



## SMART LIGHTING

Software Requirement Specification

## Introduction to Software Engineering

**TEAM 5**

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## 1. Introduction

### 1.1 Purpose

This document aims to provide a Software Requirements Specification (SRS) for Smart Lightning project. It was created by Team 5 for Sungkyunkwan University's Introduction to Software course. The requirements for the realization of the Smart Lighting project were listed, explained and summarized. The main reader in this document is Team 5, and also professor and TAs can be considered as the main readers. In this document, smart lighting, which is one of the smart home applications, is gathered in five main functions and aims to offer the experience of creating a special space with lights for users. These aims are: maintaining sleep patterns by managing the user's sleep environment and calculating the appropriate sleep time, lighting system service for hearing impaired persons by replacing the function of an alarm by changing the color or brightness of the light, customizing lighting settings, automatically turning the lights on and off according to the detection of human movements, and saving energy. It is aimed for the user to reach these smart lighting functions with an interface. This documentation highlights the specifications of the requirements of these functions.

### 1.2 Scope

This system is designed to help people customize their space and improve their quality of life. It has both hardware and software applications as it allows the user to control the lights in the house. As mentioned in the Purpose section, it aims to enable the user to access different functions. In this context, the user's home system is accessed through an interface created. It is within this scope to regulate the sleep patterns of the users with the help of light, to increase the quality of life, to create a special area with customized lights, and to provide a notification system for the hearing impaired people.

### 1.3 Definitions, Acronyms, and Abbreviations

The following tables explain the acronyms and the abbreviations that will be used in this document.

[Table 1] Table of Acronyms and abbreviations

Acronyms & Abbreviations	Explanation
UI	User Interface
OS	Operating System
MB	Megabyte
DB	Database
MySQL	My Structured Query Language
GPS	Global Positioning System
IPS	Intrusion Prevention System
TA	Teaching Assistant
IEEE	The Institute of Electrical and Electronics Engineering
MVC	Model View Controller

[Table 2] Table of Technical terms and their definitions

Technical Terms	Definitions
User	Someone who has access to the system
App Store	Platform to find and install iOS applications
Google Play Store	Platform to find and install Android OS applications
Java	Programming language that is needed to use Android Studio
Android Studio	Development environment for Android devices
Software	Set of instructions or programs used to operate computers
Hardware	Any physical components of a computer system
Application	Software program that runs on the computer

## 1.4 References

- Team 7. "Software Requirement Specification". SKKU, Last Modified: April. 23, 2021.  
[https://github.com/skkuse/2021spring\\_41class\\_team7/blob/main/doc/Team7\\_SRS.pdf](https://github.com/skkuse/2021spring_41class_team7/blob/main/doc/Team7_SRS.pdf)
- Skkuse. (n.d.). *Skkuse/2021fall\_41class\_team16*. GitHub. Retrieved April 29, 2022, from  
[https://github.com/skkuse/2021fall\\_41class\\_team16](https://github.com/skkuse/2021fall_41class_team16)

## 1.5 Overview

The document includes 4 chapters in general.

The first chapter is the introduction part that explains the goal of the project and what this paper is about with definitions of technical terms.

The second chapter which is called ‘Overall Description’ provides information about the product perspective including several interfaces for system, user, hardware and software with an addition of memory constraints and operations. In addition to that, the second chapter also covers subjects like functions provided by the product, characteristics of users, constraints and assumptions/dependencies of the system.

The third chapter is named as ‘Required Specification’, and it talks about requirements dividing them as external, functional, product and organizational requirements that are needed for the project in more detail. Moreover, this chapter includes tables to explain functions and UI in more detail also using other figures such as use case diagram, class diagram and sequence diagram. System architecture can also be found at the end of this chapter.

The fourth chapter, which is the last one, is ‘Supporting Information’. It includes Software requirement specification with a history of documentation.

## 2. Overall Description

### 2.1 Product Perspective

This system is designed for people who want to improve their quality of life at home by getting help from smart home lighting. In addition to that, people with hearing disabilities will have an easier lifestyle even though they live alone. Users will also be improving their sleeping quality

that ends up increasing the productivity in their daily lives. Lastly, the system will be saving energy with automatic lighting settings.

### **2.1.1 System Interfaces**

Users will use a smartphone application to interact with the system. The system is connected to a database to collect information that is needed for tracking the user preferences, electricity consumption/cost and more. The data is also shown to the user by the application.

### **2.1.2 User Interfaces**

With using the phone screen for the application that is provided for the system, users can change the settings for the lighting at home by their preferences, and even add/delete new configurations depending on the mood they want to use for the room's lighting. They can have automated lights, change the color/brightness of the light bulb, and see how much energy the lights consumed daily or monthly with the cost of that consumption.

### **2.1.3 Software Interfaces**

The system is intended for smartphone devices. The smartphone must have an operating system that is Android OS 10.0 or iOS 13.0 and higher versions.

### **2.1.4 Memory Constraints**

The smartphone device should have at least 50MB empty space to download the application and the system can require up to 300MB for the installation/execution later times.

### **2.1.5 Operations**

- Automatic Lighting Management

The system detects users' motion with a sensor and adjusts the brightness, color or other settings of the light. It varies depending on going in and out of the house/room, or movement in the room.

- Notification

The system expresses the notification of various situations with lighting.

The user can recognize visitors or emergencies by blinking lights or changing the color of lights.

The user can be aware of alarms that sound on the user's mobile phone as lighting.

- Customization of Lighting Settings

The user can customize the settings of each light on the house.

The system saves the configuration setting of the user and provides convenience in easily applying them to other rooms.

## 2.2 Product Functions

### 2.2.1 Visitor/Emergency Notification

The system notifies the user of someone's visiting by blinking light for a while. The same can be applied to emergencies. When a user's life-threatening situation occurs, such as a stranger attempting to enter the user's house or a fire alarm in the building, the system notifies it through changing the color of light to red, and blinking it quickly. Visitor notification can be turned off or on depending on the user's preference, but Emergency notification remains on at all times.

### 2.2.2 Automatic Lighting Management of House

The system detects the user's entering or leaving the house with GPS or IPS. When the user enters the house, the system activates the lighting system of the house and brightens the house. And when the user leaves the house, the system turns off the light automatically. In this process, the state of all lighting systems is changed simultaneously.

### 2.2.3 Automatic Lighting of the Room with Motion Detection

Automatic lighting system of the room functions differently in two cases. First, when the user enters the room without anyone in the room, the system detects the movement of the user and

activates the lighting system and automatically turns on the light. Motion detection is limited to human cases.

Second is when the user falls asleep in the room suddenly. The system detects motion of the user with an inner-motion sensor. If no movement is detected for 30 minutes, the system assumes that the user is sleeping and turns off the light of the room slowly. The system completely turns off the light if no movement is detected until the brightness of the light is minimized. These two functions are available as an option and can be turned on and off according to the user's preference.

