Northwestern | McCORMICK SCHOOL OF ENGINEERING

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Efficient Morning Routine System

Milestone 1

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Executive Summary

Since the Industrial Revolution in Britain and the socialist push for "Eight hours' labour, Eight hours' recreation, Eight hours' rest," the modern society has become extremely scheduled, with many workers overburdened with multiple jobs, appointments, shopping, and various other matters. Every modern member of society has a complex weekly schedule, which includes, to the chagrin of many, a very early start to their day.

This document provides a detailed overview of an embedded morning routine system design, which would offer some of its users a hands-free way of starting their mornings, and to some – the much-needed wake up discipline.

The main system consists of timer-based sound and light alarm modules that work in conjunction with an automated window-curtain opening system to offer the user ways of waking themselves up that were previously unexplored. Users would have a choice of natural or artificial light stimuli, as well as sound. Gentle music or harsh alarm – the user has complete control over their waking.

Besides these three components, the system will offer multiple add-on features to decrease the amount of time the user spends to get ready in the morning and to make the morning hours more enjoyable for those who do not look forward to early dawn.

These features will include a shower temperature conditioning module that will keep the shower water at a temperature that is comfortable for the user; a coffee-making module that will be able to turn on a pre-filled coffee-machine at a specified time of day; a daily organizer module that will show the user his or her list of tasks for the day; and a newscasting module that will have the capability to be turned on a time-based schedule to tune the user into the morning news.

This document describes this proposed system in detail and outlines the requirements specified for each of the above-mentioned components.

Overview

The main system will consist of light, sound, and window-curtain modules, and add-on features like shower temperature conditioning, automated coffee-making, newscasting, and daily organizer.

Although the user will have to spend some time to program each feature using a common interface before using the system, overall effect of the system is intended to alleviate some of the psychological difficulties of maintaining a healthy sleep schedule.

As opposed to the regular "beep" alarm, this design allows for much greater flexibility. All three main modules are used in conjunction with each other to produce an effective, energizing way to start a morning.

All three main modules will operate based on a common alarm timer. When the alarm goes off, the user can have three different stimuli to help him or her wake up.

First, the system has a sound module. It can be programmed to either produce a common alarm sound, or play music, nature sounds, or the like, with adjustable sound intensity.

Users who usually brush off sound alarms and would prefer a different stimuli can use a combination of natural and artificial lighting to help them wake up. Upon alarm, the artificial lighting in the room can be programmed to start increasing in brightness, until the user has no choice but to wake up. On the other hand, those who enjoy a sunny morning may find the window-opening module as a better alternative. Upon alarm, the window curtains (or blinds) can be opened to a certain degree to allow just the right intensity of light through and awaken the user.

Of course, the system will have snooze functions. But, as opposed to conventional alarms, this system will have the capability of setting different sound and light intensities and patterns upon each consecutive alarm. Heavy sleepers would find flashing lights and beeping sounds options very useful, while overworked light sleepers would prefer merely opening their window blinds to a fresh Monday sunrise.

The system will use a variety of sensors to detect if the user gets out of bed and starts getting ready for the day. At this point in the design process, a variety of options are considered, including, but not limited to bed pressure sensors, motion detectors, and others. The sensing units will communicate with the processing unit to help determine the next actions of the system. For instance, if the user snoozes the alarm too many times and does not get out of bed, a more extreme measure (programmed by the user) may be used to force him or her out of the bed.

To program these features, the user will have access to a digital interface, which may also host some of the add-on features.

As mentioned above, four add-on features are considered in the design.

First, the shower water conditioning unit will have the capability to pre-heat the shower water to a certain temperature before the user's alarm goes off. As the user gets into the shower, the water is already at the user's favorite temperature.

The automated coffee-making unit needs to be installed on the user's coffee machine. Upon alarm, the unit can turn the machine on, getting coffee ready for the user whenever he needs it, without walking over to the kitchen to turn it on.

Upon alarm, the digital interface that the user can use to program different features can also display the user's To Do list for the day. In combination with other features of the system, this can provide an effective motivation boost for the user.

Finally, the sound module can be used to tune into the user's favorite radio station – for news or otherwise. This can provide extra comfort and energy for the user.

