

Auditory interfaces for blind computer users

Supporting cross-modal collaboration

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The use of computers today almost always requires that the user is able to see what is presented on the screen, a requirement that blind computer users are not able to fulfill. Many features of the graphical user interface are inaccessible for blind computer users; direct manipulation is one of them. Direct manipulation is a fundamental property of graphical user interfaces which makes the interface easier to use by presenting all objects continuously, allowing physical interaction, and giving immediate feedback on the user's actions.

The original object of this work was to find out if accessible direct manipulation could be beneficial for blind computer users. The main research questions were whether auditory direct manipulation was possible, if blind computer users could benefit from having auditory direct manipulation, and if this could support collaboration with sighted users.

In order to investigate this, an auditory version of the game Towers of Hanoi has been implemented according to the principles of direct manipulation. Three different studies were performed on this game.

The first study was an experiment where three different levels of continuous presentation were compared. The results from this study showed that with a limited set of auditory objects (4 discs in 3 different locations) the level of continuous presentation gave no significant effect on time to complete or number of errors.

The second study was an interview study with four blind subjects where qualitative aspects of auditory direct manipulation were investigated. The results from this study pointed out important qualitative aspects, such as using the mouse to focus in the auditory space and articulatory directness. The results point both at important implementation issues, such as providing a way to focus or filter the auditory space and supporting articulatory directness, and at qualitative experiences of auditory direct manipulation, such as reactions on interacting with a direct manipulation interface and how this could be used in the subjects' daily work with computers.

The third study was a collaborative study, where one blind and one sighted subject were to play the game together taking turns in moving the discs. Important collaborative aspects such as gestures and awareness was partly supported, but insufficient feedback on movements and difficulties to get a quick overview forced the blind user to sometimes having to ask about the state of the interface rather than using the mouse to look. Especially, the possibility to monitor the activity in the shared workspace when collaborating proved to be an important aspect that was not sufficiently supported in the auditory game.

This work is presented in my licentiate thesis: "Auditory Direct Manipulation for Blind Computer Users".

Currently, my research has started to shift focus from direct manipulation to computer supported cooperative work (CSCW). Interesting issues in this work is to look at collaboration between blind and sighted users, and more specifically how to support the blind user's interaction in a cross-modal collaborative setting, where the participants have different representations of the shared space. Import-

tant questions in this research are how to support synchronous collaboration and awareness, how to support pointing and other gestures in the auditory space, and the general concern how to present and interact with complex data using sound.

Questions to be discussed

- How to decide what to do next. What is a suitable system or context to study?
- How to involve the users in the design.
- What should the focus be? On collaboration in general or on specific aspects such as awareness.