BreakBits: Using Music to Facilitate Awareness in User Interfaces

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ABSTRACT
We discuss the possibilities of using music and sound to convey information about changes in a computerized environment, exemplified by the *BreakBits* interface. Our main concern has been to investigate how music can be used to promote users' awareness of the status of the computing environment, and augment relevant information, in a way similar to how film music contributes to how a movie is experienced. We have designed and evaluated a mockup application and our results suggest that musical computer interfaces is a promising area of research.

Keywords
Sonificated user interfaces, Music, Awareness, Audio

INTRODUCTION
Music and sound effects have long since been used in movie making, and recently also in computer games and multimedia, to emphasize and carry the visual message. The use of such non-speech sounds are vital to the story-telling in these areas, and a more or less structured musical language has developed, where certain musical attributes can be mapped to specific events, characters and moods. In our everyday life we use all of our senses to get a comprehensive view of different situations. For example, when driving a car, we listen to the engine to know when to shift gears. A discordant sound may attract our attention and tell us that something is wrong.

With the exception of computer games and multimedia, the use of sounds in computer user interfaces has been sparse and primarily concerned notification of specific, often erroneous events. A lot of work in this area has focused on adding sounds to specific objects, functions or events in a graphically dominated interface, as in Earcons [cf. 3]. However, some recent research has investigated the use of ambient sounds for conveying background information [5], and using musical patterns as information carriers [1, 2]. It has also been suggested that the development of musical interfaces should focus on how the emotional meaning of musical sentences, rather than its formal structure, can be used as a communication medium [3].

In this paper, we present our initial experiences with *BreakBits*, a computer interface that uses musical pieces and patterns to complement traditional interface cues about ongoing, dynamic processes, in particular to emphasize transitional states. We designed, implemented and tested a mockup of BreakBits, simulating a factory process with meters and levers, adding a musical dimension to it.

THE BREAKBITS PROJECT
The BreakBits interface is intended as a complement to the traditional, mainly graphical, interface. The aim is to help the user concentrate on the most relevant information by giving musical guidance. Rather than directly mapping different sounds to specific events, the purpose is to continuously present information about the status of the computing environment processes in an emotional and discreet manner. Thereby, the user would get an overall experience of the ongoing processes and a guidance to the most relevant information at a specific moment. The relevance of the information is described primarily by how prominent a certain part is in the music. When important transitions and deviations occur, such as when the load on one of the servers become too high, the music may get into a state more in the foreground of the user's focus. The following scenario illustrates the BreakBits concept:

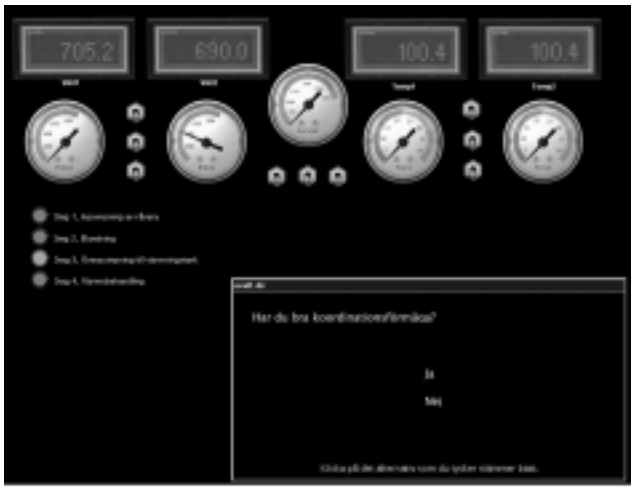

Figure 1: The BreakBits mockup interface

Susan is a system administrator. She is writing a report in a word processor when she remembers that she must upgrade one of the mailservers before lunch. She quickly launches the remote installation sequence and goes back to her word processor as a piano complements the already playing background music. After a while, the piano music is supplemented with a quiet drum rhythm. Susan knows that this signifies the initiation of the file server's automatic backup procedure. Since the music is laid-back and harmonic, she hardly pays it any attention and continues writing. A couple of minutes later, the drum rhythm gradually becomes louder and starts to slow down. Susan switches to the monitoring window of the backup procedure and discovers that it is soon about to run out of tape. She walks to the adjacent server room and loads a new tape into the backup device. Soon after changing tapes, the drum rhythm returns to its normal level.