Competing Products

There are less products that focus on efficient morning routine. This feature gets included in the overall home automation system. Home automation industry has a lot of products with plenty of features to choose for. We have chosen 3 products that resemble to the features that we want to add to our system.

Smart Home Automaton by Vivint

The Smart Home Automation by Vivint helps the user to create a smarter home with intelligently designed products that simplify user's life. It offers home security, energy management, home automation and high -speed solutions. The end product is a smart home solution that saves time and money and ultimately simplifies life. The system provides security cameras, door lock, smart doorbell, element thermostat, video recording. These features help provide a sense of security to the user.

Schneider Home Automation Solutions

Smart Homes are homes which are powered by computing devices and information technology that connect various gadgets and instruments in the house to provide enhanced comfort, convenience, security, and entertainment to residents in a sustainable way. The system helps the user control air conditioning, lights, music, entertainment, and window blinds. It helps the user program different configurations of light and sound which is similar to our system. The idea our system is related to Schneider Smart home but with addition of extra features mentioned in the document.

Control4 Home Solution

Relax and entertain in a home that is more comfortable and inviting. Be eco-conscious with smart lighting, indoors and out. And be reassured—while at home or away—that things are safe and sound. With one touch, dim the lights, play music, turn up the heat, lock the doors and arm the security system. Or, have your house respond to your schedule and needs without touching anything at all. The system integrates smart door locks, a remote to unify family room entertainment, a thermostat, and smart lighting. Extra features consists of control of the pool security cameras, and front gate. This system is similar to our system as it integrates smart lighting and various sensing units.

Functional Requirements

The functional requirements of the system can be broken up into multiple categories: overall system requirements, and individual component requirements.

Overall System Requirements

The overall system requirements have been specified as follows:

- The system should be able to wake the user up within a pre-specified time period
- The system should offer the user a choice between normal and forced wake up, in which normal wake up would be making an audible noise with mild use of natural and artificial light, and the forced wake up would involve more extreme sound and light intensities and patterns
- The system should offer the user a choice of the number of snooze times and their alarm configurations
- The system should offer the user a variety of light/sound intensity and pattern configurations
- The system should offer the user the capability to program the function of the system, including timing, type of wakeup stimuli, intensities of stimuli, and others
- The programming interface should allow the user full flexibility over both the main and the add-on features of the system
- The main system will consist of a sound alarm module, an automated light module, an automated window curtain opening module, and a programming interface
- The extra features of the system will include automated and timed shower temperature conditioning module, coffee-making module, programmable daily organizer, and a newscasting module

Individual Component Requirements: Main System

The main system will consist of an intelligent light module, sound module, and window-curtain opening module. The following subsections specify functional requirements developed for each module of the main system.

Light Module

The light module will be used to wake up the user using different light intensities and patterns. The following are requirements specified for the light module:

- The light module should be able to set the brightness of the room according to the input provided by the user prior to the alarm
- The light module should operate on time-based schedule preset by the user
- The light module should be capable of performing a variety of flashing/intensity adjusting patterns preset by the user

Sound Module

The sound module will be used in conjunction with the light module to wake up the user. The following are requirements specified for the sound module:

- The sound module should be able to set the sound intensity and pitch of the alarm according to the input provided by the user prior to the alarm
- The sound module should operate on time-based schedule preset by the user
- The sound module should be capable of playing a variety of different soundbites chosen by the user

Window Curtain Module

The user will also have a choice of being awaken by the natural light using automatically-opening window curtains. The window curtain module will have the following functional requirements:

- The window curtain module should be able to set the amount of natural light entering the room by changing the degree to which the window curtains open according to the input provided by the user prior to the alarm
- The window module should operate on time-based schedule preset by the user
- The window module should be capable of opening curtains to varying degrees

Individual Component Requirements: Add-On Features

Apart from the three main modules, the system will have options of having additional modules taking part in the user's morning routine. These modules are:

- Shower Temperature Conditioning Module
- Coffee-Making Module
- Daily Organizer Module
- Newscasting Module

