**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’ Documents |
| 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. |

**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 |  | |  |

**2.4. Use cases for Developer**

#### 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/Downloads/2.1.1.png2.1.1 | | |
| 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/未命名文件.png未命名文件 | | |
| 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 | /Users/wnjxyk/Desktop/未命名文件.png未命名文件 | | |
| 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/未命名文件.png未命名文件 | | |
| 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 |

**3.    Detailed Requirements**

**3.1 System Inputs and Outputs for Customers**

**3.1.1****Inputs**

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**

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.

**3.2 Detailed Output Behavior for Customers**

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.

**3.4 System Inputs and Outputs for Customers**

**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.

**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.

**3.5 Detailed Output Behavior for Developer**

**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**