Engineering Art

sdmay23-04

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Advisor / Client:

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Team Members:

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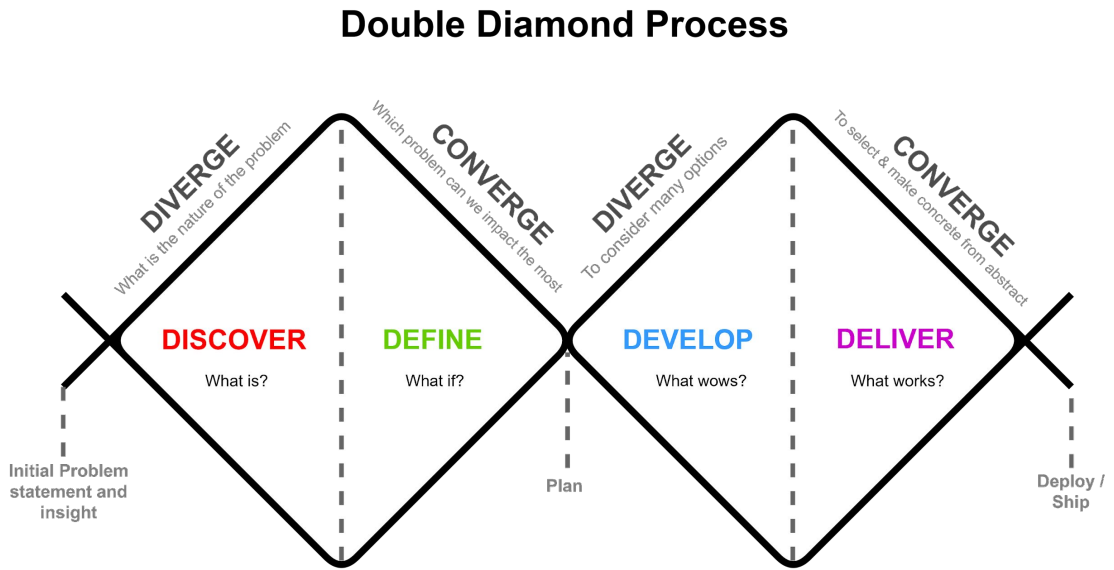
Introduction

Focused Problem Statement:

“Reverse engineering the brain is one of the National Academy of Engineers’ 21st Century Challenges—a list of complex problems that are tightly intertwined with engineering and the future. Medical and technical personnel around the world are working toward solutions that will have applications in artificial intelligence, medical treatments, and prosthetics. The knowledge of this challenge is crucial to garnering public support and increased funding. Our goal is to inform and gain the interest of the general public and potential engineers through an interactive art exhibit that converts brain wave activity generated from listening to music into art.”

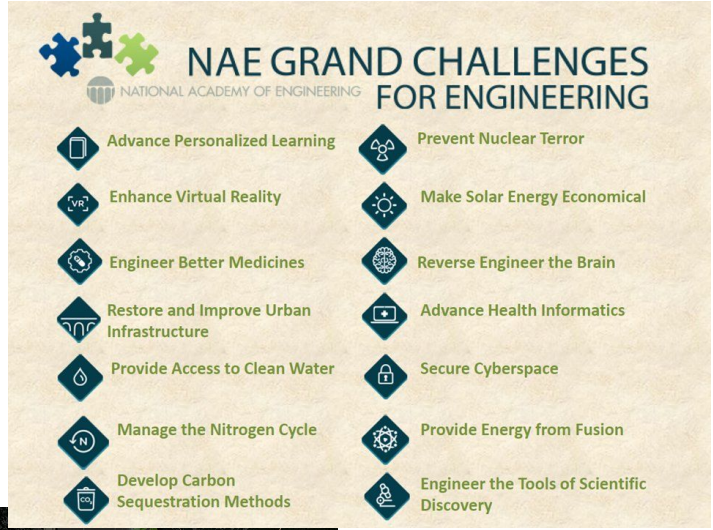
Design Process

- **Discover**
  - Primary Research
  - Secondary Research
- **Define**
  - Users
  - Requirements
  - Constraints
  - Focused Problem Statement
- **Develop**
  - Project Plan
  - Milestones
  - Risk Mitigation
- **Deliver**
  - Testing Plan
  - Implementation
  - User Testing