Shower Temperature Conditioning Module

The user may wish to have his or her shower water pre-heated to a specific temperature. The shower temperature conditioning module will heat the water prior to the alarm system waking up the user. The functional requirements of this component are:

- The shower temperature conditioning module should be able to condition the water temperature prior to the user's wake up time according to the input provided by the user prior to the alarm, so it is ready by the time the user takes a morning shower
- The shower temperature conditioning module should operate on time-based schedule preset by the user
- The shower temperature conditioning module should be capable of adjusting the water temperature as required by the user

Coffee-Making Module

The user may also wish to have his or her coffee prepared without taking any action on the user's part. The coffee-making module would automatically turn on a coffee-making machine at a time specified by the user. The only functional requirement for this component is that it should be able to automatically turn on a commercial coffee maker of user's choice on a time-based schedule set by the user.

Daily Organizer Module

As mentioned in the Design Overview section, the user may wish to see a list of things that he or she may need to do on a particular day. This could be achieved by an interface, which has the following requirements:

- The daily organizer add-on should be able to display to the user a list of things to do for the particular calendar day. The tasks will be programmed by the user
- The daily organized should be able to display this information using a digital display

Newscasting Module

Instead of or in addition to regular alarm sounds, the system should offer the user the capability to tune into local or national news or play pre-specified radio stations.

Non-Functional Requirements

Some of the requirements of the system do not pertain to system functionality. The following were derived through usability, feasibility, and cost considerations:

- All of the modules of the system will be controlled by one central controlling device.
- The programming interface will consist of a phone application that will wirelessly communicate with the controller
- The controller will wirelessly communicate with the modules
- All modules are wall powered, with the exception of the programming interface, which will be powered by the phone battery
- The front end modules like the light and window-curtain modules will be mounted on or integrated into the walls of the user's home; software-based back end modules will reside in the controller device firmware
- The system should be able to detect the whereabouts and activity level of the user. This includes, but is not limited to detection of motion, presence of the user in the bed versus out of bed, and location of the user in the house
- The system should not be storing any information about the user
- The system should not be vulnerable to external attacks that intend to collect information about the user.

Conclusion and Next Steps

Based on the above-mentioned requirements, the system should be able to awake the user efficiently, and allow the user to have an easier, more comfortable morning. In addition, the flexibility of the system grants the user unprecedented control over his or her schedule and wakeup routine.

Some of the next steps include outlining system models, selection of hardware and software, and design revisions. Communication model is essential for proper function of the system.

Appendix: Use Cases and Scenarios

This appendix summarizes different use cases involved with the operation of the efficient morning routine system and lists a few extreme cases that should be researched further. The cases presented here are:

- Normal use case
- User does not wake up
- Programming the System (window curtain opening module, as an example)
- Add-on use:
  - Coffee-Making Module (example of a simple turn on/off add-on)
  - Shower Water Temperature Conditioning Module (example of a complex add-on)
- User wakes up but returns to bed

