

## Project Summary

The team was initially instructed to “. . . develop a music box. This project will have lighting controls, record up to 20 seconds of sound, and play back the primary tones being recorded.”. Additionally, the box had to be aesthetic and simple to use. The team decided that the box would also need to be battery powered and that it would have a spinning figurine.

In the initial project planning phase proposals were made by team members for how to implement a portable power supply, how to record audio, and how to implement pre-programed songs. Rough block diagrams were produced and refined, eventually resulting in the blocks shown under “Artifacts” in the Developers Guide.

Before the start of Spring term, the team debated using an Arduino UNO or a Teensy 4.0. The hardware specifications of the Teensy 4.0 significantly surpassed the UNO, so the Teensy was chosen for theoretically being able to produce better quality audio recordings and playback. During the implementation phase of the project, it was found that the Teensy was too new and lacked the necessary library support for the project. Redesign of the Microcontroller block and the Power Supply block was required to implement the UNO instead.

After readjusting for the UNO, two methods were proposed for audio recording. One method was to use a Fast Fourier Transform to take windows of audio data and find the dominant frequency in each window, these frequencies would be compared to piano note frequencies that could be played back using the tone function on the UNO. The second method of audio recording was to utilize the recording features of the TMRpcm library to process raw audio signals from the microphone into a .wav file that would be stored on the SD card. The second method allowed for greater audio quality and less memory usage, while the first method had the benefit of being a new implementation. The TMRpcm library option was chosen to conserve memory on the UNO.

This project taught the team many lessons throughout development. Valuable experience on PCB design taught the team about the depth of PCB options and the importance of creating a ground layer across the PCB when sound quality is a concern. The team also learned that variable gain control is critical to implement in case requirements change during development.

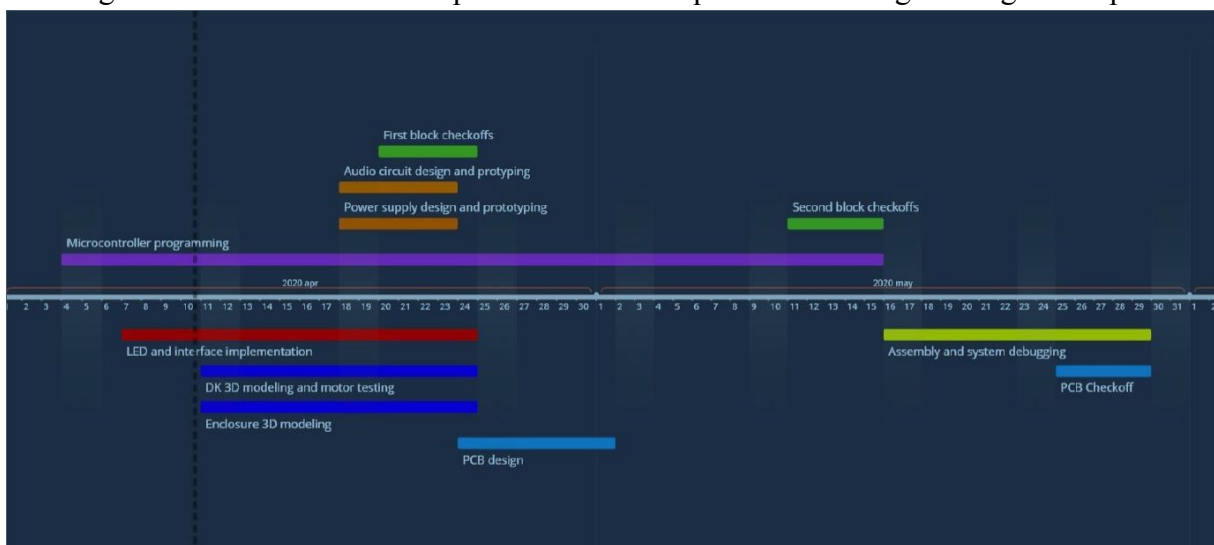


Image 1: Project Timeline