#### **2.2.4 Incoming Call or Application Alarm Notification**

The system notifies incoming calls or messages of applications in the user's phone with connected lights placed in various parts of the house. The lights in the house start to flash slowly, and when the user detects it and picks up the smartphone, the lights stop to flash. The user can designate the light for notification in advance. Message notification is available as an option and can be turned on if the user allows access to the message alarm.

#### **2.2.5 Automatic Lighting Adjustment According to Sleep Pattern**

The system adjusts the brightness and color of light automatically according to the user's sleep pattern. When the user is sleeping, the system changes the color of light to yellow or the color the user chose. Then the amount of light is reduced gradually and turned off. The system can connect with blinds in the house, so can manipulate the blinds for improving the user's sleep quality.

In the morning, the system measures the degree of sunlight and adjusts the amount of light in the room with blind or artificial light. The user can set the degree of brightness in the room or house in advance, and the system maintains the brightness to make it easier for the user to wake up. This management can operate continuously until nightfall and is available as an option.

#### **2.2.6 Customization of Lighting Settings**

The user can customize the lighting settings according to the user's preference of the rooms' usage. The user can set the various settings of lighting like brightness, color, and timer with application. In application, the system saves the user's configuration settings and makes an icon for each configuration with user-specified name. The user can easily apply the setting to the room with tapping this icon, or delete saved configuration.

### **2.2.7 Voice Detection**

The system changes the setting of the lighting for the room with voice detection. It is assumed that the voice detection of the system is performed through a smart speaker located in the user's room. According to the command of the recognized voice, the setting of the light is changed variously. Through this function, the user does not have to touch the switch for manipulating the light.

## **2.3 User Characteristics**

### **2.3.1 System Administrator**

System administrators are limited to people who have taken part in the job of designing and building the whole system. In most cases, a system administrator might be a worker who has graduated from computer science or related fields that has sufficient knowledge to take care of any kinds of errors that may occur in the system. The system administrator must be familiar with Java/Android Studio for the application and MySQL for the database.

### **2.3.2 User**

In this document, the users are the house members who can access the lighting system with a smartphone application. It is assumed that the users can read and understand basic English to make changes in the settings according to their preferences.

### **2.3.3 App Store / Google Play Store**

App Store is a platform for iOS devices where Google Play Store is for Android devices. Both platforms enable users to download/update the smartphone application for the system freely.

## 2.4 Constraints

This application and the system will be designed and implemented based on the information mentioned in this document. Other details are designed and implemented by selecting the direction preferred by the developer, but comply with the following:

- Motion detecting should be for humans only, not animals
- Use the technology that has already been widely proven
- Avoid using software that requires a separate license
- Decide in a more user-friendly way
- All services are provided through the smartphone application
- If necessary, use external files like images in compliance with copyright
- Consider the system and maintenance cost
- Use optimized source code to prevent waste of system resources
- Develop using the latest version of Android Studio as 2021.1.1.23
- Consider future maintenance and use sufficient comments in the source code
- Regarding how to cope with changes and additional requirements, improve the product by getting feedback from application and system users.
- Test operation of the product using Android OS 10.0 and iOS 13

## 2.5 Assumptions and Dependencies

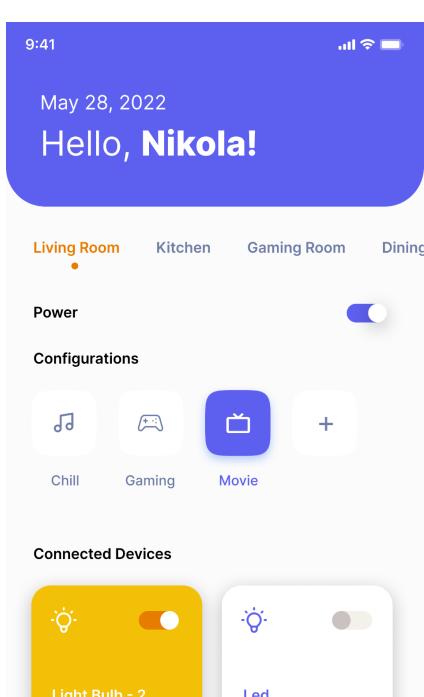
This document was written on the assumption that the product is designed for smartphone devices that have iOS or Android OS. In addition to that, the product was implemented based on the 10.0 version for Android OS, and 13.0 version for iOS. Therefore, it may not apply to other operating systems or versions.

### 3. Requirements Specification

#### 3.1 External Requirements

##### 3.1.1 User Interfaces

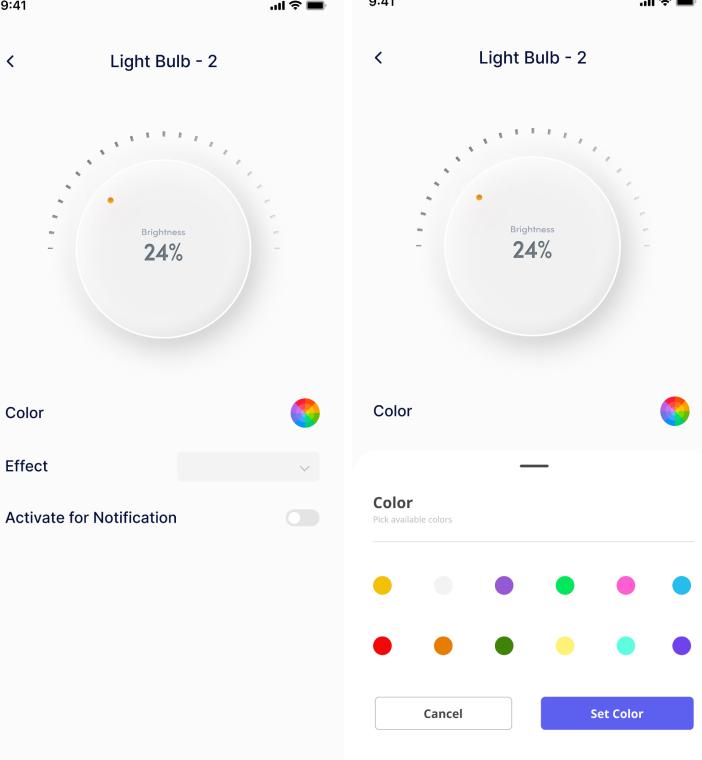
[Table 3] User interface of Main

Name	Main Interface
Purpose/Description	In main interface, user can change state of light system of room and move to other interface by interacting component of main interface
Input source/ Output destination	User / Android OS Smartphone (Higher than Android 10.0), iOS Smartphone (Higher than iOS 13.0)
Range/ Accuracy/ Margin of error	N/A
Unit	Screan
Time/ Velocity	N/A
Relationship with other input/outputs	N/A
Format and configuration of screen	<p>1. User can choose a room in the top bar menu to change settings, the default room is first element of the top bar menu.</p> <p>2. Under the top bar, the room state is presented and the interaction component is located.</p> <p>3. User can turn on / off all light of the room by tapping the switch of 'Power'</p> <p>4. User can change the room at once to the state they want by tapping the buttons of 'Configurations'. Each button is mapped to each user defined setting</p> 

