SoundSync

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A novel system that aims to autonomously turn pages in real time using eye tracking and audio processing to ensure accuracy and focused playing for the duration of practice

18500 Capstone / Team B6

Use Case

| PROBLEM | Disruptions and loss of focus for musicians resulting from page turning during rehearsals and performances |
|----------|---|
| SOLUTION | A system that autonomously turns pages in real time using eye tracking and audio processing to ensure accuracy and focused playing for the duration of practice |
| AREAS | Software Systems, Signals and Systems |

Use Case Requirements

| Eye-Tracker Accuracy | 0.5 inches | The average size of a bar of sheet music on an 11 inch tablet |
|--------------------------|------------|---|
| Eye Tracker Precision | 1.5 inches | The size of sheet music notation on an 11 inch tablet |
| Eye-Tracker Latency | 333 ms | A beat at 180 BPM with additional processing |

Use Case Requirements (1)

The amount of space the Eye-Tracker minimum eye-tracker needs to 5.5 x 8 inches² Field-of-View identify a full human head Time it takes to process **Audio Latency** 333 ms audio signal and find position in music Time between where the Audio 1 beat music actually is and where Accuracy the model thinks it is

Use Case Requirements (2)

instrument specific ± 5% Filter to remove other **Audio Filtering** frequencies outside of selected instrument range **Power Budget** Power consumed by the 8Wh system + Google Board How often did the page turn Page Turning >95% when the musician expected Success Rate it to?

Technical Challenges

Compact Design

Users will require a seamless experience that doesn't obstruct their view of the conductor or the environment

Eye tracking

Precise and accurate eye tracking to ensure we know where users are currently located in the score

Power Requirements

Orchestras cannot have hundreds of outlets or extension cords, therefore SoundSync must be battery powered

Technical Challenges (1)

Processing Delay (Model Delay)

Audio recognition and placement

The processing speed of our ML Model must be efficient and accelerated to provide real-time eye tracking with an accurately moving cursor

Robustness against tempo or rhythm changes, music recognition using ML algorithms. The algorithm must inevitably be able to tolerate musician and human error

Solution Approach

Eye-Tracker Filtering

Camera data is filtered through various techniques that improve precision **Compact Design**

Using small but powerful peripherals such as a clip-on microphone ensures low weight **Battery-Powered**

A pre-charged battery pack with enough energy to last the duration of a concert

Solution Approach (1)

Frequency Filtering

Accounting for unique harmonic series to provide instrument specific audio processing Audio Alignment

Machine Learning algorithms to process musician idiosyncrasies and adapt relative to a pre-processed MIDI file Edge Cases

Head gestures tracking for codas, long range repeats, and other nonlinear musical structures

Testing Verification & Metrics

Eye-Tracking Accuracy

Comparing and testing variations of eye tracking filters to find the optimal settings Audio Alignment

Graphing the time difference between the user's audio and the MIDI file bounded by the length of a beat Verify with user that page flips felt appropriately timed

Page Flip Success Rate

Model Delay

Send test data through the models and check if time to output is within the length of a beat

Tasks

Rohan Audio Alignment Model, Instrument Frequency Calibration

Sanjana Webpage Development, Eye-Tracker ML Model

Caleb

Data-Point Filtering, Music Processing, Audio Alignment

| 00 | Q Search tasks | ASSIGNEE * | EH 🔻 👌 |
|----|---|-------------|---------|
| | Audio Alignment: | | |
| 1 | Generate MIDI File | CL, Ro | 1.0 |
| 2 | Silter Signal Based on Instrument | Rohan | |
| 3 | Take in Player Audio | CL, Ro | |
| 4 | Signal Comparison and Alignment | CL, Ro | |
| 5 | Cursor Research | CL, Ro, Sa | |
| 6 | Robustness and flexibility resear | CL, Ro, Sa | |
| | + Add task + Add section | | |
| 8 | Eye-Tracker: | | |
| 9 | Research Eye-Tracker | Caleb Lille | |
| 10 | Setup Eye-Tracker | CL, Sa | |
| 11 | Filter Eye-Tracker Data | Caleb Lille | 100 |
| 12 | Test Accuracy on Computer | CL, Ro, Sa | 1961 |
| 13 | Assemble Data into Readable Fo | Caleb Lille | |
| | + Add task + Add section | | |
| | React Webpage: | | - |
| 16 | Find APIs, figure out tech stack | Sa, CL, Ro | |
| 17 | Setup React App & Calibration P | Sanjana | |
| 18 | Get a preliminary eye tracking o | Sanjana | - 12 |
| 19 | Instrument Selection Window | Sanjana | <u></u> |
| 20 | Display Music | Sanjana | 1(#1) |
| 21 | Implement Cursor | Sanjana | 140 |
| 22 | Slack | Sanjana | 1.5 |
| | + Add task + Add section | | |
| | Integration: | | |
| 25 | Google Board setup | Rohan | |
| 26 | ⊘ Test Microphone Connection to | Rohan | |
| 27 | O Integrate audio alignment model | Sa, CL, Ro | - |
| 28 | ⊘ Integrate visual and audio with c | Ro, CL, Sa | 100 |
| | + Add task + Add section | | |



User Experience Flow Chart

