has four kinds, { auto, instruction, time, rules}.

\*Extra\_information: set time period or make rules.

};

Extra\_information{

\*Data\_about\_time: .....

\*Data\_about\_rule: ......

\*Data\_about\_priority: ......

} ;

The input to the database comes from the server. The input to the database comes from the server. There are 5 tables in the database, namely client table, light table, sensor table, room table and actuator table. The input requirements for each attribute of each table are as follows.

|  |  |  |
| --- | --- | --- |
| Name | Type | Explanation |
| UID | int[1] | UID is the user's account number, which is an integer less than max\_int. |
| name | char[20] | name is a string of up to 20 lengths representing the user name |
| password | char[50] | The password is to save the password of each user. It should be encrypted. |
| label | int[1] | label saves the attribute identification of each user, indicating that he is a student, teacher, or administrator account. |
| LID | int[1] | LID is the light's number in a room, which is an integer less than max\_int. |
| roomID | int[1] | roomID should be generated when adding rooms. They cannot be modified and they are different. |
| State | int[1] | State is an integer that holds the state of the lamp on, off, or damaged |
| Settime | string | SetTime represents the installation time of the bulb, which should be a string limited to yyyy-mm-dd format |
| Life | int[1] | Life is an integer representing the life of a light bulb in hours |
| SID | int[1] | SID is the number of sensor, which is an integer less than max\_int. |
| Type | int[1] | Type is an integer describing the type of sensor |
| Lightnum | int[1] | Lightnum is an integer describing the number of bulbs in a room |
| sensornum | int[1] | sensornum is an integer describing the number of sensors in a room |
| AID | int[1] | AID is the number of actuator, which is an integer less than max\_int. |

**3.4.2 Outputs**

The outputs send to intelligence controller from server when something need to do with hardware should be in the form of json which content is:

sensors: The list of sensors with their up-to-date data.

device: The device and its up-to-date data.

cmd: The command (Leave blank if there is no command existed.)

authority: The level of operator.

The outputs send to client when server report hardware’s information should be in the form of json which content is:

hid: The hardware’s unique identification.

online: Whether the hardware is online.

nickname: The nickname of hardware.

last: The timestamp of last update.

data: The hardware’s data.

The outputs send to hardware when server send command should be in the form of json which content is:

data: The command.

The outputs send to the Server.

\*Result: There outputs required, there are {value, room, hint}.

{

\*value: it is a string type whose value is in set:{“open”, “close”, “null”, “exception”} . “open” means turn on the light, “close” means turn off the light, “null” means do nothing and “exception” means don’t change the light and send some error information to the Server.

\*room: it is a numerical type that means the result for which room.

\*hint: it is a string type, the content is for explaining the result when intelligent control system reject the command.

}

The output of the database is provided to the server. The following table specifies the specific form of the output that will be provided to the server.

|  |  |  |
| --- | --- | --- |
| Name | Type | Explanation |
| UID | Int[1] | UID is the user's account number, which is an integer less than max\_int. |
| name | Char[20] | name is a string of up to 20 lengths representing the user name |
| password | Char[50] | The password is to save the password of each user. It should be encrypted. |
| label | Int[1] | label saves the attribute identification of each user, indicating that he is a student, teacher, or administrator account. |
| LID | Int[1] | LID is the light's number in a room, which is an integer less than max\_int. |
| roomID | Int[1] | roomID should be generated when adding rooms. They cannot be modified and they are different. |
| State | Int[1] | State is an integer that holds the state of the lamp on, off, or damaged |
| Settime | string | SetTime represents the installation time of the bulb, which should be a string limited to yyyy-mm-dd format |
| Life | Int[1] | Life is an integer representing the life of a light bulb in hours |
| SID | Int[1] | SID is the number of sensor, which is an integer less than max\_int. |
| Type | Int[1] | Type is an integer describing the type of sensor |
| Lightnum | Int[1] | Lightnum is an integer describing the number of bulbs in a room |
| sensornum | Int[1] | sensornum is an integer describing the number of sensors in a room |
| AID | Int[1] | AID is the number of actuator, which is an integer less than max\_int. |
| Flag | Bool[1] | Flag is a flag indicating whether the operation on the database is successful |

**3.5 Detailed Output Behavior for Developer**

The database provides various access interfaces to the server. This section details the capabilities of these interfaces and their possible output formats.

* Function1: query the corresponding account information according to the user UID

Query the client-database with UID as the primary key.

1. If the user of UID does not exist in the database, return null.

2. If the user exists, return the output value.

* Function2: query the light information according to LID and roomID

Query the light-database with LID and roomID as the primary key.

1. If the light of SID does not exist in the database, return null.

2. If the light exists, return the output value.

* Function3: query light information in a room through roomID

Query the information of all the bulbs in the database whose room number equals the query value

1. If no light bulb has the same room number as the query value, return empty.

2. In other cases, list all light bulb information with room number equal to query value.

* Function4: query the sensor information according to the sensor SID

Query the sensor-database with SID as the primary key.

