BLENDED SONIFICATION – SONIFICATION FOR CASUAL INFORMATION INTERACTION

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ABSTRACT

In recent years, graphical user interfaces have become almost ubiquitous in form of notebooks, smartphones and tablets. These systems normally force the user to attend to an often very specific and narrow screen and thus squeeze the information through a chokepoint. This ties the users' attention to the device and affects other activities and social interaction. In this paper we introduce *Blended Sonifications* as sonifications that blend into the users' environment without confronting users with any explicitly perceived technology. *Blended Sonification* systems can either be used to display information or to provide ambient communication channels. We present a framework that guides developers towards the identification of suitable information sources and appropriate auditory interfaces. We aim at improving the design of interactions and experiences. Along with the introduction and definition of the framework, this paper presents interface examples, both for mediated communication and information display applications.

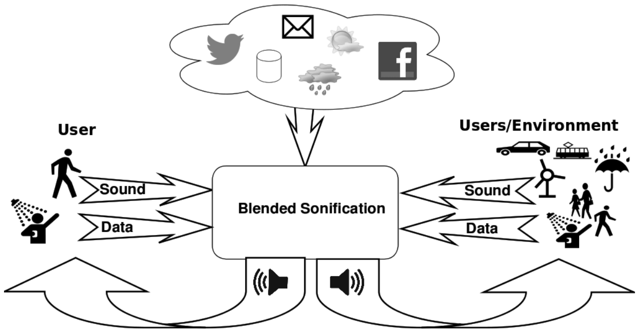

Figure 1: Overview of Blended Sonification: The sensed actions of the user and the sound of these actions are fed into the sonification. The resulting sound depends on the users' physical environment and perhaps other users within (depicted on the right side) and the digital environment (depicted as a cloud above).

1. INTRODUCTION

In today's info societies, each day we face an enormous – and steadily growing – amount of digital information, such as email, news feeds, tweets to name a few. The established interfaces to these information have one thing in common: they are WIMP [1][1]-style *Graphical User Interfaces*. These interfaces became ubiquitous in recent years. Beginning with portable notebooks, graphical users interfaces are now available everywhere we go. For instance, tablets and smartphones offer easy and quick access to the Internet anywhere. Isn't that great? We have access to all that knowledge available at our pocket without carrying a whole library. You want to listen to a new song, read a book or want to search for the answer to a question, just reach for your pocket. We do not only have access to static information, we can reach our friends, colleagues and loved ones the same way.

Yet smartphones and graphical user interfaces did not only change the way we have access to information. They also enable us to share experiences in the very moment they happen, just by taking a photo or posting a status update. This is a great way to stay in touch and share thoughts and moments with others. Communication that before was only possible via face-to-face conversation or a phone call is now possible by posting a tweet or sharing a just taken picture. It takes only few seconds to take a picture, comment it and post it e.g. on Twitter – and by doing so, you already told everyone about it. Your loved ones now may know where you are, what you have to say and when looking at the picture even what you see at the moment. Not only that you can stay in touch with everyone or may even feel closer to someone, it enables also that face-to-face (or ear-to-ear) communication can now also be mediated through smartphones, tablets or notebooks.

Is that a bad thing? Probably not. But the amount of information that is pushed through the chokepoint of a graphical user interface in a smartphone in general is growing steadily. Certainly, the shift of communication towards the digital will not replace existing face-to-face communication. However, there is the risk that – due to our narrow focus of attention – the time we spend in front of our graphical user interfaces in order to 'consume the digital information' is growing further and thus, our sense of being present in the world suffers. A recently adapted version of a quite famous quote states that:

> *Life is what happens while you're looking at your smartphone*[2]

[1]user interfaces dominated by windows, icons, menus, pointer

[2]http://www.cinismoilustrado.com/2012/07/mirar-el-celular.html

We want to start right there and argue for interface alternatives to relieve that chokepoint.

A concurrent development in technology is the enrichment of environments with sensors, ranging from sensors that capture temperature, humidity, pressure levels or oxygen ratio in air, over sensors that capture angular velocities, orientation, acceleration to sensors for the energy consumption of devices. All these generate additional information to process. Until today we often exclusively consume the information by explicit visual interfaces, i.e. by looking at visual data representations depicted on a screen.

