

**DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING
THE UNIVERSITY OF TEXAS AT ARLINGTON**

**SYSTEM REQUIREMENTS SPECIFICATION
CSE 4316: SENIOR DESIGN I
SUMMER 2021**



**THE LIGHTERS
LIGHTHOUSE**

**DIPIKA GIRI
DHRUV PATEL
PARKER SKINNER
DAVID TRIMINO**

REVISION HISTORY

Revision	Date	Author(s)	Description
0.1	7.12.2021	DG,DP,PS,DT	document creation
0.2	7.26.2021	DG,DP,PS,DT	First draft complete
0.3	12.07.2021	DP	Final draft complete

CONTENTS

1	Product Concept	8
1.1	Purpose and Use	8
1.2	Intended Audience	8
2	Product Description	9
2.1	Features & Functions	9
2.1.1	Controller - Running Patterns	9
2.1.2	Controller - Selecting Patterns	9
2.1.3	Designer/Programmer- Web Application with Scalable Interface	9
2.1.4	Designer/Programmer - Static Patterns	9
2.1.5	Designer/Programmer - Moving Patterns	9
2.1.6	Designer/Programmer - Music Patterns	9
2.1.7	Designer/Programmer - Cloud Repo for Custom Patterns	9
2.2	External Inputs & Outputs	9
2.2.1	Inputs	10
2.2.2	Output	10
2.3	Product Interfaces	10
2.3.1	Main Web Page	11
2.3.2	Patterns Web Page Design	11
3	Customer Requirements	12
3.1	Controller - Web Interface	12
3.1.1	Description	12
3.1.2	Source	12
3.1.3	Constraints	12
3.1.4	Standards	12
3.1.5	Priority	12
3.2	Running Patterns	12
3.2.1	Description	12
3.2.2	Source	12
3.2.3	Constraints	12
3.2.4	Standards	12
3.2.5	Priority	13
3.3	Selecting Patterns	13
3.3.1	Description	13
3.3.2	Source	13
3.3.3	Constraints	13
3.3.4	Standards	13
3.3.5	Priority	13
3.4	Adding New Patterns	13
3.4.1	Description	13
3.4.2	Source	13
3.4.3	Constraints	13
3.4.4	Standards	13
3.4.5	Priority	13
3.5	Programmer/Designer	13

3.5.1	Description	13
3.5.2	Source	14
3.5.3	Constraints	14
3.5.4	Standards	14
3.5.5	Priority	14
3.6	Static Patterns	14
3.6.1	Description	14
3.6.2	Source	14
3.6.3	Constraints	14
3.6.4	Standards	14
3.6.5	Priority	14
3.7	Moving Patterns	14
3.7.1	Description	14
3.7.2	Source	15
3.7.3	Constraints	15
3.7.4	Standards	15
3.7.5	Priority	15
3.8	Music Based Patterns	15
3.8.1	Description	15
3.8.2	Source	15
3.8.3	Constraints	15
3.8.4	Standards	15
3.8.5	Priority	15
3.9	Linking to and Managing Controller	15
3.9.1	Description	15
3.9.2	Source	16
3.9.3	Constraints	16
3.9.4	Standards	16
3.9.5	Priority	16
3.10	Weather Proof	16
3.10.1	Description	16
3.10.2	Source	16
3.10.3	Constraints	16
3.10.4	Standards	16
3.10.5	Priority	16
4	Packaging Requirements	17
4.1	Customer Unit	17
4.1.1	Description	17
4.1.2	Source	17
4.1.3	Constraints	17
4.1.4	Standards	17
4.1.5	Priority	17
4.2	Git Hub Software Download	17
4.2.1	Description	17
4.2.2	Source	17
4.2.3	Constraints	17
4.2.4	Standards	17

4.2.5	Priority	17
5	Performance Requirements	18
5.1	Connect to Raspberry Pi and Arduino	18
5.1.1	Description	18
5.1.2	Source	18
5.1.3	Constraints	18
5.1.4	Standards	18
5.1.5	Priority	18
5.2	Patterns Continue to Run	18
5.2.1	Description	18
5.2.2	Source	18
5.2.3	Constraints	18
5.2.4	Standards	18
5.2.5	Priority	18
5.3	Feasible to create a simple pattern	18
5.3.1	Description	18
5.3.2	Source	18
5.3.3	Constraints	18
5.3.4	Standards	19
5.3.5	Priority	19
6	Safety Requirements	20
6.1	Laboratory equipment lockout/tagout (LOTO) procedures	20
6.1.1	Description	20
6.1.2	Source	20
6.1.3	Constraints	20
6.1.4	Standards	20
6.1.5	Priority	20
6.2	National Electric Code (NEC) wiring compliance	20
6.2.1	Description	20
6.2.2	Source	20
6.2.3	Constraints	20
6.2.4	Standards	20
6.2.5	Priority	20
6.3	RIA robotic manipulator safety standards	21
6.3.1	Description	21
6.3.2	Source	21
6.3.3	Constraints	21
6.3.4	Standards	21
6.3.5	Priority	21
7	Maintenance & Support Requirements	22
7.1	LED Strip Maintenance	22
7.1.1	Description	22
7.1.2	Source	22
7.1.3	Constraints	22
7.1.4	Standards	22

