Adding Context to Multi-touch Region Selections

Sven Strothoff

Visualization and Computer Graphics Research Group University of Münster Einsteinstraße 62 48149 Münster, Germany sven.strothoff@uni-muenster.de khh@uni-muenster.de

Klaus Hinrichs

Visualization and Computer Graphics Research Group University of Münster Einsteinstraße 62 48149 Münster, Germany

Permission to make digital or hard copies of part or all of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation on the first page. Copyrights for third-party components of this work must be honored. For all other uses, contact the owner/author(s). Copyright is held by the author/owner(s). ITS'13, October 6-9, 2013, St. Andrews, United Kingdom. ACM 978-1-4503-2271-3/13/10. http://dx.doi.org/10.1145/2512349.2514913

Abstract

As applications that originated on desktop computers find their way onto new multi-touch enabled devices many interaction tasks that were designed for keyboards and computer mice spread to new touch-based environments. One example is the selection of regions, for instance in image editing applications. While there are already several studies involving multi-touch object selections, region selections have not been closely examined. Instead of using traditional mouse-based interaction schemes we propose a multi-touch selection technique that better suits touch-based devices. Based on this technique we propose a novel way to take advantage of multiple touches to easily extend, modify and refine selections based on the order and relative position—the *context*—of touches.

Author Keywords

Selection technique; region selection; selection refinement; multi-touch interaction: context information

ACM Classification Keywords

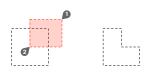
H.5.2 [Information Interfaces and Presentation (e.g. HCI)]: User Interfaces.—Input devices and strategies; Interaction styles.



Figure 1: Positions of the first and second touch and the resulting selection.



(a) Extending an existing selection.



(b) Subtracting from an existing selection.

Figure 2: The mode of selection is decided by the order of the touches and their position relative to the existing selection, their *context*.

Introduction

Region selection has been around since the mouse became an indispensable part of the human-computer interface. Virtually all graphics editing programs have a selection tool that can be used to select rectangular regions. It comes as no surprise that this popular interaction metaphor found its way into modern multi-touch-enabled applications. However, the interaction metaphor that is well established for mouse-based interaction has just been transferred to the new touch-based environment. We think that instead of just transferring the existing region selection technique it should be better adjusted to the new environment. We introduce our novel multi-touch-based approach to region selection that can not only define, but also easily extend, modify and refine selection regions using the *context* of the user's touches.

Related Work

A lot of works studied the selection of objects on multi-touch devices. Moscovich et al. [3] used a multi-finger technique to provide an adjustable cursor area for object selections. However, multi-touch region selections, like the selection of parts of raster images, have not been fully explored. Latulipe et al. [2] have used an interaction scheme to specify a rectangular region that is similar to our proposed technique. In contrast to our work that uses direct touch interaction they used an indirect approach using two computer mice.

The idea of using the contextual information of the user's gestures can also be found in an object manipulation technique introduced by Wigdor et al. [4]. Interaction schemes that use several fingers or both hands simultaneously and control multiple degrees of freedom have been examined in many works. Hancock et al. [1] have evaluated input using two or more fingers.

Transition to Multi-Touch

On desktop computers with a mouse the traditional selection technique for selecting rectangular regions works by clicking to place the first corner of the selection region and then dragging the cursor to place the second corner. While it is certainly possible to use the same technique on a multi-touch device by replacing the mouse cursor by the user's finger, we think this is not a very good approach. By taking advantage of the possibilities of multi-touch input it is possible to modify this touch and drag technique so that the whole selection area can be specified at once. Instead of first touching and then dragging, two touch points are used to specify the whole selection region in a single step, as shown in Figure 1. This has two advantages. On the one hand it is possible to adjust the whole selection region instead of just one side of it as with the touch and drag approach. This is especially important in a multi-touch environment, as it is a lot harder to hit an exact location on the screen with a finger than with the cursor of a mouse. On the other hand the users can pre-shape their hands before actually touching the surface and approximate the region to be selected. Once the users touch the screen and get a visual feedback of the selection region only a small correction is necessary.

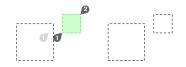
Refining Selections

Applications often allow users to refine selections by adding or subtracting a newly defined region from the current selection. This makes it possible to select complex regions or to correct an earlier selection (cf. Figure 2).

In contrast to its counterparts that originated on the desktop where only a single cursor is used our technique uses two touch points to define a selection. We refer to the placement of the touch points inside or outside of an existing selection and the order in which they are placed



Figure 3: The mode of selection is only determined by the initial touch positions. The initial position of the second touch is shown in light grey.



(a) Extending the selection by a disjoint region.



(b) Creating a hole in the selection.

Figure 4: If the touch points are moved after the selection mode has been chosen complex selections can be achieved.

as their respective context. Then we can map the four different context combinations listed in Table 1 to the different selection modes.

| | | 1st touch | |
|-----------|---------|---------------------|-------------------------|
| | | inside | outside |
| 2nd touch | inside | _ | subtract from selection |
| | outside | add to selection | start new selection |

Table 1: Decide what mode of selection to use based on the *context* of the two touches that define the selection region.