2. SKETCHING THE BLENDED SONIFICATION IDEA

We introduce *Blended Sonification* as auditory data representation that blends into the users' environment without confronting the users with any explicitly perceived technology. Depending on the use context, interaction, and application type, they can serve different purposes.

They can be used *to display information* and to provide an interactive ambient access to information. As an example let's consider that someone knocks at the office door to visit a colleague: the knocking sound is an active query to draw the colleague's attention. For the visitor, it is of limited use. A *Blended Sonification* could work with that existing sound and manipulate (e.g. augment) it in a way that the sound conveys additional information for the visitor. For instance, a reverberation could be added to the sound depending on the time the office is left empty. In result, the longer the person of interest is absent, the 'emptier' the office will sound, conveying relevant information to the person in front of the door on this subtle level. Most importantly, this enhances/enriches the interface without requiring any different user behavior to inspect the information or to elicit such details.

The almost same purpose of information display is served with the *auditory augmentation* of keyboard interactions presented in [2] – which will be discussed in more detail in Sec. 3.1. In this system, the typing sound of a keyboard is altered according to data of interest, e.g. the current weather situation. Sound parameters (as for instance filter frequencies) are controlled by data variables (e.g. temperature or humidity). In result, while typing an email or text, the user can stay aware of weather (or other data) changes at the threshold of conscious attention. In the case of weather data, the user may – from staying in contact with the weather change while typing – conclude that now a good time to head home from the office before the rain hits him on the way home.

The previous two examples show how we benefit from the amenities of sonification, such as eyes-free monitoring and not being in need to be tied to a graphical user interface. At the same time the risk of annoying the user is reduced by tightly coupling the sonification to physical interaction sounds caused anyway be the user's actions. So the sonification basically alters (i.e. modifies, enriches) the existing sound. While it is desirable to just alter the already present interaction sound, *added* sounds can work in a similar fashion as long as the additional sound is experienced as a coherent result of the interaction. A key characteristics to bind added sound to existing sound is synchronization: the better the onsets match, the more convincing the coherence. A second factor is the correspondence with excitation strength: more energetic interactions are expected to both increase the level of the natural sound and the added sound.

Blended Sonifications should be calm [4] and stay in the periphery of the user's attention. The displayed sound should be physically motivated and expectable by the user. In contrast to many other interactive sonifications, *Blended Sonifications* use interaction sounds as the frame of reference (or canvas) to augment an additional information layer. By using interactions with the physical world (or better: the sounds occurring in result of a user manipulating objects in the world) as the 'excitation' or 'query' of digital information, the complete interaction loop takes place in the auditory domain: the excitation-corresponding interaction sound becomes the display. The auditory feedback of *Blended Sonifications* should only be triggered by immediate actions of the user or actions that take place in the ambiance of the user. By doing so users are not easily annoyed because the sound would emerge anyway.

Looking at statements in the auditory display community, we find that others see the need and support developments in this direction as well: Serafin et al. state

> From the design perspective, the main question is how to create a multimodal interface that engages users in active manipulation, that provides them with auditory feedback complex enough to discover new patterns, and intuitive enough to successfully modulate their actions and gestures. [5]

and for this we see *Blended Sonification* as one possible answer and approach. Furthermore the authors continue

> For a new generation of sound designers to be capable of addressing the interdisciplinary problems the field raises, a more solid foundation of methodologies in those related disciplines needs to be developed. [5]

which underlines the need for a framework that provides guidance for design and implementation. Vickers states that the current challenges are

> [...] auditory displays challenges for direct, peripheral, and serendipitous-peripheral auditory process monitoring. From this body of work we may identify a number of principal challenges that face designers of such sonifications: 1. The potential intrusion and distraction of sonifications; 2. Fatigue and annoyance induced by process sonification; 3. Aesthetic issues and acoustic ecology; 4. Comprehensibility and audibility. [6]

With the *Blended Sonification* framework we do not only want to give answers but spark discussions, too. Before defining and discussing the details we illustrate and motivate the approach by examples of others and our own earlier work.

3. APPROACHING BLENDED SONIFICATION

In this section we briefly review and summarize examples from previous work that inspired us towards the concept of Blended Sonification.

