Soundscapes at Workspace Zero – Design Explorations into the Use of Sound in a Shared Environment

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ABSTRACT
In this paper, we describe three design explorations into the use of sound in a shared workspace. The focus of these explorations is on the interaction between people and the environment that surrounds them. Challenges include designing in context, designing for the periphery of people's attention, balancing the aesthetic and information qualities of information displays, and the design of playful interaction styles to control the auditory display.

Keywords
Auditory information display, soundscape, workspace

INTRODUCTION
In this paper we present three design explorations into the use of sound in a shared workspace. The focus of these explorations is on the interaction between people and the environment that surrounds them. How does a pervasive soundscape influence the social behavior of the inhabitants of the space? And, how is the soundscape itself shaped by intentional and/or unintentional actions of people?

Smooth information exchange between co-workers is considered one of the basic conditions to guarantee an effective workflow [6]. In the field of Human-Computer Interaction (HCI) and, more specifically, in the area of Computer Supported Collaborative Work (CSCW) a vast amount of knowledge is available on how information and computer technology can be applied to improve the effectivity, efficiency and satisfaction of work processes [4]. Most of the reported design and research efforts, however, concentrate on 'productivity'-related aspects and favor visual interaction solutions. Only a relatively small group of designers and researchers has systematically explored the possibilities of sound as an alternative for visual interaction [3] [9] [2].

In [7] the complementary nature of the auditory and visual modes of information is pointed out. Gaver states that "a simple way to contrast listening and looking is to say that although sound exists in time and over space, vision exists in space and over time." ([7]; pp70-71). From a design perspective, this contrast leads to clear possibilities and limitations for the design of information displays (Fig. 1). In particular, the observation that 'sound exists over space' calls, in our opinion, for a further exploration of the design of environmental auditory information displays.

	TIME	SPACE
SOUND	**Sound exists <u>in</u> time.** • Good for display of changing events. • Available for a limited time.	**Sound exists <u>over</u> space.** • Need not face source. • A limited number of messages can be displayed at once.
VISION	**Visual objects exist <u>over</u> time.** • Good for display of static objects. • Can be sampled over time.	**Visual objects exist <u>in</u> space.** • Must face source. • Messages can be spatially distributed.

Figure 1: Complementary modes of sound & vision [7].

In the remainder of this paper we first introduce and discuss a number of different aspects that we used to define the design space to be explored. Next, we briefly describe the 'Birds Whispering' project that was used as a starting point for the three design explorations that form the main body of this paper. Three master students of the Industrial Design department of the Eindhoven University of Technology (TU/e) each conducted one of these design explorations in a separate project. A more detailed description of the Birds Whispering project is currently being published elsewhere [5]. Together with the students we carefully studied the findings of the earlier Birds Whispering project. Based on this joint activity and together with the coaches each student identified and defined a more specific but related design challenge to be explored in the separate project. We took

care that the chosen design challenges did not overlap too much but rather build on the most interesting and promising findings of the Birds Whispering project. To put the three student projects as well as the earlier Birds Whispering project in context the actual project descriptions are preceded with a section describing the more generic design challenges that span the design space of environmental auditory design displays. At the end of the paper the main findings related to the design challenges addressed in the three student projects are briefly summarized.

DESIGNING ENVIRONMENTAL AUDITORY INFORMATION DISPLAYS

In this section we discuss a number of aspects we consider important for the design of environmental auditory information displays.

Soundscapes 'in situ'

Previous studies have demonstrated that sound at the user interface can indeed enhance human-computer interaction [1] [7] [10] [11]. In general, it has been shown that also sound design should adhere to well-established heuristics for interaction design. In addition, sound-specific knowledge on interaction design for user-system interaction is available in literature [9] [2]. However, this knowledge mainly concerns direct interaction of a person with a computer system. Much less is known about the application of sound in situations in which the interaction between people (i.e., more than one person) and the systems that surround them is much less direct [1] [11].

