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Design and Implementation of the Intelligent Music Recommender System on the Mobile Phone

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Abstract

People listen to music according to their emotions. For example, people listen to sad music when melancholy and fun music when amused. But it is hard to search music similar to their emotions. The mobile phone has information which is created by people who use it. It means the mobile phone has his or her emotions. So, to use a mobile phone, we analyze the users' emotions and recommend it to them. Music applies Valance-Arousal Model for classifying emotions and utilized Korean morpheme analyzer to understand its meaning by extracting verbs. This system is listening to music followed by the mobile phone's text message. In this paper, we designed and implemented the intelligent music recommender system.

Keywords: *Mobile Phone, Korean Morpheme Analyzer, Valance-Arousal Model, Emotions-Music*

1. Introduction

According to a survey of mobile phone usage rate in the second half of 2012, people use mobile phones for 3.4 hours a day and sending text messages occupies 20.3% of their entire using time[1]. From this, we can understand that mobile phones are frequently used in daily life[2-5].

Also, music influence people's feeling to musical element by prompting people's inner world[6]. This indicates that users listen to music for their feelings.

But in daily life there is an inconvenience that people has to evaluate music one by one when they listen to the music which fits their feelings. Thus, this paper suggests the system that recommends music for feeling in the mobile phone. To understand the user's feeling, the contents of the messages and the saved lyrics in the server are used in Korean morpheme analyzer of Lucene Library to extract verbs and are emotionally classified.

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2. Related Research

2.1. Valance-Arousal Model

As in Figure 1, we utilize Valance-Arousal(V-A) Space for extracting user's emotional information using mobile phone. V-A model make up for 2 dimensions the Valance axis and Arousal axis. (+) Axis represents the pleasant group and (-) axis the unpleasant group in the Valance axis. (+) Axis represents the activation group and (-) axis the deactivation group[7].

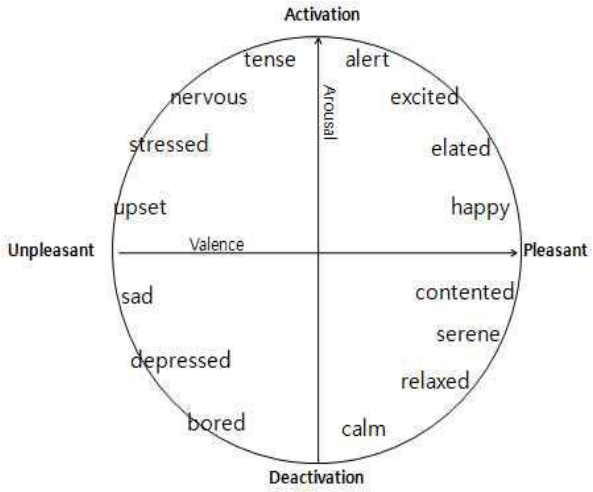

Figure 1. Valance-Arousal Space

2.2. Lucene Library

Lucene was first developed by Doug Cutting and currently is a high performing IR(Information Retrieval) Library transferred to Jakarta Project. Lucene is not a complete software program but is provided by simple library of Java and is used for importing JAR files.

Lucene is a type of searching tool box and we can make searching programs using it. We cannot apply binary files directly to Lucene but can apply it after converting it to a form of string. Therefore, it is possible to handle documents such as Word files, HTML files, and etc. which is capable of extracting general text files [8].

2.3. Korean Morpheme Analyzer

Korean Morpheme Analyzer must consider irregular predicate, word generation rule, compound word, spacing, part of speech system, grammatical morpheme, syllable system, and *etc*.

Korean Morpheme Analyzer is largely divided into followings. Morphological analysis model of types that are unsupervised probabilistic model and subordinate model. Analysis algorithm based on rule, dictionary and corpus. Morphological direction of bottom-up & parallel, top-down & predictive. Left-to-right analysis, word search direction of right-to-left analysis, 2 way analysis, concatenate restriction & formation of word. Morphological concatenate restriction using connection information & connection information table. Inspection including unit morpheme or concatenate

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morphemes, units of morphological process that are syllable and phoneme, units of input documents that are word, sentence and paragraph.

Currently, a perspective of Korean Morpheme analyzer takes account of methods using contextual information word by word in sentence[9].

2.4. Building of Sentiment Lexicon

By referencing 'Making a List of Korean Emotions Terms and Exploring Dimensions Underlying Theme' by In-Go Park and Kyung-Hwan Min[10], build sentiment lexicon. We build the sentiment lexicon sorted by researcher the originality that is how proper sentiment word is, pleasant-unpleasant feeling that is the more score the more pleasant degree, vitalizations that is the more score the more vital degree. In this paper, we supposed if pleasant-unpleasant feeling is high, pleasant is high in V-A model and if vitalization is high, activation is high.

2.5. Logcat

Logcat is a wide use of package to know log of implementing application and information of error in eclipse[11].

