A Music Application for Visually Impaired People Using Daily Goods and Stationeries on the Table

Ikuko Eguchi Yairi
Sophia University,
7-1, Kioicyo, Chiyodaku, Tokyo, Japan, 102-8554
+81-3-3238-3280, i.e.yairi@sophia.ac.jp

Takuya Takeda
Sophia University,
7-1, Kioicyo, Chiyodaku, Tokyo, Japan, 102-8554
+81-3-3238-3280, taktakeda@yairilab.net

ABSTRACT Music applications, like a GarageBand, have become more popular today because they afford intuitive comfortable visual interface for users to play, remix, and compose music. But visually impaired people have difficulties to use such a software application. Therefore, this paper introduces a novel music interface for visually impaired people using daily goods and stationery on the table. An experimental system was developed with Kinect for AR marker and gesture recognition, and with sounds of three instruments, the piano, the guitar and the percussion. Five blind young people participated in the evaluation of right combination of the goods. The results shows that the proposed interface is effective both single use and collaborative work.

Categories and Subject Descriptors
H.5.2[User Interfaces]: *Interaction styles.*

Keywords
Visually impaired people, Music application, AR marker, Kinect.

1. INTRODUCTION
Toward the upcoming ubiquitous computing and networking era, the digital divide problem of visually impaired people seems to become more serious today. Recent music applications, such as GarageBand on Mac and reacTable[1], could be ineffective for visually impaired people because of these rich intuitive comfortable visual interfaces and interactions. Our research goal is to propose the novel musical application using commodities at home for them. The idea is so simple that string objects, such as yarn, ropes and chains, help users to trace and adjust the positions of clip objects with AR marker on the table. The positions of clip objects are equivalent to musical note, and string objects are equal to phrase. This paper introduces our experimental work and evaluation with single user and two users.

2. DESIGN OF THE APPLICATION
We started this research from interviews of blind people and a teacher who developed and researched assistive applications for visually impaired students. They similarly indicated the difficulties to learn music because of the hurdle to memorize phrases or read music score with braille, and also because of the embarrassment of making funny sounds. It seems that visually impaired people are more interested in music applications than in real musical instruments, but there are few visually impaired people who master computer music applications. Agendas for designing the music application from the interviews are as follows; (1) composing music without memorizing or reading musical scores is a much-needed application for visually impaired people contrary to our expectation, (2) user friendly interface without making funny sounds helps visually impaired people to enjoy the music application with others without embarrassment. What is such a user-friendly interface of music composing application for visually impaired people? We have focused on the importance of their rich touch experiences. Tangible interface using graspable objects is a good idea, but gestural interface without any visual feedback could not be comfortable for visually impaired people[2]. For helping intuitive understanding of composing mechanism, we employed the method of laying out tangible objects on the table. A vision sensor detects the positions of the objects, and the detection results are directly changed into musical score. As the objects, daily goods and stationeries are familiar enough for users to try out the application without embarrassment. After many trials, clip objects, such as paper clips, binder clips and clothespins, with AR marker, and string objects, such as yarn, ropes and chains, to help users to trace and adjust the positions of clip objects in Fig. 1 are seemed to be practical and promising for our music application. An experimental system was implemented using Kinect, ARToolkit, OpenCV and MIDI interface on Visual C++. Users can compose the piano and the guitar melody under continuous replay of the percussion sounds. To change the tempo of the percussion, users attach an AR marker with rubber band on their wrist and make waving gesture.

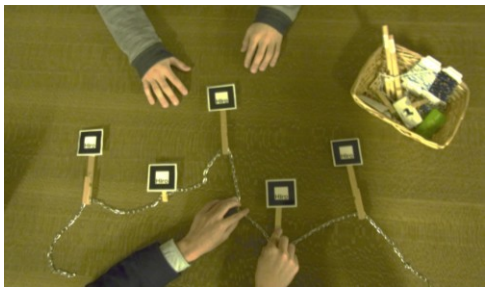

Fig. 1 A cooperative work image to compose music, using clip objects with AR markers and a string object.

3. SINGLE USER EVALUATION
Two male and three female blinds, aged 18 to 33, and all with some experiences of playing music, participated in the single user evaluation. The experiment was consists of three parts: (exp.1) composing without string objects within 10 minutes, (exp.2) with string objects within 20 minutes, and (exp.3) with favorite clip and string objects within 10 minutes.

Fig.2 is a comparison example of clip objects layout between exp.1 and exp.2. All examinees used wider area of the table, and were able to find more suitable melody with string objects than without them. Fig.3 is an example of a female examinee's changes of string objects in exp.2. She finally chose a chain as a string object and finished composing. In exp.3, all examinees answered the chain as the best string object. Large clothespins were the best clip object for three female, and small clothespins were the best for two male. The string objects helped them a lot to find clip

ASSETS'12, October 22-24, 2012, Boulder, Colorado, USA.
ACM 978-1-4503-1321-6/12/10.

objects, especially the texture of the chain perfectly suited to adjust clip objects as they liked. All participants commented that the application was so simple and satisfying to compose preferable music.