7.1.5	Priority	22
7.2	Software Maintenance	22
7.2.1	Description	22
7.2.2	Source	22
7.2.3	Constraints	22
7.2.4	Standards	22
7.2.5	Priority	22
7.3	Source Code Documentation	22
7.3.1	Description	22
7.3.2	Source	22
7.3.3	Constraints	23
7.3.4	Standards	23
7.3.5	Priority	23
7.4	Troubleshooting Guide	23
7.4.1	Description	23
7.4.2	Source	23
7.4.3	Constraints	23
7.4.4	Priority	23
8	Other Requirements	24
8.1	Installation Video	24
8.1.1	Description	24
8.1.2	Source	24
8.1.3	Constraints	24
8.1.4	Standards	24
8.1.5	Priority	24
9	Future Items	25
9.1	Support Other Devices	25
9.1.1	Description	25
9.1.2	Source	25
9.1.3	Constraints	25
9.1.4	Standards	25
9.1.5	Priority	25
9.2	Android Application	25
9.2.1	Description	25
9.2.2	Source	25
9.2.3	Constraints	25
9.2.4	Standards	25
9.2.5	Priority	25

LIST OF FIGURES

1	LightHouse conceptual drawing	8
2	Main Web Page	11
3	Device Settings Web Page	11

LIST OF TABLES

2	External Internal Outputs	10
---	-------------------------------------	----

1 PRODUCT CONCEPT

This section describes the purpose, use, and intended user audience for the LightHouse product. LightHouse is a custom LED light configuration setup to manage your LED lights. The purpose of this product is to make customers have lights around their house all year long, by controlling the visualization and color patterns to change based on the time of year or to the customer's liking.

1.1 PURPOSE AND USE

LightHouse is designed to take home decorating to the next level to provide another layer of expressiveness. All LED strips will be governed by a raspberry pi which will be able to collect information from the hub and allow the user to adjust the visualization or color patters, and brightness of the LED lights.

For LED strips that extend 5 meters a micro-controller will be introduce to the architecture to prevent voltage drop. The micro-controller will integrate seamlessly into the user's LED configuration and the user will be able to control the micro-controller's LED strips easily and separately from the raspberry pi. However, the user will still change or interact with micro-controller's LED strips in the hub.

1.2 INTENDED AUDIENCE

The intended audience our people who want to express their personality and make their home's environment more bright and friendlier. People who enjoy Christmas can keep their lights up all year round and can alter the visualization and color based on the season. Or if a college student who is not satisfied with the standard LED lights because it limits the customer's creativeness can benefit from LightHouse based on the ability to create custom lights

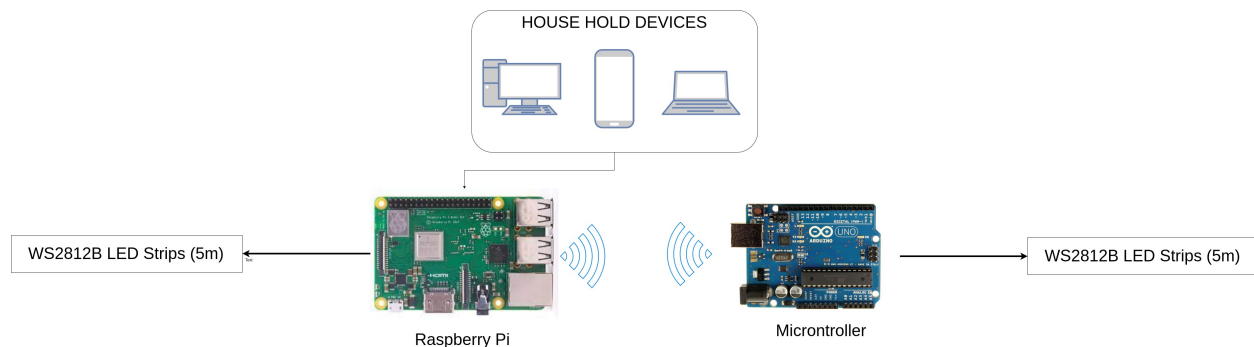


Figure 1: LightHouse conceptual drawing

2 PRODUCT DESCRIPTION

This section provides the reader with an overview of LightHouse. The primary operational aspects of the product, from the perspective of end users, maintainers and administrators, are defined here. The key features and functions found in the product, as well as critical user interactions and interfaces are described in detail.

