Dollhouse VR: A Multi-view, Multi-user Collaborative Design Workspace with VR Technology

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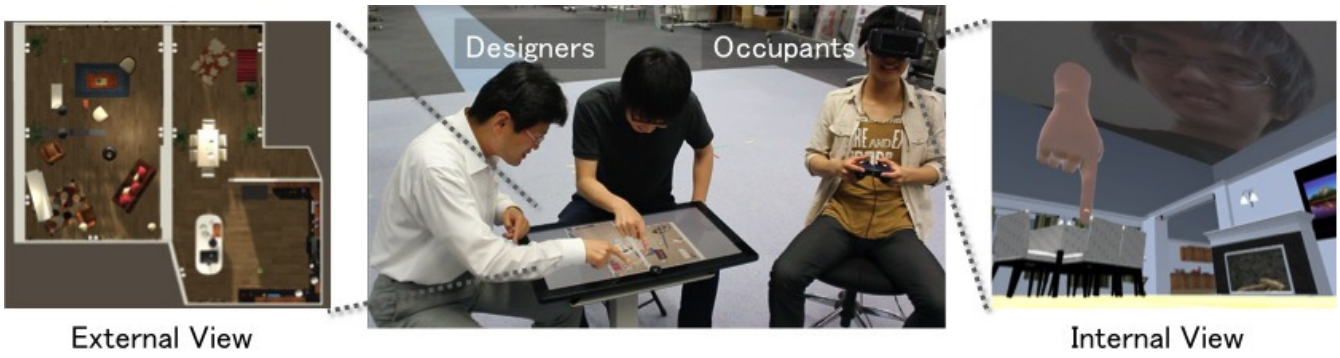

Figure 1: *Dollhouse VR interface (center) for asymmetric collaboration with two different views and interaction styles. Top-down view for the designers (left) and immersive view for the occupants (right).*

1 Introduction

Architecture-scale design requires two different viewpoints: a small-scale internal view, *i.e.*, a first-person view of the space to see local details as an occupant of the space, and a large-scale external view, *i.e.*, a top-down view of the entire space to make global decisions when designing the space. Architects or designers need to switch between these two viewpoints, but this can be inefficient and time-consuming. We present a collaborative design system, *Dollhouse*, to address this problem. By using our system, users can discuss the design of the space from two viewpoints simultaneously. This system also supports a set of interaction techniques to facilitate communication between these two user groups.

2 Dollhouse VR

Our system consists of a multi-touch tabletop device and HMDs (Figure 1, Center). We first explain the main user interfaces for these two groups of users, and then explain the interaction techniques that connect them.

External and Internal Views The external or top-down view is provided on a large tabletop interface and allows designers to manipulate the space (Figure 1, Left). We assume that multiple designers use this interface simultaneously. All interaction involves touch interaction. The internal view provides a first-person view of the virtual environment to its occupants (Figure 1, Right). Occupants see the environment using a HMD.

See-through Ceiling We made the ceiling of the virtual space transparent and use it as a communication channel. From the designers' perspective, they can see the occupants moving around through the ceiling. The head orientation of an occupant is visualized as one of virtual character. This allows the designers to see the occupants' behavior and intentions based on their head and finger motions. The occupants can see the designers by looking up at the ceiling. The designers' faces are captured by a camera mounted on the tabletop device, and the captured view is mapped to the ceiling (Figure 1, Right). This facilitates natural, efficient communication.

Pointing Target of Interest We track users' finger positions and show them to the other users. A designer's finger positions are detected by the touch-sensitive tabletop device. We then follow the God-like interaction technique [Stafford et al. 2006], which the system visualizes designer's finger as a large one coming down from the virtual ceiling. In this way, an occupant can easily recognize what the designer is pointing at or manipulating. An occupant's finger is traced using a touch sensor attached to the HMD. The habitant can point at an object simply by touchinng the corresponding position on the frontal surface of the HMD. The designers then see the occupant's finger orientation via the posture of the doll.

Acknowledgements

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Reference

STAFFORD, A., PIEKARSKI, W., AND THOMAS, B. 2006. Implementation of god-like interaction techniques for supporting collaboration between outdoor ar and indoor tabletop users. In *Proc. ISMAR '06*, 165–172.

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