Software Requirements Specification (SRS)

批注 [PS1]: All teams: good work!
I have in here some comments that in my opinion you all should think about it while implementing the next stages of the project!

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	Adding use case

	Zhu, Shijie Wen	
2019.3.23	Shijie Wen	Editing detailed requirements
2019.3.23	Zhang Hongfan	Introduction Concept of Operation
2019.3.23	Zhang Hongfan	Behavioral Requirements Expected subsets Quality Requirements Fundamental Assumptions Expected Changes
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
2019.3.25	Zhang Hongfan Rui Raposo	User Case
2019.3.26	Zhang Hongfan Rui Raposo	User Case
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
2019.3.30	Zhang Hongfan, Rui Raposo	User Case
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
2019.4.1	Hongfan Zhang	Update User Case Di agrams
2019.4.2	Zimu Hu	Combine Double Bloom's Document
2019.4.2	Zhi Zhou	Combine Apostle' s Document
2019.4.3	Zheng Chen, Pedro	Revise Use Case for Customers and hardware.
2019.4.3	Zhi Zhou	Add catalogue and update user case of server.
2019.4.8	Zheng Chen	Revise System Context, Use Case for Customers and hardware and Revise System Input for Web App.

Catalogue

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.

批注 [PS2]: NC: Web and Android, right?

批注 [ZR3]: Yes.

1.2 How to use the document

Table of Contents:

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.

The Web APP can run on browsers which are chrome or firefox.

The Android APP can run on Android 4.0+.

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.

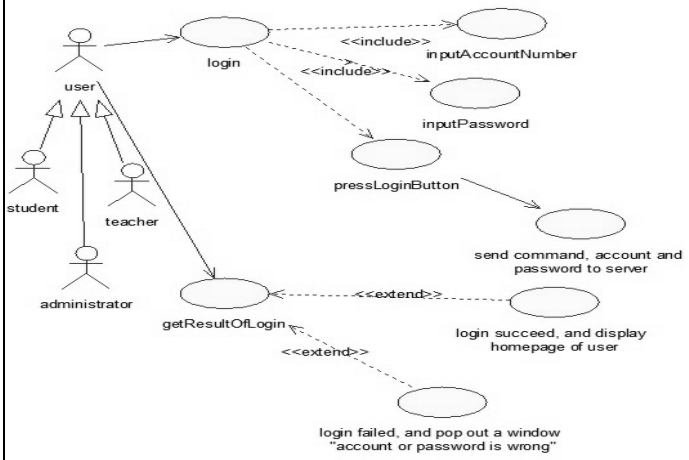
6.Add/delete new rooms. Administrators have this permission.

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.

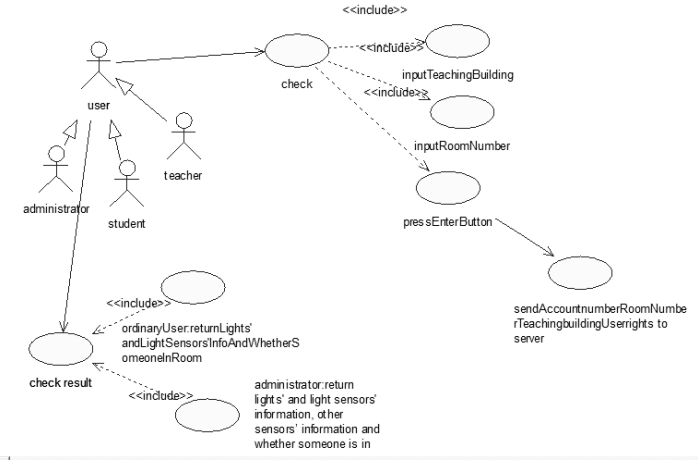
2.3. Use cases for Customers

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		
3			system will process the answer from the server. If the login was successful the user will be sent to his homepage for web app or home screen for android app, otherwise the system will alert the user that his password or account is not correct.
4	User will get into the homepage or home screen, or will get the alert for wrong		
Frequency			
Type	Primary		
Postconditions	The web page is displayed.		
Chart			
Alternate Flow	*Actor*		System

