

Music Recommendation System for Personalized Brain Music Training Research with Jade Solution Company

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Abstract

According to a recent survey, most elementary and secondary school students nationwide are stressed out by their academic records. Furthermore most of high school students in Korea have to study under the great duress. Some of them who can't overcome the academic stress finalize their life by suiciding. A study has found that it is one of the leading causes of stimulating the thought of committing suicide in Korean high school students. So it is necessary to reduce the high school student's suicide rate. Main content of this research is to implement a personalized music recommendation system. Music therapy can help the student deal with the stress, anxiety and depression problems. Proposed system works as a therapist. The music choice and duration of the music is adjusted based on the student's current emotion recognized automatically from EEG. If the happy emotion is not induced by the current music, the system would automatically switch to another one until he or she feel happy. Proposed system is personalized brain music treatment that is making a brain training application running on smart phone or pad. That overcomes the critical problems of time and space constraints of existing brain training program. By using this brain training program, student can manage the stress easily without the help of expert.

Keywords: *Recommendation system, Collaborative filtering, Brain training*

1. Introduction

According to a recent survey, most elementary and secondary school students nationwide are stressed out by their academic records. Furthermore most of high school students in Korea have to study under the great duress [1].

Some of them who can't overcome the academic stress finalize their life by suiciding. A study has found that it is one of the leading causes of stimulating the thought of committing suicide in Korean high school students. It is a serious social problem in Korea. So it is necessary to reduce the high school student's suicide rate. There have been many studies to handle stress. Among them a new groundbreaking method about stress management called biofeedback training [2].

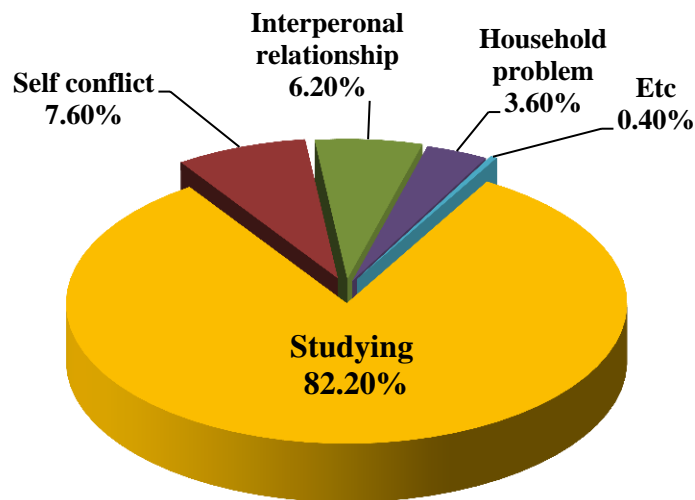


Figure 1. Stress type of high school student in Korea

Brain training with biofeedback changes the brain's neurophysiological and biochemical set up and eventually changes the brain's response to stress effectively. But most of the biofeedback training is conducted by expert instructor in professional organization. According to brain training research paper, prolonged training is more effective method than intensive training doing in professional organization. But the existing brain training program is not proper for students for their stress management because they must spend most of the time in school. So it is necessary to develop an another brain training program for Korean students to reduce the stress. I have been interested in human brain since middle school student and I will major in brain science in university. Recently portable EEG(Electroencephalography) is developed and it gives us an easy and portable way to monitor brain status and manage it through biofeedback training. The motivation of this research is that through this research I could have a more deep understanding of human brain function and research result will made a large contribution toward solving a high school student's suicide problem in Korea. Existing biofeedback brain training programs can be summarized as follows.

First, most of the brain training treatment is done by in professional organization. In reality it is not easy for Korean high school students to find free time for themselves. Furthermore according to experimental results show that everyday biofeedback training is more effective.

Second, most of the brain training programs are provided as game based form. They have defect that users play compulsively, isolating themselves from family and friends or from other forms of social contact, and focus almost entirely on in-game achievements.

To sum up the prior research we come to the following conclusion. Brain training must be universally available and it must not be a game based but a more useful form. To overcome the time and space constraints, we will combine a cutting edge technology with the brain music treatment which has never tried yet. Because most of the students in Korea use smartphone or pad, they can use the program at any place and every single day. It overcomes the problem of place and time constraints which existing brain training programs have. Another originality of this research is that we will implement a personalized music therapy system. Because individual's music preference is different, we will develop training program which automatically switch to an another music when the user can't feel relaxed. In short we will develop a personalized brain music treatment system which is running on smartphone or pad.

