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| *FLORIDA INTERNATIONAL UNIVERSITY*  School of Computing and Information Sciences  CIS 4911 Senior Capstone Project |
| **Smart Systems for Occupancy and Building Energy Control (SSOBEC)** |
| **Final Deliverable** |
|  |
|  |
| **Instructor**: Dr. Masoud Sadjadi  **Mentor**: Dr. Leonardo Bobadilla  **Mentor:** Dr. Ali Mostafavi    01/23/2015  *Group Member:*  Maria Eugenia Presa Reyes  Dalaidis Hidalgo Arencibia |

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Executive Summary

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# Introduction

The introductory chapter provides a background information about the Smart Systems for Occupancy and Building Energy Control. In the next section, the problem definition and the scope of the system will be described. After that, the design methodology used to be represented the design. Following, definitions, acronyms, and abbreviations of terms used will be show in this sections. Finally, this sections will conclude with a brief overview of what to be expected from the following chapters.

## 1.1 Problem definition.

1.2 Scope of system.

## 1.3 Over all development methodology.

1.4 Definitions, acronyms, and abbreviations

Below is a list of definitions, acronyms, and abbreviations.

**DEFINITIONS:**

**Facility Manager**: Person that has elevated privileges in the application.

**Occupant**: Person with limited access, who uses the application to track energy consumption for just his own rooms.

**Android Studio**: Is the official IDE that it is used by Android application development based on IntelliJ IDEA.

**ACRONYMS AND ABBREVIATIONS:**

**SSOBEC**: Is an app which aims to help people learn to reduce consume of energy.

**EIA:** U.S. Energy Information Administration

**DB**: Database

**FIU**: Florida International University

**SCIS**: School of Computing & Information Sciences

**App**: Application

## 1.5 Overview of document

The following chapter will explain the information presented in the project. Chapter 2, is about feasibility study and made a description of the current system identifying limitations and constraints, the description of the alternative solution and the explanation of why the solution was selected. Chapter 3, describe the project and give information about the hardware and software that will be used. Chapter 4, introduce the system requirement containing functional and no functional requirements and requirement analysis. Chapter 5, includes the system design, subsystem decomposition, hardware and software mapping, persistent data management, and security and privacy with describe the user authentication processes, encryption of data and another. Chapter 6, present the design chapter with the detailed static model and dynamic model and the code specification that describe the class interface. Chapter 7, introduce the subsystem and system tests. Chapter 8, define terms used in document. Chapter 9, provides Appendix that have the objective to provide information about the Gant chart and another miscellaneous information. As a final point provide the works used as references.

# 2. Feasibility Study

The feasibility study explores the idea of Smart Systems for Occupancy and Building Energy Control from a practical point of view. At the start, it make a research to make sure that there is no system developed capable of bring to an end the desired tasks. Then, it describe the overall purpose of the Smart Systems for Occupancy and Building Energy Control, and how the features of the SSOBEC system will easily manage the use of the energy through a sensor network in order to save energy. After that, the high-level requirement are described and following the alternatives to certain aspect of SSOBEC system are analyzed. Finally, The recommendation for the project.

## 2.1 Description of current system. Identify limitations and constraints

The current system does not provide a smart approach to compare energy consumption of the building along with occupancy behavior of the people in the different zones of the building. A facility manager and Occupant can measure how much energy is consumed only after he/she reads the utility bills of each month. The facility manager does not know which rooms consume more energy than others, or which rooms waste more energy when they are left empty and electricity is being used. There is no system that notifies a Occupant when his/her room is currently empty and wasting energy. The facility manager and Occupant can see the amount of energy usage there has been for a period of time but cannot identify how much of that energy was not consumed efficiently.

2.2 Description of alternative solutions considered.

## 2.3 Recommendation with explanation of why the solution was selected.

# 3. Project Plan

This chapter present the SSOBEC system a project manager. Initially, the organization of the project and its roles will be listed and described. Next, the milestones with all the task and Deliverables will be planned. To conclude, the estimate cost amount will be offered.