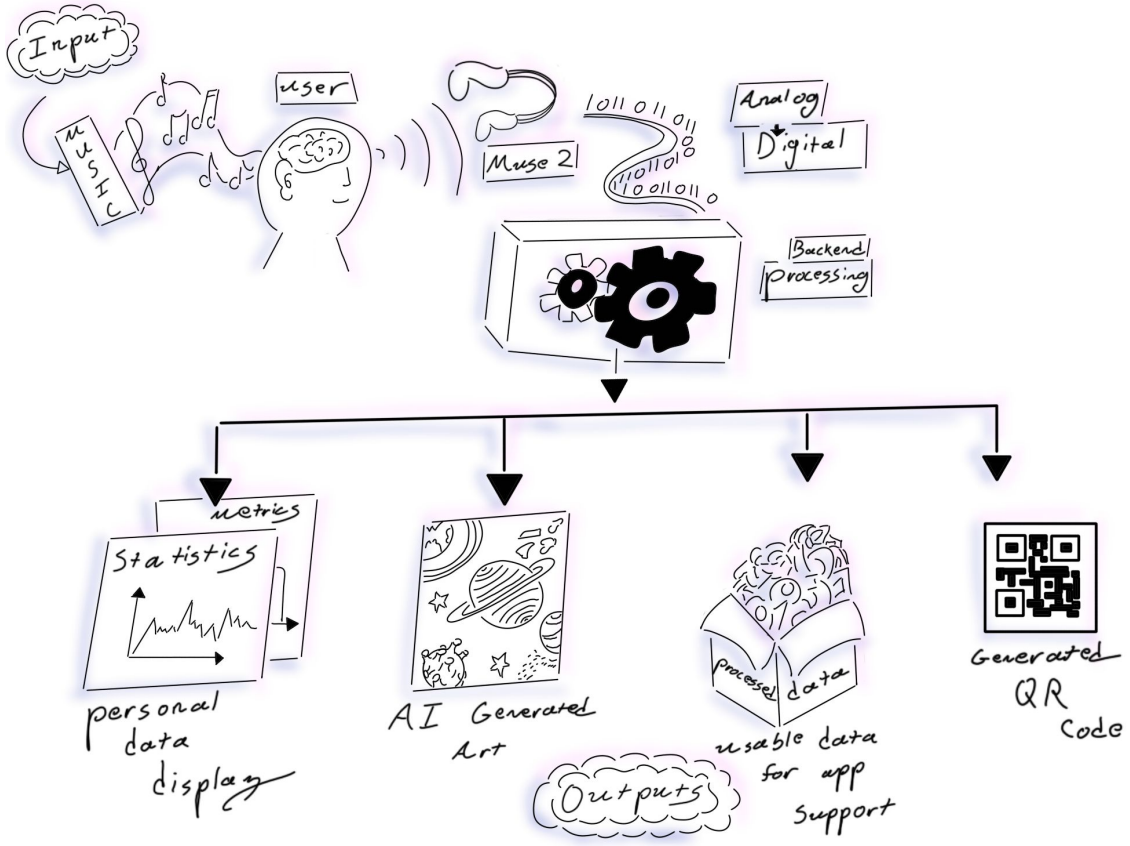
Previous Semester Recap

- **Discover**
  - Primary Research: expert interviews
  - Secondary Research: academic research
- **Define**
  - Users:
    - students
    - faculty
    - generic users
  - Requirements:
    - interactive
    - safe
    - eye-catching
    - accessible
  - Constraints: space/budget
  - Focused Problem Statement



Implementation

Implementation - Diagram



Implementation - Muse 2

- Muse SDK
- EEG Sensors
- Accelerometer and Gyroscope

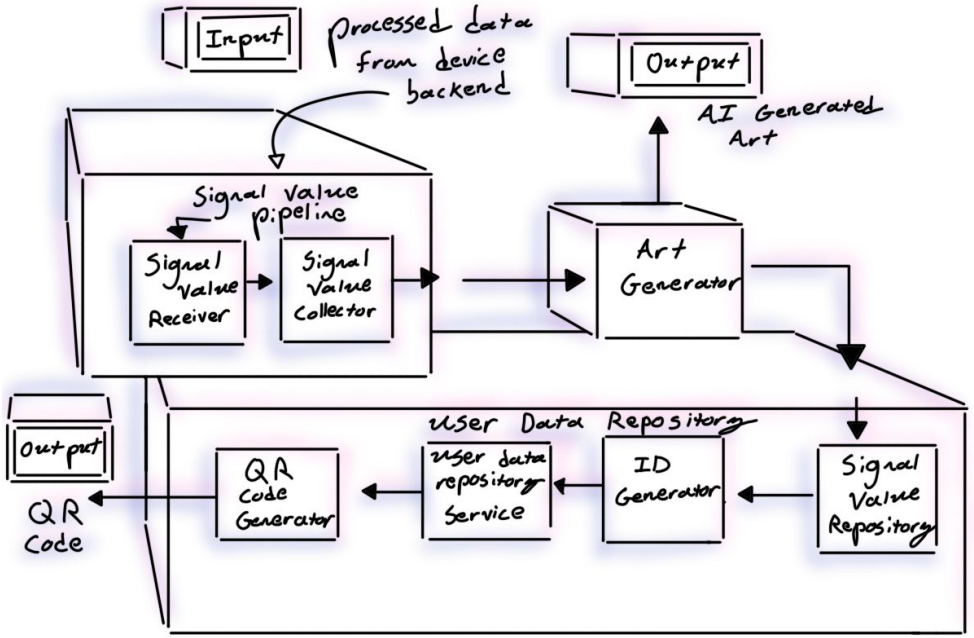
Implementation - Web Backend

Personal Data Display

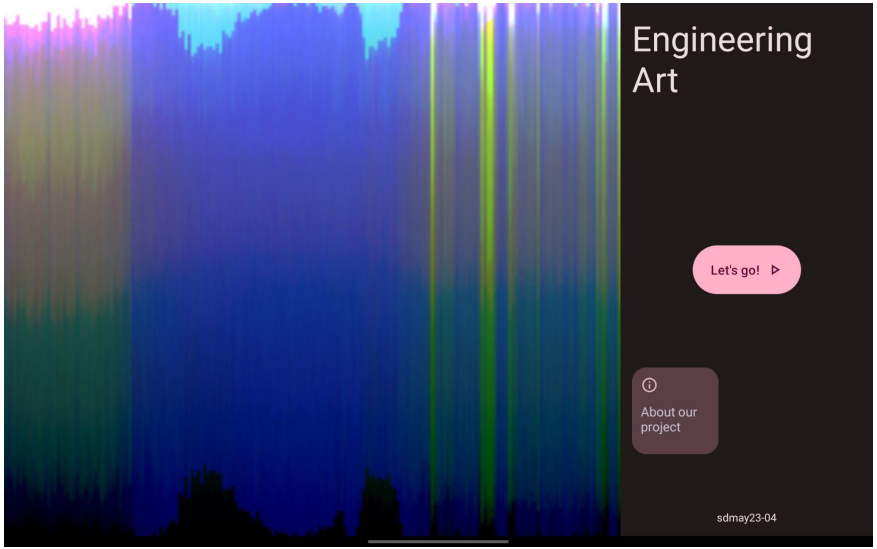
- Muse sends signals to the tablet app
- Tablet app sends data as packets to the backend
- Backend cleans up the received packets
- Packets are transformed into frequency
- Audio is synthesized
- Audio signal is viewed on CRT

