Group 15 how.dance Smart Lights

Executive Summary

Aiden K. Bahr, Christopher B. Parker, and Oluwalana Popoola

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1 Original Design Problem

The purpose of the project is to design and prototype a smart light that will integrate with the how.dance online concert platform. The vision of the project is to make the online concert experience as immersive as possible for concert hosts and their audience. The how.dance Smart Lights will do this by synchronizing over a cloud server where the concert host can change the colors and animations of all lights in real-time. The lights will also have sound reactive animations using data from an onboard microphone to increase the immersive concert experience.

This project will help artists connect with their fans during the COVID-19 pandemic and beyond. Recently, online concerts through live streams have been growing in popularity since concerts traditionally feature large crowds. In order to make the how.dance Smart Lights as similar to the reactive lighting at an in-person venue as possible, all users in the same concert will be able to share the experience with identical LED patterns displayed in each of their own homes. This will be achieved by creating a network of devices that communicate with a host server using the PubNub real-time network API. The user will pair their lights to their wifi network and put the device in concert mode to begin communications with the network.

As with any project, it's important to imagine who this product is for. Our audience is anyone who wants to experience the immersive concert or club experience from the safety and comfort of their own home. Additionally, we want our product to appeal to anyone who would put an LED strip in their room for lighting or aesthetics. For this purpose, our smart light will also feature intuitive user controls and a variety of animation and color options so most users can have at least one favorite.

2 Management and Development Process

When teams were assigned, the project team met together to decide what roles each person would perform and to discuss the project. It was determined that the project would have one main hardware developer and one main software developer. Since the team was comprised of three individuals, the third individual would assist one of the leads. Knowing this, the hardware lead position was assigned to Aiden, the Software lead position was assigned to Chris, and the floater position was assigned to Oluwalana. The team also deceived that Aiden would act as the team's project manager as he has had previous experience in that role. Once roles were established, the team contacted the project partner to discuss their vision for the project.

After meeting with the project partner, the project team determined that the project would be split into four main phases. The first phase concerned the research that needed to be done for the project. The second phase concerned the designing and development of a working prototype. The third phase concerned testing the different aspects of the prototype, and the fourth phase concerned finalizing the project. Each phase would be completed during a specified term when phase one would be completed in Fall Term, the second and third phases would be completed in Winter Term, and the fourth phase would be completed in Spring Term. After the completion of all four phases, the prototype and documentation created during the project would then be ready to hand off to the project partners.

