A Tabletop Stereoscopic 3DCG System with Motion Parallax for Two Users

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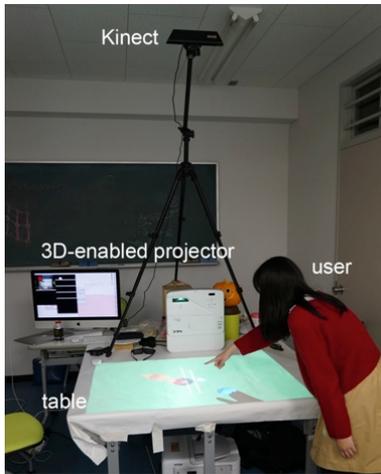
Figure 1: *The overview of the proposed tabletop 3DCG system with motion parallax.*

Abstract

In this paper, I improve a tabletop stereoscopic 3DCG system with motion parallax so as to use it with two users and share a stereoscopic 3DCG scene together. I develop a method to calculate two users' viewpoints simultaneously by using depth images. I use a 3D-enabled projector to superimpose two 3DCG images for each user, and use active shutter glasses to separate them into individual images for each user. The improved system would be useable for cooperative works and match type games.

Keywords: stereoscopic 3DCG, motion parallax

Concepts: • **Human-centered computing ~ Interaction devices;** *Displays and imagers;*

1 Introduction

Motion parallax is a change of appearances of objects resulting from our motion, and it is an important depth cues for human beings. We have developed a tabletop stereoscopic 3DCG system with motion parallax [Uehara et al. 2014]. This system follows the position of a user's viewpoint standing around a table, and
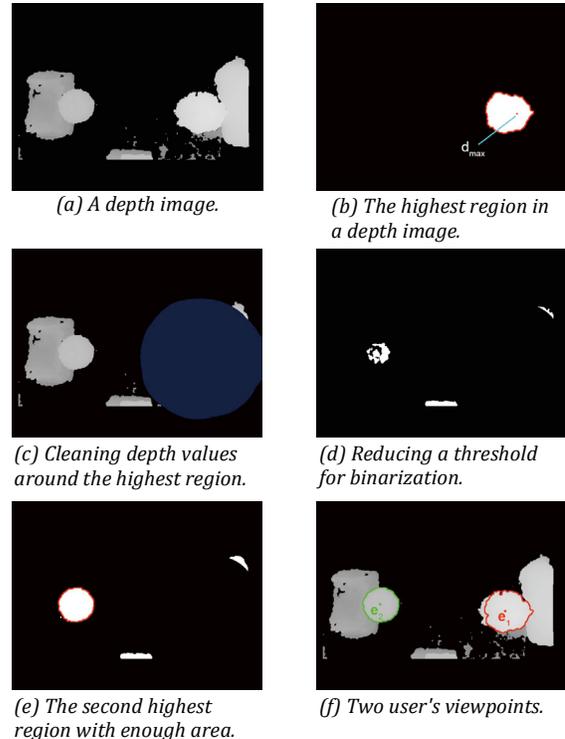
(a) A depth image.

(b) The highest region in a depth image.

(c) Cleaning depth values around the highest region.

(d) Reducing a threshold for binarization.

(e) The second highest region with enough area.

(f) Two user's viewpoints.

Figure 2: *Calculating two users' viewing points from a depth image.*

generates 3DCG images for the viewpoint every moment on the table. As the result, the system reproduces motion parallax and the user can observe stereoscopic 3DCG from any place around the table.

In the former system, 3DCG image was specialized for a user, and it was not possible to use the system with two users. In this research, we improve our tabletop stereoscopic 3DCG system to use it with two users by using 3D-enabled projector. The improved system enables us to share a stereoscopic 3DCG space with motion parallax, and it is useable for cooperative works and match type games.

2 Methods

The improved system is composed of a table, a Kinect, a 3D-enabled projector, active shutter glasses, and a PC. The Kinect is set above the table, and the setting is almost the same as that of the former system as shown in Figure 1.