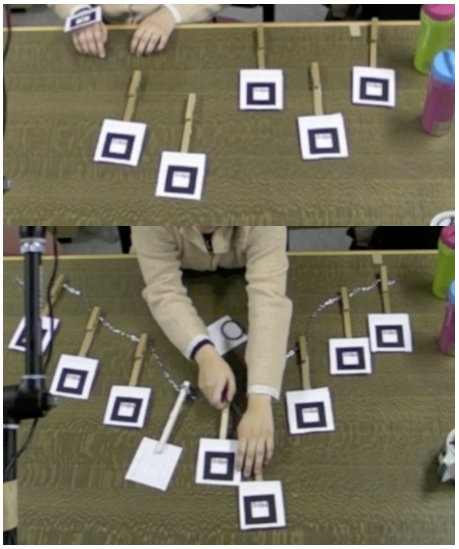

Fig. 2 The effect of string objects on clip objects' positions, upper: without string object, and lower: with string objects.

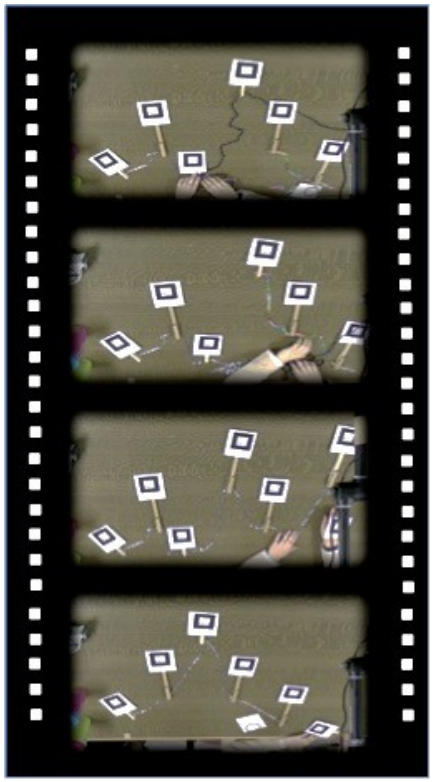

Fig. 3 Changes of the string object, (1)yarn, (2)paper clips, (3)a chain, (4)completion.

4. TWO USERS EVALUATION

Five blinds mentioned previously and one sighted male aged 22 participated in this evaluation, and were divided in three couples of a male and a female. The experiment was to compose music with favorite clip and string objects by two users within 10 minutes. All couples chose clothespins and chains.

Fig.4 is a Kinect't recognition output on two users' collaborations of composing music. AR marker worn on users' hands, which have the function for checking the musical note of the indicated clothespin, are equally detected as AR makers on clothespins. White dots and lines are optical flow for the recognition of hand waving gesture which has the function to up/down the tempo of percussion.

The first couple was close friends with lively communications and influences on each behavior during the experiment. They composed two phrases of the guitar and the piano, and were satisfied with their music. The second couple was not friends but knew each other with reserved communications. They divided composing area on the table into left and right parts and did not get involved in each others' composing. But they commented that the collaboration for composing was amusing. The third couple was first meet, and the male was the sighted. The male was an active helper for the blind female with lively communications. The female commented that the communications for collaborative composing was a pleasurable experience. From this experiment, it was confirmed that our proposed interface was effective to help users' collaboration of composing music in laying out objects on the table and also in the communication.

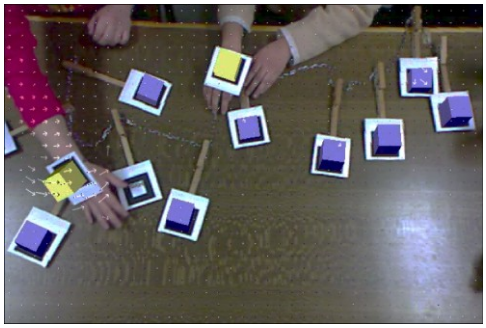

Fig. 4 A gesture and AR markers recognition result on the two users collaboration experiment.

5. CONCLUSION

This paper introduced our idea for the musical application interface for visually impaired people. The interface using daily goods and stationeries could be useful and fun for all people to compose music.

The experimental system employed a string object for the expression of the musical phrase, and clip objects with AR markers for the expression of the musical notes. As a future work, we would like to implement the application without AR markers. The information of colors, the size and shapes of the clip objects will be the important elements for nuanced music performance.

6. ACKNOWLEDGMENTS

We are deeply grateful to all participants of our experiments and Prof. Makoto Kobayashi at Tsukuba University of Technology. This work was supported by Scientific Research (C) (General) No.23500155 from the MEXT, Japan.

7. REFERENCES

[1] S. Jordà, et al., "The reacTable: exploring the synergy between live music performance and tabletop tangible interfaces", In Proc. of TEI '07, ACM Press, 2007, pp. 139-146.

[2] N. Rasamimanana, et al., "Modular musical objects towards embodied control of digital music", In Proc. of 'TEI 11, ACM Press, 2011, pp. 9-12.