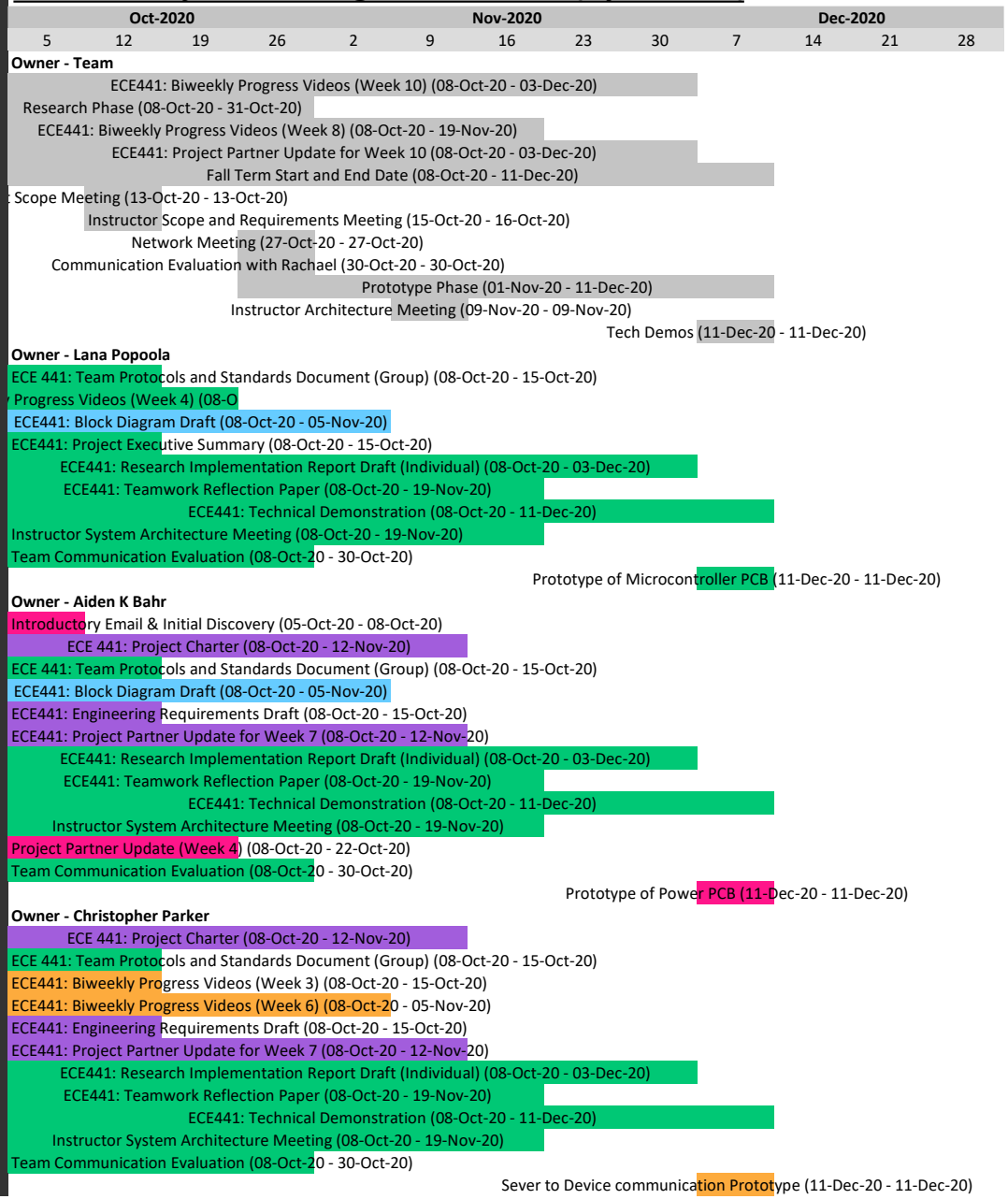
Once the team established the phases that needed to be reached, the team decided on ten system blocks that would ensure that the system would function appropriately and assigned them to the specified team member. The Enclosure block, Light Display block, and the Power PCB would be assigned to Aiden because of his background in Fusion 360 and Solidworks. The Audio Processing block, Main Code block, Microphone block, and Wireless Host block would be assigned to Chris. The LED Animations block, Microcontroller block, and User Interface block would be assigned to Oluwalana.

At this time, the project has completed phase four, passed all system checkoffs, and all of the documentation is being finalized in order to be handed off to the project partner or the next team that will pick up where we left off.

