Department of Computer Science & Engineering
The University of Texas at Arlington

Project Charter
CSE 4316: Senior Design I
Summer 2021

The Lighters
LightHouse

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Revision History

Revision	Date	Author(s)	Description
0.1	07.07.2020	DP, DG, PS, DT	First Rough Draft Complete
0.1	12.07.2020	DP	Final Draft Complete

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List of Figures

1 Problem Statement

The LightHouse project was developed to give the average house owner a reason to keep lights up on the house year round for decorations and ward off anyone who found keeping lights up after holidays a problem. The problem was the constant hassle of having to put up holiday lights every year and removing them each time. LightHouse was created to give the owner the control of changing the lights to match the current holiday or just have a cool design around the house year round. The owner would not have to remove the lights, they would simply change the colors to match the time of the year, a permanent holiday lights solution.

2 Methodology

We will be creating a product in which the user will be able to control the LED lights connected to a web server on their house with a controller in which they will be able to change patterns, select new ones and with the user interface be able to create new patterns of their choice and liking. They will be able to change specific lights and also make new patterns.

3 Value Proposition

Lights are extremely popular in the United States and even more so during the holidays. Most Americans use the lights to light up during the Christmas time. They put up the lights only to take them down after Christmas ends. Our product allows them to keep the lights up all year long; it is not only hassle free for the consumers, it will allow them to create designs for other holidays such as Independence day, Valentine's day, etc. It is a great business product, users will be using the web application all year long and can create their own projects. Our teams are very excited to work on this project. We all enjoy playing with lights colors and design patterns. Our goal is to make the web application user friendly and fun to play with.

4 Development Milestones

This list of core project milestones should include all major documents, demonstration of major project features, and associated deadlines. Any date that has not yet been officially scheduled at the time of preparing this document may be listed by month.

Provide a list of milestones and completion dates in the following format:

- Project Charter first draft - July 7, 2021
- System Requirements Specification - July 26, 2021
- Architectural Design Specification - August 16, 2021
- Demonstration of ADS Document, Overview of Design - September 2021
- Detailed Design Specification - September 2021
- Demonstration of Authentication and Connect to Web Server - September 2021
- Demonstration of Selecting Light Patterns on Controller - October 2021
- CoE Innovation Day poster presentation - December 2021
- Demonstration of UI to Create New Patterns - October 2021
- Demonstration of Implementing Created Designs to Controller - November 2021

- Demonstration of Flow Between Controller and Programmer is Complete - December 2021
- Final Project Demonstration - December 2021

5 BACKGROUND

The main purpose of holiday lights are to light up during Christmas and it is taken down right after. Majority of the led lights do not offer user's choice of patterns so many of the consumers only use the lights for just one purpose. We are working on this project to change that. We want the consumers to be able to put up the lights all year long and be able to choose light color patterns so that they can create a pattern for any holidays they like such as Independence Day, Valentine's Day, or Birthdays. Many Americans take down the lights due to social conflicts. There are people who think it is abnormal for people to put holiday light on year long. We would like to change that perspective by allowing cool design patterns for the lights.

The sponsor would like to be able to keep the holiday lights on the house permanently and be able to create or choose few design patterns and not just choose from two or three choices that are usually given to the users by other companies. The application should be easy to access and use. Allowing multiple devices will also be our goal allowing flexibility to our customers. There are very few applications that allow users to control the led lights for their house. It is the sponsor's and our goal to provide the users a flexible light design patters along with letting them create their own patterns.

This project can be a great business product. The product will be very popular around Christmas time. If finished properly, this project will be something that consumers who are excited to put up a Christmas lights in their house would enjoy utilizing our application. The project will be finished around the Christmas time as well, we would like to present a working application that not only us, the team but also our sponsor will enjoy putting up the lights and using the application in their homes.

6 RELATED WORK

There are multiple existing solutions related to this project. The first solution we will talk about is Dancy Pi, which is an enthusiast project for LEDs. Dancy Pi is a console project that makes LED lights "dance" by changing the colors and patterns according to music. Everything is controlled through the console. If you wanted to change a feature you must stop what you are doing, change whatever needs to be done, then restart the software. Dancy Pi is specifically made for individuals who have Linux experience and lacks a basic user interface as well a low user experience. This solution does not attract basic customers who interested in LED lights with a complex installation.

The next solution related to this project is Raspberry Pi - Control RGBW LED Strip from your web browser, which is an enthusiast related project idea. This idea has a friendly user interface and experience for the user to be able to change only the color for a single LED strip. The user can access certain strips using endpoints to change the color of the strip. The downside of the project is UI/UX is very dull because it offers the user to just the color. The user interface is too simple and does not let the user customize their LEDs to their fullest potential.

