Development of an Interactive Puppet Show System for the Hearing-Impaired People

Ryohei Egusa
Graduate School of Human Development and Environment
Kobe University
Kobe, Hyogo, Japan
126d103d@stu.kobe-u.ac.jp

Kumiko Wada
Master's Degree Course
Tama Art University
Hachioji, Tokyo, Japan
viscount-ff@hotmail.co.jp

Miki Namatame
Faculty of Industrial Technology
Tsukuba University of Technology
Tsukuba, Ibaraki, Japan
miki@a.tsukuba-tech.ac.jp

Fusako Kusunoki
Department of Information Design
Tama Art University
Hachioji, Tokyo, Japan
kusunoki@tamabi.ac.jp

Hiroshi Mizoguchi
Faculty of Science and Technology
Tokyo University of Science
Noda, Chiba, Japan
hm@rs.noda.tsu.ac.jp

Shigenori Inagaki
Graduate School of Human Development and Environment
Kobe University
Kobe, Hyogo, Japan
inagakis@ kobe-u.ac.jp

***Abstract*—In this study, we developed Interactive Puppet Theater. Interactive Puppet Theater is a puppet show system that is designed for appreciation by hearing-impaired people. This system has two features to allow the hearing-impaired people to enjoy a puppet show. First, to ensure that aural information is conveyed, we project the dialogues (textual data) onto the background of the puppet show. Then, using Kinect, we allow the audience to participate in the story through physical movements. Thus, the audience is allowed to influence the story's progression. Similar to gestures and sign language, physical movement is a relatively easy way for the hearing-impaired people to express themselves. Therefore, we aimed to create a system that would make it relatively easy for them to facilitate the progression of a story using means that they are most familiar with. We believe that these features will assist the hearing-impaired people in enjoying a puppet show.**

Keywords-Inclusive Design; Puppet Theater; Digital Storytelling; Interactive; Hearing-impaired People

I. PURPOSE OF THIS STUDY

The research field targeted at providing support for the hearing-impaired people has received growing attention in recent years [1-3]. In this study, we developed Interactive Puppet Theater (hereafter simply Puppet Theater). Puppet Theater is a puppet-show system meant for the hearing-impaired people. A normal puppet show is difficult for the hearing-impaired people to appreciate. This is because everything in a puppet show, from the dialogue to the narration and effects, relies on sound.

To this end, we implemented two features in Puppet Theater so that the hearing-impaired people could easily watch and enjoy a puppet show. First, we projected the dialogue (textual data) on the background of the puppet show to supplement the aural information. Next, we added the feature for the audience to participate in the story by using physical movement. Egusa et al. [4] conducted a preliminary evaluation experiment using university students with normal hearing as subjects to evaluate the effectiveness of the audience with respect to participation in the story without any physical movement. In this paper, we describe in detail the feature to participation in Puppet Theater using physical movement.

Physical movement is a relatively easy way for hearing-impaired people to express themselves. This is because, for many hearing-impaired people, the most common method of communication is that involving the use of language based on physical movements such as gestures. In addition, since communication using physical movement is a common practice, it would be easy for the hearing-impaired people to understand the situation by seeing other people's physical movements. It can be expected that stress for the hearing-impaired

 ISBN: 978-1-61208-220-2

people would be lowered more easily through physical movement rather than through writing or speech. By using a range image sensor (Xbox360 Kinect sensor developed by Microsoft Corporation, i.e., Kinect sensor), the viewer can watch Puppet Theater presentation without having to worry about the operation of the terminal. By becoming a facilitator in the story, the viewer can actively participate in and thus enjoy the puppet show. Hence, we added the feature for the audience to participate in the story through physical movement.

We can measure the physical movement of a person by using the Kinect sensor. Several studies have been conducted using a Kinect sensor, owing to its attractive advantage [5-6]. Its depth sensor is beneficial for Puppet Theater. The depth sensor can function accurately and capture a human body in a dimly lit room. This function is effectiveness for measuring the physical movement of a person during a performance of Puppet Theater. This can be attribute to the fact that it is necessary to keep the room dimly lit to be able to project the animation clearly. Moreover, the Kinect sensor can be reasonable to be installed with ease Puppet Theater. Therefore, we use the Kinect sensor to measure the physical movement of a person in Puppet Theater.

