Rubbing the Fisheye: Precise Touch-Screen Interaction with Gestures and Fisheye Views

Alex Olwal *Steven Feiner*

Department of Computer Science
Columbia University
{aolwal,feiner}@cs.columbia.edu

ABSTRACT

Fisheye lenses are powerful tools for visualizing dense data while simultaneously providing focus and context. Unfortunately, target acquisition in fisheye lenses is complicated by magnification effects that make it seem as if objects in the fisheye view are moving when the view is changed. These problems become even more evident with touch-screen–controlled fisheye views, where there is no continuous navigation and pointing is inaccurate.

We show how rapid targeting can be facilitated in fisheye views through transparency and additional stabilized representations of the view. We also present rub-pointing, an interaction technique based on simple gestures that allows precise target acquisition in fisheye lenses on touch screens.

KEYWORDS: Pointing, interaction techniques, touch screens, fisheye views

1 INTRODUCTION

Touch screens are intuitive and easy-to-learn, with few or no moving parts. Yet, one of their biggest problems is the precision with which a user can interact. While it is easy to point to large objects, it can be difficult when finger-pointing needs to occur at a close-to pixel level.

Potter et al. [4] explore a set of strategies for high-precision touch-screen pointing. They introduce the take-off interaction technique, where the user controls a cursor that is located slightly above the finger and the selection is made upon release with the surface. Albinsson and Zhai [1] compare this approach with traditional zoom-pointing (where a user zooms in before selecting) and two new interaction techniques; cross-keys (which uses discrete taps on virtual keys integrated with a crosshair) and precision-handle (in which the user's finger acceleration is scaled down when mapped to the cursor).

Non-pressure-sensitive touch screens also lack much of the functionality that is taken for granted in user interfaces today (e.g., mouse-overs). This becomes especially evident in fisheye views, where targeting is hard, since motion effects in magnification can make potential targets change

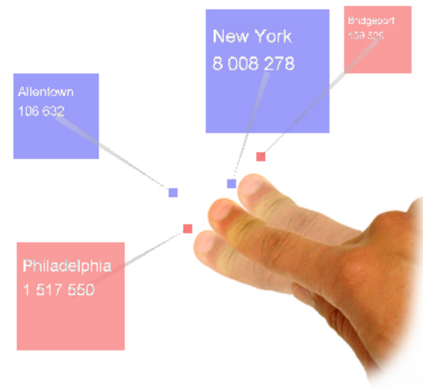

Figure 1. Fisheye view supported by stabilized targets. Rub-pointing is used for interaction.

location while the user is navigating towards them. Gutwin [2] addresses this problem through speed-coupled flattening, where mouse cursor velocity and acceleration are taken into account for the amount of distortion. Zhai et al. [5] discuss an improved version of the MacOS X dock that facilitates targeting by predicting the destination of the mouse cursor and temporarily freezing the fisheye view when the cursor enters the dock.

We extend this work by describing a method for providing touch-screen access to fisheye views, as well as introducing rub-pointing, a one-step technique for precise and intuitive touch-screen pointing.

2 TOUCH-SCREEN INTERACTION WITH FISHEYE VIEWS

Fisheye views are good for providing focus, while preserving context through a scaled-down view of the surroundings. On the other hand, they cause problems in interaction and targeting, since the distortion introduces magnification effects that can make it hard to focus on an object.

Previous research [2,5] has addressed these problems for mouse-based systems. Unfortunately, these solutions are not applicable to touch screens. Interacting with a fisheye view on a touch-screen display can be very confusing, unless continuous contact is maintained with the surface. Since the focal point changes for each touch, objects will rearrange themselves, and a potential target may jump to another location upon touch.

Lieberman [3] discusses zooming and panning in multiple transparent layers to help the user regain context. Our solution uses transparency to provide the user with a stabilized

Olwal, A. and Feiner, S. Rubbing the Fisheye: Precise Touch-Screen Interaction with Gestures and Fisheye Views.
In Conference Supplement of UIST '03 (ACM Symposium on User Interface Software and Technology), Vancouver, BC, November 2-5, 83-84, 2003.