## 3.1 Project Organization

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **NAME** | **ROLES** | **TASKS** | **PERIOD REQUIRED** | **KEY PHASES** |
| Maria Presa | * Project manager * Document Editor * Developer * Test Engineer |  |  |  |
| Dalaidis Hidalgo | * Project manager * Document Editor * Developer * Test Engineer |  |  |  |

### 3.1.1 Project Personnel

### 3.1.2 Hardware and Software Resources

**HARDWARE**

* Computer that has a 1.6 GHz or faster processor
* 1GB(32 Bit) RAM
* 3GB of available hard disk space
* Mobile phone
* Tablet with Android

**SOFTWARE**

* Git
* GitHub
* Google Drive
* Gmail
* Android Studio
* Mingle
* StarUML
* Netbeans
* SQLite
* SQL

### 3.2 Identification of Tasks, Milestones and Deliverables

|  |  |
| --- | --- |
| **MILESTONE** | **TASK AND DELIVERABLE** |
| Documentation | * Feasibility Study * Project Plan * System Design * Object Design |
| Environment Setup | * Android Studio * JDK 8 * Source Tree * Git * Github * StarUML * Visio 2013 * LAMP * Vertabelo * PHPMyAdmin * SqliteBrowser * Google Drive * Mingle |
| UI Design (Project) | * Login * Logout * Zone Details * Occupancy in different zones * Plug Load * Temperature * Artificial Lighting |

## 3.3 Cost of the Project

# 4. System Requirements

Introduce the proposed system (one or two paragraphs).

## 4.1 Functional and Nonfunctional Requirements – similar to RD

## 4.2 Requirements Analysis

This section consist of different subsections like the use case model of the Smart Systems for Occupancy and Building Energy Control, the static model, and the dynamic model.

### 4.2.1 Use case Model

The use case diagram provide the list of steps that defines the interaction between the two types of users displayed in the diagram: facility manager and occupant. They all have the intention to accomplish the goal of this proposed system.



### 4.2.2 Static Model

A static model states the system. The diagram will display the structure of the system by showing the classes, attributes, methods, and also the relationship that can be between these classes. You can go for reference to the Appendix D.

### 4.2.4 Dynamic Model

The dynamic model does account for time. For the Smart Systems for Occupancy and Building Energy Control, sequence diagram will be included. These has objective to show the interaction between object and class in a sequence of event arranged in a time line. In addition, it displays functionality in order to allow the developers and programmers to view how the users should made transition based on these actions.

5. System Design

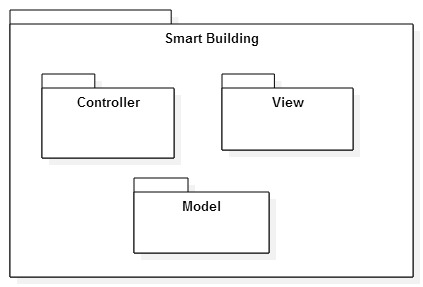
This chapter give an overall of the system design implemented in the Smart Systems for Occupancy and Building Energy Control. It will made a description of the system design architecture using two architectural patterns. It will be responsible for a detailed description of the subsystem decomposition for each subsystem. It will be cover hardware and software mapping. Following, it will present the persistent Data Management showing the data that need to be stored and also the structure of the data. Finally, it will describe the security and privacy through authentication processes, encryption of data, and use of firewall in order to improve the security of the system.