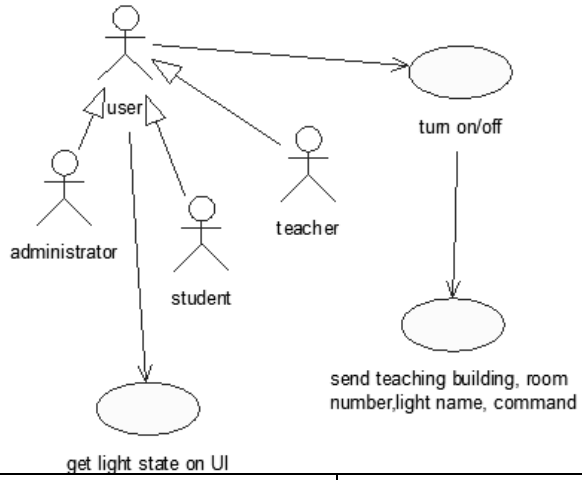
2.3.2 User checks the state of lights or light sensors or checks whether someone is in room.

Use Case	User checks the state of lights or light sensors or checks 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 choosing room number and choosing teaching building.		
Actors	user		
Trigger	choosing room number and choosing teaching building		
Precondition	Login and press “lights and sensors”		
Basic Flow	Actor		System
1	User chooses teaching building name and room number from the drop-down lists and presses *enter* button.		
2			To server: UI part will send account number, room number, teaching building and checking command.
3	The user checks results.		
4			The server returns lights' and light sensors' information, switch sensors and presence sensors’ information and whether someone is in room.
Frequency			
Type	Primary		
Postconditions	The check results of light are displayed.		

Chart		
Alternate Flow	*Actor*	System

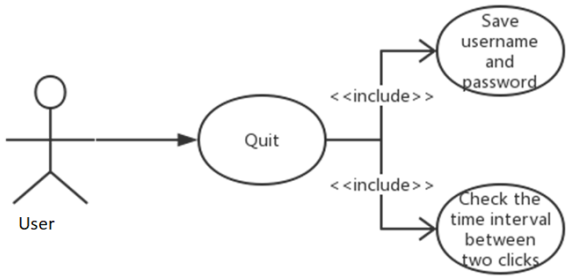
2.3.3 User turns on/off the lights.

Use Case	User Turn on/off the lights		
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	User press the turn on/off button.		
Precondition	User logins and chooses room number and choose teaching building and choose lights.		
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		
Frequency			
Type	Primary		
Postconditions	The result is displayed.		

Chart		
Alternate Flow	*Actor*	System

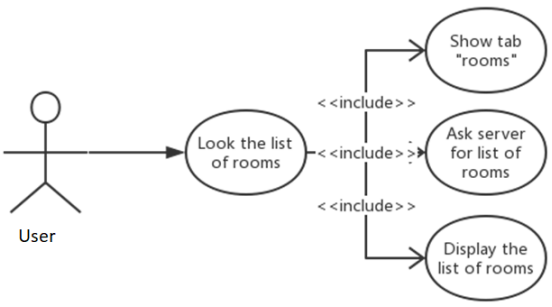
2.3.4 User Wants to Quit the Application

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	User forces shutdown (by shutting down his 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	

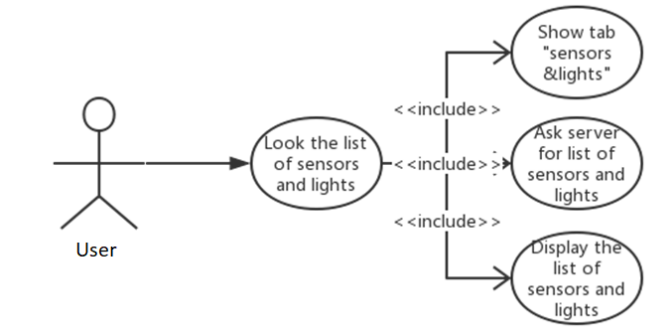
2.3.5 User Wants to Browse the List of Rooms

