

# UCF Senior Design I

## Smart Lights



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### Divide and Conquer

#### Group 2

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## Introduction:

The common person usually spends most their time in one place, their home. When at home there are many mundane tasks which take up a minute amount of time and effort, but this adds up. These tasks include turning on lights and fans, playing music, controlling air conditioning and many more. As technology progresses so does the way we interact with the things around us, thus changing the way we interact with our home. We can now use technology to eliminate or simplify some of these mundane tasks. Home automation, is a growing field which allows users to have control of some household features and appliances. The Internet of Things is what makes home automation possible.

Internet of Things (IoT) is a term which refers to a basic concept in which devices can connect to wireless technology. This includes devices ranging from mobile phones, coffee makers, lights, washing machines and many more. The Internet of things has many uses, such as setting the lights in a user's home to turn on or off at a certain time, allowing the user to change the state of the lights from an application. Many times, the user can also change the color of the lights based if they have the necessary bulb. The Internet of things is very useful, not only for users trying to save time and effort but also for people with disabilities. A user who normally cannot walk to turn on the lights in their home can now use a mobile device to control their lighting.

This project's objective is to develop an application which can communicate with a hub, this hub would control an arrangement of lights which can be used in a user's location of choice. These lights will receive instructions from the hub, which will indicate whether these lights should turn on or off, dim or change color. Additional features of this application would include having different lighting patterns which would change per music, as well as preset lighting pattern for each user. The user can control multiple bulbs in this application. The hub will take advantage of wireless technologies to pass instructions to the bulbs. Along with creating the mobile application and the hub to control the lights, we will also create the lights. The lights will be some variation of an LED strip with multi colored LED's. We will make a few of these lights as to provide the user with more lighting possibilities.

The motivation behind this project is the limited sources for smart home lighting and the high cost. Our project will be a small, low cost and energy hub and a free application which will run on a mobile operating system.

There are different competitors such as Lixx and Philips Hue. Lixx is a company whose bulbs are Wi-Fi enabled, and multi colored LEDs. A user can use an Android or iOS application to control each of these bulbs individually.



Figure 1

On the other hand, Philips Hue implements a similar technology as our proposed project. Philips Hue uses a mobile application or website to communicate through the internet with their bridge. The bridge to control the bulbs connected to it. The Philips Hue bridge is connected by Ethernet cable to the internet, and through the internet it connects to their portal. Which is a web based control panel, this portal connects the user's home to the internet. The portal is used to keep the bridge software updated, as well as, deliver control commands from outside. The output of the system are the lights. The Philips Hue bulbs contain 3 LED to allow a range of colors. In this system, the lights create a mesh network with the other bulbs in the system, this mesh enables each bulb to pass messages to the next bulb, thus extending the range. These bulbs are connected to the bridge by using ZigBee Light Link, which is an open standard protocol.



Figure 2

## **Specification:**

- The hub shall broadcast a signal from a cellular device to turn on lights.
- The lights should be able to be turned on and off while also being dimmed from the control of a cellular device
- The device will be using wireless technology to communicate between the hub and the lights
  - With the programming aspect of this design, the device can be programmed to specifically turn on and turn off the lights at a specific time.
- The bulbs being utilized will be energy efficient bulbs
- The design of this device should allow it to be portable
- The device will be made up of premium materials and will feature a lightweight design
- The device will be child friendly and elderly friendly
- The device will utilize microcontrollers to relay the connection between the cellular device and the hub
- The device will use an external power supply which will keep the device running
- The device size will be less than 3 feet by 3 feet.
- The price of designing this device will cost less than \$250.
- Mobile application will allow a user to control lighting
- Application Details:
  - Implementation to support multiple users for different preferences
  - Allow user to set timers for lights
  - Ability to dim lights down to x%
  - Ability to change the color of lights based off a color palette
  - Allow users to select music, lights will change per the selected music
  - Users can have preset lighting patters to select from

## **Project Constraints:**

With regards to the budget, when testing the device, it will be easily seen that some light bulbs will burn out right away due to faulty connections between the hub and the light source. Each light bulb for this design will depend on the overall specifications of the device. The amount time that we have allotted to Senior Design becomes challenging when we are trying to balance a heavy load of classes. Not only that, but because this group is graduating in Summer 2017, the overall timeline for the completion of this device is shortened to approximately 23 weeks. The next issue is if the technology being utilized for this design will not be compatible with the overall software being used. To remedy the overall technology compatibility, we must ensure that we are reading the specifications of the microcontrollers being used in the design. We will also need to make sure that we read the documentation for the software compatibility of the device. To remedy the timeline issue for this design, we will constantly need to be working every week diligently and effectively so that we can produce a project that can meet the specifications outlined above. The last remedy would be the budget. Overall to keep our budget of the project from escalating out of proportion, we will set a certain number of items that we order. We will also ensure that we are looking for the least expensive.

