Executive Summary

This report describes the smart lighting system, Lumin. Specifically, the physical components and requirements of the mobile application, comparison with other solutions, and known constraints.

Currently, potential Lumin users struggle with traditional alarms. Either setting multiple ones, or excessively using the snooze button. Lumin alleviates these struggles by:

- Using an accelerometer to track user's sleep cycle and wake them when in their lightest phase
- Utilizing RGB lighting so the user wakes to apparent morning light

Lumin is a smart system design involves:

- RGB lighting capable of varying dimness
- Accelerometer that can be placed under mattress
- Integrate with the user's smartphone
    - Weather
    - Calendar
    - Alarm

Smartphone apps and existing lighting accomplish similar tasks to Lumin:

- smartphone apps use breathing or an accelerometer to track users sleep patterns and wake accordingly
- Smart Lights integrate with smartphones for mobile control of color and dimness

The success of Lumin depends on its successful integration with other services. It must be able to:

- connect to Wi-Fi
- interact and gather information from user's weather, calendar, and alarm applications

It is understood that finishing both the mobile application and the hardware of Lumin may be larger than the scope of this course. For this reason, the supplier may choose to:

- Use a webpage to simulate functionality of the lamp
- Use discretion in selecting weather, calendar, and alarm apps capable of integration

Lumin is a true IoT device, it is integrated with surrounding technologies, and would not be the same device without the supporting applications. It has potential to allow users who struggle with waking to improve their mornings, and therefore the rest of their day.

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V00797175 **V00799800** **V00821821** **V00805493**		**Lumin**
January 29,2016		**1.1**

Version	When	Who	What
1.0	Jan. 8/16	Jake Runzer	Initial Drafting
1.1	Jan. 29/16	Jake Runzer, Zev Isert, Claire Champernowne, Dylan Golden	Detailed Request for Proposals

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1.0 Problem description / expression of need

Waking up in the morning should be a pleasant and enjoyable part of your day. The main method people use to wake up is a bedside clock radio or phone alarm. Often Multiple alarms need to be set because when the first one goes off in the morning you are rudely awaken by an annoying irritable sound. Other times, the snooze button is grossly overused until you panic because you are late. In the age of smart devices, there are many modern technologies to improve your morning ritual.

Lumin will have an RGB lamp that slowly illuminates while the alarm plays. The user wakes up to a room in apparent daylight, meaning they have more of an inclination to wake. An accelerometer placed under the sheets will trigger the alarm when the user is in their lightest sleep phase. Both the alarms and lights can be fully configured with a mobile application. The alarms and settings will be saved onto Lumin, so it will have full functionality, even when no phone is near.

2.0   Project Objectives

Lumin wants you to waking up feeling energized and ready for the day ahead. Lumin uses a lamp to simulate daylight, a gentle alarm, a sleep tracking monitor, integration with calendar/weather applications and an attractive and user friendly mobile application for android.

The lamp should consist of RGB lighting suited for frequent dimming and lighting. It should also be capable of playing sounds/music in incrementally louder volumes. In addition, a way to store (onboard microcontroller or computer) the information from the mobile app is needed so that if the linked phone's battery dies or the phone is turned off, all the alarms are still triggered.

Connected to the lamp should be an accelerometer to monitor your sleep. The alarm will be play when it is closest to its set time **and** you are in your lightest sleep phase. You should be able to customize the time window of your alarm by choosing an earliest and latest wake time. The mobile app should record sleep data from previous nights so that you can revisit it later.

Lumin should integrate with your phone's calendar and weather apps. This will allow you to have your upcoming appointments read aloud to you as you get ready for the day. The weather integration will both tell you the weather for the day so you can dress appropriately and plan for any delays due to the weather and alter the shade of the light to match the outside.

All of the settings and control of the lamp and accelerometer should be on a mobile app for android with an attractive and easy to use UI. The lamp should look sleek and modern; not out of place in any home as its objective is to both look beautiful and be functional: as a modern system that lets you wake up feeling refreshed and to be prepared for the day ahead of you.

