CONSTRUCTING MUSIC APPLICATIONS FOR SMARTPHONES

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ABSTRACT

This paper describes three applications for iPhone / iPod Touch: ShakeGuitar, BandNavi, and Twitraker. ShakeGuitar enables users to have a simulated experience of playing a guitar by simply shaking the iPhone / iTouch; shaking with varying degrees of strength influences the level of guitar-melody difficulty, which smoothly changes in real-time from soft backing to heavy soloing. BandNavi enables users to find new bands and music by examining the relations between musicians in bands, which are affected by member changes, collaborations, etc. Twitracker enables users to share music fragments by using twitter's time-line, and users can compose a piece of music using the fragments, even if they are musical novices. The main advantage of our applications is that they are based on our research on computer music. So far, our applications have been downloaded more than one hundred and fifty thousand times, and we have gotten a lot of positive comments from users.

1. INTRODUCTION

Smartphones such as iPhone and Android include not only telephone and e-mail functions but also functions to execute a large variety of software applications. There are many applications for iPhone and Android, and users can easily download applications to these smartphones from just about anywhere. Users can also easily develop their own applications by using software development kits for these phones.

Although many music applications have been released, most of them have been sequencers [1], rhythm machines [2], and synthesizers [3], and they are very much like software applications [1-3] that run on personal computers.

On the other hand, the Ocarina by Smule [4] enables users to simulate playing the ocarina by touching a multi-touch display and blowing on a microphone. Sound drop [5] enables users to draw lines on a screen onto which balls fall and make sounds that depend on the location of the lines and the speed of the balls. These applications [4, 5] exploit the advantages of smartphones, i.e., a convenient multi-touch display and a microphone.

We have constructed three iPhone / iPod Touch applications, called ShakeGuitar, BandNavi, and Twitracker. We constructed these applications with the following purposes in mind.

- Investigations leading to practical applications
  ShakeGuitar is intended to test the feasibility of the melody morphing method we developed. The melody morphing method generates an intermediate melody between a melody and another melody with a systematic order according to a certain numerical measure.
  We have been working on an interactive melody generator for composing melodies with the melody morphing method. However, users will not likely understand what the melody morphing method is. We developed ShakeGuitar as an easy way to demonstrate the melody morphing method.
- Evaluation and feedback by users
  BandNavi is a music recommendation system which enables users to discover new bands and music by tracing musicians who have participated in the same band. Generally, it is difficult to evaluate the usability of a music recommendation system, because we cannot evaluate the usability through objective measures such as the time taken by users to manipulate the system. In other words, we need to evaluate systems subjectively as well as objectively.
  We implemented an iPhone application and obtained information by means of questionnaires. We hope to improve the method on the basis of the feedback in the questionnaires.
- New interactions for creating music
  Twitracker is a composing system, with which users can post monophonic melodies on Twitter and compose a song from the posted melodies. Unfinished songs can be posted, shared, and modified in the compositional process.
  Twitracker represents a new sort of interaction between users, because remote users can post and reuse a melody as simply as tweeting on Twitter, yet it will be as if they are participating in a jam session.

We released ShakeGuitar, and so far more than one-hundred and fifty thousand copies have been downloaded from the iTunes App Store [6]. We feel that ShakeGuitar has been useful to us in promoting the melody morphing method. We also received a hundred questionnaires on BandNavi; almost all respondents said they had discovered a new band that they want to hear. Moreover, users have said that they can collaborate by using Twitracker to compose a piece of music.

2. SHAKEGUITAR

ShakeGuitar (Figure 1) is a demonstration system for the melody morphing method that changes the morphing level of each half bar by using the values from the accelerometer in the iPhone / iPod Touch. When the

Figure 1. ShakeGuitar.

user stops moving the iPhone / iPod Touch, the unit plays the backing melody of "The Other Day, I Met a Bear (The Bear Song)". When the user shakes it vigorously, it plays heavy soloing. When the user shakes it slowly, it plays a morphed melody between the backing and the heavy soloing.

2.1. Time-Span Tree of GTTM

Our melody morphing method uses time-span trees acquired by analysing the results of the generative theory of tonal music (GTTM) [7]. Figure 2 is an example of abstracting a melody by using a time-span tree. There is a time-span tree from melody D, which embodies the results of the GTTM analyses. The important notes are connected to a branch nearer the root of the tree. In contrast, unimportant notes are connected to the leaves of the tree. We can obtain an abstracted melody E by slicing the tree in the middle and omitting notes that are connected to branches under line E. In the same manner, if we slice the tree higher up at line F, we can get a more abstracted melody F. We regard the abstraction of a melody as a kind of melody morphing because melody E is an intermediate melody between melody D and melody F.