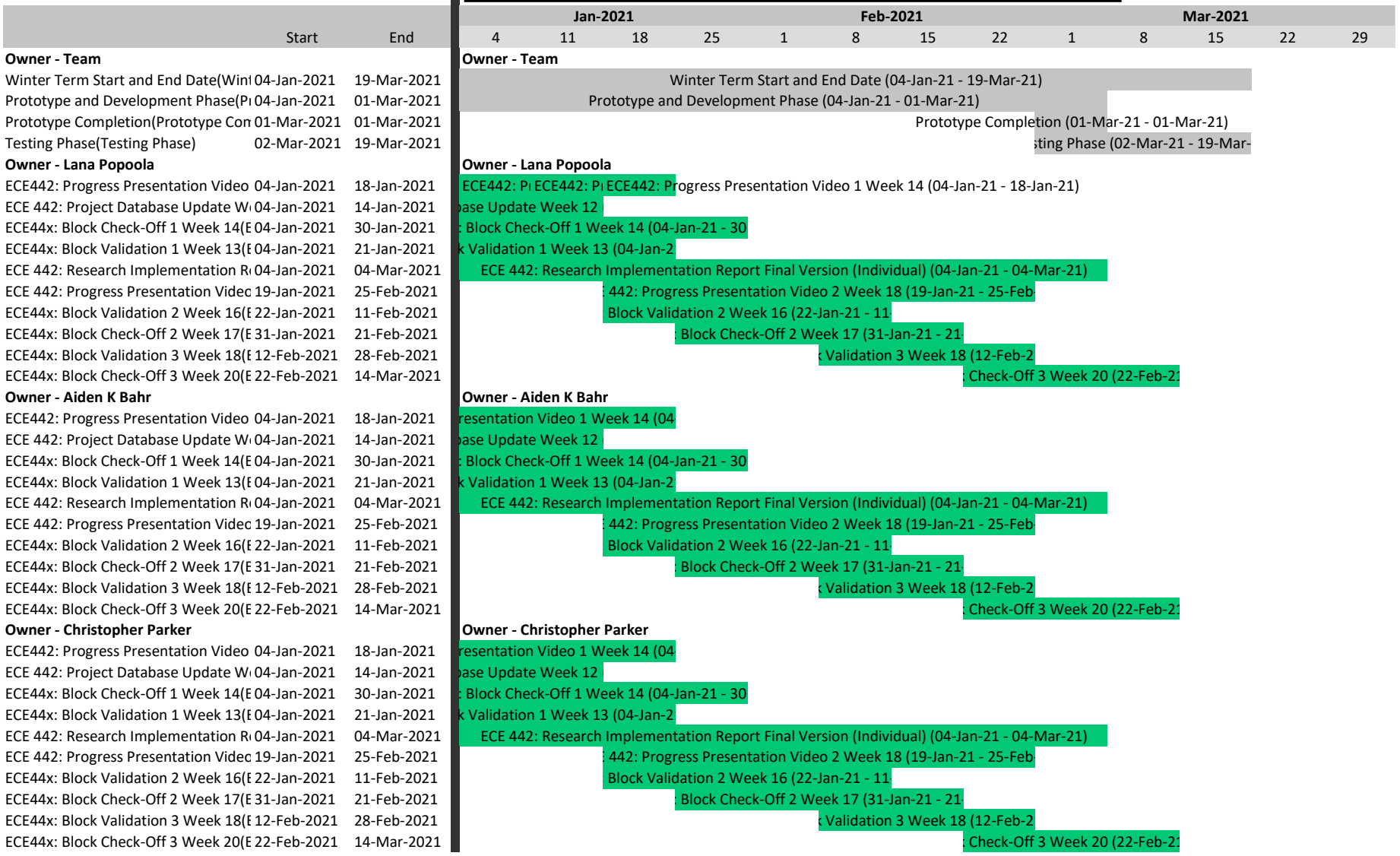
3 Project Timeline

Board - Project Planning For Fall Term (by months)

