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AN EMOTION-BASED METHOD TO PERFORM ALGORITHMIC COMPOSITION

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Abstract

The generative music using algorithmic composition techniques has been developed in many years. However it usually lacks of emotion-based mechanism to generate music with specific affective features. In this article the automated music algorithm will be performed based on Prof. Phil Winosr's "MusicSculptor" software with proper emotion parameter mapping to drive the music content with specific context using various music parameters distribution with different probability control, in order to generate the necessary music emotion automatically. When the emotion scenario varies, the generative music will be logically made via the emotion and context control based on the emotion music classification method. This innovative technique not only generates the emotion music according to the scenario, but also plays the different content of the music every time to make listeners feel "fresh". The emotion music classification method and the automated music development can be analyzed as the reference for the input of the automated music program. The result shows the proposed method generating music emotions successfully such as happy, angry, sad, and joy, with the correspondent parameter mapping between music and emotion. Although this paper only demonstrates the possibility of emotion-based algorithmic composition, hopefully the proposed idea can be extended to apply into the fields including multimedia and game, to make the background music automatically generated any time according to the context changed by the interaction between human and machine.

Keywords: algorithmic composition, automated music algorithm, emotion music classification

1. Introduction

This paper is mainly based on the automated composition technique to generate emotion-based music via Prof. Phil Winsor's "MusicSculptor" software. Automated composition or so-called algorithmic composition can be implemented with probability control with musical style synthesis (Cope, 2004), to generate music with intelligence in experimental way (Cope, 1987 & 1992).

Emotion and music can be related and mapped with their various features. A 2D emotion model was established with arousal and valence to define the emotion (Thayer, 1989), and the related music features can be mapped with emotion features (Gabrielsson and Lindstrom, 2001). For instance, tempo, mode, loudness, melody, and rhythm can be related to emotion expression. In this paper, the proposed way is to use Prof. Phil Winsor's "MusicSculptor" program to compose a section of emotion-based music automatically in an experimental way (Duarte, etc, 2006) with proper music parameter settings.

2. Emotion-Music Feature Mappings

The proposed way to generate music with desired emotions such as happy, angry, sad, and joy, with the correspondent parameter mapping between music and emotion, is based on the 2D emotion plane (Wagner, Kim, & André, 2005), as shown in Fig. 1. The X-axis stands for positive/negative emotion, which is the valence of the emotion, where Y-axis represents the arousal of the emotion for exiting/calm.

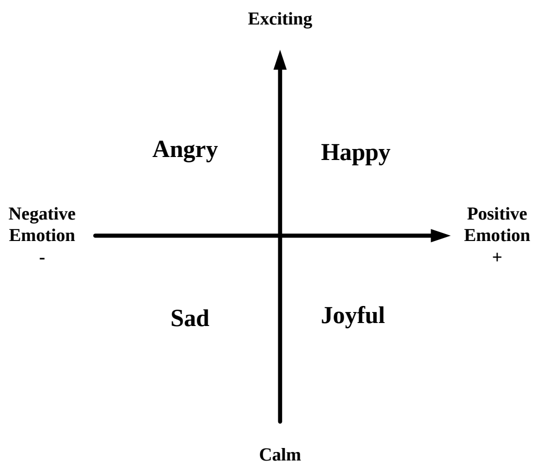

Figure 1. 2D Emotion Plane

After the desired emotion coordinate is determined by the 2D emotion plane, based on Haag's article (Haag, 2004), Table 1 is summarized and extracted with all of the music parameters into a mapping table with the composition method for the emotion-based generative music.

