Mood Tracking of Musical Compositions

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Abstract. This paper presents a new strategy for the analysis of emotions contained within musical compositions. We present a method for tracking changing emotions during the course of a musical piece. The collected data allowed to determine the dominant emotion in the musical composition, present emotion histograms and construct maps visualizing the distribution of emotions in time. The amount of changes of emotions during a piece may be different, therefore we introduced a parameter evaluating the quantity of changes of emotions in a musical composition. The information obtained about the emotion in a piece made it possible to analyze a number of pieces, in particular the Sonatas of Ludwig van Beethoven. This analysis has provided new knowledge about the compositions and the method of their emotional development.

Keywords: Emotion detection, Mood tracking, Music visualization.

1 Introduction

Listening to music is a particularly emotional activity [1]. People need a variety of emotions and music is perfectly suited to provide them. However, it turns out that musical compositions do not contain one type of emotion, e.g. only positive or only negative. During the course of one composition, these emotions can take on a variety of shades, change several times with varying intensity. This paper presents a new strategy for the analysis of emotions contained within musical compositions. We present a method for tracking changing emotions during the course of a musical piece. The collected data allowed to determine the dominant emotion in the musical composition, present emotion histograms and construct maps visualizing the distribution of emotions in time.

There are several other studies on the issue of mood tracking. Lu et al. [2], apart from detecting emotions, tracked them, and divided the music into several independent segments, each of which contains a homogeneous emotional expression. Using labels collected through the game MoodSwings, Schmidt et al. [3], [4] tracked the changing emotional content of music. Myint and Pwint [5] presented self-colored music mood segmentation and a hierarchical framework. The use of mood tracking for indexing and searching multimedia databases has been used in the work of Grekow and Ras [6]. The issue of mood tracking is not only limited to musical compositions. The paper by Mohammad [7] is an interesting

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extension of the issue; the author investigated the development of emotions in literary texts. Also Yeh et al. [8] tracked the continuous changes of emotional expressions in Mandarin speech.

2 System Construction

The proposed system for tracking emotions in a musical composition is shown in Figure 1. It consists of a database of musical compositions, composition segmentation and result presentation module. The segmentation module was combined with classifiers of an external emotion detection system, which was described in a previous paper [9]. The resulting emotion labels were used to designate the consecutive segments of a musical composition. The collected data allowed for analysis of a musical composition in terms of the emotions contained therein.

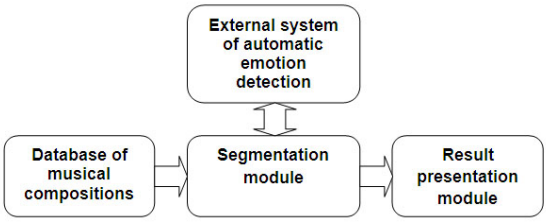

Fig. 1. Construction of the emotion tracking system

3 Mood Tracking

The model we chose in this work is based on Thayer's model [10]. Following its example, we created a hierarchical model of emotions consisting of two levels, L1 and L2 (Fig. 2).

The detection of emotion was conducted in our research on six-second segments. Each consecutive segment was shifted by 2 seconds. In this way, successive segments overlapped at a 2/3 ratio. This allowed to exactly track and detect even the slightest change of emotion in the examined musical composition. For a musical composition lasting $T = 120$ seconds, $N = 60$ segments $(S1, S2, ..., S59, S60)$ were analyzed, and for each L1 and L2 level of emotion detection was performed.

4 Results of Mood Tracking

4.1 Emotion Histograms of a Musical Composition

The first method used for presenting the distribution of emotions in a musical composition is emotion histograms (Fig. 3a and Fig. 3b). On the presented graphs, the horizontal axis corresponds to the type of emotion, and the height of the bar indicates how often a specific emotion occurred. Figure 3a presents the histogram of