Emotion-Based Music Player

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***Abstract*— Nowadays, people tend to increasingly have more stress because of the bad economy, high living expenses, etc. Listening to music is a key activity that assists to reduce stress. However, it may be unhelpful if the music does not suit the current emotion of the listener. Moreover, there is no music player which is able to select songs based on the user emotion. To solve this problem, this paper proposes an emotion-based music player, which is able to suggest songs based on the user's emotions; sad, happy, neutral and angry. The application receives either the user's heart rate or facial image from a smart band or mobile camera. It then uses the classification method to identify the user's emotion. This paper presents 2 kinds of the classification method; the heart rate-based and the facial image-based methods. Then, the application returns songs which have the same mood as the user's emotion. The experimental results show that the proposed approach is able to precisely classify the happy emotion because the heart rate range of this emotion is wide.**

Keywords—Music player, Emotion, Heart Rate

I. Introduction

In the past few years, the percentage of Thai people who have stress has raised at a higher rate. This is because of several reasons such as debts, higher product price, bad economy, high living expenses, etc [1]. In 2017, the Thai department of mental health collects information from Telephone service for mental health counselors and presents that the stress of Thai people tended to increase. The number of phone calls is more than 30,000 calls which are twice in 2014.

Stress can be eliminated in various ways; for example, workouts, watching movies, meditation, and listening to music. Many pieces of research state that music can assist people to reduce stress and be more focus. Unfortunately, listening to music may be unhelpful if the music does not suit the current emotion of the listener. Thus, to reduce stress, the music with the proper mood should be chosen [4]. Furthermore, although there are many music player applications, there is no application which is able to select songs based on the user emotion.

To solve these limitations, this paper proposes a mobile music player application which is able to recommend songs based on the user emotion. To classify the user emotion, the proposed application applies both the heart rate and face image. When the application receives a user heart rate from a smart band or a face image from a mobile camera, it analyses what the user emotion is. Then, it suggests songs whose moods are relevant to that user emotion. The user and song emotions in this paper are divided into four types; namely, neutral, happy, sad and angry. The experimental results present that detecting the happy emotion is the most precise with around 98%, while the accuracy of the sad mood detection is the lowest with 40%.

II. Related work

A. Music Emotion Classification

This section presents the existing methods for classifying emotion from the music. There are some relevant approaches which are concluded as follows.

- Robert E. Thayer [2] applies rhythm, tempo, intensity, pitch, and timbre to distinguish music emotions. He defines emotion types based on energy and stress. The energy of the music is a range between calm and energetic, while the stress is a range of happy and anxious/sad. This research divides the music emotions into 8 types; namely, exuberance, anxious/frantic, contentment, depression, calm, energetic, happy, and anxious/sad.
- Y. Song et al [5] apply an SVM-based approach for classifying the music emotions based on tags of the Last.FM website. There are 4 emotions provided in this research; namely, happy, angry, sad, and relax.
- Mood Cloud [6], a real-time music mood visualization tool, classifies music emotions into 5 types; namely aggressive, happy, party, relax and sad. It applies the SVM library to analyze the emotion dataset. The result is then presented by using a Flash player.

B. Human Emotion Classification

M. T. Quazi [3] applies the heart rate to classify human emotions. The research proposes 4 different types of human emotions; namely neutral, happy, sad and angry. The neutral emotion has the most stable heart rate (60 – 80 bpm), while the happy emotion has the highest variation rate (70 – 140 bpm) which depends on the type of happiness. The sad emotion has the second highest variation rate (80 – 100 bpm). The heart rate of angry emotion is in the same range as the happy emotion, but it will not lower than 100bpm.

III. System Analysis and Design

A. Existing Music Player Applications

To develop an appropriate application, the existing music player applications are investigated. Currently, there are 3 mainstream music streaming applications with high user percentage.

- Joox: The Asian popular music application which is owned by Tencent. Joox has not only a regular

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music streaming function for VIP users but also a live stream concert function and Karaoke function.

- Apple Music: The well-known worldwide music streaming application. The advantage of this application is the music suggestion by user favorite; however, the subscription cost is quite high.
- Spotify: Another worldwide music streaming application. It also suggests songs based on the user's data collection. Moreover, the subscription cost is much cheaper than Apple Music.

The comparison of the mentioned applications is shown in Table I. that every other music player application contains these basic features except for Joox that has a Karaoke mode but there's no other application that can detect user emotion and suggested songs.

TABLE I. MUSIC STREAMING APPLICATION COMPARISON

	Online music streaming	Offline download	Create Playlist	Search	Karaoke mode	Emotion detection
Spotify	✓	✓	✓	✓	×	×
Apple Music	✓	✓	✓	✓	×	×
Joox	✓	✓	✓	✓	✓	×
Emotion-Based Music Player	✓	✓	✓	✓	×	✓

B. *System Requirement*

The emotion-based music player has 2 actors; namely, admin and user.

1) Admin: this actor can upload the music files on the database. Admin is unable to interfere with any of the users' preferences and playlists.
2) User: this actor can access to almost features of this application i.e. playlist creation, user emotion detection, song searching, and song recommendation.

