Interacting with Wall-Size Screens

Patrick Baudisch
Microsoft Research
Redmond, WA, USA
baudisch@microsoft.com

CHI 2006, April 22–27, 2006, Montreal, Canada.
ACM 1-xxxxxxxxxxxxxxxxxx.

Abstract
When attempting to transfer the main interaction paradigms involving mouse, pen, and touch from the desktop to large screens many of them “break”. The sheer size of wall-size displays caused users to lose track of the mouse pointer. When using touch or pen input, the screen size makes it hard to reach distant screen content. And those techniques that seem to transfer, now often suffer from limited accuracy, caused by the inferior tracking that many of the large displays offer. I am describing a series of research projects that address these problems.

ACM Classification Keywords
H5.2 [Information interfaces and presentation]: User Interfaces. - Graphical user interfaces.

Motivation
While desktop PC screens used to be the norm, the range of available display devices has exploded in the past years. Today, users obtain large personal display surfaces by connecting multiple screens to their PCs, by using a projector, or by combining multiple projectors into interactive display walls. The transition from the desktop screen to this wide range of display devices brings up a wide range of research questions in the space of user interfaces. The straightforward approach, i.e., an attempt to apply user interfaces designed for the desktop to wall-size screens leads to problems…

Focus-plus-context screens [7] are an inexpensive way to create a large personal display and became the basis for several follow-up projects on large screen interaction. A focus-plus-context screen consists of a smaller hi-res display embedded into a larger low-res display. Figure 1 shows our prototype that seamlessly integrates an LCD into a projection screen. Customized software displays graphical content across both display regions, such that the scaling of the image is preserved, while its resolution varies across the two display regions. Content panned into the focus region is viewed in higher detail, making the focus display behave like a magic high-resolution lens.

We built a series of prototype applications for image viewing, video conferencing, and a simple driving simulation. In experimental comparisons, we found that participants performed tasks significantly faster and with less error when using the focus-plus-context screen than when using a traditional overview plus detail setup [7].

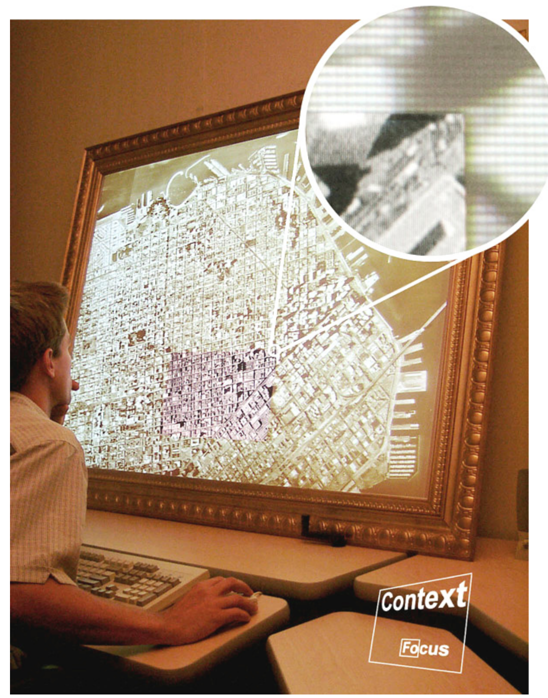

Figure 1: Focus-plus-context screen prototype. Most of the display is created using a low-resolution front-projection. Only the area in the center was turned high-resolution by embedding an LCD screen. The callout illustrates the different resolutions of focus and context areas.

Once we started working with these and other wall-size displays, a wide range of usability issues became apparent: When we attempted to transfer the main interaction paradigms involving mouse, pen, and touch from the desktop to large screens many of them "broke". The sheer size of wall-size displays caused users to lose track of the mouse pointer. When using touch or pen input, the screen size made it hard to reach distant screen content. And those techniques that seemed to transfer, now often suffered from limited accuracy, caused by the inferior tracking that many of the large displays offer. We started addressing these problems in a series of research projects, a selection of which I describe in the following.