	<p>5. Tapping the plus('+) button of 'Configuration' direct user to configuration interface</p> <p>6. 'Connected Devices' board show state of room by card's colors of the board</p> <p>7. User can turn on / off each light device by tapping the switch of each card that mapped to each light device</p> <p>8. Long touch each card direct user to light setting interface of light device that mapped to interacted card</p> <p>9. User can register a new light device in the light system of the room by tapping the plus('+) buttons of 'Connected Devices'.</p> <p>10. Tapping 'electricity icon' button direct user to electricity usage interface</p>
Format and configuration of window	N/A
Data type	Text, Bar, Card, Button, Slider, Image
Instruction type	Instruction mapping according to the value of a button code
Exit message	N/A

[Table 4] User interface of Setting Light

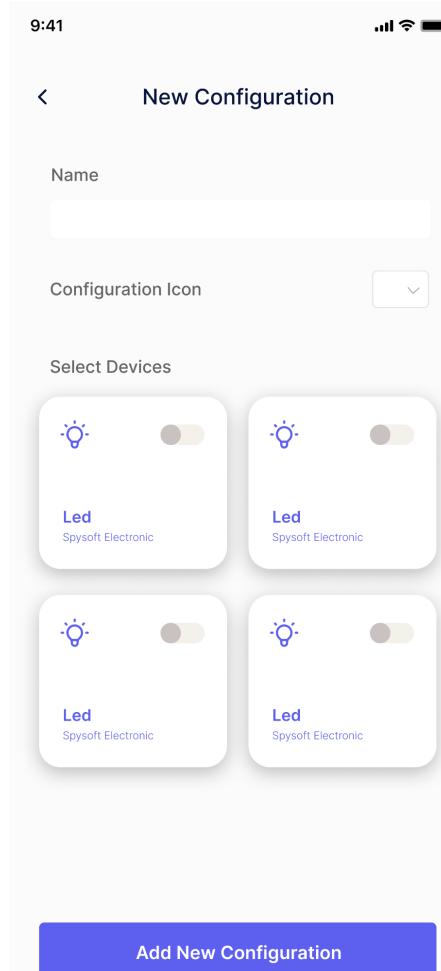
Name	Setting Light Interface
Purpose/Description	When customizing the setting of each light bulb, the user can choose the brightness, color, and effect like blinking on this screen.
Input source/ Output destination	User / Android OS Smartphone (Higher than Android 10.0), iOS Smartphone (Higher than iOS 13.0)
Range/ Accuracy/ Margin of error	Range according to the number of buttons or dials on the screen / Accuracy based on user's touch accuracy / Limit of touch sensitivity error
Unit	Screen
Time/ Velocity	Immediate execution of asynchronous user input or user command

Relationship with other input/outputs	After receiving all user inputs, the user device transmits the input data to the server for saving the data.
Format and configuration of screen	 <p>1. This screen can be accessed by tapping the card of the 'Connected Devices' board on the main screen.</p> <p>2. By touching the name of the light bulb, the user can edit the name of the light bulb.</p> <p>3. With a dial on the screen, the user can adjust the brightness of the light bulb.</p> <p>4. On the Color tab, the user can select the color of light and save the setting by touching the 'set color' button.</p> <p>5. On the Effect tab, the user can set the effect of the light bulb, such as blinking or flashing.</p> <p>6. With the Activate for Notification bar, the user can choose whether the function of notification is available or not.</p> <p>7. Press the &lt; button at the top left of the application bar and the user can return to the previous screen.</p>
Format and	N/A

configuration of window	
Data type	Dial, Bar, Button, Dropdownbutton, Slider
Instruction type	Instruction mapping according to the value of a button code.
Exit message	N/A

[Table 5] User interface of Configuration

Name	Configuration Interface
Purpose/Description	Save customized configurations that include location, color, brightness of lights
Input source/ Output destination	User/Android OS Smartphone (Higher than Android 10.0), iOS Smartphone (Higher than iOS 13.0)
Range/ Accuracy/ Margin of error	Range according to the number of the lights which are on and color and brightness of the lights
Unit	Screen
Time/ Velocity	Immediate response after the user input
Relationship with other input/outputs	Users set a configuration and then send data to the database.
Format and configuration of screen	<ol style="list-style-type: none"> <li>1. A user writes the name of a configuration.</li> <li>2. The user can set the icon of the configuration.</li> <li>3. The user chooses the devices(the lights) that user wants to be on.</li> <li>4. The user sets the color and brightness of each light.</li> <li>5. If all settings are done, the user touches the 'Add New Configuration' button. Finally, a new configuration is added to the main system.</li> </ol>

	
Format and configuration of window	N/A
Data type	String, float
Instruction type	Touch the button triggers the instruction.
Exit message	N/A

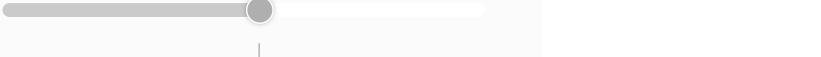
[Table 6] User interface of Electricity Usage

Name	Electricity Usage Interface
Purpose/Description	Let the user know how much electricity is consumed for lighting and how much it costs in the bill daily/monthly.

Input source/ Output destination	Lighting System / Android OS Smartphone (Higher than Android 10.0), iOS Smartphone (Higher than iOS 13.0)
Range/ Accuracy/ Margin of error	Range by consumption of energy / Accuracy by calculation of energy consumption and cost / Any error caused by the system while calculating
Unit	Screen
Time/ Velocity	Updated daily and monthly
Relationship with other input/outputs	The system sends consumption data to database, and database sends that information to the application for user to see.
Format and configuration of screen	<p>1. Electricity usage page can be accessed at the end of all rooms listed</p> <p>2. <b>Today / This month:</b> Shows how much energy is consumed</p> <p>3. <b>Electricity Cost Today / Month:</b> Shows the cost of energy consumption</p> <p>4. <b>Graphs:</b> Compares the cost between months</p>
Format and configuration of	N/A

window	
Data type	Text, Button, Float
Instruction type	Touching the button changes the text of float data
Exit message	N/A

