

THE DEVELOPMENT OF A METHOD FOR DESIGNING AUDITORY DISPLAYS BASED ON SOUNDTRACK COMPOSITION

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ABSTRACT

This paper details work toward the design of a method for creating auditory displays for the human-computer interface, based on soundtrack composition. We begin with the benefits to this approach before discussing methods for auditory display design and the need for a unification of different design techniques. We then outline our on-going investigation into the tools and techniques employed within the working practices of sound designers and soundtrack composers. Following this we report our observations of the main priorities that influence how composers create soundtracks and propose ways in which our method may support these. We argue that basing the first steps of the method on a 'cue sheet' could enable designers to identify actions, objects and events within an HCI scenario whilst taking into account the user and the context of use. This is followed by some initial observations of a preliminary study into whether a participant can successfully use this cue sheet methodology. We conclude by identifying that certain elements of the methodology need to be changed: Further investigation and subsequent design needs to be carried out into ways participants can successfully comprehend and systematically use the cue sheet to identify seen and unseen events, actions and objects within the human-computer interface. Additionally we need to investigate how best to categorize and map these elements to sound. We conclude our paper with our plans for future work

1. INTRODUCTION

Sound and music in both a soundtrack and in multimedia are used to represent information; support and reinforce action; reveal meaning; direct attention; cue memory and engage and encourage interaction [1]. Multimedia has been defined as concurrent use of data, in different forms [2] with the use of the computer or other electronic devices to present this information. When sound is used in the computer to present information it is referred to as an auditory display [3].

The process of designing sound suitable for both an auditory display of information within the human-computer interface and a soundtrack, involves identifying significant points at which objects, actions, characters and events need to be represented in audio in order to communicate meaning [4]. There exist, for example, several established techniques for creating auditory displays. These include *Sonification* whereby one or more streams of data are mapped to sound and sound in turn is used to monitor changes

in data and the use of *Earcons* and *Auditory icons* to represent actions, events and objects within the human-computer interface [5].

Soundtrack composers often rely on intuition and creativity when choosing, placing and creating the sound. However, there exist well-established tools and frameworks to support and to some extent hone this creativity through its various stages [4]. It has been pointed out that there is a lack of widely used methods for developing auditory displays, and that many publications reporting auditory displays lack design rationale or an explanation of the methods used for auditory display creation rendering the methods and for their creation unattainable for novice designers [6, 7, 8]. Whilst there is a lot of research into the aforementioned techniques of sonifying data, creating auditory icons and designing earcons, lacking is the knowledge of how to methodically select and or combine these different display elements when faced with the challenge of creating an auditory display. As a result, we argue that the creators of auditory displays can benefit from the tools and frameworks that soundtrack composers are at liberty to employ to support their craft and production choices. We think that the practice of creating auditory displays could be supported by similar tools and guidelines which will not only lead to auditory displays that are aesthetically pleasing (something [9] has pointed out is needed) but that also support a creative, methodically unified and accessible approach to their creation.

1.1. Aim and approach

We aim to develop a method for creating auditory displays that is based on soundtrack composition. The method will support creativity and keep under consideration a number of approaches to auditory display design that will see the design process through from its conceptual stage to the production stage. We begin the development of our approach by aiming to comprehend the practice of soundtrack composition (as a result of a literature search and an on-line survey) and the tools to support the different stages of creation. We have added to this investigation through an exploration of whether HCI scenarios involving user interaction with auditory displays can be treated in a way similar to scripted scenes. This will make up the first steps of the method; a model of which is presented as part of this paper.

1.2. Structure of paper

This paper begins with an overview of auditory display design. In section 3 we then provide insight into the function and practices of

soundtrack composition. Within this section we present the aim, questions and results of our, ongoing, on-line survey into the current working practices of soundtrack composers. This includes the identification of design principles we feel to be important to composers and as a result, should be supported by our final method. In section 4, we then bring the two areas together in section by presenting our draft model for the proposed method, based on similarities between auditory display and soundtrack creation. The start of the early stages of this method involves techniques for treating an HCI scenario like a scripted scene. As a result, in section 5 we discuss our early study into the feasibility of operationalizing the first steps of this method. In section 6 we conclude our work and in section 7 we discuss ideas for future research.

