IMAGS

Music-induced Analgesia Genome Study

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HUA 3910

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Introduction

What is IMAGS?

The IMAGS (Music-induced Analgesia Genome Study) project is an interdisciplinary effort to study the effects of music on chronic pain relief. The study uses both software and hardware components to collect and analyze data on participants' physiological responses while listening to music.

Project Description

The IMAGS project integrates a web application and a hardware system to track Galvanic Skin Response (GSR) and Beats Per Minute (BPM) while users listen to a song on Spotify. The goal of this project is to refine these components to improve data accuracy and usability for future research.

Objectives

During this term, our primary objectives were:

1. **Web Application Enhancements**: Improve the user interface, add new features, and migrate the codebase to React.
2. **Hardware Upgrades**: Implement a more efficient GSR prototype using a better microcontroller and integrate a BPM sensor to make the data more useful.
3. **Data Analysis Improvements**: Enhance data collection to provide more accurate and useful insights for researchers.

Methodology

How We Did It

Timeline Overview

- **Week 1**: Project kickoff; established goals and objectives. Team members researched the IMAGS project's history, existing documentation, and GitHub repositories. Discussed hardware improvements for the GSR sensor and potential software features.
- **Week 2**: Focused on hardware improvements for the GSR sensor, including upgrading to the Arduino WiFi 1010. The team began setting up the GitHub environment and researching data visualization possibilities while integrating the Spotify API for basic functionality.
- **Week 3**: Integrated the Spotify API into the web app, allowing user login and access to public playlists. Created the main repository with a React environment and began developing features for the web app.

- **Week 4**: Assembled and prototyped the GSR device; tested Arduino code for data collection. Continued refining the web app UI and integrating Spotify API functionality.
- **Week 5**: Began research on iIntegrating the pulse sensor with the GSR prototype, capturing data from both sensors. Began troubleshooting the Arduino code and collected initial GSR data while improving the user interface and functionality of the web app.
- **Week 6**: Finalized the integration of the updated UI with the Spotify API and conducted research on potential material improvements for the GSR prototype. Developed data visualization techniques to display GSR and pulse sensor data within the web app.
- **Week 7**: Focused on syncing sensor data with the Spotify API for real-time interaction. Finalized project deliverables, including documentation and presentation materials; prepared for the project demonstration.

Web Application Development

Description

The IMAGS web application serves as a platform for researchers to view and aggregate data collected from the mobile application. It provides insights into the relationship between music selection, pain ratings, and physiological responses, facilitating data analysis and interpretation. The initial focus was on developing a user-friendly interface that displays the collected data in a coherent and insightful manner.

Improvements

The web app has undergone a complete redesign with a new user interface (UI) that enhances usability and visual appeal. The application is now connected to Spotify, enabling it to play playlists directly in the webapp, songs can also be selected from the Spotify app. A pause/play button has been integrated, allowing users to easily control music playback but this can also be done through the Spotify app once connected. Additionally, the codebase has been migrated to React, which improves the app's performance, scalability, and maintainability.

Future Areas of Improvement

Future enhancements include implementing machine learning algorithms to analyze patterns in the data and predict user responses to different music genres. We could also optimize the web application for mobile devices to enhance accessibility for researchers on the go.

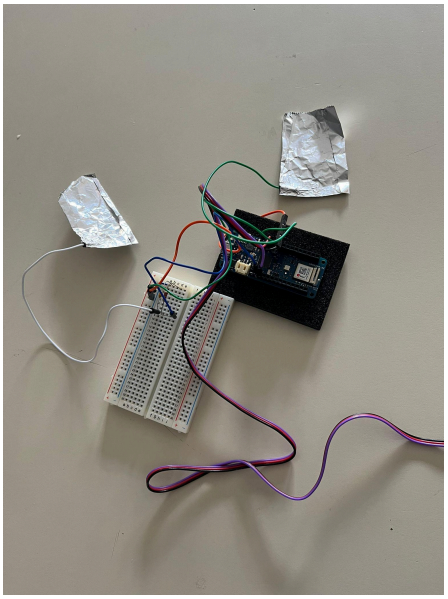
Hardware Development (Yan)

