Access to Music
for Deaf and Hard-of-Hearing People
at the
Wilson Center at Cape Fear Community College

Created by Kira Eagon

OVERVIEW

The Wilson Center at Cape Fear Community College (CFCC) is a local performing arts center, where numerous shows are put on year-round. The shows held at the Center cover a wide range of performances. Everything from Broadway shows, musical performances, dance, and other entertainment options are offered. The Wilson Centers' motto is "Be our guest", this is a strong value the employees and volunteers work hard to adhere to, generating a memorable experience for all visitors. This means accommodating visitors with disabilities. During my internship last summer at the Wilson Center, I was given the task of researching ways the Wilson Center could improve its existing accommodations for people with disabilities. As a deaf person, I took note of the accommodations available to Deaf and Hard-of-Hearing (Deaf/HOH) patrons. These include assistive hearing devices, closed captioning, and Certified American Sign Language (ASL) interpreters available at all live performances. I felt more could be done.

PROJECT DESCRIPTION:

A mobile app that can take music and convert the sound to vibrations, while displaying a visual representation of the music. The app will have the capability of connecting to a wristband allowing Deaf/HOH patrons to experience non-lyrical music, hepatically, and visually in a performing art setting. The user will be able to feel and see the music as its being played in real-time. As a result of creating this device, music will be more accessible to the Deaf/HOH population.

AUDIENCE:

The intended audience: the wristband will be created for Deaf/HOH people 8 years and older, while the mobile app will be designed for people ages 5 and up. According to the American Community Survey (ACS), conducted in 2011, "… about 11 million individuals, consider themselves deaf or have serious difficulty hearing" (5). While the incidence of Deaf/HOH may be relatively low, there are still Deaf/HOH people who could benefit from this product. The mobile app and the wristband will enable the wearer to feel and see the music, extending how Deaf/HOH people experience music. Both products could potentially be expanded to anyone who wishes to experience music beyond sound.

INITIAL IDEA:

Audio Visualization

To start this project, I researched a variety of audio visualization programs online, these included Renderforest Music Visualizer and Videobolt Music Visualizer to name a few. These programs made it easy to upload a track and render quickly. However, these programs limited the options for visualizing to a small number of effects. The duration of the track was also limited. These programs were not the best option when working with a budget. This led me to utilize the resources I have at my disposal through a variety of multi-media software options to visualize the music effectively, at a lower cost.

SOFTWARE:

After Effects

Using After Effects I decided to create an audio spectrum. With limited experience using After Effects, I researched a way to visualize music. I created the visualizer based on an uploaded

track, where I manipulated the high and low frequencies of the song and assigned each frequency to a band on the color spectrum. A problem with using After Effects to create the visualizer, is that I was unable to easily change the track later or have it programmed to render immediately based on a new track.

Touch Designer

Along with using After Effects to create a visualizer, I experimented with Touch Designer. An advantage to using Touch Designer over After Effects is that it is easier to switch out the tracks if necessary as it is a live / pre-rendered software system versus one that has to be rendered to see a final output. Touch Designer renders the file based on the new uploaded track and adjusts the visuals according to the music on demand.

HARDWARE:

A mobile app that can convert sound to vibrations while displaying a visualizer based on pitch. The mobile app would be set up to work as a stand-alone and be enabled to connect to a wristband, via Bluetooth. This will enable Deaf/HOH people to be in full control of the musical experience.

FUNCTIONAL SPECIFICATIONS OF THE MOBILE APP:

- ▶ The mobile app will:
  - Allow users to connect to audio using the built-in microphone of a smartphone and/or upload a music track.
  - The phone will vibrate based on the volume and display a visual representation of the music according to pitch.