[Table 7] User interface of Settings

Name	Settings Interface
Purpose/Description	Let the user choose which functionality he/she wants to be activated.
Input source/ Output destination	User / Android OS 또는 iOS가 장착된 사용자 장치 *Android OS smartphone (Higher than Android 10.0), iOS 기기 (Higher than iOS 13.0)
Range/ Accuracy/ Margin of error	Range by the number of options on the screen / Accuracy by user touch accuracy / Touch sensitivity error limit
Unit	Screen
Time/ Velocity	Immediate response after the user input
Relationship with other input/outputs	After setting an option, the user device sends this input data to the server and the server saves this input data in the database.
Format and configuration of screen	<p>Settings</p> <p>Visitor Alarm <input type="checkbox"/></p> <p>Room Light Automation <input type="checkbox"/></p> <p>Notification Lighting <input type="checkbox"/></p> <p>Sleep Detection <input type="checkbox"/></p> <p>Sleep Lighting <input type="checkbox"/></p> <p>Set Sleep Cycle <input type="button" value="06:05"/> - <input type="button" value="23:00"/></p> <p>Maintain fixed Brightness <input type="checkbox"/></p> <p>Choose Brightness</p> 

	<p><b>Settings</b></p> <p>Visitor Alarm <input type="checkbox"/></p> <p>Room Light Automation <input type="checkbox"/></p> <p>Notification Lighting <input type="checkbox"/></p> <p>Sleep Detection <input type="checkbox"/></p> <p>Sleep Lighting <input checked="" type="checkbox"/></p> <p>Set Sleep Cycle <input type="button" value="06:05"/> - <input type="button" value="23:00"/></p> <p>Maintain fixed Brightness <input checked="" type="checkbox"/></p> <p>Choose Brightness </p>
Format and configuration of window	N/A

Data type	Text, button, Boolean, Int
Instruction type	Int type value of the button code
Exit message	N/A

## 3.2 Functional Requirements

### 3.2.1 Use Case

[Table 8] Use case of Change the Light to Alarm Certain Situation to the User

use case name	Change the Light to Alarm Certain Situation to the User
Actor	A person
Description	When someone is visiting a house, the system changes color or brightness of the light to let people in the house know that there is a visitor.
Normal Course	<ol style="list-style-type: none"> <li>1. Person visits the house.</li> <li>2. Sensors recognize the person.</li> <li>3. System makes the lighting blink for a while.</li>   <li>1. Emergency alarm goes off.</li> <li>2. System makes the lighting red and blink fast.</li> </ol>
Pre-condition	Option for the alarm should be on. For the emergency part, it is always on.
Post-condition	Lights have to be different from normal state.
Assumptions	The actor has to be a person.

[Table 9] Use case of Room Light Automation

use case name	Room Light Automation
Actor	User
Description	When someone enters the room, it is detected by the sensors and the light turns on automatically.
Normal Course	<ol style="list-style-type: none"> <li>1. Person enters to the room</li> <li>2. Sensors recognize the movements and the person</li> <li>3. Sensed signal activates the light system</li> <li>4. Lights turn on as long as the person is there</li> </ol>

Pre-condition	No one should be in the room. Option for the automation should be on.
Post-condition	Lights turn on.
Assumptions	The actor is a person, not an animal like a pet.

[Table 10] Use case of Notification Alarm

use case name	Notification Alarm
Actor	A (hearing impaired) user
Description	Notification of phone and calls by changing the color and brightness of special lights placed in various parts of the house to inform hearing impaired persons.
Normal Course	<ol style="list-style-type: none"> <li>1. The user receives a message or a call on her/his phone.</li> <li>2. Incoming notification is detected by the app.</li> <li>3. App activates the connected lights.</li> <li>4. The lights begin to flash slowly.</li> <li>5. The user picks up the phone and opens the notification.</li> <li>6. The lights stop to flash.</li> </ol>
Pre-condition	This feature has been activated by the user. Option for the alarm should be on.
Post-condition	The color and the brightness of the light is changed.
Assumptions	The user agrees to receive the desired notifications with light.

[Table 11] Use case of Change the Light for the Night

use case name	Change of Light for the Night
Actor	System
Description	It is a process where the color of light is changed by the user's choice, and the amount of light is reduced according to their sleeping cycle.
Normal Course	<ol style="list-style-type: none"> <li>1. Blinds are closed.</li> <li>2. Color of light is changed</li> <li>3. Amount of light is adjusted</li> </ol>

Pre-condition	The data for the sleeping cycle of the user should be recorded. Option for the automation should be on.
Post-condition	The color/amount of light should be changed.
Assumptions	N/A

[Table 12] Use case of Change of the Light for the Day

use case name	Change of Light for the Day
Actor	System
Description	It is a process where the amount of light in the room is adjusted by artificial light or blinds to make waking up easier.
Normal Course	<ol style="list-style-type: none"> <li>1. Blinds are open</li> <li>2. Amount of artificial light is adjusted according to sunlight</li> </ol>
Pre-condition	Amount of sunlight in the room should be recorded. Option for the automation should be on.
Post-condition	Amount of light should be updated with blinds or artificial light.
Assumptions	There should be a threshold so the system does not try to adjust the amount of light in every short period of time.

[Table 13] Use case of Customize the Lighting Settings

use case name	Customize the Lighting Settings
Actor	User
Description	Customize various lighting settings according to the room's usage or user's preference. Save those settings so that you can call that particular lighting configuration in one touch.
Normal Course	<ol style="list-style-type: none"> <li>1. User sets the lighting brightness, color and timer of a single light bulb, by tapping and holding the light bulb icon</li> <li>2. After finishing the settings for all the light bulbs, press the 'Save' button to save the overall configuration, and enter a name for the config.</li> <li>3. Then the new configuration icon will appear in the 'Configurations' tab, which the user can access by tapping the 'Configurations' button.</li> </ol>

	<ul style="list-style-type: none"> <li>4. The user can tap the new configuration icon in order to import the saved config into the room whenever the user wants.</li> <li>5. The user can delete an existing configuration by tapping the cross button on the configuration icon.</li> </ul>
Pre-condition	N/A
Post-condition	The name of the config icon should match the name entered by the user. The config information should be saved in the database.
Assumptions	N/A

[Table 14] Use case of Maintain Fixed Brightness

use case name	Maintain Fixed Brightness
Actor	System
Description	The system maintains brightness in the house by adjusting the amount of natural and artificial light according to the level preset by the user.
Normal Course	<ul style="list-style-type: none"> <li>1. The system automatically detects and measures the degree of natural light.</li> <li>2. If the amount of natural light is more than the user's setting, the system connects with a device which can block light, such as blind. And if the amount of natural light is less than the user's setting, the system automatically turns on the light.</li> </ul>
Pre-condition	The user should set the desired brightness through the brightness control bar in the light amount setting of the application in advance. Option for the automation should be on.
Post-condition	System maintains brightness until the user turns off the light or adjusts the brightness through application.
Assumptions	N/A

[Table 15] Use case of Voice Recognition

use case name	Voice Recognition
Actor	User

Description	When the user speaks, the system recognizes the sound and automatically turns the light on/off.
Normal Course	<ol style="list-style-type: none"> <li>1. Users tell the smart speaker to turn the light on or off.</li> <li>2. The system detects the sound.</li> <li>3. The system changes the lighting settings according to the sound.</li> </ol>
Pre-condition	N/A
Post-condition	Change of the lighting should be the same as the user wanted.
Assumptions	N/A