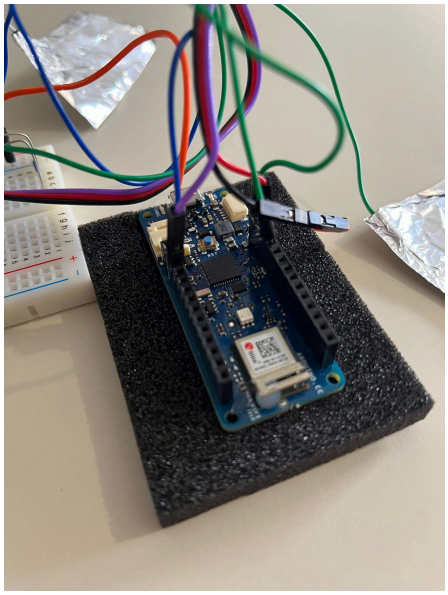
Description

The IMAGS prototype tracks GSR and BPM which provides psychological data for analyzing the patient's response to music. The focus of the project's hardware aspect was on remaking the GSR prototype from the previous year. Afterwards the focus shifted to integrating the Arduino Pulse Sensor into the existing prototype while doing research on how to improve the GSR prototype.

Improvements

To enable us to gather both the GSR and BPM data some modifications to the previous prototype were required. We upgraded the board to an Arduino Wifi 1010 for its superior processing power and potential for wireless communication. To be able to read the BPM of the user we needed to integrate the arduino pulse sensor to the existing circuit. This required some minor adjustments to the circuit since the GSR and the pulse sensor have different power requirements. Finally, to be able to read a BPM some data filtering and peak detection was added to the Arduino code. This was used to optimize signal processing and data transmission from the sensor which enables us to be able to calculate the BPM from the pulse sensor readings.





Materials List

- Arduino Wifi 1010 Board
- Breadboard
- 68nF capacitor
- 2kΩ - 2.2kΩ resistor

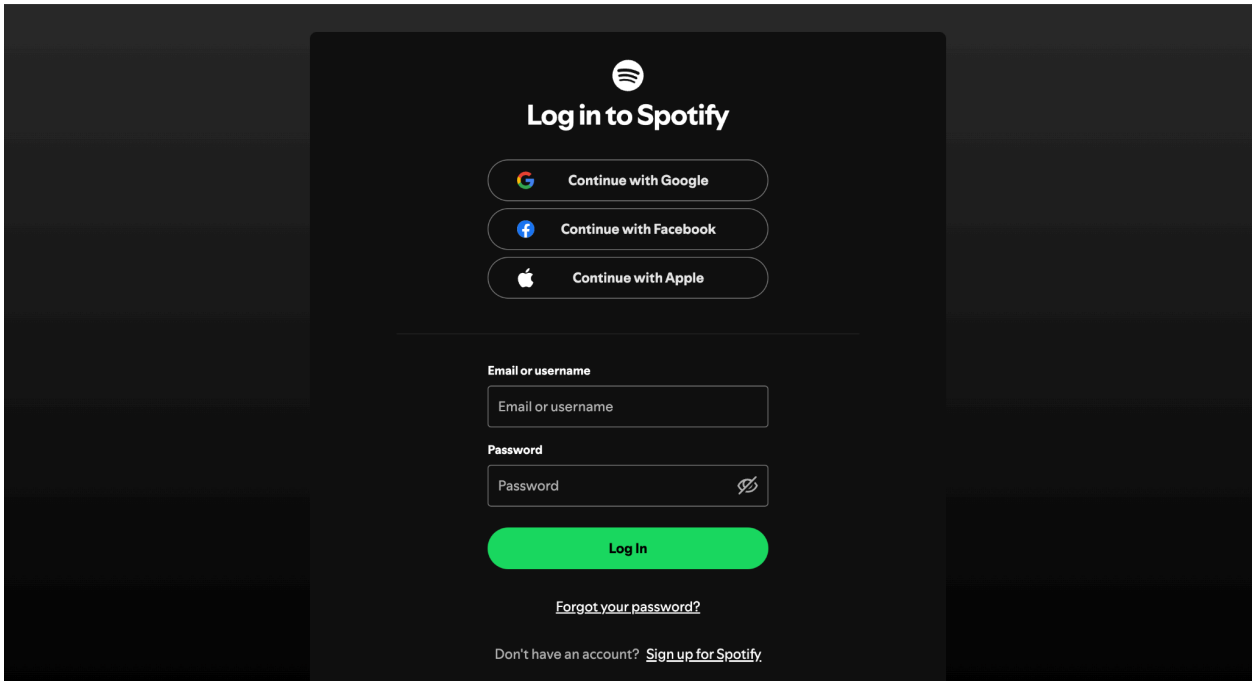
- Microusb to USB cable
- Jumper cables
- Aluminum foil
- Tape or Velcro (for attaching electrodes and pulse sensor)

