Hummi-Com: Humming-based Music Composition System

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ABSTRACT

In this paper, we propose a composition-by-humming system, called *Hummi-Com*, that automatically corrects musically inappropriate notes. Although various systems with a composition-by-humming function have been developed, it is difficult in practice for non-musicians to compose musically appropriate melodies with these systems due to the target user's insufficient skill at controlling pitch. In this paper, we propose note correction rules for avoiding such musically inappropriate outputs. This rule set is designed based on the idea of searching for a reasonable trade-off between removing dissonant nonchord tones and retaining musically acceptable nonchord tones.

Categories and Subject Descriptors

H.5,5 [**Information Interfaces and Interaction**]: Sound and Music Computing

Keywords

Music composition, creation, digital entertainment

1. INTRODUCTION

Digital content including movies and music created by non-professionals, called *user-generated content*, has become popular in recent years. Web-based video hosting services such as YouTube and Nico Nico Douga store a numerous pieces of user-generated content, which are enjoyed by audiences worldwide. In particular, as virtual singer systems become popular, the number of people composing original songs for such virtual singers has been increasing. However, Composing original songs is difficult in practice because it is difficult for inexperienced people to express their musical ideas exactly and appropriately.

To solve this problem, we propose a *composition-by-humming* system called *Hummi-Com*. Humming is a way that everyone can use to express melodies. Therefore, existing music systems, such as Voice-to-MIDI [1], MAISTAMUSIC [2], Song Raita [3], and Singer Song Writer [4], also have a composition-by-humming function. In practice, however, such systems rarely generate musically appropriate melodies because the pitch is often unstable in the target users' humming. In this paper, we introduce some note correction rules designed from music theory to avoid musically inappropriate melodies.

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2. ISSUES AND KEY CONCEPT

Because our system targets musically unskilled people such as those who do not play an instrument, we assume that the audio signals hummed by users contain notes with incorrect pitches because such users are expected to have a relatively low pitch control skill when humming. When such users try to hum an original melody, the following phenomena often occur:

1. The boundaries between notes tend to be unclear because the pitch is unstable.
2. The pitch cannot be correctly converted to a discrete note scale because the pitch tends to be ambiguous (e.g., between C and C♯).

To resolve the first issue, we adopt finger-tapping for inputting boundaries between notes. The user taps the space bar on the keyboard at each note boundary while humming. This makes it possible to input note boundaries without ambiguity. This is the same approach used in Itou et al.'s Voice-to-MIDI System [1]. To resolve the second issue, we introduce a rule set for correcting the pitches of musically inappropriate notes. When the given note is G♯ under the C chord, for example, this note is corrected to G. This makes it possible to reduce musically inappropriate notes.

3. SYSTEM DESIGN

3.1 System Overview

The overview of our system is shown in Figure 1. Once the system is launched, the *accompaniment playback part* starts to play back the MIDI file prepared as an accompaniment. At the same time, the *mic input part* obtains the audio signal of the humming by the user, and the *tapping observation part* observes the user's key tapping. Then, the *humming analysis part* generates the tentative MIDI file of the user's humming. Next, the *note correction part* and *rhythm correction part* correct the pitch and rhythm of the tentative MIDI file, and finally the *MIDI output part* outputs the corrected MIDI file.

3.2 Design of Note Correction Rules

3.2.1 Basic Policies

An important point in designing the note correction rules is that this system aim to help unskilled people compose mu-

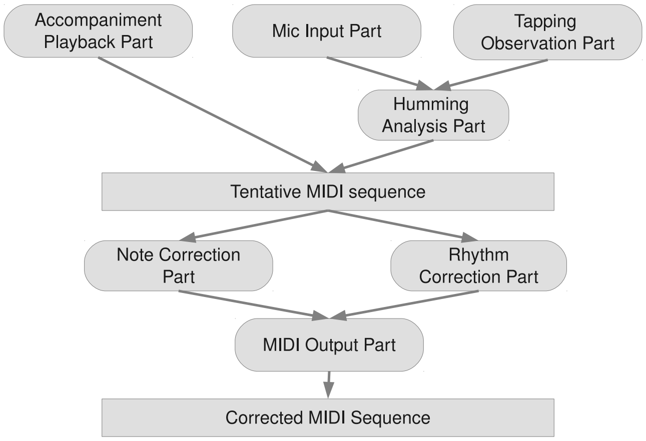

Figure 1: System overview.