2.1 FEATURES & FUNCTIONS

Our product will consist of a hub, which is essentially a web-page, raspberry pi, micro-controller, and LED strips that work and communicate effectively with each other. See Figure 2-1 for a high-level concept of the components

2.1.1 CONTROLLER - RUNNING PATTERNS

LightHouse will allow the user to run certain visualization patterns based on the user's liking. This is the main feature of the project because this is what everyone wants. Which is to see the LED lights successfully run a pattern.

2.1.2 CONTROLLER - SELECTING PATTERNS

LightHouse will allow users to not only run patterns but also change patterns as well. This feature allows user to change their patterns based on mood, time of day, or depending on the season.

2.1.3 DESIGNER/PROGRAMMER- WEB APPLICATION WITH SCALABLE INTERFACE

LightHouse will include a web application that is designed to allow users to access their LED lights that are connected to the raspberry pi or the micro-controller. The web application will be built with scalability in mind to enable the same functionality on a mobile device as it would be on a desktop. This approach will provide a similar look and feel across different interface devices and will enable our software to be used on a wide array of platforms.

2.1.4 DESIGNER/PROGRAMMER - STATIC PATTERNS

LightHouse will all have static patterns that offer a wide variety of colors. Static patterns will just be a constant one color that user can choose (up to 256 different colors). There will be a default list of colors that the user can choose from. The user can add more colors by entering a hex-code or by clicking from a color circle selection.

2.1.5 DESIGNER/PROGRAMMER - MOVING PATTERNS

To have a little bit more of dynamic elements or patterns LightHouse introduces moving patterns. There will be a default of 20 patterns that user can select from. The moving patterns are just predictable patterns that will repeat throughout a certain amount of time. The user will be able to make custom moving patterns if they wish.

2.1.6 DESIGNER/PROGRAMMER - MUSIC PATTERNS

Music Patterns allow the user to connect a moving pattern to not change the pattern over time but instead change to when the USB microphone picks up certain sound frequency from a song.

2.1.7 DESIGNER/PROGRAMMER - CLOUD REPO FOR CUSTOM PATTERNS

This allows users to share custom configurations with other users.

2.2 EXTERNAL INPUTS & OUTPUTS

This section describes the input and outputs for each component of the architecture.

2.2.1 INPUTS

LightHouse will require multiple inputs across each of its components. The microphone on the raspberry pi will be an example of an audio input that will receive and process the audio input from the environment. This input enables the music pattern feature to exist. The web application will receive input from the user on instructions on how the LED lights should be displayed for the LED lights connected to the raspberry pi or for the ESP8266 micro-controller. The ESP8266 will receive data or instructions on how to display the LED lights using a UDP datagram (UDP packet) from the server.

2.2.2 OUTPUT

When the user requests a new feature or display option will trigger a response from the server to send information about this directly to the raspberry pi or over UDP to the ESP8266 micro-controller.

Name	Data Flow	Description	Use
ESP8266	Input	Response from the web server	Establish a connection between the web server and the ESP8266 to be able to receive data from the server
ESP8266	Output	Send data to LED lights	Send data on how to light up the LED lights (RGB and HSV)
USB Microphone	Input	Get the bytes from the microphone	Get the bytes when music pattern led lights are enabled
Web Application	Input	Get RGB and HSV data from the user	Instructions on how to display LED lights to the user's liking
Web Application	Input	Get RGB and HSV data for the ESP8266 lights	Instructions on how to display LED lights for the ESP8266 LED lights to the user's liking
Web Application	Output	Send RGB and HSV data to LED lights	Instructions on how to display LED lights that are connected to the raspberry pi
Web Application	Output	Send RGB and HSV data to ESP8266	Instructions on how to display LED lights that are connected to the ESP8266

Table 2: External Internal Outputs

2.3 PRODUCT INTERFACES

This section describes the draw up for all the web pages in the application including the main web page with color hex wheel and patterns page as well as the general settings web page. The first figure (2) has the option to select the color to be displayed onto the lights, we will be adding a hex slider to to add any color they would like. The next figure (3) is the patterns page to select what pattern the user wants to run at this point we are thinking 9 patterns and an off as shown below.