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	

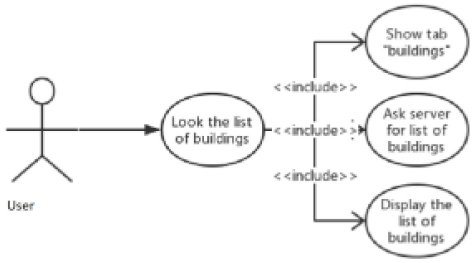
2.3.6 User Wants to Browse the List of Sensors and Lights

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 “rooms” 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	

2.3.7: User Wants to Browse the List of Buildings

Use Case	User Wants to Look the List of Buildings	
Version	1.0	
Author	Rui Raposo, Hongfan Zhang	
Source	Directly from Portuguese teacher	
Purpose	Display the list of buildings.	
Goals	Show the list of buildings on application.	
Summary	Ask servers for information about buildings, and show the list of buildings on application.	
Actors	User	
Trigger	User log in or click “buildings” tab.	
Precondition	The application is open and running. User is logged.	
Basic Flow	User	System
1	The user clicks on the tab “Buildings”.	
2		The application asks the server for a list of buildings.
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 building”.	
3.2		Go to 1
Postconditions	None	

User case diagram	

2.4. Use cases of Server

This section is written for developer who wants to know the functions of server.

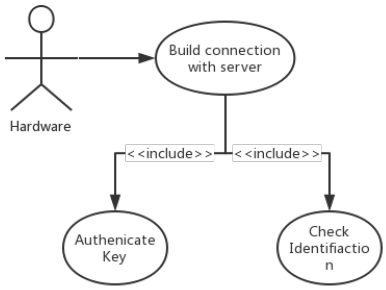
2.4.1 Hardware connects to server

Use 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.	

批注 [PS4]: Server team, Web App Team, Android APP Team and Database Team, do not forget in the next stages of the project that:
- Actions in the Android APP must have the corresponding actions in the server part. For example: For the android client to be able to login you must have that service in the server;
- Actions in the server must have the corresponding part in the database. For example, when the Android APP requests the server to login a user, the sever must ask the database;
- Actions in the web app (that are the same as in the Android APP) must have the corresponding part in the database.

批注 [ZR5]: Agreed.

批注 [PS6]: If webservices are used (see the comments in 2.4.2) this will happen every time the hardware sends sensor data.

Chart		
Alternate Flow	*Actor*	System
1		Reject the connecting request.

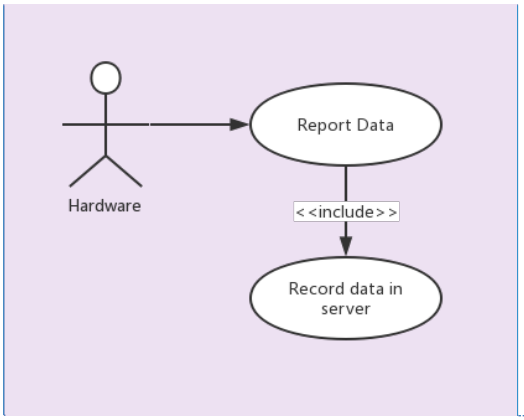
2.4.2 Hardware reports data

Use 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.	
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。
Frequency		
Type	Primary	
Postconditions	Data is sent.	

批注 [PS7]: Using plain sockets, you will have to deal with: setting up high-level protocols and threads. If you use web services and an already existing web server, such as Apache, you only have to deal with the application logic.

批注 [PS8]: And will have a more standard solution.

批注 [ZR9]: We should have think about that.

Chart		
Alternate Flow	*Actor*	System
1	Try to reconnect per 5 sec.	

批注 [PS10]: Missing sent to Intelligent Controller? "Record data in server" is store in DB?

批注 [ZR11]: The answer on the last class was yes. I do not know the current status.

批注 [PS12]: For how long? Can't be trying to reconnect forever.

2.4.3 Client sends command

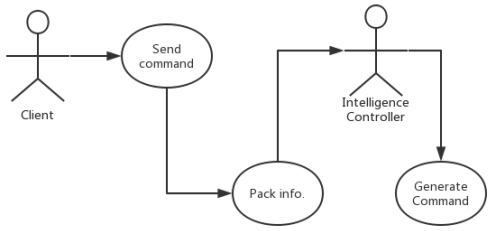
批注 [PS13]: Client asks for light state?