2. CREATING AUDITORY DISPLAYS

An investigation into the available guidance and the current practices of auditory display designers was carried out by Frauenberger and Stockman [6, 7]. The authors carried out a survey involving 86 participants from a general HCI background. The survey aimed to investigate the approaches that the HCI community took to auditory display design and the sources of any support or guidance. They concluded that, whilst the majority of participants saw some benefit of using audio in the interface, there still existed the view that audio is a medium with which many designers felt unfamiliar, lacking guidance and unclear how to use.

Interestingly, the authors discovered that the auditory display design process was largely considered to be a craft-based exercise, regarded suitable for musicians or professional sound designers. To exemplify this, one of the participants of their survey observed that the creativity involved in sound design and composition may be hard to capture. As a result the authors argued for a framework that unified the different approaches taken for the design of auditory display and a way to capture and transfer this design knowledge.

2.1. Methods for auditory display design

2.1.1. Narrative and task-based design

Designing for human computer interaction (HCI) often employs scenario-based design [10]. Scenarios are concerned with the tasks and the users involved within the interaction. They are stories and have narratives that explore what potential users of a given system do when engaged in a particular activity [10]. Importantly they take into account the user and the context in which the action takes place. Scenarios involve settings, and have a plot involving a sequence of actions and events, things that actors do, things that happen to them. Scenarios can be represented through various forms from textual narratives; storyboards; videos or scripted prototypes and are often developed using simple sketching tools such as paper and coloured post-it notes [11]

The use of scenario and narrative to inspire sound design for human-computer interaction is not new. The affordances of the desktop metaphor were observed by [12]. They argued that every component within the desktop has its own story to tell and that narrative takes the metaphor a step further by including time into its function which means that behaviour becomes possible. [13] also developed a database of 'EarBenders'; stories about peoples interaction with sound, and used them to provide useful structural information for the design of auditory displays, based on ways that

people hear sounds. An exploration into ways narrative sound design strategies from film can be applied to the design of interactive commodities was carried out by [14]. They claimed that finding narrative in "natural" sounds helped create aesthetically fitting mixes of everyday fictional sounds.

2.1.2. Action and event based design

Closely tied in with the use of scenarios and narrative to support the design of auditory displays is the task of identifying actions and events within an HCI interaction scenario. Specifically, the task of identifying this information in order to map it directly to sound. Stephen Brewster et.al devised a method that analysed interactions within the human-computer interface in terms of event, status and mode (ESM) information [15]. The ESM method supports the analysis and categorization of this information in order to decipher what feedback is needed to present it. Specifically the ESM method proved useful for identifying and sonifying information that remained hidden from the user in the interface. Events were seen as 'something that happens at a discrete point in time' and remained action dependent. In contrast the state referred to any persistent value that the user could use to perceive the given state of the system and remained action-independent. The mode of the system referred to any state within the system in which a certain interpretation is placed on information. Interestingly Brewster et.al referred to two types of sound suitable for representing ESM information within the interface. The authors argued that sounds that represent events need to occur at the time of the event and be demanding in nature. Whereas the sounds used to represent status need to be sustained and avoidable. The sounds used to represent mode needs to be demanding, but can last for both long and short durations of time. In addition to these guidelines the authors propose that sounds can be either static or dynamic depending on whether the feedback changes whilst it is being presented.

It is of interest to consider user-action as a trigger for information about a system and in turn, the feedback required. A notation system for user action within the interface was devised by [16]. Whilst this research did not directly relate to the creation of auditory display, it still provided useful guidelines into how user action relates to direct feedback and state change within the interface. Specifically the authors proposed that user actions and associated tasks can be combined with temporal relations such as sequencing, interleaving and concurrency to describe allowable time related user behaviour (p153). "*it would be nice to have each indication of feedback side-by-side with the user action that caused it, so the two can be associated*"

