Where's That Sound? A 2-D Locator - Project Executive Summary

Purpose

There are often situations where it is desirable to find the location of a specific sound or tone. This may include activities such as birdwatching, troubleshooting mechanical devices, or tracking a person speaking with a camera. This project will simplify the sound location process by locating and displaying the positions of a specified frequency range to the user.
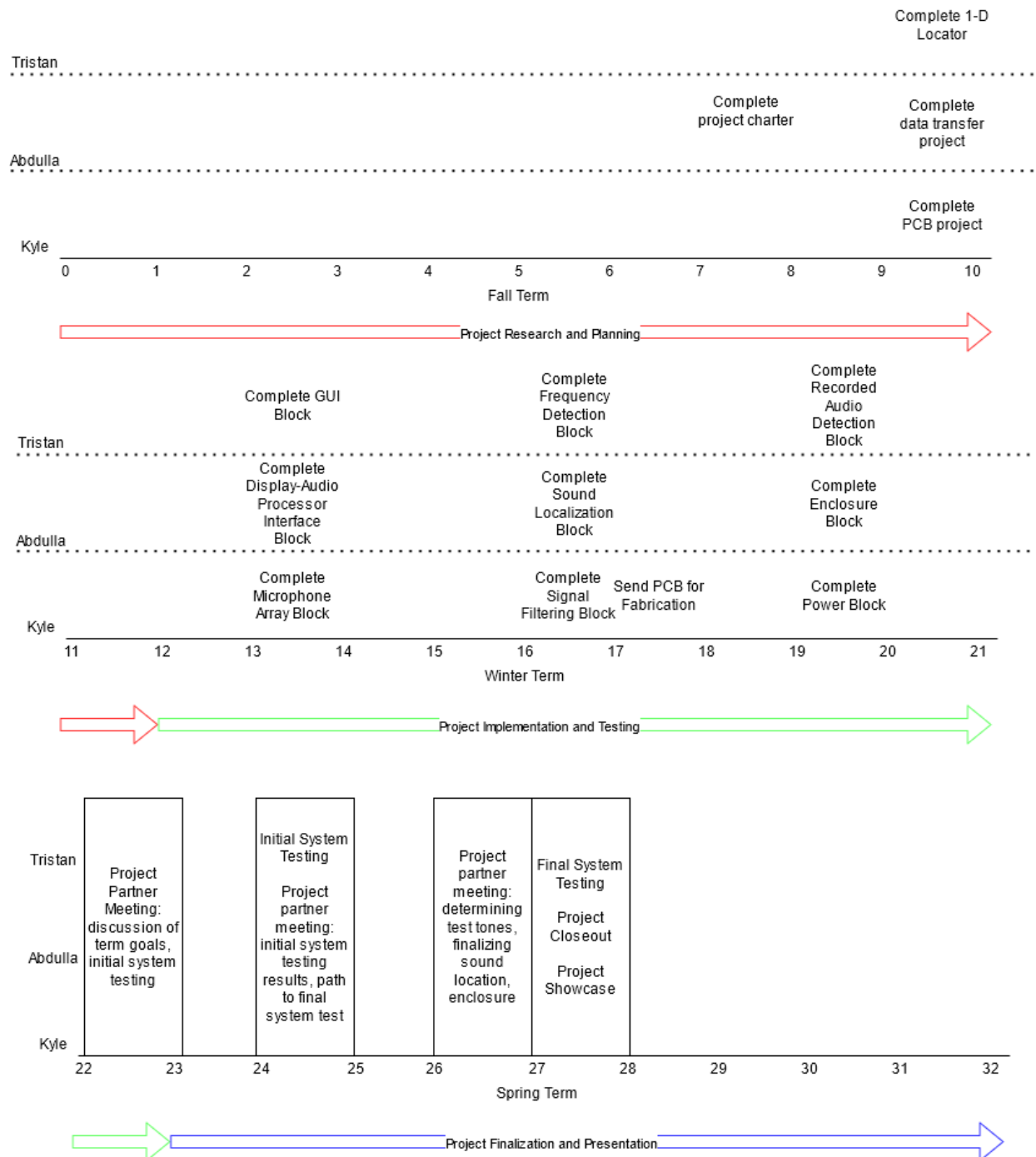
Summary

We first began developing for this project by prototyping aspects of the project by producing technical projects. Tristan developed a 1-D locator using off the shelf microphones and a desktop computer to identify some of the problems that may arise when developing the 2-D locator. Abdulla created a project for communicating between an STM32 microcontroller and a separate device. Kyle produced a PCB that amplifies incoming signals. The knowledge gained from these projects helped guide hardware and software decisions, such as using high quality microphones with direct connections to the microcontroller or deciding to use serial to communicate between the GUI and the locator device. The project block diagram was fully developed at the end of Fall term and was used as a guide for block implementation.

In Winter term, we began designing and implementing our blocks completely separate from one another due to COVID concerns. This produced many challenges down the line as many of the blocks relied on hardware-software interfaces (such as between the microphones and microcontroller) that made accurately testing the operation of the block difficult. While the blocks were successfully produced, we were unable to determine their exact functionality due to hardware being simulated in software for the purposes of block testing.

Spring term was difficult as it was found that many of the assumptions made in software for sound localization and communication (noiseless microphone input, endianness between devices) were false. Debugging was made more challenging by the fact that when the GUI and microcontroller were connected together by USB, no direct probing of the signals passing between them could be done. Because of this, it was decided that one member (Tristan, as he developed most of the sound location system) would integrate both the hardware and software with external guidance by the other teammates. This was successful and the system was eventually integrated and working, although the enclosure and power blocks were dropped from the final system due to lack of time.

Timeline

Tristan
Complete 1-D Locator

Abdulla
Complete project charter | Complete data transfer project

Kyle
Complete PCB project

0 1 2 3 4 5 6 7 8 9 10

Fall Term

Project Research and Planning

Tristan
Complete GUI Block | Complete Frequency Detection Block | Complete Recorded Audio Detection Block

Abdulla
Complete Display-Audio Processor Interface Block | Complete Sound Localization Block | Complete Enclosure Block

Kyle
Complete Microphone Array Block | Complete Signal Filtering Block | Send PCB for Fabrication | Complete Power Block

11 12 13 14 15 16 17 18 19 20 21

Winter Term

Project Implementation and Testing

Tristan

Abdulla

Kyle

Project Partner Meeting: discussion of term goals, initial system testing

Initial System Testing

Project partner meeting: initial system testing results, path to final system test

Project partner meeting: determining test tones, finalizing sound location, enclosure

Final System Testing

Project Closeout

Project Showcase

22 23 24 25 26 27 28 29 30 31 32

Spring Term

Project Finalization and Presentation

Key Lessons

The key lesson learnt in the process of designing, implementing, and finalizing the project is the importance of continuous integration during the block implementation phase. If doing this project again, we would have made sure that each teammate has copies of the relevant hardware for testing the interfaces to their block. We would have also made more effort to communicate overall as the lack of communication in the block implementation phase meant that there were inconsistencies between blocks that slowed down integration.