System and Software Architecture Description (SSAD)

Mobil Application for Mobile-Controlled Lighting

Team 13

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Version History

Date	Author	Version	Changes made	Rationale
08/25/05	PA	2.0	• Original template for use with Instructional ICM-Sw v1.0	• Initial draft for use with Instructional ICM-Sw v1.0
05/25/09	SK	2.1	• Embedded description in each table	• To be consistent with ICM EPG template set standard V2.1
11/10/2014	PM	2.2	• System and software architecture description document which includes system analysis, hardware and software component description.	• To comply with Instructional ICM-Sw standard
11/30/2014	PM	3.0	• Changing of handmade diagrams to computerized diagrams. • Made the suggested changes in the last feedback.	• To comply with Instructional ICM-Sw standard
12/07/14	SS	3.1	• Version and date change in footer	• Final document review

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1. Introduction

1.1 Purpose of the SSAD

The objective of this document is to describe software architecture of the project and the design decisions taken during the design process and the basis for each of them.

1.2 Status of the SSAD

This is the final draft of this document.

2. System Analysis

2.1 System Analysis Overview

The primary purpose of the Mobile-Controlled Lighting is making buildings switch free. This system will help able users to control lights of their home and offices from mobile devices. User can turn on or off the switch, all switches of the room, and all switches on one click. User can group switches to room, floor. It will help to save electricity and also energy as we don't have to walk to switch to toggle it.

2.1.1 System Context

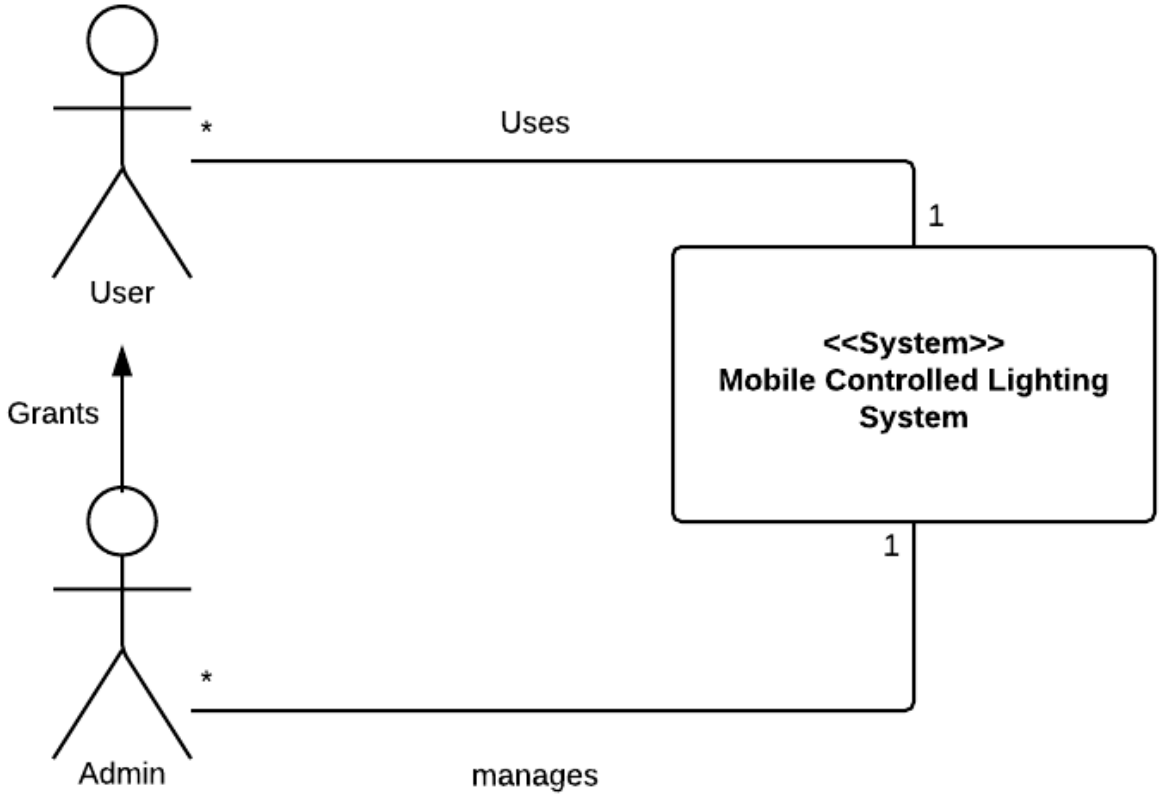


Figure 1: System Context Diagram

Table 1: Actors Summary

Actor	Description	Responsibilities
User	General User	Any User can only switch on/off a switch.

Actor	Description	Responsibilities
Admin	An admin who give access permissions to other users	Add gateway, configure gateway, add switch and provide access rights to other users.