3. System Design

3.1. System Flow Chart

Figure 2 shows system flow chart of this paper.

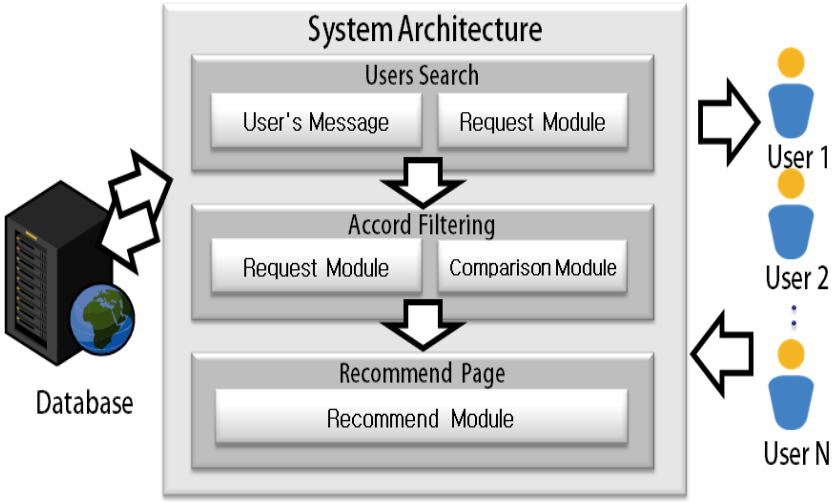

Figure 2. System Flow Chart

When implementing mobile application, the message is transmitted to the server by using the Korean morpheme analyzer. The server extracts only verbs in message received by the user. Then, the data is searched through the database and extracts sentiment data using V-A model. Music is recommended to the users which sentiment data is equal with sentiment data of extracted verb.

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3.2. System Architecture

Figure 3 shows System Architecture in this paper.

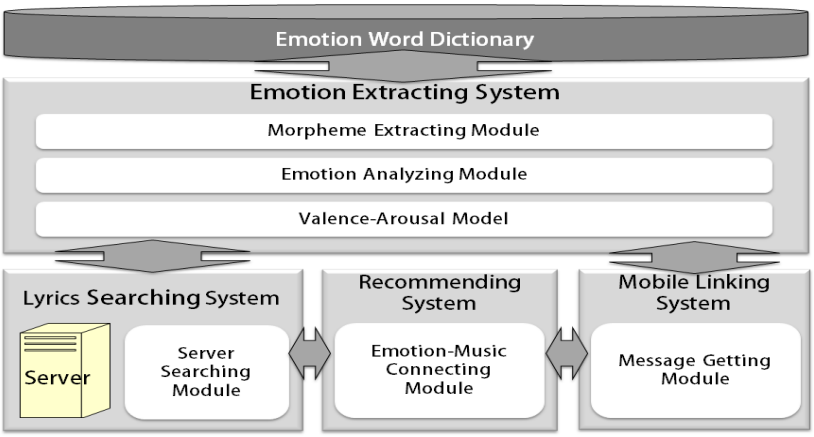

Figure 3. System Architecture

Build sentiment word lexicon by referencing 'Making a List of Korean Emotions Terms and Exploring Dimensions Underlying Theme'[6]. If new lyrics entered to the server, it is saved in Server Searching Module of Lyrics Searching System. And if the user implements mobile applications, the contents of the text message is obtained through the Message Getting Module of Mobile Linking System. Data that is received by Lyrics Searching System and then Mobile Linking System is refined and classified by the Emotions Extracting System. Obtained data from the Emotions Extracting System's Morpheme Extracting Module extracts verbs and makes it into a type of 'be ~'.

Analyze verbs with the Emotions Word Dictionary in Emotions Analyzing Module. Look for verb's average of pleasant-unpleasant score and vitalization score in database of server. Based on it, after classifying context of text messages and music through emotions in Valence-Arousal Module, music is classified with sentiment category and saved in database. Afterwards, the user is recommended music as same as sentiment category of text messages in Emotions-Music Connecting Module of Recommending System.

4. System Implementation

Table 1 shows system in test. The hardware specification is Intel® i5 2.50GHz, 8GB RAM and use Windows 7 SP1. Also, Lucene which is open source JAVA searching engine was used for the test . Used mobile phone is Samsung Galaxy Note2.