TODO

- Connect Art Generation to Main
- User Data Repository

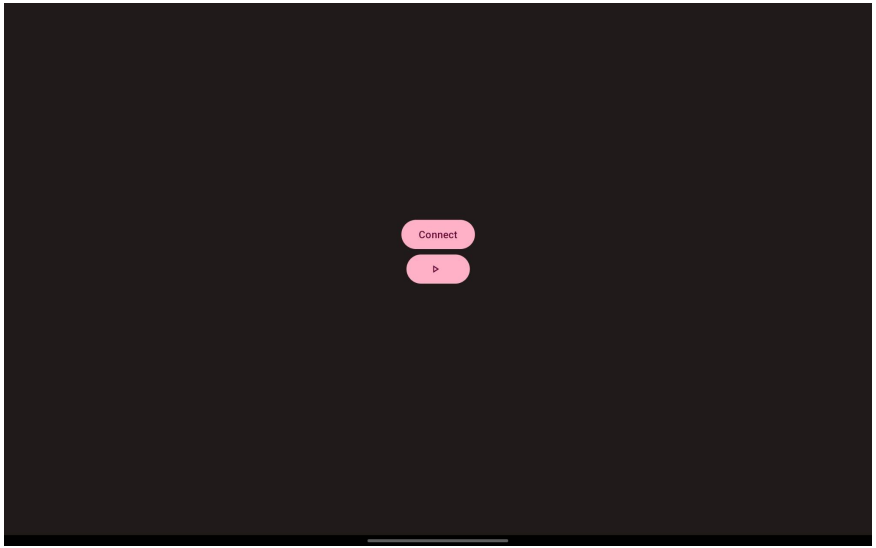


Implementation - Tablet & Android Application



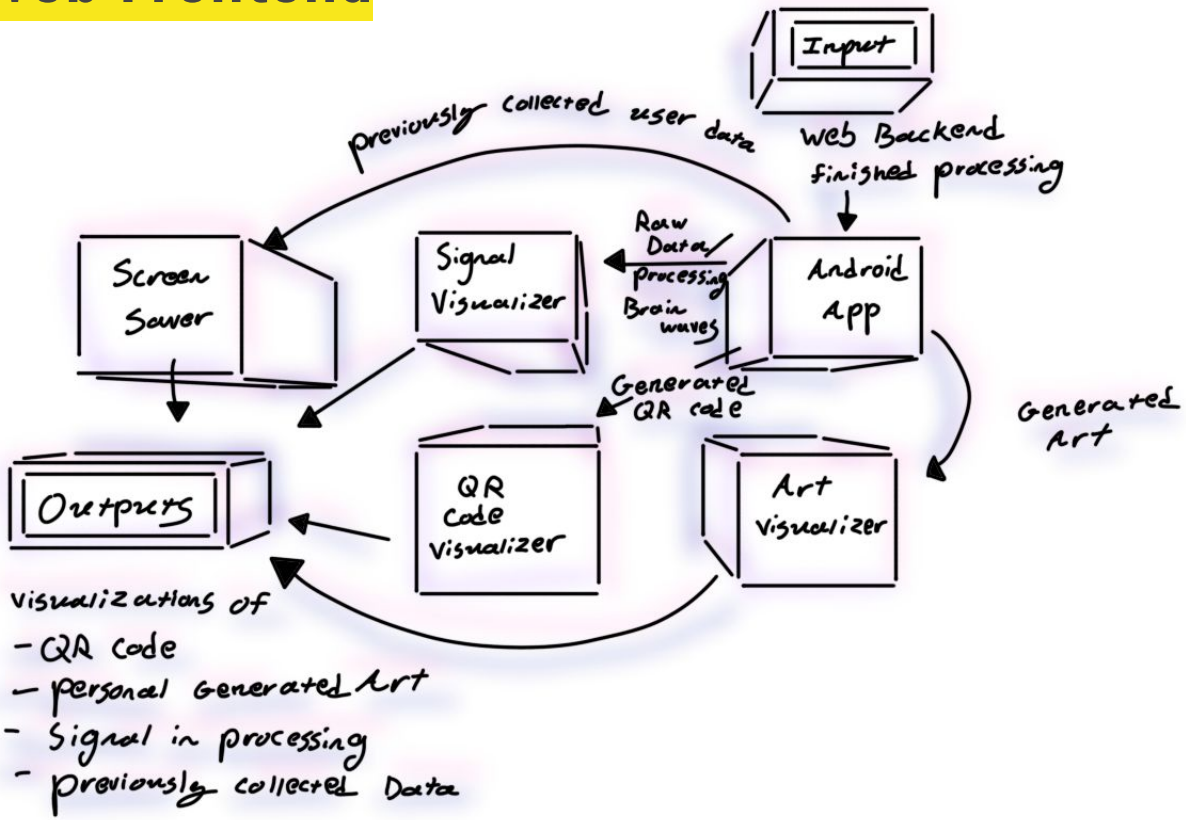
Main fragment

Muse fragment



Implementation - Web Frontend

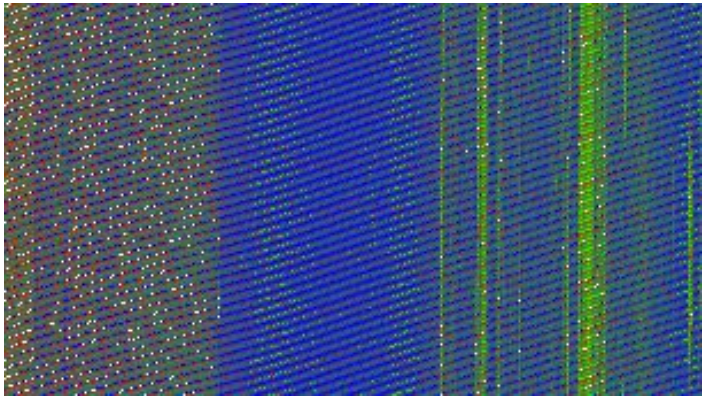
- React structure
- Javascript & CSS

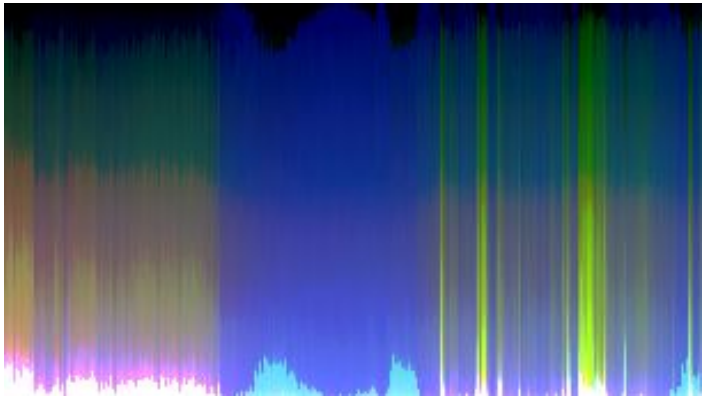


Implementation - Art Generation

MATLAB

- Input a CSV file of Muse data, the desired save location, and user ID
- Generate RGB channels based on total proportion and sort for all color channels
- Output image in generic 9x16 ratio