The present design studies were carried in such a 'pervasive computing' setting. The physical space of the design studio in which the designers carry out their daily design activities is supposed to become an intelligent space. This shared workspace should not only inform its inhabitants to increase workflow, it should also support everyday social interactions at the workplace. From a sound design perspective, this means that the soundscape should become part of this multi-user multi-system environment. It should merge with existing soundscapes and it should adjust (or be adjustable) to the situation at hand or the changing environmental conditions. The overall environmental sound level could, for example, signal the number of people in the design studio and the nature of their activities.

Information decoration

People decorate physical spaces to create atmospheres that feel more comfortable to work in. Also, people use decorative patterns to give identity to their workplace. We believe environmental information designers can learn from the world of decoration [12]. The primary goal is not information but aesthetics. Information decoration, means seeking a balance between aesthetic and informational qualities. We want to emphasize that information decoration should go further than just making data look better: it requires a genuinely different information model. Traditional information theory usually advises against things like ambiguity and repetition. In information decoration, these factors play an influential role, because ambiguity and repetition are classic aesthetic means of achieving interesting images. The big advantage of information decoration is that when it is not informative, it is still decorative. This seems more than you can say for most contemporary information carriers. Information decoration is not only about aesthetics but can also be considered a means to make the environmental 'noise' acceptable.

Background/foreground – calm technology

Generally speaking, sound easily becomes annoying when it does not contain meaningful information for the listener. In the previous section we have seen that decorative qualities of the sound can compensate for this lack of information. In case neither informative nor decorative qualities are present, sound becomes noise and noise potentially interferes with ongoing activities. The chances sounds will be perceived as noise not only increase when more people are simultaneously exposed to the same soundscape, but also when more systems have the capability to simultaneously use the auditory mode of information. This situation resembles the pervasive scenario sketched above.

As people do not have 'ear lids', auditory displays should be designed in such a way that the soundscapes they display can easily fade into the background of everyday life. On the other hand, the moment the soundscape (again) contains relevant information it should quickly move from the periphery to the center of people's attention. According to Weiser and Brown [14], 'Calm Technology' should enable smooth transitions between these two perceptual modes of communication. This calls for a completely different design approach of information displays. Traditionally, designers are trained to create designs that attract people's attention. Designing for the background is something different, but can be equally challenging as, according to Weiser and Brown [14]: "The periphery is informing without overburdening because people can attune to information without explicitly attending to it." Recently, it has been argued that this focus on calm computing should be shifted towards challenges in the area of "engaging UbiComp experiences" [13].

Interactive sound - pervasive expression

So far, environmental soundscapes that have been described in literature do not support interaction. Although the soundscape dynamically adjusts to the changing state of the system, it is usually not designed to evoke playful interaction of people with the environment. In our designs we tried to explore this interaction dimension to allow people to intentionally change the soundscape as integral part of their environment.

BIRDS WHISPERING

The goal of this first project was to create a subtle indoor soundscape that was pleasant to have around, but also informative in relation to the presence of people in the space. The project was conducted inside one of the office gardens at the TU/e Industrial Design faculty. The goal was to create a virtual colony of birds inside the office space that would react to the movement and activities of people in the space. Below we briefly describe the project. More detail can be found in [5].

Sound Design

The choice for bird sounds was made at an early stage of the project. After considering different types of more abstract soundscapes, we readily converged to the use of bird sounds. Although we were a bit concerned that the user group would perceive the bird sounds as kitsch, it turned out they appreciated them as long as they were lively and non-repetitive and kept in the background. To meet this requirement a system was build to generate dynamic and complex bird whistling from snippets of bird sounds.

Scenarios

Another important design decision dealt with the relation between the birds and the people. Various scenarios were considered. In an early scenario, which was not implemented, the idea was to have the bird sounds represent absent people. The main function of this concept is that the emptiness, created by an absent colleague, will be filled up, so that a team of co-workers always is "complete". Every person has got her own representative sound. Absent colleagues would be able to communicate through the birds, for instance when working at home.

In the 'Utility Bird' scenario, the soundscape is used to convey information about devices and activities inside and/or relevant for the workspace: the printer, meeting rooms, coffee machine, elevator, toilets. The soundscape is supposed to stay in the periphery of people's attention, so it will never force itself upon people present in the workspace. We think it is positive that this 'Utility Bird' scenario has a learning curve. If you work in a place for a longer period of time, you will probably just know where all the bird songs are coming from, without anybody telling you. We don't want to tell people what the birds are telling, they would have to find out by themselves. The exciting thing about this concept is that you will create a bond with the system because every day you will understand it better.