1. Improving targeting with the mouse on large screens

High density cursor [5] On large screens, users employ higher mouse accelerations in order to traverse the screen reasonably quickly. The faster the mouse cursor moves, however, the more it seems to jump from one position to the next, as it is updated only at the refresh rate of the monitor. *High-density cursor* helps users keep track of the mouse cursor by filling in additional cursor images between actual cursor positions (temporal supersampling). Unlike existing techniques, such as the Windows *mouse trail*, high-density cursor preserves the responsiveness of the mouse cursor. In our user study, high-density cursor significantly improved participants' performance on a Fitts' law targeting task.

Our follow-up project **Mouse Ether** [4] simplifies targeting with the mouse across multiple monitors by compensating for the distortion of the mouse path otherwise caused by bezels, gaps, and resolution differences. We found mouse ether to improve participants' targeting performance by up to 28%.

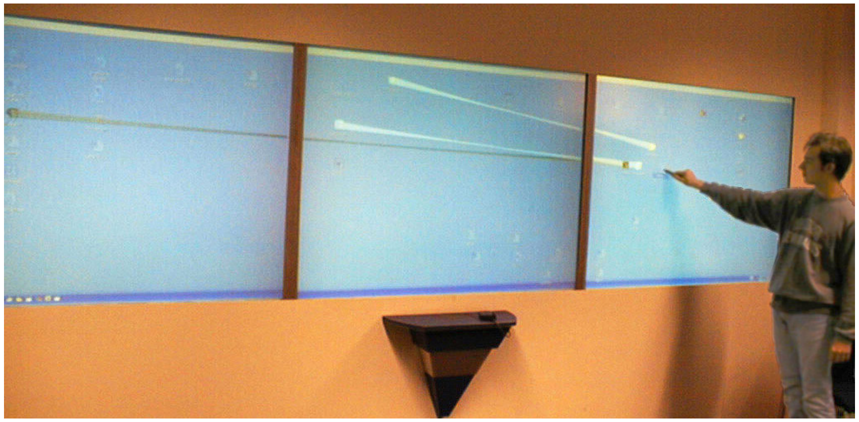

Figure 2: This user drags an icon into a distant folder using drag-and-pop. As he starts dragging the icon towards the left, all potential targets located in that direction "stretch" towards him.

2. Reaching distant targets on wall-size displays

Drag-and-pop [6], is an extension of traditional drag-and-drop that provides users with access to screen content that would otherwise be hard or impossible to reach. Figure 2 shows an example. The user is filing an icon located in the right screen unit into a folder located in the center screen unit. As he starts dragging his icon towards the target folder, drag-and-pop responds by temporarily moving all three potential target icons towards the user's current cursor location. While being moved temporarily, the three icons leave "rubber bands" behind that help the user visually track what happened. The user can now file his icons using a comparably small hand movement. In a user study conducted on the shown display wall, participants were able to file icons up to 3.7 times faster when using the drag-and-pop interface than when using traditional dragging [6]. A follow-up study showed that drag-and-pop outperforms the more traditional approach of extending the user's reach.

3. Precise manipulation on wall displays

Snap-and-go [3] is a technique that helps users align objects and acquire very small targets. With traditional snapping, placing an object in the immediate proximity of a snap location requires users to temporarily disable snapping to prevent the dragged object from snapping to the snap location. This make a deactivation interface necessary, which can not only be hard to learn, but on large displays such an interface can also be hard to reach. Snap-and-go in contrast *guides* objects to aligned positions, thereby eliminating the need for a deactivation interface. In our user studies, participants were able to align objects up to 231% faster with snap-and-go than without. Snap-and-go also proved robust against the presence of distracting snap targets.