Figure 2. Rub-pointing used for zooming in on a map and its overlaid fisheye visualization. The user touches the target, uses rub-pointing to zoom (if needed), translates the finger to the desired target, and lifts the finger to select the target.

undistorted view of the objects, and a transparent overlaid fisheye view of the same objects (see Figure 1). Building on Lieberman's approach, we also provide a contextual link through a reference cone from each object in the fisheye view to its stabilized counterpart. A user is thus able to point directly at a target, and, upon touching the screen, that object in the fisheye view will appear directly on top of the stabilized version. Our approach naturally extends to helping target rapid mouse movements in fisheye views.

3 RUB-POINTING

Rub-pointing addresses the problem of precision pointing on touch screens. Rub-pointing starts with the user touching the screen. The user can then translate the cursor in the plane, as well as zoom in and out (through rubbing, as described below) as long as contact is maintained with the surface. When a satisfactory target has been reached, lifting the finger will select the object currently under the cursor. This use of rub-pointing, shown in Figure 2, adds the advantages of zoom-pointing to the take-off technique.

We tested several approaches for the zooming action, and concluded that rotational rubbing and diagonal rubbing were the most comfortable and the easiest to learn. *Rotational rubbing* is performed by rubbing clockwise to zoom in, and rubbing counter-clockwise to zoom out. However, we found rotation to be potentially overly complex from a cognitive perspective, and thus implemented an alternative version. *Diagonal rubbing* is performed through a repetitive diagonal motion of the hand. A right-handed user zooms in by rubbing back and forth along the diagonal from bottom-left to upper-right, and zooms out by rubbing bottom-right to upper-left (with the motions switched for left-handed users). We found that the zoom-out operation is slightly less convenient to perform, which gives rise to an effective distinction between the two in kinesthetic memory. Although easier to perform, the similarity between diagonal rubbing and erasing could be a potential problem.

Our discussion of fisheye views has thus far addressed only visualization. However, while our use of rub-pointing provides increased precision, it can also potentially cause a loss of context. Therefore, we have extended work by Zhai et al. [5], by considering the case where the cursor is *constantly* in the fisheye view, and where the view may take up the entire screen. In this alternative to the approach of Figure 2, we freeze the fisheye temporarily when rubbing is detected, and the rubbing determines the amount of fisheye distortion. The fisheye is frozen for about a second after the rubbing ends to allow the user to take advantage of the expanded fisheye targets. This technique suggests an interface where the fisheye view appears only on rubbing to provide precise target selection, while regaining context through fisheye distortion, reference cones, and transparent overlay.

4 CONCLUSIONS AND FUTURE WORK

While long popular for visualizing dense data, only recently have fisheye lenses received attention for target selection [2,5]. We have presented a technique for facilitating rapid target acquisition in fisheye views, through transparency and additional stabilized representations of the view. While it was designed for interaction with fisheye lenses on a touch screen, we anticipate it would also benefit mouse-based fisheye interaction.

We have also introduced rub-pointing, an interaction technique for touch-screen interaction, based on simple gesture. We have discussed how rub-pointing can be used for traditional zoom, as well as for precise target selection on touch screens.

We intend to explore the use of rub-pointing further in both fisheye lenses and undistorted views, as well as for touch screens and for mouse-based applications. We would also like to conduct a user study to compare our two implementations of rub-pointing with the interaction techniques discussed in previous work [1,4]. We also plan to extend this implementation to pen-based systems, and multi-user touch surfaces, such as the MERL DiamondTouch.

ACKNOWLEDGEMENTS

This research was funded in part by Office of Naval Research Contracts N00014-99-1-0249 and N00014-99-1-0394, NSF Grant IIS-00-82961 and IIS-01-21239, and gifts from MERL, Microsoft Research, and Alias | Wavefront.

REFERENCES

1. Albinsson, P-A. and Zhai, S. High Precision Touch Screen Interaction. *Proc. CHI '03*, 105–112, 2003.
2. Gutwin, C. Improving focus targeting in interactive fisheye views. *Proc. CHI '02*, 267–274, 2002.
3. Lieberman, H. Powers of Ten Thousand: Navigating in Large Information Spaces. *Proc. UIST '94*, 15–16, 1994.
4. Potter, R.L., Weldon, L.J., and Shneiderman, B. Improving the accuracy of touch screens: an experimental evaluation of three strategies. *Proc. CHI '88*, 27–32, 1988.
5. Zhai, S., Conversy, S., Beaudouin-Lafon, M., and Guiard, Y. Human On-line Response to Target Expansion. *Proc. CHI '03*, 161–169, 2003.