批注 [PS14]: In need a clarification about this. This use case is used when the hardware that commands the light asks the server if light must be turned on or off?

批注 [ZR15]: Not exactly, as it's a precondition of the command execution.

批注 [PS16]: Or is when the hardware sends the sensor data to the server?

Use 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 are 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	

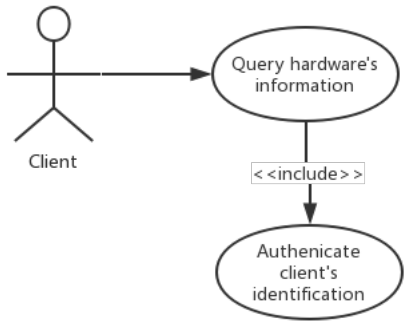
Postconditions	Hardware executed the command.	
Chart		
Alternate Flow	*Actor*	System
1		Reject the command
2		Tell client that the target is offline.

2.4.4 Client queries hardware's information

Use Case	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.	

批注 **[PS17]:** NC: what type of information?

批注 **[ZR18]:** We may need to list the type of information here for the customer.

Chart		
Alternate Flow	*Actor*	System
1		Reject the query request.

2.4.5 Sensors' data affect the hardware

Use Case	Sensors' data affect the hardware	
Version	V1.0 Created	*2019.3.25*
Author	Zhi Zhou	
Source	Hardware	
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.	

批注 [PS19]: Unless all IP addresses of the hardware are public (which will not be the case), or you keep a connection open between server and all hardware nodes (which is not feasible if you have many nodes), you should have the hardware querying the server and not the server pushing data to the client.

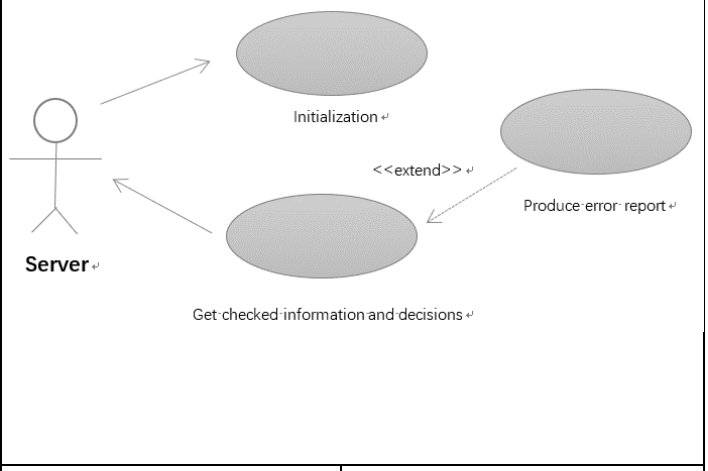
Chart		
Alternate Flow	*Actor*	System

2.5. Use cases of Intelligent Controller

This section is written for developer who wants to know the functions of intelligent 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 sends a package of info	
2		IC verifies the situation, checks the priority and ruls, then sends the command to server (hardware ID included?)
Frequency	1 time in a minute	
Type	Primary	
Postconditions	The project assignment is created	

批注 [ZR20]: More clarifications needed.

删除的内容: give

删除的内容: the data

带格式表格

删除的内容: Judge

批注 [PS21]: Because commands cannot be sent to the light directly (lights must ask for their state), "give the command" means that the new state of the light is stored in memory or database?

批注 [PS22]: If this means that the command to turn on or off the lights are sent to the server, then see the comments in the previous use cases.