Table 1. The Composition Method for Emotion-based Music Parameter Mapping

Music Parameter	Composition Method
Mode	Major – Minor
Tempo	Fast – Slow
Harmony	Simple -- Complex Melodic
Loudness	Soft – Medium -Loud
Articulation	Staccato – Legato
Pitch	High – Low
Rhythm	Flowing – Smooth – Rough – Activity – Complex – Firm
Pitch Range	High – Low
Pitch Variation	Large – Small
Pitch Contour	Up – Down
Note Onset	Rapid - Slow - Sharp
Loudness Variation	Rapid - Few - Small
Timbre	Few - Many – Sharp
Vibrato	Fast - Deep – Intense
Meter	Triple – Duple
Tonality	Tonal - Atonal – Chromatic

3. Algorithmic Composition

Algorithmic composition is implemented with algorithms. The total randomized music can be automatically generated easily with random function, however it lacks of any musical rules and algorithms to control the music progression. In 1950's Lejaren Hiller and Leonard Isaacson used computer by Illinois University to compose music automatically, with the composition of ILLIAC Suite (Xenakis, 1959). Stochastic process and "Sieve" theory (Ariza, 2005) is used to generate music in a formulized way (Xenakis, 1971) automatically. Our proposed way to compose emotion-based music automatically is according to 2D emotion model, and control emotion-based music features such as pitch, rhythm, velocity (dynamic), articulation (duration), tempo, and timbre, which can be set up by MusicSculptor program (Winsor, 1992). Please refer to Fig. 2 for the proposed automated emotion-based music composition method. Every time the music composed with the same parameter settings, however the music result is different due to the random number function, even though the emotion expression is consistent.

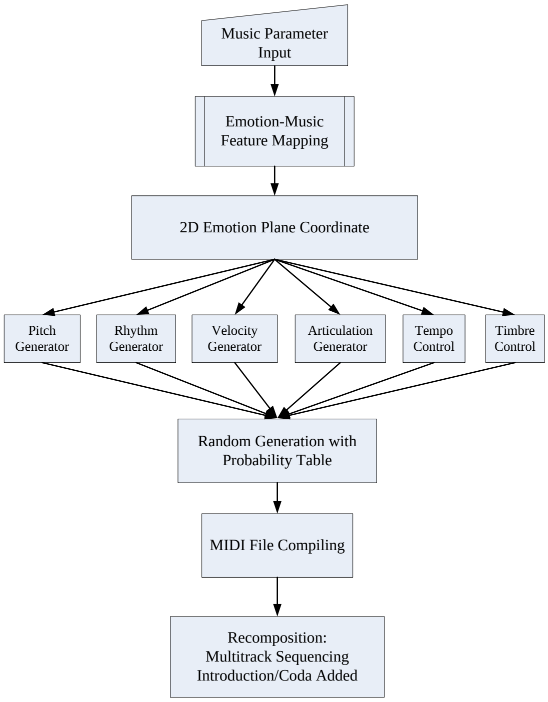

Figure 2. The Proposed Automated Emotion-based Music Composition Method.

Sieve Theory becomes one of the most important theories to generate pitches within a specific scale when the scale is defined by the user. The function is described as below, where RP means Random Pitch, where $0 \leq \text{RP} \leq 127$, and RC refers to Residue Class.

$$\text{RC} = \text{RP mod } 12$$

For example, if Chinese Pentatonic Scale is selected, the RC set (RC) is {0, 2, 4, 7, 9}; for Japanese Five Tone Scale, the RC set (RC) is {0, 2, 3, 7, 8}, and for Balinese Pelog Scale, the RC set (RCB) is {0, 1, 3, 7, 8}.

4. Using MusicSculptor for Emotion-Based Music Generation

The automatic composition function included with MusicSculptor is designed to produce an anonymous stream of "musical wallpaper" in the ubiquitous environment. Our proposed way is to compose unique pieces of emotion-based music within a specific emotion style using probability distribution table. The sieve function to generate music scale is also considered (Duarte, etc., 2006).

Fig. 3 shows the inter-onset time distribution table by MusicSculptor.