II. PUPPET THEATER DESIGN

A. System Configuration

Puppet Theater takes the form of a paper puppet show. Figure 1 shows the framework of a basic Puppet Theater system. Flash animation is projected onto the background screen with a projector. Puppets are then manipulated in front of the screen. The stage is composed of a 180-inch screen, paper puppets, a short-focus projector, and a Kinect sensor. The Flash animation is operated through use of a notebook PC. Interference between the puppets and the background is avoided with the help of the short-focus projector.

Figure 2 shows the characters as puppets. Puppets are used for lending a sense of reality to the show a sense of reality, as it is believed that viewers are more likely to be interested in a story if the character "exists" in the real world. Furthermore, as puppets are relatively simple constructions, they can be easily handled by anyone.

Figure 3 shows the system composition of the Kinect sensor. The notebook PC connected to the Kinect sensor is connected via a network to another notebook PC connected to a projector in order to reproduce Flash. The Kinect sensor and a physical operation are used for choosing a subsequent story. The Kinect sensor functions as a reader of the position and the gesture of a person's hand. In order to select a story, one viewer is chosen from among the audience. This viewer then stands in a predetermined spot. The spot is located approximately

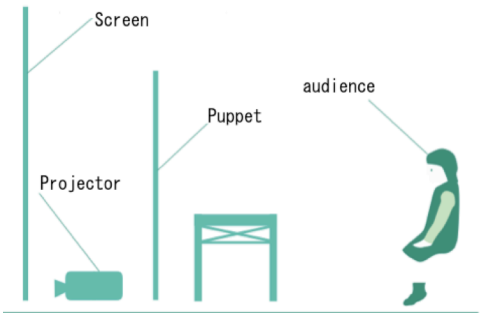

Figure 1. Framework of the system.

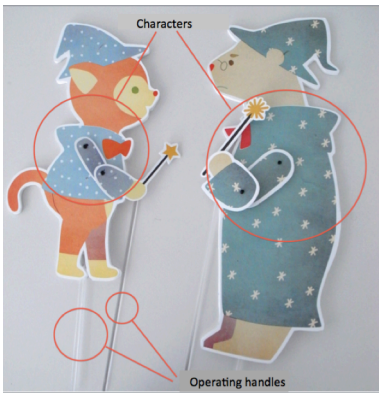

Figure 2. Puppets.

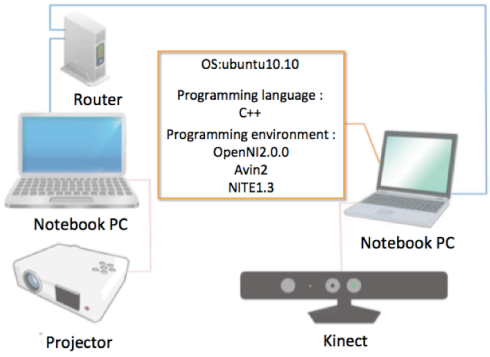

Figure 3. System composition of the Kinect sensor.

2 meters in front of the Kinect sensor. Then the viewer points a palm toward the screen. In response to the hand position detected by the Kinect sensor, the cursor moves in the background. To choose a story, the viewer performs a gesture to push the palm forward when the cursor is placed on an icon.

B. Presentation of Dialogue

All of the show's dialogues are visually expressed through Flash animation. Since the area where the dialogue is displayed is transparent, the background

 ISBN: 978-1-61208-220-2

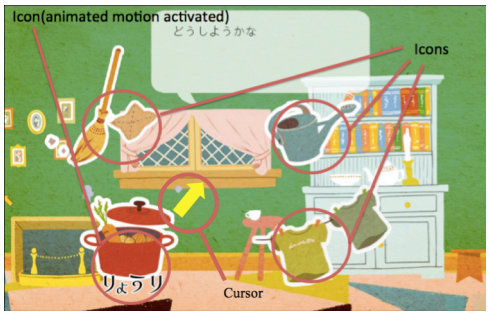

Figure 4. Selection point of branches of the story.