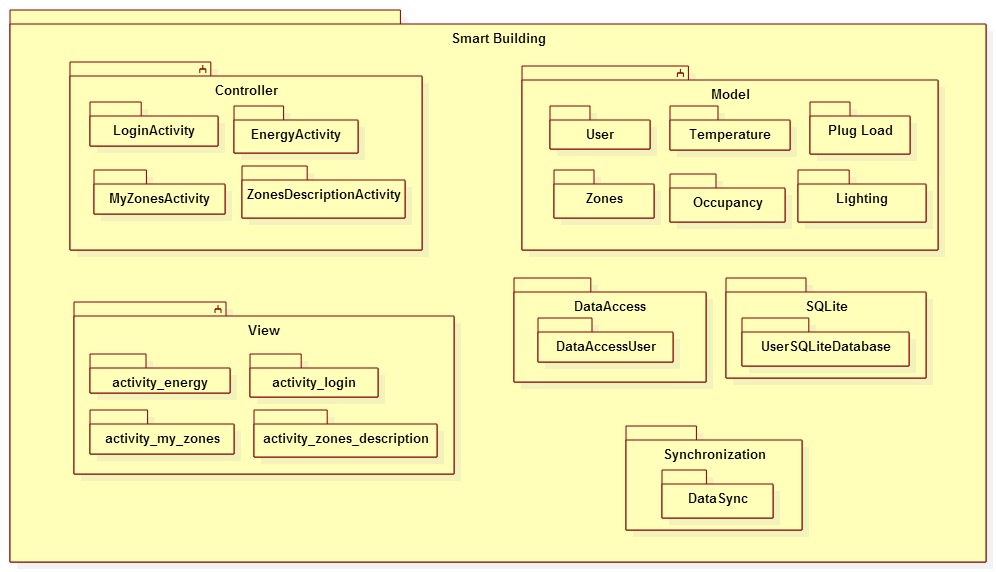
5.1 Overview

The two architectural are Model View Controller (MVC) and Three-tier architecture.

The three-tier architecture is compose of a interface layer, application layer and storage:

* **Interface layer**: the view of the system, it includes all boundary objects such as: buttons, input text fields and more.
* **Application layer**: is the controller of the system, it includes all the android activities.
* **Storage**: is the model of the system that realizes the storage and retrieval of persistent objects from either our SQLite database or the external MySQL Database.





5.2 Subsystem Decomposition

**Activity:** Symbolizes a single user interface class. It is frequently packaged together to form the UI components of the application. That is why, controller has ZoneActivity, ZoneDescription Activity and Login Activity.

**Model:** Permit the access to the database like SQLite and My SQL Database. In brief, the logical sense is to tie the user interface components with the data store components.

**View:** The objective of this pattern is to separate the components of user interface.  View is defined by the XML file.

**Login:** This will welcome the users (Facility Manager or Occupant) when the application started.

**Zone activity:** This will display the zones to the user. At the same time wait for an action.

**Zone description:** This will display the description of all his/her zones for the facility manager and only specify description for occupant that is the responsible of only one room.

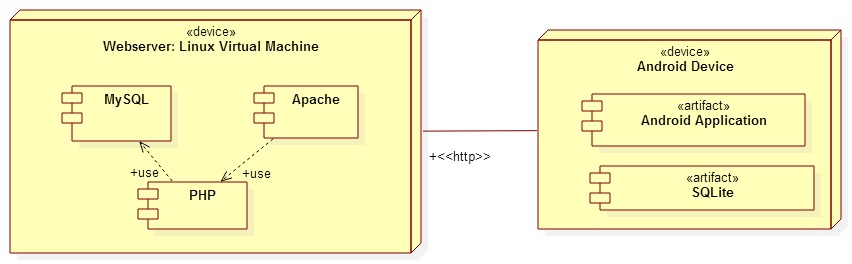
**Report:** This will display all the information that user can. Permit manipulate the information that user can have access. Also, they can manipulate the information and show statistic and graph.

**Report of Limited Zones:** The occupant will have a limited report of his/her zone.

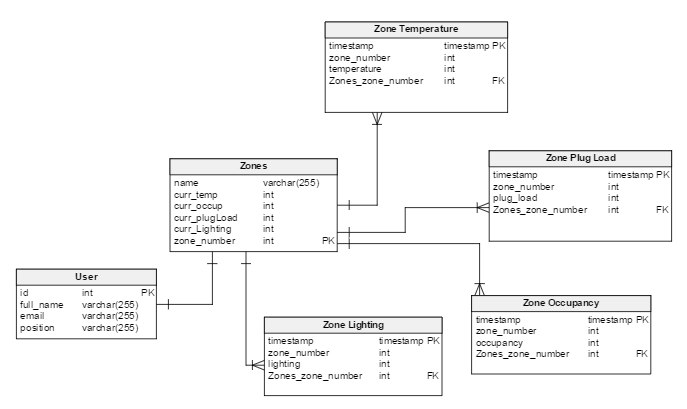
**SQLite:** This is an internal Database of the device.

