Evaluating Performance in Immersive Displays

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Figure 1: *Tiled LCD immersive environment (left) and Continuous immersive system (right).*

1 Introduction

3D Immersive visualization systems provide a novel platform to present complex datasets and virtual environments (VEs). The objective of the research presented here is to compare user-interaction and performance between two immersive displays: a low-cost, tiled, multi-screen immersive visualization system and a more expensive, continuous, immersive visualization facility. The low cost system is designed using off-the-shelf components and constructed by arranging LCD displays in a tiled hemispherical layout. The expensive system is a Rockwell-Collins semi-rigid, rear projected, continuous curved screen. With the low cost paradigm, seams are introduced into the image where the displays are tiled. We hypothesize that the tiled system presents an equivalent visual experience, despite the seams introduced by connecting the screens. Both systems will be tested through psychophysical experimentation designed to measure aspects of human performance. Proving our hypothesis will impact lower budget organizations, currently unable to afford such displays, by providing an opportunity to work with lower cost immersive visualization systems at no sacrifice to user-experience.

2 Approach

The mode of interaction with immersive environments is vital to the correct perception of the data presented, whether it is a scientific visualization or a game level. Results from our experiments have the potential to advance our knowledge of human interaction with 3D immersive displays. This human-centered knowledge will in turn prove powerful when designing new interactive displays. To examine various modes of interaction our research is comprised of a suite of formal experiments that will compare different interaction techniques across the aforementioned immersive display systems.

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The experiments will span two years and include:

- Navigation and Wayfinding: Navigation through a 3D VE using a Nintendo Wii controller is evaluated in each paradigm.
- Soccer Heading: Participants accuracy "heading" a soccer ball in the VE using a Nintendo Wii balance board is compared.
- Exploration & Map Construction: Participants draw a 2D map of the 3D VE they have just explored.
- Driving Reaction Times: Accuracy of driving in a VE while avoiding obstacles is compared.

Twenty participants will perform each experiment. Performances on both immersive systems will be recorded, analyzed, and compared. Our aim is to investigate what disadvantage, if any, is present in the less-costly system due to image separation caused by screen borders. For this talk we present the results of the first experiment only.

3 First Experiment: Navigation & Wayfinding

To correctly interact with a spatial immersive display, the user must understand the 3D VE, in particular structure and depth perception [Klein et al. 2009]. This experiment investigates how navigational skills might be affected by the physical separation of the imagery. A model of a building comprised of corridors with offices serves as the test environment for this experiment. Participants examine a 2D map of the floor plan showing their initial position and end position in the environment. They then navigate the shortest route through the immersive 3D rendition of this environment. Navigation is controlled using a Nintendo Wii controller. The user remains stationary and simply points the controller in the direction they wish to travel having the freedom to control the speed at which the user travels. The faster the locomotion, the more confident the user is deemed to be in their choice. The response of interest is the time of travel measured in milliseconds. We compare timings in both immersive systems and will report differences between the two systems.

References

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