2.1.2 Artifacts & Information

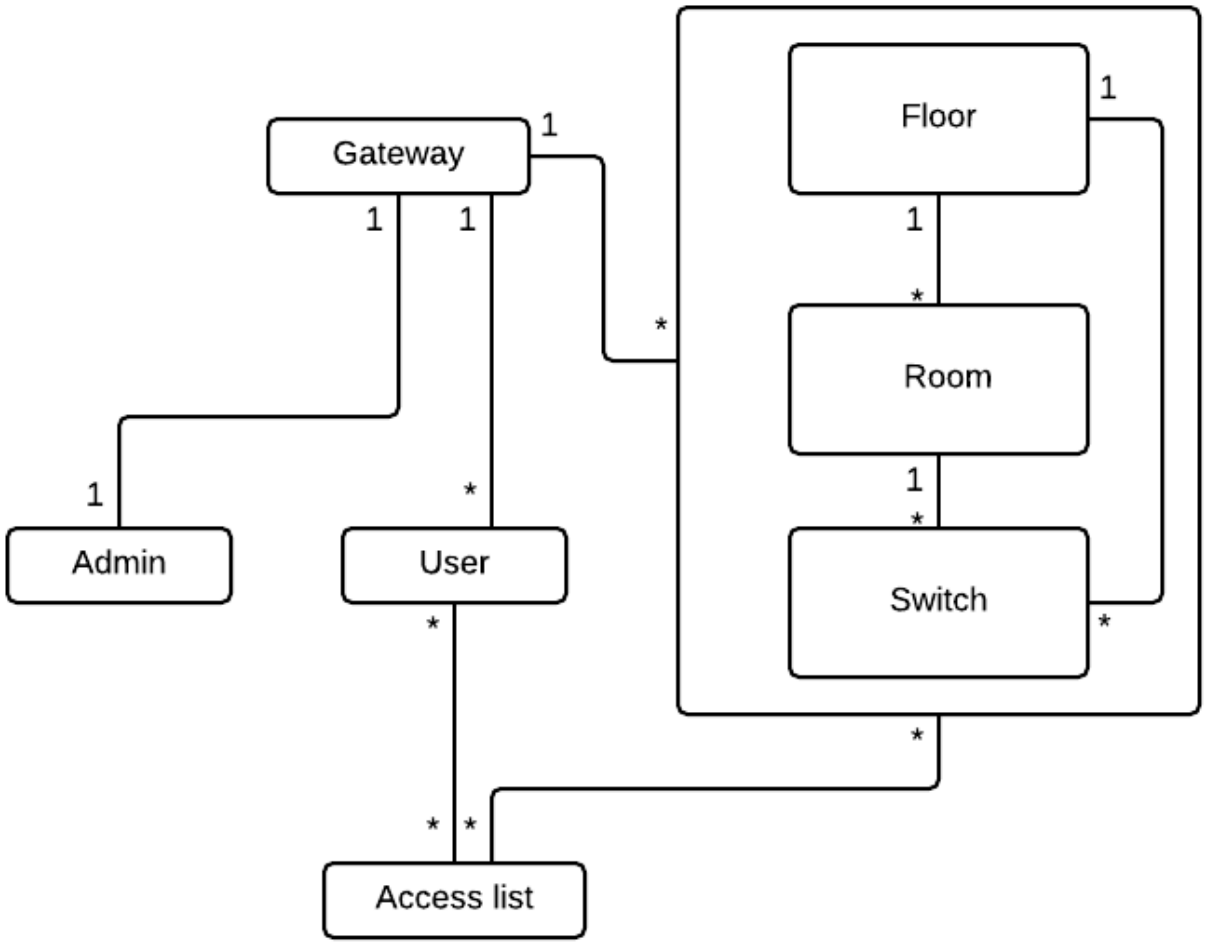


Figure 2: Artifacts and Information Diagram

Table 2: Artifacts and Information Summary

Artifact	Purpose
Admin	An admin who give access permissions to other users.
User	General User.
Gateway	To connect mobile application to switches.

Access List	List of users who have access to particular switches.
Room, switch and floor	Room and floors have switches.

