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Augmented Workspace: The World as Your Desktop

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Abstract. We live in a three dimensional world, and much of what we do and how we interact in the physical world has a strong spatial component. Unfortunately, most of our interaction with the virtual world is two dimensional. We are exploring the extension of the 2D desktop workspace into the 3D physical world, using a stereoscopic see-through head-mounted display. We have built a prototype that enables us to overlay virtual windows on the physical world. This paper describes the Augmented Workspace, which allows a user to position windows in a 3D work area.

Keywords. Ubiquitous computing, cooperative buildings, human-computer interaction, physical space, context awareness, visualization.

1. Introduction

In our daily lives, much of what we do and how we interact has a strong spatial component. Your calendar is on a wall, or on a certain part of your desk, and sticky notes are placed on walls and whiteboards. Yet, as an increasing portion of our work is done on computers, a large majority of our interaction is confined to the small, two-dimensional workspace of the computer monitor. While windows based systems allow the user to arrange windows spatially anywhere on the monitor, these systems do not offer anywhere near the freedom of placement that is inherent in the three-dimensional physical world.

The limitations of the desktop metaphor have been known for some time [1]. The fields of Ubiquitous Computing and Wearable Computing are demonstrating the potential value in moving computing out of its traditional context of a box on a desk and out into other contexts in the physical world. . An increasing number of researchers are developing prototypes that illustrate different capabilities that become possible once one breaks out of the desktop metaphor, including a number of recent systems such as the BubbleBadge [2], and comMotion [3]. However, while these prototypes invent new and exciting applications for ubiquitous computing, they do not address how the idea of ubiquity may improve traditional computing activities such as everyday office work. Our goal in developing an Augmented Workspace is to move com-

puting beyond the desktop but to stay within the boundaries of one's office, to see if we can enhance normal computer-oriented activities by vastly expanding the available display space.

2. The Augmented Workspace

An Augmented Workspace incorporates the technologies and concepts behind Augmented Reality [4] to create a workspace that takes greater advantage of the physical world. To use this workspace, a user wears a high-resolution stereoscopic see-through head mounted display (HMD). The HMD allows the user to interact with the real world while using head tracking to overlay computer-generated data and objects in specific spatial locations. In our prototype, "windows" are not only confined to a two-dimensional location on a screen, but can have a full three-dimensional position anywhere within the user's physical work environment. Calendars can be placed on the walls, along with sticky notes and reminders. Current work can be placed around the desk or directly in front of the user.

The result is a computing environment that takes better advantage of the physical world. Because information can be arranged throughout the entire physical environment instead of the screen, the "resolution" of the computing environment is virtually limitless. "Windows" can be projected onto nearly any surface in the user's space, or they can simply float or move around if need be.

3. A Look into the Augmented Workspace

Below are some screenshots of the prototype. They are taken from the point of view of the user, as seen through the HMD. These shots begin to show how system can be used to create an environment where the effects of the computer are truly ubiquitous.

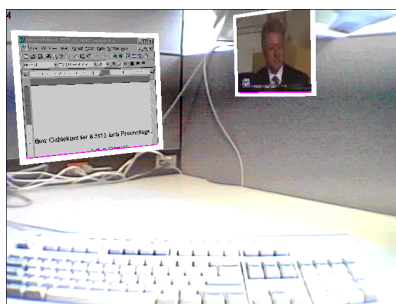


Figure 1: Work Windows



Figure 2: a Wall Calendar

In Figure 1, we see the basic windowing system. The primary work window (a word processor) is situated above the desk in front of the keyboard, while a video newsfeed

is shown off to the right side. With 3D audio, the volume from the video is lower and less obtrusive unless the user turns and focuses attention to it.

In figure 2, we see the calendar in a familiar position on the wall. Here, the calendar is placed in a position that is intuitive to this user, while still maintaining the online, dynamic properties of a computer based calendar and scheduler.

Currently, the Augmented Workspace system is built using a 400MHz PC with a 6 degree of freedom head tracker and a stereoscopic HMD. As the user's head moves, the head tracker ensures that the virtual objects stay correctly registered. Most of the rendering overhead is handled by a powerful 3D accelerator, which leaves most of the PCs computing power available for standard applications.

4. Conclusion and Future Work

Work on the Augmented Workspace is still in its early phases. We believe that the advantages of such a workspace will become very apparent as the system grows and as the equipment becomes more ergonomically comfortable. For instance, companies such as the MicroOptical Corporation [5] are introducing technologies that can place this kind of personal display in a pair of normal eyeglasses.

As work of the Augmented Workspace continues, we will begin to explore different modes of interaction with the virtual objects. Because of the 3D nature of this workspace, traditional modes of interaction may not be adequate. One alternative we will explore is using the head tracker as means to gauge which window has the user's attention. We will also use more trackers attached to hands to facilitate more natural interactions such as pointing, grabbing, and moving.

Plans are also being made to tie the Augmented Workspace in with locator and asset tracking systems. The result will be the ability to track and label people and objects in the physical world with virtual captions and labels. This extends the idea of ubiquitously located displays - the display could be virtually placed on or around the person.

5. References

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