2. Music Recommendation System

The EEG is typically described in terms of rhythmic activity. It is divided into 5 categories depending on the frequency[4]. In this research we focus on Alpha and Beta wave among 5 categories. Beta wave is associated with stress, anxiety and restlessness whereas Alpha wave indicates in deep relaxation. The brain's natural response to stress is a decrease of Alpha wave and an increase in Beta one [5]. Studies have shown that listening to Alpha wave music is the most efficient way to reach states of deep relaxation within a short time [6][7]. Main content of this research is to implement an EEG based music therapy. Music therapy can help the student deal with the stress, anxiety and depression problems. An ideal music recommender system should be able to automatically recommend personalized music to human listeners [8][9]. Different from books or movies, the length of a piece of music is much shorter, and the times that listening their favorite songs are normally more than once. The existing recommender systems such as Amazon, Ebay have gained a great success. It can recommend complementary goods, the buyer can compare the products and negotiate with the sellers [10].

However, music recommender is not only giving products with reasonable price, but suggesting them personalized music. Collaborative filtering (CF), one of the most successful recommendation techniques to date, uses known preferences of a group of users to recommend products (e.g., movies, music, book, ...) to new users. Collaborative filtering techniques have been popularly deployed in commercial systems such as Amazon.com. Collaborative filtering techniques can be broadly classified into several categories: memory-based CF techniques such as the Pearson correlation-based CF algorithm [11]; model-based CF techniques such as Bayesian belief net CF algorithms [12] and clustering CF algorithms; and hybrid CF techniques such as the content-boosted CF algorithm [13]. Memory-based and model-based CF algorithms predict recommendation values based only on the rating matrix; content-based recommender systems use the regularities found within content information to make predictions; and hybrid CF algorithms use both content information and the rating matrix.

To be effective, a collaborative filter must deal with major challenges including sparseness of the data (that is, most people do not rate most movies), and large number of users and items (scalability). The traditional Pearson correlation-based CF algorithm (Pearson CF), a pure memory-based CF algorithm, addresses the scalability problem by calculating similarities between item pairs co-rated by a user, or between the pair of users who rate the same items. Although this type of algorithm is easy to implement and very effective in practice, its recommendations become less accurate as the data become sparser. Model-based CF algorithms, such as naïve Bayes (NB) and tree augmented naïve Bayes (TAN), whose parameters are optimized using extended logistic regression (NB-ELR and TAN-ELR [14], are able to deal with incomplete data and thus address the sparsity problem of CF. However, existing research results show that the performance improvement over Pearson CF is not significant [15]. A hybrid recommender system combines CF and content-based techniques in an attempt to avoid the limitations of either recommender system and thereby improve recommendation performance.

A representative hybrid CF algorithm, content-boosted CF recommender, uses NB to fill in the missing values of the rating matrix of the CF data with the predictions of the pure content-based predictor, to form a "pseudo rating matrix". One shortcoming of hybrid recommender systems is that the content information is not always available for the reasons such as privacy protection. It has been proved that hybrid CF model outperforms any individual method [16]. So in this paper we will deploy hybrid collaborative filtering algorithm.