- Options will also be provided allowing users to decide if they want both vibration and display at the same time or just one feature over the other.
- Allow for a connection to a smartwatch or a wristband via Bluetooth
- Have the option of connecting to an HDMI cable for an on-screen visual display

FUNCTIONAL SPECIFICATIONS OF THE WRISTBAND:

- ▶ The wrist band will:
  - Vibrate based on the volume and music visualizer will adjust according to the pitch of the music
  - Have an adjustable wrist band
  - Connect to smartphone via Bluetooth
- ▶ Material:
  - 3D printed
  - Vibration motor
  - Silicon
  - Microprocessor/Bluetooth
  - Screen-display

RELATED WORK:

Other Devices Made with Deaf/HOH People in Mind

Similar products have been invented for Deaf/HOH people to feel and see sound. Each device has its own unique features. ViBeat uses a device connected to Bluetooth to vibrate based on an uploaded music track (10). VibroHear vibrates and flashes an LED light based on the pitch and closeness of a sound with the intent of personal security in mind (6). Ontenna has many prototypes one of them being a hairclip and an earring that vibrates and lights up based on

surrounding noise (9). All these devices have their advantages and disadvantages as they were all invented with a different purpose in mind.

A Haptic Experience

One invention that allows for a haptic experience is the Sound Shirt. This is a wearable piece of clothing that sends vibrations to different areas on the body in real-time based on the instrument being played (8). This enables the Deaf/HOH to feel the music generating a unique experience. Bhaptics is another brand with a similar invention, the TactSuit, which I learned about from Accessibility Services Specialist, Selina Harvey during an interview at the Wilson Center. Harvey told me the TactSuit was made initially for gaming and movies. Recently, the Wilson Center added this device to its accessibility line up. The TactSuit has never been used in a performing arts center before and is still in Beta. This device was tested by hearing people and one HOH person. According to Harvey, she, and a coworker, both of whom are hearing were impressed by the experience. More importantly, Harvey also related that a HOH person who tested the TactSuit felt that the device did not meet their expectations and felt that a visual representation of the music would have enhanced the overall experience, thus making it more enjoyable (4).

Other Devices Made to Enhance the Musical Experience

The Gemio Wristband is a smart Band that can be paired with its own App. The Gemio band lights up in color based on motion and sound. The light effects and colors of the band can be set using the App. A neat feature the App has is the ability to react based on the environment without needing to unlock the phone. Users can also, fully customize the look of the bracelet by swapping out tiles for a different appearance as well as send messages to friends within a close range (3). A key component the band lacks is the ability to vibrate, which is what gives Deaf/HOH people another way to experience music. The Gemio bands range from $25-$40+ tax per unit. I am hoping to make my version of wristband more reasonable priced.

HOW WRISTBAND WILL CONNECT TO AUDIO:

Bluetooth vs. Wi-Fi

The downside of Bluetooth is that it only works up to a 10-30 meters, a limited number of devices can be connected at once and is less secure than using Wi-Fi. Aside from being wire-free, Bluetooth is relatively inexpensive to implement and does not use up a lot of battery life on mobile phones. Using a Wi-Fi connection generally uses up the battery life quicker and requires a connection to some type of hardware or software. A key component of Bluetooth is it is easier for people to connect and switch between devices with the click of a button (2).

Connecting to Bluetooth Enabled Mobile Device

An advantage to making the mobile app and wristband Bluetooth enabled is that it eliminates the need for wires and a Wi-Fi connection. Wi-Fi would be preferable for mobile app updates and downloads. This allows the device to be used anywhere at any time making it more portable. By using the built-in microphone of the phone to pick up sound, the processing power of the mobile device can take in the music and send out signals.

OTHER APPS:
Apps Made with Deaf/HOH People in Mind

BeWarned is an app created for Deaf/HOH people. The App is divided into three components, each serving a different purpose. The first part enables users to set their phones to alert them to specific noises such as alarms, using the microphone on the cellphone. The second part of the app allows for speech-to-text or text-to-speech. The last section of the App allows for a music track to be uploaded converting the sound to vibration signals and a flashing light, along with a synthesizer to help visualize the beat of the music. These features can aid Deaf/HOH people as they go about their daily lives. However, the app has a major flaw, in that it crashes once it is opened. This app does not show variation in musical pitch only rhythmic changes (1).

Apps That Have or Use Sound/Audio Visualization

LED Audio Spectrum is a simple phone App that uses the microphone of a cellphone to visualize sound. The audio takes in any surrounding noise and displays it in the form of an equalizer. The equalizer can be changed to one of several different colored themes and visual displays to allow people to "see" sound. The ability for the user to customize allows them to be in full control of

how they want the sound to "look". A disadvantage to this app is that the user cannot upload

their own music track, as it relies solely on the built-in mic on the phone (7).