Installation-Design

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Feedback from 491

- Installation
- Interactivity

Parker Smith

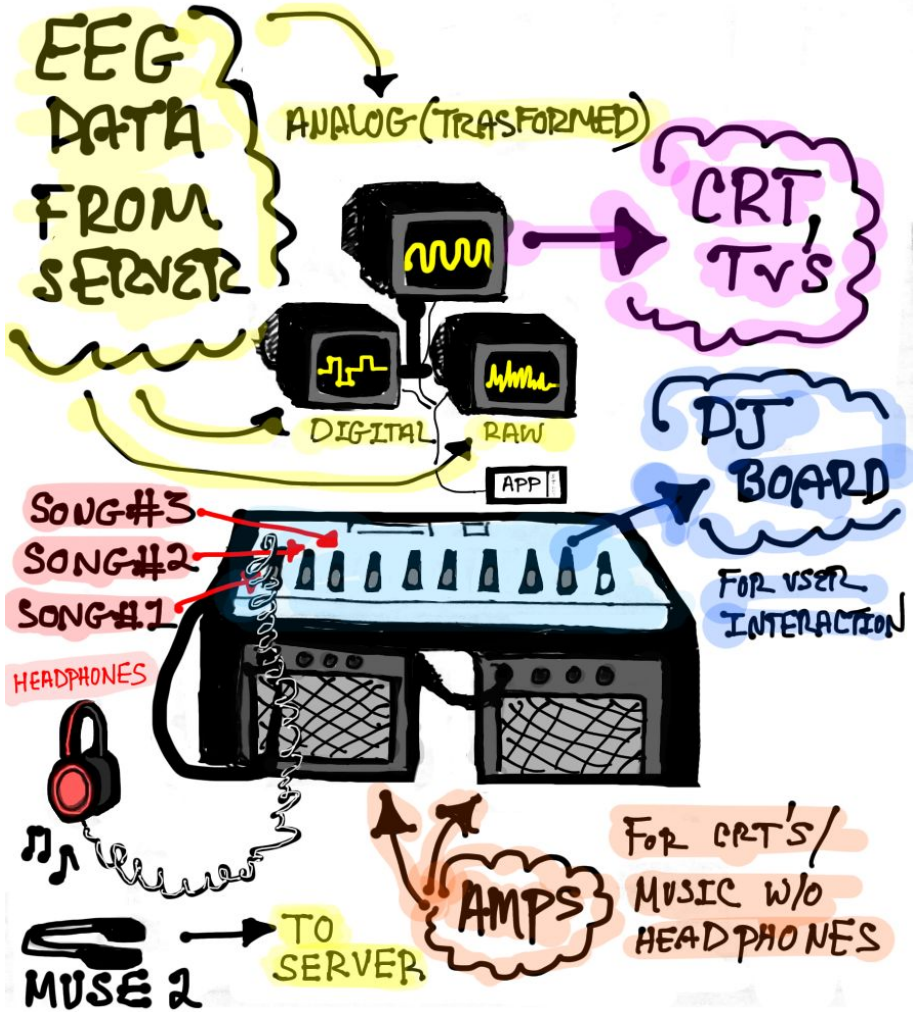
- Industrial Design

Nam June Paik

- CRT’s

KURE 88.5

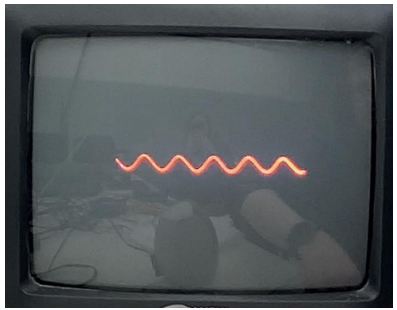
- DJ Board Donation

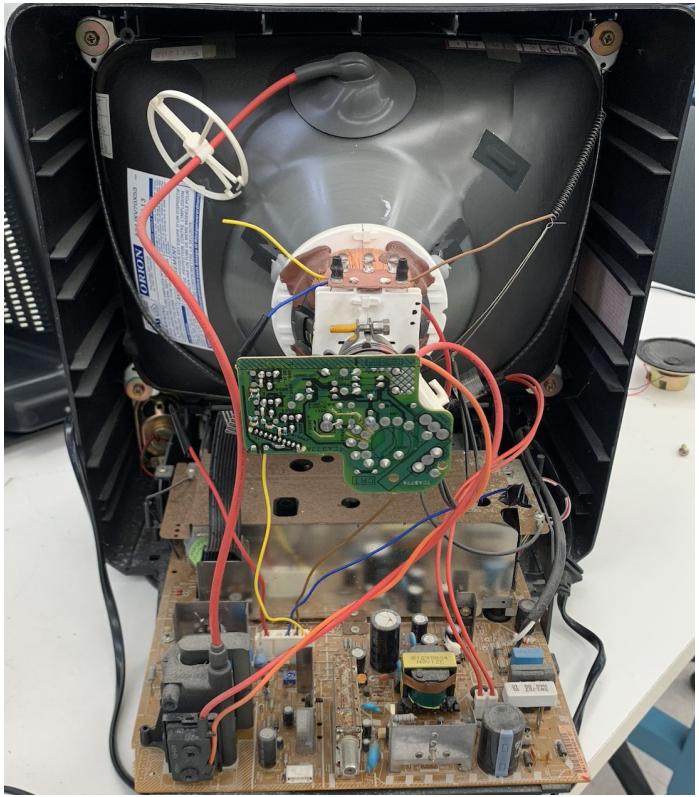


Implementation - CRT Visualizers

CRT Modifications

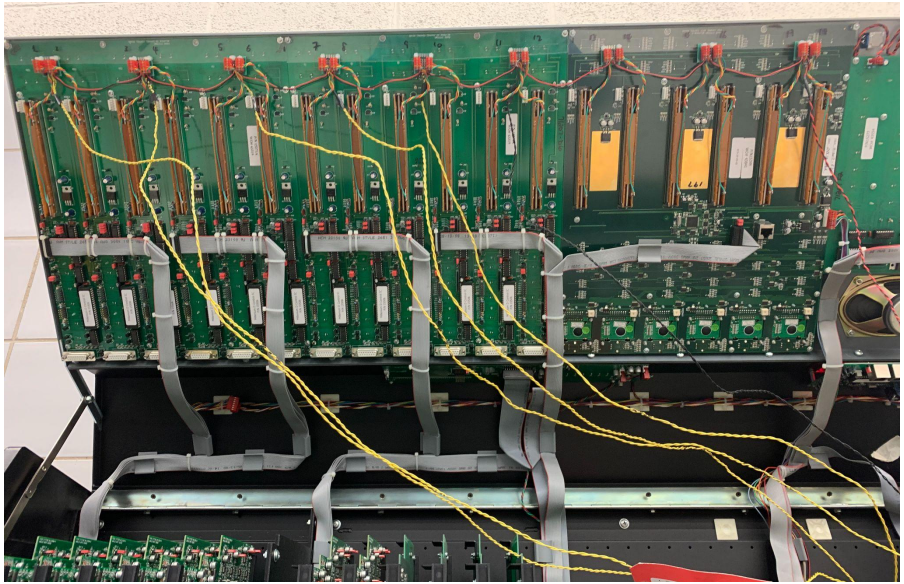
- Vertical Coil Supply
  - Horizontal Coil
- Vertical Coil
  - Music (Spliced 3.5 mm Cord)
- Horizontal Coil Supply
  - Unused with Electrical Tape