2.1.3 Behavior

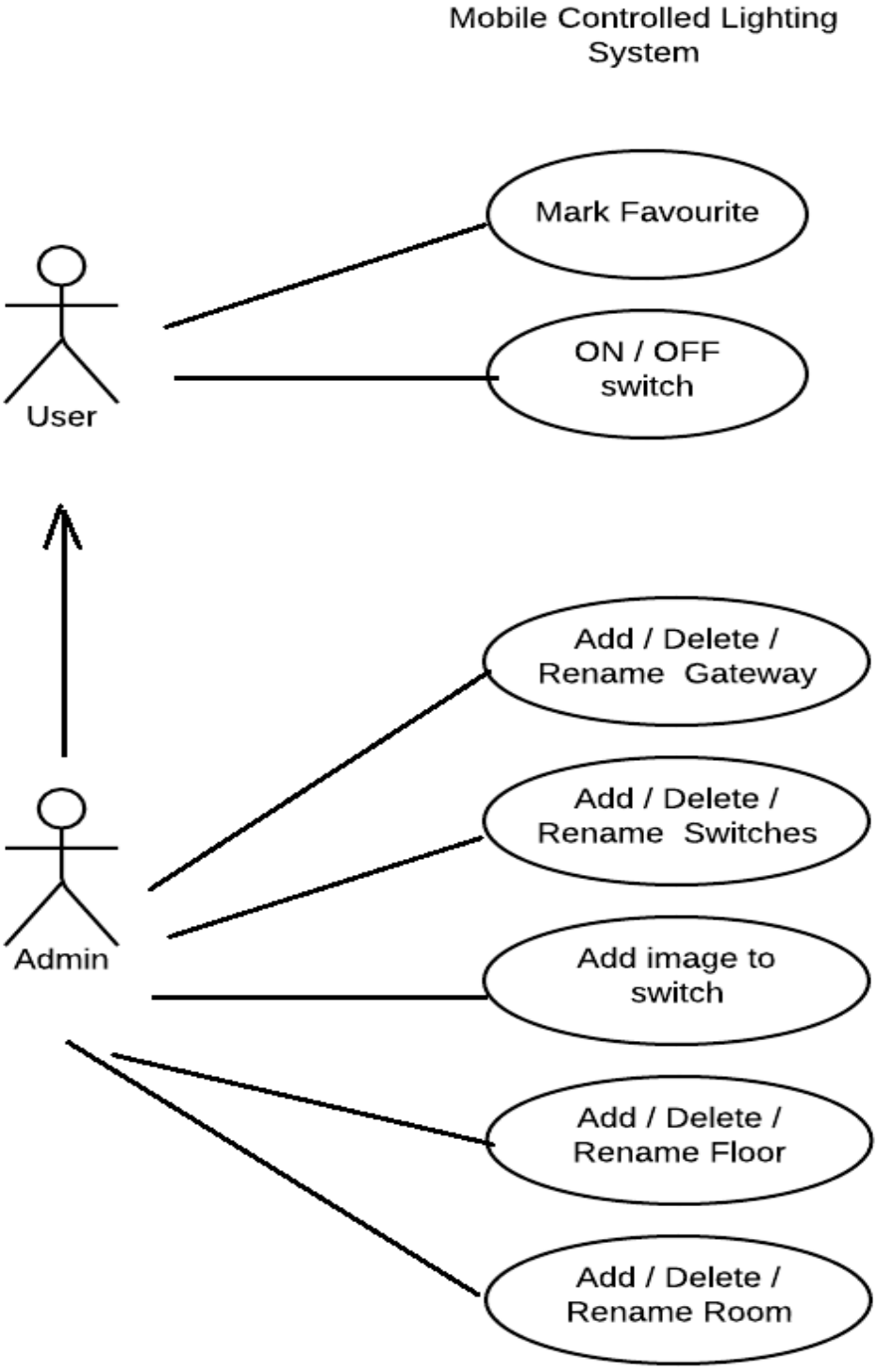


Figure 3: Process Diagram

2.1.3.1 Mobile Controlled Lighting System

2.1.3.1.1 Switching the light with android app

Table 3: Process Description

Identifier	Controlling the switch with an app.
Purpose	Ease of use.
Requirements	Hardware(gateway and switch), Software(in server and in app)
Development Risks	People are not willing to use the new system.
Pre-conditions	Login, gateway is configured, switch is added.
Post-conditions	Added gateway should not be added again, added switch should not be added again and revoked access user will not be able to use the system until permission has been given again.

Table 4: Typical Course of Action

Seq#	Actor's Action	System's Response
1	Add image for each switch	Update the image in the database
2	Assign gateway names	Update the database if succeed
3	Delete gateway	Delete the gateway entry in the database.
4	Switch On/Off switches	Update the state of the switch in the database.
5	Add favorite screen	Update the database with the favorite screen having list of switches for a particular user.

Table 5: Alternate Course of Action

Seq#	Actor's Action	System's Response
1	Add image for each switch	Failure and try again.
2	Assign gateway names	Failure and try again
3	Delete gateway	Failure and try again
4	Switch On/Off switches	Failure and try again
5	Add favorite screen	Failure and try again

Table 6: Exceptional Course of Action

Seq#	Actor's Action	System's Response
1	Any user action and server is down	No response from server
2	Configuring gateway but	No response from gateway.

	gateway is not configured	

2.1.4 Modes of Operation

The system will operate in two modes:
1) Normal User Mode
2) Restricted User Mode

In Normal User Mode, anyone can access all the features in the app.
In Restricted User mode, user can lock manage gateway and manage switch screens. So that only the authorized user can access those screens with password and no one else.

2.2 System Analysis Rationale

The rationale in system analysis is that the users are willing to use the mobile controlled lighting and not the traditional switches. They are willing to add gateway, add switches and give the access permissions to others for using them.