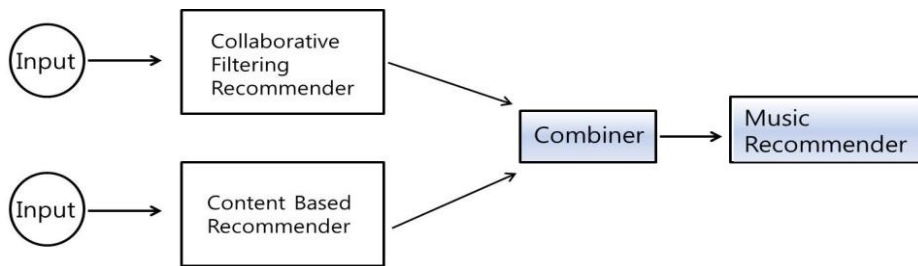


Figure 2. Hybrid collaborative music recommender system

3. Experiment

After selecting the proper music, we will provide experimental group with music as smartphone application. We will request the experimental group to listen the music at least 30 minutes every day during 4 weeks. Because individual's music preference is different, we will develop training program which automatically switch to an another music when the user can't feel relaxed. EEG recording was done for 90 seconds with a sampling rate of 128 Hz using 2 channels. EEG was recorded simultaneously and the each frequency bands (delta, theta, alpha, and beta) was calculated. The EEG data was collected in a relaxed position with eyes closed. At first students of control group listen to classic music for ten minutes. If Alpha wave is increased then he or she listens to the classic music continuously. But in inverse case the application switches the music to another one. The application repeats this process until the increasing of experimenter's Alpha wave. Students who are joined this research desire accessing their preferred music while they listening to music such as popular music, new age music, or etc. To provide such request to the students, proposed application must provide the function of adding the playing list. Proposed application operates as follows.

First The bicycle computer can receive sensor information and display metrics related to the sensor information on a display for the user. The displayed information can be updated at any suitable interval, for example determined based on power considerations, sensor refresh rates, user requests for particular information, or any other suitable interval. The overall system configuration is as follows.

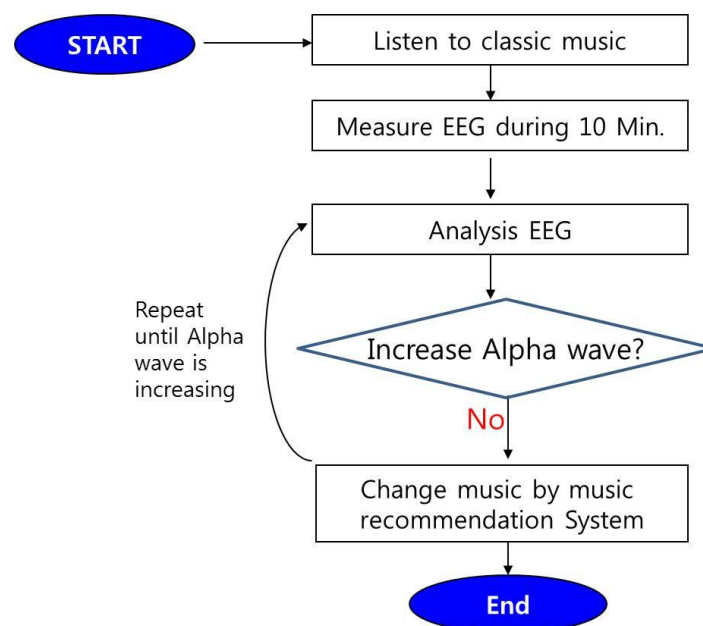


Figure 3. System diagram

4. Research result

4.1 Data Analysis

After 4 week's training we evaluate EEG before and after training using statistical method (i.e. chi-square test of homogeneity) whether proposed training program is efficient. Table 1 shows the change of Alpha wave according to music stimulation. In table 1 stimulation 1 is listening to classic music and stimulation 2 is listening to his or her favorite music.

Table 1. Mean and standard deviation of Alpha value according to music type

	Experimental group		Control group	
	Before	After	Before	After
	Mean(SD)	Mean(SD)	Mean(SD)	Mean(SD)
Stimulation 1	0.354(0.185)	0.402(0.192)	0.498(0.101)	0.401(0.204)
Stimulation 2	0.293(0.171)	0.419(0.199)	0.515(0.088)	0.510(0.105)

Mean and standard deviation value of experimental group are more or less increasing whereas control group is decreasing. This result shows that listening to music increases the Alpha wave in other words, stress is reduced. Another interesting result is that in stimulation 2 increasing portion is larger than stimulation 1. We can interpret this result that preferred music is more effective than classic music. Fig.4 and 5 shows the experimental results. After that we will interview the participants in experimental group about the proposed training. From them we will receive valuable feedback whether it is helpful or not. On the basis of feedback we will modify the training program until students will satisfy comparatively.