Model-Based Sonification (MBS) [7, 8] was our first step to tightly bind excitatory interactions to real-time computed sonifications. In MBS, excitation is the main mechanism to query a data set, and a dynamical process in the 'model world' creates the corresponding sound signal. We have introduced various models that make use of and promote manual interactions such as shaking or

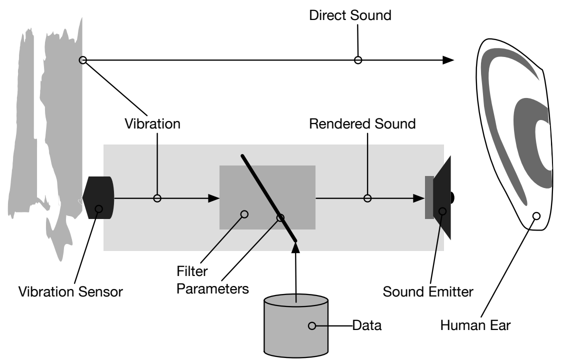

Figure 2: Auditory Augmentation model: Structure-borne sounds are sensed with a contact microphone, filtered according to parameters defined by an external data source an then played back. The filtered signal shapes the resulting interaction sound as it blends with the original sound.

Figure 3: A setup used by participant in the *augmented keyboard* study. The transducer was attached to the external video adapter of her laptop. This made it easy for (dis-)assembly, since she only used the system only at her workplace, but carried her laptop with her

squeezing objects or knocking on surfaces. For instance the audio-haptic ball interface [9] is an interface object to excite a sonification model so that shaking displaces model elements attached to model springs. In result the ball sounds as if filled with glass or plastic balls, depending on the structure of the sonified data. This idea was then also applied by Williamson and Murray-Smith in *shoogle*, where the inner items represent SMS text messages in a smartphone [10]. These examples have in common that the users interaction is sensed (e.g. via an accelerometer) and that interaction is then used along the metaphor of shaking the object to display a sound that conveys information.

Other's works also use the auditory signal of the interface itself. The Pebblebox is an audio-haptic interface for the control of a granular synthesizer which extracts information such as onset, amplitude or duration of grain-like sounds captured from physically interacting pebbles in a box [11]. These high-level features derived from the colliding stones are used to trigger granular sounds of e.g., water drops or wood cracking to simulate rain or fire sounds. The performance of the Pebblebox relies on the fact that the captured signal has to be a superposition of transient sound events. A change of the sound source such as implemented in the Scrubber – another closely related interface also developed by the authors of the Pebblebox [12] – has to extract a completely different feature set from the input signal. It is designed in assuming incoming scrubbing sounds in order to synthesize artificial scrubbing sounds. In another example everyday interactions are augmented with sound: The *Flo)(ps* by Franinovic [14] for example sense the handling of a physical object and augment the action with sounds.

All these examples including our own work yet remained far less widely spread as most attack a very specialized task. In contrast, our later designs focus on problems that do not so much ask for *intentional interactions to excite a sonification*, but position sonification as a sideline to *already-existing interactions in the world*.

3.1. Auditory Augmentation

In 2010 we presented a framework [2] to support the design of data representation tools, which unobtrusively alter the auditory characteristics of structure-borne sounds. Applications enrich the structure-borne sound of objects with a sonification of time data streams. The object's auditory gestalt is shaped by data-driven parameters, creating a subtle display for ambient data streams. Auditory augmentation can be easily overlaid to existing sounds, and does not change prominent auditory features of the augmented objects like the sound's timing or its level. In a peripheral monitoring situation, the data stay out of the users' attention, which thereby remains free to focus on a primary task. However, any characteristic sound change will catch the users' attention.

The Augmented Keyboard [2] demonstrates these principles: Typing on a keyboard causes the keyboard naturally to emit sounds, which are generally not annoying, at least not for the one typing. These sounds are technically altered, which offers a central benefit: When the information stream of interest changes, the sound of the keyboard changes accordingly and can attract the user's attention. Thereby the data stays out of the users' way if they want to concentrate on other things. *The Augmented Keyboard* changed the inherent interaction sounds when typing by controlling adaptable filter parameters according to the current weather situation outside.

The interaction sounds are picked up by a contact microphone, filtered and played back by nearby loudspeakers. The resulting sounds blend together with the real typing sound into a single auditory entity.