## Project Milestones

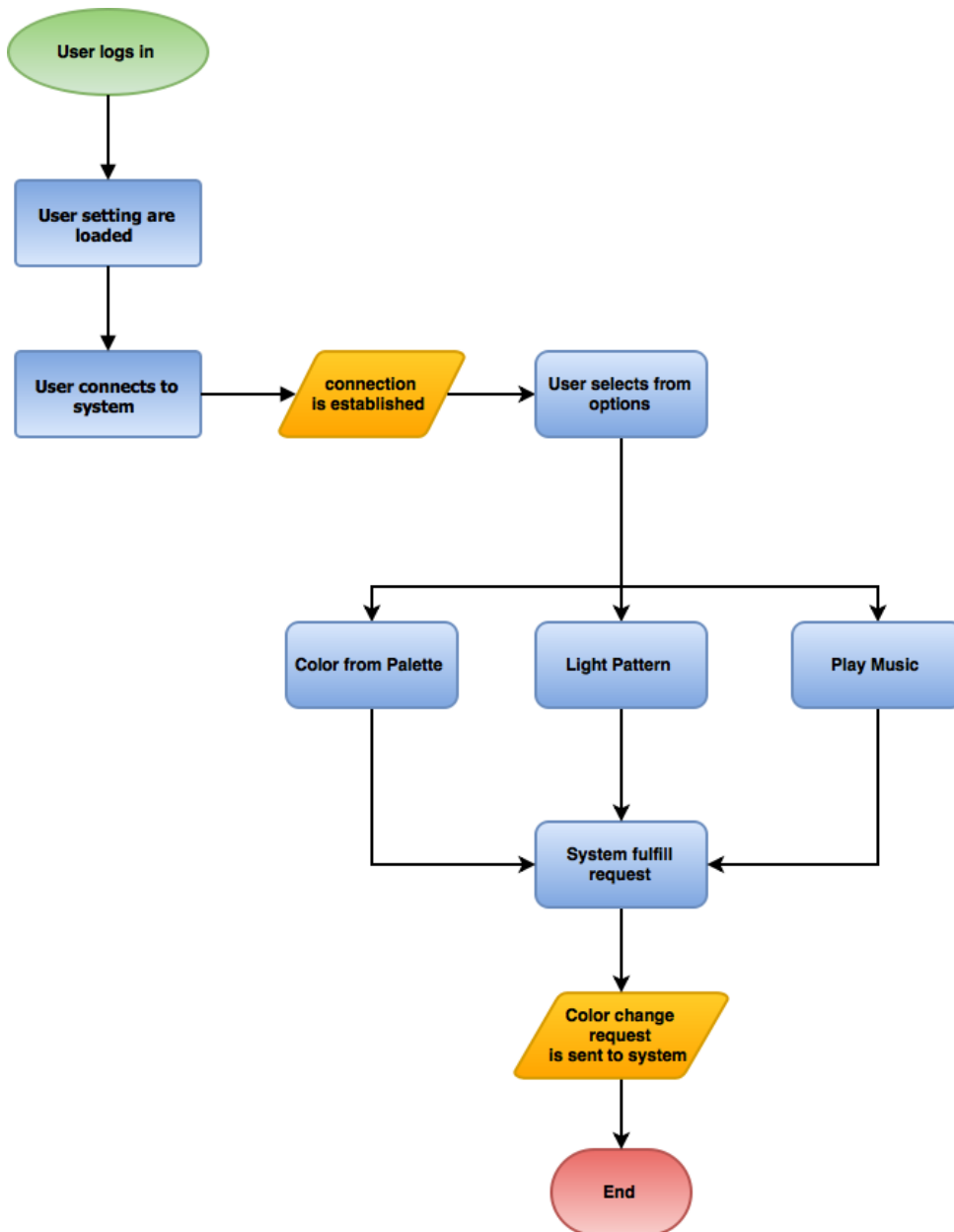
<b>Senior Design 1 Hardware Section</b>					
Number	Task	Start	End	Status	Responsible
<b>1</b>	<b>Ideas</b>	<b>1/23/2017</b>	<b>1/26/2017</b>	<b>Completed</b>	<b>Group 2</b>
<b>2</b>	<b>Project Selection &amp; Role Assignment</b>	<b>1/28/2017</b>	<b>2/27/2017</b>	<b>In Progress</b>	<b>Group 2</b>
<b>Project Report</b>					
<b>3</b>	Initial Document- Divide and Conquer	<b>1/31/2017</b>	<b>2/3/2017</b>	<b>In Progress</b>	<b>Group 2</b>
<b>4</b>	Table of Contents	<b>2/6/2017</b>	<b>3/24/2017</b>	<b>In Progress</b>	<b>Group 2</b>
<b>5</b>	First Draft	<b>2/6/2017</b>	<b>3/31/2017</b>	<b>In Progress</b>	<b>Group 2</b>
<b>Research, Documentation &amp; Design</b>					
<b>6</b>	Initial PCB Stage	<b>2/6/2017</b>	<b>2/24/2017</b>	<b>Researching</b>	<b>Ryad</b>
<b>7</b>	Mobile OS & IDE	<b>2/6/2017</b>	<b>2/12/2017</b>	<b>Researching</b>	<b>James</b>
<b>8</b>	Open Source API's	<b>2/6/2017</b>	<b>2/12/2017</b>	<b>Researching</b>	<b>Anthony</b>
<b>9</b>	Lightbulbs	<b>2/14/2017</b>	<b>2/19/2017</b>	<b>Researching</b>	<b>Kevin</b>
