WITHINDOWS

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A Single Authoring Framework for Desktop and Immersive Interfaces

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Image-plane techniques can help transition between desktop and immersive
A virtual cursor in the dominant eye allows image-plane selection in stereo
Interacting with 2D interfaces placed below the hand reduces fatigue
Principle immersive tasks can be accomplished completely within a window

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A smooth migration to ubiquitous augmented reality for existing applications
A single development effort to produce both desktop and immersive applications
Minimal learning curve, user fatigue, and resolution restrictions

The Desktop as a Special Case of Image-Plane

The standard WIMP desktop environment is actually a special case of image-plane selection where the viewpoint is fixed, the perspective is parallel projection, and the cursor is a fixed depth in front of the desktop content. In this context, the transition to a fully immersive environment can be made by adding stereoscopic display, head tracking, and 6 DOF cursor tracking in any order. The addition of head tracking to the typical desktop allows the user to change the selection referent under the cursor by not only moving the mouse but also their head.
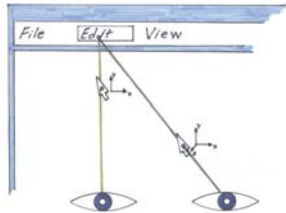
Adding a tracked input device allows traditional horizontal mousing, relative virtual mousing, or absolute image-plane selection when combined with head tracking. Studies show that a virtual mouse is more accurate on large displays and that image-plane selection is unnecessarily fatiguing under these conditions.

Placing the Virtual Cursor in the Dominant Eye
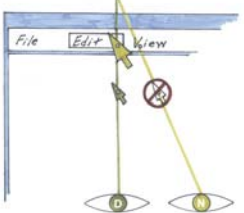
Adding stereo creates an ambiguous selection condition with the cursor off of the desktop. The typical solution to this problem has been to use image-plane techniques exclusively with monoscopic displays. Our approach is to place a virtual cursor exclusively in the dominant (D) eye of the user. People routinely use their dominant eye to resolve ambiguities in the visual plane when pointing. We conducted a user study that found image-plane well tolerated in stereo for both drag-and-drop and simple selection tasks. We are also investigating a reinforcing cursor in the other eye (N) for increased comfort and selection feedback.

A Proof of Concept Virtual World Builder

We have developed a graphical interface for the Ygdrasil VR authoring platform based on the Withindows framework. We were able to develop a single application that is both a desktop development tool and an immersive environment retaining complete desktop functionality. The viewing window encapsulates the functions associated with viewpoint manipulation, while object sensitive functions such as property and positioning can occur on objects either within the window or in situ. Because the basic system controls are reinforced on the desktop, we believe that the user faces a reduced learning curve and can focus more time on development. We also feel that reinforcing the interface on the desktop helps alleviate some of the restrictions that reduced resolution has placed on the complexity of immersive interfaces.

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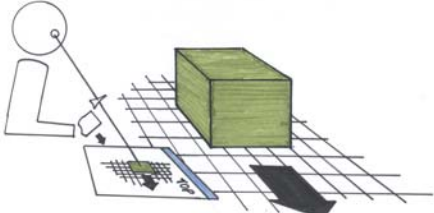aej@evl.uic.edu
www.evl.uic.edu/yg

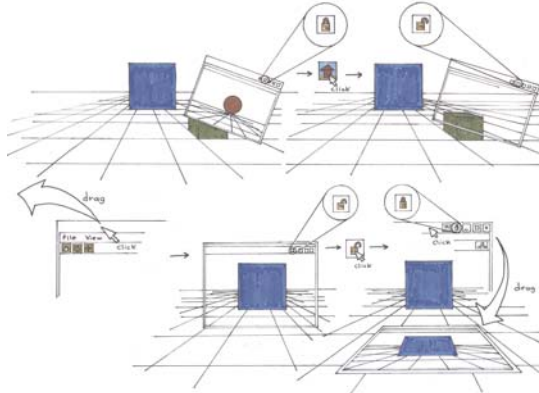## Using Interfaces Under Hand to Reduce Fatigue

Although image-plane techniques are more fatiguing than ray-casting for selection at a distance, they can be faster and no more fatiguing under more generalized conditions. Floating 2D widgets below the hand allows users to support their arm while working. A formal evaluation found no significant difference in arm fatigue, eye strain, or ease of use versus ray-casting under hand. Informal evaluation suggests that using image-plane on cascading menus held below the hand also works as well as ray-casting. Given the proper system architecture, existing 2D applications become immediately usable within any immersive environment.

Combining Image-Plane and Through-The-Lens

The principle VR interaction tasks of navigation, object selection, object manipulation, and global search can be accomplished completely within Through-The-Lens windows (above). Using image-plane selection on these viewing windows is analogous to existing 2½D desktop interaction techniques. Furthermore, novel IVE interaction techniques leverage 6 DOF input without altering the existing interaction style (below). These same windows can then be used without redevelopment directly on the desktop to create a more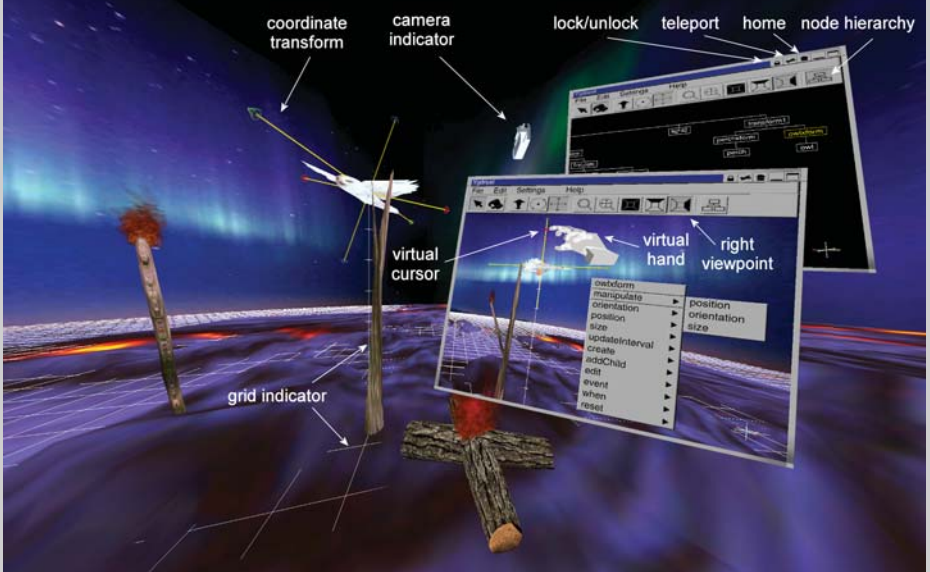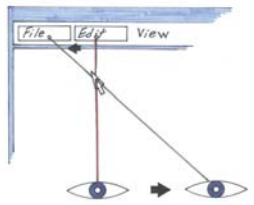 flexible workflow and reinforce the IVE interface.