Prototypes round 1 –Music Visualizers/Animated Infographic

Renderforest Visualizer

After Effects Visualizer

Touch designer Visualizer

Figure 1

"Intial idea of an audio visualizer. Tried 3 different software programs and weighed out the pros and

cons of each. First animated infographic illustrating my project idea. "

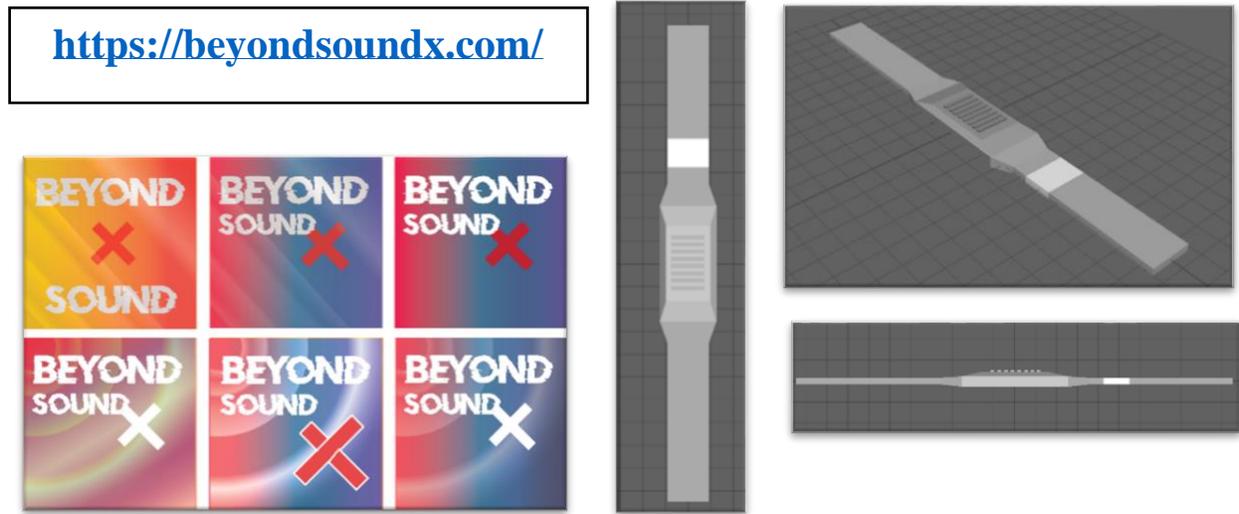**Prototypes round 2 – Brand/Domain-Name/Logo/3D Modeling**

https://beyondsoundx.com/

Figure 2

"Brand/domain name is "BeyondSoundx" because I want my project to appeal to anyone who wishes to

experience music in a new way, instead of relying solely on sound. First stage of designing a logo and 3D

modeling a wristband."