[Table 16] Use case of Turn the Light On and Off According to a Person's Presence

use case name	Turn the Light On and Off According to a Person's Presence
Actor	User
Description	When a person enters a house, the system turns the light on to brighten the house. When a person leaves the house, the system turns the light off to save energy.
Normal Course	<ol style="list-style-type: none"> <li>1. A person enters or leaves the house.</li> <li>2. System detects whether the person enters or leaves the house by the GPS or some IPS.</li> <li>3. If the person enters the house, the light turns on. If the person leaves the house, the light turns off.</li> </ol>
Pre-condition	Sensors can detect if the person is in or out.
Post-condition	All of the lights have to be turned on or off simultaneously.
Assumptions	N/A

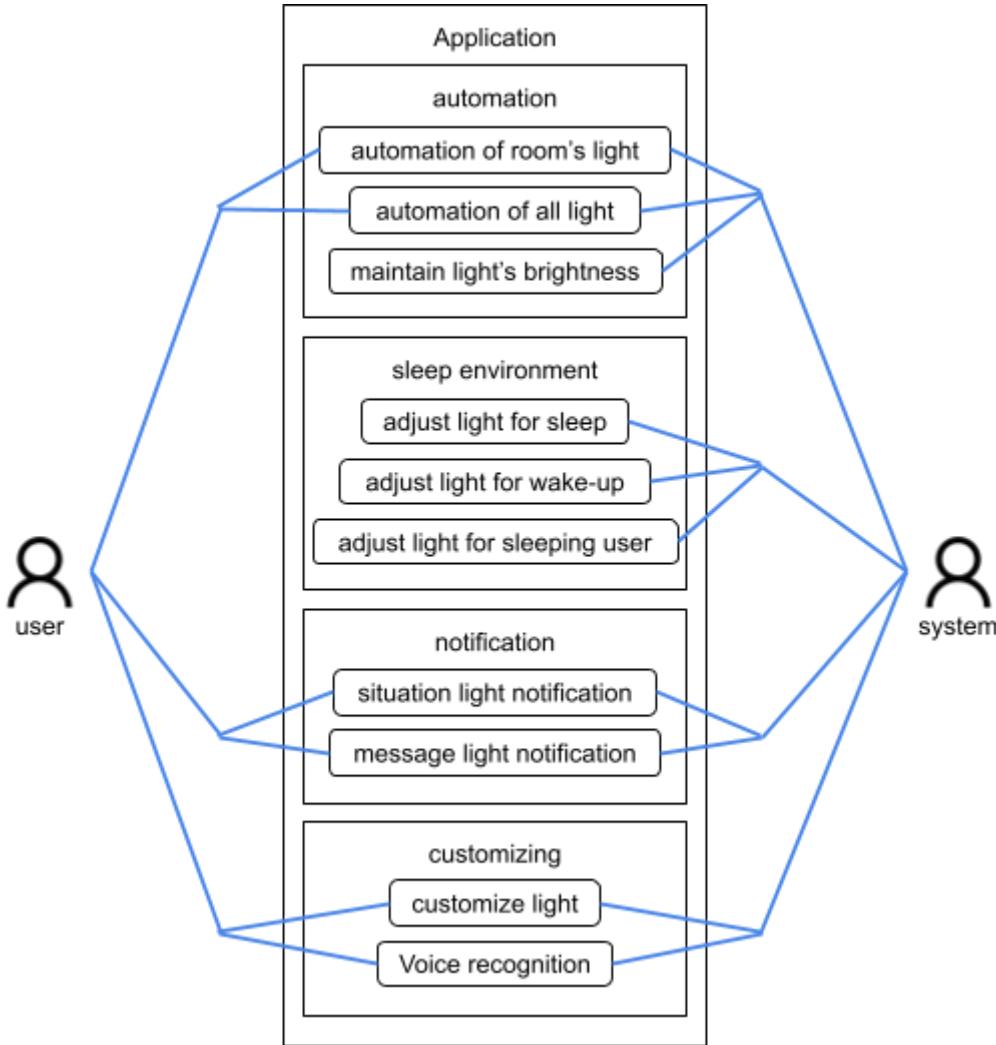
[Table 17] Use case of Turn Off Light for Sleeping(Unconscious) User

use case name	Turn Off Light for Sleeping(Unconscious) User
Actor	User in a room
Description	Turn-off light for sleeping user is the process that turn-off automatically room's light if the user in the room falls asleep
Normal Course	<ol style="list-style-type: none"> <li>1. When some user is in the room, if no movement is detected by the inner-room motion sensor for 30 minute, the system assumes that the user has fallen asleep.</li> </ol>

	<ol style="list-style-type: none"><li>2. Slowly turn off all lights in the room for 10 seconds.</li><li>3. If movement is detected while processing step 2, the system returns to the state of the room before step 2</li><li>4. After 10 second since processing step 2, all lights in the room are turn off</li></ol>
Pre-condition	option of turn-off light for sleeping(unconscious) user is on some users are in the room. Option for the detection should be on.
Post-condition	all lights in the room are turn off
Assumptions	no movement detected for 10 minute means all user in the room are sleeping(unconscious)

### 3.2.2 User Case Diagram

[Figure 1] Use Case Diagram



## 3.3 Product Requirements

### 3.3.1 Usability Requirements

The smart lighting system targets people who want to improve the quality of their time spent at home with different kinds of smart lighting functionalities. People with hearing disabilities are also targeted so that they can have a better quality of independent lifestyle. The system should be easy to use by every age of user and should be organized in a way that errors are minimized. The

user interface should be simple and easy to use after a basic tutorial supported by the smart-phone application.

### **3.3.2 Efficiency Requirements**

Since more than one rooms/users are accessing at the same time, and almost all day, the system needs to be fast enough to respond and not spend a lot of time updating the adjustments that should be done.

#### **3.3.2.1 Performance Requirements**

- a. The system should respond and inform the user within 5 seconds in case of emergency alarms.
- b. During the day, the system should measure and adjust the amount of light hourly while being accessible to more than one user.
- c. The tutorial should include photos/documents within 5 pages that are easy enough to understand within 3 minutes.

### **3.3.3 Security Requirements**

The system should prevent users that are not living in the household from accessing the system managing and information involving privacy. Before using the system, the users should download the application for their smart-phones, then they can use the code specified for their house and access the lighting settings.

### **3.3.4 Dependability Requirements**

The system should not affect the basic functions of appliances. If there is a conflict between user setting and basic functions, or between user settings, the system shall notify and warn it. Except in the case of conflict, the user's setting should remain in the most recently saved state.

## **3.4 Organizational Requirements**

### **3.4.1 Environmental Requirements**

This system presupposes that the user operates lighting and appliances in the house through an application, so an IoT-based system must be equipped.

The user is limited to the actual residents of the house in which the system is used.

