Multimodal Feedback for tilt controlled Speed Dependent Automatic Zooming

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The Goal

Speed Dependent Automatic Zooming proposed by Igarashi and Hinckley is a powerful tool for document navigation on mobile devices. We show that browsing and targeting can be facilitated by using a model-based sonification approach to generate audio feedback about document structure, in a tilt-controlled SDAZ interface. We implemented this system for a text browser on a Pocket PC instrumented with an accelerometer and headset, and found that audio feedback provided valuable information, supporting intermittent interaction, i.e. allowing movement-based interaction techniques to continue while the user is simultaneously involved with other tasks. This was demonstrated by a blindfolded user successfully locating specified elements in a text file.

Overview

- Speed-dependent automatic zooming (SDAZ) on mobile devices is a relatively new navigation technique[1] that unifies rate-based scrolling and zooming to overcome the limitations of typical scrolling interfaces and to prevent extreme visual flow.
- SDAZ is well suited to implementation on mobile devices instrumented with tilt sensors, which can then be comfortably controlled in a single-handed fashion[1].
- Touch screen position control is a new feature in multimodal SDAZ which lets the user freezes the screen by shaking the PDA and tap the screen to select the target. The system automatically scrolls to the target and gradually zooms in fully.
- The significant disadvantage of using motion as input in a handheld device is that it reduces the quality of the visual display for the duration of the input, due to reflections from the screen and difficulty in concentrating on a rapidly moving screen [5].
- We believe audio or vibrotactile feedback in such interaction scenarios may be crucial to support tasks or functionality on mobile devices that must continue even while the user is not looking at the display [3].

Figure 1. Pocket PC and accelerometer attached to serial port (1a). 3 screen shots of the document browser (1b) showing a red box moving rapidly over the picture(left), the user finding the picture and landing there(middle), and the zoomed in picture(right).

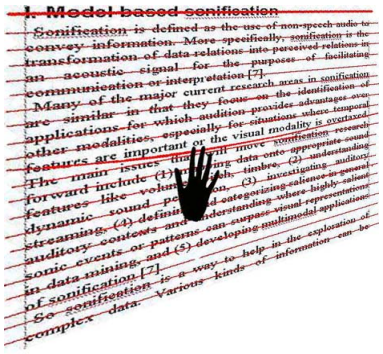

Figure 2. Simulating dragging over the text by exciting elastic band or guitar string. As an intuitive model of the sonification process for a document, we can imagine each line of the text on the screen as a string of guitar. When the user scrolls over the text he/she excites the string associated to each line and it gives a notion of embossed text .

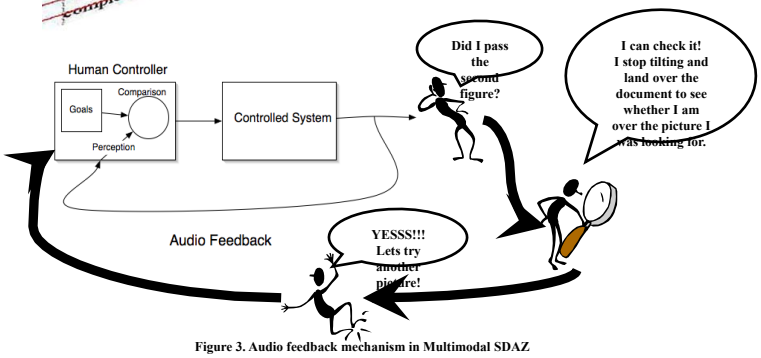

Figure 3. Audio feedback mechanism in Multimodal SDAZ

Scenario & Simulations

- Our scenario was reading and navigating documents on small screen devices using tilt input device (Figure 1.)
- Reading a document involves at least two forms of browsing; searching for specific pieces of information or reading all of the document.
- As an intuitive model of the sonification process for a document, we can imagine the text on the screen to be embossed on the surface. This embossed type excites some object (elastic band or guitar string, for example) as it is dragged over the text (Figure 2). In this fashion, the audio texture as we pass over the document gives both an impression of the structure of the text, as well as the speed and zoom level at which we are passing it (Figure 3).
- In simulation we draw an audio sample and place that in an audio buffer, as each line on type "hits" the cursor. This technique is a form of granular synthesis;
- The strength of excitation associated with higher rate-of-scroll changes the acoustic response of the system, (e.g. sampling frequency and volume of the audio sample).
- As the speed increases, headings, sub-headings, figures and tables become relatively more prominent, to give a better overview of the document structure (an audio equivalent of semantic zooming), because these structures have a higher priority than the standard lines of text.
- Volume and frequency have inverse relation to rate of scroll. At greater 'heights' the features are blurred and damped suitably. As frequency and volume of the audio samples decreases when the user is at full magnification, scrolling slowly gives distinct audio feedback for individual lines of text.
- The particular audio cues chosen in our implementation of the text browsing are:
  - Scrolling over lines gives the impression of the sound of typing with a teletype keyboard.
  - Passing over headers produces the sound of knocking a heavy object;
  - Sub-headers have less important role than headers so the audio is the same as header but with lower pitch,
  - The sound for figures gives the sense of dragging a large object.
  - The sound for tables highlights the tabular structure.
  - A change in zoom level, as e.g. in target acquisition in the position control mode, is accompanied by the sound of rushing air.

Experiment

- This study was carried out with an HP 5500 PDA with the Xsens P3C accelerometer and a headset (Figure.1).
- We mapped the cursor's position and movement to the audio space.
- Users worked with the software in two different modes:
  1. tilt-based SDAZ with audio feedback, but no visual display (the user did the experiment blindfold), and
  2. with visual display but without audio feedback.
- The results showed that the audio cue was sufficient for the user to distinguish when they passed the target, slowed down and returned to the target (Figure 4).
- In informal evaluation with a blind user, the user commented that ***"... [the system] has potential as a scrolling interaction for non-visual interfaces such as speech, but it has yet to be integrated with speech-based content. The sounds used are well-chosen from the point of view of controlling the speed of scrolling and drawing attention to key features in the document."***
- An interesting observation was that most users had a strong sense of vibrotactile feedback. A combination of the approaches seems a promising research direction.

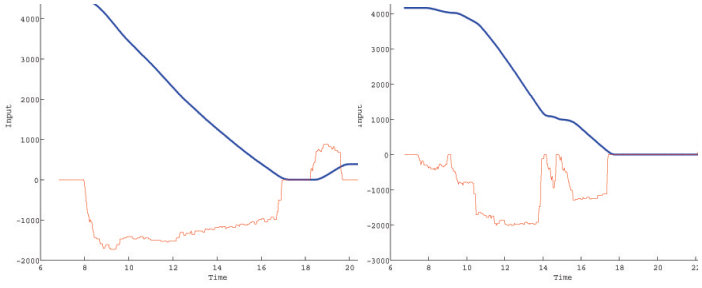

Figure 4. The left picture shows the user's trajectory and tilt angle input in audio only (Blindfold) SDAZ and the right picture shows the same user's data in visual only SDAZ. The trajectory and tilt angles are as smooth as the visual-only SDAZ .The difference here is the overshoot on the audio trajectory, while the visual one allowed an over-damped target acquisition because of the extra predictive power of the visual display. Speed of target acquisition is very similar in both cases.

Acknowledgments

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