1. If the sensor of SID does not exist in the database, return null.

2. If the sensor exists, return the output value.

* Function5: query sensor information in a room through roomID

Query the information of all the bulbs in the database whose room number equals the query value

1. If no sensor with room number equal to the query value is found in the database, return empty

2. In other cases, list all sensors information with room number equal to query value.

* Function6: query room information by roomID

Query the room-database with roomID as the primary key.

1. If the user of rommID does not exist in the database, return null.

2. If the user exists, return the output value.

* Function7: list all the rooms

input: no iuput

output: roomID(int[1]), lightnum(int[1]), sensornum(int[1])

Detailed output：

Traverse the room database and output all information.

1. If the database is empty, return null.

2. Output all information of the room database.

* Function8: query the sensor information based on the actuator AID

Query the actuator with AID as the primary key.

1. If the actuator of AID does not exist in the database, return null.

2. If the driver exists, return the output value.

* Function9: add/remove/modify a light

First use the roomID as the primary key to query the room-database, and then use the roomID and the LID as the primary key to query the light-database.

1.If the room dose not exist, the flag is false.

2.If the LID in the room has exist, the flag is false.

3. Else the flag is true

* Function10: add/delete/modify a room

Query the room-database with roomID as the primary key.

1.If the roomID has already exist ，the flag is false.

2 Else the flag is true

* Fuction11: add/remove/modify a sensor

First use the roomID as the primary key to query the room-database, and then use the room number and the SID as the primary key to query the light-database.

1.If the room does not exist, the flag is false.

2. If the SID in the room has exist, the flag is false.

3. Else the flag is true.

* Fuction12: add/delete/modify an actuator

First use the roomID as the primary key to query the room-database, and then use the room number and the AID as the primary key to query the light-database.

1. If the room does not exist, the flag is false.

2. If the AID in the room has exist, the flag is false.

3. Else the flag is true.

* Fuction13: add/delete/modify a user

input: SID(int[1]), roomID(int[1])

output: flag(bool[1])

Detailed output：

1. If the UID has already exist, the flag is false.

2. In other condition, the flag is true.

**4   Quality Requirements (Non-functional Requirements)**

The system must show good behavior in many fields like Performance, Security, Availability, Reliability, Modifiability, Maintainability, Understandability.  
Interface aesthetics:

Simple, comfortable and elegant.

Performance:

The system can respond the users’ operation in less than 500ms

The hardware can respond the command in less than 1000ms

Security:

The system must have different authority. The administrator’s jurisdiction must not be used by any other users.

Availability:

The user’s operation must be judged strictly by control part. Every situation must have a solution even if the user has a wrong operation.

Reliability:

The system must be anti-interference. When some signal comes in a wrong way, the system should recognize it and give the respond.

Modifiability:

The system can be changed. When users need some new functions, we can add up them into the system.

Maintainability:

The system has to easily to be fixed. If some parts get wrong, it can easily to find some other things to take place.

Understandability:

The system must be easy for users. The UI and specification have to be good for users.

**5. Expected Subsets**

L0:

- Basic GUI.

- Users can log in. Ability to send data to back-end storage and call data from back-end storage.

L1:

- Better GUI

- Ability to add/remove actuators (lights). Administrators have this permission.

- Ability to add/delete new rooms. Administrators have this permission.

- Ability to add/remove sensors.

L2:

- Complete GUI for Intelligent Lighting Control

- Ability to see the status of the light. All three users have this permission.

- Check if a room is occupied. All three users have this permission.

- Ability to check the status of the light sensor. All three users have this permission.

- Ability to turn on/off the light. All three users have this right.

**6.   Fundamental Assumptions**

Hardware: Raspberry pi 3B+, Camera, Light sensor, Light.

Software: Linux operating system，Python 3.6

**7.    Expected Changes**

* Add light history analysis function.
* Add monitor function.
* Adjust the brightness of the light
* Personal Web Pages for Skin Change
* Provide personalized web customization
* Provide hotline for maintenance personnel.
* Provide multilingual support.
* Retrievable password and change password at any time
* Support binding mobile phone number and login by phone number.

**8.    Appendices**

**8.1    Definitions and acronyms**

**8.1.1    Definitions**

|  |  |
| --- | --- |
| **Keyword** | **Definitions** |
| Raspberry Pi | A portable single-board computer |
|  |  |
|  |  |
|  |  |

**8.1.2    Acronyms and abbreviations**

|  |  |
| --- | --- |
| **Acronym or**  **Abbreviation** | **Definitions** |
| GUI | Graphical User Interface |
| IC | Intelligence controller |
|  |  |

**8.2    References**