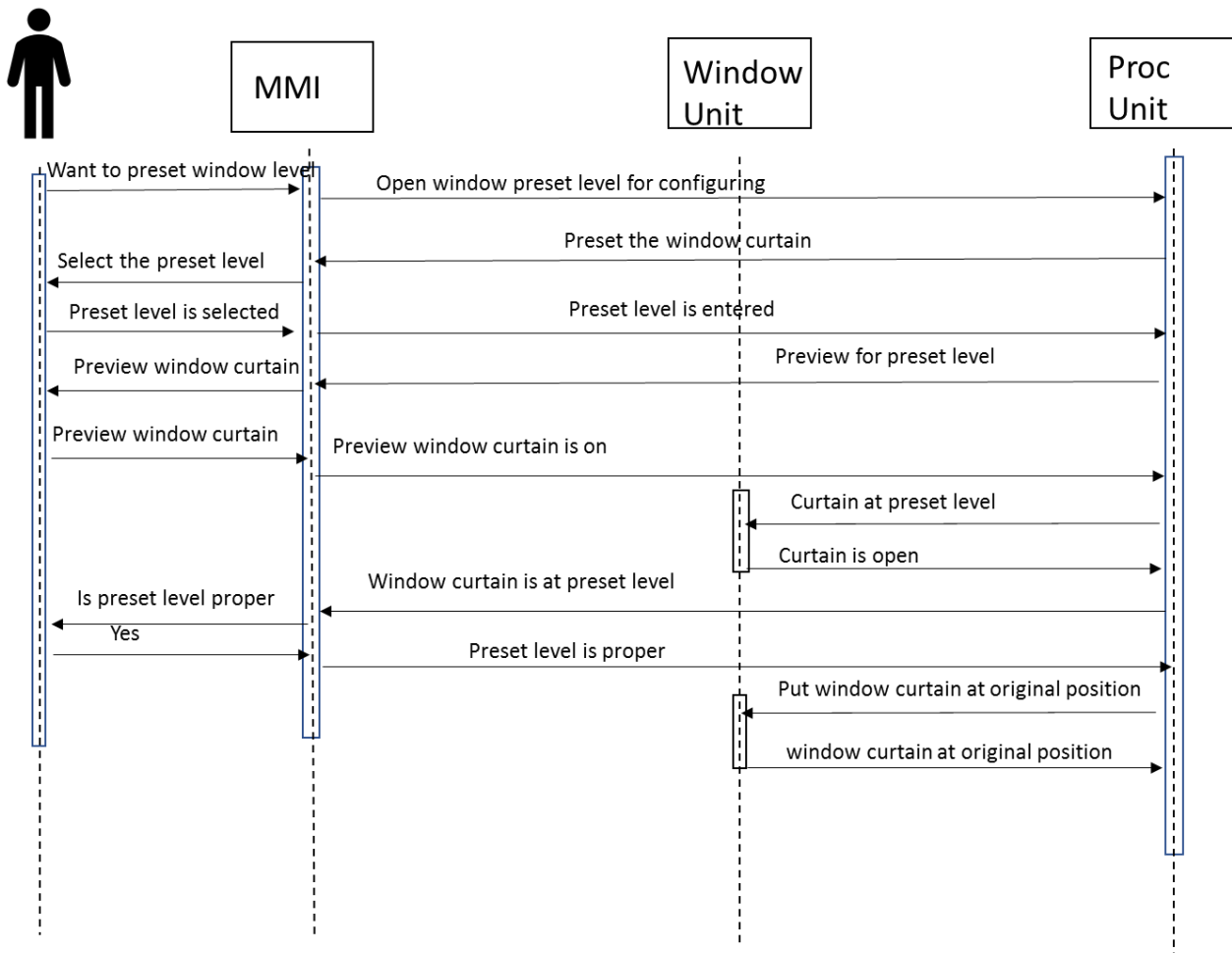The add-on feature cases demonstrate the simplest vs. the most complex features of the system.