2.3.1 MAIN WEB PAGE

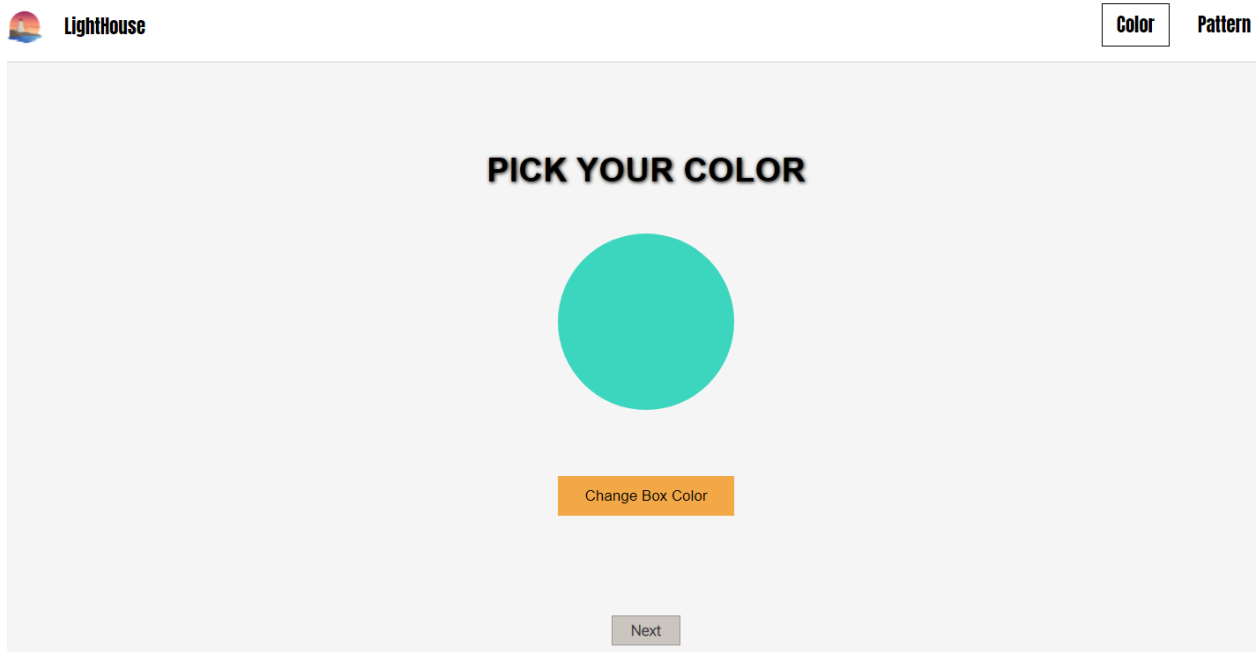


Figure 2: Main Web Page

2.3.2 PATTERNS WEB PAGE DESIGN

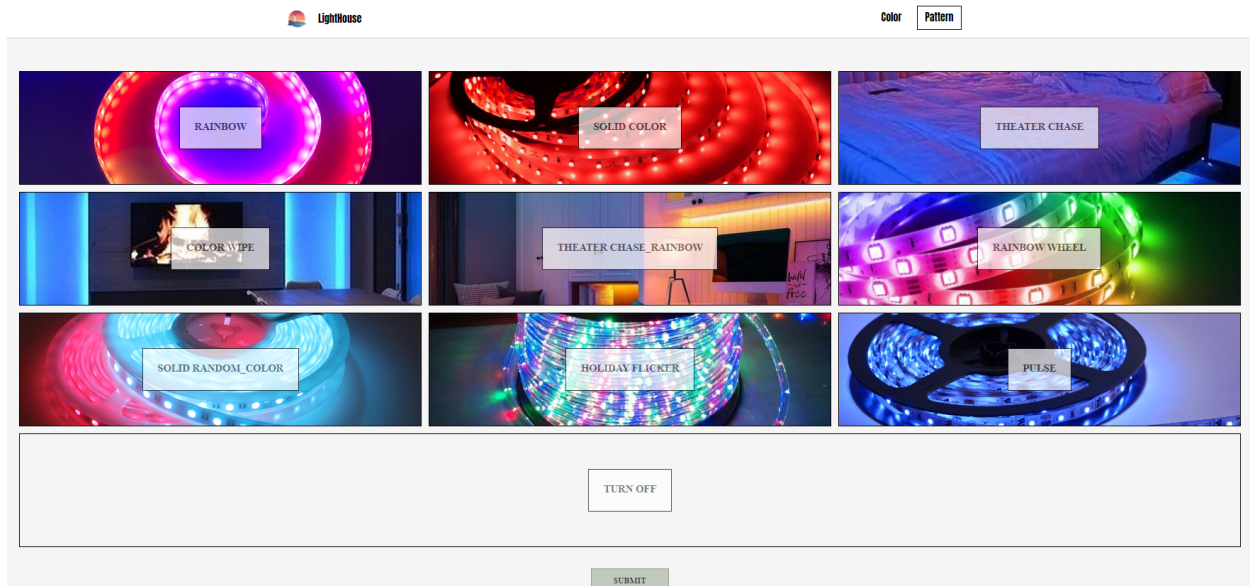


Figure 3: Device Settings Web Page

3 CUSTOMER REQUIREMENTS

The requirements for the product lighthouse are described below including the source of them constraints and any standards that need to be followed for each. The priority of each of the requirements is also stated to show the importance of when they need to be implemented and how important it is for the product as a whole. Specific details for each requirement are also listed to provide an in depth look at what is to be done.