Another LED enthusiast solution is called Striptease. Striptease has two main goals. The first main goal is to simplify the development of visual effects to be rendered on LED Strips, by providing abstractions. The second is to provide run-time support for rendering multiple LED strips. The main problem with this project is the hardware setup. It requires those hardware enthusiasts that want to have 170 frames per second LEDs. Lot of manual hardware setup not which is not feasible for a wide range of customers.

The final enthusiast project that will be mentioned in this report is called led-lights. This project is a very simple setup which uses just a pair of LED strips and a Raspberry Pi. The Raspberry Pi acts as a web server and takes data from the user and sends it off to the LED strips. Again the UI/UX for this project is very dull and limits the user's creativity.

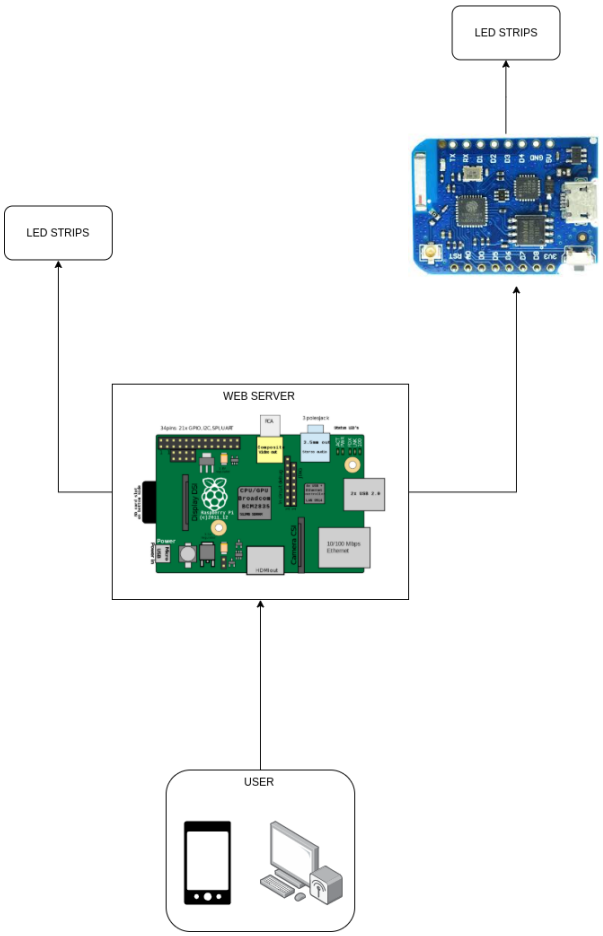
The final solution can be bought on Amazon for $24. There is an app for it, but the app only allows the user to change colors. The setup comes with a controller that offers the user a little more features.

The problem is that if you lose the controller than the user essentially loses all the features that the controller had.

7 System Overview

The solutions architect has three main components: a user, a web server, and the client. The architect uses a unidirectional approach to send data. Commands from the user will be sent to the web server. The web server will take these commands and translate it into a readable language that the LED strips can execute. The web server can also send commands to a micro-controller if a micro-controller is needed in the setup.

The user will be the user's phone or computer and will have access to the web server by typing in the ip address and port number in a browser. Once the connection is established the user will be able to send commands to the web server controlling power, color, patterns, and more. The controller will send commands on how the LED strips should be displayed.



8 Roles & Responsibilities

Our project has one primary stakeholder, Dr. Shawn Gieser. This project was thought up by him and he will be our primary point of contact for the team. Our team members are Dipika Giri, Dhruv Patel, David Trimino, and Parker Skinner. Parker Skinner will be the our team's primary point of contact between the development team and the customer as well as development for the micro controller. David Trimino will be our scrum master and system architect. Dipika Giri will be our database specialist and will handle

the front end of the web server. Dhruv Patel will work with the back end of the web server. Our product owner and scrum mater will be maintained throughout the entirety of the project.

9 Cost Proposal

The need for the items is necessary as the time to test can be saved greatly if everyone is able to complete testing in their own home. This will significantly speed up the fixing of problems in code as well, because everyone will be able to test and look for the error in their own home. The need for these items uses just 1/4 of the budget and for the final product for demo will also be available as we have one for the group testing.