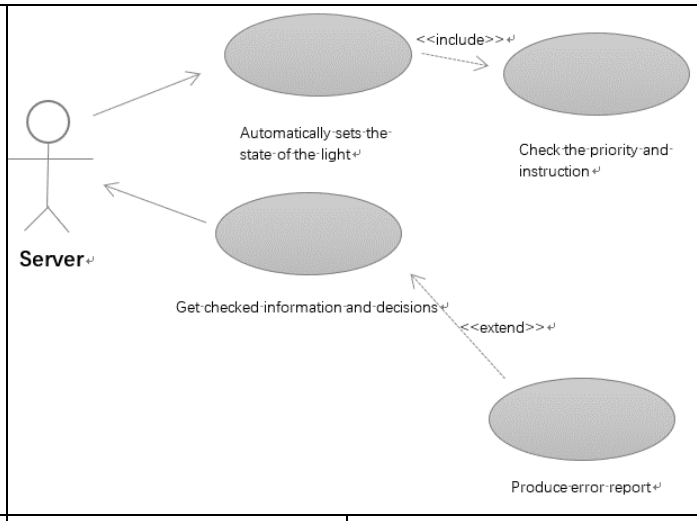
删除的内容: instruction

删除的内容: and give

批注 [PS23]: NC: why this time?

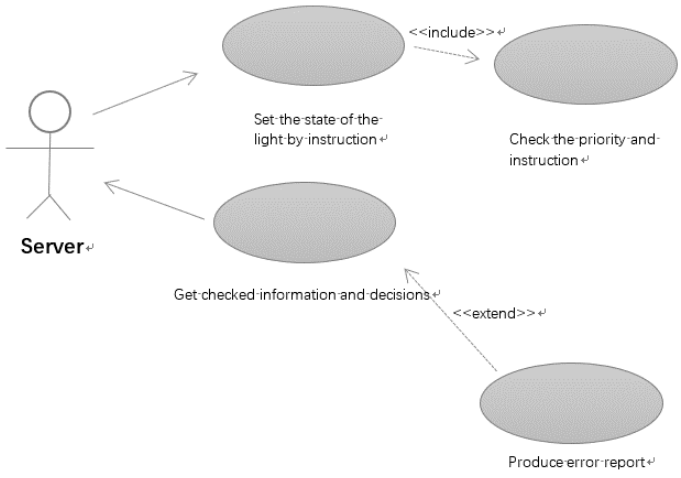
批注 [PS24]: ?

批注 [ZR25]: Should be deleted from the template.

Chart		
Alternate Flow	*Actor*	System

2.5.3 Command-light mode

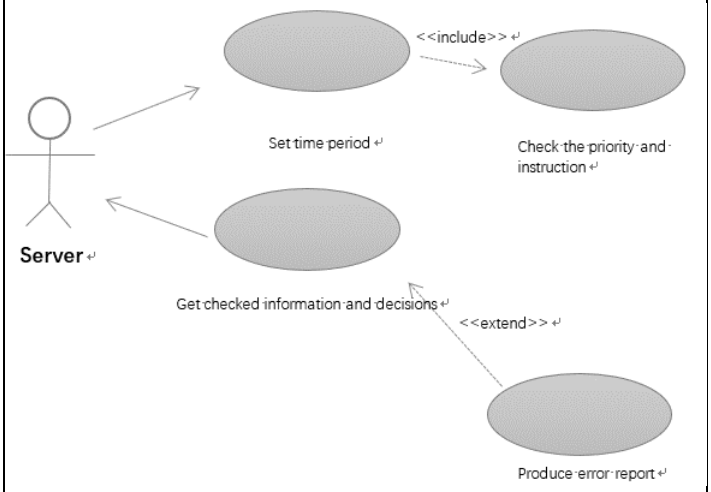
Use Case	Command-light mode	
Version	2.0 Created	*2019-3-31*
Author	Zhang Yifan	
Source	Requirement	
Purpose	Turn the light on or off correctly by instruction	
Goals	Change the status of the light or give the error report	
Summary	A user issues an instruction to change the light through the server, then 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

