Algo-arias

Music and A.I.

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Abstract

This project explores the exciting potential of merging music and technology to create a new frontier in personalized music therapy. Its focus is on harnessing the power of **Affective Algorithmic Composition (AAC)** to generate music tailored to an individual's emotional state in real-time.

Music has a profound impact on our emotional well-being and music therapy has proven effective in various healthcare settings. However, traditional methods of music therapy may lack real-time personalization to the degree of precision at which computers can generate it.

Imagine a system that "reads" your music taste through facial expression/mood as you listen to a variety of pre-selected music with various differing musical components. By listening to a curated selection of music with diverse elements like tempo, melody, and instrumentation, the system would analyze your facial expressions to understand which components resonate most with you. Then this same system would create personalized music that perfectly complements your unique taste in real-time, or to bring about some desired effect / brain activation.

This is especially useful for patients diagnosed with autism, Alzheimer's, Parkinson's.

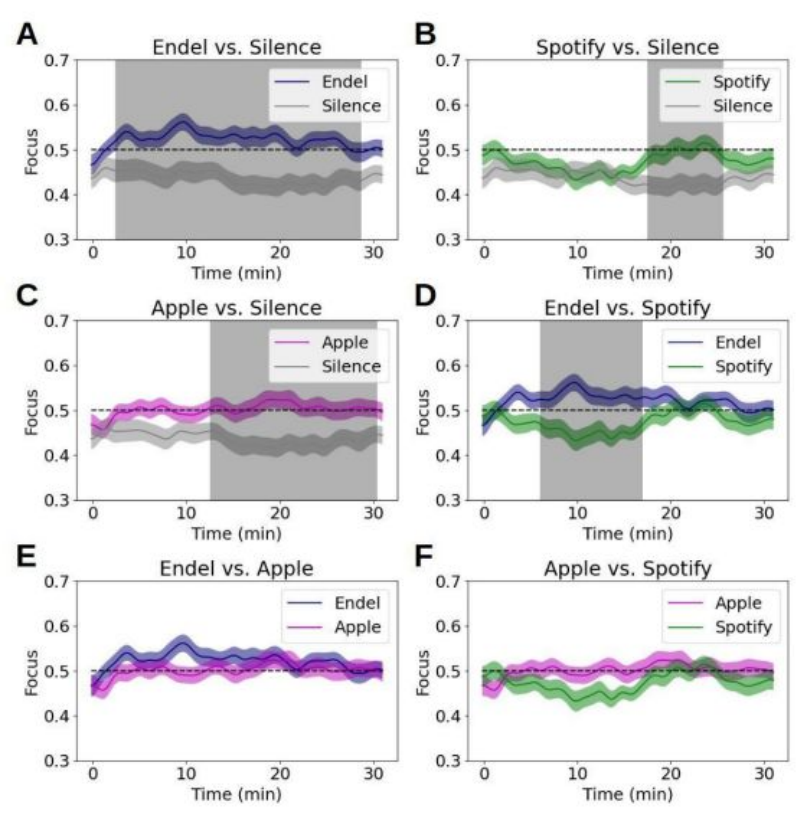
Research Question

How can AI technology make highly effective and personalized music using computer vision in conjunction with the knowledge of specific musical components such as rhythm, chord progressions, melodies, timbre, etc.?

Background Research

- Established impact of music on emotional well-being
- Effectiveness of music therapy in healthcare settings.
  - Examined neuroscientific studies on music's impact on the brain.
- Facial Expression Recognition
- Affective Algorithmic Composition (AAC)
- Development of a Web Application
  - Deployment of a Machine Learning Model as a Service