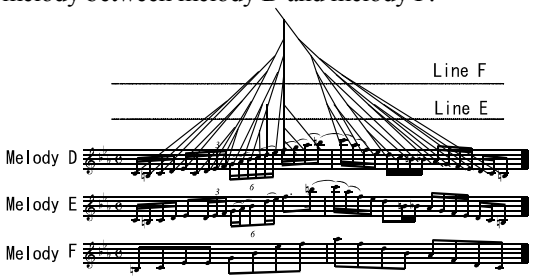

Figure 2. Abstraction of melody.

2.2. Primitive Operation Using Time-Span Tree

In melody morphing, we use the primitive operations of the subsumption relation (written as ⊑), meet (written as ⊓) and join (written as ⊔), as proposed by Hirata [8]. The subsumption relation represents the relation "an instantiated object" ⊑ "an abstract object" (Figure 3a). For example, the relationships among T_D , T_E and T_F, which are the time-span trees (or reduced time-span trees) of melodies D, E and F in Figure 2, can be represented as follows:

$$T_F \sqsubseteq T_E \sqsubseteq T_D$$

The meet operator extracts the largest common part or the most common information of the time-span trees of two melodies in a top-down manner (Figure 3b). The join operator joins two time-span trees in the top-down manner as long as the structures of two time-span trees are consistent (Figure 3c).

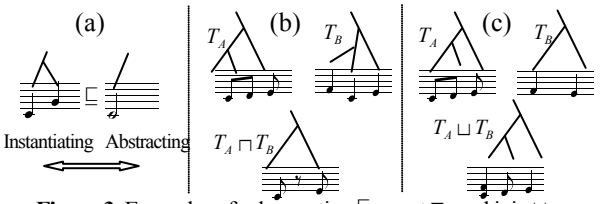

Figure 3. Examples of subsumption ⊑ meet ⊓ and join ⊔ .

2.3. Melody Morphing Method

By using the time-span trees T_A and T_B from melodies A and B, we can calculate the most common information, $T_A \sqcap T_B$, which are the essential parts of melody A, as well as those of melody B. The meet operations $T_A \sqcap T_B$ are abstracted from T_A and T_B, and those discarded notes are regarded as the difference information of T_A and T_B (Figure 4a). We consider that there are features without the other melody in the difference information of T_A and T_B. Therefore, we need a method for smoothly increasing or decreasing these features. The melody divisional reduction method can abstract the notes of the melody in the differential branch of the time-span tree [9]. We use the join operator to combine melodies C and D, which are results of the divisional reduction or augmentation using the time-span tree of melodies A and B (Figure 4c).

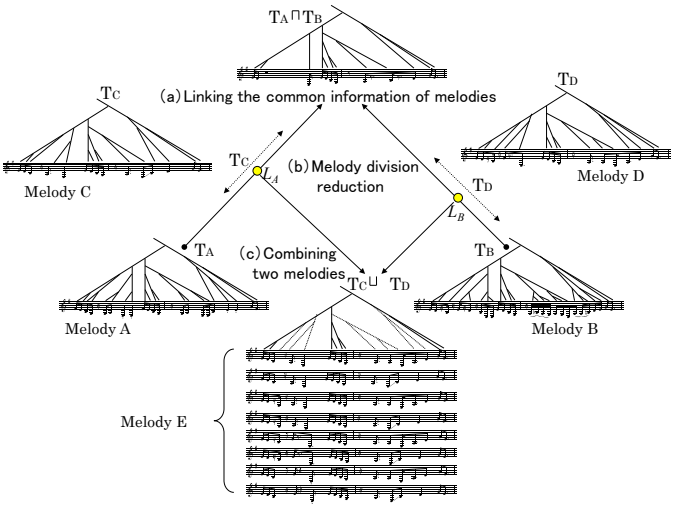

Figure 4. Overview of melody morphing method.

3. BANDNAVI

The previous music retrieval systems for audio signal of enable users to retrieve similar music, but they cannot be used to look for music related to a particular musician because they only use audio signal similarity or collaborative filtering. On the other hand, BandNavi is able to discover various bands in which a musician has participated by using member change information collected automatically from the web.

3.1. The Band-Network

A musician often has the relations with more than one band he or she may be a guest musician and or have been a member in a number of bands. Therefore, relationships between musicians and bands form a complex network connected by lines. We call the network formed by connecting an affiliation relationship of bands and musicians in the Band-Network (Figure 5).

