UlteriorScape: Optical Superimposing on View-Dependent Tabletop Display and Its Applications

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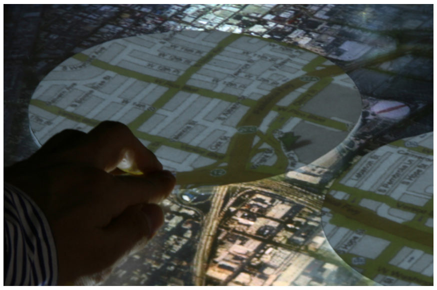

Figure 1: Superimposed Map

Figure 2: "Pick up and Move"

Figure 3: "Tabletop Theater" for Multiple Users

1 Introduction

When we use a table, we often put various objects on the tabletop. Likewise, for intuitive interactions on a tabletop display, the placed objects on the tabletop should be enhanced more as well as the tabletop surface [Raskar et al. 2001]. To achieve this goal, we propose a novel tabletop display system 'UlteriorScape'. UlteriorScape takes two major functions from our previous systems. One is an interaction with small-sized screen objects. Like Tablescape Plus [Kakehi et al. 2006], we can utilize tabletop objects as projection screens and input interfaces. As for the other function, this system also works as a view-dependent image projection. Though the Tablescape Plus was designed for a particular direction, the tabletop screen on UlteriorScape is physically single, but visually multiple like Lumisight Table [Kakehi et al. 2004] and it can show appropriate images to each user surrounding the table.

2 UlteriorScape

In the UlteriorScape, we offer following core technical innovations. One is the novel optical design of display. This system is based on a screen system that is composed of Lumisty Film and Fresnel lens. It has high transparency for the perpendicular direction while it is diffusive from other directions. By projecting images from transparent direction, it allows us to reveal additional images just by holding a simple screen over the tabletop. On the other hand, when an image is projected onto the screen from the opaque direction, users can see the image from the projector in front of them on the tabletop screen.

Secondly, this system has also the function of capturing the appearance of the tabletop from inside the system by using the transparency of the screen.By attaching a marker of a known shape underneath the screen object, their ID, position and rotation can be recognized in real-time. Note that all devices are installed inside the table and users need not wear any special equipment for tabletop interaction.

Third innovation is the calibration of projected images so that the system can project images appropriately according to the object data. By using the software-based calibration, we can harmonize images from each projector and also use various shape of objects which have not only horizontal screens but also inclined screens.

We have developed three types of interactive applications. One is for a single user without sensors. In this application (Figure 1), when users hold paper screens over the aerial photo displayed on the tabletop screen, they can see the map information of the covered area. Besides, this sytem can change projected images interactively according to the position or ID of the object. In "Pick up and Move" application (Figure 2), by putting the screen object on the tabletop, the tabletop image of the covered area will be copied onto the screen object and the user can move it and tilt it up to easily viewable direction.

We also have developed application aimed for multiple users. By utilizing a triangular shaped object, UlteriorScape can display different images on each side of the triangle independently. In addition, the tabletop also works as a view-dependent display which can show different images to each user around the table. As an example of multiple user applications, Figure 3 shows a tabletop theater. Character's images from opposite angle are projected on each side of the triangular shaped objects and users can control them with intuitive manipulations.

In the future, we plan to implement more applications such as new type of tabletop games and educational tools.

References

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SIGGRAPH 2008, Los Angeles, California, August 11–15, 2008.
ISBN 978-1-60558-466-9/08/0008