3. Technology-Independent Model

3.1 Design Overview

3.1.1 System Structure

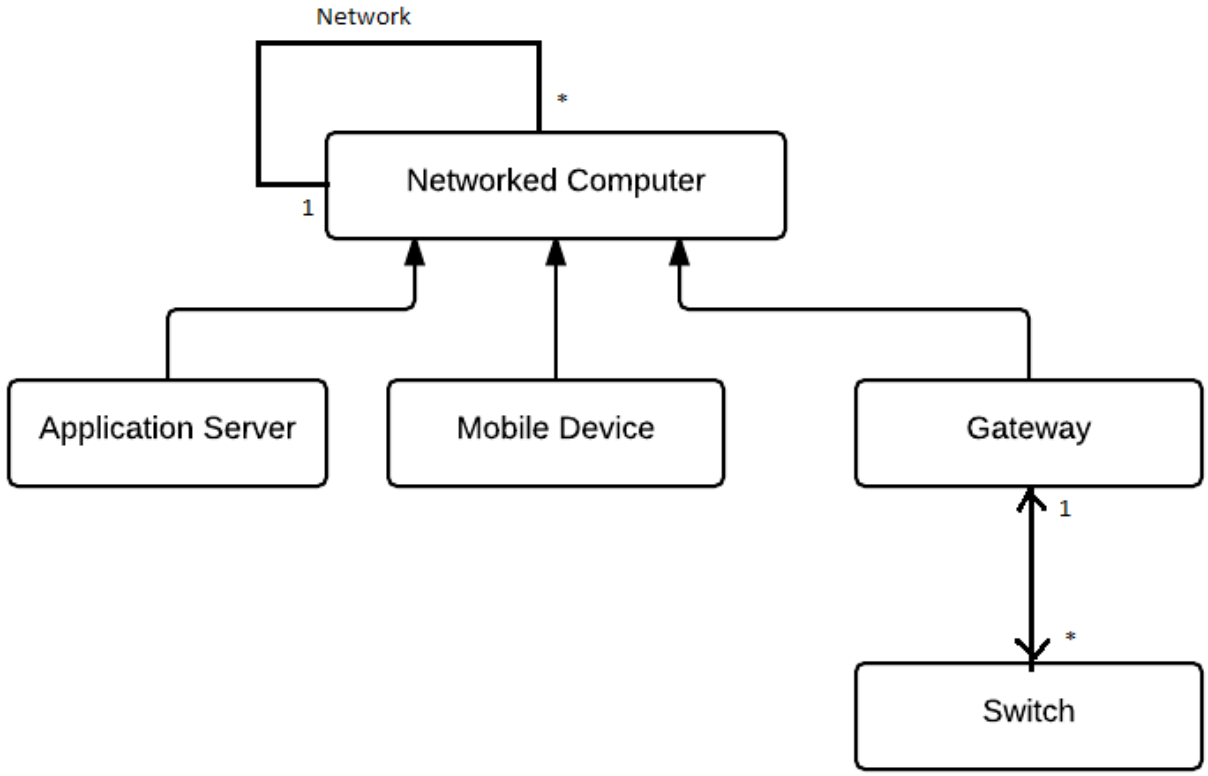


Figure 4: Hardware Component Class Diagram

Figure 5: Software Component Class Diagram

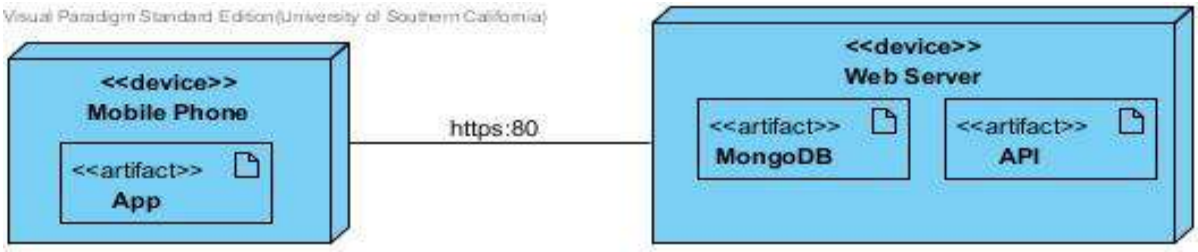


Figure 6: Deployment Diagram

Figure 7: Supporting Software Component Class Diagram

Table 7: Hardware Component Description

Hardware Component	Description
Application Server	The application server is the server on which the gateway management and switch management application resides.
Switch	Hardware for automatically turning on/off the light.
Gateway	Hardware to send/receive signal to/from switch.
Mobile Device	A mobile device to access the switch via server.

Table 8: Software Component Description

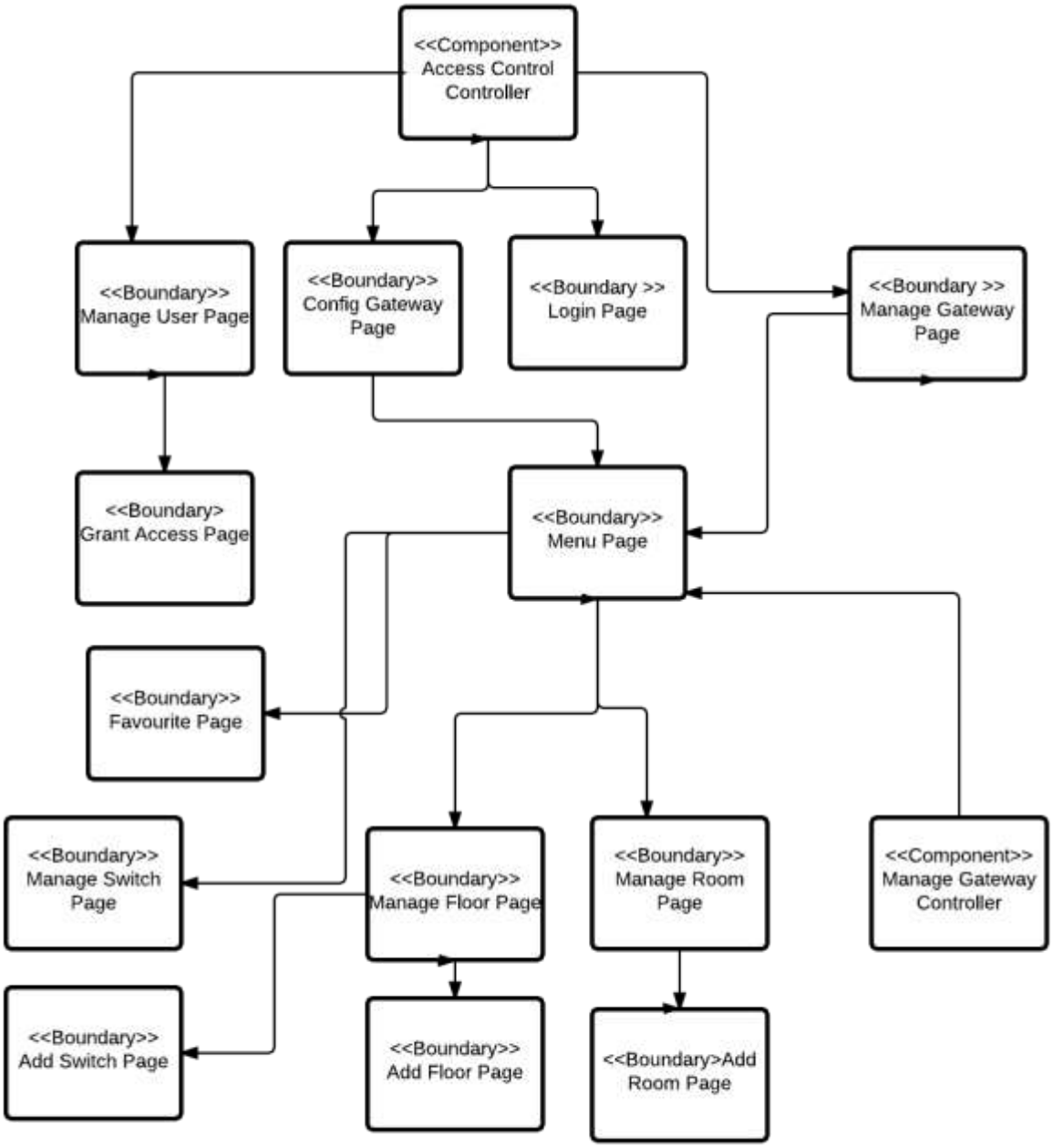
Software Component	Description
User Interface Component	This component comprises of all the pages on the web to access the application server by the users.
Access Management Component	This component is used by the access management controller (admin) to provide access to the users.
Gateway management Component	This component is used by the gateway management controller to configure the gateway and to add switches to a particular gateway.
DBMS	This is the database management system (DBMS) that stores all the data used by the gateway management and switch management system.