9.1 Preliminary Budget

The cost for the items is minimal as all the members of the group already posses a raspberry pi and so the only item everyone needs is the lights. The current plan is to provide each member with a strip of LED lights for home testing which will cost about $20 each so a $80 total for the lights fro 4 members. A set of lights for on campus testing will also be purchased bringing the total to $100 dollars excluding tax. An arduino for each member and one for on campus testing should be $24 times 5 so $120 total cost here. So far these are the only planned purchases for the project.

9.2 Current & Pending Support

The funds fro the project are $800 provided by the CSE department which will be more than enough to complete the project. No other potential funding sources.

10 Facilities & Equipment

Each team members already posses a raspberry Pi to work with so testing will be done individually if need be. We will purchase LED lights for each team members to allow efficient testing environment at any location. We will also be testing with LED light that we received from the lab along with the raspberry pi that the professor provided us for group testing in person. We will be testing the application with the LED lights at our home majority of our time. We will do final testing at the designated lab space in ERB building. The overall need for facilities and equipment is minimal as everyone is able to test in their own home and share the code with each other and also the amount of equipment is also minimal, LED lights, the raspberry pi and connections.

11 Assumptions

An assumption is a belief of what you assume to be true in the future. You make assumptions based on your knowledge, experience or the information available on hand. These are anticipated events or circumstances that are expected to occur during your project's life cycle.

Assumptions are supposed to be true but do not necessarily end up being true. Sometimes they may turn out to be false, which can affect your project significantly. They add risks to the project because they may or may not be true. For example, if you are working on an outdoor unmanned vehicle, are you assuming that testing space will be available when needed? Are you relying on an external team or contractor to provide a certain subsystem on time? If you are working at a customer facility or deploying on their computing infrastructure, are you assuming you will be granted physical access or network credentials?

This section contains a list of 5 of the most critical assumptions related to our project.

The following list contains critical assumptions related to the implementation and testing of the project.

- Access to internet at the site of installation and testing.

- LED light testing will be done using smaller strip lengths rather than larger one.
- Different testing site will result in same output
- There will be ample power and network connectivity at the testing site
- The raspberry Pi will connect to the web application without any problems

12 Constraints

Constraints are limitations imposed on the project, such as the limitation of cost, schedule, or resources, and you have to work within the boundaries restricted by these constraints. All projects have constraints, which are defined and identified at the beginning of the project.

Constraints are outside of your control. They are imposed upon you by your client, organization, government regulations, availability of resources, etc. Occasionally, identified constraints turn out to be false. This is often beneficial to the development team, since it removes items that could potentially affect progress.

This section contains a list of 5 of the most critical constraints related to your project. For example: The following list contains key constraints related to the implementation and testing of the project.

- Final prototype demonstration must be completed by May 1st, 2022
- The customer will provide no more than two maintenance personnel to assist in on-site installation
- Customer installation site will only be accessible by development team during normal business hours
- Total development costs must not exceed $800
- All data obtained from customer site must be reviewed and approved for release by the Information Security Office prior to being copied to any internet connected storage medium
- The team cannot meet no more than twice a week due to scheduling conflicts
- Client is not descriptive about requirements or responses
- Supplier for hardware could fail or not deliver the parts on time for testing given adequate time to do so

13 Risks

This section should contain a list of at least 5 of the most critical risks related to your project. Additionally, the probability of occurrence, size of loss, and risk exposure should be listed. For size of loss, express units as the number of days by which the project schedule would be delayed. For risk exposure, multiply the size of loss by the probability of occurrence to obtain the exposure in days. For example:

The following high-level risk census contains identified project risks with the highest exposure. Mitigation strategies will be discussed in future planning sessions.

Risk description	Probability	Loss (days)	Exposure (days)
Incorrect sizing of pins and wires on parts	0.40	10	4
Software issues	0.20	8	1.6
Connectivity issue between web server and controller	0.30	4	1.2
Shipping delays of lights or parts	0.20	10	2.0
Defective LED lights	0.10	10	1

Table 1: Overview of highest exposure project risks

14 Documentation & Reporting

14.1 Major Documentation Deliverables

14.1.1 Project Charter

This document will be maintained on a bi-weekly basis but can be more often depending on if there needs to be a major change to the document or a significant development has occurred in the project. The initial version will be delivered on July 7th, 2021. The final version be delivered on December 6th, 2021.

14.1.2 System Requirements Specification

The system requirements specification document will be maintained on a less intensive level than the charter as it will contain the requirements and the documents for the product. This is due to the need for change will only arise when the requirements will change or the overall system view changes. Normal checks will be made monthly for sure to make sure it is up to date with the product. The initial version will be delivered on July 26th, 2021. The final version be delivered on December 6th, 2021.

