Tapping into effective emotional reactions via a user driven audio design tool

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Abstract. A major problem when tackling any audio design problem aimed at conveying important and informative content, is the imposing of the designer's own emotion, taste and value systems on the finished design choices, rather than reflecting those of the end user. In the past the problem has been routed in the tendency to use passive test subjects in rigid environments. Subjects react to sounds without no means of controlling what they hear.

This paper suggests a system for participatory sound design that generates results by activating test subjects and giving them significant control of the sounding experience under test. The audio design tool application described here, the AWESOME (Auditory Work Environment Simulation Machine) Sound Design Tool, sets out to enable the end user to have direct influence on the design process through a simple yet innovative technical applications This web based device allows the end users to make emotive decisions about the kinds of audio signals they find most appropriate for given situations. The results can be used to both generate general knowledge about listening experiences and more importantly, as direct user input in actual sound design processes.

1. Introduction

Sounds, in the form of indicators, alarms and feedback signals, are often used to indicate current, passed and future events without communicating any properties of the actual event itself. When we need to give highly specific information, we almost always rely on text and graphics to do this crucial job. Our environment is jumbled with warning signs, instructive diagrams, signposts and a myriad of other information designed to catch our eye and retain our attention.

In a number of specific environments this is beginning to present real and serious problems. The amount of visual information available is so massive that the receiver becomes the victim of sensory overload. While this maybe purely annoying and may erode efficiency in some situations, in others such as truck cabs, control rooms and hospitals, this presents serious problems.

One method of addressing this problem of visual distraction is to shift certain information from the visual to the auditory channel of perception. While we do have some specific and recognised uses of audio signalling for safety awareness, fire alarms and car horns being the most obvious, we do not possess the same experience and routine for designing in the auditive environment as we do for the visual. In all aspects, resources, techniques, research, experience and training, the audio is inferior. This is not a question of quality, but of critical mass. Visual communication is overwhelmingly dominant.

This less than ideal situation creates the need to find new and innovative ways to design auditory messages and signals as clearly and unambiguously as possible.

Sound designers have access to a limited range of tools, methods, guidelines, software applications etc. for sound design as a carrier of this kind of information. As a result, sound designers must still largely rely on intuition and their own experience to create viable audio solutions to what have been traditionally graphical communication problems.

2. Background

Traditionally, research on auditory displays, music psychology and other sounding experiences has used traditional and well-established methods based on language or rating scales to capture the experiences and tacit knowledge of test subjects. Most often the tests utilize existing or pre-made sounds and music as input for the tests. The test subjects are asked to relate their experience in free text, by marking adjectives or rate the experience on scales. One recent, language-based, project drawing from earlier work in the field, is The Sonic Mapping Tool described in [1]. Here four challenges for the design of sound for contemporary computerized artefacts are identified:

1. A need to focus upon the context of use of sonically enhanced technologies.
2. A need to focus upon the growing complexity of interaction with non-speech sound in different forms of computerized artefacts.
3. A need to develop methods to provide insight into context of use and context of interaction.
4. A need to realize ways of presenting the insights gained from the methods in a way that is most appropriate to designers.

The paper referenced above describes three studies using natural language and different ways of structuring text-based "captures" and analyzes of the auditory environment to meet the challenges described above.

The absence of any common language for talking about sounding experiences is still a problem and finding taxonomies for listening experiences has been the aim of many projects. The same is true also for The Sonic Mapping Tool. One of the problems identified by the project mentioned above was that some participants were frustrated and confused by the process of trying to relate and map their listening experience to the relatively abstract terminology used in the test.

In "Music, A Very Short Introduction" Nicholas Cook writes "Writing about music is like dancing about architecture". The same could be argued is true for many sounding and listening experiences. The project described in this paper acknowledges the same challenges as those mentioned above, plus adds a new: a need to find non-language, non-text based methods to capture the hidden and tacit knowledge of peer users of sounding artefacts.

Sound and sound design can be described as a neglected area of competence, a fact that is reflected in the number of educations,

design methodologies and tools available. The tools available today are mostly built on a traditional tape recorder metaphor developed during the 1980's and 90's and there is a need to explore new and complementary tools.