### **3.4.2 Development Requirements**

For application development, it is based on android 10.0 or higher devices.

User information and configuration settings are managed in a database.

## **3.5 External Requirements**

### **3.5.1 Regulatory Requirements**

The user's consent should be obtained to provide access to the operation of devices such as lighting or appliances in the house.

### **3.5.2 Ethical Requirements**

There should be no case where the system manager, not the actual resident, arbitrary views and modifies the user's information or settings.

### **3.5.3 Legislative Requirements**

#### **3.5.3.1 Accounting Requirements**

Users should not be required to pay extra for using all functionalities provided by the system.

#### **3.5.3.2 Safety/Security Requirements**

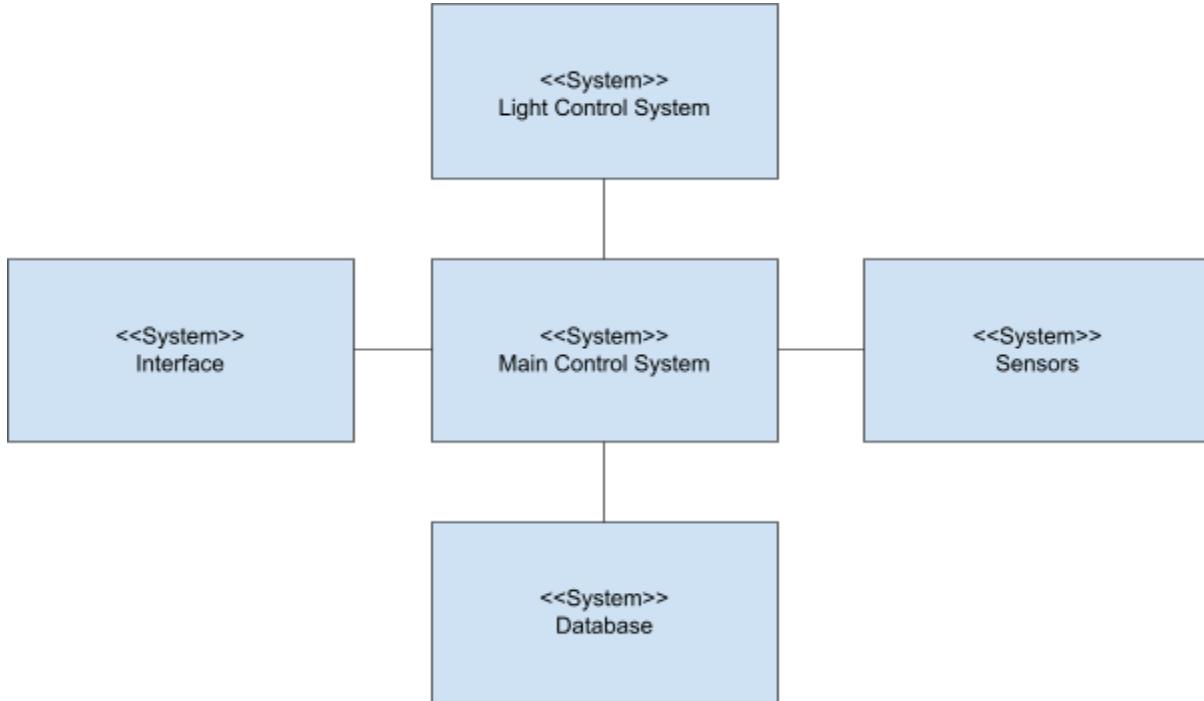
The system must be designed in a way that it cannot be accessed by users of external systems so that all kinds of data is safely protected and not damaged. In addition, in accordance with personal information-related laws and regulations, privacy of users should be guaranteed.

## 3.6 Organizing the Specification Requirements

### 3.6.1 Context Model

We can show the relationship between subsystems.