The Kinect is used to take depth images around the table. The former system detected the highest region whose area is greater than a threshold in a depth image, and calculated a user's viewpoint in a space. On the other hand, the improved system has to calculate two users' viewpoints every moment simultaneously. Thus, the system detects two peaks of height from a depth image. Figure 2 shows the process of calculating two users' viewpoints. First, the system detects the highest region in the depth image, and
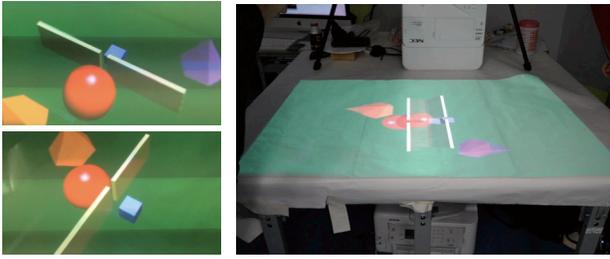
Figure 3: *Two images for each user's viewpoints, and superimposing them with a 3D-enabled projector on the table.*

Figure 4: *Active shutter glasses one of whose glasses is closed.*

one user's viewpoint is calculated in the same way as the former system. Then, the system clears depth values around the highest region, and tries to detect the next highest region in the depth image by reducing a threshold for binarization. If the second highest region with enough area is detected, another user's viewpoint is calculated from the region.

Using two viewpoints, the improved system generates two 3DCG images simultaneously in real time. Then the system superimposes both images with a 3D-enabled projector, and displays them on the table as shown in Figure 3. We would observe double images on the table with naked eyes. Thus, each user wears active shutter glasses one of whose glasses is closed as shown in Figure 4. When the left glass is closed for one user and the right glass is closed for the other user, each user would observe a separate image.

Each user could observe a specialized 3DCG image for their own viewpoint, and they could share a tabletop where stereoscopic 3DCG images with motion parallax are displayed.

3 Experiment

I implemented a prototype system and carried out a preliminary experiment.

The system could calculate the 3D position of two user's viewpoints accurately enough to reproduce motion parallax, and it was possible to share a stereoscopic 3DCG scene with motion parallax together as shown in Figure 5. Two images for each user superimposed by a 3D-enabled projector are separated into individual images clearly by using active shutter glasses as shown in Figure 6. Each user could observe stereoscopic 3DCG objects with motion parallax from any point around the table as shown in Figure 7.

4 Conclusion

In this paper, I improved a tabletop stereoscopic 3DCG system with motion parallax so as to use it with two users and share a stereoscopic 3DCG scene with motion parallax together.
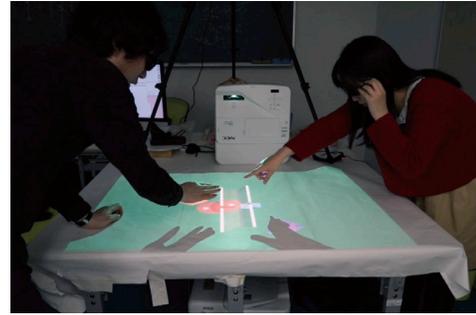
Figure 5: *Sharing a stereoscopic 3DCG scene with motion parallax together.*
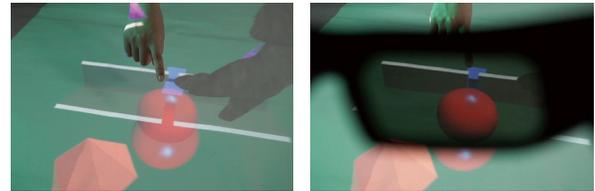
Figure 6: *Separating superimposed images into individual images by using active shutter glasses.*
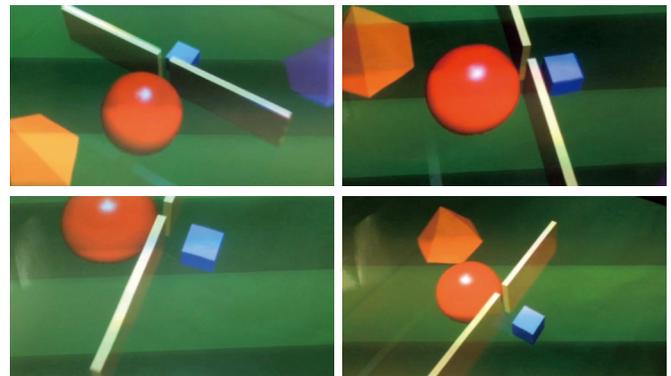
Figure 7: *Observing 3DCG objects with motion parallax on the system.*

Interaction with 3DCG object on the improved system is one of future works.

Acknowledgements

References

UEHARA, Y., MIZUNO, S., 2014, A Virtual 3D Photocopy System, *SIGGRAPH 2014 Posters*.