This paper describes a work-in-progress project that builds on the Remupp (Relations between Musical Parameters and Perceived Properties) project [2]. Using this tool, a test subject can answer questions about music and musical experiences by utilizing the medium of music itself. The tool's interface allows a test subject to alter a piece of music to his or her satisfaction by manipulating a number of on-screen sliders. The task of the subject is to alter the music in such a way that it fits, as close as possible according to her/him, a predefined entity of some sort. The entity can for example be an emotion or concept expressed through a picture. By comparing the "answers" or "opinions" from the subjects, similarities and common denominators can be found, which in turn can be used to inform a sound design process. In the project described here, these ideas are taken to a broader sound design scope.

3. The AWESOME Sound Design Tool

AWESOME (Auditory Work Environment Simulation Machine) is a project that develops a collection of new tools for audio design. The project's objective is to create a set of supporting and enabling tools intended for people working with sound design. The aim of the project is also to start shaping a methodology and a set of guidelines for sound design by encapsulating knowledge and experience in the area in a set of software systems. These can then support both experienced and novice sound designers in their everyday work. This paper describes the design process of one of these tools – The AWESOME Sound Design Tool, hereafter called the Sound Design Tool.

The Sound Design Tool is a web-based client/server application that presents a number of scenarios together with specific tasks to test persons. The test persons are asked to use the application's interface to adjust a sound in accordance with the given task in the given situation. One task can for example be to adjust the sound to work as a collision warning signal and the situation can be that you are driving a car and the collision warning system is triggered by a child running out in the street.

The Sound Design Tool is intended to be a tool for designers, developers and researchers to engage peer and end users in the design of sounding messages. As such, the tool can be described as a tool for participatory design and follows the paths of this tradition at the same time as contributing new aspects of user involvement in design, development or research projects. By inviting a number of test persons and analysing their contributions, a test or design leader can get indications on what sound properties will best communicate an intended meaning.

Usage of the tool is divided into three phases. First the test leader prepares the system by creating two types of content. The first is a number of sound files that defines the available design space. The second content is a number of situations or Examples defined by a still image and a short text. In the actual tests, the test subjects are given these situations as context and the sound files as design material for the assignment.

In the second phase the subjects are given the prepared situations and are asked to manipulate the sound in such a way that it fits the assignment. The data generated by the subjects are stored in a database.

In the last phase, data gathered from the second phase is analysed by statistical and other means in order to find similarities and differences between how the subjects choose to design the sounds. The test or design leader can use the results from this analysis to inform a continued sound design process.

4. The Sound Design Tool System

The system is a web-based client-server application. The server side is a database of pre-made situations and sound files supplied by the test leader. The database also stores the results from the tests. The client side has two interfaces, one for administration used to prepare tests sessions and to extract data from past tests. The second interface on the client side is the subject's interface used to manipulate sounds according to the situations in the assignments.
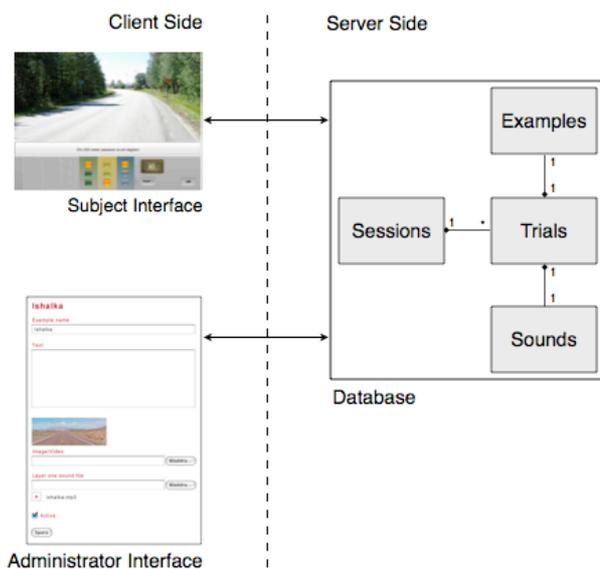

Figure 1. Overview of the system.