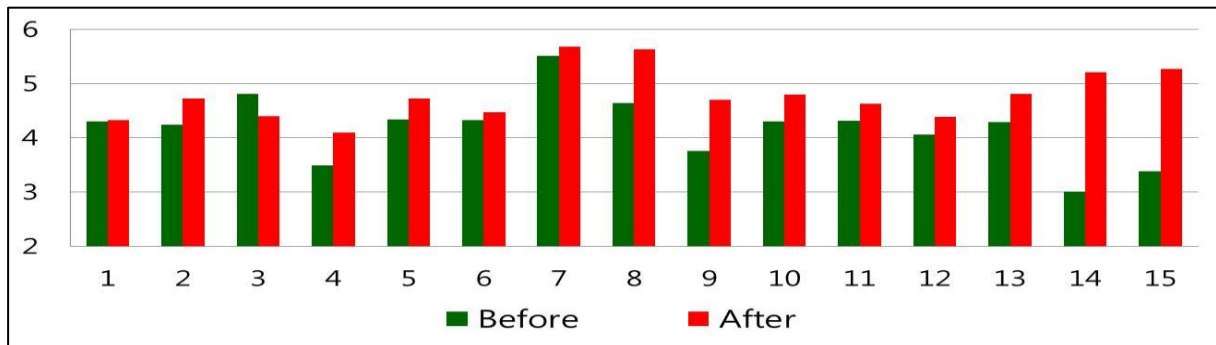


Figure 4. Change of Alpha wave

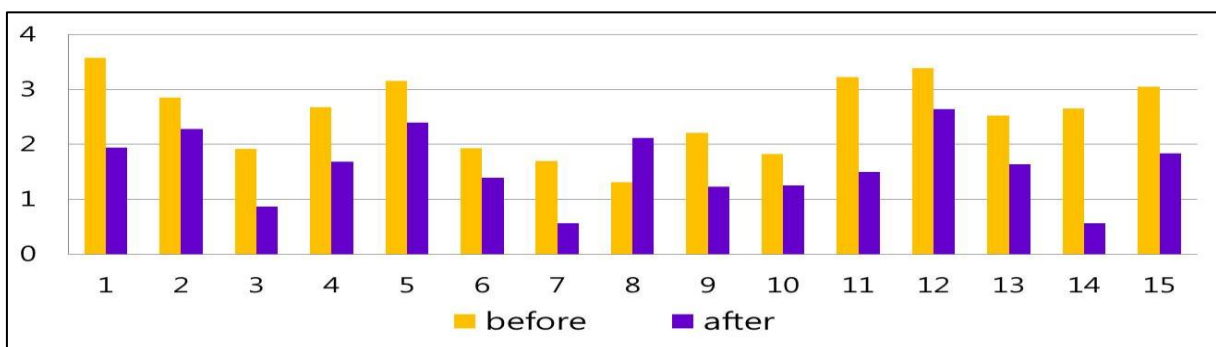


Figure 5. Change of Beta wave

We interview the students who join this experiment. The main topic of interview is merits and demerits of proposed personalized music treatment system. Table 2 shows the detailed description of interview. Through interview merits and demerits of current personalized music treatment system is as follows. In the early stages of music treatment system plays fixed list of music. But proposed system can add the preferred music from YouTube. This makes users feel more flexible and attractive system. Through interview we can conclude that developing personalized music treatment system is very meaningful to students who are under the stress of studying.

Table 2. Interview with students

Student	Rehabilitation program	Merit	Demerit
YS, Kim (18, female, experimental group)	- Heavy stress in study - Likes listen to music - Play the various instruments	- Personalized music listening is very attractive	- Wearing the EEG device is inconvenient
ES, Kang (18, female, experimental group)	- Heavy stress in study - Likes to play sports	- Overcome the time and space constraints	- Classic music is boring

5. Summary and Discussion

Our proposed personalized music treatment system has following advantages.

- ① According to research paper, 82 percent of the entire stress is caused by studying and this kind of situation will not change easily. Our proposed application will be very useful to the students who are under the stress of studying.
- ② Through this research we will develop a brain training program for students. Because it is designed for stress management, it can be applied to anyone who is suffering from any kind of stress.
- ③ Students medical spending on relieving stress of studying will be increased as an competitive society progress. This situation also leads to a budget deficit of national health insurance. Our proposed system causes not only decreasing of individual medical spending but also helpful to government to overcome the current financial difficulty.
- ④ Finalize their life by suiciding is one of the most serious problem in Korea. Because proposed application reduces their stress, it will be very helpful to prevent suicide.

Future work is as follows.

- ① Current system initially plays classic. Because each person's music preference is difficult we will survey more deeply what kind of music is more friendly to each person.

Acknowledgement

This work was supported by a 2017 research grant from Youngsan University, Republic of Korea.

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