3.2. *Upstairs*: coupling users as if they'd mutually live upstairs

Upstairs is a calm mediated communication system [13] intended not only for couples in long distance relationships. It follows the same principles that also form the basis for *auditory augmentation*, but applies these to mediated communication. It was inspired by the observation that noises that diffuse through walls, e. g. coming from the neighbors living one floor up, can give long-term insights about the neighbors' behavior and emotions. When sharing a space, we are subconsciously aware of other people's activities, mainly because of their interaction with the environment. This awareness can be recognized as a socially organized and contingent achievement which is often bound to artifacts in the users' environment. *Upstairs* was built to study if a subconscious level of awareness and communication can be sustained while the interactants live at two remote places. Based on communication theory,

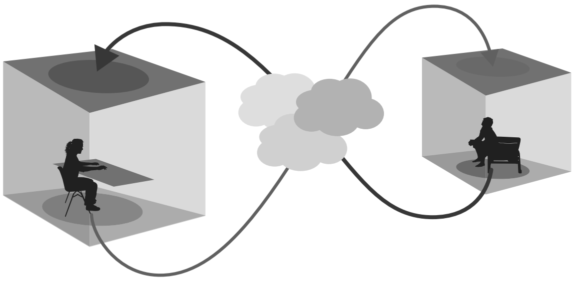

Figure 4: The *upstairs* logo. Interaction sound from the floor is filtered and played back in another room, creating the illusion of mutually living upstairs.

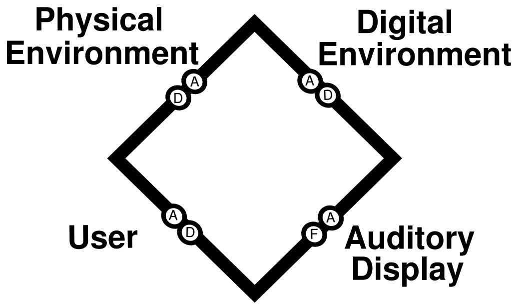

Figure 5: Blended Sonification Diagram

such a system should consist of at least two parts for each space: a capturing device and a display for peripheral use, i. e., "out of a person's primary focus of attention". Interpersonal interaction consists of many information cues that the interactants most often process in parallel. Roughly, these streams can be discerned into being either consciously (e. g. speech, sign language) or more implicitly used (e. g. prosody, facial expressions, proxemics). While the conscious part of a conversation might stop at some point, implicit streams remain indefinitely as long as people share a space. In other words, although people might not talk to each other, there is still communication going on. Today's telepresence and social presence research focuses mostly on the transmission of the conscious part of communication [16, 17].

The setup is similar to the one used for the *augmented keyboard*. The interaction sounds are picked up by contact microphones on the floor, filtered to match the muffled characteristic when experiencing a sound from above, transmitted to the remote place and then played back from above. In contract to *auditory augmentation* the filtering is static and does not convey any additional information. The sound itself already carries plenty of information about the person of interest. Important is that the result is coherent. The auditory experience has to be eligible.

4. DEFINING BLENDED SONIFICATION

A well designed *Blended Sonification* integrates well into the user's daily life. The user should be quickly able to use the interface because the used metaphors are based on everyday experience. The interface should stay out of the way when not needed, but should be ready to hand. They support the monitoring or the display of events as an auditory change catches the user's attention when otherwise hiding in the environmental soundscape. Blended Sonification bridges the gap between digital spaces and our natural environment. Information that otherwise is only available when using a graphical interface and thereby tying the user to a device, becomes directly available. In this section we propose (i) a *working definition*, (ii) a graphical framework along four main *factors* to describe sonifications and (iii) *guidelines* that shall support the design.

A working definition of Blended Sonification:

> Blended Sonification describes the process of manipulating physical interaction sounds or environmental sounds in such a way that the resulting sound signal carries additional information of interest while the formed auditory gestalt is still perceived as coherent auditory event.

Working with Blended Sonifications has shown that some additional aspects are important in the design. They are discussed in detail in the guidelines section but due to their importance are formulated as amendment.

definition amendment

> Blended sonifications should be calm, well motivated and expectable by the user. They should stay in the periphery but be ready to hand.

When discussing designs and interface ideas we often ended up drawing them on paper in a variety of different ways, not only to communicate the concept but also to develop new interfaces or adapt existing ones. As the visual vocabulary differed a lot we started to develop a standard that made it easier to sketch, compare and discuss technical (and other) aspects of a certain sonification. The basic frame consists of four edges (see Figure 11). Each edge represents one of the four main *factors*.

