Ensemble System with i-trace

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ABSTRACT

This paper proposes an interface for improvisational ensemble plays which synthesizes musical sounds and graphical images on the floor from people's act of "walking." The aim of this paper is to develop such a system that enables nonprofessional people in our public spaces to play good contrapuntal music without any knowledge of music theory. The people are just walking. This system is based on the i-trace system [1] which can capture the people's behavior and give some visual feedback.

Keywords

Improvisational Ensemble Play, Contrapuntal Music, Human Tracking, Traces, Spatially Augmented Reality

1. Introduction

The aim of this paper is to install a collaborative performance system to our public space. The system enables nonprofessional people to play good ensembles just by "walking" without any knowledge of music theory.

It is well known that collaborative performance is a useful nonverbal communication tool in many societies. Most of the people, however, may not have enough opportunity to join such performances in their daily life. Unfortunately, many people believe that only professional musician can play music. Consequently, it is much difficult for nonprofessional people to improvise with acoustical instruments which require the knowledge of music theory and performance technique. To eliminate these difficulties, some new music interfaces are proposed [2-4] in which the design phase of instrument form is supported by computers. However, there still remain the difficulties in improvisational ensemble play described above. The authors have developed a music interface for improvisational ensemble plays which synthesizes musical sounds and graphical images on the floor from people's act of "walking" without any knowledge of music theory, performance technique and particular equipment (such as sensors and HMDs). This paper presents the concept, design and implementation of our new system.

2. Ensemble System with i-trace

Ensemble system with i-trace is a new music interface which synthesizes musical sounds and graphical images from our daily act "walking." In our system, you can enjoy playing music without any knowledge of music theory, performance technique. As shown in Fig.1, our system consists of motion capturing, melody generation and image projection from the ceiling to the floor. The melody and the image are synthesized from the positions of people in the system. The i-trace system [1] is utilized for the motion capturing and image projection. The positions of people are acquired by the motion capturing part of the i-trace system, and utilized by Max/Msp to generate musical sounds.

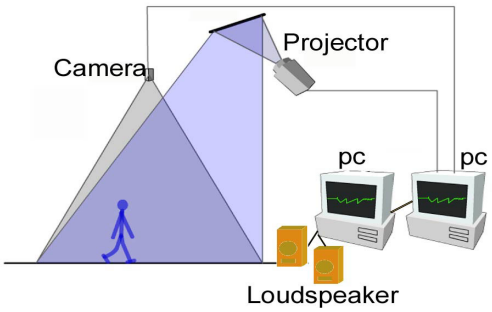


Figure1: System Configuration.

We have designed and implemented an application on the proposed system. The aim of this application is to generate natural melodies of ensemble plays. In this paper, we consider that the tonal melody is natural and adopt the contrapuntal music as the ensemble style. Moreover, we focus on the relationship between musical sounds and graphical images, since they are very important for users to understand his/her own melody and collaborator's one. The i-trace system can capture the human behavior, and the captured data is listed in Table 1 as input data. In this section we describe how to generate melodies and images from the input.

Table1: The factor of walking, sound and images are matched.

Input	Output		
	sound		graphic
position	pitch	melody	trace
speed	duration		
user	range of melody		color of trace
crossing	bubble sound arpeggio		ripple

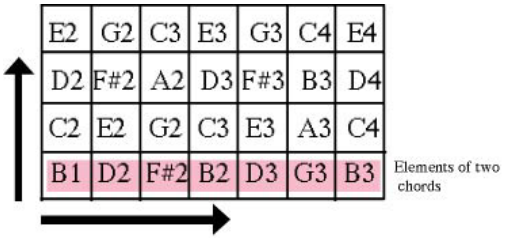


Fig.2: Sound Map. The direction of arrow indicates higher frequency.