3.1 CONTROLLER - WEB INTERFACE

3.1.1 DESCRIPTION

The product will include the controller which will be the hardware responsible for controlling the LED patterns which will be most likely a web interface in which the user will be able to run, select, change and add new patterns for the lights. The controller will have a display showing all of these options that the user can select what they would like to do.

3.1.2 SOURCE

The source of the requirement is the customer, Shawn Gieser.

3.1.3 CONSTRAINTS

No major constraints for this requirement as only the web interface is needed to control the lights. It will be developed with nothing needed to be manufactured as well.

3.1.4 STANDARDS

Underwriters Laboratories Inc., is the most relied upon source globally for determining safety standards of products determined in 2008 with the UL 588 stating that if using a 22 gauge wire, the number of strands linked together can vary so long as the wattage does not exceed 210 and if using a 20 gauge wire, strings can be added on up until the wattage reaches 420. [2] Also the Senate Bill 227 filed in 2019 stating that it would regulate what HOA can restrict mainly stating that it would be allowed to restrict the display of a religious item for more than 30 days if the item. [1]

3.1.5 PRIORITY

The priority for this requirement is critical.

3.2 RUNNING PATTERNS

3.2.1 DESCRIPTION

LightHouse will allow users to not only run patterns but also change patterns as well. This requirement allows user to change their patterns based on mood, time of day, or depending on the season. This will be included in the web interface and the user will be able to handle all the patterns here and have patterns to run.

3.2.2 SOURCE

The source of the requirement is the customer, Shawn Gieser.

3.2.3 CONSTRAINTS

The only possible constraints here would be the any environmental or political constraints that can restrict the use of certain patterns. Patterns that may be offensive to some.

3.2.4 STANDARDS

Following the guidelines of UL 588 and adhering to HOA rules in accordance to SB 227.

3.2.5 PRIORITY

The priority of this requirement is critical.

3.3 SELECTING PATTERNS

3.3.1 DESCRIPTION

LightHouse will allow users to select new patterns to be put up on display. This will be in the controller part of the web interface and the user can select new or existing patterns that they would like to run on the LED lights. In the option once selected the user will be presented the patterns which they have saved and can simply make the decision and start running them on the lights!

3.3.2 SOURCE

The source of the requirement is the customer, Shawn Gieser.

3.3.3 CONSTRAINTS

The only possible constraints here would be the any environmental or political constraints that can restrict the use of certain patterns. Patterns that may be offensive to some or dangerous for drivers due to flashing lights.

3.3.4 STANDARDS

Following the guidelines of UL 588 and adhering to HOA rules in accordance to SB 227.

3.3.5 PRIORITY

The priority for this requirement is critical.

3.4 ADDING NEW PATTERNS

3.4.1 DESCRIPTION

LightHouse will allow its users the ability to create new custom patterns that can be selected and run within seconds of selecting them from the controller. The user will be able to add new patterns either from saved ones or make completely new ones in the programmer/designer portion. This will be in the web interface as an option to add new patterns from existing or make one to add.

3.4.2 SOURCE

The source of the requirement is the customer, Shawn Gieser.

3.4.3 CONSTRAINTS

Again here the only major constraints that can be thought of are ones such as environmental, health or political. Being bad for the environment, rules against using certain patterns or ones that can potentially be hazardous to drivers or pedestrians passing by.

3.4.4 STANDARDS

Following the guidelines of UL 588 and adhering to HOA rules in accordance to SB 227.

3.4.5 PRIORITY

The priority for this requirement is critical.

3.5 PROGRAMMER/DESIGNER

3.5.1 DESCRIPTION

The programmer/design requirement is one of the most important requirements and this will provide the user with a user interface in which they will be able to select new patterns from selected designs,

down to each LED or even music control patterns. The user will be presented with a screen on which they will be able to select from static, moving, music and more to begin designing their new pattern!

3.5.2 SOURCE

The source of the requirement is the customer, Shawn Gieser.

3.5.3 CONSTRAINTS

Here the constraints that can apply are again any environmental constraints that restrict the use of certain patterns, or even political rules restricting the use of certain patterns and finally health related rules that can be dangerous for people walking or driving by and catch a glimpse of the lights.

3.5.4 STANDARDS

Following the guidelines of UL 588 and adhering to HOA rules in accordance to SB 227.

3.5.5 PRIORITY

The priority of this requirement is critical.

3.6 STATIC PATTERNS

3.6.1 DESCRIPTION

This will be one of the options in the programmer in which the user will be able select from a wide range of static colors for the lights. LightHouse will all have static patterns that offer a wide variety of colors. Static patterns will just be a constant one color that user can choose (many different colors). There will be a default list of colors that the user can choose from. The user can add more colors by entering a hex-code or by clicking from a color circle selection.

3.6.2 SOURCE

The source of the requirement is the customer, Shawn Gieser.