Background

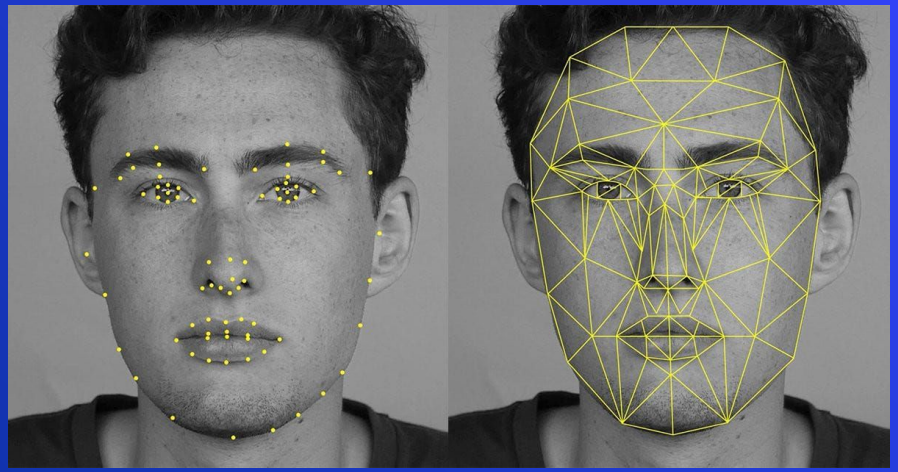


- Music is becoming popular as non-invasive medical intervention
- Algorithmic music affects your brain directly
- Real-time input highly personalizes this music for much stronger effects

(Haruvi et al., 2022)

Facial expression recognition

Analyzing facial changes to map the mental states caused by music

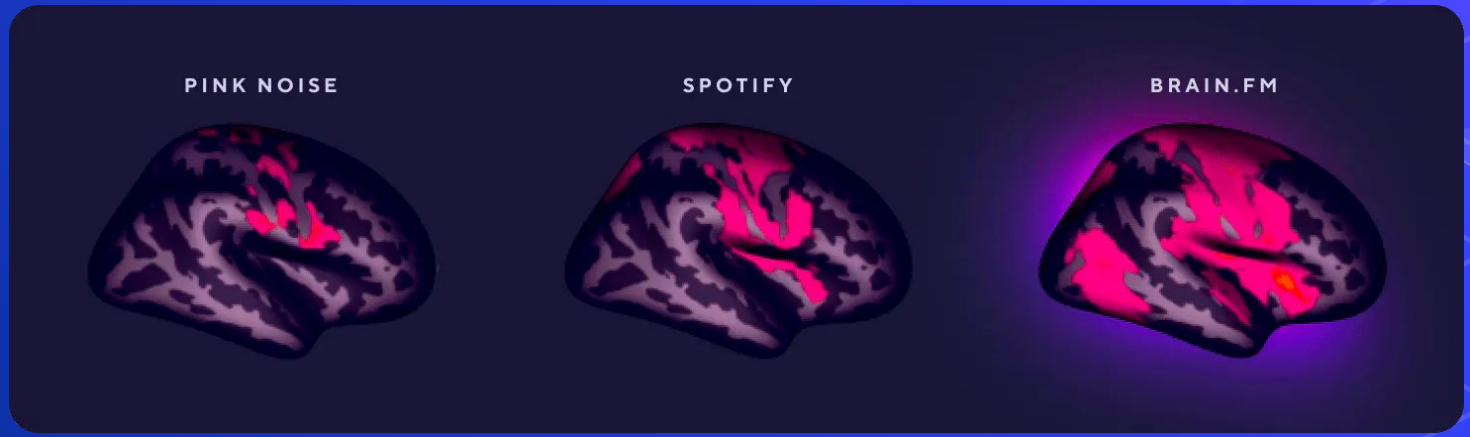


- Universal language
- Provides immediate feedback
- Free from bias and conscious manipulation (Weth et al., 2015)

Music Therapy Facts

- Dropped ~4.4 mg ME of opioids used by surgical patients in 10 studies (Fu et al., 2020)

- Tailored music intervention reduced $2,155 in expenses per ICU patient (Chlan et al., 2018)



(Woods et al., 2021)

Functioning of the Proposed Application

1. Various samples of music differing in genre, key, timbre, etc. played.
2. Facial microexpressions of the user analyzed in real-time.
3. Timestamps where the user experiences the strongest changes noted.
4. Musical components around those times recorded.
5. New music generated tailored to the user's emotional responses during next session.