2.1.3. Ecological and contextual design

Providing the rationale for design decisions is useful in making design approaches re-usable and explicit [17]. Arguably, one such angle on this approach is to make explicit the context in which the auditory display is to be used. Relating to this are recent developments in auditory display design that draw inspiration from the argument that the mobility and ubiquitous nature of contemporary technologies needs to be taken into account [14]. Recently, [18] asked designers to consider the different sounds within the display in combination with the different sounds, external to the display, but remain audible whilst the display is being presented. These approaches to designing auditory displays also cater for how the differing sounds (those within the interface and those of the environment) mix and combine and the effect they have on one another

when creating an entire display. Specifically, this approach adopts principles of acoustic ecology, a field of research that concerns the effect and composition of the acoustic environment. In relation to auditory display design, acoustic ecology has shaped the investigations of researchers such as [19, 20]. Similarly, [18] argued that acoustic ecology can help identify issues that may arise when introducing ‘sonically enhanced artefacts’ into an existing auditory environment.

2.1.4. Composition and musical design

The understanding of how different sounds combine within an auditory display was considered by [21] with the investigation of how auditory icons and sonification can be used simultaneously within the interface. Similarly [22] attempted to create a system that allowed designers to combine music and sound effects for the interface for both a telephone network simulation and a parallel computation simulation. Arguably, this can be seen as a fore-runner for the consideration of how everyday, contextual, environmental sounds combine with audio in the interface (as referred to in the previous section). The aesthetic nature of auditory display was an issue for [23] when they created *AeSon*, a toolkit for the creation of aesthetically pleasing displays. The authors supported this creation with the argument that aesthetic design can enhance the communicative power of the data it supports. The use of music as a communicative medium was explored by [9] in relation to auditory interfaces. They proposed that there were not enough guidelines for non-musical designers. Similarly [24, 25] explored the use of musical-based grammar for the design of earcons and ways that the construction of small musical units can form to create larger musical phrases with the power to communicate complex meaning.

2.1.5. Summary

This is not a complete overview of the different approaches to auditory display design but demonstrates the broad nature of the ones that are in existence. To summarize, it has been argued that needed is an approach to auditory display design that permits designers to access the available knowledge about how to go about creating an auditory display [7] as well as taking into consideration the context of use [18]. In addition there is arguably a need for designers to be able to construct the sounds in a systematic way and time-based way whereby sound choices relate directly to the feedback needed to communicate information about user action and events within the interface. Additionally it is important that the sounds are considered in relation to other existing sounds, albeit sounds used within the interface itself, or existing in the location of use. We argue, that these needs can be met by an approach to auditory display design that is based on soundtrack composition. Therefore, what follows is an overview of the different functions of a soundtrack and compositional approaches.

3. COMPOSING SOUNDTRACKS

There are multiple functions of a soundtrack: the musical underscore can be used to establish setting; specify time and place; create atmosphere and mood, reinforce narrative progression; smooth over editing and provide rhythm to a series of images [26]. In addition to this character development and associated events can

be communicated through recurring and developing musical motif. The music within a soundtrack can also help establish a sense of structure and order to the narrative [27]. Sound is also used to draw attention to both on-screen and off-screen elements. The structural properties of the sound can help draw attention to aspects of the visual scene, for example when specific properties of visual objects match similar properties of the music [1]. One such technique to achieve this in film and radio soundtrack is through the art of Foley which involves the live synchronization of sound to an on-screen action.

One stage in the process of creating a soundtrack involves the unification of the separate tracks of music, speech and sound effects (STEMS) to make a seeming whole [28].

Important to this process of overseeing the construction (composition), conceptualization and design of a soundtrack is the notion that the tracks (music, sound effects and dialogue) do not exist in isolation and all contribute equally to the effectiveness of the soundtrack to communicate meaning; support action; enhance the story; smooth over the editing and develop narrative. In terms of the artisty this can afford, the different ‘types’ of sound can be used to inspire each other for dramatic effect. Often this fuels the creative approach of the people working on their part of the soundtrack. For example, it is possible to make sound effects purposefully ‘musical or construct the musical score out of ‘everyday’ sounds that belong (or have belonged at some point) to the on-screen action¹. Importantly, this emphasises the fact that all sound is added, constructed, composed and designed and that no sound ‘comes’ with the images, despite how it might seem [29]. To summarize, there is creative scope within the role of the soundtrack composer and there are frameworks and tools to support this.