3.6.3 CONSTRAINTS

The same constraints apply here as well, any environmental constraints that restrict the use of certain patterns, or even political rules restricting the use of certain patterns and finally health related rules that can be dangerous for people walking or driving by and catch a glimpse of the lights. These pattern should not be uploaded for use. Lights such as bright neon static colors can significantly obstruct a drivers vision and cause a distraction that can lead to an accident.

3.6.4 STANDARDS

Following the guidelines of UL 588 and adhering to HOA rules in accordance to SB 227.

3.6.5 PRIORITY

The priority for this requirement is critical.

3.7 MOVING PATTERNS

3.7.1 DESCRIPTION

This will be one of the options in the programmer in which the user will be able select from a wide range of moving patterns for the lights. LightHouse will have moving patterns that offer a wide variety of colors and ones that the user will get to select for themselves as well to be included Moving patterns will just be a many colors or a single color depending on the user that he moving patterns are just predictable patterns that will repeat throughout a certain amount of time. There will be a default list of

colors and patterns that the user can choose from. The user can add more colors by entering a hex-code or by clicking from a color circle selection.

3.7.2 SOURCE

The source of the requirement is the customer, Shawn Gieser.

3.7.3 CONSTRAINTS

The same constraints apply here as well, any environmental constraints that restrict the use of certain patterns, or even political rules restricting the use of certain patterns and finally health related rules that can be dangerous for people walking or driving by and catch a glimpse of the lights. These pattern should not be uploaded for use. Lights such as bright flashing moving patters and colors can significantly obstruct a drivers vision and cause a distraction that can lead to an accident. Flashing bright lights such as bright yellow or white cause also lead to health concerns such as epilepsy.

3.7.4 STANDARDS

Following the guidelines of UL 588 and adhering to HOA rules in accordance to SB 227.

3.7.5 PRIORITY

The priority for this requirement is critical.

3.8 MUSIC BASED PATTERNS

3.8.1 DESCRIPTION

Music Patterns allow the user to connect a moving pattern to not change the pattern over time but instead change to when the USB microphone picks up certain sound frequency from a song. The user will be the one playing the song of their choice for the music patterns but the colors that the pattern includes will be selected by the user here. There will be a wide range of colors to choose from but the user can add more colors by entering a hex-code or by clicking from a color circle selection.

3.8.2 SOURCE

The source of the requirement is the customer, Shawn Gieser.

3.8.3 CONSTRAINTS

The same constraints apply here as well, any environmental constraints that restrict the use of certain patterns, or even political rules restricting the use of certain patterns and finally health related rules that can be dangerous for people walking or driving by and catch a glimpse of the lights. These pattern should not be uploaded for use. Lights such as bright flashing moving patters and colors can significantly obstruct a drivers vision and cause a distraction that can lead to an accident. Flashing bright lights such as bright yellow or white cause also lead to health concerns such as epilepsy.

3.8.4 STANDARDS

Following the guidelines of UL 588 and adhering to HOA rules in accordance to SB 227.

3.8.5 PRIORITY

The priority for this requirement is low.

3.9 LINKING TO AND MANAGING CONTROLLER

3.9.1 DESCRIPTION

For this requirement establishing a secure connection, which will be wireless most likely as a web server will be used, to the controller to push and upload new patterns that are created must be accounted for.

This is an integral requirement for the product as this is the only way the user will be able to upload their made patterns for use. The programmer portion will make the patterns and connect to the controller to have them synced to the controller where the user will be able to select new ones.

3.9.2 SOURCE

The source of the requirement is the customer, Shawn Gieser.

3.9.3 CONSTRAINTS

The same constraints apply here as well, any environmental constraints that restrict the use of certain patterns, or even political rules restricting the use of certain patterns and finally health related rules that can be dangerous for people walking or driving by and catch a glimpse of the lights. These pattern should not be uploaded for use.

3.9.4 STANDARDS

Following the guidelines of UL 588 and adhering to HOA rules in accordance to SB 227.

3.9.5 PRIORITY

The priority for this requirement is critical.

3.10 WEATHER PROOF

3.10.1 DESCRIPTION

For this requirement, the need for the lights to be weather proof is of high priority. We will be either using LED lights that are made for all weather or adding a coating to the lights that will make them water resistant. Usually all lights usually come this way as they are made for the wintry weather.

3.10.2 SOURCE

The source of the requirement is the customer, Shawn Gieser.

3.10.3 CONSTRAINTS

The constraints for this requirement are environmental depending on how efficient the lights work and how energy conscious they are. Also the coating that may need to be used must comply with what is allowed. Sustaining the lights for the length of the use with updates and repairs must be also accounted for. The longevity of the lights in short must be accounted as well.

3.10.4 STANDARDS

None.

3.10.5 PRIORITY

The priority for this requirement is low as of now.

