The Look-At/Look-Through Interface: A Conceptual Test

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Abstract

On-screen keyboards have always competed for space with tasks being performed on the computer. Making the keyboard larger makes the individual keys easier to see and click, but decreases the available space for the task being performed. Making the keyboard smaller increases the available workspace, but makes typing more difficult. This project tested the efficacy of a layered approach, using a full-sized keyboard and full-sized workspace. The results indicated a significant improvement in productivity, suggesting further work on this concept.

Keywords

On-screen keyboard, computer access, screen space

Background

For a person with a severe disability who needs computer access, many options are available. For the person who has lost the use of both arms, but retained head control, one of the easiest to learn and use is the combination of a head-controlled mouse emulator and an on-screen keyboard.

When using a head-controlled mouse emulator, turning the head to the left and right moves the mouse pointer on the screen to the left and right, and nodding up and down moves the mouse pointer up and down. Mouse clicks may be produced with head-mounted switches, switches controlled by other motor sites, or by dwelling over a location. Studies have shown that head-controlled mice provide a high degree of control, and are an effective alternative to the conventional mouse (Angelo, Deterding, & Weisman, 1991; Anson, et al., 2002; DeVries, Deitz, & Anson, 1998; Kanny & Anson, 1991).

On-screen keyboards are graphical images of keyboards, presented on the computer screen, which respond to mouse clicks just as the physical keyboard responds to button presses. When the mouse is clicked over the image of a key on the keyboard, the character is sent to the foreground application. While this approach directly builds on past keyboarding experience, on-screen keyboards compete with the computer application being used (Wobbrock, Aung, Myers, & LoPresti, 2005). Making the on-screen keyboard larger makes typing easier, but reduces the available workspace.

Making the keyboard smaller preserved workspace, but makes selecting the desired key more difficult.

One possible solution to this problem would be to create a full-screen on-screen keyboard that could be looked-through (and acted through) to the underlying application program. Using such a system, the user could elect to look “at” the keyboard for typing, or “through” the keyboard to read what has been typed. Such a system would also provide a means of directing mouse action to the keyboard or to the underlying program.

Before an extensive development effort was undertaken to develop such a system, it seemed prudent to test the assertion that a larger on-screen keyboard actually improves typing speed, if it does not compete with the application program being used.

Methodology

As a test of the efficacy of full-screen keyboards, this study used dual-monitor computers. This approach is not recommended for individuals with disabilities, as the side-to-side movement required to both edit a document and type are too great for many people with neck injuries. Additionally, of the available head-controlled mice, only the HeadMouse Extreme had sufficient lateral range to control the mouse over two, side-by-side 19” screens.

Participants

48 subjects with ages from 18 to 41 (mean age = 22.5) were recruited for this study. 14 of the subjects were male, and 34 female. None had significant limitations in vision, hearing, or postural stability. While some of the subjects had brief experience using on-screen keyboards, none were practiced users.

Procedure

Subjects were randomly assigned to either the control or experimental group. The control group used a combination of WiViK (on-screen keyboard) and HeadMouse Extreme (head-controlled mouse emulator) on a single 19” monitor to type segments of the novel “Anne of Green Gables” (Montgomery, 1908) for 20 minute intervals. The on-screen keyboard was arranged to occupy the lower 20% of the screen for each subject. The experimental group used the same computers and assistive technology, but with a second 19” monitor attached. In this group, WiViK occupied all of right-hand monitor, and the word processor all of the left-hand monitor. Each subject typed six sequential segments of the novel, and speed and accuracy were recorded for each trial.

Because some users of on-screen keyboards complain of eye or neck strain produced by the intense concentration, each subject was also asked to rate their level of eye-strain after each trial using a 100mm scale.

Results

Subjects in the experimental group typed at an average speed of 7.9 words per minute, while those in the control group averaged 6.7 words per minute. This 15% difference was highly significant ($p<.01$), and indicates that the full screen keyboard allows faster typing, as predicted. There were no significant differences in accuracy if typing nor eye-strain, though the mean rating of eyestrain was higher in the two-screen group. It may be that this reflects the greater lateral movement required of this group, or it may be a result of the subjective nature of the assessment.

Discussion

The results of this study support the hypothesis that a full-screen keyboard and full-screen word processor allow faster typing than a system where the keyboard and activity compete for space. However, it is not suggested that individuals who use on-screen keyboards should have two monitors, for two reasons.

In the planning stages of this study, we had intended to use the three major infrared pointing systems that are currently available (Madentec Tracker Pro, NaturalPoint SmartNav, and Origin Instruments Headmouse Pro). However, in early testing, we discovered that neither the Tracker Pro nor the SmartNav have sufficient range to control the mouse across dual 19-inch monitors. This suggests that a two-monitor system would encounter technological constraints that are not acceptable.

Second, the neck motion required to control the mouse over two screens, typing on one and editing on the other, may be greater than what is available for an individual who has sustained a spinal injury. Our subjects were tested for neck range prior to inclusion in the study, but those in the two-screen study complained of eye/neck strain in early trials.

The concept of the Look-At/Look-Through interface is that the keyboard and productivity program are layered, so that the user can, by selective attention, look at the keyboard or through the keyboard to the underlying word processor. We have demonstrated that this is possible using heads-up displays, but are concerned that the gadget-tolerance of most people would not support such a solution. It may, however, be possible to use a combination of selective transparency and mouse-pass-through to produce an effective Look-At/Look-Through keyboard.

The effect of a full-screen keyboard in this study were much larger than expected. This strongly supports continued investigation of the concept. In conducting this study, we developed a means of constraining the mouse to either of the screens to support the edge-bumping used to recenter the mouse when using a mouse emulator, but need to also explore ways of changing the mouse-pointer to show whether the mouse is currently interacting with the keyboard or the underlying productivity application.

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