In his book, *Sound Design: The Expressive Power of Music, Voice and Sound Effects in Cinema*, Sonnenschein offers a detailed set of guidelines suitable for starting the creative process [4]. Firstly, he suggests ways to begin simply by using pen and paper to sketch and visualize initial ideas for sound. He identifies the following ‘voices’ to listen out for, namely by identifying and circling explicit words and phrases within the written script: *People, objects, actions, environments, emotions and transitions (between scenes and themes)*. Sonnenschein suggests representing these ‘voices’ by marking their occurrence along a vertical timeline. This method is based on a *cue sheet*, a hand drawn map of the sound, traditionally generated by the sound editor as a guide for the re-recording mixer to follow the dialogue, effects and music tracks, along a time-line of minutes and seconds.

In order to understand how to operationalize the use of the frameworks and tools described, it is essential firstly to develop an understanding of how they are used in practice. The survey we describe in the following section is a first step in trying to do this

3.1. The Survey

As a means to appreciate the processes behind creating a soundtrack we have initiated an on-line survey, targeted at practising composers and sound designers. The main purpose of the survey is to gather this information directly and compare professional, semi-professional and textbook based methods. The questions we included in the survey are outlined below:

¹for example in the film *Atonement* (Dario Marianelli, 2007) we hear the sound of a type writer matched to the on-screen action. This then becomes part of the musical underscore

1. What do you create soundtracks for? For example silent film, existing film with previous audio, your own films, TV, radio, gaming, interactive art, other?
2. What would you say is the function of a soundtrack?
3. What software do you use when composing/designing sound?
4. When you are first presented with a script or piece of footage, what are the first steps you take toward creating a soundtrack?
5. Are there any particular things you 'listen out' for, or identify in the script or footage that may inform the soundtrack?
6. How do you represent your initial ideas?
7. How do you organise your materials once you start working?
8. How would you describe your process of working?

3.2. Method

The survey is currently on-line ² and the link to it has been sent to the post-production sound department at the National Film and Television School in the UK. We have also contacted staff running the postgraduate sound design and film composition courses at Bristol University, The university of Sussex, Glasgow College of Art and Kingston University.

To date we have had 12 responses. Whilst we acknowledge that this is a small number of returns, we point out that this is a new and on-going study and expect more responses.

3.3. Outcomes and design principles

From the current survey results we have extracted a number of significant approaches and principles that are important to the way composers create soundtracks and we feel, as a result, should be supported by our method. However, it is important to note that because the survey is on going, if necessary, the principles will be refined as as further responses are received.

- To be able to review the footage or script before working or hearing sound
- To develop themes and ideas separately from the footage/script and to be able to explore and sketch ideas freely and iteratively (drawing / visualizing)
- To review quality and impact of the footage/script as a whole composition and to think about each sound in relation to other sounds presented within the scene
- To organize sound materials once working into categories based around different ideas or cues (location of sound within the scene)
- Flexible ordering and way of working. To easily switch between tasks and adopt a potential non-linear approach to working with narrative
- To have time and the means to be able to identify the following due to the direct relation they bear to the audio choices
 - Emotions in the scene
 - Rhythm of the scene
 - Events, Objects and Actions (elements) within the scene

4. METHOD DEVELOPMENT

4.1. Auditory display meets soundtrack composition

The priorities and principles of sound track composers demonstrate the importance of narrative or to be more precise, the structured ordering of actions, events and themes along a time line. When producing a soundtrack the footage (scene) that the composer is working with needs to be initially mapped out for review in order to identify and mark key points in the scene alongside reviewing the emotional content, intent and pace of the scene (due to the influence this has on musical choice). Therefore, when considering the creation of an auditory display it may benefit the designer to think about the particular scenario that they are designing for as a scene. To be able to have the means to identify key points suitable for sound alongside the general context of the action involved in the scenario (something that could possibly relate or translate as the emotion and pace of the scene). For example the users involved and the context of their interaction with the auditory display may well effect the sound used.

It was proposed by [30] that writing scenarios for the specific purpose of sound design for interactive commodities could be inspired by the approach adopted by scriptwriters of fiction films.