4 PACKAGING REQUIREMENTS

This product is not intended to be mass produced, so the software will be pre-loaded on the hard drive of the pi, as well as being available for download via the Git Hub page of the project. Hardware requirements will be listed to allow for the user to gather and build the product themselves, as well as there being a unit made for project presentation and being turned in to the customer.

4.1 CUSTOMER UNIT

4.1.1 DESCRIPTION

One unit of the product will be produced for testing purposes and to be used by the customer, Shawn Gieser. This will include the Pi, Micro controller, LEDs, and any needed software pre-installed. Instructions and Guidelines will also be included

4.1.2 SOURCE

The source of the requirement is the customer, Shawn Gieser.

4.1.3 CONSTRAINTS

No major constraints for this requirement as this unit will be created and tested with as the project is being completed.

4.1.4 STANDARDS

None.

4.1.5 PRIORITY

Critical.

4.2 GIT HUB SOFTWARE DOWNLOAD

4.2.1 DESCRIPTION

All product software and a list of hardware requirements will be posted on the project's git hub page for any users to gather parts themselves and install all needed software.

4.2.2 SOURCE

The source of the requirement is the customer, Shawn Gieser.

4.2.3 CONSTRAINTS

The main constraint here is Time. This task shouldn't be difficult, but may be slightly time consuming.

4.2.4 STANDARDS

None.

4.2.5 PRIORITY

Non-Critical.

5 PERFORMANCE REQUIREMENTS

This section will describe performance requirement for the Lighthouse. The performance requirement for Lighthouse include connecting to the Raspberry Pi and Arduino, the lights shall continue to run unless user disconnects, simple pattern shall take less than 30 seconds.

5.1 CONNECT TO RASPBERRY PI AND ARDUINO

5.1.1 DESCRIPTION

The system shall easily connect to the raspberry Pi and Arduino. Adding the source code to the Raspberry Pi and Arduino should not take more than 30 minutes.

5.1.2 SOURCE

Shawn Geiser.

5.1.3 CONSTRAINTS

All the device shall be connected to the same internet.

5.1.4 STANDARDS

None.

5.1.5 PRIORITY

High Priority.

5.2 PATTERNS CONTINUE TO RUN

5.2.1 DESCRIPTION

The lights should continue to run the designed pattern unless the user disconnects. The light pattern should perform the correct light pattern throughout.

5.2.2 SOURCE

Shawn Geiser.

5.2.3 CONSTRAINTS

None.

5.2.4 STANDARDS

None.

5.2.5 PRIORITY

High Priority.

5.3 FEASIBLE TO CREATE A SIMPLE PATTERN

5.3.1 DESCRIPTION

The user should be able to create few simple light patterns in no more than 2 minutes.

5.3.2 SOURCE

Shawn Geiser.

5.3.3 CONSTRAINTS

None.

5.3.4 STANDARDS

None.

5.3.5 PRIORITY

Medium Priority.

6 SAFETY REQUIREMENTS

This section will go over Safety Requirements of the LightHouse product. The key safety issues with this project is with electricity. This product must follow the National Electric Code (NEC), and any wiring done must meet this code. To be safe advisories may be added on the packaging as need depending on the final state of the wiring done. Another key issue is with the LED Lights potentially causing burns if they reach a certain heat level or possibly damaging eye sight if improperly used. Advisories will be issued to the user directing them to not touch the LED lights while on and to not alter the product to increase brightness levels beyond what the product specifications.

6.1 LABORATORY EQUIPMENT LOCKOUT/TAGOUT (LOTO) PROCEDURES

6.1.1 DESCRIPTION

Any fabrication equipment provided used in the development of the project shall be used in accordance with OSHA standard LOTO procedures. Locks and tags are installed on all equipment items that present use hazards, and ONLY the course instructor or designated teaching assistants may remove a lock. All locks will be immediately replaced once the equipment is no longer in use.

6.1.2 SOURCE

CSE Senior Design laboratory policy.

6.1.3 CONSTRAINTS

Equipment usage, due to lock removal policies, will be limited to availability of the course instructor and designed teaching assistants.

6.1.4 STANDARDS

Occupational Safety and Health Standards 1910.147 - The control of hazardous energy (lockout/tagout).

6.1.5 PRIORITY

Critical.

6.2 NATIONAL ELECTRIC CODE (NEC) WIRING COMPLIANCE

6.2.1 DESCRIPTION

Any electrical wiring must be completed in compliance with all requirements specified in the National Electric Code. This includes wire runs, insulation, grounding, enclosures, over-current protection, and all other specifications.

6.2.2 SOURCE

CSE Senior Design laboratory policy.

6.2.3 CONSTRAINTS

High voltage power sources, as defined in NFPA 70, will be avoided as much as possible in order to minimize potential hazards.

6.2.4 STANDARDS

NFPA 70.

6.2.5 PRIORITY

Critical.