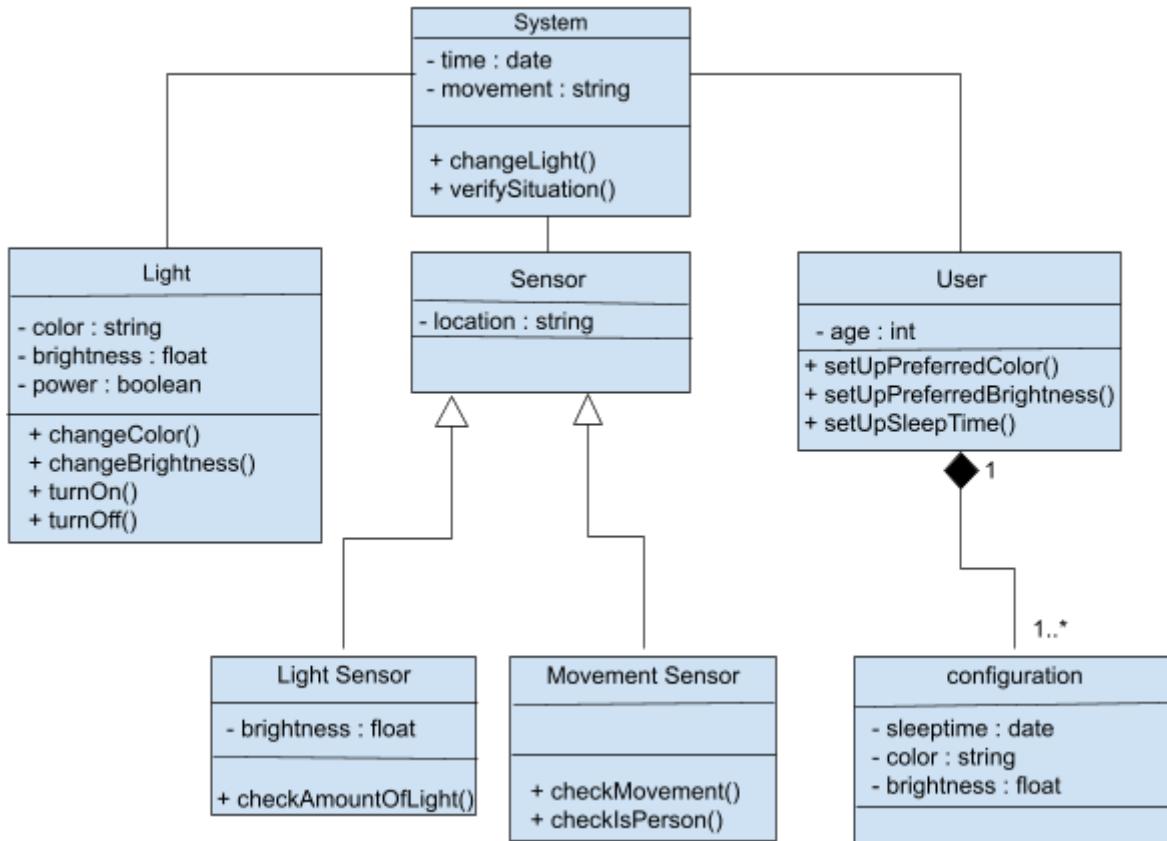
[Figure 2] Context Model



### 3.6.2 Class Diagram

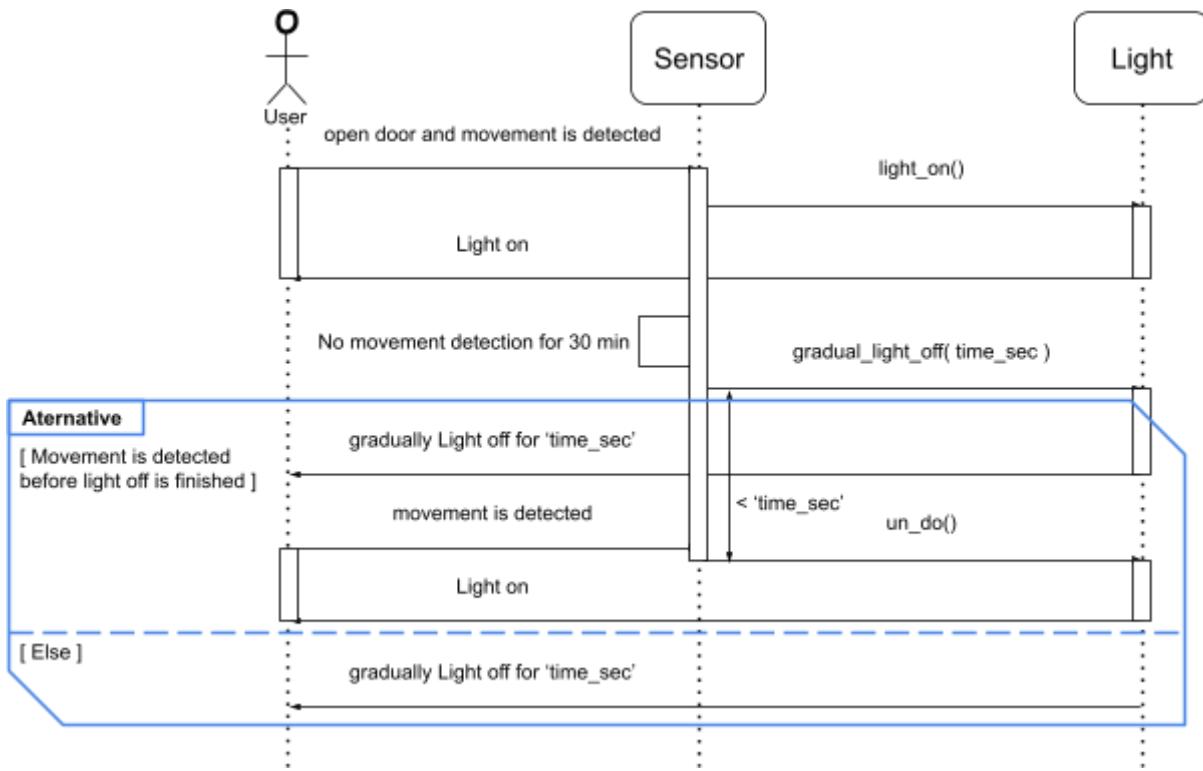
We can see variables and methods of each class and the relationship between classes.

[Figure 3] Class Diagram



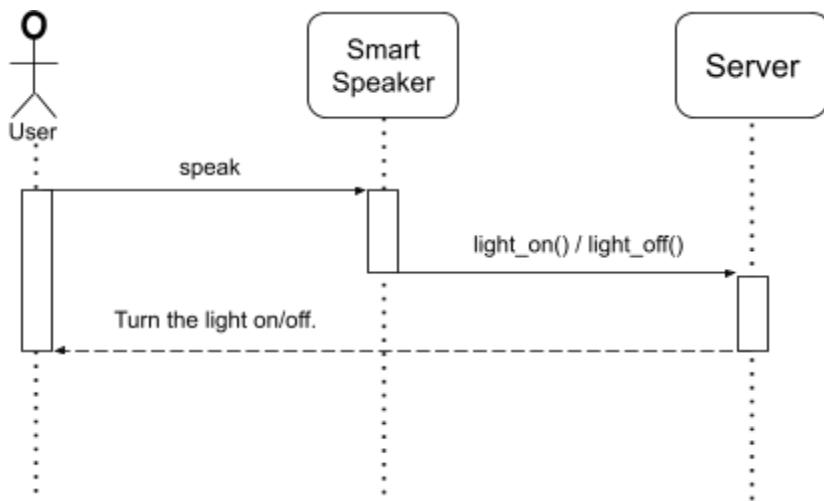
### 3.6.3 Interaction Model

[Figure 4] Sequence Diagram : Detecting Sleeping User and Turning Off the Light



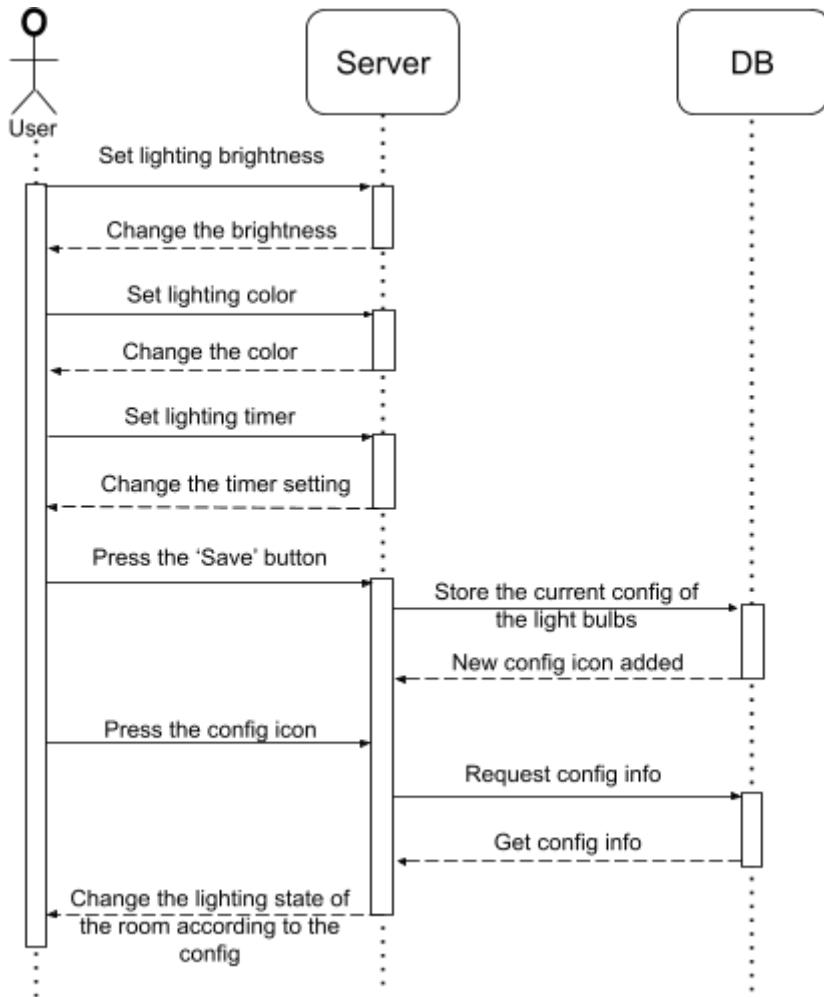
This sequence diagram shows the process of detecting sleeping user and automatically turning the light off gradually.