Drawing together ideas for creative sound design as proposed by Sonnenschein [4] and the use of scenario development for sound design as suggested by Pirhonen et.al, [30] we developed the first steps of our method. Whilst we have been influenced by the work of the latter in terms of the steps used to create scenarios, are work did not involve a workshop setting and group discussions over sound design choices.

We wanted to design our method so that it directly employed approaches advocated for soundtrack creation and could support the processes and practices involved, so we created a model based on parallels between the two.

Figure 1. illustrates a comparison between auditory display and soundtrack creation in regards to the techniques employed and suggested order of creation. This model represents the underlying structure of our proposed method.

4.2. The Cue Sheet

Based on our early stage method, demonstrated in steps 1-3 of our model we created a cue sheet (see Figure 1). The cue sheet was designed to be a structured and systematic way to gather information regarding the different events within an HCI scenario and ideas for how these might relate to sound. The cue sheet was made up of 8 columns with time represented on the vertical axis and space on the horizontal

(see Figure 2). The columns were labelled as follows:

- Time/place and character(s) involved
- Actions
- Objects
- Attributes and Descriptions
- Sound Association (yes or no)
- Cause of sound and what the sound may be
- Type of Sound
- Category: (Music, speech, sound effects)

²www.surveymonkey.com

5. THE STUDY

We performed a study in which we got participants to explore ideas for an auditory display using an early stage version of our cue sheet.

5.1. Aim

1. To investigate the usability of the first part of the method and gather insight into whether utilizing a cue sheet methodology to identify action, events and themes within the HCI scenario is usable.
2. To provide means for participants to consider the whole soundscape and context that audio display will be used in
 - Inspire creativity from the soundscape when thinking about designing sounds for the display
 - To let sounds inspire sound effects/music crossovers, by providing means for designers to think about whole composition
3. To measure the amount of learning needed to use the method and the level of help required at this stage and ways we may develop tools to support this.
4. To gather initial ideas for how we may classify, categorize and subsequently provide access to the different types of sounds involved.

5.2. Scenario design

We designed 3 scenarios, using an approach similar to that described in steps 1-3 from [30]. We intended the scenarios to represent the benefits of using sound in the interface and offer designers, new to the process, a simple demonstration of some significant uses of auditory displays. The first scenario involved a student interacting with an MP3 player without a screen (inspired by the design problem presented in [6] and using sound to move through a playlist whilst walking; the 2nd portrayed a professor using sound within an email application to inform of when sent emails had been read and new emails received and from whom, due to the fact that they were concentrating on another task. The 3rd scenario involved a visually impaired teacher interacting directly with their computer desktop in order to fill out a spreadsheet. The teacher had access to a screen reader. Due to lack of space, but by way of example, we have included just one of the scenarios in this paper (see section 5.2.1 for an example of the text the participant received). Ultimately we wanted to present the participants with the task of using these scenarios as a basis to design a hypothetical and novel auditory display. This in turn we hoped would support creativity in the design process

5.2.1. Scenario number 2

This scenario represents a user who is busy and cannot continuously focus on the screen. The scenario describes a character using a new email system that, through audio signals, lets the user know when an email they have sent has been opened by its recipient. The system also uses audio to signify when an email has arrived in the in-box and, specifically, who the email is from.

George is a 63 year-old professor of psychology who has the task of reading a PhD thesis. On this warm Monday morning he enters his office and walks straight to the window to let some air in. He opens the window onto the busy campus below. He sits down in his chair and turns his desktop computer on and launches the email application. He does not check the email, instead he opens the thesis on his desk and begins to read. After turning 3 pages he hears the audio that indicates that the email he sent to his colleague has been opened followed immediately by the audio that indicates that his wife had just sent him an email.

5.3. Method

Participants were presented with written instructions and a set of two example scenarios and corresponding, filled out, cue sheet. When they felt ready they were given a document containing the 3 different HCI scenarios. The scenarios were typed and all presented a hypothetical narrative involving a person interacting with an auditory display. The participants were asked to read through the scenarios and the cue sheet (see Figure 2) marking out the categories from left to right. They were allowed to use as many sheets as needed and there was no time constraints on the time allowed to do so. Participants were told that they could ask questions and for help at any point and that they could be as creative with their responses as they liked. The hands of the participants were filmed whilst completing the cue sheets in order to capture the approaches they took and their feedback and comments post experiment.