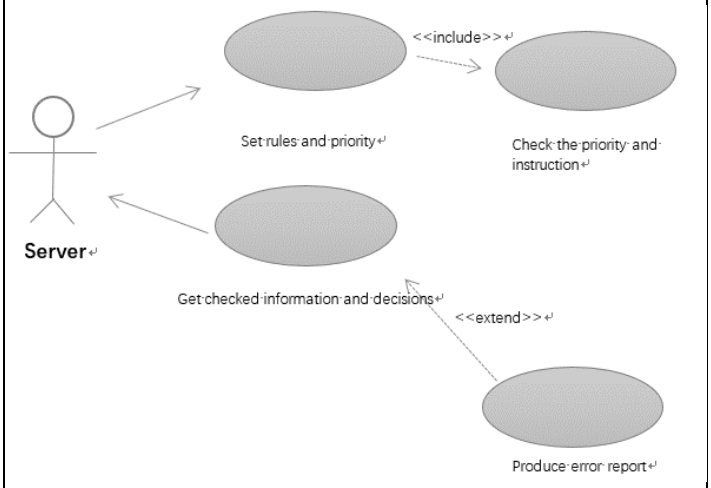
Use Case	Time setting mode	
Version	2.0 Created	*2019-3-31*
Author	Zhang Yifan	
Source	*Requirement*	
Purpose	(The administrator) Set the time period that during these time slots our system will keep the light on or off all the time, until a teacher's or administrator's command change the state.	
Goals	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	

批注 [ZR26]: Attention that the dates are not of the same format.

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	

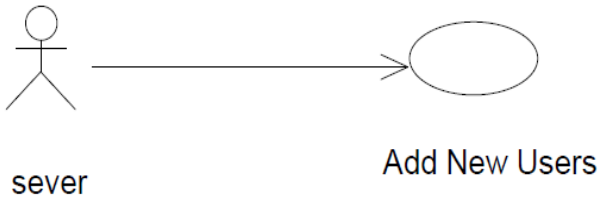
Chart		
Alternate Flow	*Actor*	System

2.6 Use Cases of Database

This section is written for developer who wants to know the functions of database.

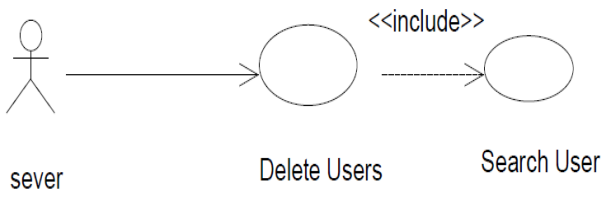
2.6.1 Server Wants to Register an Account for End Users

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,	
2		The database adds personal information to
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.

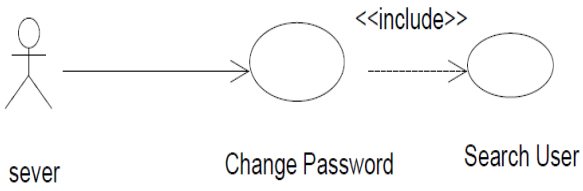
2.6.2 Server Wants to Delete a User Account

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.	
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

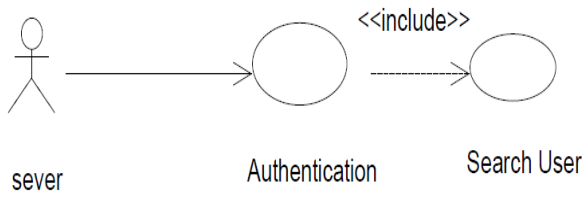
Use Case	*Server Wants to Change a User's Password*		
Version	1.0	Created	*4-1-19*
Author	Rui Xing, Yuru Wang		
Source	Customer		
Goals	The server would like to change user's password.		
Summary	The server would like to change user's password. And the server calls the change password function.		
Actors	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
3		The database saves the encrypted password
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		

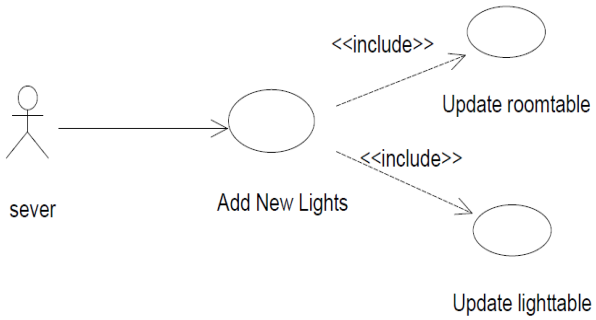
Alternate Flow	Actor	System
1	The user chooses to "cancel" the process.	
1		The database will keep the original password of current user.
2	The user that be searched does not exist.	
2		Return the flag of not exist.