Figure 5. Attempting Kinect operation.

illustration is not masked. Performers can determine the timing of all the texts through a simple operation.

C. *Participation in the Story through Physical Movement*

In Puppet Theater, the performers and the audience carry the story. During the puppet show, a scene from which the story branches is shown to the audience. Figure 4 shows an example of the scene presented to show the branches of the story. The relevant icons and the cursor are displayed on the screen. These icons are then used for choosing from multiple possible subsequent stories. If the viewer chooses a favorite icon, the story corresponding to that icon begins to develop. Through this approach, the viewers can not only appreciate the show in a unilateral way but also manipulate the story.

The chosen individual then operates the cursor to choose a favorite icon from among the many options. When the cursor is placed on an icon, the icon's animation begins to play. Figure 5 shows how the viewer chooses an icon.

D. *Contents*

The Puppet Theater system is composed of Flash animation and puppets. Therefore, in some cases we can change the animation's content. The content adopted here was composed of five scenes corresponding to five tasks. First, as an introduction, the audience watches the scene in which water is drawn. Then, the various branching paths are displayed, presenting the remaining four choices. The viewer chooses his/her favorite from among the remaining scenes. Whenever the scene is over, the story returns to the branching point. The viewer then chooses the scene he or she wants to see next. After the viewer has seen all the available scenes, the ending of the story is initiated through the operation of a notebook PC.

III. CONCLUSION & FUTURE WORK

This paper demonstrates that the Puppet Theater is an effective aid for hearing-impaired people in enjoying experience of watching puppet shows. In the future, we intend to evaluate Puppet Theater in cooperation with the hearing-impaired people to determine the system's effectiveness and to discuss any problems encountered.

ACKNOWLEDGEMENTS

This research was supported by JSPS the Grants-in-Aid for Scientific Research (B) (No. 23300309).

REFERENCES

[1] Lee, S., Henderson, V., Hamilton, H., Starner, T., Brasher, H., and Hamilton, S., "A Gesture-Based American Sign Language Game for Deaf Children", In *Proceedings of CHI2005 Extended Abstract,* Portland, Oregon, pp. 1589-1592, April 2-7 2005.

[2] Gentry, M. M., Chinn, K. M., and Moulton, R. D., " Effectiveness of Multimedia Reading Materials When Used with Children Who Are Deaf", *American Annals of the Deaf* , 149 2005, pp. 394-403.

[3] Namatame, M., and K, Muneo., "Suitable Representations of Hyperlinks for Deaf Persons: An Eye-tracking Study", In *Proceedings of the 10th International ACM SIGACCESS Conference on Computers and accessibility* , Canada, Nova Scotia, Halifax, pp. 247-248, October 13-15 2008.

[4] Egusa, R., Wada, K., Namatame, M., Kusunoki, F., Mizoguchi, H., and Inagaki, S., "Learning Support System Based on Inclusive Design Method for Story Comprehension", In *Proceedings of the 35th Annual Meeting of JSSE,* Japan, Tokyo, pp. 456-457, August 23-25 2011.

[5] Shotton, J., Fitzgibbon, A., Cook, M., Sharp, T., Finocchio, Mark., Moore, R., Kipman, A., and Blake, A., "Real-Time Human Pose Recognition in Parts from Single Depth Images", In *Proceedings of the 24th IEEE Conference on Computer Vision and Pattern Recognition,* USA, Colorado Springs, pp. 1297-1304, June 20-25 2011.

[6] Xu, D., Chen, Y., Wu, X., Ou, Y., and Xu, Y., "Integrated Approach of Skin-color Detection and Depth Informationfor Hand and Face Localization", In *Proceedings of the 2011 IEEE International Conference on Robotics and Biomimetics*, Thailand, Phuket, pp.952-956, December 7-11 2011.

 ISBN: 978-1-61208-220-2