5.3.1. Rules

In order to create a time-based representation of the identification of objects, actions, attributes and sound in the scenarios the participants were required to stick to certain rules when filling out the table. The rules were also in place to support and structure the different possible answers:

- Complete boxes from left to right only
- Preferably put just one response in each box
- Do not have to fill in every box and boxes can be skipped, if felt unnecessary
- Cannot fill in any box to the left of the box that text had initially been entered into. If this is required then start a new line

6. OUTCOMES

The method has so far been tested out, individually, on 7 participants. The participants were made up of 4 media, arts and technology Ph.D. students and 3 people from a more diverse background. This included a visual artist, a teacher and a therapist. All participants used a computer daily. 5 out of 7 of the participants had experience using computer film or audio editing software. None of the participants had experience designing audio in the interface.

Data was gathered from video footage, the completed cue sheets and participant feedback during, and post, experiment. At the end of each session the participants were asked to describe how they found the experience. We have combined these with our early observations and the nature of the questions asked during the study

itself, to form a set of outcomes that will be significant to further method development.

6.1. Understanding and usability

6.1.1. Observations

It was intentional that the amount of information the participant received regarding the purpose of the study, remain minimal. This was down to an attempt to simplify the study for the participants due to the perceived volume of instructional and written information that the participant would have to deal with as a result of the tasks involved. As a result it is possible to conclude that the study was considered as too abstract by the participants.

The scenarios remained complex to participants and the reason for wanting an auditory display still not widely understood.

It was also evident that it was not clear whether the example sheet helped or in fact put pressure on or limited the responses in some way

(e.g., P1: (“I’m not sure you should give examples categories. But it is difficult because there just is not the vocabulary to describe sound”).

(P7: “I don’t want to see the examples first, do you mind, it makes me nervous”).

It was also noticeable that the experience of the participants seemed to be reflected in how well the overall concept and approach was grasped. Similarly the level of experience with interface design also had impact.

(e.g., P4: “I figured it was an individual thing. I think that’s what is nice about what you have it people can bring things to it. Because I work in assistive technology it triggers something in me that someone from say a music background wouldn’t get. People coming from different backgrounds will see different things”).

6.1.2. Implications for future development

It may benefit the designers to be aware of what an audio display is and specifically, the different means by which these may be created. However, providing guidance, examples or suggestions within the method itself may limit the amount of artistic freedom designers feel they can pursue. A balanced approach will need to be taken whereby designers can optionally choose to see an example should they require.

In addition future implementations of our method need to refine the target user and consider trade-offs between experience and outcome.

6.2. Learning and progression

6.2.1. Observations

It was clear that the layout of the text caused some confusion, in relation to the task of breaking down the sentences to identify action, objects and events.

(e.g., P6: “Bit about not going backwards; you don’t know how far to read, where to break it down. One line at a time-if you want this then break up the sentences into how you want people to read it.”).

(e.g., P3: “Do I have to read it all, or read and fill, read and fill?”).

(P4: “First part involved getting used to the process and deciding how detailed or not detailed you want to be with the text.

For example, every time you see something with an action do you comment on it or not? I figured it was an individual thing.”).

6.2.2. Implications for future development

Tools and guidance will be needed to support ways that actions, objects and events within the interface can be identified. Additionally the method will need to support the order in which designers choose to carry out this identification process. For example, it should support a designer preferring to read and notate incrementally or one wishing to read first before notating second.

6.3. Categorization

6.3.1. Observations

The cue sheet provided means to classify sound choices according to conventions used in soundtrack composition. The intention was to get ideas for how we may further categorize sounds in order to provide guidelines for the design of a palette of sounds to be used with the next stages of the method. However, the categories used for describing and identifying the sounds seemed to cause confusion.

(e.g., P6: “Sound effects was difficult. I put it a lot because not music, not speech, but sound effects to me means someone has created the sound. But actually, a kettle being boiled is a real sound and it’s not an effect, not speech and its not music”).

(e.g., P7: “Can I describe the sound here? It goes [participant sings] ‘beep boop’, can I just write that?”).