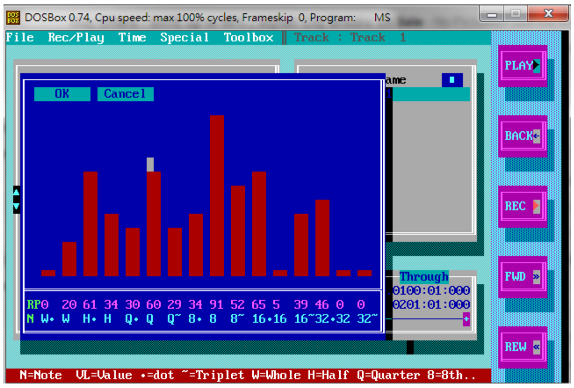

Figure 3. The Inter-onset Time Distribution Table.

Pitch class settings can be implemented with the distribution table too, and Fig. 4 shows the example of a pentatonic scale with a higher octave range to express "happy" emotion.

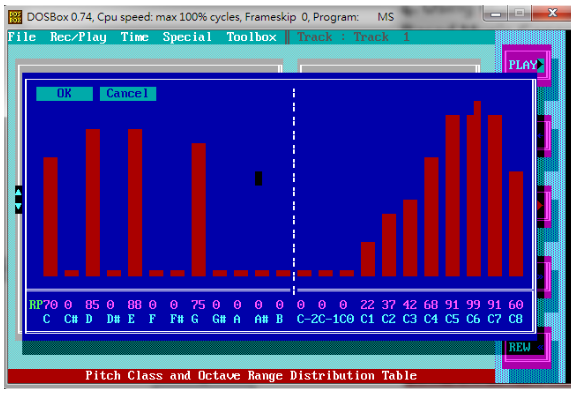

Figure 4. The Pitch Class and Octave Range Distribution Table.

Fig. 5 and Fig. 6 show the velocity distribution table and the duration range setting, which can be used to generate various emotion expressions too.

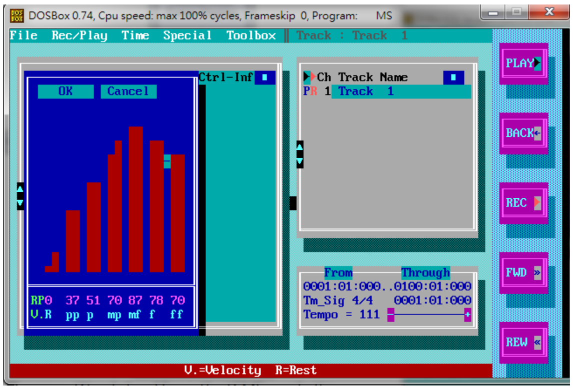

Figure 5. The Velocity Distribution Table.

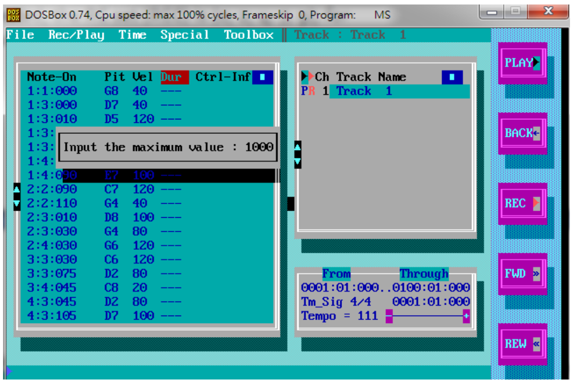

Figure 6. The Duration Range Setting.

5. Conclusion

This experimental result of the proposed music generation is to relate both music and emotion features, and the following a few points is summarized.

1. User can compose music easily by our proposed way using MusicSculptor.
2. The emotion that user would like to express is mapped to music features.
3. Style imitation is currently not considered yet, and users can compose their music in a specific emotion (Angry or Happy, for instance) simply.
4. Melody generation is based on thematic development with PC (pitch class) distribution table, according to the music-emotion feature mapping.
5. The system will synthesize MIDI file to produce the musical pieces with emotion characteristics.
6. In the future the emotion-based music can be generated in more efficient way with the implementation of Java or C languages and proper GUI design.

6. Acknowledgment

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