MyMusicShuffler: Mood-Based Music Recommendation with the Practical Usage of Brainwave Signals

Saim Shin, Dalwon Jang, Jongseol J. Lee and Sei-Jin Jang and Ji-Hwan Kim

Abstract — *This paper proposes an automatic music service, the MyMusicShuffler, which recommends music based on received brain signals. This service is focused on eliminating the unnecessary hand interactions in multi-tasking environments. By analyzing brainwave signals, the application can select music which effectively reflects the emotional responses of the user in real time. This paper explains the implementation of the service, MyMusicShuffler, a mood-based music recommendation service which interacts with the mood status of user*[1].

Index Terms — Mood-based music recommendation, EEG based mood classifier, Brain machine interfaces.

I. Introduction

The consumption of digital music has expanded considerably and related services have become increasingly popular. However, the enlarging personal music libraries have led to some unforeseen discomforts to users. Users must filter their libraries to find old favorites, search for new music items, and constantly add items to their favorite playlists. Furthermore, although the music items already exist in a playlist, users still need to update the playlists by eliminating undesired items periodically. These issues waste the user's time and causes unnecessary stress. As such, several music recommendation services which try to reduce the user's discomfort have recently arisen. However, previous recommendation techniques still have limitations: user preferences about certain music items can change over time, as conditions or situations shift. Current music recommendation techniques only analyze the music signals of specific music items or previous user consumption patterns. It is hard to reflect the subtle aspects of music mood.

People typically listen to music in order to support their mood and to increase performance at some task. The aim of the proposed service is to maximize comfort to allow users to enjoy music without minimal interruption or concern. The Brain Machine Interface (BMI) can support this environment without any interruption of other actions.

This paper applies real-time brainwave signal classification techniques to the mood-based music recommendation in the MyMusicShuffler service. The proposed system facilitates easy personalized music consumption under multitasking environments. MyMusicShuffler has personalized user mood models which learn based on the brain signals of the user. After analyzing the user's mood using the personal mood models, the recommendation engine automatically updates the music playlist with the appropriate songs.

[1] This work was supported in part by the Ministry of Trade, Industry and Energy (MOTIE) grant funded by the Korean government (No. 10037244).

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II. MyMusicShuffler: System Architecture

A. Mood and Brainwave Signals

Mood and music can never be thought about separately. Detecting a user's emotional reaction to music is one of key aspects in developing music recommendation services.

This paper uses EEG (ElectroEncephaloGraphy) signals for the real-time detection of the user's mood. EEG signals consist of sequences of electrical voltages generated by brain cells. EEG acquisition devices have become more wearable [1].

The proposed music recommendation system catches user's emotional state by analyzing the EEG signals as the user listens to music. There are two advantages to the EEG-based music recommendation. First, the proposed service is able to respond to the user's real-time emotional state since EEG reflects the real-time emotion response of the user. Second, the BMI is one of the best methods to analyze man-machine interaction in multi-tasking environments because many users typically consume music while they perform other main jobs - working, exercising, reading and so on - in order to feel energized or to maintain a certain mood. The proposed system is an eye-free and finger-free interface. It does not need any touch-based interface. Furthermore, the service can create the optimal music list based on the user's real-time mood status.

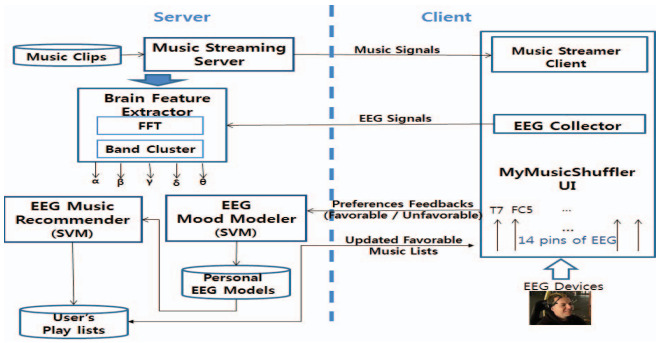


Fig. 1. System Architecture of MyMusicShuffler

B. Mood-Based Music Recommendation using EEG

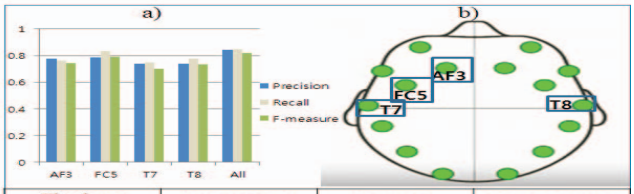
Fig.1 shows the proposed service. The mood modeler gathers the EEG signals and the user responses to the music.