If the first touch is located inside the existing selection and the second touch is placed outside of the selected region this indicates, that the newly defined region should be added to the selection (Figure 2(a)). If the order of the touch points is reversed, first outside, then inside, the defined region will be subtracted from the current selection (Figure 2(b)). If both touches are placed outside of the existing selection it is cleared and a new selection is begun. The case for both touches inside the selected region has been intentionally left blank in Table 1, because it can be mapped to some other operation.

What may at first look like an arbitrary assignment in Table 1 is actually based on a very simple mental model. The first touch determines what should be extended. If it is inside the selected region the selection is extended into the unselected region. If on the other hand the first touch point is outside of the current selection this can be viewed as *extending* the unselected region into the selection, thereby making the selection smaller.

It is important to note that only the context of the touch when it is placed on the surface matters for the selection mode. As soon as the selection mode is decided the touches can be moved around freely, as shown in Figure 3. By moving the touch points after the selection mode has been decided, complex selections containing disjoint regions or holes in the selected region can be achieved. In Figure 4(a) the user placed the first touch inside the already selected region to begin an extension and later moves his touch point outside to add a disjoint region to the current selection. If the first touch is placed outside the selected region to signal a subtraction and later both touch points are moved inside an already selected region it is possible to cut a hole in the selection region, as shown in Figure 4(b). By repeating the different selection modes arbitrary regions can be selected using our selection technique.

Preliminary User Study

We were concerned that controlling more degrees of freedom simultaneously with our multi-touch selection technique could have a negative impact on its performance. As complex selection shapes are constructed as a series of simple rectangular selections we investigated how our technique performs for simple selections, in comparison to existing approaches. In a preliminary user study 21 participants performed a number of region selections with each technique. In each trial a target region that had to be selected was displayed. Participants were asked to select the target regions as precisely as possible. To validate our design (MULTI) we compare it with two selection techniques that have been frequently used in multi-touch environments: Touch and Drag (DRAG) and Selection Widget (WIDGET). With DRAG the user touches to place the first corner of the selection region and than drags the touch point to place the second

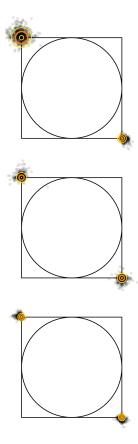


Figure 5: Touch positions relative to the target rectangle scaled to a unit square. Actual touches of DRAG (top) and MULTI (middle) are shown. The final position of WIDGET (bottom) is shown for comparison. Mean distances from the target corner are shown in orange. Yellow circles represent the standard deviation from these means.

corner. For WIDGET handles for modifying the selection are placed around the actual selection region.

Through observation of the participants during the experiment and examining the collected data we found a common pattern in the participants' behaviour. For DRAG all participants started their selection in the top left corner and extended their selection towards the lower right corner. Several users tried other directions during the training trials, but eventually settled on the top-left to bottom-right motion. All participants used their thumb and index finger for MULTI. The thumb was used to define the lower left corner of the selection, the index finger defined the upper right corner.

Figure 5 shows the touches recorded during the experiment relative to the target rectangle scaled to a unit square. As expected for DRAG the top-left corner is the most inaccurate one, because it is the one that could not be adjusted once it was placed. The adjustable corner of DRAG shows a similar precision to both adjustable corners of MULTI. In Figure 5 the touches of MULTI have been mirrored horizontally for a better comparison to the other techniques. WIDGET has the highest precision although it is closely followed by MULTI. Note that for WIDGET the positions of two corners defining the selection region were plotted to allow a comparison to the other techniques for which actual touch positions were plotted.

When our technique is compared to DRAG as expected the accuracy for the first corner is much better, because using DRAG it is initially placed and cannot be corrected afterwards. But the interesting result is that the accuracy of both touches of MULTI is similar to the single movable corner of DRAG. Even compared to WIDGET for which also only one corner of the selection area could be moved at a time the accuracy of MULTI is only slightly lower.

Conclusions and Future Work

We have shown that adapting rectangular selections to the new multi-touch environment instead of just transferring the mouse-based metaphor results in a better suited interaction technique. Using the increased expressiveness of multi-touch interaction our presented technique can naturally be extended to support refinements of selections through the use of context information.

The preliminary user study has shown promising results, so we would like to further explore this selection technique in our future work and examine the application of the context idea to other selection or interaction techniques. Especially the closely related lasso or free form selection tool will be the focus of our ongoing research in this area.

References

- [1] Hancock, M., Carpendale, S., and Cockburn, A. Shallow-depth 3d interaction: design and evaluation of one-, two- and three-touch techniques. In *Proc. CHI* 2007, ACM (2007), 1147–1156.
- [2] Latulipe, C., Bell, I., Clarke, C. L., and Kaplan, C. S. symtone: two-handed manipulation of tone reproduction curves. In *Proceedings of Graphics Interface 2006*, Canadian Information Processing Society (2006), 9–16.
- [3] Moscovich, T., and Hughes, J. F. Multi-finger cursor techniques. In *Proceedings of Graphics Interface 2006*, Canadian Information Processing Society (2006), 1–7.
- [4] Wigdor, D., Benko, H., Pella, J., Lombardo, J., and Williams, S. Rock & rails: extending multi-touch interactions with shape gestures to enable precise spatial manipulations. In *Proc. CHI 2011*, ACM (2011), 1581–1590.