C. *System Design*

The system overview of the proposed application is presented in Figure 1. The application will detect user's emotion by using smart band's heart rate detection or using Face detection API to analyzed user's current emotion, thus, this application will suggest songs that suit user's current emotion from a database which categorized manually by Admin.

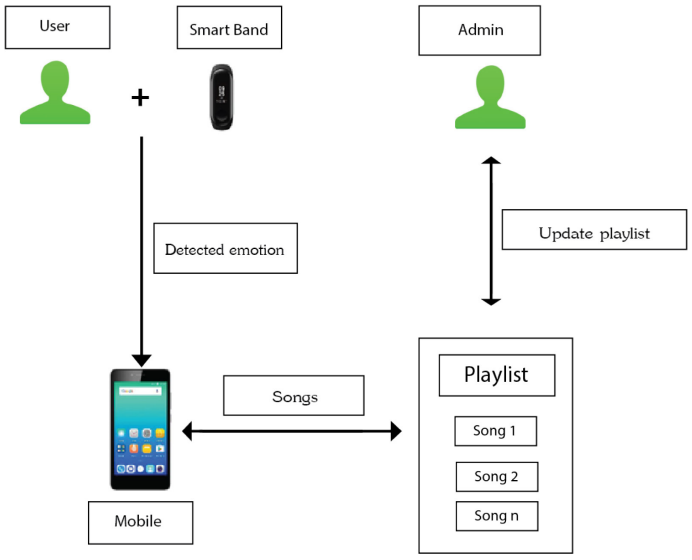

Figure 1. System Overview

IV. SYSTEM IMPLEMENTATION

This application requires hardware, such as a smart band and a camera. In this research, to get the user heart rate, a smart band has to connect to an Android smartphone. The application receives the heart rate input and then analyzes what emotion the user has. This paper also proposes a simple user emotion classification method which is described in Section IV. In case that the user has no smart band, the application is able to analyze the users' emotions from their facial images by using the face detection API from Microsoft Azure.

After classifying the user emotion, the system will use that emotion to match and recommend songs which have the relevant mood. Then, it will generate an emotion-based playlist and pick up the songs from a firebase database. Currently, there are 200 songs in the database. They are grouped into different emotion types by the system admin. The songs are suggested based on a user's preference; either positive or negative. For Example, if a user's current emotion is sad and his preference is set to positive, the application will suggest a happy song which contains a cheer up song element. On the other hands, if a user's preference is set to negative, a song in a sad mood will be suggested, and that song may be a heavy or pop song.

A. *User Emotion Classification Methods*

The emotion-based music player applies the user's heart rate and facial image to identify the user's emotion.

- Heart rate-based method

a) Exact Classification Method

The user emotion in this paper is divided into 4 types; namely, angry, sad, happy, and neutral emotion. The exact classification method is a simple method that classifies the user heart rate based on the ranges provided in Quazi's research [3]. The ranges of heart rates for each emotion are presented in Table II. In case that the user's heart rate is in multiple ranges, the system will identify that the user has multiple emotions. For example, if the user's heart rate is 110 bpm, the application will conclude that the user is in both angry and happy emotion.

TABLE II. HEART RATE RANGES FOR EACH EMOTION

Emotion	Heart Rate (Lowest)	Heart Rate (Highest)
Angry	83	135
Happy	72	140+
Neutral	56	72
Sad	62	100

b) Average Classification Method

The average classification method will compare the given heart rate with the average heart rate value of each emotion. The method will suggest the emotion whose average heart rate is the closest to the user heart rate. For example, if the user's heart rate is 110 bpm, the application will identify that the user is in an angry emotion. The average heart rate of each emotion is shown in Table III.

TABLE III. AVERAGE HEART RATE FOR EACH EMOTION

Emotion	Average Heart Rate (bpm)
Angry	109
Happy	106
Neutral	64
Sad	82

- Facial image-based method

This method applies the Face detection API of Microsoft Azure to identify the user emotion from given facial images. Based on the facial expression analyzing, the Face detection API is able to classify the images into 8 different emotions, such as anger, contempt, disgust, fear, happiness, neutral, sadness, and surprise. As mentioned above, this paper focuses on only 4 basic emotions, such as angry, happy, sad and neutral. If user emotion doesn't match the 4 basic emotion. The application will group these emotions into neutral.

B. Song Emotion Classification

Based on the music emotions in the existing research, the proposed music player classifies the music emotions into 4 types; namely, happy, sad, angry, and neutral. This is because those 4 emotions are fundamental and they appear in every paper. Moreover, they are able to be apparently classified by the principal of music theory. For example, songs with angry emotion contain fast tempo, a heavy instrument with low pitch and distortion combined. Although the music is able to represent song emotions, the meaning of the songs is also important for reflecting the song emotions. Thus, this research also applies the lyric to classify songs.

