Chapter 15
Issues for the Evaluation of Ambient Displays

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ABSTRACT

This article is motivated by two evaluation case studies of ambient information displays. Firstly, an intrusive evaluation of a display called MoneyColor concentrates on the relationship between "distraction" and "comprehension". This revealed that the comprehension is in direct proportion to display-distraction, but there is no clear relationship between comprehension and self-interruption. Secondly, a non-intrusive evaluation of a display called Fisherman described a quantitative measurement of user "interest" and applied this measurement to investigate "evaluation time" issue. These experiments give some insight into number of issues in evaluation of ambient displays.

INTRODUCTION

In this article, the term "ambient display" is used generically to denote a subfield in information visualization research that investigates the presentation of information through the periphery of user attention. It has its roots in the ubiquitous computing dream of Weiser (Matthews, T., et al.,

2003). Related terminologies include peripheral displays (Matthews, T., et al., 2003), informative art (Future-Application-Lab), notification systems (McCrickard, D. S., et al., 2003), and even ambient information systems (Pousman, Z., & Stasko, J., 2006). The differences between these terms are not immediately obvious, and perhaps the subtle disparities are not significant.

The functional relationship between ambient displays and more generally, information

visualization, has not been clearly defined. This article treats ambient displays as a specific type of information visualization characterized by two design principles: *attention* and *aesthetics*. Mainstream information visualization demands *full*-attention (*e.g.* users explore, zoom and select information mainly in the primary focus of their attention [Somervell, J., et al., 2002]), while ambient displays only require *partial* attention, in that human attention can also be committed to other tasks at hand. Also, the use or consideration of visual aesthetics is at most a secondary concern in the design of most information visualization applications (versus the currently more dominant focus on measuring and optimizing the effectiveness and efficiency of visualizations [Lau, A., & Moere, A. V., 2007]). However, aesthetics is a key issue in the development of ambient displays, which generally require being visually unobtrusive but still needing to draw user interest by way of enticing and maintaining human curiosity through visual theatrics, even over longer periods of time.

To date, many ambient displays have been designed and some have been commercialized (*e.g.* ambient orb [Ambient-Device, 2008], ambient umbrella [Ambient-Device, 2008], ambient football scorecast [Ambient-Device, 2008]). Furthermore, most ambient display design approaches use vision, audio and tactile senses. *InfoCanvas* (Plaue, C., Miller, T., & Stasko, J., 2004) is a typical visual example, which uses a beach scene to depict multiple pieces of real-time information. Other similar examples include: the *Digital Family Portrait* (Mynatt, E. D., et al., 2001) (which uses the density of icons in a band to represent a measurement for one habit of a user); the *Kandinsky system* (Fogarty, J., Forlizzi, J., & Hudson, S. E., 2001) (provides an artistic collage of images to represent email notes and news articles); and the *Interactive Poetic Garden* (White, T., & Small, D., 1998).

Lumitouch (Chang, A., et al., 2001) is a tactile example, which can transmit emotional content when the picture frame is touched. Other similar systems include: *Vispad* (Weissgerber, D., Bridgeman, B., & Pang, A., 2004) (a new haptic data display), *Water lamp* and *Pinwheel* (Dahley, A., Wisneski, C., & Ishii, H., 1998), *Dangling String* (Weiser, M., & Brown, J. S.), *Information Percolator* (Heiner, J. M., Hudson, S. E., & Tanaka, K., 1999), *BusMobile* (Mankoff, J., et al., 2003), *Daylight Display* (Mankoff, J., et al., 2003), *Personal Ambient Display* (Wisneski, C., et al., 2006), and *Haptic shoes* (Fu, X., & D. Li., 2005). *Non-speech audio glance* (Hudson, S. E., & Smith, I., 1996) is an example of an ambient audio display, which represents important properties of a message as a concise sound. *Musicbox* (Ullmer, B., & Ishii, H., 2006) is a wooden box which glows and plays music in response to light, movement and live music around a remote piano.

Unfortunately, little progress has been made in defining evaluation methodologies for ambient displays, in comparison to the design. Mankoff et al. (2003) proposed a heuristic evaluation for ambient displays. Pousman et al. (2006) proposed a four dimensional guide for the evaluation of ambient information systems. McCrickard (2003) proposed a so-called IRC framework (I-Interruption, R-Reaction, C-Comprehension) to evaluate the notification system. Shami et al. (2005) proposed the CUEPD (Context of Use Evaluation of Peripheral Displays) evaluation method to capture context of use through individualized scenario building, enactment and reflection. In this article, we also adapt a DECIDE framework from Preece (2002) (originally used for interaction designs) to guide the evaluation of ambient displays (Shen, X., 2006).

Despite the lack of attention paid to it, evaluation is one key research challenge for ambient displays. We believe that future research into evaluation should be a priority for ambient display researchers. Effective evaluation methods have the capability of judging the quality of the design to provide a basis for making future improvements and further development of the field. Our interest

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