Table 9: Supporting Software Component Description

Support Software Component	Description

3.1.2 Design Classes

3.1.2.1 <Classes n>



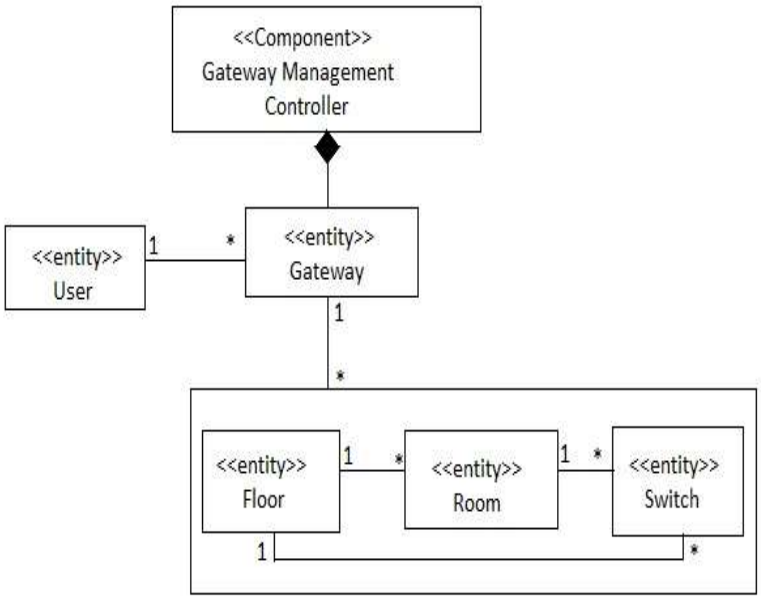


Figure 8: Design Class Diagram

Table 10: Design Class Description

Class	Type	Description
Gateway Management Controller	Component	Contains all the logic components for interacting with other entities.
User	Entity	User
Floor	Entity	Contains information about the switches in the floor.
Room	Entity	Contains information about the switches in the room.
Switch	Entity	Contains information about the switches.
Gateway	Entity	Contains information about the gateway and the switches attached to it.

3.1.3 Process Realization

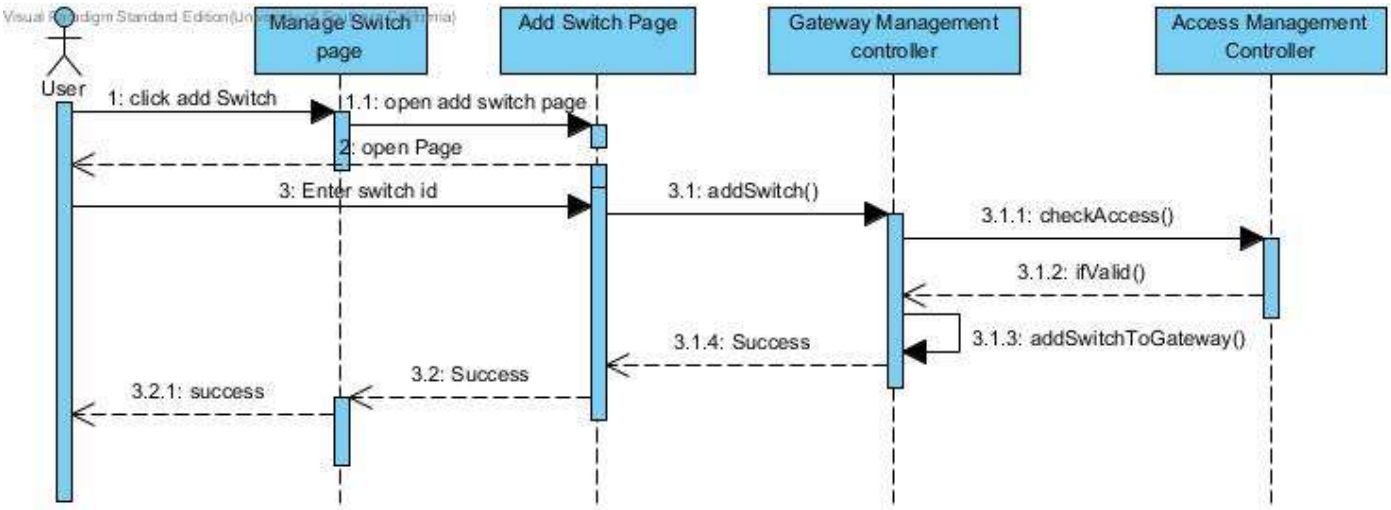


Figure 9: Process Realization Diagram

3.2 Design Rationale

We have 3 tier architecture because we wanted to decouple the user interface, business logic and stored data. The following is the list of the 3 tier architecture and specific components in each tier:

- User Interface Layer
  - User Interface component
- Business Logic Layer
  - Access Management component
  - Gateway Management component
- Database Management Layer
  - DBMS

The three-tiered architecture clearly shows the separation between user interface and business logic and between business logic and data storage. The Business Logic layer components are broken down in such way that each component performs specific functions that do not overlap with the functions assigned to any other component.

Although the access management component and gateway management component may appear to be highly coupled, they server different purposes and their separation allows for better integration with the systems. Access management component is used for providing access to other users by admin and gateway management component is used to configure gateway and add switches to a particular gateway.

We decided to use a COTS DBMS because it would be too time consuming to implement the data storage component through the hardware platform's file system.