**My SQL Database:** This is an external Database.

5.3 Hardware and Software Mapping



5.4 Persistent Data Management



5.5 Security/Privacy

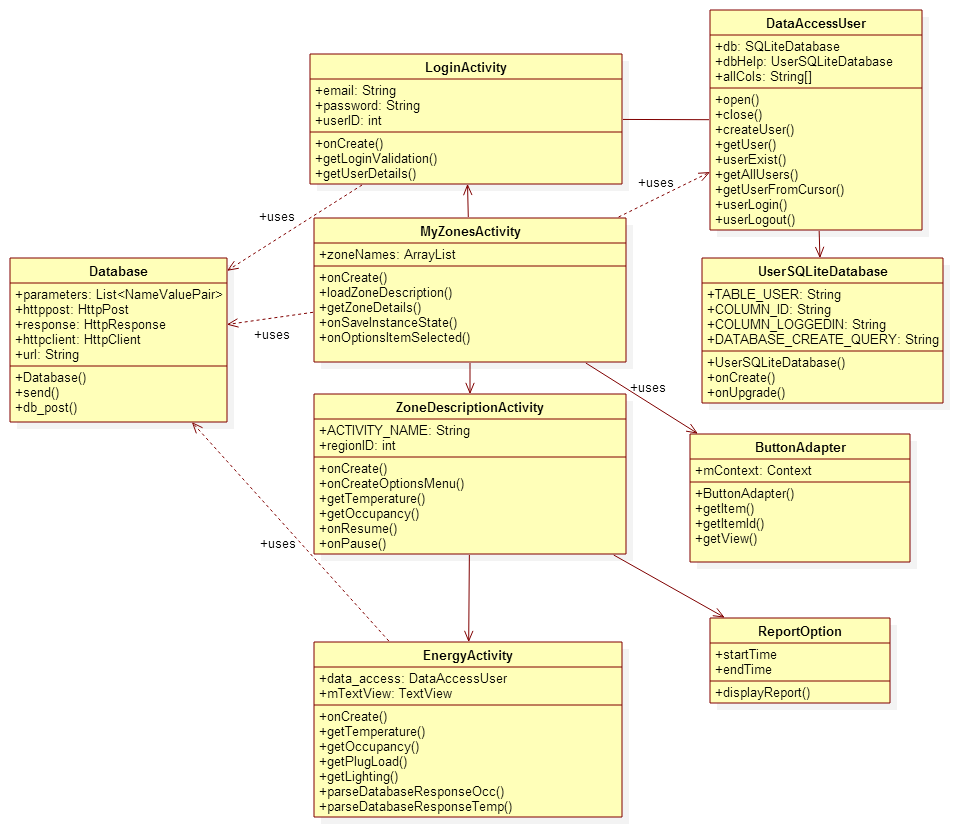
Android applications use an advance hardware and software, and it is designed to be truly open. To guarantee this protection its platform offer an application environment that ensures the security of data, users, applications, the devices, and the network. Android provide protection for all users of the platform. An application’s process is a secure sandbox that permit gain some security. Also the sandbox can isolates apps from each other, so they cannot tamper which each other, except by explicitly declaring the permissions it needs for additional capabilities not provided by the basic sandbox.

