MELODY SLOT MACHINE

Masatoshi Hamanaka
RIKEN
masatoshi.hamanaka@riken.jp

ABSTRACT

This paper describes our interactive music system called the “Melody Slot Machine,” which enables control of a holographic performer. Although many interactive music systems have been proposed, manipulating performances in real time is difficult for musical novices because melody manipulation requires expert knowledge. Therefore, we developed the Melody Slot Machine to provide an experience of manipulating melodies by enabling users to freely switch between two original melodies and morphing melodies.

1. INTRODUCTION

Our Melody Slot Machine provides a unique experience, enabling the control of a virtual performer. The Melody Slot Machine has these three features.

User-Friendly Interface: To enable anyone to easily control his or her virtual performer, we used a dial-type interface that enables replacing a part of the melody segment that the virtual performer will play (Figure 1a, 1b). The score is sandwiched between an acrylic board and a tablet. The dial interface on the tablet can be operated with fingers through a rectangular hole in the acrylic board . When the red lever on the right side of the score is pulled down, all the dials rotate, and one of the melody segments on the dial is randomly selected. Variations in melody segments are composed on the basis of the melody morphing method, so switching the melody segments maintains the overall structure of the melody and only changes the ornamentation [1].

Easy-to-understand Control Results: We prepared a display showing a performer so that the results of the control can be confirmed visually as well as aurally. A holographic display is used to show the performer so as to increase the feeling of presence (Figure 1c). The users can feel like they are controlling a performer by operating a melody.

Improving the Feeling of Presence: We recorded all the performance sounds to increase the feeling of presence. For the recording, we used a studio with very little reverberation; only the reverberation of the preceding sound enters the beginning of the melody segment because of the melody splitting into segments. Reverberation is added when the melody is played. Three pairs of speakers were installed, and the pan pot and reverb were set for each direction so that the hologram seemed to be a real performer (Figure 1d). By placing one’s head between two pairs of speakers, both the sound and video enhance the feeling of presence.

2. MELODY MORPHING METHOD

The Melody Slot Machine is a system that enables novices to experiment with melody manipulation on the basis of the melody morphing method [1].

Figure 2 shows 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 Generative Theory of Tonal Music (GTTM) analyses. The structurally important notes are connected to a branch close to the root of the tree. In contrast, ornamentation 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 melody morphing, we use the primitive operations of subsumption relation (written as $\sqsubseteq$), meet (written as $\sqcap$), and join (written as $\sqcup$), as proposed by Hirata [2]. Subsumption represents the relation by which “an instantiated object” $\sqsubseteq$ “an abstract object.” 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. 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.

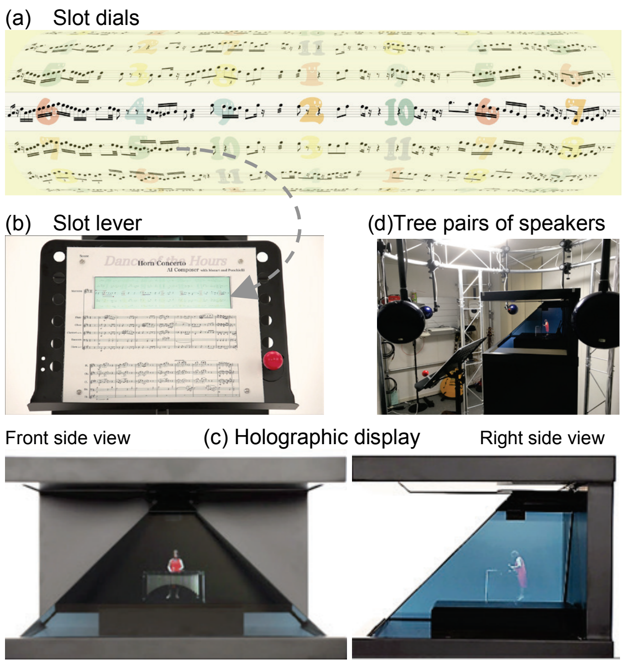

Figure 1. Melody Slot Machine components

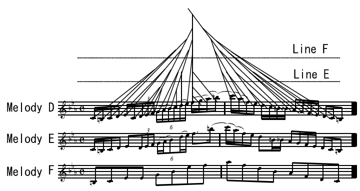

Figure 2. Abstraction of melody

By using the time-span trees T_A and T_B from melodies A and B, respectively, 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 3a). 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 (Figure 3b). We use the join operator to combine melodies C and D, which are the results of the divisional reduction or augmentation using the time-span tree of melodies A and B (Figure 3c).

