Chapter XXIX

Model-Based Target Sonification in Small Screen Devices: Perception and Action

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ABSTRACT

In this work, we investigate the use of audio and haptic feedback to augment the display of a mobile device controlled by tilt input. The questions we answer in this work are: How do people begin searching in unfamiliar spaces? What patterns do users follow and which techniques are employed to accomplish the experimental task? What effect does a prediction of the future state in the audio space, based on a model of the human operator, have on subjects’ behaviour? In the pilot study we studied subjects’ navigation in a state space with seven randomly placed audio sources, displayed via audio and vibrotactile modalities. In the main study, we compared only the efficiency of different forms of audio feedback. We ran these experiments on a Pocket PC instrumented with an accelerometer and a headset. The accuracy...
INTRODUCTION

One of the main goals of interaction design is to make the interfaces as intuitive as possible. In our everyday environments, humans receive a variety of stimuli playing upon all senses, including aural, tactile, and visual, and we respond to these stimuli. Even though hearing and vision are our two primary senses, most of today’s interfaces are mainly visual.

Visual interfaces have crucial limitations in small-screen devices. These devices have a limited amount of screen space on which to display information. Designing interfaces for mobile computers/phones is problematic, as there is a very limited amount of screen resource on which to display information, and users’ need to focus on the environment rather than the interface (so that they can look where they are going) so output is limited (Blattner, Papp, & Glinert, 1992; Brewster, 1997; Brewster & Murray, 1998; Johnson, Brewster, Leplatre, & Crease, 1998; Kramer, Walker, Bonebright, Cook, Flowers, Miner, 1999; Rinott, 2004; Smith & Walker, 2005; Walker & Lindsay, 2006); also, low graphics resolution and further constrain the freedom of interface designers. In new generations of mobile phones (e.g., iPhone) with high graphics resolution, power consumption for graphics rendering is high, which can adversely affect battery life; also, large screens can lead to physical robustness issues, as well as being very demanding of user attention in mobile scenarios.

One way around these problems would be sonically enhanced interfaces that require less or no visual attention and therefore, the size of the visual display and the portable device can be decreased; also, auditory interfaces potentially interfere less in the main activity in which the user is engaged. Consequently, the user may be able to perform more than one task at a time, such as driving a car while using a telephone or grabbing a cup of coffee while waiting for a mobile phone to finish downloading an image. Auditory feedback can often be a necessary complement, but also a useful alternative to visual feedback. When designing a mobile electronic device, it is difficult to predict all possible scenarios when it might be used. Obviously, visual feedback is preferred in many situations such as in noisy environments or when the user has to concentrate on a listening task. However, as there might be numerous occasions when a user cannot look at a display, versatile devices such as mobile phones or handheld computers benefit from having flexible interfaces.

Novel Interaction and Continuous Control

In the past 10 years many researchers have focused on tilt-based inputs, and audio and haptic outputs in mobile HCIs (Dong, Watters, & Duffy, 2005; Fallman, 2002a, 2002b; Harrison & Fishkin, 1998; Hinckley, Pierce, Horvitz, & Sinclair, 2005; Oakley, Ångeslevä, Hughes, & O’Modhhrain, 2004; Partridge, Chatterjee, Sazawal, Borriello, & Want, 2002; Rekimoto, 1996; Sazawal, Want, & Borriello, 2002; Wigdor & Balakrishnan, 2003). The results of these researches have proved one-handed control of a small screen device needs less visual attention than two-handed control and multimodality in the interaction can compensate for the lack of screen space. So these novel interaction techniques, that is, gesture recognition, and audio and haptic devices, are characterised by the significance of the temporal aspect of interaction and in such an emerging environment, the interaction is no longer based on a series of discrete steps, but on a continuous input/output exchange of selecting, exploration density, and orientation of each target was measured. The results quantified the changes brought by predictive or “quickened” sonified displays in mobile, gestural interaction. Also, they highlighted subjects’ search patterns and the effect of a combination of independent variables and each individual variable in the navigation patterns.
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