[Figure 5] Sequence Diagram : Process of Control of the Lighting with Voice Recognition



This sequence diagram shows the process of control of the lighting with voice recognition.

[Figure 6] Sequence Diagram : Process of Customizing the Lighting Settings and Saving Configuration of the Lighting



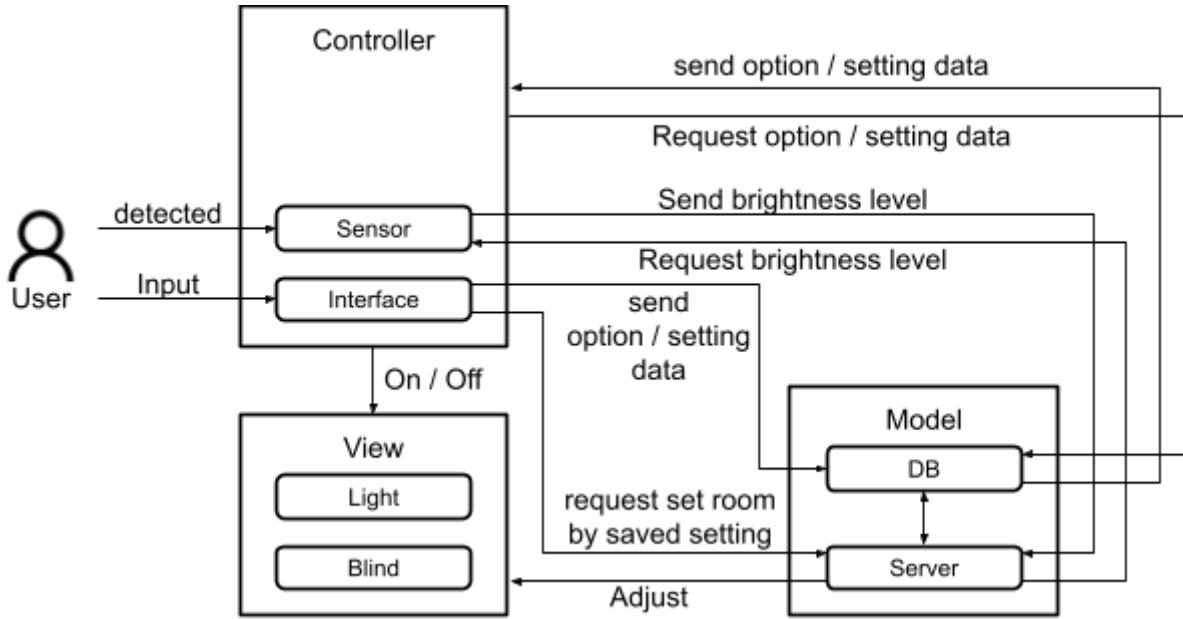
This sequence diagram shows the process of customizing the lighting settings and saving the configuration of the lighting.

### 3.7 System Architecture

This section shows the system architecture using the MVC(Model View Controller) pattern. Server interacts with sensors to maintain the brightness of the environment at fixed time intervals. Option data is used by the sensor or server to check if the function is enabled before it executes the function. setting data is user defined data that Lighting environment desired by the

user in specific situations. User saves option and setting data in DB and changes the room environment to a predefined setting by requesting through the interface.

[Figure 7] MVC Pattern



### 3.8 Limitations And Assumptions

With new developments, smart homes are getting more and more common each day. While some people are big fans of this system, some might think it is unnecessary or hard to live with. Therefore, as it can be seen in other smart home features, our lighting system can be difficult for some people to use or they might think that they do not need it for their home. However, despite the limitations, we assume that our system will be able to reach a big number of smart home users with our easy usage and the benefits that are provided.

### 3.9 System Evolution

#### 3.9.1 User Requirement Evolution

As time goes by, the system might get overloaded because a lot of users are trying to change the settings at the same time. The system and the hardware should be powerful enough to deal with this problem, or user requirements can be changed and different levels of users might be provided for the system.

## 4 Supporting Information

### 4.1 Software Requirement Information

This document is written in accordance with the IEEE Recommendation

### 4.2 Role of Writers

Writer	Description
황정윤	<ul style="list-style-type: none"> <li>Dividing roles and duties</li> <li>Functional requirements / Use case table</li> <li>Sequence model</li> <li>UI table</li> </ul>
이채은	<ul style="list-style-type: none"> <li>Non-Functional requirements</li> <li>Functional Requirements / Use case table</li> <li>UI table</li> <li>Overall Description</li> </ul>
유상범	<ul style="list-style-type: none"> <li>Functional requirements / Use case table</li> <li>Sequence model</li> <li>UI table</li> <li>Use case diagram</li> <li>System Architecture</li> </ul>
정성욱	<ul style="list-style-type: none"> <li>Functional requirements / Use case table</li> <li>Context and Process model</li> <li>UI table</li> <li>Documenting the final format</li> </ul>
Aysun Öğüt	<ul style="list-style-type: none"> <li>Functional requirements / Use case table</li> <li>UI design</li> <li>Introduction</li> </ul>
Selin Samra	<ul style="list-style-type: none"> <li>Non-Functional requirements</li> <li>Functional requirements / Use case table</li> <li>UI table</li> <li>Introduction-Overall Description</li> </ul>

### 4.3 Document History

Date	Version	Description	Writer
2022/04/25	1.0	Addition of 3.2	Everyone
2022/04/25	1.1	Addition of 3.3-3.5	이채은, Selin Samra
2022/04/25	1.2	Addition of 3.6	황정윤, 유상범, 정성욱
2022/04/26	1.3	Addition of 3.7, 3.2.2	유상범
2022/04/26	1.4	Addition of 3.1 & Revision of 3.6-3.7	Everyone
2022/04/26	1.5	Addition of 2.1-2.3 & Revision of 3.2	이채은, Selin Samra
2022/04/27	1.6	Addition of 1.1-1.5	Aysun Ogut
2022/04/27	1.7	Addition of 4.1-4.3	정성욱
2022/04/27	1.8	Revision of 3.1	Aysun Ogut, 황정윤
2022/04/28	1.9	Revision of 1.1-2.3	이채은, 유상범
2022/04/29	1.10	Revision of Style	정성욱