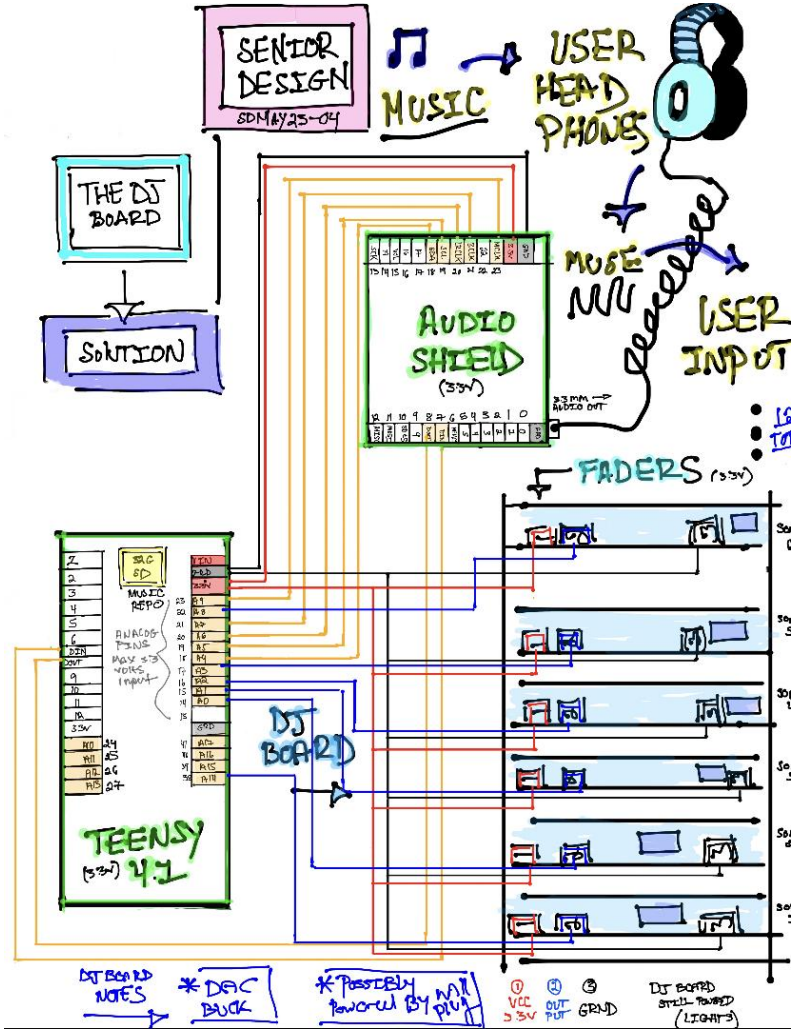




Implementation - DJ Board

KURE DJ Board & Teensy 4.1 Microcontroller



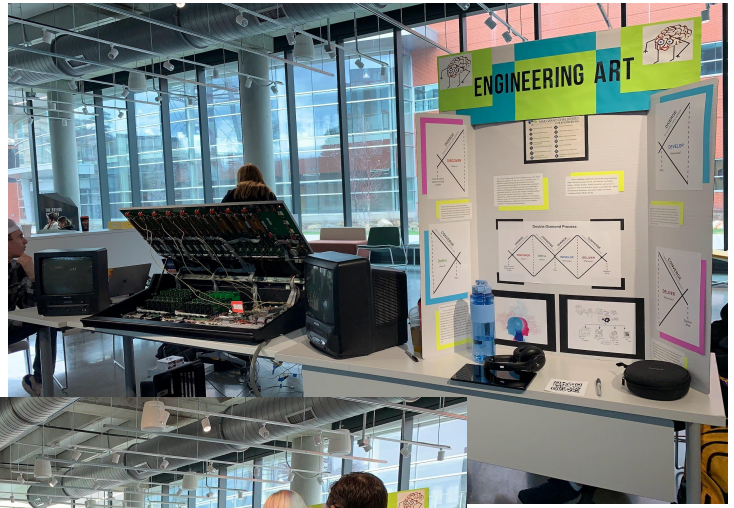


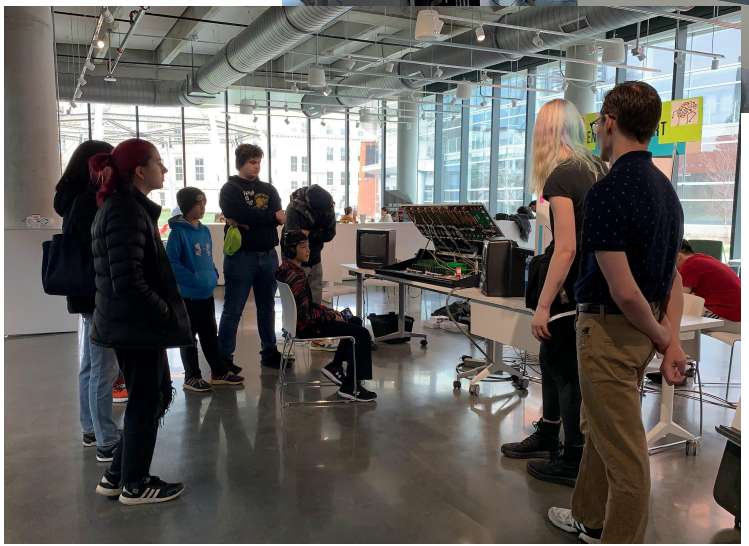
User Testing

User Testing