The binary classifier – whether the song is a favorite item or not - generates a personalized music mood model per a user by using the EEG signal patterns. The recommendation engine analyzes the EEG signals emitted by the user as the user listens to the item. In case of new music, if the classifier decides the item is a favorite, the music is automatically added to the user's play list. If the classifying result is unfavorable, the engine discards the music in the playlist and then suggests a different song. In case of music already in the playlist, if the classifying result of the user's EEG is unfavorable, the item is removed from the list. If the answer is the favorite, the system saves it for the user's continuous enjoyment.

Support Vector Machine (SVM) classifier is used with a RBF (Radial Basis Function) kernel in the modeling and recommendation module [2]. The power spectra of the EEG are often assessed in 5 frequency bands: delta (δ: 1–3 Hz), theta (θ: 4–7 Hz), alpha (α: 8–13 Hz), beta (β: 14–30 Hz), and gamma (γ: 31–50 Hz) [3]. The system extracts the power spectra from these bands after taking the Fast Fourier Transform (FFT) of the EEG as a feature of the SVM classifier.

III. Evaluation and Implementation

To evaluate the proposed system, EEG data and the correlating feedback to the selected music items were collected. A music corpus, KETI AFA2000, was used [4]. Each user selected his or her 10 favorite clips and 10 least favorite clips from the AFA2000. The mood modeling module gathered the EEG signals regarding the selected clips. 1-minuite EEG signals were extracted from each of the above 20 clips for each of the 10 participants. The used EEG devices, the Emotiv EPOCs, are 14-pin wireless devices for EEG acquisition [5]. The sampling rate of the EEG was 128Hz, the window size for 512-point FFT of EEG was 8 seconds and the shift periods were 8.7ms. After analyzing the 15 second-EEG for a music clip, the dominant mood of the classification results for the music was determined.



The best performance	Precision	Recall	F-measure
All	0.8421	0.8473	0.8181

Fig. 2. a) The top 5 performances by EEG pin places – 'All' means the performances with the combination of 14 pins. b) The positions of the pins in a) among 14 positions

A. Mood Classifier Evaluation

We evaluated the performances of the EEG classifier in MyMusicShuffler by measuring the precision/recall/f-measure - from 0 to 1 - with a 10-cross validation of the data. One favorable EEG and one unfavorable EEG for the test data are used repeatedly among the 20 clips' EEGs. Fig. 2 explains the performance of the EEG classifier. The Fig.2-b shows the 14 pin positions with EPOC. The histograms in Fig. 2-a represent the performance of the mood classification based on the pin positions of the EEG acquisition. The classifier which utilized all of the 14 pins showed the best performance.

B. Implementation of the Service Platform

The implemented results of the proposed music player are displayed in Fig. 3. MyMusicShuffler was constructed for the client and server system. The client module gathers the EEG signals and delivers the signals to the server. The client module shows the classification results graphically to the user and manages the playlist. The mood modeler and the EEG music recommender on the server train the mood models, classify the mood and deliver the updated list to the client.

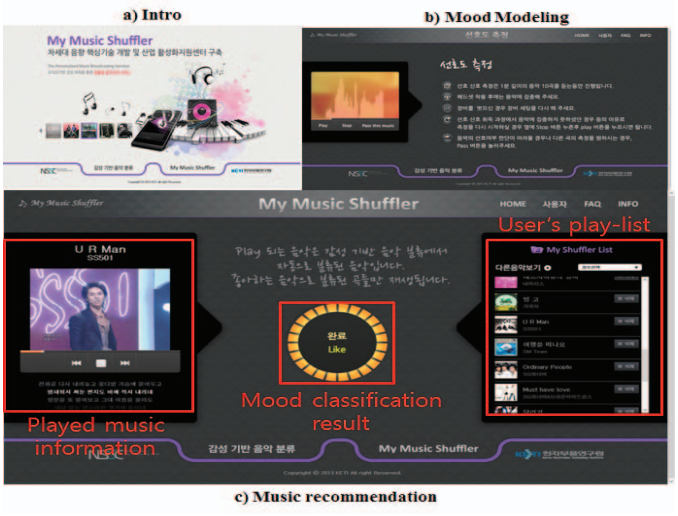


Fig. 3. Implementation results of MyMusicShuffler

IV. Conclusion

The proposed service - MyMusicShuffler - uses BMI techniques to provide the most satisfying music service to maximize the user's comfort. The light client platform can be applied to various mobile devices. And EEG-based real-time recommendation shows the comparable performances with the previous recommendation algorithms.

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