14.1.3 Architectural Design Specification

This document will also be looked at on a less intensive level possibly once or twice a month like the system requirements specification, only due to the any major design changes as that is when it will be required. Normal checks will be made monthly for sure to make sure it is up to date with the product. The initial version will be delivered on August 16th, 2021. The final version be delivered on December 6th, 2021.

14.1.4 Detailed Design Specification

The detailed design specification which outlines the hardware and software specifications from the functional requirements will be maintained on a regular bases checked every 1-2 weeks to implement any changes to the project if need be. Normal routine checks just like on all the documents will be done to make sure all the requirements are up to date as well and any other changes that need to be made. The initial version will be delivered on September 27th, 2021. The final version be delivered on December 6th, 2021.

14.2 Recurring Sprint Items

14.2.1 Product Backlog

Items will be added to the backlog based upon the system requirements specification in the order that the group deems is the best way to handle the requirements to be addressed. The prioritization of the items will be based upon the number of hours that will be required to complete the item as well as the importance of that item as a whole. The decision will be discussed among the group and everyone will come to a final decision agreed upon by everyone. The software used to maintain the product

backlog will most likely be a word document or excel document on teams that will be accessible by all the members of the group. A clearer copy will be put on word and converted to a PDF for all the stakeholders to view and also during the sprint presentations it will be shown to everyone.

14.2.2 Sprint Planning

Each sprint will be planned in a meeting with the group, with everyone pitching in ideas on what should be of focus for that sprint along with what we can work on from the get go. What is to be done at each meeting is everyone will consider and discuss which items have to the most importance and work on those first by prioritization. There will be a total of 7 sprints with 3 being in the summer and 4 in the fall semester (senior design II).

14.2.3 Sprint Goal

The sprint goal will be decided by the entire group as a whole as it will be an open discussion in the team meeting with everyone pitching on ideas for the sprint explaining why it should be considered. The a print plan presentation will be given to the customer and any other stake holders to discuss and present the goal. The customer will be able to ask questions along with suggesting any changes that they may want made.

14.2.4 Sprint Backlog

The items from the product backlogs will be talked about by the group and the corresponding sprint backlogs for each item will be made as a team and tweaked by whichever member that has suggestions. The backlogs will be maintained on teams files that can be accessed by all the members of the group and regularly opened and discussed at meetings that require them. The backlogs will be split up and talked about to make sure that each item is addressed.

14.2.5 Task Breakdown

The items from the sprint backlog will be assigned using the volunteer system, whoever feels the most comfortable doing a task will likely volunteer and receive that task and the remaining tasks can be assigned in accordance to the members of the group but can also be worked on by numerous members of the group as well. The time spent on the tasks will be monitored individually on an excel document for example and reported at team meetings if necessary.

14.2.6 Sprint Burn Down Charts

The person responsible for generating the burn down charts for each sprint will rotate on a sprintly basis. Starting with myself, Dhruv Patel will generate the first burn down chart and the next week it will be the next person who volunteers or assigned to. As mentioned earlier, everyone will have a document that they will keep track their individual hours expenditure and when needed will report it to the person who will make the chart that week. The chart will be made using excel and an example of one is shown on the next page with the actual time and estimated time (numbers are made up to show an example).

14.2.7 Sprint Retrospective

The sprint retrospective will occur the day after each sprint review presentation to talk about the past sprint and what can be done differently in the next one. Items that can be discussed are what was done correctly, what can be done better and what can be excluded in the next one. Each member will be able to share their perspective and suggest their ideas at these meetings. As a group the charts the backlogs and the presentations will be documented and time spent in meetings as well. As individuals the time worked on a specific task or time spent working on the project can be tracked as well. All of these items

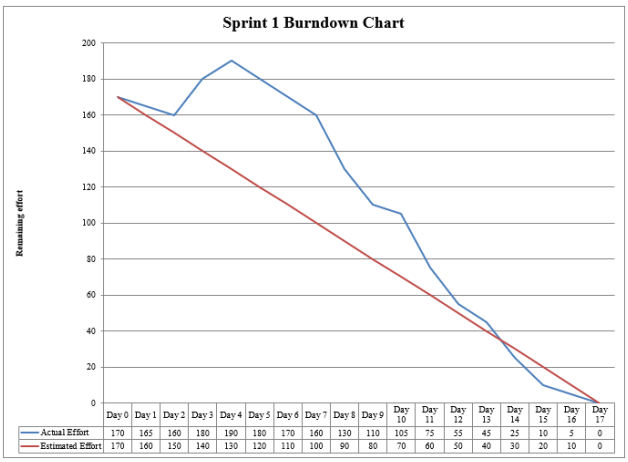


Figure 1: Example sprint burn down chart

will be presented a day or 2 before the next presentation to the customer to make sure everyone is on the right track.