3.2. Using Web Mining to Acquire Members' Names

We constructed the Band-Network by automatically acquiring of band-member names from Web pages. The member name extraction process is composed of four phases.

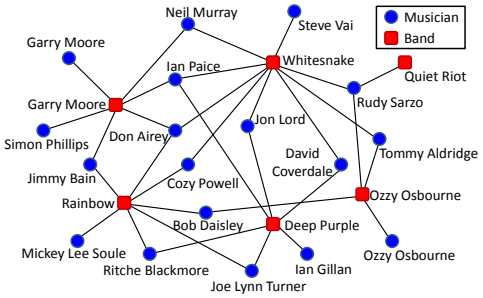

Figure 5. Band-Network.

First, we use Google's Search API to collect Web pages. Given a band name B, we retrieve Web pages using by the query that adds the following keywords after B. (The character "+" in the keywords means "AND".)

A) "B"+music
B) "B"+band
C) "B"+band+member
D) "B"+band+lineup

Second, we detect the person names in the collected pages by using N-grams from the plain text. We assume that most names are composed from two words up to four words; therefore, an N of 2,3, or 4 is used.

Third, we extract the musician names by pattern matching with the instrument name and person name set. We extract the musician names with this clue because a musician name often appears on the Web page together with the name of the instrument which he or she plays (guitar, drum). We use the following three patterns.

a) Role Member
b) Member (.*Instrument.*)
c) Member -.*Instrument.*

Here, the Instruments of b) and c) are names such as "guitar" and "drums" used by the band. Accordingly, the Roles of a) are names such as "guitarist" and "drummer". The person names which match any patterns of a, b, and c on the collected Web pages are regarded as musicians' names.

Finally, we automatically remove unwanted elements, i.e., the names of persons who aren't band members.

3.3. Implementation

BandNavi has three modes: navigation, media access, and browse (Figure 6).

In navigation mode, we can trace musicians by iteratively displaying the member list of a band and the band list of a member. For example, in a test when we played a song by "Deep Purple", the member list of Deep Purple was displayed (Figure 6a). Then, a user selected the musician "Roger Glover" from the list, and the list of bands that Roger Glover participated in was displayed (Figure 6b). After that, a user selected the band "Rainbow", and the member list of Rainbow was displayed (Figure 6d).

When we push the button to the right of the band name in the navigation mode, The mode changes to the media access mode and two buttons, "Search In YouTube" and "Search In iTunes Store", are displayed (Figure 6e). By pushing the buttons, we can trial listen through YouTube or the Samples in the iTunes Store.

In browse mode, we can verify the relationship between a band and a member by browsing the web page that the relationship was extracted (Figure 6i). We can also correct incorrect information.

4. TWITRACKER

Twitracker is an iPhone / iPod Touch application in which user can collaborate in composing music through Twitter. User can record a fragment of a melody by using the keyboard displayed on the iPhone / iPod Touch and post the fragment on Twitter (Figure 7a, 7b).

4.1. Posting Melody Fragments on Twitter

In order to post a melody fragment on Twitter, we use Music Macro Language (MML) [10], because MML expresses a music score in text format. We also use the URL shortener service [11], because Twitter only accepts text no more than one hundred and forty

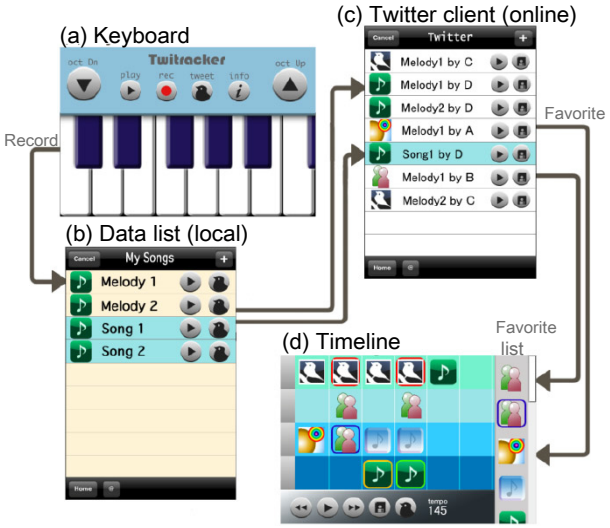

Figure 7. Overview of Twitracker.