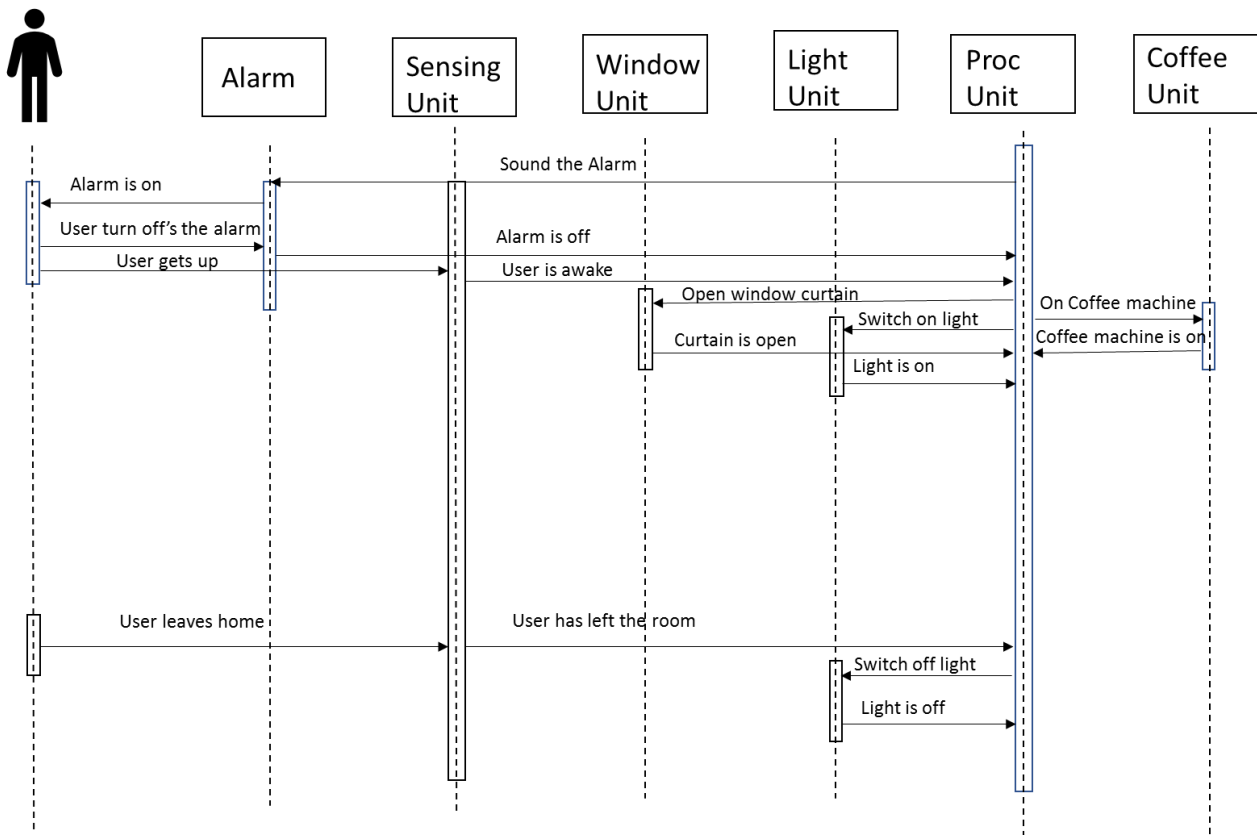
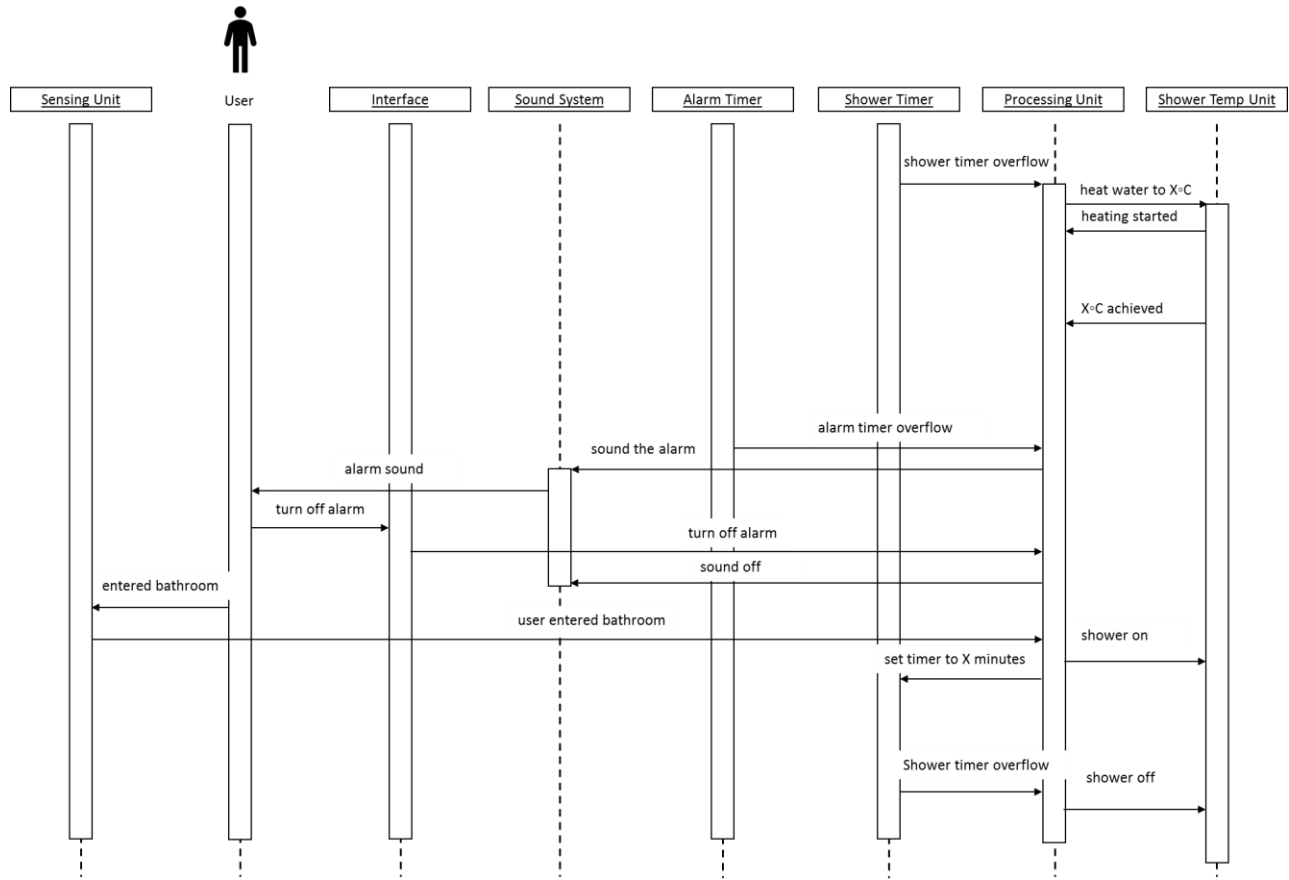*Normal Use Case*
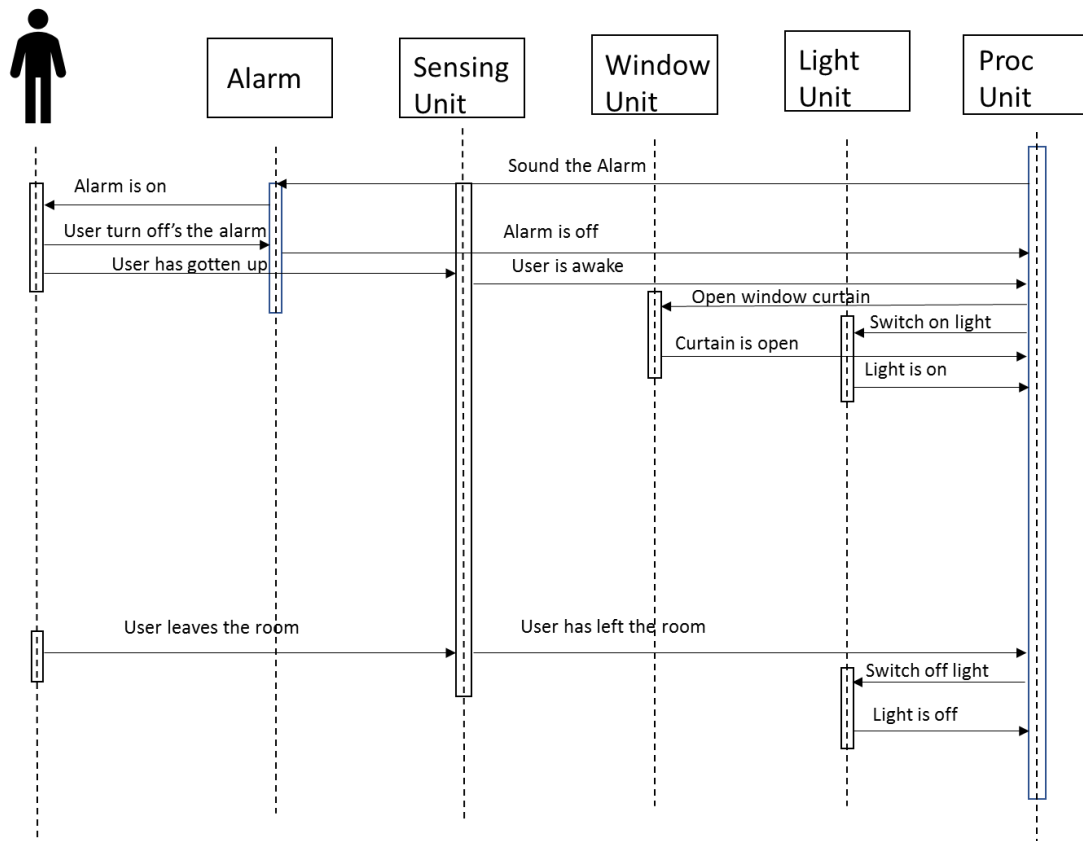