1) The Physical Environment (PE)
2) The Digital Environment (DE)
3) The User (U)
4) The resulting Auditory Display

Each factor contributes a data (D) and an auditory (A) component (see Figure 5). The environment – both digital and physical – as well as the user shape the resulting sonification. The information 'flows' from these three towards the auditory display (see Figure 7 and 8). The Auditory Display factor is different from the others. It is divided into filtered (F) and added (A) output. Filtered sonifications are sonifications that stay very close to the original sound, such as the augmented keyboard or the *upstairs* example mentioned earlier. Blended Sonifications that superimpose for example sound samples or synthesized sound fall in the 'added' category.

As said, the user's actions are discerned in data (D) and auditory (A) input. The data component comprises all information that is non-auditory. All input sensed, such as accelerometer data, body tracking data or just mouse and keyboard input fall in that category.

To have a common frame, the diagram consists of at least these four basic factors, even if a factor is not used in the sonification.

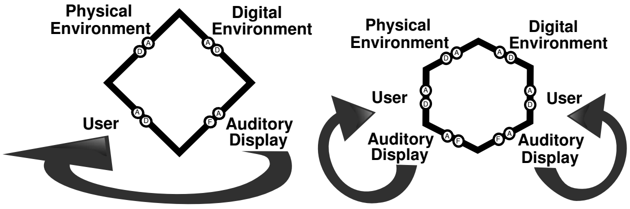

Figure 6: Basic *Blended Sonification Diagram*: single user (left), two users (right).

This leads to a much better readability and comparability. However there are cases in which an extension is needed. The *upstairs* system is such a case. It is designed for two users which each have a different Auditory Display. To represent *upstairs*, we introduced two additional edges. One could think of it as opening the square on the right corner and inserting a user and and Auditory Display edge in the opening (see Figure 6). The Auditory Display always belongs to the user edge next to it, as indicated by the arrows. To indicate the contributing factors, the involved component pins are connected to the pins of the Auditory Display (as illustrated in Figure 7 and 8). The nature of the components is defined by the type which is indicated by the letter inside the pins.

The left diagram in Figure 8 illustrates the *WindChime* concept. It is a concept for a sonification that manipulates the sound of a wind chime[3] to notify the user about new messages for example. The sound of the chimes would be transduced by contact microphones, subsequently filtered if the user shall be notified and than added to the natural sound of the chimes. As the sonification uses the environmental sound generated by the wind chimes the audio pin (A) of the PE is connected to the filtered output pin of the Auditory Display. Given that the filter is parametrized by the digital environment, such as that the number of unread emails in the inbox, the data pin (D) of the DE is also connected to the filtered output pin of the Auditory Display.

4.1. Guidelines

The diagram allows to visually represent what factors and what components are used for the AD at a glance. With the following, we want to give *guidelines* that evolved and have been helpful in the design and development process of *Blended Sonifications*.

a) calmness and peripheralness

b) coherency

c) expectability and familiarity

d) physical origin

Calmness connotes that sonifications should only be triggered by actions of the user and actions that take place in the ambiance of the user. The reason a sound occurs should lay in the environment of the user. Activities that create auditory feedback may originate from own actions such as typing, knocking at a door or from other persons when they walk down a hallway, the traffic noise outside

[3]"Wind chimes are chimes constructed from suspended tubes, rods, bells or other objects and are often made of metal or wood. Wind chimes are usually hung outside of a building or residence, as a visual and aural garden ornament, and are to be played by the wind." (`http://en.wikipedia.org/wiki/Wind\_chime`)

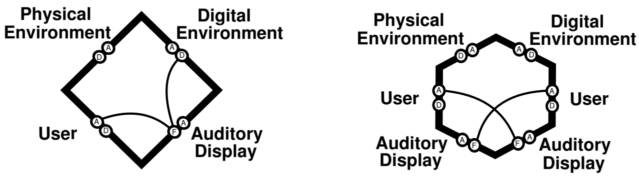

Figure 7: Diagrams for the *Augmented Keyboard* and the *upstairs* system.