4. Technology-Specific System Design

4.1 Design Overview

4.1.1 System Structure

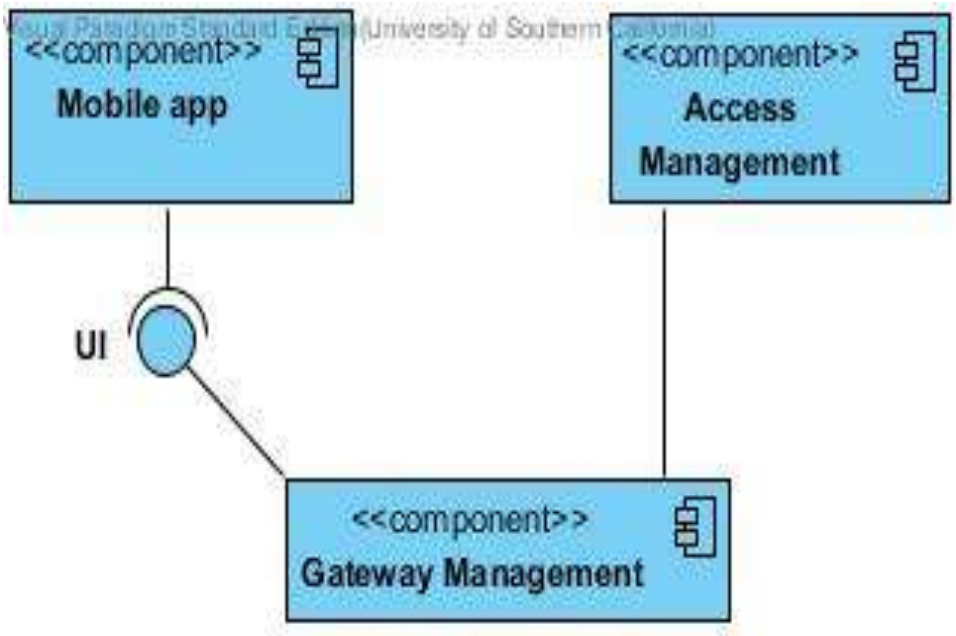


Figure 10: Hardware Component Class Diagram

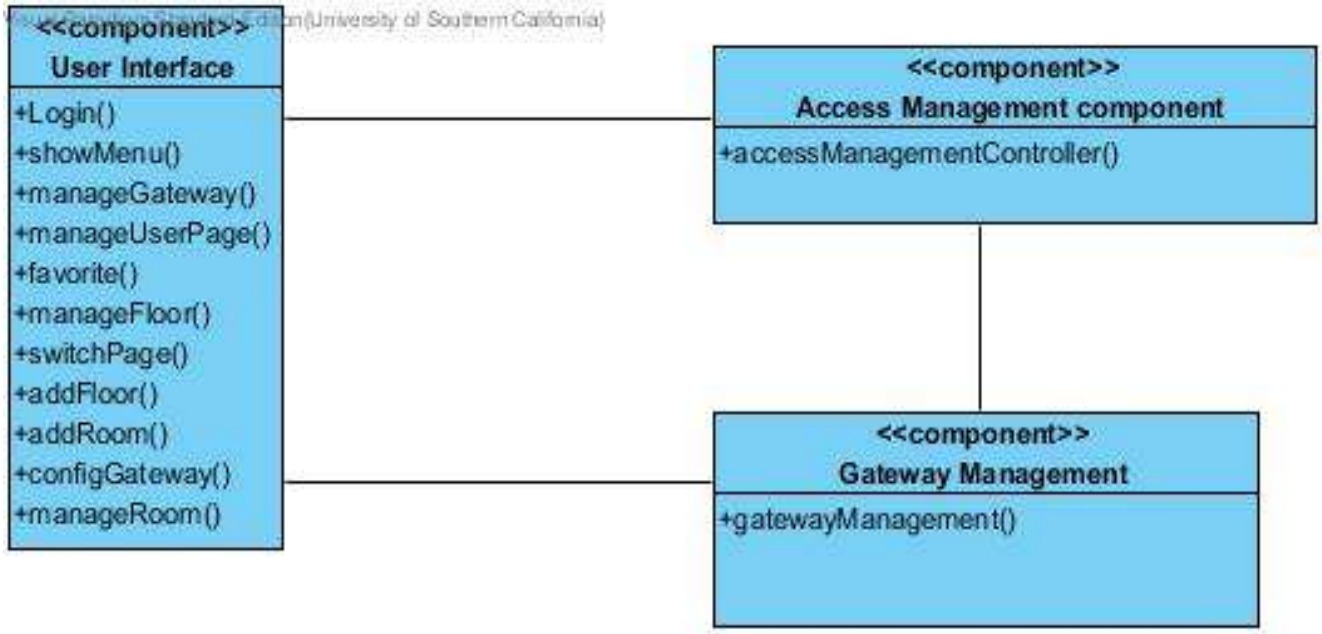


Figure 11: Software Component Class Diagram

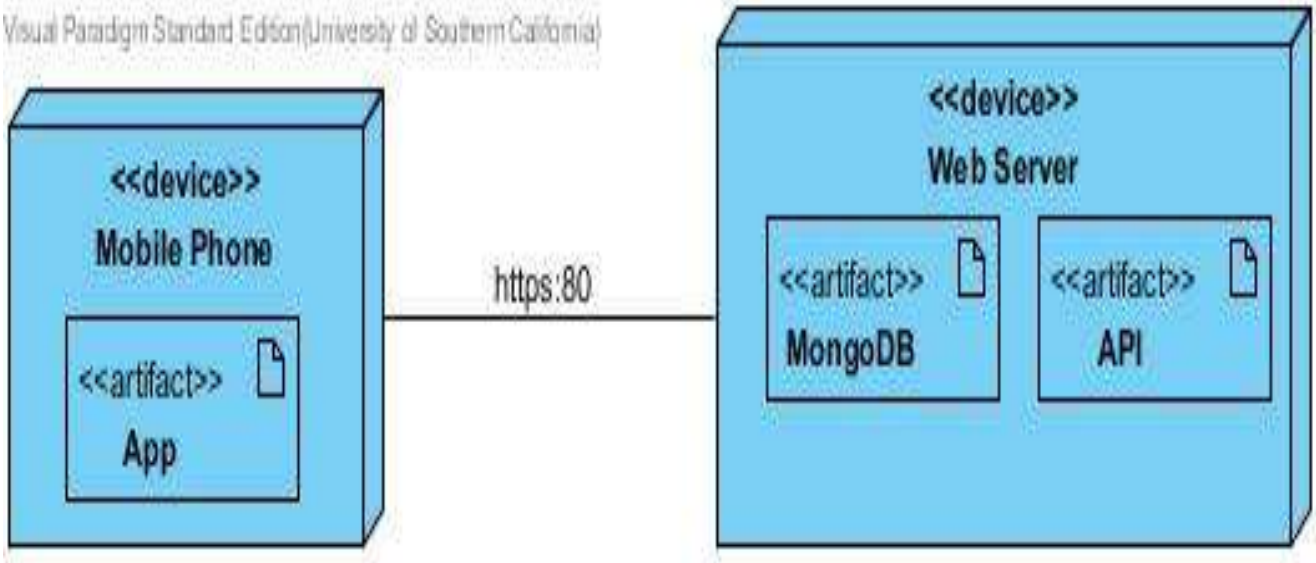


Figure 12: Deployment Diagram

<<Optional: Supporting Software Infrastructure Diagram>>

Figure 13: Supporting Software Component Class Diagram

Table 11: Hardware Component Description

Hardware Component	Description
Node JS	Node.js is an open source, cross-platform runtime environment for server-side applications
Switch	Hardware for automatically turning on/off the light.
Gateway	Hardware to send/receive signal to/from switch.
Android device	Android mobile app is used to access the switch via server.