Materials/Tools

- Integrated Development Environment (IDE)
  - VS Code
  - Angular CLI
- Existing Machine Learning Models
  - MorphCast
- Services Framework
  - GitHub Pages
- Algorithmic Composition Models

Architecture

User

Music clips

(Headphones)

Facial Expressions

(Camera)

Web App Interface

Timestamps of greatest effect

(Morphcast)

Database of musical components

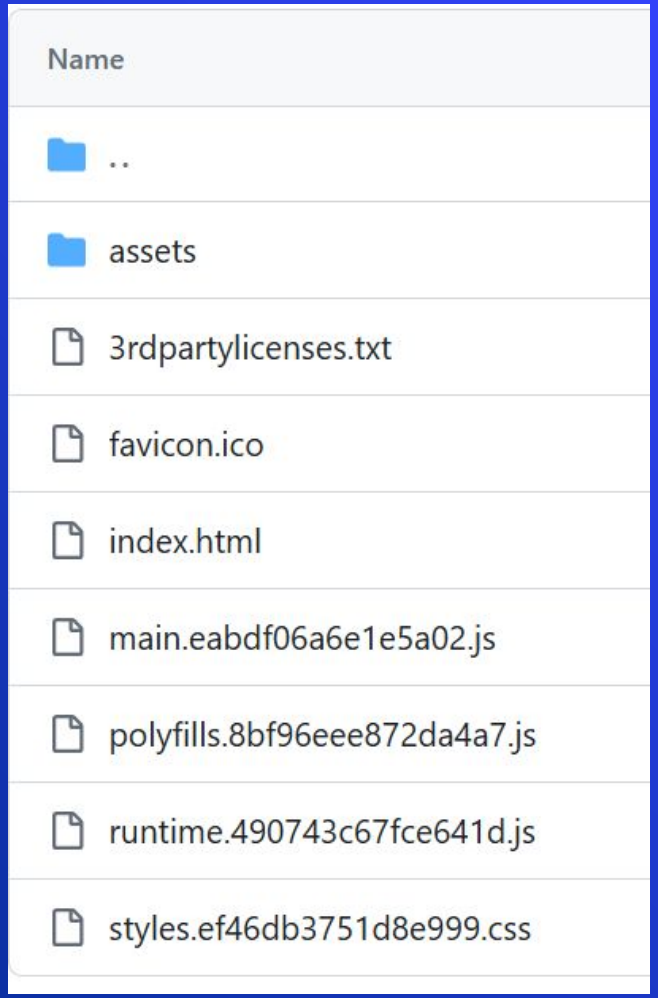
Musical components at recorded timestamps

Algorithms

AAC

New music

Code Snippets




```
export class Source {
  constructor() {
    this.currentSource = {
      getFrame: async () => {
      },
      start: async () => {
      },
      stop: () => {
      },
      stopped: true,
      isDummySource: true
    };
    this.mutex = new Mutex();
  }

  async getFrame(maxSize) {
    return await this.mutex.runExclusive(async ()=>{
      return await this.currentSource.getFrame(maxSize);
    });
  }

  async start() {
    return await this.mutex.runExclusive(async ()=> {
      return await this.currentSource.start();
    });
  }
```

Challenges and My Solutions

- Choose the best responsive and efficient web app framework
  - Evaluated several frameworks (React, Angular, Svelte)
  - Selected Angular for its robust features and easy scalability.
- Obtain a sophisticated tool for facial expression recognition.
  - Reached out to MorphCast company CEO
  - Secured unlimited free usage of their facial expression recognition HTML SDK for research purposes.
- AAC
  - Upcoming research

Future Research possibilities

- Developing a proper list of musical components
- Finding a sufficient blend of music that tests all musical components
- If real-time music generation is feasible vs. batch/offline processing
- The overwhelming need for the mechanism which actually generates the music
- A user-friendly GUI
- Possible eye-movement-tracking implementation

Works Cited

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