Student Innovation Center Atrium

- CRT brainwave visual
- DJ board internals
- Project overview posterboard
- Google Form for quantitative feedback

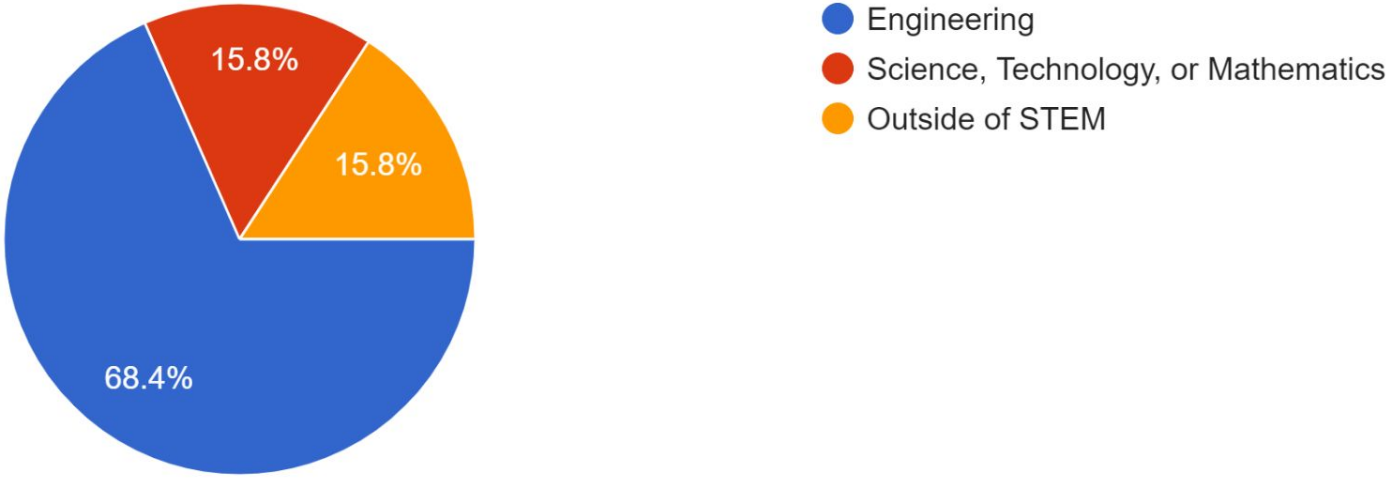




User Testing Feedback

What is your educational/major background?