	Start	End
Owner - Team		
ECE441: Biweekly Progress Videos (W	08-Oct-2020	03-Dec-2020
Research Phase(Research Phase)	08-Oct-2020	31-Oct-2020
ECE441: Biweekly Progress Videos (W	08-Oct-2020	19-Nov-2020
ECE441: Project Partner Update for V	08-Oct-2020	03-Dec-2020
Fall Term Start and End Date(Fall Ter	08-Oct-2020	11-Dec-2020
Project Scope Meeting(Project Scope	13-Oct-2020	13-Oct-2020
Instructor Scope and Requirements M	15-Oct-2020	16-Oct-2020
Network Meeting(Network Meeting)	27-Oct-2020	27-Oct-2020
Communication Evaluation with Rach	30-Oct-2020	30-Oct-2020
Prototype Phase(Prototype Phase)	01-Nov-2020	11-Dec-2020
Instructor Architecture Meeting(Instr	09-Nov-2020	09-Nov-2020
Tech Demos(Tech Demos)	11-Dec-2020	11-Dec-2020
Owner - Lana Popoola		
ECE 441: Team Protocols and Standar	08-Oct-2020	15-Oct-2020
ECE441: Biweekly Progress Videos (W	08-Oct-2020	22-Oct-2020
ECE441: Block Diagram Draft(ECE441	08-Oct-2020	05-Nov-2020
ECE441: Project Executive Summary(I	08-Oct-2020	15-Oct-2020
ECE441: Research Implementation Re	08-Oct-2020	03-Dec-2020
ECE441: Teamwork Reflection Paper(	08-Oct-2020	19-Nov-2020
ECE441: Technical Demonstration(EC	08-Oct-2020	11-Dec-2020
Instructor System Architecture Meeti	08-Oct-2020	19-Nov-2020
Team Communication Evaluation(Tea	08-Oct-2020	30-Oct-2020
Prototype of Microcontroller PCB(Pro	11-Dec-2020	11-Dec-2020
Owner - Aiden K Bahr		
Introductory Email & Initial Discovery	05-Oct-2020	08-Oct-2020
ECE 441: Project Charter(ECE 441: Pro	08-Oct-2020	12-Nov-2020
ECE 441: Team Protocols and Standar	08-Oct-2020	15-Oct-2020
ECE441: Block Diagram Draft(ECE441	08-Oct-2020	05-Nov-2020
ECE441: Engineering Requirements D	08-Oct-2020	15-Oct-2020
ECE441: Project Partner Update for V	08-Oct-2020	12-Nov-2020
ECE441: Research Implementation Re	08-Oct-2020	03-Dec-2020
ECE441: Teamwork Reflection Paper(	08-Oct-2020	19-Nov-2020
ECE441: Technical Demonstration(EC	08-Oct-2020	11-Dec-2020
Instructor System Architecture Meeti	08-Oct-2020	19-Nov-2020
Project Partner Update (Week 4)(Pro	08-Oct-2020	22-Oct-2020
Team Communication Evaluation(Tea	08-Oct-2020	30-Oct-2020
Prototype of Power PCB(Prototype o	11-Dec-2020	11-Dec-2020
Owner - Christopher Parker		
ECE 441: Project Charter(ECE 441: Pro	08-Oct-2020	12-Nov-2020
ECE 441: Team Protocols and Standar	08-Oct-2020	15-Oct-2020
ECE441: Biweekly Progress Videos (W	08-Oct-2020	15-Oct-2020
ECE441: Biweekly Progress Videos (W	08-Oct-2020	05-Nov-2020
ECE441: Engineering Requirements D	08-Oct-2020	15-Oct-2020
ECE441: Project Partner Update for V	08-Oct-2020	12-Nov-2020
ECE441: Research Implementation Re	08-Oct-2020	03-Dec-2020
ECE441: Teamwork Reflection Paper(	08-Oct-2020	19-Nov-2020
ECE441: Technical Demonstration(EC	08-Oct-2020	11-Dec-2020
Instructor System Architecture Meeti	08-Oct-2020	19-Nov-2020
Team Communication Evaluation(Tea	08-Oct-2020	30-Oct-2020
Sever to Device communication Prot	11-Dec-2020	11-Dec-2020

