

EMIR: A Novel Music Retrieval System for Mobile Devices Incorporating Analysis of User Emotion

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Abstract. We present an Emotional Music Information Retrieval system for mobile devices that utilizes a machine learning approach to detect latent emotion from within both user queries (non-descriptive queries) and the lyrics of songs and uses both elements to develop an effective Music Information Retrieval system. Emotion is extracted from the songs and queries and mapped into a high-dimensional emotion space, which allows for the employment of conventional text retrieval techniques to calculate the similarity between a user query and the latent emotion in song lyrics, thereby producing a ranked list of songs for playback.

Keywords: Music Information Retrieval, Emotion Detection, Machine Learning, Emotion Space.

1 Introduction

Music is inherently expressive of emotional meaning, however many music search and recommendation systems (*Google Music*, *Last.fm* and *Xiami Music* etc.) rely on search using descriptive keywords (*title*, *album*, *artist*, etc.), or rely on a recommendation engine using past history. It is our conjecture that by integrating the emotion of the user, that the utility provided by a Music Information Retrieval (MIR) system can be significantly enhanced. Such a system is presented in this work, which allows a user, with no specific piece of music in mind, to still get recommendations that match their stated mood.

A basic underlying premise of this work is an understanding that a user query may contain no descriptive keywords of specific music; rather the query may simply indicate the current emotional state of the user. In this paper and in prior work [1,2], we define such queries as Non-Descriptive Queries. We exploit the emotional context of such queries with the aim of providing a ranked set of songs for the user that matches their stated mood. In prior work on emotion detection in the text domain, emotion can be categorized into six basic categories (ANGER, DISGUST, FEAR, JOY, SADNESS and SURPRISE) [3]. In addition, contextual text information from lyrics has been proven effective in music emotion recognition [4]. This work on contextual text information has had significant impact on music emotion recognition, but very few researchers have explored the application of emotion detection in for

music information retrieval. At the same time, collaborative social tagging has become an essential part of the solution to many MIR problems, including employing lyric-based search [5,6]. In this work, we extend previous work mapping the emotional context of both queries and songs in a high-level emotion space and calculating similarities within this space, whereas previous work mostly focused on original key attribute matching method.

2 Approach to Emotion Detection

With the consideration of integrating emotion into the MIR system, we designed and implemented a demo EMIR System, which is now described. For complete details of this technique, see our previous work [1,2].

2.1 Detecting Emotion from Lyrics

In order to create an effective emotional music IR system, there are a number of core challenges that need to be addressed:

- 1) A model of music representation, in our case, into a six-dimension model for plotting songs into an emotion space, needs to be created.
- 2) Analysis of the structure of sentences in lyrics to discover potential relationships between emotion and sentence structure.
- 3) Selection of the best performing features for emotion detection and subsequent emotion detection.
- 4) Computation of emotion similarity between songs and queries to create a ranked list of results for playback.

To solve these problems, we employ machine learning classify the emotion of the music and the queries in the same six dimension emotion space. Due to the complexity of computing emotion-based similarity (explicit keyword terms to implicit emotions), we use an increasing saturation to give weights the emotions in queries. Finally, to support the generation of ranked lists, we use a revised BM25 retrieval model, to modify the traditional *tf-idf* weighting method, as was proposed in our previous work [1, 2]. An architecture of this demonstration system is shown in Fig. 1.

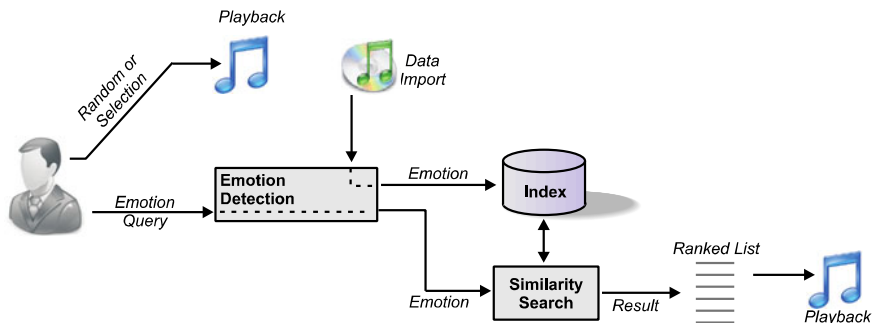


Fig. 1. Overview of EMIR system

2.2 User Interaction with the EMIR Demonstrator

Our EMIR system mainly deals with user music needs by analyzing the emotion of users according to their queries. For demonstration purposes, the system is implemented on an Android mobile phone. As shown in Fig(s). 2-4, users after logging into the system are presented with a search interface (Fig. 2), or they may select the random options. Assuming search, users enter a textual query that describes their emotional state (e.g. 'having a bad day'), and the emotion detection engine detects the emotion of the query, and the similarity search (retrieval engine) generates a ranked list of music according to the emotion of the query (Fig. 3). In the result interface, users can view more detailed information of the song or click to listen, as well as add it into personal playlist. The EMIR system also collects user clickthrough data and queries to maintain a mood curve of the user over time (Fig 4).

Future work includes exploring fusion of mood and descriptive textual queries as well as a real-time recommendation engine based on the users general textual input to a computer (i.e. constant mood monitoring) or social networking status updates.

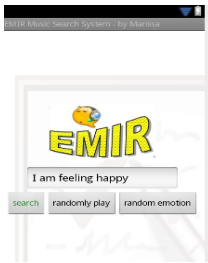


Fig. 2. Search



Fig. 3. Search Results

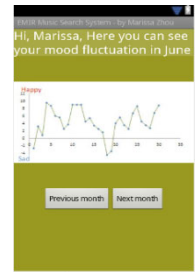


Fig. 4. Mood Curve

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