# 6. Detailed Design

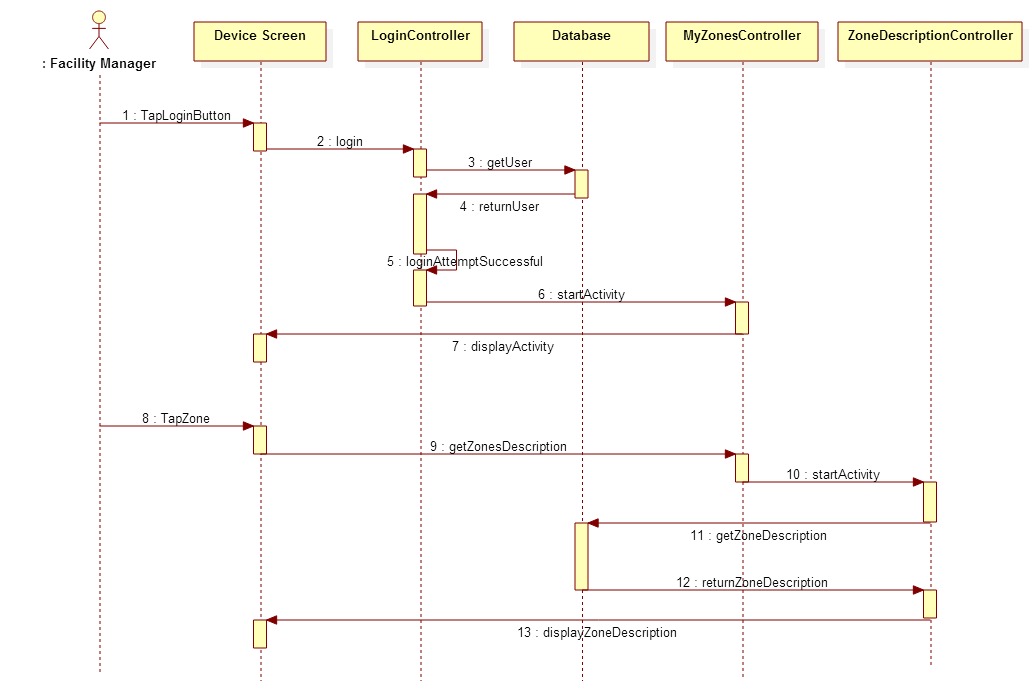
Introduce the detailed design chapter (one or two paragraphs).

6.1 Overview – briefly describe the behavior and structure of each subsystem. Describe the design patterns used and why they were selected.

6.2 Static model



6.3 Dynamic model





6.4 Code Specification - describe the class interfaces (attributes and method signatures) and constraint (invariants, pre-condition and post-conditions). Code should be in Appendix E.

# 7. System Validation

Introduce the system validation chapter (one or two paragraphs).

7.1 Subsystem Tests – test each of the subsystems. This will involve the creation of a test drivers and stubs. Include the code for the test drivers and stubs in Appendix G.

7.2 System Tests - For each use case create at least 3 test cases, 2 sunny day and one rainy day, should include security test cases. Each test case should include: test case id, purpose, test setup environment, test inputs, and expected outputs.

7.3 Evaluation of Tests – evaluate how successful the tests were. Use a tabular form.

8. Glossary

|  |  |
| --- | --- |
| **TERM** | **MEANING** |
| Class Diagram | An illustration of all the classes in the system. |
| Sequence Diagram | An illustration on how processes operate with one another and the user during the execution of one specific functionality. |
| Use Case | List of steps describing the interaction between a user and a system to achieve one goal. |
| Task | A piece of job that require to be done within a certain time. |
| Functional Requirement | Statements of services the system should provide, how the system should react to particular inputs and how the system should behave in particular situations. |
| Non- Functional Requirement | Constraints on the system e.g., max. response time, min. throughput, reliability, OS platform etc.. |

# 9. Appendix

## 9.1 Appendix A - Project schedule (Gantt chart or PERT chart).





## 9.2 Appendix B – All use cases with nonfunctional requirements.

The following use cases that we are implementing:

UseCase ID: **SSOBEC01-Login**

Actors:

Facility Manager

Occupant

Pre-conditions:

1. Download the application.
2. Install the application.
3. Application activated.
4. Created account.
5. Users must have a username and password created.

Description:

1. Use case begins when the Facility Manager/Occupant access the login option.
2. Use case ends when the user will be prompted with a data entry template for username and password.

Relevant requirements:

A user will only be admitted into the system if he/she has a valid username and password.