4.1. Server side

The server side database has four tables: Sessions, Examples, Trials and Sounds. Before a test begins, the test leader sets up a number of Examples and Sounds using the administrator interface. An Example describes a situation and consists of the following components:

a still image depicting the situation, a short text describing the situation and an optional background audio file.

The database table Sounds is used to store a three-dimensional matrix of audio files constituting the sound design space within which the subjects can manipulate the sound they are designing. Each axis in the matrix has three positions and each position in the matrix holds one, unique audio file. In total this gives 3 x 3 x 3 = 27 audio files, defining the total sound design space.
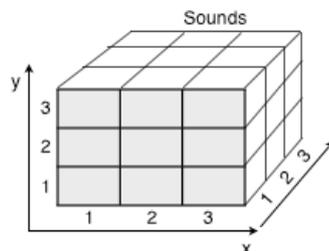

Figure 2. The Sounds database table.

Each axis corresponds to one sound property. The x-axis can for example be volume, the y-axis pitch and the z-axis room size or reverberation. Prior to a test round, the test leader fills the matrix with pre-rendered audio files. In order to function easily and reliably on the web and over platform boundaries, the system does not do any sound processing on its own. Instead it is designed to use pre-rendered audio files. This in turn means that

there is currently no possibility to use continuous parameters. Instead each individual combination of discrete parameter positions/settings points to one unique and pre-rendered audio file. Another advantage with this design is, that since the sound properties are not modulated by the system, but are pre-rendered into the individual audio files, any combination of sound properties are possible and allowed by the system. Note that the number of positions on any of the axis's can be individually changed and adapted to special needs.

The database tables Sessions and Trials are used to store data from the actual tests. Sessions holds the overall information about the test subjects such as gender, age and test specific information. Trials holds the data entered by the subjects during the tests.

4.2. Client side

The client side has two interfaces, one for administrators and test leaders and one for test persons.

4.2.1. Administrators interface

Using the administrator interface, the test leader performs three main tasks. The first is to create new and/or edit existing Examples. This task includes uploading still images to the server, editing the descriptive texts and optionally uploading background sound files.

The second task is to upload the sound files that defines the available sound design space and assign each a unique position in the three-dimensional Sounds database. Note that the system does not include any functionality to create or edit those basic sound files.

The third task carried out using the administrator interface is the export of data from the system. Data is exported as standard tab-separated text files, making it easy to import the data to Excel, SPSS etc. for further analysis.

4.2.2. Test person's interface

The test person's interface is an Adobe Flash application consisting of two main areas shown in Figure 3.
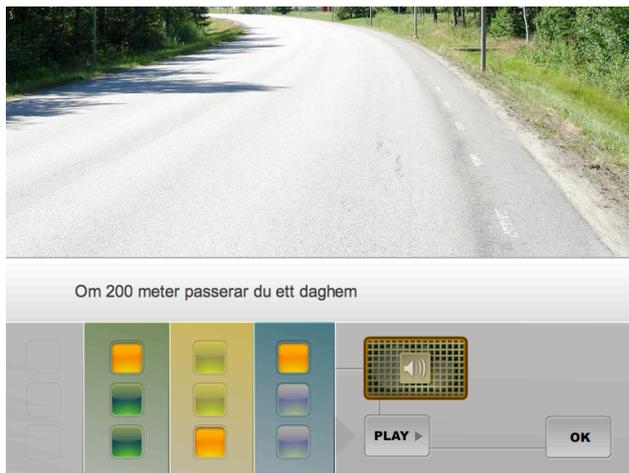

Figure 3. The Sound Design Tool's test person interface.

The top-most area holds the context to which the sound under construction is to be related. The context is expressed through a picture and a short describing text. The second part, at the bottom of the screen, holds the buttons with which the user interacts with the application. Figure 3 shows the test person's interface with a context in the form of a picture and a short descriptive text.