6.3 RIA ROBOTIC MANIPULATOR SAFETY STANDARDS

6.3.1 DESCRIPTION

Robotic manipulators, if used, will either be housed in a compliant lockout cell with all required safety interlocks, or certified as a "collaborative" unit from the manufacturer.

6.3.2 SOURCE

CSE Senior Design laboratory policy.

6.3.3 CONSTRAINTS

Collaborative robotic manipulators will be preferred over non-collaborative units in order to minimize potential hazards. Sourcing and use of any required safety interlock mechanisms will be the responsibility of the engineering team.

6.3.4 STANDARDS

ANSI/RIA R15.06-2012 American National Standard for Industrial Robots and Robot Systems, RIA TR15.606-2016 Collaborative Robots.

6.3.5 PRIORITY

Critical.

7 MAINTENANCE & SUPPORT REQUIREMENTS

This section details the requirements for ongoing use of LightHouse after its final delivery to the user. Achieving maximum long-term performance is the key to reducing product maintenance. These requirements aim to minimize system errors and hardware failures.

7.1 LED STRIP MAINTENANCE

7.1.1 DESCRIPTION

The LED lights will be replaceable in the event of hardware failure. The user will need to get a strip of WS2812B LED lights.

7.1.2 SOURCE

LED Strips WS2812B.

7.1.3 CONSTRAINTS

LED strips must be compatible with the rpiws81x library.

7.1.4 STANDARDS

None

7.1.5 PRIORITY

Priority: 2 - High Priority.

7.2 SOFTWARE MAINTENANCE

7.2.1 DESCRIPTION

All code files and relevant documentation must be available for software maintenance and troubleshooting. The required files and documentation will be available via GitHub repository. The software will be spilt into loosely coupled parts so it would be easier to make changes and improvements over time.

7.2.2 SOURCE

Team LightHouse.

7.2.3 CONSTRAINTS

None.

7.2.4 STANDARDS

None.

7.2.5 PRIORITY

3 - Moderate Priority.

7.3 SOURCE CODE DOCUMENTATION

7.3.1 DESCRIPTION

All source code files required for LightHouse will be extensively commented to support future updates and troubleshooting.

7.3.2 SOURCE

Team LightHouse.

7.3.3 CONSTRAINTS

None.

7.3.4 STANDARDS

None.

7.3.5 PRIORITY

3 - Moderate Priority.

7.4 TROUBLESHOOTING GUIDE

7.4.1 DESCRIPTION

A troubleshooting guide will be presented to the user that details some possible problems that they might encounter in typical use and their appropriate solutions.

7.4.2 SOURCE

Team LightHouse.

7.4.3 CONSTRAINTS

The troubleshooting guide will only be provided in English.

7.4.4 PRIORITY

3 - Moderate Priority.

8 OTHER REQUIREMENTS

This section will go over any other requirements that are not given by the customer but decided upon by the team to make sure to include in the final product. The main one here is an instructional video on how to use the product and including a manual with it. The priority of the requirements is given as well to indicate how much importance should be given to it.

8.1 INSTALLATION VIDEO

8.1.1 DESCRIPTION

A video demo as well as a small manual to know how to install and use the lights right out of the box. It will demonstrate the proper handling and also simple instructions on how to add, change or create new lights to run.

8.1.2 SOURCE

Team LightHouse.

8.1.3 CONSTRAINTS

Length of the video and the amount of detail that can be shown in a video format as well as written.

8.1.4 STANDARDS

None.

8.1.5 PRIORITY

4 - High Priority.

9 FUTURE ITEMS

This section details all additional requirements for the project that do not directly fit in previous sections. All of the following requirements should be completed for the project to be deemed complete. Requirements not listed in this sections will not be part of the overall implementation of LightHouse

9.1 SUPPORT OTHER DEVICES

9.1.1 DESCRIPTION

Support more IoT (Internet of Things) devices other than an ESP8266.

9.1.2 SOURCE

Shawn Gieser.

9.1.3 CONSTRAINTS

None.

9.1.4 STANDARDS

None.

9.1.5 PRIORITY

Priority - Critical.

9.2 ANDROID APPLICATION

9.2.1 DESCRIPTION

Build android application for quick and easy access to change and add new light patterns.

9.2.2 SOURCE

LightHouse Team.

9.2.3 CONSTRAINTS

None.

9.2.4 STANDARDS

None.

9.2.5 PRIORITY

Medium Priority.

REFERENCES

- [1] Ken Herman. Texas lawmaker wants law defending holiday lights, decor from hoas.
<https://www.statesman.com/news/20181221/texas-lawmaker-wants-law-defending-holiday-lights-decor-from-hoas>, 2018.
- [2] Christmas Lights Etc. Ul standards for christmas light strings.
<https://www.christmaslightsetc.com/pages/UL-Standards-for-Christmas-Light-Strings.htm>, 2020.