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A Sonically-Enhanced Interface Toolkit

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ABSTRACT

This paper describes an on-going research project investigating the design of a user-interface toolkit composed of sonically-enhanced widgets. The motivation for this work is the same as that which motivated the creation of graphical interface toolkits: To simplify their construction; to allow designers who are not experts to create such interfaces; to ensure the sonically-enhanced widgets are effective and improve usability; and to ensure the widgets use sound in a clear and consistent way across the interface.

INTRODUCTION

Why should sound be added to human-computer interfaces? There is a growing body of research which indicates that the addition of non-speech sounds to human-computer interfaces can improve performance and increase usability (for example [5, 7]). Non-speech sound is an important means of communication in the everyday world and the benefits it offers should be taken advantage of at the interface. Such *multimodal* interfaces allow a greater and more natural communication between the computer and the user. They also allow the user to employ the appropriate sensory modalities to solve a problem, rather than just using one modality (usually vision) to solve all problems.

In spite of the increased interest in multimedia, little systematic research has been done on the most effective ways of combining graphics and sound, even though many computer manufacturers now include sound producing hardware in their machines. Arons & Mynatt [1] suggest one reason for this: "…the lack of design guidelines that are common for the creation of graphical interfaces has plagued interfaces designers who want to effectively build on previous research in auditory interfaces".

Using sound can be beneficial but, because this area is still in its infancy, sounds may be added in *ad hoc* ways by individual designers and this can lead to them being ineffective [2, 9]. The aim of the research described here is to help designers to create effective sonically-enhanced interfaces. This paper describes an on-going research project to construct a sonically-enhanced interface toolkit.

Aims of the toolkit

The four main aims of the toolkit are similar to those that motivated the development of graphical interface toolkits. These are:

- *To simplify the implementation of applications that include sound in their interfaces.* Currently it is difficult to create sonically-enhanced applications. It is difficult to write the code necessary to include the sounds because it is usually very device-dependent and time-consuming. This is a similar problem to that faced by graphical interface designers before graphical toolkits were available. Myers [8] suggests that the use of graphical toolkits significantly reduces the development time of graphical interfaces. This toolkit will do the same for sonically-enhanced interfaces.

- *To allow designers who are not sound experts to create sonically-enhanced interfaces.* Interface designers are not often skilled in sound design. A toolkit that has the sounds included would remove the need for detailed knowledge of sound design. This again follows the same approach as graphical toolkits in that an interface designer without a detailed knowledge of graphic design can create an interface using a standard graphical interface toolkit.

- *To ensure that the sounds added are effective and enhance the user's interaction with the computer.* The sounds added will not be gimmicks. Detailed investigations of usability problems will show where sounds can help usability. Sounds will be added to overcome these problems, so improving usability.

- *To ensure the sounds are used in a clear and consistent way across the interface.* This consistency will avoid the problems of each application having its own sounds that mean different things in other applications. In graphical interface toolkits, the widgets look consistent across different applications, e.g. a scrollbar looks the same in any application where it is used. In the sonically-enhanced toolkit, widgets will sound consistent across different applications.

This project brings together previous work on individual sonically-enhanced widgets to form a complete interface toolkit. In each of the widgets sound is used to support graphics. Part of the motivation for this research is that users' eyes cannot do everything. The visual system has a small area of focus. If users are looking at one part of the display then they cannot be looking at another at the same time. In highly complex graphical displays the user must concentrate on one part of the display to perceive the

graphical feedback, so that feedback from another part may be missed. It is suggested here that some information should be presented in sound. This will allow users to continue looking at the information required but to hear information that would otherwise not be seen (or would not be seen unless they moved their visual attention away from the area of interest, so interrupting the task they are trying to perform). Sound and graphics will be used together to exploit the advantages of each.

Sounds used
The non-speech sounds used for this investigation are based around structured audio messages called *Earcons* [3]. Earcons are abstract, synthetic tones that can be used in structured combinations to create sound messages to represent parts of an interface. Detailed investigations of earcons by Brewster [4] showed that they are an effective means of communicating information in sound.

OVERALL STRUCTURE OF THE TOOLKIT
Each of the widgets in a standard widget set will be enhanced with sound. The overall structure of the sounds will be as follows: Each application will have its own timbre and spatial location (via stereo) as a base for all of its sounds. All widgets within an application will use these and modify them by changing the rhythm, pitch, etc. Figure 1 shows such a hierarchy. At level 1, the three applications all have different timbres and spatial locations. These are inherited by level 2 and modified with pitch, rhythm, etc. These modifications are constant across applications so that widgets in different applications sound consistent (similar to graphical widgets that look consistent across applications). It is hoped that after using the system, users would come to associate a certain timbre with a particular application.

As an example, consider a button widget in the three applications in Figure 1. If a button was used in the Write application it would have the Write instrument, for example an organ, and stereo position, for example on the left. The button would have its own rhythm and note structure, for example a two note chord. In the Write application this chord would be played by an organ on the left of the stereo space. If the Spreadsheet application had a piano timbre and a right stereo position, then the same two note chord would be played but modified by that instrument and stereo position. In this way the earcons for each widget would be consistent across the whole interface (the button would always use the same two note chord) but would also fit with the sounds of the application of which it was part.

The sounds will be controlled by MIDI. Almost all current computer systems either have built-in MIDI-controlled synthesisers (for example on sound cards or via DSP chips) or can easily be connected to them. Using MIDI will also

provide an easy way for users to customise the sound Standard synthesiser control software can be used change the timbre or intensity of the sounds in any widge

SONICALLY-ENHANCED WIDGETS
Earcons will be used to overcome usability problems standard graphical widgets. The earcons will be design using the guidelines proposed by Brewster [4]. Each of t widgets in a standard toolkit will be analysed to discov any usability problems. From this analysis earcons will created for the auditory feedback. These new widgets w then be experimentally tested to ensure the sor enhancements improve their usability.

So far sonically-enhanced buttons, scrollbars, windows a menus have been implemented and tested. The results we very promising [5, 6]. For example, the sonically-enhanc buttons were given a significantly higher overall preferen rating than graphical buttons by users. The time a number of mouse-clicks needed to recover from erro were both significantly reduced. There was also difference in terms of annoyance between standard butto and the sonically-enhanced ones.

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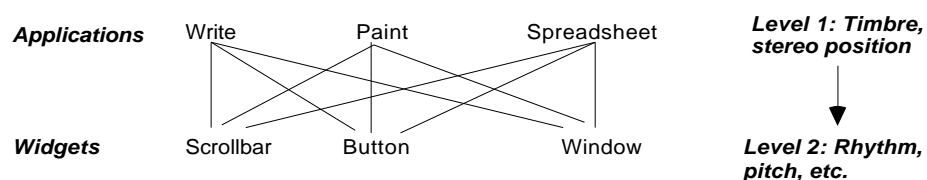9. Portigal, S. *Auralization of document structure*. M Thesis, The University of Guelph, Canada, 1994.

Figure 1: A hierarchy of sonically-enhanced widgets across applications.