One aim of our method is to encourage creative thinking when it comes to composing music and sound effects into one unified audio display. However, it was hard to measure how successfully the cue sheet methodology catered for this, due to the confusion over the sound effect category.

6.3.2. Implications for future development

To clarify the categories for the designers. To further investigate how best classify the different types of sound effects. To possibly provide a tool that can support a cross reference search of any sounds that may belong in more than one category. To measure how well designers consider the potential for creative use of music and sound effects.

7. CONCLUSION AND FUTURE WORK

The aim of our research was to test out our concept of basing a method for designing auditory displays on soundtrack composition. This involved the gathering of knowledge into how soundtracks are composed alongside an investigation into practices for auditory display design. This enabled us to devise the first steps of the method, based on the design and function of a cue sheet. The intention of this design was to provide means by which designers could identify places for sound within an HCI scenario in a logical and structured way, similar to the approach taken by composers.

It is fair to conclude that in this paper we have not provided insight into a completed or conclusive outcome of a study to test the first steps of our method. Instead we have detailed the work that has gone into supporting the concept of our research, the first steps of the method and a practical study suitable for their evaluation.

The concept and the supporting literature and survey are the primary contributions of this paper whereas the method and evaluative study need further refinement. Our intention is to do the following:

1. Re-design the cue sheet to be less abstract for participants by having clearer instructions and category definition.
2. To provide means for a lower level analysis and documentation of actions, events and states within the interface. To base such structures on a combination of Hix's UAN method of analysing user-action within the interface [16] and Stephen Brewster's ESM method because it relates directly to analyzing events and status as a result of both seen and unseen action within the interface [15].
3. To get more data out of the questionnaire for soundtrack composers
4. Analysing the information from the survey to further refine and design a set of techniques and tools grounded in soundtrack composition
5. To gather literature and contacts from ICAD in order to get as good a handle as possible on what auditory display designers actually do
6. To create a questionnaire for auditory display designers similar to the one for soundtrack composers
7. Using the information from 5 to select and structure the techniques and tools to tailor them more effectively for auditory display creation into a consolidated methodology.
8. Evaluating the use of the output from 7, i.e. does it work, how effective is the method and what can be said about both the process and product.

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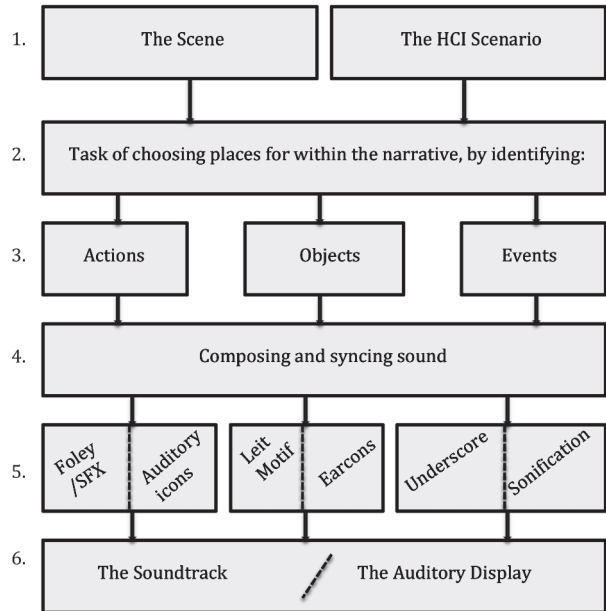


Figure 1: Model comparing soundtrack and auditory display creation

CUE SHEET/SOUND MAP/SPOTTING SHEET. List of things that trigger sound

Page Number ___ Scenario Number ___ Participant number _____

TIME and PLACE _____ CHARACTERS _____

Actions	Objects	Attributes and descriptions. <i>What do you know about the action or object? For example, Does the action or object have a size, quantity or a type? Is their a location in which the action or object happen/exist in? Does the action trigger another action or event?</i>	Do you associate sound with this? (Y/N)	Cause of sound	What the sound may be	Length of sound	Type of sound	Music (M) Speech (S) Sound Effects (SFX)

Figure 2: Cue sheet used during experiment