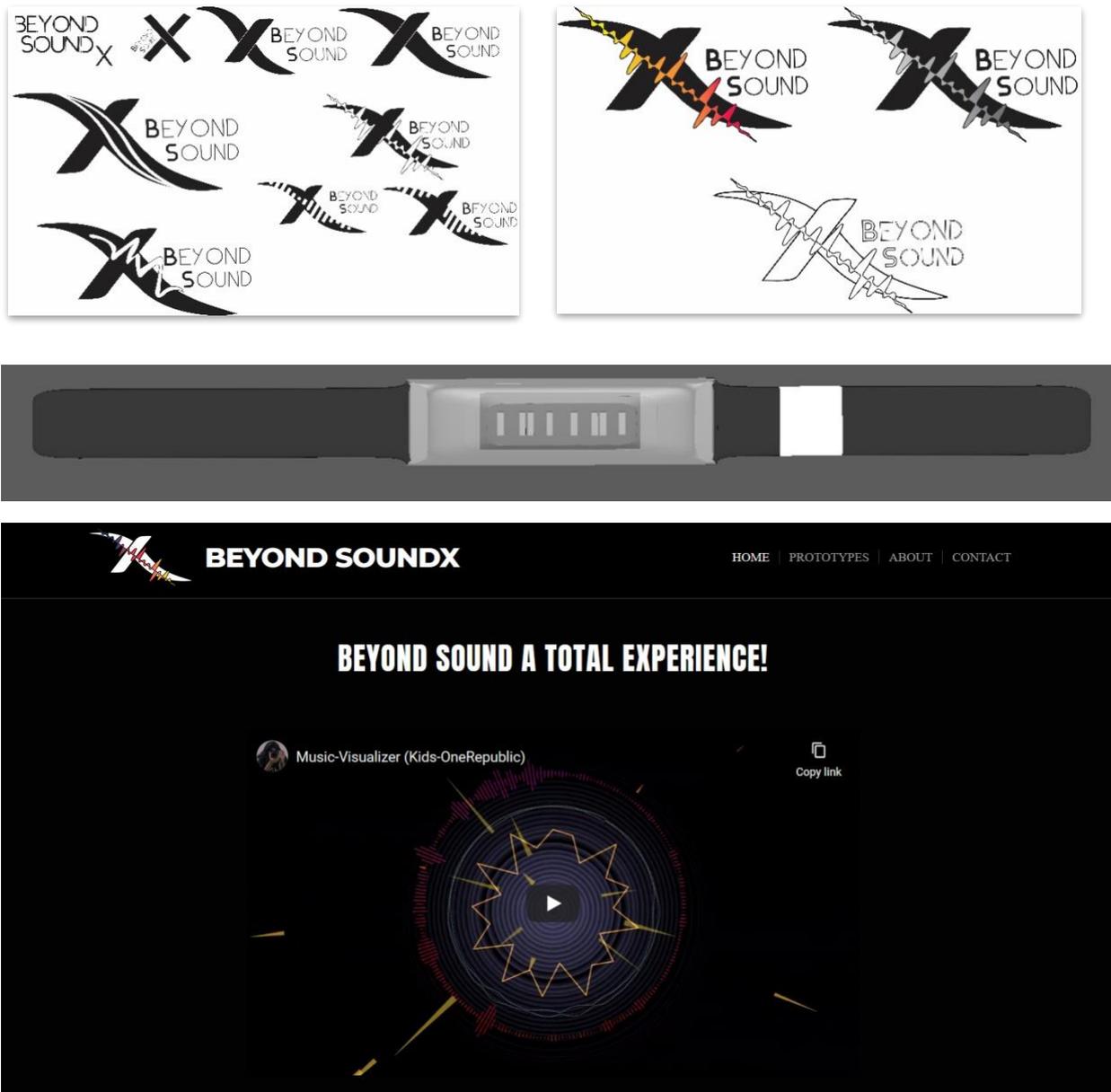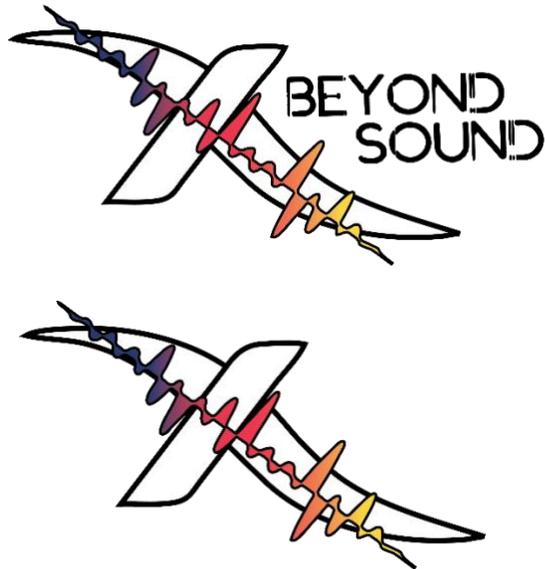**Prototypes round 3 – Continued Logo/3D Modeling/Website**

Figure 3

"Continued progress on creating a logo and 3D modeling a wristband and first stage of building the

website. Iterations of the logo begin to have more of a flow to the overall design. "