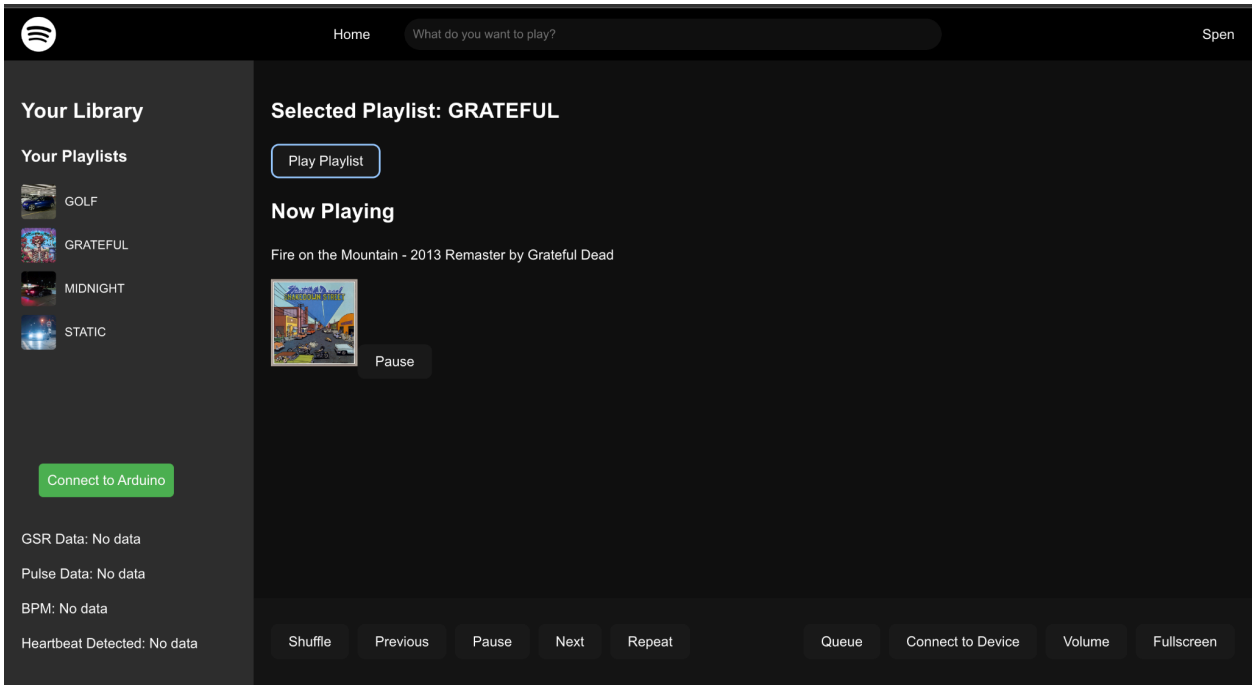
Future Areas of Improvement

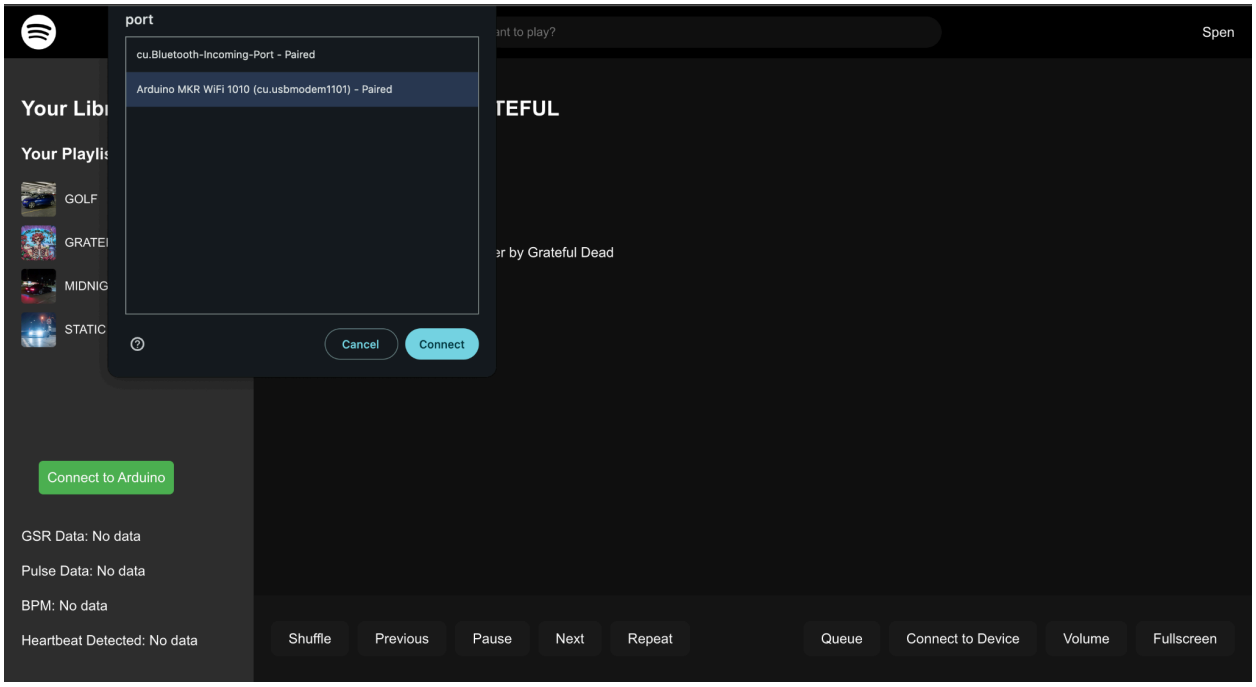
Materials

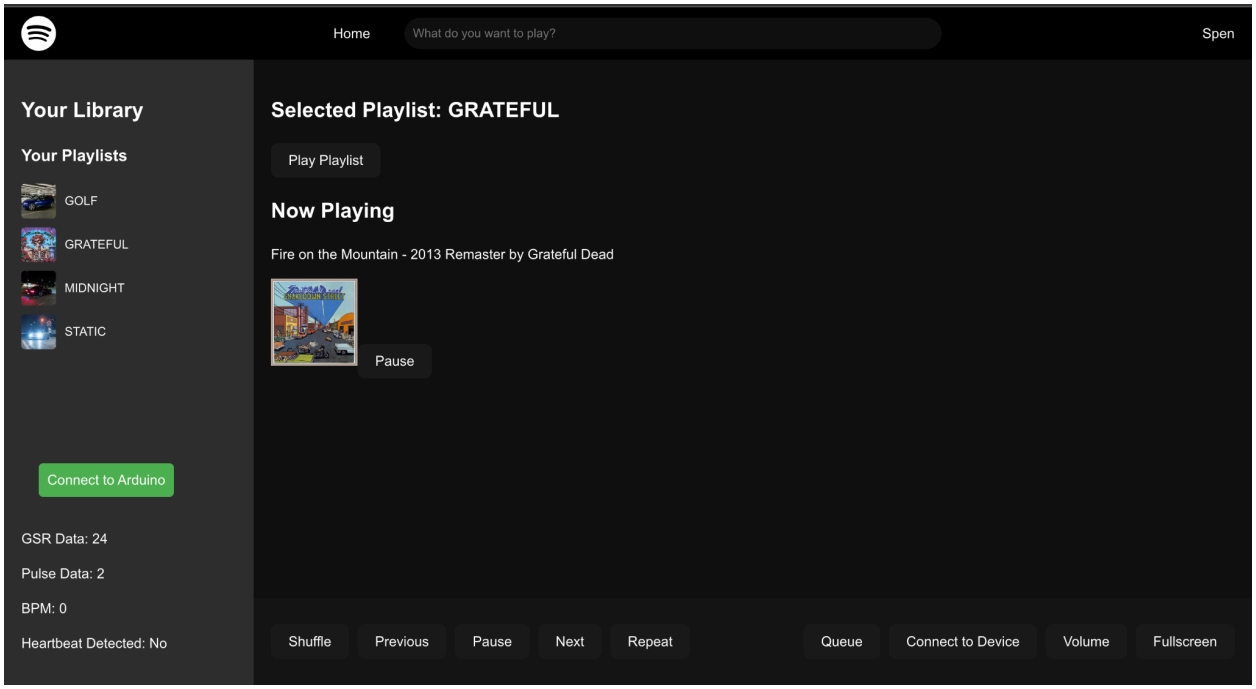
The current prototype is optimized for affordability and robust prototyping. In the future using more specialized materials would improve the overall GSR but they may not improve functionality. Changing the GSR electrodes from aluminum to copper tape would improve durability and the higher conductivity of copper would make the readings more sensitive providing a wider range of values, although it also introduces more noise to the data readings. In later stages of prototyping it is recommended to solder the components together to improve the durability of the IMAGS prototype itself and reduce its form factor substantially. The biggest area of improvement should be to get a more reliable bpm sensor that can be integrated with the arduino GSR prototype. The arduino pulse sensor we used was not reliable at reading BPM, sometimes it would work flawlessly but usually the data was unreliable and it was very tedious to place the pulse sensor so it would read accurate data.

