Curve Dial: Eyes-Free Parameter Entry for GUIs

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ABSTRACT
In this demonstration, we introduce "curve dial" a technique designed to extend gesture-based interactions like FlowMenus with eyes-free parameter entry. FlowMenus, let users enter numerical parameters with "dialing" strokes surrounding the center of a radial menu. This centering requires users to keep their eyes on the Menu in order to align the pen with its center before initiating a gesture. Curve dial instead tracks the curvature of the path created by the pen: since curvature is location-independent, curvature dialging does not require users to keep track of the menu center and is therefore eyes-free. We demonstrate curvature dial with the example of a simple application that allows users to scroll through a document eyes-free.

Author Keywords
Eyes-free, FlowMenus, marking menus, dialing.

ACM Classification Keywords
H5.2. Information interfaces and presentation: User Interfaces, input devices and strategies.

INTRODUCTION
Gesture-based interaction techniques like those supported by marking menus [5] and FlowMenus [3] have been shown to offer users performance benefits over fixed position menus both for controlling functions/menus and for data/parameter entry in GUIs. There are two main benefits for the marking/flow menu approach. First, users do not have to acquire a menu target at some fixed position in the interface in order to initiate a function; second, users can initiate commands directly by gestures rather than navigate through a visual list of other commands. When learning the gestures, a persistent pie-shaped menu is available under the pen, directly at the location where the menu is invoked. The pie-shape approach of a visual menu, when used to support learning the gestures, ensures faster access to a specific command [4] than using lists. Use of the menus in the circle reinforce the gestures used to invoke commands. Thus, marking menus allow users to make menu selections based on muscle memory: a flick gesture up and to the left, anywhere on the screen, for instance, invokes a particular menu command. FlowMenus extend marking menus to support parameter input from letters and numbers to degree of zoom. However, FlowMenu's method for entering real valued parameters (rotating the pen around the center of the flow menu) is not eyes-free: users need to track the menu center visually in order to assure proper alignment while turning the pen.

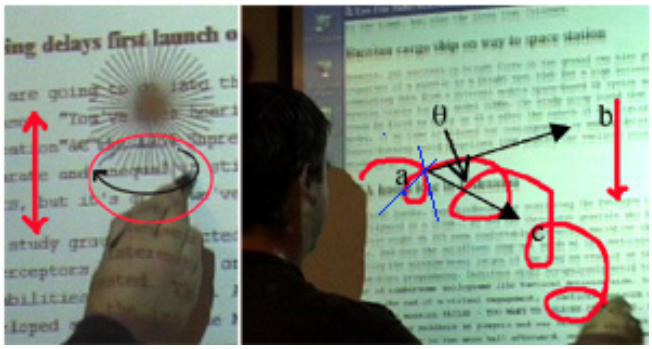

Figure 1: (Left) The problem: As the user is focused elsewhere on the screen, the dial motion drifts away from the menu center and the interaction degenerates – in scrolling, the document appears to bounce up and down (Right) Curvature offers the same dial functionality, but tracks the curvature arc rather than the center, making this technique eyes-free – here, as the user's hand circles clockwise across the document, the arc rather than the center is detected and the document still scrolls down.

We present "curve dial," a technique that tracks the curvature of the path created by the pen. Since curvature is location-independent, curvature dialing does not require users to keep track of the menu center and is therefore eyes-free, thus it can extend the eyes-free benefits of marking/FlowMenus to parameter entry. To demonstrate the curve dial technique, we created a test application to control speed and direction of scrolling in an eyes-free manner.

RELATED WORK
GUI-oriented eyes-free work has looked at approaches like marking menus to reduce visual attention for secondary tasks like making tool selections via gestures rather than menu traversal. The physical demands of newer GUI spaces, like large-scale displays, can also impose constraints where tool access may be at a distance from current focus [1]. Indeed, FlowMenus was invented in part both to bring marking menus to large displays, and extend marking menus to include parameter entry through menu-centered

CHI 2005, April 2–7, 2005, Portland, Oregon, USA.
ACM 1-59593-002-7/05/0004.

gestures [3]. Radial Scroll [7] adds continuous parameter entry to marking/flow like menus. Clockwise dialing gestures around a center point increase values; counter clockwise dials decrease values. The approach, influenced by Evans' turntable and stirrer controls [2] uses the Vernier effect: parameters like speed are controlled by the size of the circle made: the larger the circle the slower the increase in the parameter. Radial scroll, however, is not an eyes-free technique. Like FlowMenus, it relies on users making circles around a fixed center (Figure 1, left). Tests showed that, when focusing on a document rather than the widget, users regularly drifted off center, thus circling only part of the circle, effectively increasing and then decreasing a set of values. The result was that the document appeared to bounce up and down (Figure 1, right).

CURVATURE DIAL

Curve Dial, like radial scroll, takes advantage of the Vernier effect for speed parameter entry. Also like radial scroll, direction of the circles either increases or decreases values entered. Curvature dial solves the problem of drift by replacing detection of points around a center with the detection of curvature of an arc. While the curvature dial widget is activated, mouse position information is constantly sent to it. This information, along with past positional information, is used to determine curvature and hence scroll speed and direction. A minimum of three points, A, B, and C, are required to determine curvature. Initially the three points will be in a line forming two vectors joined head to tail. The second of the two vectors is transformed such that it shares a tail with the first thus producing two vectors *ab* and *ac* separated by an angle θ, as shown in Figure 2.

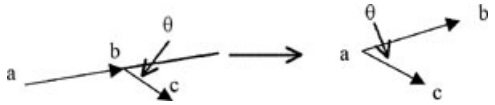

Figure 2 Recorded vectors and transformations

The three points used to determine curvature need not simply be the last three points received but maybe the first, third and fifth in the history list. A larger gap between points increases the smoothness of the response and decreases the likelihood of misdetection at the expense of over all responsiveness.

Informal user testing has shown that curvature dial does perform better than either traditional scrolling or radial scrolling on projection-based large screen displays and on Tablet PC's. Indeed, one of our immediate observations was that scrolling a document slowly on a plasma display with a touch skin, using the standard document scroll bars was nearly impossible: the scroll bar elevator had to be constantly re-acquired; that problem was eliminated with curvature dial.

CONCLUSIONS AND FUTURE WORK

We have demonstrated curvature dial, a simple yet powerful enhancement for marking/FlowMenu type interactions: curvature dial adds eyes-free, continuous, real value parameter entry. Contiguous with our work on Curve Dial, Moskovich and Hughes introduced the Virtual Scroll Ring (VSR) [6] which instead of the Vernier effect uses motion frequency and amplitude to control eyes-free scrolling. We are currently collaborating on a comparative evaluation to understand when the amplitude/frequency mapping of VSR and the repetitive/Vernier circling of Curve Dial may be most effective.

ACKNOWLEDGMENTS

Thanks to the IAM group participants, and to Ed Cutrell, MSR. Support has been partially provided by Smart Tea, CombeChem Project, UK, EPSRC GR/R67729/01.

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