Prototypes round 4 – Logo/3D Modeling/Mobile App Wireframe
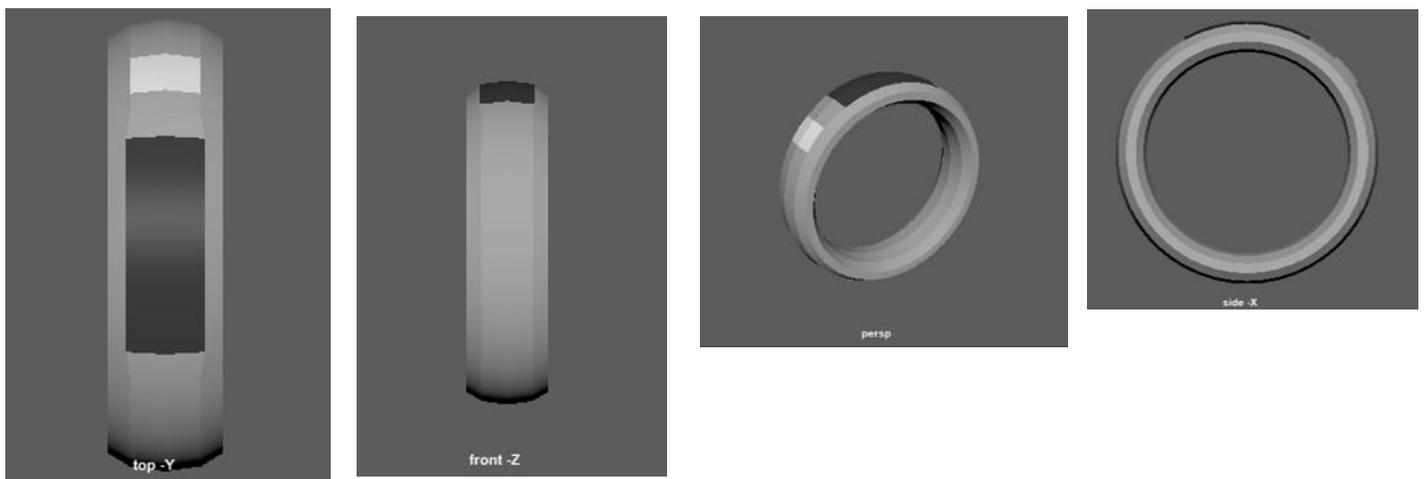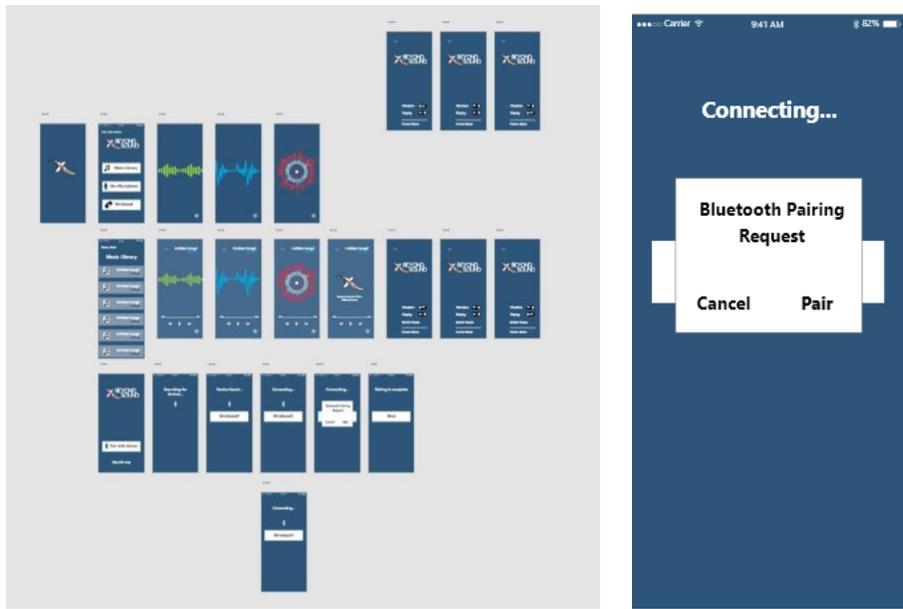