<b>10</b>	Database	<b>2/14/2017</b>	<b>2/20/2017</b>	<b>Researching</b>	<b>Anthony</b>
<b>11</b>	Open Standard Protocol	<b>2/14/2017</b>	<b>2/20/2017</b>	<b>Researching</b>	<b>James</b>
<b>12</b>	Wireless Technology	<b>2/22/2017</b>	<b>3/9/2017</b>	<b>Researching</b>	<b>Kevin &amp; Ryad</b>
<b>13</b>	Microcontroller	<b>2/22/2017</b>	<b>3/9/2017</b>	<b>Researching</b>	<b>Ryad</b>
<b>14</b>	Design Login Process	<b>2/22/2017</b>	<b>3/9/2017</b>	<b>Implement</b>	<b>Anthony</b>
<b>15</b>	Login Backend Implementation	<b>2/24/2017</b>	<b>3/9/2017</b>	<b>Implement</b>	<b>James</b>
<b>16</b>	Power Supply	<b>2/14/2017</b>	<b>3/6/2017</b>	<b>Researching</b>	<b>Kevin</b>
<b>17</b>	DDR RAM	<b>2/18/2017</b>	<b>3/2/2017</b>	<b>Researching</b>	<b>Ryad</b>
<b>18</b>	Portability	<b>3/3/2017</b>	<b>3/16/2017</b>	<b>Researching</b>	<b>Kevin</b>
<b>19</b>	Form Factor	<b>3/3/2017</b>	<b>3/16/2017</b>	<b>Researching</b>	<b>Ryad</b>
<b>20</b>	Material Composition	<b>3/6/2017</b>	<b>3/21/2017</b>	<b>Researching</b>	<b>Kevin &amp; Ryad</b>
<b>21</b>	Packaging	<b>3/6/2017</b>	<b>3/24/2017</b>	<b>Researching</b>	<b>Kevin &amp; Ryad</b>