In this example, BreakBits helped Susan to focus on the most relevant information from the system. Using a traditional in-

terface, it would be hard to actively monitor the different processes all the time. With BreakBits, she could concentrate on her writing and still be aware of important stages in the ongoing processes, allowing her to take action, before being presented with an annoying alert box. Many other processes were also active in the background, manifesting themselves in the smooth musical flow, but since they were of less importance to Susan at the moment, she did not pay any attention to them.

In addition to musical interfaces [1,2,3], BreakBits relates to research on ambient media [5]. The ambientROOM [5] uses sound in combination with other media to move information off the screen into the physical environment as a means to keep users aware of people or general states of large systems. However, this research has generally been about mapping events across different media using custom installations, rather than complementing already known computerized processes with another dimension. Another difference is our focus on music and musical patterns rather than discrete sounds or lights.

PRELIMINARY EVALUATION

The BreakBits interface was tested using a mock-up application, designed to resemble an industrial process monitoring system. LED displays, together with analogue gauges, monitored a fictive manufacturing process (see **Figure 1**).

We composed suitable music, where the harmonies, rhythms and events corresponded to the events and parameters in the manufacturing process. A raise of the temperature in the system caused the music to get slightly out of tune, a spinning wheel whose speed got below its ideal speed, caused a slow drum rhythm to appear, etc.

12 persons with various musical experience tested the application. They were supposed to monitor different parameters in the system, while at the same time answering multiple-choice demographical questions in a window, overlapping the "system interface", once without music, and once with music in combination with slightly harder questions.

Most of the users thought that the first test, without music, was very stressful and that it was very hard to know which part of the screen to concentrate on. Almost all users thought that the music in the second test helped them very well to distinguish between the different stages of the process. Many also pointed out that the music made them feel more relaxed, since they did not have to concentrate on the gauges and displays continuously. Several users commented that “time passed faster” using the musical interface. However, some of them thought that it probably would be annoying to hear the same type of music over and over again, which is coherent with the ambientROOM findings [5].

DISCUSSION

We argue that music could indeed be used to set a general mood, which could be used to represent the status of a computerized environment. However, in order to develop a more general way of using music to augment visual information, specific musical attributes and parameters have to be identified. Film music studies [4] show that movie music tends to use a rather predictable and well defined language, mapped to different kinds of moods, genders, characters and events. We believe it could be possible to define a musical language, mapped to processes and states in a computer, even when using music from very different genres.

Rhythm parameters, most specifically the tempo, is probably best suited for the representation of quantitative information, such as the speed of a file download, or the rate of hits on a web server. Tonal parameters (pitch, key, etc.), on the other hand, have to be used in a way that make the ‘interface music’ somewhat musical. The strengths of the tonal parameters are instead that they can be used to represent a large set of identifiable states, events and applications, within the computer environment, much like music can identify a mood, a character or even a specific actor in a film. Thus, the musical language becomes the information carrier, but specific parametres of the tonality and the sound should still be used to emphasize the actual messages. By using different instruments, the mapping to different computational ‘actors’ such as processes becomes even stronger.

CONCLUSION AND FUTURE WORK

In this paper, we have discussed some of the the possibilities of using a musical interface, complementing a traditional computer interface. We have performed an initial user test and our results indicate that there lies great potential in using music for conveying cues about computational states. However, there is much work left to be done in this area. Different musical parameters have to be studied in more detail and thorough user studies have to be performed. It is also important to be aware of the limitations related to this kind of interface. Music can be annoying for the user in the long run and it may also be disturbing for co-workers. Neither is it suitable to use music in a noisy environment or in other situations where the user probably wouldn’t hear it.

An interesting idea would be to allow users to create and share musical themes over the Internet, much like how ‘desktop themes’ and ‘skins’ are used today. This would allow each user’s musical taste and need for variation could be satisfied, and maybe this would create a new market for musicians. This implies, of course, that a common standard for musical parameters applicable on different musical styles have to be used.

We believe that there is need for computer interfaces taking advantage of humans’ extraordinary capabilities in using our senses to detect and react upon even small changes in a complex environment, sometimes partly without being aware of it.

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