Position: The pitch of tones is mapped on the floor as shown in Fig.2. The positions of people are utilized for generating pitch of tones, and visual traces. The floor is divided into 4×7 blocks. A specific pitch is mapped on each block. This is based on G-major. Each horizontal line is constituted of element tones of two similar cords (or cord groups). Intervals between adjoined tones are either three or four tones. Moreover, those cord groups are mapped by minimum intervals of adjoined tones on a vertical line. The color of the floor is also divided into four regions corresponding to the cord gropes. Since the map is limited to element tones of G-major, we can easily generate G-major melody by just walking in the system.

speed : In order to generate melodies with unique rhythms, the durations of each tone is changed by the speed of walking.

user: Distinction between users are expressed by range of the tones and color of the traces. In our system, potentially, up to five users can join at the same time. At this stage, we have implemented an application for two users.

crossing: In counterpoint music, several good relations between melodies are well studied. As shown in Fig.3, for the original melody, the other melody could be imitation, retrograde, inversion or retrograde-inversion of the original. These ideas could be embodied in the act of "walking". When one user chases the other one on the floor, good melodies will be generated, since this act is similar to the imitation. Moreover, we introduce audio and visual feedback when the traces of users are crossing each other (See [5, 6] for the efficacy of visual feedback).

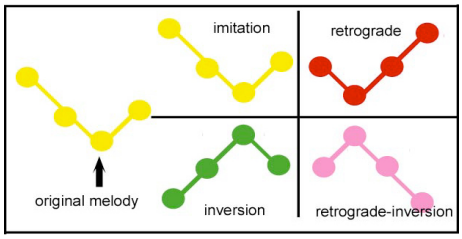
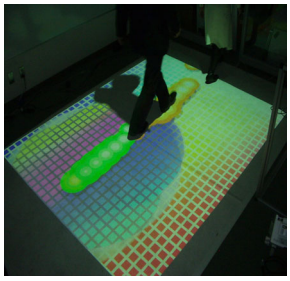


Figure.3. Four relations in contrapuntal music.

3. Implementation and Results

Fig.6 and Fig.7 show the melodies played on our system by nonprofessional people. Both melodies are surely G-major. Two lines of melodies expressed in Fig. 6 are almost the same. This means that one user chases the other user as shown in Fig.4 and the imitation is realized. On the other hand, the relation between melodies expressed in Fig.7 is inversion. This means that users walked symmetrically as shown in Fig.5. The good point of this system is that various melodies could be played even if two persons walk to the same direction, since different rhythms are generated depending on the speed of each user. Moreover, users recognize the relation between the music and the image by visual feedback (trace).



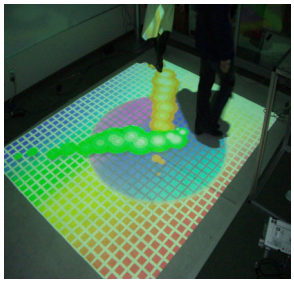
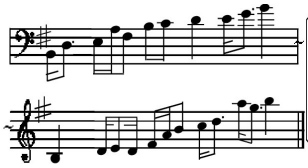


Fig.4: Walking in the same. **Fig.5: Walking symmetrically.**



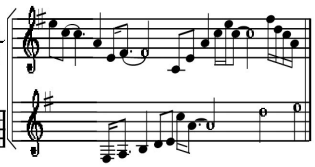


Fig.6: melodies of imitation. **Fig.7: melodies of inversion.**

4. Conclusion

In this paper we proposed an ensemble system with i-trace that can be installed to our public spaces. In the future, we are going to design various music sounds based on the other cultural music theory. We will also investigate some effective methods of visualizing melodies. We therefore consider the future application of this system, for example, an ensemble tool for music therapy, a sound design system of building space, and an interactive media for studying music theory.

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5. REFERENCES

[1] Kakehi, Y., et al., "i-trace: an Interactive System Drawing One's Traces and Illuminating the Area," ICAT2002, pp. 154 – 161, 2002.

[2] Roads, C., "The computer music tutorial," pp.502-537 1996, MIT Press, Cambridge.

[3] Ishida, K., et al., "ism: An Improvisation Supporting System based on Correcting Unnatural Melodies," WISS, pp19-24, 2003

[4] Nishimoto, K., et al., "A Supporting Method for Creative Music Performance-Proposal of Musical Instrument with Fixed mapping of Note-functions," IPSJ, Vol.43, No.2, pp.256-259, 2002

[5] Couturier, J. M. and Arfib, D., "Pointing Fingers : Using Multiple Direct Interactions with Visual Objects to Perform Music," 2003 Conference on New Instruments for Musical Expression (NIME-03), pp.184-188, Montreal, May 2003

[6] Patten, J., Retch, B. and Ishii, H. "Audiopad : A Tag-based Interface for Musical performance," 2002 Conference on New Instruments for Musical Expression (NIME-02), Dublin, May 2002