3.0 Current System(s)

There are two main types of sleep tracking apps readily available for modern smartphones. The first is an app that requires the used phone to be charging and placed face down under the sheets on the mattress. It tracks movements while the user sleeps and will awake them in their lightest sleep phase closest to their alarms. As mobile devices are becoming larger and thinner, this can be a risky option for expensive phones.

The second system is an application that requires the phone to be plugged in and next to the bed. It listens to the user while they sleep with the phone microphone. When it is quietest, it means they are in their deepest sleep. The app uses this data to trigger the alarm appropriately.

Both of these sleep tracking systems require your phone to be on and plugged in throughout the night. This degrades the phone's battery life and requires you to have your phone with you every night.

There are tons of RGB light bulbs currently on the market. Most notably is the Hue light. The Hue light is an IoT device that has the capability to connect to smartphones and integrate with other services. As good as the Hue is, it is just a light. It does not track sleep or have an alarm built in. Its capabilities are just a component of Lumin.

4.0 Intended users and their interaction with the system

The intended user for Lumin is the general public. Specifically targeting those who have trouble waking up in the morning feeling restful and prepared for the day. With this in mind the users age will be around 15-60 from all demographics. Power users of Lumin will likely set up the notification system and basic users will only use the light up alarm connected with the accelerometer.

All users will interact with Lumin through their smartphones from a mobile app. The app will be free for everyone that has purchased Lumin. From the app, users will be able to set alarms and appointments, as well as being able to integrate with other applications (like calendars, alarm clocks, and weather). Users will also be able to change all settings from the android app

The app and Lumin will have real time updating with the information from the app being stored on the lamp. This way users will not have to worry about manually updating Lumin and possibly missing an alarm.

5.0 Known interaction with other systems within or outside the client organization

Lumin is an integrated service, it depends on other services to provide its full functionality. Some of these external systems will include a weather API and an online calendar API. The Lumin alarm is an IoT device. It should connect to the internet via Wi-Fi to synchronize the user's calendar with the device. The internet connection will be used to query the user's online calendar, as well as connecting to a weather service to discover the weather predictions for the day.

Calendar integrations allow automatic scheduling of alarms with a specified time before the calendar event begins. Weather integrations optionally allow the alarm to choose a LED color dependent on the day's weather. Additionally, the should be able to set alarms with Lumin when they are not connected to the same network. To avoid burdening the user with router configurations, Lumin will connect to a centralized server run by Lumin's parent company, this way the device can act as a listener to this server, thus maintaining a connection to the external network such that alarm updates can be received. On the following page are idealized sequence diagrams detailing a possible setup process for remote configuration of alarms and the process of setting an alarm from a remote network.
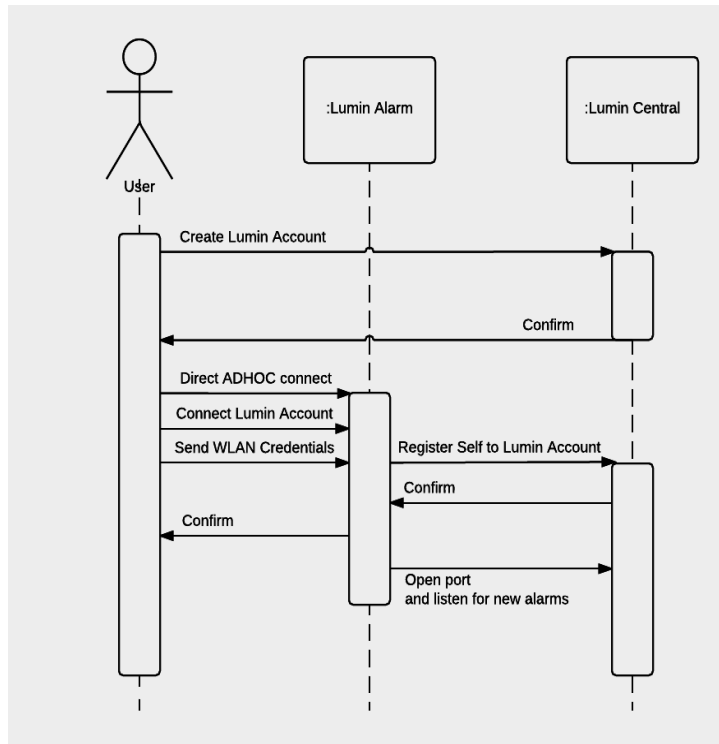
Remote alarm access setup
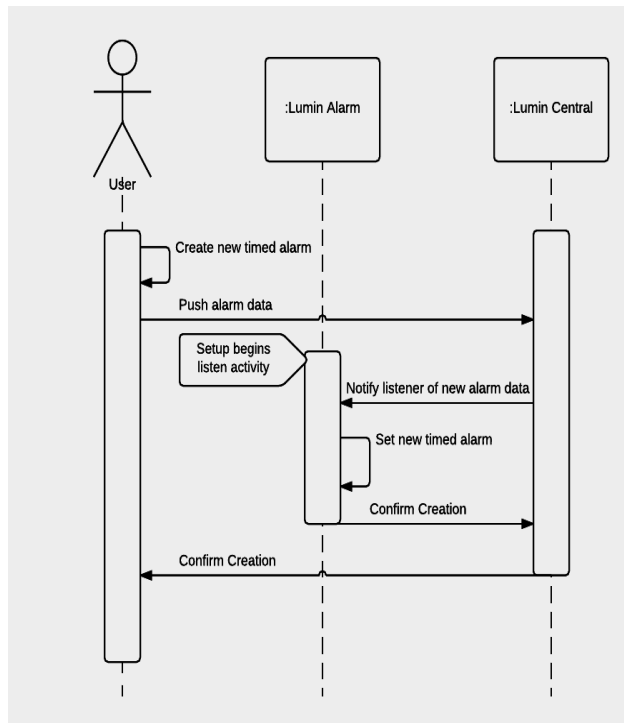
Alarm creation using remote server sequence diagram