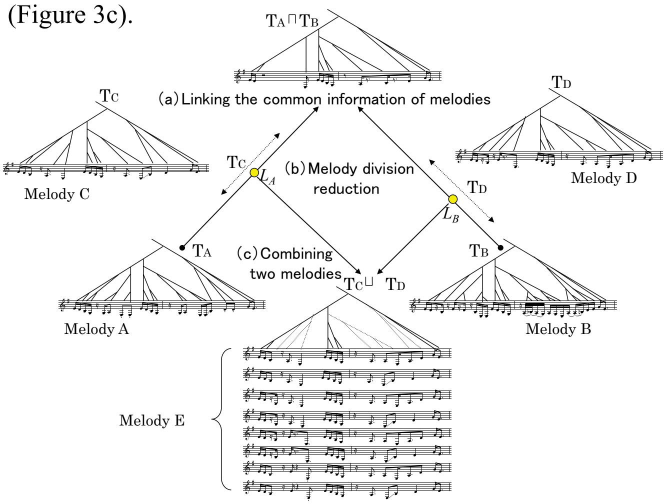

Figure 3. Melody morphing method

3. IMPLEMENTATION

The holographic display (Dremoc HD3) can be viewed from three directions by using three glass panes with semitransparent film and reflecting the display installed on the top of the device. Figure 4 shows the hardware implementation of the Melody Slot Machine.

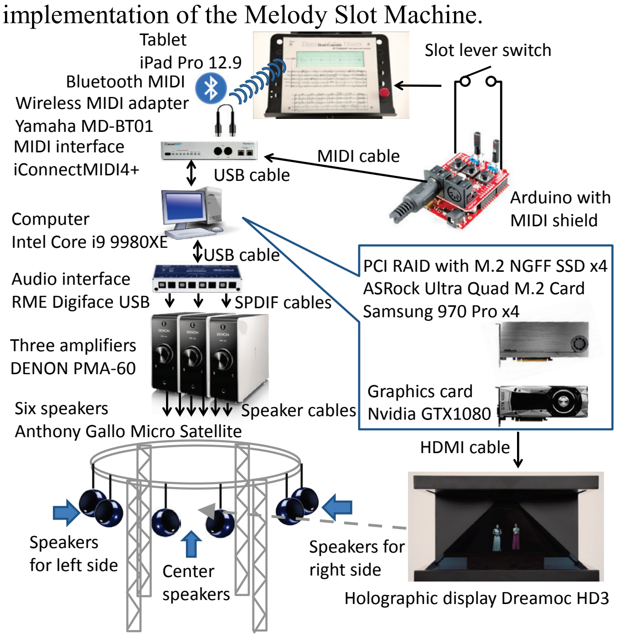

Figure 4. Implementation

The video signal is connected to the holographic display with an HDMI cable via the graphics card. The video data have been taken in advance from three directions for all melody tracks. When the user sets the dial numbers on the tablet, the system plays in accordance with those numbers. The video is large in size compared to that of the audio, and it takes more time to start playing the file, making it more complicated than sound processing.

First, all the video files are concatenated into one file, and two copies of that file are written to a disk as file 1 and file 2. Then, during the playback of video A in file 1, if the next video to be played back is B, file 2 seeks the playback posi-tion of video B, and playback occurs immediately. At the moment video A ends, it releases the connection of the renderer connected to file 1, connects to file 2, and plays video B. The switching of this renderer ends within one frame, which is within 33.3 milliseconds, so a smooth connection without dropped frames is apparent.

We implemented this algorithm by using the VIDDULL video engine in MAX/MSP and Apple ProRes 422 video co-dec with a frame rate of 30 fps.

4. EXPERIMENTAL RESULTS

With VIDDULL, we can set the cache size of the buffer to be read ahead when seeking the play back position. Table 1 shows the frame rate of the video when cache size changes. We used a cache size of 0.5 gigabyte, where the frame rate did not decrease much. The seeking of the playback position starts 0.5 seconds before playback. This is because with a cache size of 0.5 gigabytes, the time to seek is within 0.5 seconds. If the seeking time is less than 0.5 seconds, frame dropping occurs.

Table 1. Maximum and minimum frame rates

Cache size	Maximum frame rate	Minimum frame rate
0.01 gigabyte	27 fps	24 fps
0.05 gigabyte	27 fps	24 fps
0.08 gigabyte	28 fps	24 fps
0.15 gigabyte	28 fps	25 fps
0.50 gigabyte	30 fps	28 fps

5. CONCLUSION

In this paper, we described the Melody Slot Machine, which enables control of virtual performers on a holographic display. We plan to create various contents for the Melody Slot Machine in future works.

6. REFERENCES

[1] M. Hamanaka, K. Hirata, and S. Tojo, "Melody Morphing Method Based on GTTM," *ICMC2008*, pp. 155–158, 2008.

[2] K. Hirata and T. Aoyagi, "Computational Music Representation Based on the Generative Theory of Tonal Music and the Deductive Object-Oriented Database," *CMJ*, Vol. 27, No. 3, pp. 73–89, 2003.