Table 12: Software Component Description

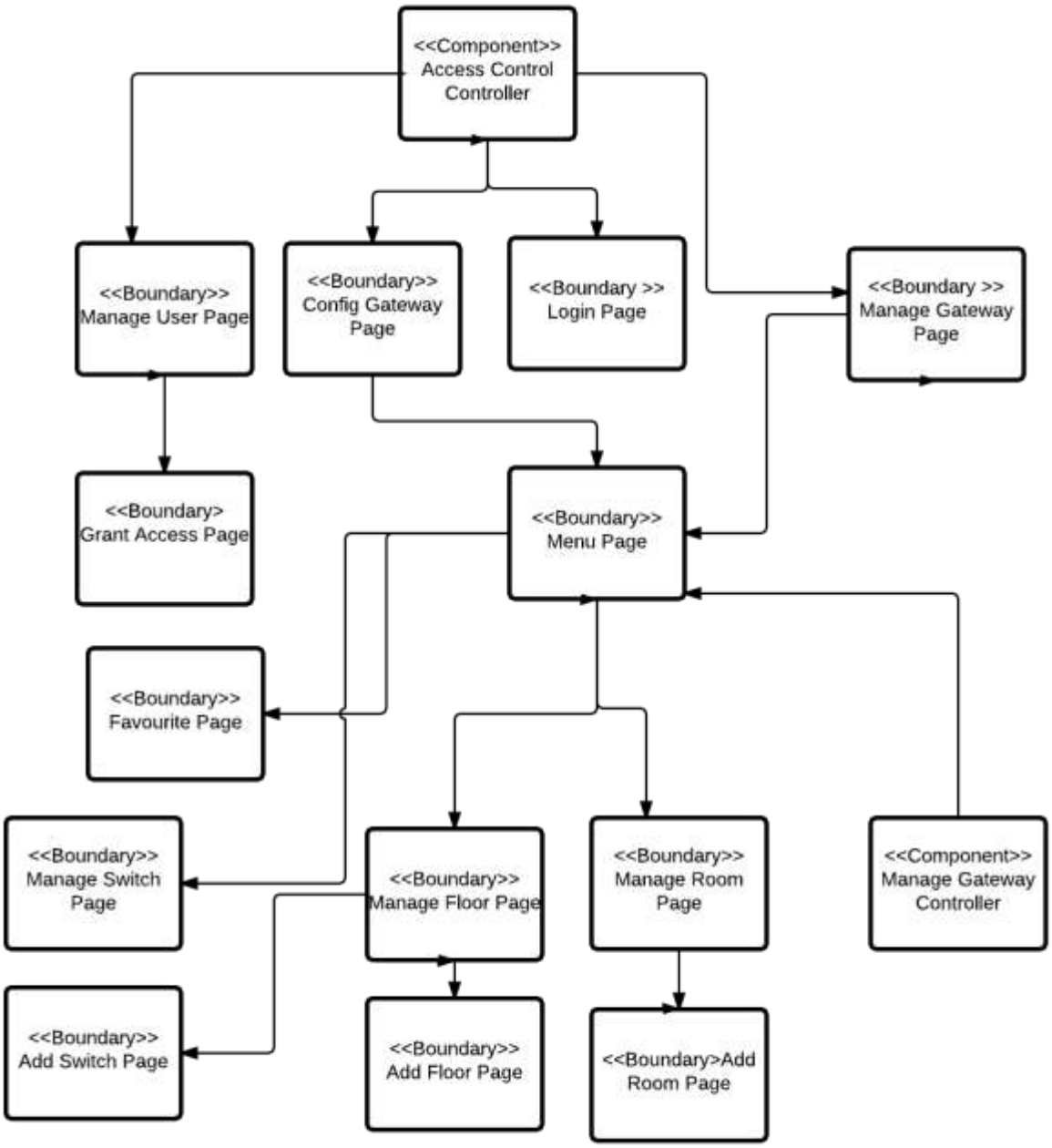
Software Component	Description
User Interface Component	This component comprises of all the pages on the web to access the application server by the users.
Access Management Component	This component is used by the access management controller (admin) to provide access to the users.
Gateway management Component	This component is used by the gateway management controller to configure the gateway and to add switches to a particular gateway.
MongoDB	MongoDB is a cross-platform document-oriented database NoSQL database.