Table 1. Experiment Environment

RAM	8GB
Programming Language	Java
	Android
Database	MySQL
Search Engine	Lucene
CPU	Intel i5 2.50GHz

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Used words are 76 typical words in ‘Making a List of Korean Emotions Terms and Exploring Dimensions Underlying Theme’[6]. In database of server word is saved with each vitalization score and pleasant-unpleasant score of word. Vitalization score and pleasant-unpleasant score in V-A model have positive integer, so convert it to space by minus average of each degrees. Figure 4 shows algorithm of applying V-A model.

```
//apply Variation-Arousal Model Algorithm
//emotion_num : V-A Model's emotions number
//radian : function degree to radian
angle = atan(activation, pleasant)
For k=0 to emotion_num-1 then
If angle >= radian((360/15)*i)
&& angle < radian((360/15)*(i+1)) then
break
else ++count
End
End
If count == 14 then k=emtion.length-1
End
```

Figure 4. Applying V-A model Algorithm

Verbs are extracted from user’s text messages. After, find the score of pleasant-unpleasant and vitalization of the verb, and if extracted verbs are numeral figure the average of those. Look for degree of radian in application of atan function in average of vitalization divide pleasant-unpleasant. Then save arrays in order of ‘Happyness’. In V-A model, if the degree of radian decreases, it is close to ‘Content’. Choose the limitations of using those.

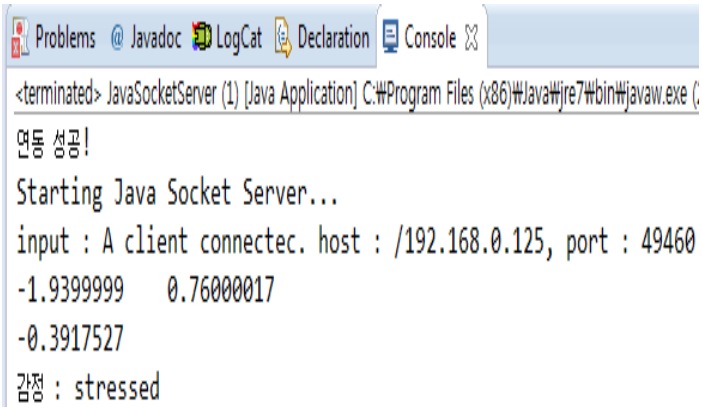

Figure 5. Console of Result in Server

Figure 5 is a result of algorithm in server using a text message of ‘deep sorrow’. ‘0.9399999’ is a score of pleasant-unpleasant, ‘0.76000017’ is score of vitalization and ‘-0.3917527’ is radian. Then print out ‘Stressed’ of emotions.

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Table 2. Postclassified Music

Music	Emotions
Noon wi qot *Miryunhae ahjicdo saranghae* *Manyakae*	sad
Gangnamstyle FANTASTIC BABY *Magiccarpetride*	happy
Yozm noe malya Officially Missing You *Noe ibuyl na ahjick*	calm

Table 2 shows music that is classified by lyrics. This is music of 3 emotions that is happy, sad, and calm of entire 15 emotions in V-A model. Music is saved with emotions category in database of the server.

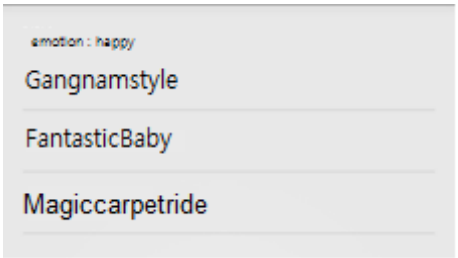

Figure 6. Implemented Result of Application for Emotions 'Happyness'

Figure 6 shows implemented result of sentence 'I'm happy'. It is classified well and user is recommended music of 'happy' category.

5. Performance Evaluation

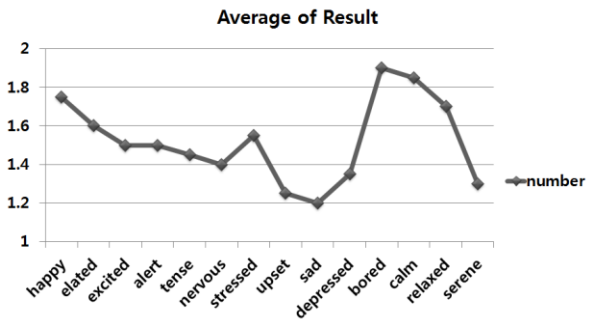

Figure 7. Result of Experiment

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The experiment was processed by 20 people with 30 text messages in three days. Figure 7 shows count of average of text messages which were recommended by each emotions. Average of text messages that were recommended to music was 22.5 cases. Most frequent emotions is 'bored', and next was 'calm' and 'relaxed'.

User's satisfaction score was 6.5. It shows users are mostly satisfied with this system.

6. Conclusion

People listen to music according to their emotions. But it is inconvenient to search music like this. So we implement an application extracting emotions using user's text messages in their mobile phone. User's satisfaction score is 6.5 which quite high. However, information is minimum to classify emotions with lyrics. In the future, considering lyrics as well as many other contents, we will postclassify music. Also, we will consider other media to recognize user's emotions.

Acknowledgements

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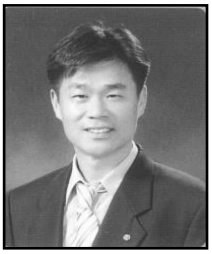

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