sically acceptable melodies, not to help skilled people compose artistically superior melodies. This means that the note correction rules should give priority to melodies that do not create dissonant or unpleasant sounds, even if the melodies are dull or boring. According to this concept, we plan to follow two basic policies:

- Avoid notes that are unnecessarily distant in pitch from the adjacent notes.
- Avoid notes that may cause dissonance with the accompaniment.

One possible way to avoid notes that may cause dissonance with the accompaniment may be to transform all of the notes to chord tones. If all of the notes are transformed to chord tones, however, the melody may become rather unnatural. In general, musically natural melodies contain moderate numbers of nonchord tones. The musically natural uses of nonchord tones are distinguished in music theory, such as for appoggiatura, passing tones, and neighbor tones. Focusing on these three types of nonchord tones, which we call *acceptable nonchord tones* in this paper, we introduce note correction rules for generating these nonchord tones to avoid musically unnatural melodies.

3.2.2 Diatonic Rule

If a non-diatonic note is found in the given melody (the MIDI sequence obtained by accurately converting the user's humming), the note is transformed to the neighboring diatonic note.

3.2.3 Acceptable Nonchord Tone Rules

We focus on the following three types of nonchord tones:

- *Appoggiatura*: an accented nonchord tone, especially having the same onset time as a chord change, that subsequently resolves into a chord tone by a stepwise motion;
- *Passing tone*: a nonchord tone prepared by a chord tone a step above or below and resolved by continuing in the same direction stepwise to the next chord tone; and,

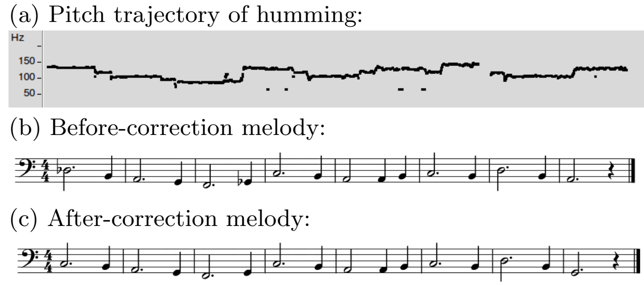

Figure 2: Example of use

- *Neighbor tone*: a nonchord tone that passes stepwise from a chord tone directly above or below and resolves to the same chord tone.

To retain such musically acceptable nonchord tones, we introduce the following rules:

- If a nonchord tone that has the same onset time as a chord change is found, the subsequent note is transformed into the note a step above or below it.
- If a note surrounded by chord tones that have an interval of a 3rd is found, this note is transformed to the diatonic tone between the surrounding tones.
- If a note surrounded by the same chord tones is found, this note is transformed to the note a step above or below the surrounding tones.

3.2.4 Chord Tone Rule

If a nonchord tone is found to which the acceptable nonchord tone rules are not applied, this note is transformed to the neighboring chord tone.

3.2.5 Octave Rule

Finally, if a note that has a more-than-one-octave pitch interval with the previous note is found, this note is transformed to a note one octave higher or lower to achieve a smooth sequence in the melody.

4. EXAMPLE OF USE

We asked a person who did not have experience in music composition to hum his original melodies to the system. The hummed melodies consist of eight measures with the chord progression of Am-F-G-C-Am-F-G-C in the key of C major.

An example of the trials is excerpted in Figure 2. Whereas the original melody contains a number of dissonant notes, the corrected melody contains no dissonant notes. By generating appoggiatura and passing tones, the notes of the melody are smoothly connected.

Other demonstration materials will be available at: http://www.kthrlab.jp/proj/hummi-com/.

5. REFERENCES

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