Tailgater Scoreboard
Executive Summary

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The Tailgater Scoreboard is a wireless LED scoreboard that can keep track of several games like cornhole and basketball. It is controlled using a wireless remote that can change the score and customize the board for each team. The board also has a versatile mounting system that allows the players to stand it up on a flat surface or mount it on a wall. The scoreboard consists of four seven-segment displays, two for each team, that can be customized with a range of colors. At the beginning of the project, many extra options were considered. These options included a renewable power supply using a solar panel placed on the enclosure, a timer on the scoreboard, and three LEDs for each team to keep track of wins/rounds for tournament-style games. After meeting a few times with the project partner, the team decided to add a small, rechargeable battery with an LED indicator, a different seven-segment display that shows a timer, the win counter LEDs, and extra color options than originally requested. Overall, the design must be lightweight and easy to bring to any tailgating event. It must also be straightforward to use with a low cost of manufacturing in order to beat much more expensive competitors.

In its early stages of development, the team spent several weeks researching different options as they decided on a final design. The team explored options with the type of LEDs to use and how to design the power supply. These choices were made in tandem as the many LEDs will be the main power draw. Ultimately, Neopixels were chosen for the LEDs and a 12 v battery with a buck converter was chosen for the power supply. Neopixels were chosen as they automatically index themselves, have built-in RGB capabilities with a range of brightnesses, and use a single data line to communicate. The choice for the project's microcontroller is an ESP32 as it is small, powerful, and cheaper than other options. Several team members also have relevant experience working with it on past projects. The team has decided on using an infrared remote to communicate with the board. Infrared will be good enough for these purposes as it does not need to communicate over a very large range. The team also researched seven-segment display drivers but came to the conclusion that they were unnecessary if Neopixels are used. The scoreboard digit PCBs are built from scratch due to their large size, but the timer display is a premade module with a built-in LED driver. Finally, the win counter lights are simply segments of the score digits consisting of three lights each.

Before the first round of system verification, the team spent time testing and assembling the entire system. The code was feature complete, but there was still a lot of time dedicated to debugging once the system was built. Before the first system verification, the following steps had been completed. All of the scoreboard PCBs were assembled and tested, as were the timer and the win counters. User inputs were made to use an IR remote and diode, and all inputs were tested to show they were processed smoothly and accurately. The power supply components had also been bought and tested. System verification 1 went very smoothly for the team, and they were easily able to pass 4 out of 5 of the universal constraints and

4 of the 8 engineering requirements. The only universal constraint not met at this time was because that the system still used a breadboard.

The next steps were to prepare for final verification. In the next few weeks, the team built an enclosure, designed the battery indicator circuit, and fully assembled the system. Rounds of tests and videos were then taken and documentation was created to prove the rest of the requirements. The enclosure was a particularly difficult task as it is much larger than other projects and the team would not be able to 3D print it. It also had to be light enough to mount and move. The team's solution was to build a wooden frame and laser-cut transparent plastic for the face and back plates. After all of this preparation, the team earned full points at the final system verification. After this, the project was officially finished and the team has been working on completing the documentation and preparing for the engineering expo.

The timeline for this project is shown in Figure 1 below. It shows the general steps for building the system and how many of the larger steps require a lot of upfront work to first be completed. This timeline was completed early on in the course of the project, but the team did their best to stick to it throughout the entirety of the project.

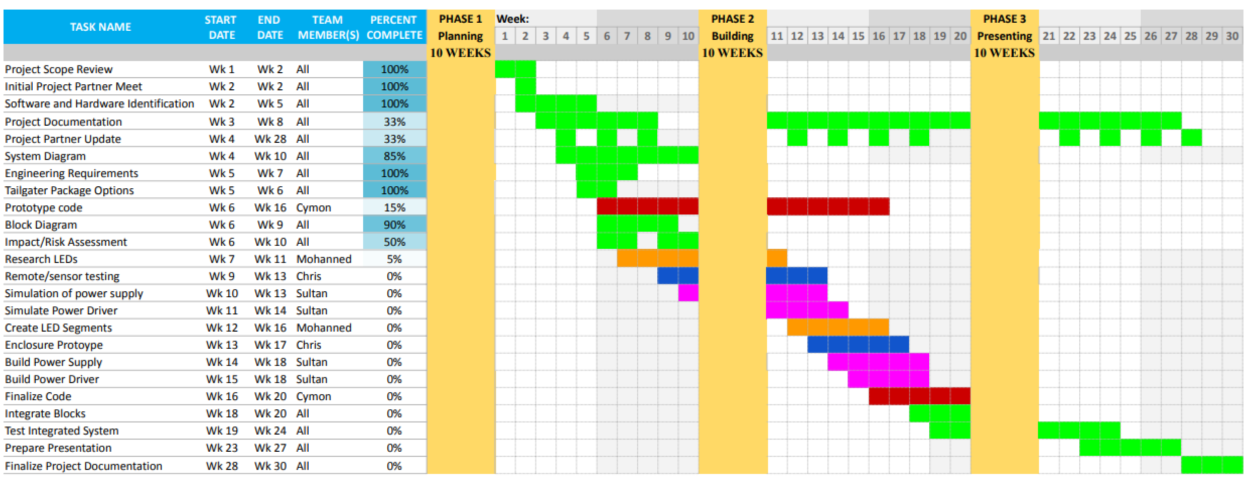

Figure 1: Project timeline

The team learned many key lessons throughout this project. At the beginning of the second term, a teammate had to leave the class, dropping the team from 4 to 3 members. This caused the team to initially scramble to re-split up the work, but it ultimately made them become closer and work together more smoothly as many system blocks were now shared between two teammates. So, although this initial challenge took a long time to get used to, it ultimately caused the team to come together and focus. The team also had to learn several new techniques and technologies. These include IR communication, woodworking, and creating LED displays with little to no noise. All of these took many hours of research and reaching out to more knowledgeable peers and mentors. Finally, as with any long term project, the team greatly developed their communication skills. Not only did they learn how to work better together, but they also learned how to communicate within the industry as they worked with their project partner to create a product that will eventually be sold to the public.