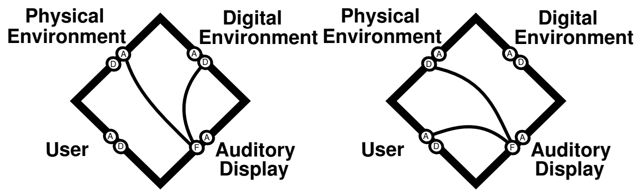

Figure 8: Diagrams for the *WindChime* concept and the *Knock Knock* system.

or voices from a crowd of people outside or even environmental sounds as signing birds, the wind whistling or a rolling river are part of our daily lives. We background large parts of our complex surrounding soundscape. When these are used as canvas we can benefit from that fact. If a user wants to selectively pay attention to something, it is available at an instant which no further effort, if not, it stays out of the way. Additionally when the information changes and thereby the auditory representation it can catch the user's attention before returning to the usual background noise.

The auditory response from the (inter)action and the added or augmented sound should emerge in *coherent* sound events. Both sound streams should blend into a single cognitive unit which should be perceived as having the same origin.

As already pointed out earlier, the response should have its cause in the the physical actions of the user or the physical actions in the immediate environment of the user. However there are exceptions. The *upstairs* system for example creates the illusion that a remote person is present in the environment of the user. Technically speaking the sound is not caused by the user or at the immediate environment of the user. But as the aim is to virtually place the person in the environment, exceptions can be made. However if otherwise reasonable the sound should have its cause in the immediate environment.

In general, the resulting auditory response should be *expectable* by the users. It should stay in the bounds of being *familiar* as much as possible. Hearing the sounds from a neighbor above is an experience that many have made before and is thereby well suited for this kind of display because it builds on prior experiences. The interface thereby creates some kind of illusion.

When designing Blended Sonifications, stay with the original sound signal if possible. Do not add arbitrary sounds if the result can be achieved with a variation of the original sound. The familiarity of the sound is important. The *upstairs* project for example creates the illusion that the other person live above you by exploiting the fact that people often are very familiar with walking sounds from person that live in the floor above us. When new sounds are introduced – for example the playback of sound sam-

Figure 9: Someone in front of an office knocking at the door. The augmented knocking sound is recorded using the phone. A recording is available on our website `http://www.techfak.uni-bielefeld.de/ags/ami/publications/TH2013-BSS`

ples or parameter-mapping sonifications – it is a good practice to choose sounds that a user would expect.

5. KNOCK'KNOCK – EXPLORING BLENDED SONIFICATION

The manipulation of everyday interaction sounds is a core aspect of *Blended Sonification*. We introduce *Knock'Knock* to demonstrate this aspect. When knocking at a door, we perform an active query. Thereby we provide the signal that we are interested to see the person behind the door. At first, one may just think about two different outcomes: (i) The person inside is available and signals that by maybe telling the visitor to come in or (ii) telling that this is not a good time. One either gets to talk to the person or one may be told when to come back. In case nobody is there, however, the query does not get answered. Nonetheless, the resulting sound tells something about the quality of the door, the material or even if the door is locked and therefore better damped because it sits tighter to the frame. With *Knock'Knock* we use the auditory feedback as carrier for additional information about the person someone wishes to see.

In case the person is absent, we want to convey additional information about the person by augmenting the knocking sound. But why not just mount a visual display onto the door which tells when the person has left or where the person is? This would clutter the environment and would not be calm. Instead our approach – although using audio – is calm: when not queried it is not adding any visual or auditory element. It does not make any sound when not knocked on. It stays completely out of the way when not needed, but is available by the action that the user would carry out anyway.

There are plenty ways to manipulate the sound. We wanted to alter the sound in a way the user can easily understand. We were looking for a metaphor that was physically motivated and at the same time would tell something useful about the person. We chose to map the amount of time passed since the person has left the room to the reverb time applied to the knocking sound, using the following rationale: In a natural situation, the reverberation of the interaction sound would tell something about the room behind the door. A big empty room would have probably more reverb than a smaller fully staffed room. By choosing this mapping the room appears 'emptier' if the person is absent. For a certain amount of time the person is absent the 'emptiness' is increased.

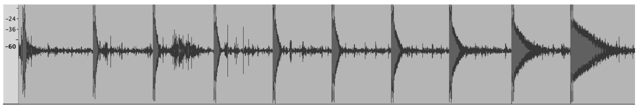

Figure 10: Auditory response of the *knock'knock* system. To demonstrate the system the away time is raised every ten seconds.

Figure 11: The Knock'Knock setup: A contact microphone is fixed at the door leaf. The signal is processed by SuperCollider3 on a computer (not shown in the image). The resulting sound is played back using the loudspeaker pointing towards the door.

