Interaction on the Go

Mark Billinghurst
Human Interface Technology Laboratory (New Zealand)
mark.billinghurst@hitlabnz.org

The WIMP (Windows, Icon, Menus, Pointers) 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, as computing moves from the room scale into the hand and onto the body there are increasing opportunities for more innovative forms of human computer interaction. This is particularly true with mobile devices where users do not have the luxury of a large screen, full sized keyboard, or even a pointing device. Luckily, 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.

Three emerging interface trends are particularly suited to mobile multimedia devices; Augmented Reality (AR), Perceptual User Interfaces (PUI) [Turk 2000] and Tangible User Interfaces (TUI) [Ishii 97]. 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. TUI techniques are used to provide intuitive input, AR interfaces support enhanced display, and PUI provide expert reasoning that connects input to display.

However, in many cases interfaces in these individual 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 [Ishii 97]. For example, the seam between computer word processing and pen and paper makes it difficult to produce digital copies of handwritten documents.

Natural seamless interaction is important for mobile devices. When interacting on the go, users need the least amount of distraction and the most intuitive ways of interacting with information. However, 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 cognition, and real object manipulation.

The use of real objects to manipulate virtual content is often referred to as Tangible Augmented Reality. This is an exciting new area of interaction design possibilities for mobile devices. 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.

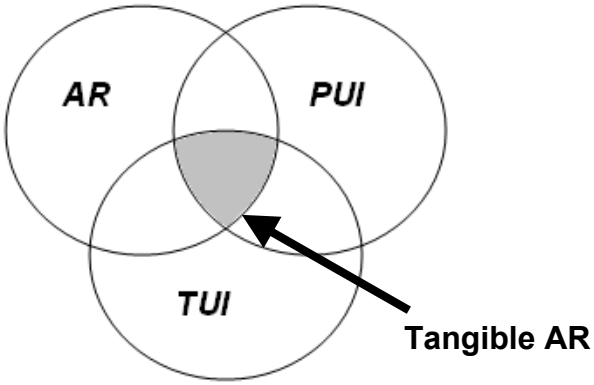

Fig. 1. *The convergence of AR, PUI and TUI metaphors*

The ability to seamlessly interact with the real world is important for mobile devices. PUI techniques can be used to provide the devices with awareness of the user's location and state. Context cues such as these can be used to customize the information presented back to the user. AR techniques can then overlay information in such a way that it doesn't interfere with the users actions in the real world.

There are several advantages of Tangible AR interfaces for mobile devices. 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. Finally, the *physical form-factor* of mobile devices suggests how they are to be used. The device itself can be used as an intuitive interface object facilitating natural interaction.

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. It is metaphors such as this that will be necessary for supporting interaction on the go.

References

Ishii, H., Ullmer, B. Tangible Bits: Towards Seamless Interfaces between People, Bits and Atoms. In proceedings of CHI 97, Atlanta, Georgia, USA, ACM Press, 1997, pp. 234-241.

Turk, M., Robertson, G. Perceptual User Interfaces *Communications of the ACM*, March 2000.