Post-conditions:

1. Login Successful to the system.

Alternative Courses of Action for Venue Registered Visitor:

1. In step 2 the user have the option to reset the password if he/she want.

Exceptions:

1. The login option on the application is not active.
2. The cancel option in the application is not active.
3. The option to reset password is not active.
4. The database is inactive.

Related Use Cases:

Special Requirements:

* Usability: No previous training time because is simple and easy following the instruction.
* Reliability: The application should perform correctly 99% of the time.
* Performance: The application should be sent and save within 5 seconds.
* Supportability: The application should be easy to maintain and make appropriate changes and be correctly handled by Android.

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

UseCase ID: **SSOBEC02-Logout**

Actors:

Facility Manager

Occupant

Pre-conditions:

1. Users must have previously logged in.

Description:

1. Use case begins when the Facility Manager/ Occupant accesses the logout option.
2. Use case ends when the user is log out of the system and display the login screen.

Relevant requirements: A user will only have access to logout if he/she has been previously signed into the system.

Post-conditions:

1. User gets successfully logged out of the system.

Alternative Courses of Action for Venue Registered Visitor:

1. N/A.

Exceptions:

1. The logout option on the application is not active.

Related Use Cases:

Special Requirements:

* Usability: No previous training time because is simple and easy following the instruction.
* Reliability: The application should perform correctly 99% of the time.
* Performance: The application should be sent and save within 5 seconds.
* Supportability: The application should be easy to maintain and make appropriate changes and be correctly handled by Android.

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

UseCase ID: **SSOBEC03-Zones**

Actors:

Facility Manager

Occupant

Pre-conditions:

1. The user has registered the zone he/she which to observe
2. The user has access to the zone

Description:

1. Use case begins when the user taps on the zone that appears in the screen
2. The application will then fetch all the data for that particular zone
3. Use case ends when the system displays on the phone screen all the information for the zone chosen by the user

Relevant requirements:

1. An occupant will only be able to add a room if he/she is authorized by the facility manager

Post-conditions:

1. The user will have a list of drop down menus named: “Occupancy”, “Temperature” and “Plug Load” each with further examples of the description of the room.

Exceptions:

1. The database is not active

Related Use Cases:

Special Requirements:

* Usability: No previous training time.
* Reliability: The system should work 99% of the time.
* Performance: ...
* Supportability: The application should be easy to maintain and make appropriate changes and be correctly handled by Android.

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

UseCase ID: **SSOBEC04-Add a zone**

Actors:

Facility Manager

Occupant

Pre-conditions:

1. Occupant must be first authorized to be able to view the energy usage and occupancy activity of a certain zone.

Description:

1. Use case begins when the user taps the option to “Add a zone”
2. The application will present the user with a text field that asks which room the user wishes to add
3. The user will enter the name of the zone they want to add

Relevant requirements:

Post-conditions:

1. .

Alternative Courses of Action for Venue Registered Visitor:

Exceptions:

Related Use Cases:

Special Requirements:

* Usability:
* Reliability:
* Performance:
* Supportability:.

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

UseCase ID: **SSOBEC05- Notification**

Actors:

Facility Manager

Occupant

Pre-conditions:

1. Occupant is logged in.
2. Occupant is located in one zone.

Description:

1. Use case begins when the system recognize that in one zone of the occupant is not saving energy. (e.g. the lights were left on while room is empty).
2. Use case ends when the system automatically sends a notification message to an Occupant using a text message to his/her phone.

Relevant requirements: An occupant  will only be notify if he/she is the responsable on save energy specifically on his/her zone.

Post-conditions:

1. The occupant has a notification on his/her phone.

Alternative Courses of Action for Venue Registered Visitor:

1. None

Exceptions:

1. The notification is not received but it is sent.
2. The notification is not sent.

Related Use Cases:

Special Requirements:

* Usability: None
* Reliability: The use should perform correctly 99% of time.
* Performance: The notification should be sent immediately when the times comes.
* Supportability: Notification should be correctly handle by Android.