2.6.4 Server Wants Authentication of the User ID and Password

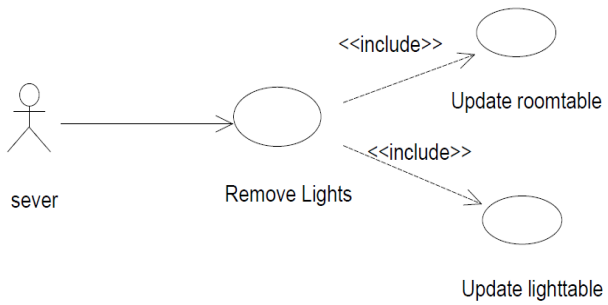
Use Case	*Server Wants Authentication of the User ID and Password*		
Version	1. 0	Created	*4-1-19*
Author	Rui Xing, Yuru Wang		
Source	Customer		
Goals	The server would like to search for username and password.		

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.
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.

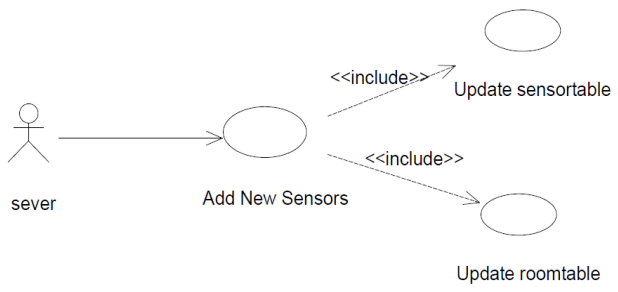
2.6.6 Server Wants to Remove Lights from a Room

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.

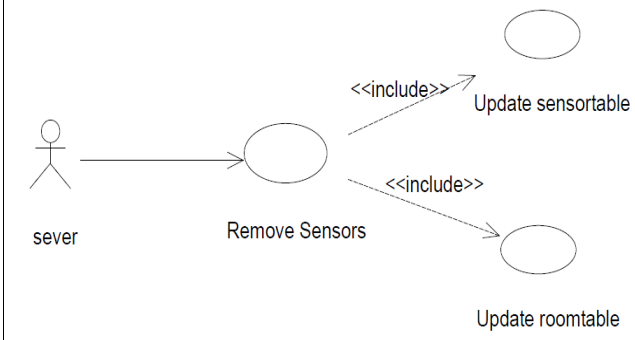
2.6.7 Server Wants to Add New Sensors

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
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.

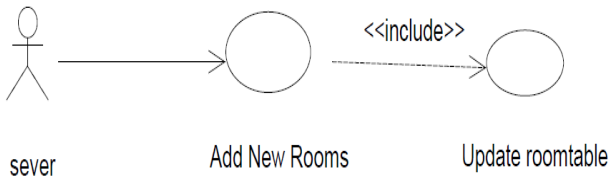
2.6.8 Server Wants to Remove Sensors from a Room

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.

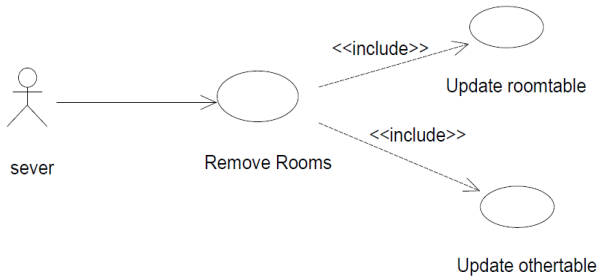
2.6.9 Server Wants to Add New Rooms

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
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.

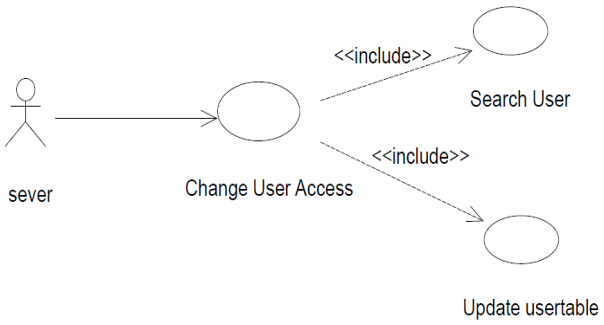
2.6.10 Server Wants to Remove Existing Rooms

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.