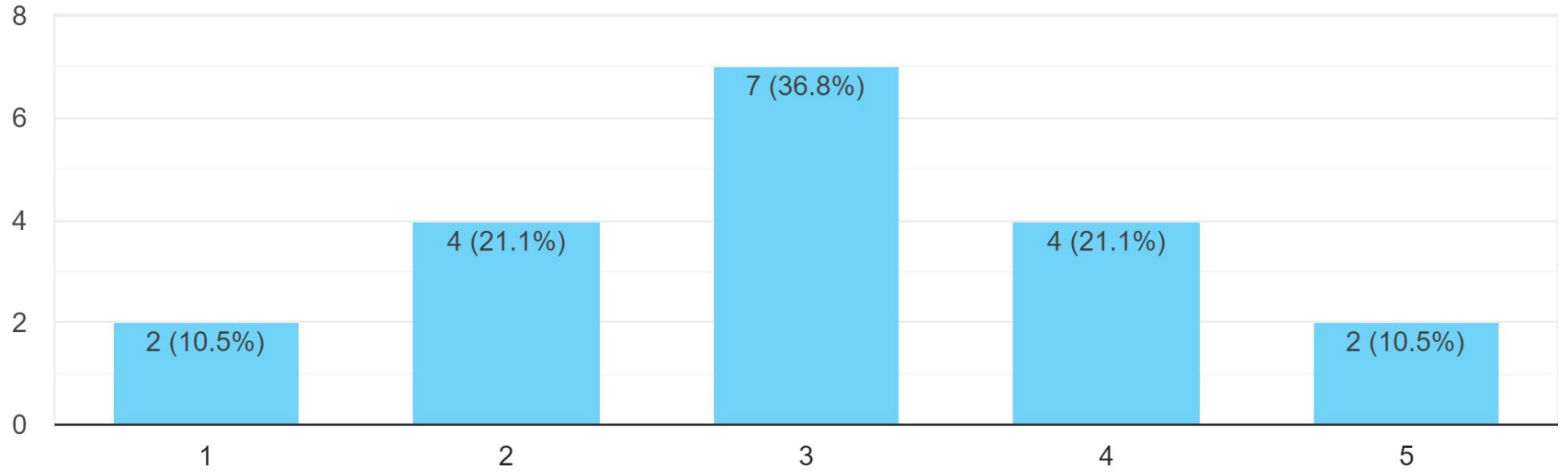
19 responses



User Testing Feedback

How did this project affect your knowledge of engineering challenges, such as reverse engineering the brain?

19 responses

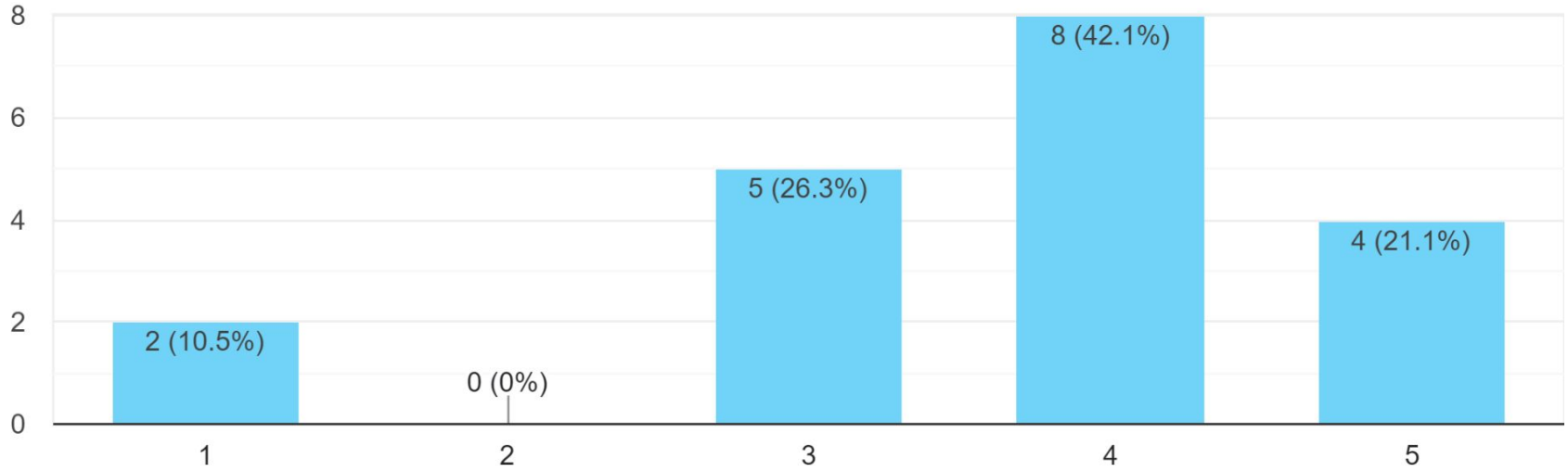


1 for not increased, 3 for moderately increased, 5 for greatly increased

User Testing Feedback

How did the DJ board affect your likelihood of approaching the display?

19 responses



1 for greatly decreased, 3 for unchanged, 5 for greatly increased

Semester Wrapped

Work Accomplishments

Tasks	Explanation	Progress
Backend	Roundtrip, transportation of Muse data	100%
Art Generator	MATLAB for V1	100%
Website	Add consultants page and update website with documents	100%
User Testing	Tested users in SIC	100%
DJ Board	5 Faders working - hardware complete (code needs work)	90%
Tablet App	Core functionality was finished and UI was reasonably well-polished. Some features omitted due to being made unnecessary or lacking backend support.	70%
Integration	Integration of the frontend, backend, art generation code, and also the physical technology used for user demonstration	70%

Key Contributions

Group Members	Team	Contributions
Tomas Elias	Frontend	Tablet Frontend, Process Book, Poster Board
Nathan Underwood	Backend	Backend Security, Poster Board, CI/CD
Liz Fransen	Backend: Integration	Audio Synthesis, Client/Server Comm.
Shelby Murray	Backend: Art Generation	MATLAB, DJ Board Support, Documentation
Juno Robertson	Frontend: Tablet App	UI, Muse Connection/Data, Server Comm.
Cosette Thompson	Backend: Installation	CRT Configuration, DJ Board
Ayden Boehme	Frontend	Tablet Frontend, Poster Board
Derrick Brandt	Frontend: Web	Web Frontend, Process Book, SQL Server