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

UseCase ID: **SSOBEC06- Report**

Actors:

Facility Manager

Occupant

Pre-conditions:

1. Facility Manager/Occupant is logged in.
2. The database is up to date in the system and in real time.

Description:

1. Use case begins when the user wants to make a request of some information for a specific period of time.
2. Use case ends when the access to create a report is granted with full access to the Facility Manager and a Limited access for the Occupant.

Relevant requirements: A Facility Manager can has full access to create a report while the Occupant has only access to one limite zone in with he/she is the responsible to save energy.

Post-conditions:

1. Access to made a report is granted.

Alternative Courses of Action:

1. N/A

Exceptions:

1. The report in the Android application is not active.

Related Use Cases:

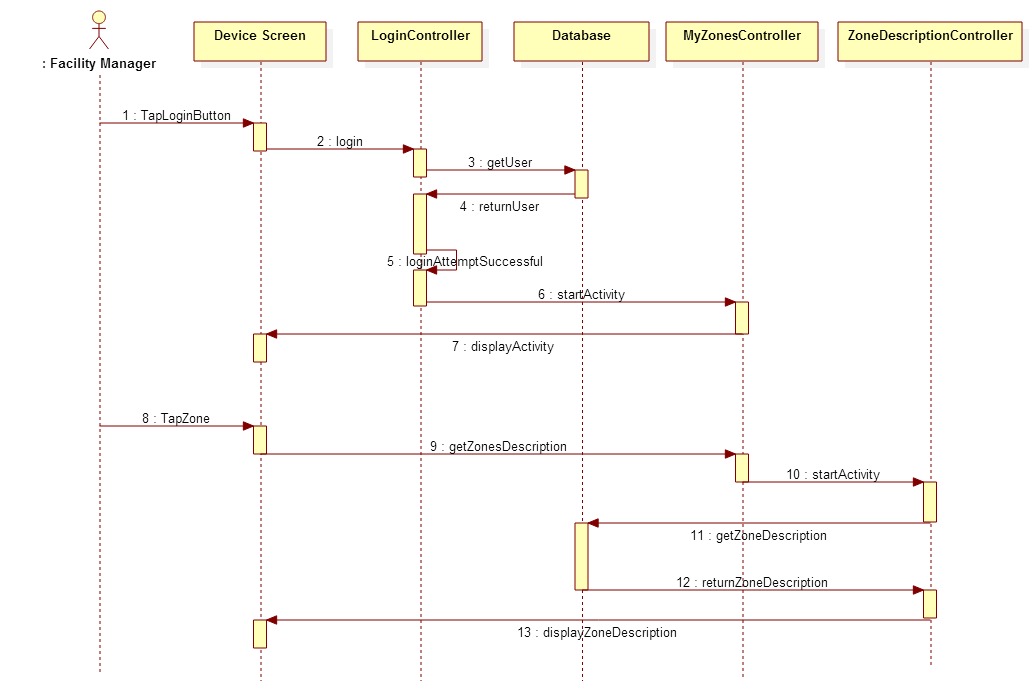
Special Requirements:

* Usability: No previous time because is simple and easy to follow the steps.
* Reliability: The system should perform correctly 99 % of the time.
* Performance: The application should be sent and save within 5 seconds.
* Supportability: Report should be correctly handle by Android.

## 9.3 Appendix C – User Interface designs.

## 9.4 Appendix D – Analysis models (static and dynamic)







## 9.5 Appendix E – Design models (static and dynamic)

## 9.6 Appendix F – Documented Class interfaces (code) and constraints.

## 9.7 Appendix G – Documented code for test drivers and stubs.

## 9.8 Appendix H – Diary of meeting and tasks for the **entire semester**.

Following are the diary entries for all of our meetings throughout the semester.

