CALIFORNIA STATE SCIENCE FAIR
2007 PROJECT SUMMARY

Name(s)
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Project Number
S1311

Project Title
Acoustic Music Similarity Analysis

Abstract

Objectives/Goals
The popularization of digital music presents the problem of quickly finding music to suit individual users' tastes and moods. The collaborative user feedback (e.g. iTunes' "Listeners Also Bought...") used presently is often skewed due to extremely popular songs and fails to account for music without much customer feedback, such as undiscovered independent ("indie") artists.

This project investigated methods of improving audio-based music analysis to find songs similar to given query songs. A new method of improving similarity results using spectral graph theory and the eigenspace transformation has been presented.

Methods/Materials
A collection of 800 songs from 8 different genres was analyzed. The statistical characteristics of the frequency distribution were used to capture the perceived texture of the music as signatures. Distances between songs were calculated using the Earth Mover's Distance (EMD), an algorithm for comparing song signatures.

These distances were represented as a connected graph. The eigenspace transformation was used to rearrange the points based on a random walk of this graph. This was a novel approach that separated songs into distinct groups.

Playlists of 10 similar songs were generated using each song in the collection as a query. The percentage of songs in the same genre as the query was defined as the genre matching accuracy.

A 3-D music navigation system was also developed as a visualization of the song collection in eigenspace, where similar songs are shown near each other.

Results
It was found that applying the eigenspace transformation on the EMD distances used in other research improved genre matching accuracy by 13.5% over the EMD alone, which is statistically significant.

Conclusions/Discussion
Music similarity analysis has the potential to change the way consumers listen to music. This project contributes an algorithm that improves similarity results considerably.

Summary Statement
This project explored ways to automatically find pieces of music that sound similar to each other, which enables people to quickly find music similar to their tastes.

Help Received
Dr. Beth Logan at Intel and Professor George Tzanetakis at the University of Victoria answered my questions by email, and George Tzanetakis also provided the music collection.