Table 1

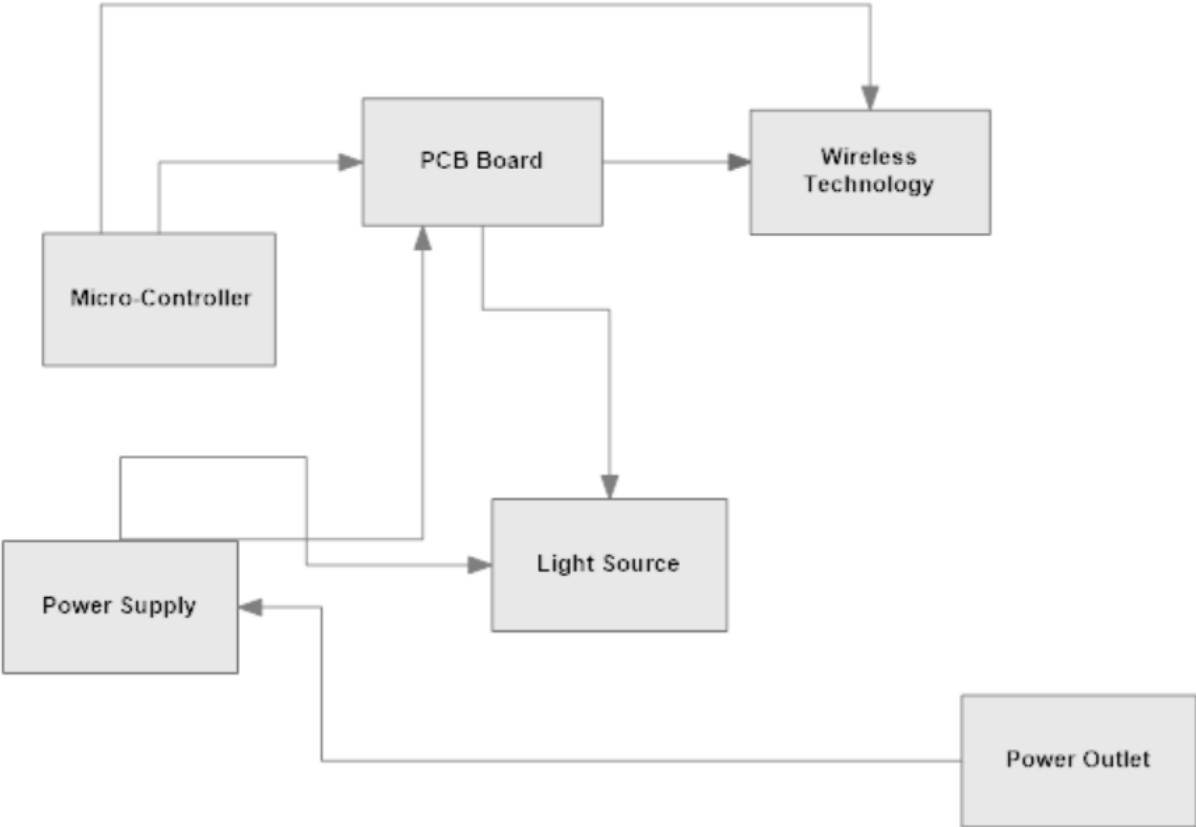
Senior Design 2					
Number	Task	Start	End	Status	Responsible
22	Build Prototype	3/6/2017	5/2/2017		Group 2
23	Testing & Redesign	TBA	TBA		Group 2
24	Finalize Prototype	TBA	TBA		Group 2
25	Peer Presentation	TBA	TBA		Group 2
26	Final Report	TBA	TBA		Group 2
27	Final Presentation	TBA	TBA		Group 2

Table 2

**Software Flowchart:**



Hardware Section Block Diagram:



**House of Quality:**

- Positive Correlation            ↑
- Strong Positive Correlation   ↑↑
- Negative Correlation           ↓
- Strong Negative Correlation   ↓↓

		Efficiency	Output Power	Weight	Cost
		+	+	-	-
Portability	+	↓	↑↑	↑↑	↓↓
Ease of Use	+	↑	↑↑	↓↓	↓
Wireless	+	↓	↓	↑↑	↓↓
Cost	-	↓	↓	↓↓	
Targets for Engineering Requirements		> 60%	50 Watts	< 15 lbs	< \$450

**Budget:**

Description	Price Per Unit	Amount	Total Estimated Price
PCB	\$50	2	\$100
Wireless Module	\$45	1	\$45
Multi-Color LED	\$70	1	\$70
Microcontroller	\$26.99	1	\$26.99
TOTAL			\$241.99

**Conclusion:**

In conclusion, home automation and the Internet of Things, are a growing field which allow users the ability to some control household appliances from a device such as a mobile phone. There are many companies in this field of technology, but the price of the devices is expensive. Our proposed project is a lighting system which has a mobile application, a hub to control the lights, and a few LED lights which would allow multiple colors. This hub will take advantage of wireless technology, to communicate with the mobile application and the light bulbs. With our mobile application, a user will be able to fully control the lights in their house which are connected to the hub. The user can change the state of the lights, the colors, and dim. Additionally, the user can select from preset lighting patterns or select music and have the lights display a pattern based off the music which was selected. This project will be low cost and lightweight.



## Image sources

Lifx Image/figure 1

<https://www.bobvila.com/articles/ behold-the-worlds-first-and-only-99-light-bulb/>

Hue Image/figure 2

<https://www.cnet.com/products/philips-hue-white-ambiance/>