14.2.8 Individual Status Reports

Each individual of the team will submit a report of what they worked on the past sprint as well as report the time worked to the person who will be doing the burn down chart for that week. It will be reported before the sprint review presentation so the burn down chart individual can get all the data. Key items to include will be exactly what they worked on what they are working on and the hours they put in the the weeks.

14.2.9 Engineering Notebooks

The engineering notebooks should be updated after each meeting for sure but also any research and work that the individual team members do should also be updated on their own time. The amount of pages for each sprint interval can vary from person to person due to different writing styles and sizes of font but at minimum there should be roughly 3-4 pages initially and then 5-7 for the more intensive sprints in senior design 2. Each interval currently follows a 2 week patter but can be increased as needed. Each member will of course submit for ENB checks to the professor but should also show fellow group members the entries that they have done and discuss. Finally the witness for each page will be fellow group members to make sure that the entries are correct and have everything that is necessary and also the correct format is followed.

14.3 Closeout Materials

14.3.1 System Prototype

The final system prototype so far is planned to include a full set of working led lights that follow the patterns that are sent to it. With the lights a controller in the form of an application as of now to change and manage patters will be included as well and in said application will be the user interface to create new patterns and select new ones as well. Yes a PAT will be conducted with the customer to make sure that all of their needs are satisfied and up to par to the best of their ability. Nothing offsite will be demonstrated, everything in person at the time.

14.3.2 Project Poster

The poster will include most of the items included in the final prototype including all the features that were added along with the capabilities of the product. Explanations in brief will also be given to give the customer and any others a solid idea of what the product is supposed to do. The dimensions of the poster so far are determined to be a medium 18 x 24 inches and will be delivered with the final product on December 7th, 2021.

14.3.3 Web Page

The web page will have similar items on it like the poster detailing the major features of the product but will have more in depth explanations of all of them. The web page will also include images of the product and the patterns as well and a link to the user manual and video for the installation (both to be implemented at a later date). It will be available to the customer first and foremost and the public will have access after the final demo and approval from the customer. It will also be delivered on December 7th, 2021 with the poster. It will be updated as features are completed throughout the project.

14.3.4 Demo Video

The demo video will show the main features of the product as well as a simple setup guide on how to use the lights and controller with the user interface on creating new patterns of lights. B-reel footage will most likely not be provided as the main footage will suffice as it will be directly on the actual product. The main topics will be the ones mentioned such as main features and how to use and implement them and also how to set up the product. The video length will most probably be 7 minutes to show setup in terminal in the first 1 and features in the next 6 minutes.

14.3.5 Source Code

The source code will be maintained by all the group members using GitHub as everyone will have access to the repository and push any changes that need to be made. Along with updates to any code and any advancements made will be updated on the repository. The customer will have access to the source code as they please to recommend their changes or suggestions. Yes after the demo the plan is to release it to the public and the license in mind as of now subject to change will be the GPL license allowing the code to be open and free to other users. The license terms will be listed in each source file to make sure the message is received.

14.3.6 Source Code Documentation

The documentation standards will be followed by all the group members to ensure continuity and smooth transition from one persons code to another. Currently the plan is to use Doxygen as most of us have heard of or used this tool to generate documentation. The final documentation will be provided in a PDF format for ease of transfer-ability and to make sure no formatting issues occur.

14.3.7 Hardware Schematics

Yes we will be wiring components together, specifically in 1 of the two following ways: from the raspberry pi directly to the LED lights or from the pi to the arduino to the LED lights. We will first be attempting the first way to get it working and experiment to see which way works better for us. Currently we have no diagram other than the system overview diagram of how we will be wiring the components. Also currently we have connection from the pi directly to the lights making it easier for the user. Pi to the arduino will be implemented in future models.

14.3.8 Installation Scripts

The customer can go onto the web page created for the product and be able to download any latest software updates packaged in a zip file. He/She will then be able to update the software for the controller

or programmer easily. The scripts will be provided and yes there will be different scripts for different components of the product such as the controller, web server, and programmer.

14.3.9 User Manual

The customer will be provided with a digital user manual that will be delivered with the overall final product in the future. The detailed instructions will be more than enough to set up the lights and instructions on how to use the controller as well as how to create new patterns. The customer will also be given a video explaining how to setup the lights as well as how to use the controller as well.

References