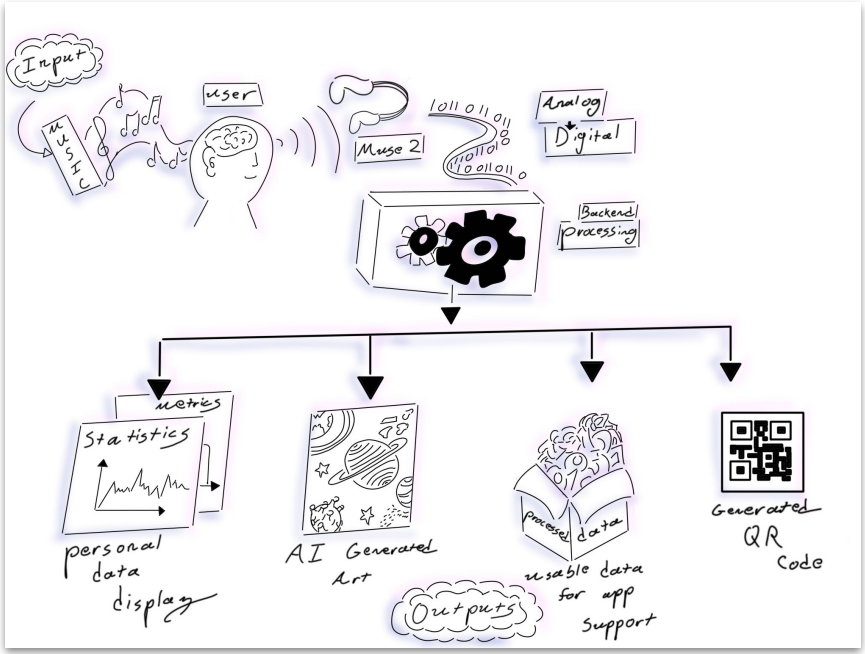
Challenges & Solutions

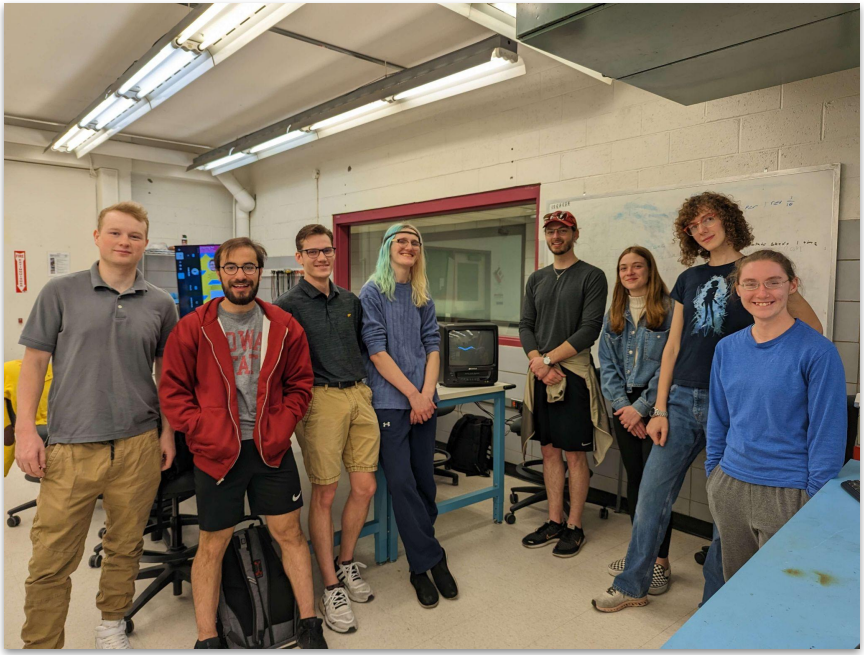
- **Challenge:** Team Size & Scheduling
  - With so many members, it was difficult to coordinate between every individual on the team and finding times that work best for everyone
    - **Solution:** We split ourselves into smaller teams to work on different portions of the project
- **Challenge:** Idea phase
  - We were constantly thinking about adding new features and coming up with new goals to add onto the project
    - **Solution:** We had to scrap some ideas, or label them as “extension goals,” and then focus on getting a working implementation of our project
- **Challenge:** Time
  - Not enough time to implement everything we wanted
    - **Solution:** The project may be passed down to a future group for them to (hopefully) complete our existing project in their own image
- **Challenge:** Handling the Muse’s output
  - The Muse does not generate data files that we could easily use for the purposes of our project, so we needed to translate the data files into a useable file type. This proved to be more difficult than anticipated and delayed our progress a bit.
    - **Solution:** After a couple weeks of being held up on the translation, we eventually did create a way to successfully translate the data files into csv.

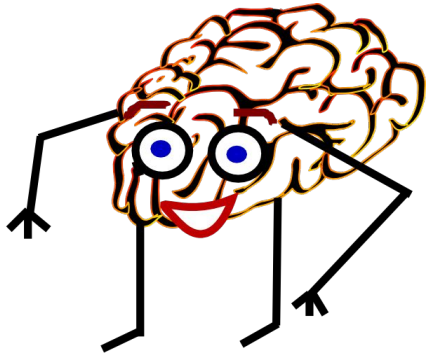
Future Work Ideas

- **Storing user data**
  - Plan to store the data of chosen songs/genres and try to see if there are any identifiable correlations between the users' brain results and their chosen songs/genres
- **QR code generation**
  - Generate a QR code for each user which will send them to a link of their art
- **More CRT displays**
  - Each CRT hosts a display of one type of brain wave from the user, so we would hope to acquire enough CRTs to display each type of brain wave that the Muse can measure
- **More advanced art generation**
  - Plan to work closer with Professor DiBlasi and upgrade our AI art generation using P5.JS
- **Error correction**
  - Use accelerometer and gyroscope data to correct EEG data

Conclusion


Input
user
Muse 2
Analog
Digital
Backend
Processing
metrics
Statistics
personal data display
AI Generated Art
Outputs
processed data
usable data for app support
Generated QR Code





Questions?