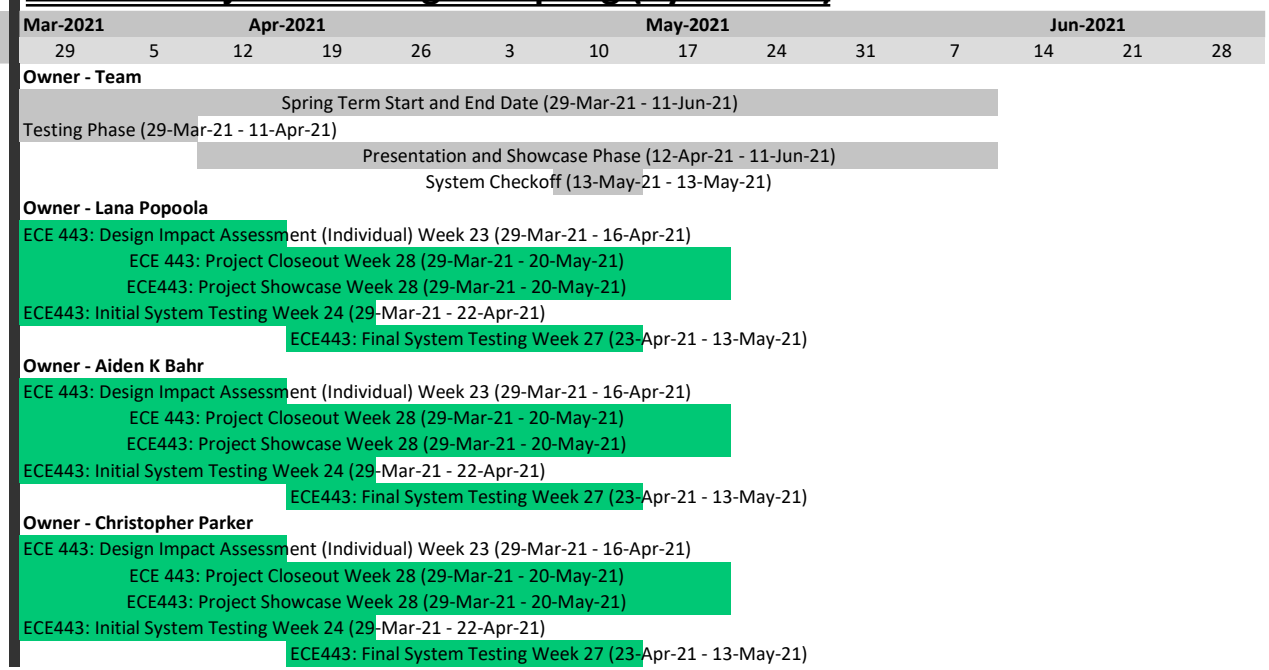


Board - Project Planning For Winter (by months)



Board - Project Planning For Spring (by months)

	Start	End
Owner - Team		
Spring Term Start and End Date(Sprin	29-Mar-2021	11-Jun-2021
Testing Phase(Testing Phase)	29-Mar-2021	11-Apr-2021
Presentation and Showcase Phase(Pr	12-Apr-2021	11-Jun-2021
System Checkoff(System Checkoff)	13-May-2021	13-May-2021
Owner - Lana Popoola		
ECE 443: Design Impact Assessment (	29-Mar-2021	16-Apr-2021
ECE 443: Project Closeout Week 28(E	29-Mar-2021	20-May-2021
ECE443: Project Showcase Week 28(E	29-Mar-2021	20-May-2021
ECE443: Initial System Testing Week 2	29-Mar-2021	22-Apr-2021
ECE443: Final System Testing Week 2	23-Apr-2021	13-May-2021
Owner - Aiden K Bahr		
ECE 443: Design Impact Assessment (	29-Mar-2021	16-Apr-2021
ECE 443: Project Closeout Week 28(E	29-Mar-2021	20-May-2021
ECE443: Project Showcase Week 28(E	29-Mar-2021	20-May-2021
ECE443: Initial System Testing Week 2	29-Mar-2021	22-Apr-2021
ECE443: Final System Testing Week 2	23-Apr-2021	13-May-2021
Owner - Christopher Parker		
ECE 443: Design Impact Assessment (	29-Mar-2021	16-Apr-2021
ECE 443: Project Closeout Week 28(E	29-Mar-2021	20-May-2021
ECE443: Project Showcase Week 28(E	29-Mar-2021	20-May-2021
ECE443: Initial System Testing Week 2	29-Mar-2021	22-Apr-2021
ECE443: Final System Testing Week 2	23-Apr-2021	13-May-2021



4 Project Reflection

This project taught all of us how to deal with the challenge of remote collaboration. In the corporate world, even after the pandemic, it is likely you will have to work with people in other parts of the world. Large companies often have multiple branches and projects can be collaborations between them. We learned to use a shared drive and constant communication to keep track of roles and deadlines. This made sure every assignment was completed promptly.

We also learned how to work with wireless communication, specifically minimizing overhead to get the lowest possible latency. Our interfaces encode the color and mode information as hexadecimal values that only require 1 byte each to transmit. Working with this has prepared us for jobs that involve network communication and real time applications.

The final takeaway our team received was the ability to work around constraints. Since we had to make our engineering requirements before we even started the engineering of our capstone, we had to figure out how to manage ambitious requirements. Due to the maximum budget, we ended up running out of money before we could make enough parts to meet one of the constraints we initially set. Our team met to discuss what approach we needed to take and eventually decided that reducing the number of parts we needed to demo didn't affect the end product. We ended up changing the requirement from 5 LED bars down to only 3 and were still able to demonstrate the modularity of the device.