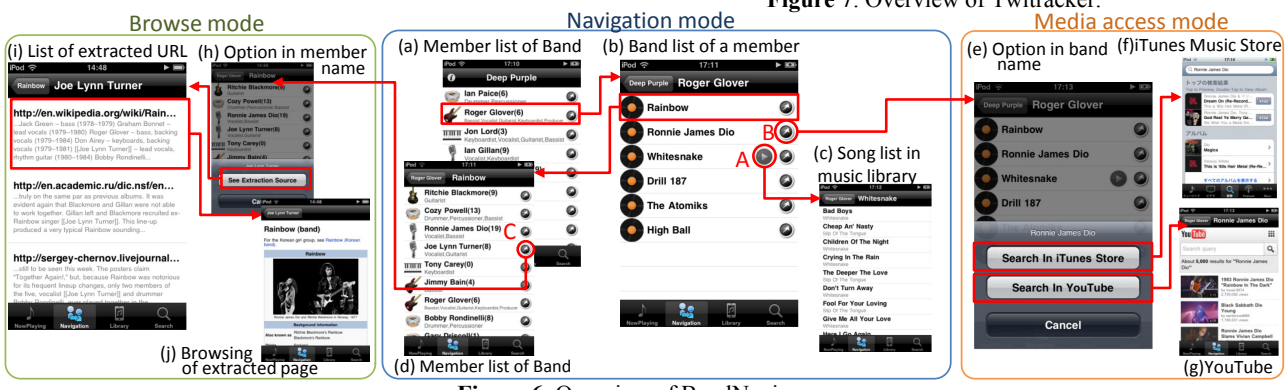

Figure 6. Overview of BandNavi.

characters long and songs written in MML sometimes exceed this limit. The URL shortener service reduces the size of MML text and enables it to be posted on Twitter.

The users can listen to fragments that another user has posted by using the Twitter client on Twitracker (Figure 7c). On each tweet, there is a play button for playing the fragment and a favorite button for putting the fragment on the favorites list.

4.2. Composing using Twitracker

Figure 7d is a screen snapshot of the editing window for composing a piece of music. On the right side of the editing window, there is a favorites list of fragments in the form of Twitter icons of the composer-user. If there are more than two fragments from the same user on the list, color of the outline of the icon will change.

In the middle of the editing window, there is a timeline for dropping the icon from the favorites list. In the timeline, the horizontal axis indicates the time axis and vertical axis indicates the part.

5. DISCUSSION

The three iPhone / iPod Touch applications each have their own purpose. In this section, we discuss the level to which these apps have achieved their purposes.

5.1. Figures, tables and captions

ShakeGuitar was downloaded more than one hundred and fifty thousand times. Figure 8 is the download ranking of iTunes App Store (Japanese) in the music category. Shakeguitar reached third place. ShakeGuitar was featured on a TV program, and hence we can say that it is quite popular.

Thus, as a result of releasing this app, many people have come know the nature of the melody morphing method. We therefore believe that ShakeGuitar has been a very successful means of promoting the method.

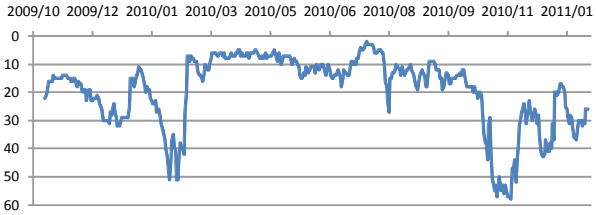

Figure 8. Download ranking of ShakeGuitar.

5.2. Feedback from Users

We prepared questionnaires for BandNavi and posted them at the following URL: http://musicdb.iit.tsukuba.ac.jp/bandnavi.html. So far, we have gotten more than a hundred response from users. The questionnaires indicated almost all respondent had discovered a band that they hadn't heard of before and they enjoyed tracing the relations between bands and musicians.

Seventy percent of respondents were able to understand the operation method of BandNavi within five minutes. However, five percent needed more than fifteen minutes to understand the operation method. We plan to investigate the reason why some people took such a long time to understand, and we should implement changes, if necessary.

5.3. Creating a New Means of Interaction

Although many collaborative composing system have been proposed [11], Twitracker enables composers to share fragments of melodies thorough Twitter and collaborate in composing music. We hope that Twitracker will lead to a new style of composition in which musicians compose a piece of music by sharing their work.

6. CONCLUSION

We developed three iPhone / iPod Touch applications. Of them, ShakeGuitar was downloaded more than one hundred and fifty thousand times, and it has proven to be a good way of promoting the melody morphing method. BandNavi recommends new songs or new artists by storing relationships between bands and musicians. More than a hundred users filled out or our questionnaire on the usability of the system, and their answers helped us to improve the system. Twitracker enables people to collaborate in composing music by using Twitter. We plan to study how to guard against infringement of copyright when using Twitracker.

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