Web Application









Features

- **New UI Design**: Implemented a more user-friendly interface.
- **Spotify Integration**: Users can connect to their Spotify accounts which allows them to play and control music from the Spotify app or they can play their Spotify playlists from the Webapp.

- **React Migration**: Wrote our code in React, while the previous IMAGS project was written in Max

Resources

- **GitHub Repository**: Contains the complete codebase, including documentation on setting up the Spotify integration and the React components.
- https://github.com/EAMIRorg/IMAGS_React

Conclusion

What We Learned

- The importance of integrating hardware and software seamlessly to ensure smooth data flow.
- Improved knowledge of React for web app development and handling third-party APIs like Spotify.
- Key insights into refining hardware for better physiological data collection.

Challenges

The main challenges of this project was due to the materials used. We had a lot of difficulty getting access to the correct capacitor and had to order it online. The capacitor is an essential component of the GSR prototype and without it we were unable to make progress on the project for that period of time. Another challenge we encountered was the integration of the arduino pulse sensor with the existing GSR prototype, the biggest challenge was not the circuit but the data readings of the sensor, they were mostly unreliable and inconsistent which made it very difficult to work with. Finally, the integration of the hardware and software created some issues since the Webapp had some errors reading the data the arduino was outputting through the serial port.

Information for Future Projects

- **Continuing Development**: Future teams should focus on refining the GSR and BPM sensors for more accurate readings.
- **Web App Expansion**: Explore additional features to enhance user engagement and data visualization.
- **Documentation**: Detailed setup guides and documentation can be found in the GitHub repository to help future teams understand the current state of the project.

Acknowledgements

- **Ava Mattimore**: Gave us helpful information about the GSR as well as recommendations for the Webapp.
- **Prof. Manzo**: Provided valuable guidance and recommendations throughout the project.