No More WIMPS: Designing Interfaces for the Real World

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ABSTRACT
New interface trends such as Augmented Reality (AR), Perceptual User Interfaces (PUI) and Tangible User Interfaces (TUI) allow the creation of a new generation of interactive experiences. At the overlap of these research areas is a design approach called Tangible Augmented Reality, in which real objects can be used to intuitively manipulate virtual content. Tangible AR techniques allow designers to build interfaces that enhance interaction in the real world and offer a fertile area for future research.

Keywords
Augmented Reality, Tangible User Interfaces

INTRODUCTION
The WIMP (Windows, Icon, Menus, Poinrters) metaphor is one of the most successful user interface paradigms ever developed. Even though the mouse was first demonstrated nearly 40 years ago, Englebart's invention is still the dominant tool for computer interaction.

However exponential advances in computer processing, graphics, networking and storage have enabled a wide range of other user interface techniques and devices. We are now entering a post-WIMP era where interface designers have a wide range of approaches to choose from. This is especially true with new types of interactive experiences.

Interactive interfaces are being influenced by three important trends in user interfaces; Augmented Reality (AR), Perceptual User Interfaces (PUI) [5] and Tangible User Interfaces (TUI) [3]. AR interfaces superimpose virtual imagery over the real world, so that both reality and virtual reality are seamlessly blended together. PUI use cameras, and other sensing devices to give computers some of the same perceptual capabilities of humans. Finally, TUI bridge the worlds of bits and atoms by enabling the user to interact with digital information by manipulating real objects.

Each of these research fields is important its own right and all explore innovative ways to interact with computers. However, in many cases interfaces in these areas introduce artificial seams and discontinuities into the workspace. Seams are spatial, temporal or functional constraints that force the user to shift among a variety of spaces or modes of operation [3]. For example, the seam between computer word processing and pen and paper makes it difficult to produce digital copies of handwritten documents.

Seamless interaction does naturally occur in the overlap of AR, Perceptual and Tangible User Interfaces (fig. 1). Research in this area explores how to enhance interaction with virtual imagery by using machine perception and real object manipulation.

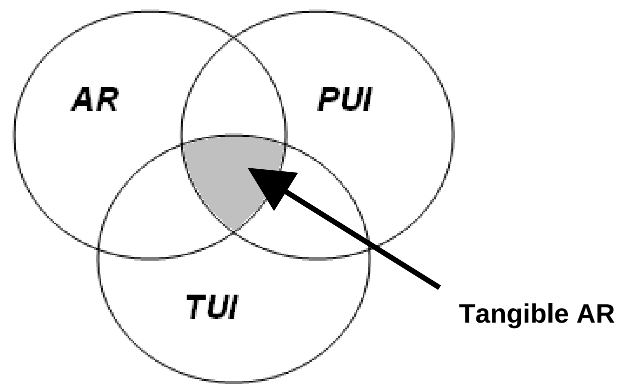

Fig. 1. The convergence of AR, PUI and TUI metaphors

The use of real objects to manipulate virtual content is often referred to as Tangible Augmented Reality. Tangible AR interfaces provides true spatial registration and presentation of 3D virtual objects anywhere in the physical environment, while at the same time allowing users to interact with this virtual content using real objects. In this way the interface is moved from the screen space into the familiar real space.

TANGIBLE AUGMENTED REALITY
A good example of a Tangible AR application is the MagicBook interface [2]. Augmented Reality technology is used to overlay virtual imagery on the pages on a real book. The book is a normal book that can be read without any additional technology. However when the user looks through at the pages through a handheld display they can see three-dimensional virtual content popping out of the page (figure 2a). This is achieved by using computer vision software that tracks the users viewpoint from patterns on the pages [1]. The virtual models appear attached to the real pages so users can view the virtual models from any side just by rotating the book, or they can change the scene entirely by turning to the next page. When they see a

virtual scene they are interested in, they can flick a switch on the handle of the display and fly into a fully immersive virtual space (fig. 2a).

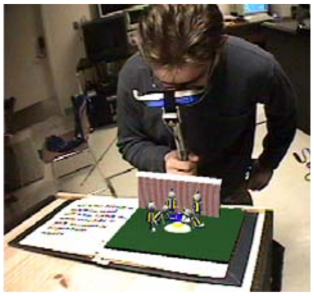

Fig. 2a: MagicBook AR scene

Fig. 2b: Immersed in the Space

The MagicBook is based on aspects of AR, PUI and TUI interface design and can be placed at the junction of these fields. The seamless nature of the interface is apparent. For example, changing the virtual scene simply by turning to a real page is perhaps more natural than using a mouse and keyboard for the same task. Users report finding the interface extremely intuitive, especially the transition from reality to virtual reality.

The VOMAR project explores how a more complicated Tangible AR interface could be designed [4]. It uses a single input device that allows the user to perform multiple different tasks in a virtual scene assembly application.

The physical components of the interface comprise a real book, a cardboard paddle the user holds in their hand, a large piece of paper and a lightweight head mounted display (see figure 3a). The form of each of these objects reflects their function; the book holds all the virtual models, the paddle is the main interaction device, and the large piece of paper the workspace.

Fig. 3a: VOMAR Interface

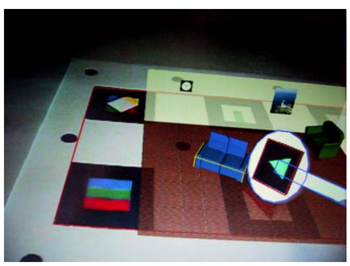

Fig. 3b: Moving Objects

The application is layout of virtual furniture in a room. When the user opens the book on each of its pages they see a different set of virtual furniture, such as a set of chairs, rugs etc. The 3D virtual models appear exactly superimposed over the real book pages. Looking at the large piece of paper they see an empty virtual room. They can then copy and transfer objects from the book to the virtual room using the paddle.

To copy an object from the book the user simple places the paddle on the desired object and the object is copied onto it. Once a model is on the paddle it can be picked up and viewed from any viewpoint. To drop a model into the virtual room the paddle is placed at the desired location and tilted until the model slides off. Models in the scene can be moved around by pushing motions of the paddle (fig. 3b). A shaking motion is used to delete an object from the paddle, while models can be removed by hitting them.

As can be seen these interactions are very natural to perform with a real paddle, so in a matter of a few moments a user can assemble a fairly complex arrangement of virtual furniture. Of course what the user is really doing is interacting with a simple CAD program, but instead of using a WIMP interface they are just manipulating a cardboard paddle in a very intuitive way.

DISCUSSION

We have found that there are several advantages of Tangible AR interfaces. First, they are *transparent interfaces* that provide for seamless two-handed 3D interaction with both virtual and physical objects. Users can manipulate virtual objects with the same input devices they use in physical world – their own hands.

Tangible AR allows *seamless spatial interaction* with virtual objects anywhere in their physical workspace. The user can pick up and manipulate virtual data as easily as real objects, and arrange them on any working surface, such as a table. The digital and physical workspaces are therefore continuous, naturally blending together.

Another advantage is the use of *physical form-factor* to support interface functions. The physical design of the tangible interfaces elements suggests how they are to be used. For example, in the MagicBook interface it is natural to turn the page to see more virtual content.

CONCLUSION

Tangible Augmented Reality blends elements of AR, Perceptual and Tangible interfaces. Technologies in this area do not separate actions in the physical environment from the digital domain and so support seamless interaction. In this way they enable us to move beyond WIMP interfaces and enhance interaction in the real world.

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