Wireframe of app version 1:

https://xd.adobe.com/view/b7511561-891b-438e-6190-eeae0bb06a64-c160/

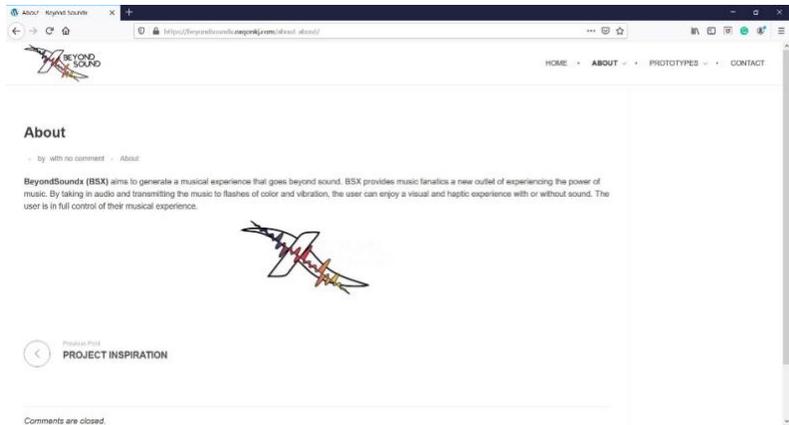**Figure 4**

"Finalized logo and 3D modeling a wristband and beginning of wireframe for mobile app. The new logo

has a wavy looking 'X' which coinsides with the flow of music. The color gradient represnts the colors of

music and the wave represents soundwaves. The updated 3D model has a screen display which will allow

people to have a visual to go along with the music. "

Prototypes round 5 – Website/Mobile App Wireframe/Animation

Wireframe of app final version:
https://xd.adobe.com/view/fd582522-3adc-4256-59d6-de0ee2dc081e-8b69/

Figure 5

"Finalized wireframe of mobile app, website and an animation showing how the app and wristband work

together. While the app is not fully functional the navigation is works."

Issues Encountered:

The challenges experienced during this project include:

- ▶ Figuring out how the wristband would take in audio/display visualizer/vibrate

- ▶ 3D modeling a circular shaped wristband was difficult. I could not flatten out the model for a top view of the wristband.

- ▶ Often After Effects and TouchDesigner would crash in the middle of a project.

- ▶ I did not much feedback on the testing of the app. More feedback would been more beneficial when redesigning the app.

Future Work:

The prototypes I have could be improved by:

- ▶ 3D Model
    - ▪ Adding in a hook/catch to show how the wristband will be put on and taken off
    - ▪ Texture mapping
    - ▪ 3D print model

- ▶ Mobile App
    - ▪ Research music libraries for how music can be downloaded/uploaded to a mobile device
    - ▪ Look more into musical pitches and their color values
    - ▪ More user testing to find out what is working well and what needs to be modified.

- ▶ Animation
    - ▪ Adding in statistics and audio to better market the product

- ▶ The goal would be to produce this product. This would have to be done with the help of an engineer and programmer.

Final Product Results:

- Logo (see figure 4)

- 3D model (see figure 4)

- Mobile App Wireframe (see figure 5)

- Website (see figure 5)

- Animation (see figure 5)

Works Cited

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Timeline Goal:

Week 1 (1/14)	Week 2 (1/21)	Week 3 (1/28)	Week 4 (2/4)
Begin brainstorming	Research Narrow topic Project Description	Proposal presentation/FA due Draft Outline Description Interview	Individual meetings Research 3D model ideas
Week 5 (2/11)	**Week 6 (2/18)**	**Week 7 (2/25)**	**Week 8 (3/3)**
Prototype 1 due/progress doc./class critique Get materials/3D print	Poster design/press release/RP draft #1 due RP	FA visit/review#1 Assemble 3D print RP	Prototype 2 due/progress doc./class critique 3D model
Week 9 (3/10)	**Week 10 (3/17)**	**Week 11 (3/24)**	**Week 12 (3/31)**
SPRING BREAK	FA visit/review#2/ RP draft #2 due 3D print/Assemble	FA visit/review#3 Finalize RP	Project due for review/final approval
Week 13 (4/7)	**Week 14 (4/14)**	**Week 15 (4/21)**	**Week 16 (4/28)**
Test public display setup Make amendments as needed	Final class critique 4/16-public display Make amendments as needed	Post grad workshop Finalize	Oral defense presentations

Timeline Completed:

Week 1 (1/14)	Week 2 (1/21)	Week 3 (1/28)	Week 4 (2/4)
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