An Affective Music Recommendation System

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ABSTRACT
Given that the affective features of music are often the most relevant criteria in selecting music, we propose in this abstract that a music database should be able to be categorized according to its affective influence, and likewise, music recommendations made with consideration to the user's current affective state. This can be made possible using pre-existing emotion-measuring technology with new algorithms for selecting music with appropriate affective influence, as proven by several studies. An affective music recommender system could avoid many of the inadequacies of traditional recommender systems.

Keywords
Music recommendation, affective computing, physiological measures, music affect, music categorization.

1. INTRODUCTION
Music's power to enrich our lives deals to a large extent with its ability to influence our affective state [6,11]. This ability could arguably be the most valuable attribute of music to us, especially since our affective state in turn has the power to influence all aspects of our lives, such as health, productivity, and relationships. Given the significance of the affective impact of music on us and its influence in our music preferences at any given time, we advocate a music database categorization system based on affective influence, and a corresponding music recommendation system that makes music selection and recommendations from that database with consideration to the user's current affective state. Use of physiological indicators both for assessing music's affective influence (through users' affective reactions to it) and a user's current affective state is one viable method of achieving this.

1.1 Current Database Categorization
Music databases today are typically sorted by artist, genre, or style, which are features of music not directly indicative of its mood. Music within any of these search criteria would exhibit a wide variety of affective character. Thus, consumers do not yet have the means to search for new music on the basis of its potential effect on them. However, the studies in [5] have revealed the importance of having recommended music suit a user's moods.

1.2 Current Recommendation Systems
The most prevalent music recommendation systems rely on a content-based method (Pandora), collaborative filtering, user profiles, or some combination of these (Last.fm). Collaborative filtering relies on the assumption that the behavior of many people can be used to predict the behavior of one individual, based on past purchases, but is a limited system for considering singularities of individual preference. User profile systems rely on what users explicitly state they like or dislike (thumbs-up or down approach), but data based on user ratings is often too inconsistent as user preferences change with their current mood and context

[3]. Pandora's thorough content-based method, where recommendations are based on musical similarities to user's past choices or favorites, has proven more favorable to users in studies such as [5]. However, all three methods base recommendations on the user's past choices and pre-existing preferences. The possible downfall of this is stagnation in the user's tastes, in that music recommendations are confined to the safe realm of what they already know and like. Not only is this less conducive to discovery of new and different music, but such past-driven recommendations may lack immediate relevancy, and would not necessarily be appropriate to the user's current affective state, a factor revealed to be very important to users [5]. Assuming the ideal recommender system would be personalized and relevant to the user's immediate context, and foster growth in musical preferences, there is some room for improvement in current systems.

1.3 Affective Music Recommendation
We assert that a recommender system influenced directly by the user's mental state could be more insightful about the user's immediate needs than his/her past choices. Such a system would involve three basic components: a database of music able to be sorted by affective influence, a method of determining the user's current affective state, and an algorithm for determining the best match between the two. Used alone or in conjunction with other traditional recommender devices, it would offer a highly personalized system sensitive to the user's immediate affective context. Additionally, users would not be restricted to the same or similar artists or genres to which they have grown accustomed; rather, they would be offered an opportunity to expand their musical "repertoire" by discovering other music that may achieve their same affective aims equally or better than that which they are familiar. Building and incorporating such a system is a complex challenge, but is becoming increasingly more viable with new developments and studies into physiological computing such as [2, 4, 7, 8, 9].

2. Design Concept
In exploring the possibilities of an affective music recommendation system, we used a preliminary non-computational low-fidelity prototype and "Wizard of Oz" technique, as well as explored current technologies and studies that could be applied in a new way to implement our concept in the future.

2.1 Prototypes
We conducted a primitive trial whereby the "user"—a cat, for emotional openness and simplicity, was followed during its daily activities while being played music on the oboe, improvised on the basis of its apparent affective state. This proved invaluable for understanding possible mechanisms required in computationally implementing our future system, such as what inputs would determine music selection and change in the music. Also, it yielded the realization that the ultimate music recommender

would not just recommend existing music, but would be capable of *creating* original music customized to the user's internal and external context, through awareness of the user's past context, prediction of future context, and current environment, activities and affective state.

2.2 Affective Computing and Other Solutions

Recently there have been numerous affective computing breakthroughs towards computer awareness of human affective states. In particular, the use of tools that measure the physiological indicators of emotion, like a polygraph, as input devices make it possible for computers to not only be aware of the user's affective state, but to record affective responses to a given experience, like a piece of music. Such tools could be used alone to determine affective music recommendations, or be augmented and revised by explicit user input. Janssen's work on an "Affective Music Player" [4] is very important to our concept here for its proof of the capability to have a computer algorithm choose music that will bring a user to a desired affective state. Use of data on physiological response to music has potential application for categorization of music by affective influence, either using common responses of many users, or by an individual user's response to their own music library [4]. Another way to achieve this affective influence categorization is through the use of an online "game with a purpose,"[1] whereby two players have to agree on how it makes them feel, unwittingly providing data on what the common perception of its affective character. In any case, developments in affective computing and data gathering techniques are rapidly yielding the tools needed to implement an affective music recommender, either as a commercial service or in an individual's home music library.

3. FUTURE WORK

We are only at the threshold of exploring this concept of an affective music recommendation system. Future implementation and evaluation efforts are required to determine an effective method of identifying the affective influence of music, the best way to determine the user's affective state, and ideal nature of the relationship between the user's affective state and the music selected for them. Ultimately, as mentioned earlier, this system can transcend the current realm of recommender systems as simply a consumer tool, to become a music generator that can accompany a user throughout his daily life, tailoring new music for them in response to their affective needs and contexts, and open to user control via physiological signals. Such a system would offer a unique symbiosis of music and life currently unmatched, and is worthy of further exploration.

4. CONCLUSION

Consideration to user's affective relationship with music can add a new, dynamic dimension to today's music recommendation systems. Developments in affective computing and collaborative data gathering offer viable options for implementing an affective music recommendation system. Current systems call for improvement in anticipating individual preferences, considering the user's mood, and promoting discovery of new music. Rethinking music categorization in terms of its affective influence, and considering the user's current affective state in the recommendation criteria, could be the answer to opening up new levels of personalization, context-sensitivity, and music exploration. The vast range of possibilities of such a system are worthy of further study.

5. REFERENCES

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