6.0 Known constraints to development

This project also comes with some known limitations. Half of the design of Lumin is reliant on the physical device, requiring the supplier to also spend time on hardware research and development, such a task could be considered outside the scope of this course. As a possible workaround, the physical Lumin alarm could be foregone and a web page be created to simulate the functionality of the hardware device. Furthermore, due to the abundance of mobile services that provide online calendar management, only a select few, if not only one, should be integrated into the scope of this application.

7.0 Project Schedule

S1	Tue, Feb 16	Formal Requirements Specification
S2a	Tue, Mar 1	Management Plan
S2b	Thu, Mar 3	Beta Demo
S3a	Tue, Mar 15	Specifications
S3b	Tue, Mar 22	User Manual
S4	Mar 29-31	Completion Deadline

- Jan 21 - Start mobile application and building of the lamp
- Jan 26 - Lamp RGB LEDs installed and working
- Jan 31 - Connect lamp to Wi-Fi network
- Feb 2 - Mobile app can control basic lamp functions
- Feb 3 - Start building accelerometer to track sleep
- Feb 10 - Mobile app lamp color and brightness UI functional and looking good
- Feb 20 - Alarms working and set using the mobile app
- Mar 3 - Demo
- Mar 15 - Mobile app can see and graph accelerometer data
- Mar 25 - Use accelerometer data to alarm at better time
- Mar 29-31 - Final Demo

8.0 Project team

Role	Details
Hardware Specialist	This member will organize and build the Lumin bedside alarm using off the shelf electronic products. For the purposes of this request it may be feasible to develop the bedside alarm using a microcontroller, or simulate the bedside alarm using a web page.
Embedded Programmer	This member will program on the embedded device. It will need to connect to the Internet and be able to save and retrieve configuration data. To connect from an external network, a new application level protocol would be ideal, supporting the ability to create alarms, and set alarm properties such as light color and audio.
Mobile Programmer	This member will program the mobile app that will utilize the new protocol to connect to and control the lamp
Product Manager	This member will have knowledge in all areas and will control and direct the team in the right direction.

Project Team Members:

- Brian Pattie (bpattie@uvic.ca)
- Chenchen Guo
- Cameron Long
- Thing Nguyen

9.0 Glossary of terms

Term	Definition
UI	user interface, the system that the user is able to interact with
RGB	red green blue, the three hues of light so any color can be produced by "mixing" the individual lights
IoT	Internet of things, the ability of everyday things to communicate with each other and send data back and forth
API	Application program interface, defining software in terms of its functions