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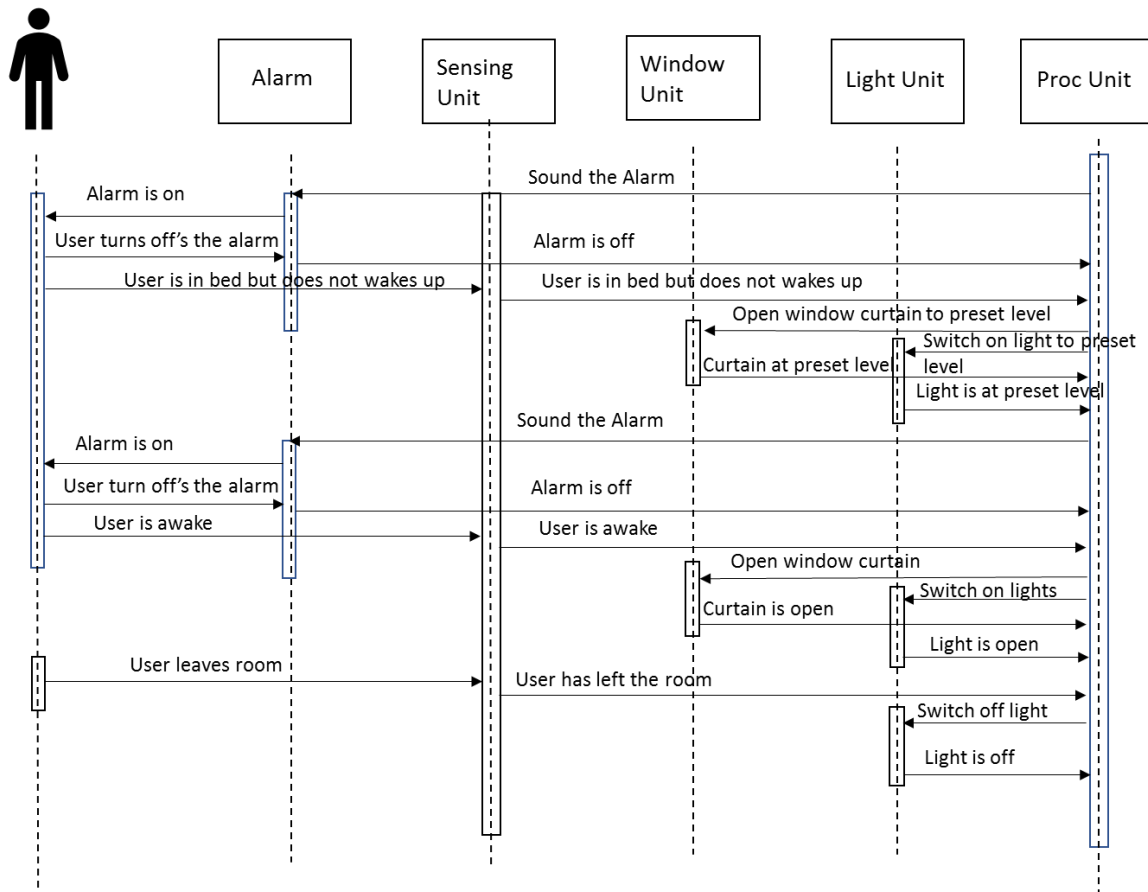
Programming the System: Window Curtain Opening Module

Add-On Use: Coffee-Making Module (Simple Add-On)

Add-On Use: Shower Water Temperature Conditioning Module (Complex Add-On)

User Wakes Up and Returns to Bed