Dual finger selection techniques [1] help users select very small targets on *multi-touch* screens. In Figure 3, the user adjusts the control-display ratio with the left hand (here stopping the pointer altogether by selecting "freeze") while the primary finger controls the pointer. We implemented our techniques on a multi-touch tabletop prototype that offers computer vision-based tracking. In our user study, the three tested techniques (*Stretch*, *X-Menu*, and *Slider*) performed significantly faster and with less error than a control condition, across a variety of target sizes and noise levels.

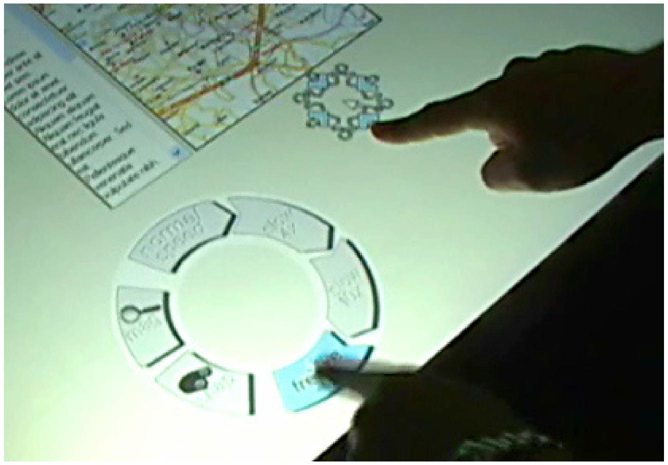

Figure 3: Dual finger selection techniques running on a table top display. The user operates a crossing menu of a control-to-display ratios with the left hand while pointing with the right hand.

Conclusions

Large display technology is becoming available to larger and larger audiences. Today's systems often rely on technology initially designed for regular sized screens. However, installations involving one or more large display units are qualitatively different from smaller screens. The techniques presented in this paper address the base layer: the basic input devices and interaction techniques. This is only a first step towards creating a user experience explicitly targeting large screens. Future research will have to address the layers on top of this—create and research new ways of operating applications and hopefully entirely new types of applications.

Acknowledgments

Thanks to Ken Hinckley, Ed Cutrell, and the co-authors & supporters of the work presented in this paper.

References

[1] Benko, H., Wilson, A., and Baudisch, P. Precise Selection Techniques for Multi-Touch Screens. To appear in *Proc. CHI'06*.

[2] Robertson, G., Czerwinski, M., Baudisch, P., Meyers, B., Robbins, D., Smith, G., Tan, D. Large Display User Experience. In *IEEE Computer Graphics & Application, Special Issue on Large Displays,* July/August 2005, pp. 44-51.

[3] Baudisch, P., Cutrell, E., Hinckley, K., and Eversole, A. Snap-and-go: Helping Users Align Objects without the Modality of Traditional Snapping. In *Proc CHI'05,* pp. 301–310.

[4] Baudisch, P., Cutrell, E., Hinckley, K., and Gruen, R. Mouse Ether: Accelerating the Acquisition of Targets Across Multi-Monitor Displays. In *CHI 2004 Extended Abstracts* (short paper), pp. 1379-1382

[5] Baudisch, P., Cutrell, E., Robertson, G. High-Density Cursor: A Visualization Technique that Helps Users Keep Track of Fast-Moving Mouse Cursors. In *Proc. Interact'03*, pp. 236–243.

[6] Baudisch, P., Cutrell, E., Robbins, D., Czerwinski, M., Tandler, P. Bederson B., and Zierlinger, A. Drag-and-Pop and Drag-and-Pick: Techniques for Accessing Remote Screen Content on Touch- and Pen-operated Systems. In *Proc. Interact'03*, pp. 57–64.

[7] Baudisch, P. Good, L., Bellotti, V., and Schraedley, P. Keeping Things in Context: A Comparative Evaluation of Focus Plus Context Screens, Overviews, and Zooming. In *Proc. CHI '02*, pp. 259–266.