Table 13: Supporting Software Component Description

Support Software Component	Description

4.1.2 Design Classes

4.1.2.1 <Classes n>


<<Component>>
Access Control Controller
<<Boundary>>
Manage User Page
<<Boundary>>
Config Gateway Page
<<Boundary >>
Login Page
<<Boundary >>
Manage Gateway Page
<<Boundary>
Grant Access Page
<<Boundary>>
Menu Page
<<Boundary>>
Favourite Page
<<Boundary>>
Manage Switch Page
<<Boundary>>
Manage Floor Page
<<Boundary>>
Manage Room Page
<<Component>>
Manage Gateway Controller
<<Boundary>>
Add Switch Page
<<Boundary>>
Add Floor Page
<<Boundary>Add
Room Page

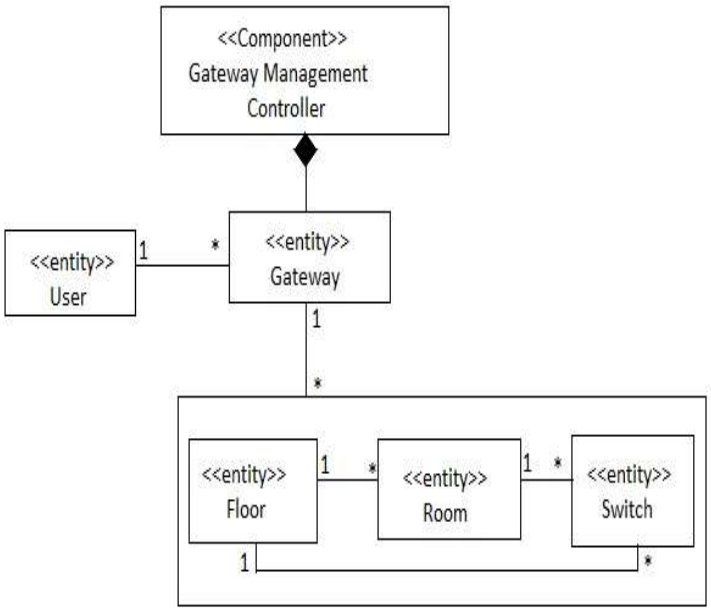


Figure 14: Design Class Diagram

Class	Type	Description
Gateway Management Controller	Component	Contains all the logic components for interacting with other entities.
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Gateway	Entity	Contains information about the gateway and the switches attached to it.

Table 14: Design Class Description

4.1.3 Process Realization

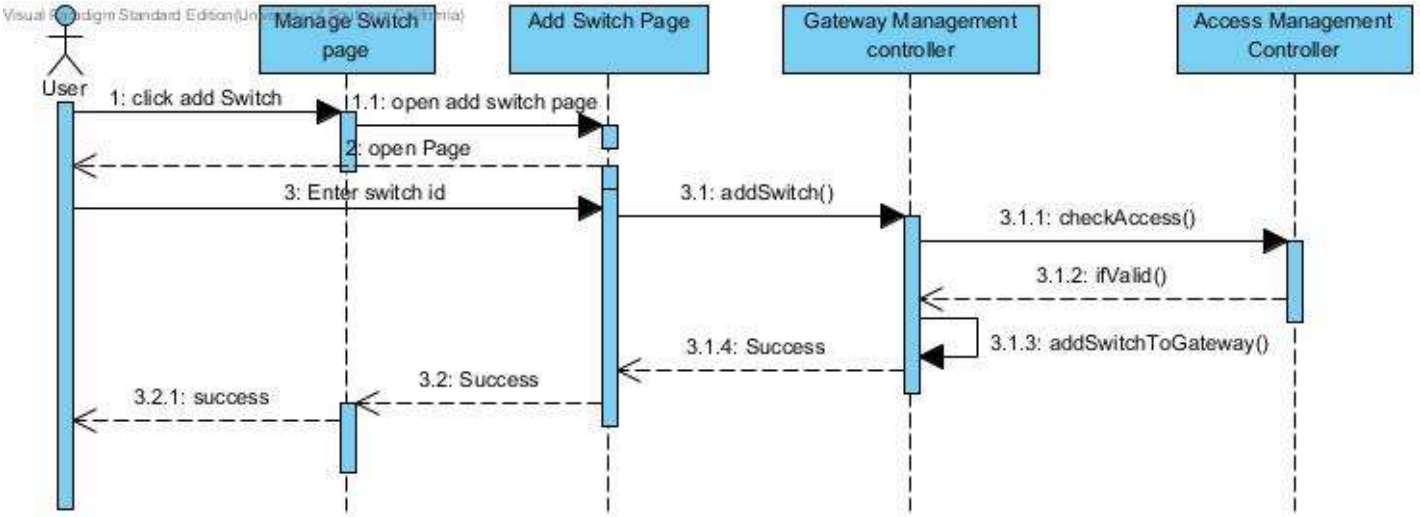

Figure 15: Process Realization Diagram

4.2 Design Rationale

We have 3 tier architecture because we wanted to decouple the user interface, business logic and stored data. The following is the list of the 3 tier architecture and specific components in each tier:

- User Interface Layer
  - Android Mobile device
- Business Logic Layer
  - Access Management component(Node JS)
  - Gateway Management component(Node JS)
- Database Management Layer
  - Mongo DB

The three-tiered architecture clearly shows the separation between user interface and business logic and between business logic and data storage. The Business Logic layer components are broken down in such way that each component performs specific functions that do not overlap with the functions assigned to any other component.

We use node.js as an open source, cross-platform runtime environment for server-side applications because it has already been used by the last semester students and it is a continuation project.

MongoDB	MongoDB is a cross-platform document-oriented database NoSQL database.

5 Architectural Styles, Patterns and Frameworks

Table 15: Architectural Styles, Patterns, and Frameworks

Name	Description	Benefits, Costs, and Limitations

3-tier architecture	• User Interface Layer
	  ○ Android Mobile device
	• Business Logic Layer
	  ○ Access Management component(Node JS)
	  ○ Gateway Management component(Node JS)
	• Database Management Layer
		Decouple the user interface, business logic and stored data.

NodeJS	Node.js is an open source, cross-platform runtime environment for server-side applications	Node.js main advantage is that it doesn't have any flaws that usually appear when we work with streams - creation of new data structures providing stream work, blocking memory.
Express	Express.js, a Sinatra-inspired web development framework for Node.js, and the de-facto standard for the majority of Node.js applications out there today.	It is used for routing of rest APIs.
Node Mailer	Nodemailer is an easy to use module to send e-mails with Node.JS (using SMTP or sendmail or Amazon SES) and is unicode friendly.	It is used as an email sending service.
Mongoose	Mongoose provides a straight-forward, schema-based solution to modeling your application data.	It includes built-in type casting, validation, query building, business logic hooks and more, out of the box