5.1. Setup

A contact microphone connected to the door leaf is used as transducer (see Fig. 10). The gathered signal is processed by SuperCollider3 to add reverb. Together with the direct knocking sound produced by the user knocking a different impression is created. A demonstration of the system can be found on our website [4]. As illustrated in Fig. 11, the time away and thereby the reverb decay time is increased every ten seconds to give an expression of the evolving sound.

6. DISCUSSION

The *Blended Sonification* framework provides a unified conceptual roof/umbrella for a variety of interactive sonification techniques. The common denominator for the techniques is (i) the tight coupling of user interaction and sonic feedback, and (ii) the strong orientation towards interactions that occur as regular acting-in-the-world. We discussed an orientation towards 'human activity in the world' initially in [18], where we identified the aim of actions of-

[4] `http://www.techfak.uni-bielefeld.de/ags/ami/publications/TH2013-BSS`

ten to be different from the intention to create sound, giving sound rather the role of a side product of action.

Sonification researchers (including ourselves), however, by being enthusiastic – and oriented towards conscious listening – often loose the perspective for the role of sound in the multi-sensory concert of acting-in-the world. Blended Sonification, in contrast, settles it as underlying assumption and starting point towards a more balanced use of sonification, allowing it to move far into the periphery of attention.

With the framework we introduced a design diagram stencil/template which allows manifold internal interconnections to specify the concrete information flow. The diagrams do not only provide a structural abstraction to help researchers to quickly grasp the architecture of the sonification system, they also help to better organize instances of *Blended Sonifications* into clusters. Let's assume that in some time there are hundreds of applications in various areas: those that – according to the diagram – share a common diagram layout are structurally similar and are thus grouped. This grouping can help to focus on the common aspects between these examples, and to extract more meaningful diagram-type-specific guidelines. Finally the diagrams also function as a *fingerprint* for Blended Sonifications which allows (a) to quickly discover similar instances and (b) to make developers aware of unexploited variation possibilities.

At the moment, the diagram styles are rather basic, and may be subject to refinement as we and others find, develop, discover and integrate more and more examples. The approach is scaleable in that it can be extended towards more fine-structure within the box, or via external pins. Obviously our current examples (including the newly presented Knock'Knock system) do not yet cover all possible interconnections.

It can be inspiring to start from a given diagram and try to find an application where this would be useful. While this would certainly be similar to having a hammer and looking for nails, it may enable unconventional ideas beyond the familiar approaches.

The Knock'Knock system has been introduced as an example that plugs into an established routine, without any technology becoming visible to the visitor, and as an example for systems that shift both input (excitation) and output (sonification) away from the visual domain, freeing us from the GUI chokepoint. One might argue that a naive visitor will not be able to interpret the reverb sound since the natural interpretation bindings point towards a larger room, or a room with hard walls, and in fact, the acoustics never changes with the duration of absence in real-world settings. So worst case this reverberation effect is useless to the visitor. But at least it does not infer with the authentic meaning. It remains an open question how visitors – after repeated trials to find the colleague – would build up an internal mapping between 'office empty time' and reverb, or whether an explicit explanation is the only useful way to understand the system.

7. CONCLUSION

We have introduced the Blended Sonification framework to open and widen the view on how sound can be tightly coupled to interaction in order to shift interfaces away from the narrow confinement of a screen or GUI into an open, *present-in-the-world* mode of information awareness.

Blended Sonification is both a design approach and a conceptual framework. Different from traditional sonification design, where the sound is considered as an explicit and consciously listened-to information stream, the assumption is here to extend/augment (physical) interaction processes that already occur in the world. However, it goes beyond the established approach of auditory augmentation – in which only structure-borne interaction sounds of objects are used and modified by filtering them – and extends various other modes, both including additional sound elements as well as interaction sounds and information that come from either another user or the environment.

We are confident that Blended Sonification can inspire sonification researchers and interaction designers towards new ideas on how to use sound in artifacts and hope that we can, together with the community, develop this approach further. As a vision, we hope that the entry of information-carrying sounds into our everyday interactions will *not* add to the acoustic pollution, but instead lead to an increased awareness of our acoustic ecology, and that some awareness of the richness of possibilities that auditory interfaces will gradually be appreciated. Perhaps, in the long run, this can even help to lighten the problems arising from more and more information sources pervading our current info society through the visual chokepoint.

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