|  |  |
| --- | --- |
| **DATE** | January 21, 2015 |
| **Location** | FIU Modesto A. Maidique Campus ECS 212B |
| **Start** | 5:00 pm |
| **End** | 6:30 pm |
| **In Attendance** | Leonardo Bobadilla  Ali Mostafavi  Maria Presa Reyes  Dalaidis Hidalgo Arencibia |
| **Late** | N/A |
| **Agenda** | - General Background of the project  - Collect User Stories  - Begin to work with Feasibility Study |
| **Summary of Discussion** | -Meeting Time (All  weeks) |
| **Assigned Tasks** | -Create Google Drive to share our document between us.  - Continue working with user stories to improve our work. |

|  |  |
| --- | --- |
| **DATE** | January 26, 2015 |
| **Location** | FIU Modesto A. Maidique Campus ECS 212B |
| **Start** | 4:00 pm |
| **End** | 5:10 pm |
| **In Attendance** | Leonardo Bobadilla  Ali Mostafavi  Maria Presa Reyes  Dalaidis Hidalgo Arencibia |
| **Late** | N/A |
| **Agenda** | - Product Backlog  - Feasibility Study  -Project Plan  -System Design  -Object Design  -Name Android Application |
| **Summary of Discussion** | -Programs and tool to use in our application. |
| **Assigned Tasks** | -Dr. Leonardo Bobadilla and Dr. Ali Mostafavi make the selection of the Name of the Android Application.  -Continue working with the documentation in order to try to do the most that we can.  -Make a selection of the Linux machine for the Database. |

|  |  |
| --- | --- |
| ***DATE*** | *January 30, 2015* |
| ***Location*** | FIU Modesto A. Maidique Campus ECS 212B |
| ***Start*** | 4:00 pm |
| ***End*** | 5:00 pm |
| ***In Attendance*** | Leonardo Bobadilla  Ali Mostafavi  Maria Presa Reyes  Dalaidis Hidalgo Arencibia |
| ***Late*** | N/A |
| ***Agenda*** | - Check the Name of the Android Application  - Check our ideas of the Product Backlog with our mentors  - Check Feasibility Study  - Check Project Plan  - Check System Design  - Check Object Design  - Continue working of the documentation  -Continue thinking on the design of different diagrams  -Prepare the PorwerPoint for the presentation |
| ***Summary of Discussion*** | -The user stories that we are going to implementing in Sprint 1 |
| ***Assigned Tasks*** | Dalaidis: Login, Logout and Temperature  Maria: Zone Details, Occupancy in different zones  Continue improving our documentation |

|  |  |
| --- | --- |
| ***DATE*** | *February 13, 2015* |
| ***Location*** | FIU Modesto A. Maidique Campus ECS 212B |
| ***Start*** | 4:00 pm |
| ***End*** | 5:00 pm |
| ***In Attendance*** | Leonardo Bobadilla  Ali Mostafavi  Maria Presa Reyes  Dalaidis Hidalgo Arencibia |
| ***Late*** | N/A |
| ***Agenda*** | -Explain and show our Code  -Give more ideas for to do in our project during this semester |
| ***Summary of Discussion*** | -New stories point that should be assign  -New ideas for the project  -The user stories that we are going to implementing in Sprint 2 |
| ***Assigned Tasks*** | -Maria: Continue working with Occupancy in different zones and begin to do Artificial Lighting.  Dalaidis: Continue working with Temperature and begin to do Plug Load  Continue improving our documentation |

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| --- | --- |
| **DATE** |  |
| **Location** | FIU Modesto A. Maidique Campus ECS 212B |
| **Start** | 4:00 pm |
| **End** | 5:00 pm |
| **In Attendance** | Leonardo Bobadilla  Ali Mostafavi  Maria Presa Reyes  Dalaidis Hidalgo Arencibia |
| **Late** | N/A |
| **Agenda** |  |
| **Summary of Discussion** |  |
| **Assigned Tasks** |  |

|  |  |
| --- | --- |
| **DATE** |  |
| **Location** | FIU Modesto A. Maidique Campus ECS 212B |
| **Start** | 4:00 pm |
| **End** | 5:00 pm |
| **In Attendance** | Leonardo Bobadilla  Ali Mostafavi  Maria Presa Reyes  Dalaidis Hidalgo Arencibia |
| **Late** | N/A |
| **Agenda** |  |
| **Summary of Discussion** |  |
| **Assigned Tasks** |  |

# 10. References