

Research Question:

AI Search for Physiologically Arousing Songs

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Project type: 3rd Year Project for BSc Computer Science

Subjects:

- AI Search
- Sound and Music Computing
- Human-Computer Interaction
- Wearable Tech

Objectives:

- Effectively search a large space quickly when computing the fitness value of a point takes minutes.
- Listeners should feel an increase in physiological arousal over time while the search is active and when replaying the songs which caused the largest increases during the search.
- Listeners should intuitively see similarities between songs that are classified as highly arousing, and differences between those songs and songs classified as relaxing.
- Visually show the differences in what music arouses multiple listeners.

Deliverables:

- **Minimum**
 - Read user's physiological arousal levels into a computer
 - Algorithm that searches the space for highly arousing songs
 - Integration with the Spotify API to fully automate the search
- **Intermediate**

- Produce graphical representation of fitness landscape
- Automatically populate playlists with highly arousing songs for later listening
- Test the arousing songs again at a later date to determine whether arousal is stable in that songs that arouse you one day will do so in a week's time also
- Try to minimise arousal instead of maximising it to find relaxing songs

- **Advanced**

- Make it into a wearable device
- Explore using alternative sensors, such as heart rate monitor or simple EEG headset to monitor focus levels.

1 Background

Sound and music can cause intense emotional reaction in listeners ([Rickard, 2004](#)), but the action of storing music in a playlist can easily distract the listener and ruin the experience. In addition to this, each listener may respond differently to the same song based on context, past experiences, and psychology ([Sandra Garrido, 2011](#)).

Physiological arousal is the state of the brain and sympathetic nervous system being 'awake', or highly active, often due to intense emotion or emotional stress. When a song causes a listener to get 'pumped up', it is accompanied by an increase in the user's physiological arousal ([Francesca R. Dillman Carpentier, 2007](#)). This can be measured using galvanic skin response (GSR) sensors, which measure a change in arousal ([IMOTIONS, 2015](#)). These are commonly used in lie detectors and are available very cheaply ([seeed, n.d.](#)).

2 Discussion of how to Achieve Objectives

We can model the problem of finding a song which causes increased physiological arousal as an AI search problem. The Spotify Web API includes an endpoint named `audio-features`, which returns a list of 13

scalars describing the properties of the song ([Spotify, n.d.](#)). These scalars include ‘danceability’, ‘loudness’, and ‘instrumentalness’, among others, and can be used as the axes of a high-dimensional space. We can map a fitness landscape onto this space, where each song is represented by a point in the space, and each point in the space has a fitness determined by how much the song increased a listener’s physiological arousal.

The main difficulty in this project is how to perform a robust search of the fitness landscape with very limited data. It will take the full length of each song to determine the listener’s change in arousal, and the task cannot be easily parallelised due to the need for a human listener, and the fact that each listener may respond differently to each song.

Once this system is working reliably, we will develop it into a wearable device so it can be used portably. This system has applications for the general consumer, in addition to potential uses in a music therapy setting ([Pelletier, 2004](#)). Further research in the area could move to using more complex sensors, such as EEG headsets, rather than GSR sensors, or alternatively generating physiologically arousing music from scratch.

3 Timeline

- **Summer Break:**

- Get Ethics Approval
- Order Equipment
- Do background reading on AI Search and Physiological Arousal
- Set up equipment, measuring arousal and reading into program

- **1st Term:**

- Test songs, understand baseline and gain an intuitive understanding of what kind of songs increase arousal in myself
- Start writing + make good progress with AI Search algorithm

- **2nd Term:**

- Test on other listeners
- Compare the fitness landscapes of multiple listeners

- Experiment with fitness function, i.e. finding songs that decrease arousal
- **Easter Break:**
 - Write report

References

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