The sound is manipulated using nine buttons in three columns below the picture. Each column represents one sound parameter that can be manipulated in three steps or levels. When the user selects a button in one of the columns, the sound file corresponding to the current combination of buttons is played. When the user clicks the PLAY-button, the sound corresponding to the current button combination is re-played. Clicking the OK button advances the user to the next Example.

Note that the system allows any combination of sound parameters to be tested. The buttons of the three columns merely points to unique, pre-rendered sound files in the database. Since the system does not synthesize any sound itself, different tests can be carried out simply by exchanging the pre-rendered sound files to others containing different sets of parameters.

5. Pilot study

A pilot study was conducted as part of a project on the design of sounding warning signals for vehicle drivers and for specific traffic situations. The aim of the pilot study was to address questions about the usability of the system and in particular the test persons experience of the test situation, the user interface and the available sound design space.

In the pilot study the test persons was presented five traffic situations, two of high urgency (collision with child and collision with other car), two of relatively low urgency (approaching parked school bus and approaching cyclists). The fifth situation was a speed camera ahead.

Instructions presented on the screen introduced test persons to the design task. Neither the sound parameters nor the characteristics of the traffic situations were revealed in the instructions. By clicking a button the test persons continued to the first driving situation. The five situations were presented in random order and the test leader was present during the test but participants were not allowed to ask any questions unless they got stuck. After the last traffic situation, the test persons were given a questionnaire containing 15 statements related to the usability questions addressed in the study. They were also allowed to write freely about any issues experienced while using the interface and suggest improvements.

The sound parameters used in the pilot study where musical parameters corresponding to register (pitch), harmonic complexity (amount of dissonance) and rhythmic density (number of notes per time unit). The musical sounds where played by string instruments.

6. Results

For the two most urgent traffic situations, a majority of the drivers preferred the highest level in all three parameters. It was assumed that drivers would perceive the speed camera situation as the least urgent situation. This situation showed opposite patterns in all three sound parameters compared to the two most urgent situations. The other two, less urgent, situations tended to have rather even distributions with a small peak in either the low or medium levels of the parameters.

Based on previous research on sound parameters and urgency it is reasonable that drivers would associate more urgent situations with a high register, more tones per time unit and a higher level of harmonic complexity. The clear tendencies indicate that the test persons were able to actively manipulate the sounds to make them correspond to the situations.

About 80 % of the test persons choose the highest level of harmonic complexity in the most urgent situations. This indicates that the predefined design space was not adequate for such urgent situations. In the questionnaire two test persons explicitly stated they were not able to design signals that sounded urgent enough for the most urgent situations. It is reasonable to believe that many drivers would have selected

sounds with even higher level of sonic urgency if that had been possible.

In general, most of the test persons found the interface easy to use. A couple of test persons experienced difficulties in the very first Examples. 6 of the 40 test persons stated that they did not understand directly how to change the shape of the sound using the interface. 3 test persons got stuck in the first example and had to ask the experimenter for assistance. One of the test persons suggested that a practice example at the beginning of the test would have been helpful.

Results from the questionnaire showed that the test persons were comfortable expressing themselves using sound. They seemed to like the interactive and nonverbal concept. Almost all the test persons answered that they would prefer using the tool compared to expressing themselves verbally. They answered that it is appropriate for them to participate in the design of warning signals and also found the participation meaningful. 4 test persons wrote that they would have preferred the possibility to go back and change previous designs. The current version of the tool does not have such a feature. In the present study the idea was to collect spontaneous opinions from drivers. Although, in other types of studies it may be preferable if subjects are allowed to compare situations and designs.

Most of the comments related to the design space were related to the musical timbre used for the sounds. 11 test persons wrote that they felt restricted by the sound of string instruments. Also, as mentioned previously, some drivers found it impossible to design sounds for the most urgent situations. Selecting parameters and levels within parameters that suits the design task may be one of the mayor challenges for developers attempting to use the tool.

7. Future works

A number of new studies that use the AWESOME Sound Design Tool are planned or discussed. In these studies we do not plan to do any alterations to the basic system design. In the study presented here the parameter space was defined by musical sounds. It at least one of the future studies, we are going to base the available design space on sound effects.

References

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