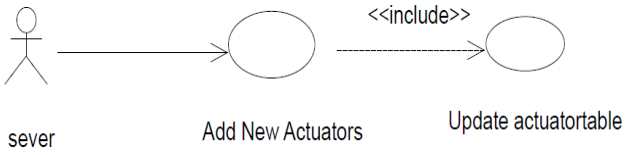
2.6.11 Server Wants to Change the User's Permissions

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.

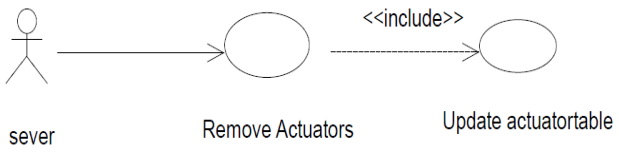
2.6.12 Server Wants to Add New Actuators

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

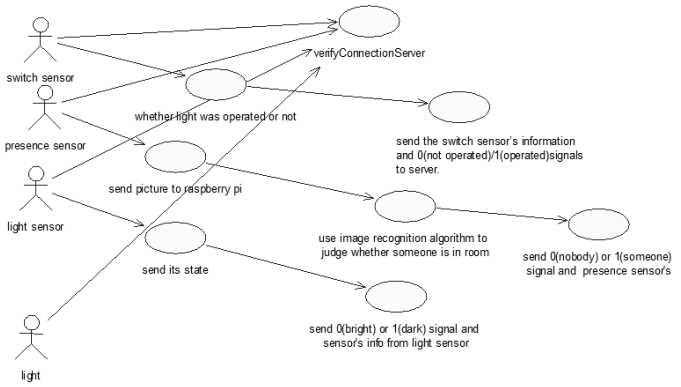
This section is written for developer who wants to know the functions of hardware.

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		

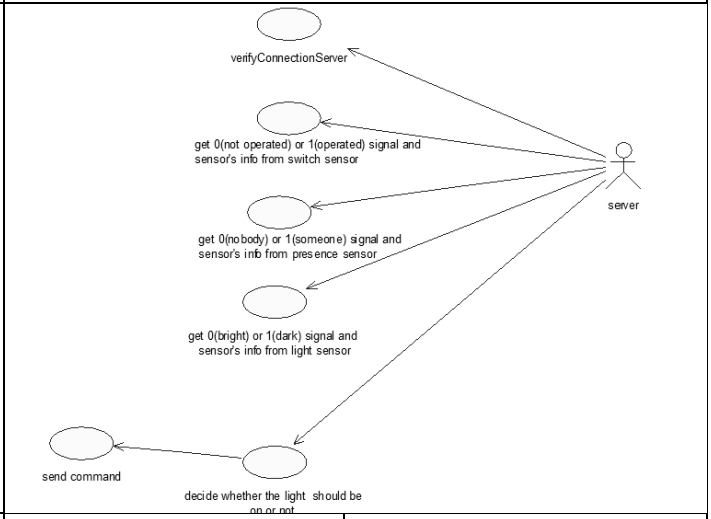
2.7.2 hardware sends signals and gets command

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	Switch sensor tells communication module whether light was operated or not. Presence sensor send a picture to raspberry pi to communication module. Light sensor send its state to communication module.	
4		Communication module sends the switch sensor's information and 0(not operated)/1(operated)signals to server. Communication module uses image recognition algorithm to judge whether someone is in room. And then it sends 0(nobody) or 1(someone) signal and presence sensor's information to server. Communication module send 0(bright) or 1(dark) signal and light sensor's information to server.
Frequency		
Type	Primary	
Postconditions		
Chart		
Alternate Flow	*Actor*	System
1		

2.7.3 Server gets signals from communication module

Use Case	Server gets signals from communication module		
Version	1.0	Created	3-23-19

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

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 200 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.

3.3 System Inputs and Outputs for Developer

3.3.1 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.

3.3.2 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	Intelligent controller