Gesture-based Tool to Enhance Accessibility for Low Vision Students

ABSTRACT

In this paper, we present a novel tool for low-vision students that provide an easy access to accessibility features through multi-finger gestures on the touchpad. Current operating systems provide a host of accessibility features such as zoom, voice-over and contrast. However, it takes a lot of time and effort to access these features, since they are hidden in a stack of menus. We hypothesize that our gesture-based tool to access the accessibility features will be faster and easier than menu traversing.

Keywords

Multi-finger gestures, accessible features, low vision

INTRODUCTION

Of the millions of students attending college in the United States, a very small minority is visually impaired [1]. Although they comprise such a small minority, they still use computer-based technology to access information at a large rate [2]. Unfortunately, with the increase in use, comes an increase in an accompanying number of physical maladies, such as eye, neck, and back strain. One way for these students to relieve their levels of discomfort and to increase their efficiency is to utilize the assistive features of the Windows operating system that already exists [6].

Accessibility features have been imbedded in the Windows operating system for many years. However, "Accessibility" features require an inordinate number of mouse or keyboard clicks to access them. The paper we present will outline how we created a novel system that allows a visually impaired college student to "access" the accessibility features of the Windows operating system with basic touch gestures.

Existing System

Even though existing operating systems (OS) provide accessibility features such as zoom, narrator, and invert color, the complex menu structure makes it difficult to access them. For example, in Windows 7 OS, these accessibility features are available to users within the Ease of Access Center inside the Control Panel. To control features within the Center, it takes user at least 6 clicks to reach them from the desktop. Some features are also available through elaborate keyboard shortcuts. For example, to toggle high contrast setting, a user needs to press left-ALT + left-SHIFT + PRINT-SCREEN. This shortcut is hard because in most of the PCs the Print Screen button is buried under Fn key and hence takes an additional key hold to press. Therefore, the purpose of our tool is to reduce this type of complexity and provide an easy way to access the features such as zoom and contrast for low vision students.

SYSTEM DESCRIPTION

During the brainstorming session, we evaluated the main accessibility features used by low vision users. We listed the five most frequent accessible features, which are 'Show Desktop', 'Zoom', 'Narrator', 'Contrast', 'Volume', and 'Speech'.

Table 1. Set of Gestures

Feature	Sub Feature	Type	Action
Show Desktop		Three finger	Single tap
Zoom	Access zoom	Three finger	Double tap
	Increase Zoom	Three finger	Slide up
	Decrease Zoom	Three finger	Slide down
Invert	On/ off	Three finger	Triple tap
Volume	Increase Volume	Two finger	Slide up
	Decrease Volume	Two finger	Slide down
Speech	On / off	Two finger	Double tap

Studies show that gesture interfaces provide a natural and intuitive way for users to interact with digital objects like we do with physical objects [5]. These gesture-based interfaces also suit low-vision users because they do not rely on a user's visual acuity like graphical user interfaces do. For our system, we studied the gestures that are in use in current Operating Systems, as well as the ones various touchpad hardware support. Our target platform, Microsoft Windows, by itself does not employ any multi finger gesture, but in some cases the hardware manufacturers provide services that let users customize various gestures to perform particular activities. We focused at using simple gestures while avoiding complicated gestures such as making a circle. The gestures we used are three-finger single tap for 'show desktop', three-finger double tap for 'zoom', three-finger triple tap for 'invert' and two-finger

double tap for 'speech'. To control zoom level, a user needs to slide up and down with three fingers and to control volume, user needs to slide up and down with two fingers. A summary of the set of gestures and their actions is shown in Table1. In case of zoom increase or decrease, we also provide an additional non-speech auditory feedback.

Our application runs as a background process without a graphical user interface. It can be manually started or can be set to start at boot. To familiarize the users with the gesture set, we also created a Training User Interface (TUI) with a practice module as shown in Figure 1. The TUI helps to train users through video and speech interaction and within the practice module users can perform a gesture and gain feedback about the action the gesture ports to.

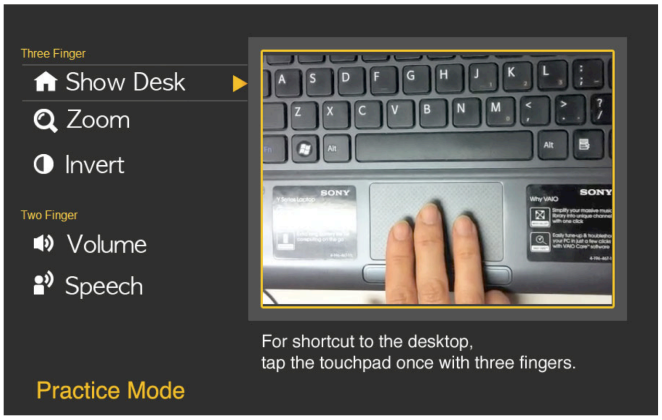

Figure 1. Training user interface

SYSTEM IMPLEMENTATION

Our High-Fidelity prototype can be deployed on any other machine running Windows OS and containing a Synaptics touchpad hardware (about 60% of laptops running Windows OS [3]). The application has been coded in C++, and has been built upon the open source two-finger-scroll project hosted at googlecode [4].

CONCLUSIONS

We presented a novel tool to provide an easy access to accessibility features through multi-finger gestures for low-vision students. Our preliminary results show that the low vision users easily perform the set of gestures. Future work requires us to conduct a thorough usability study with the users as well as incorporate additional features and set of customizable gestures.

ACKNOWLEDGMENTS

We thank Professor XXXXX, XXXX, for their valuable feedback on this study.

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