To effectively recommend the songs which suit the user emotion, the application has to know not only what emotion the user has, but also what mood the songs are. In this paper, the system admin has to manually classify the songs into related moods by considering both music and lyric. Regarding the lyric, the admin identifies the song mood from specific words in each mood. For example, the words, "lonely", "pain" and "wound", are applied in sad songs. The admin then deeply analyze the lyric by the meaning of the whole song. With this concept, the application is able to differentiate a normal sad song and depressed heavy song which is a sad lyrical heavy song like the Puzzle by My First Story.

C. Song Matching

After the user's emotion is defined, the application then suggests the songs based on the user preference, which comprises positive and negative mode. The positive mode will recommend songs that can make the user feel better with a cheer up type of songs, while the negative mode will recommend songs that have the same mood as the user emotion.

For example, if the current user's emotion is sad and user preference is set to negative, it then means that the user wants to listen to a sad song, not a happy or a neutral song, for some reasons. In this case, the application may provide either a slow deep sad song or a hard or fast sad song with the deep lyric, like Itazura Fiction by My First Story and Breaking the Habits by Linkin Park. The rules of matching the user's emotions and the song's emotions are presented in Table IV.

TABLE IV. SONG MATCHING TABLE

Current User Emotion	Recommended Song Emotion	
	Positive	Negative
Happy	Happy	-
Sad	Neutral	Sad
Angry	Neutral	Angry
Neutral	Happy	-

V. EXPERIMENTS

This section demonstrates the experimental results to evaluate the performance of the proposed application.

A. Dataset

To evaluate the accuracy of the heart rate-based methods for classifying the user's emotion, we have collected the heart rates from 7 people who are between 18 to 50 years old. The dataset contains the current emotion, listening song or activity, heart rate, gender, and age. The samples of the dataset are shown in Table V. Currently, the dataset contains 97 records, which relate to various emotions that we mentioned previously.

B. Evaluation Results

The results in Table VI presents that the accuracy of the happy emotion has the highest percentage because of massive heart rate range and other uncontrolled variables like exhausting, drinking an energy drink, smoking cigarette, etc.

Although the facial image-based method is moderately precise, it leads to being less convenient. This is because the users need to take pictures of themselves before analyzing their current emotions.

VI. CONCLUSION

This paper proposes an emotion-based music player, which is implemented as an Android application. The application aims to suggest songs based on the users' emotions. To classify the emotion, the user's heart rate and facial image are analyzed based on the heart rate ranges and Face API respectively. Then, given the user's emotion, the application suggests the relevant songs based on the user preference mode. If the user selects the positive mode, the application will recommend positive songs. In contrast, it will recommend songs with a negative mood because the

users want to unleash their anger, sadness or stress. Regarding the heart rate-based classification method, the experimental results show that uncontrolled environment affects massively on the precision of heart rate detection. To improve the performance of the application, we plan to explore more techniques to eliminate the uncontrolled environment affection. Moreover, we plan to expand the song database in order to support more users' interests.

TABLE V. DATASET EXAMPLE

Music/Activity	Heart Rate	Emotion State
My First Story Alone	82	Neutral
Pay Money to My Pain Voice	72	Neutral
Pay Money to My Pain Rain	90	Sad
Pay Money to My Pain This life	83	Sad
My First Story Itazura Fiction	113	Sad
My First Story Drive Me	83	Neutral
None	60	Neutral (Calm)
None	73	Neutral (Calm)
Gaming	113	Angry
Gaming	110	Angry
Before Coding	82	Neutral (Negatively to Angry)
Before Coding	60	Neutral
Coding	108	Angry
Coding	107	Angry
Writing Rhyme	98	Happy
Got hit by stranger accidentally while catching the bus	170	Angry and exhausting
Laptop slowly reboot	90	Angry

TABLE VI. ACCURACY OF EMOTION CLASSIFICATION

Emotion	Accuracy	
	Exact method	Average method
Neutral	55%	70%
Angry	60%	50%
Sad	40%	40%
Happy	100%	98%

REFERENCES

[1] Healthcare Department, "Healthcare Department news," 2 February 2018. [Online].

[2] R. Thayer, "Music Mood Classification," 2014.Available: https://sites.tufts.edu/eeseniordesignhandbook/2015/music-mood-classification/.

[3] M. T. Quazi, "Human Emotion Recognition Using," MASSEY UNIVERSITY, PALMERSTON NORTH, New Zealand, 2012.

[4] Wendy E. J. Knight Nikki S. Rickard, Ph.D., "Relaxing Music Prevents Stress-Induced Increases in Subjective Anxiety, Systolic Blood Pressure, and Heart Rate in Healthy Males and Females," Journal of Music Therapy, p. Pages 254–272, December 2001.

[5] Yading Song, Simon Dixon, Marcus Pearce, "EVALUATION OF MUSICAL FEATURES FOR EMOTION CLASSIFICATION", University of London, ISMR, 2012

[6] Cyril Laurier and Perfecto Herrera, Mood Cloud : A Real-Time Music Mood Visualization Tool, Music Technology Group Universitat Pompeu Fabra Ocata 1, 08003 Barcelona, Spain.