A third concept, which we fully implemented, was the idea of the bird colony as an autonomous entity, with a natural tendency to move to the quiet places in the office space. This was realized with a system consisting of eight speakers and eight microphones. Using Max MSP the sound levels of the eight locations in the room were continuously measured. The virtual birds could move between speakers and did so depending on the sound volume measured at the location of the speaker. Once people would move into a quiet area and started conversations or made other kinds of sounds, the birds would find their way into a more quiet area of the office space. The final result was a subtle soundscape of bird sounds that emphasized the quiet locations in the office space to the inhabitants (Fig. 2).

Based on informal observations of people working in the office space we decided to further explore specific aspects of the Birds Whispering project in three subsequent student projects. The 'Utility Bird' scenario was further developed by Emar Vegt in the 'Mediated Intuition' project. More explicit and tangible ways to interact with soundscapes were investigated in the 'IrisBox' project by David Menting. Wouter Widdershoven designed 'Holaire', a mechanically played acoustic guitar providing information about people entering the space.

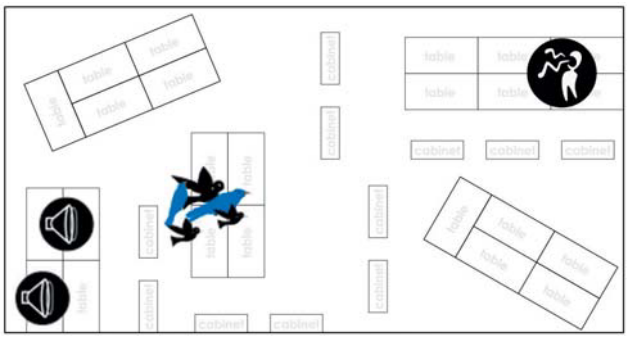

Figure 2: **If someone turns on the music or produces 'noise', the birds will search for another place. The birds will always fly to the quietest place [5].**

THREE DESIGN EXPLORATIONS

'Mediated Intuition' by Emar Vegt

The goal of this project is to provide people in the office with information that they would have to actively search for otherwise. The system communicates this information through sound, in such a way that it remains in the background, unobtrusive, not claiming attention or effort from the user, yet passively providing insight into what goes on outside the local environment of the user. Instead of actively shifting from the periphery to the centre of people's attention, this system always stays in the background. It is the user who decides about relevance and required focus, instead of the system. It builds on people's ability to filter out background noise and focus on relevant sounds. The sound itself can contain a level of detail that is not noticed at first when not paying attention, but when focusing, it provides the user with another layer of more detailed information.

If the system works well, it could create a kind of 'Mediated Intuition', allowing people to do their daily tasks more efficiently and goal oriented. Because you know more about the state of things that you might need for such a task (information that you actively have to look for otherwise)

the execution of the task can potentially benefit from the enhanced awareness.

Based on brainstorm sessions in which inhabitants of the actual workspace (floor 0) participated, the current queue at the printer located in a different area (floor 2) was chosen as a suitable and practical source of information. If a person who is in the workspace is subtly informed of the size of the queue, it can be judged whether or not it is the right time to go upstairs, preventing unnecessary walks between printer and workspace to check if the printer is free. Just checking the status of the printer on the computer also is a conscious act that requires attention and distracts from the actual task. Even merely wondering if the printer is available calls for attention. With a continuously available soundscape that displays printer information, a person does not have to be consciously aware of the state of the printer - one just knows 'intuitively' and acts accordingly. Although printer status can be considered a simple and one-dimensional example, it perfectly illustrates the setting in which sound can create added value without intruding into the user's space, both physically and mentally.

Another reason for choosing the printer is that the status information can be gathered without requiring explicit user input. This matches the goal of creating a passive system to which people do not need to devote explicit attention.

System and sound design

The final system and its components are shown in Fig. 3.

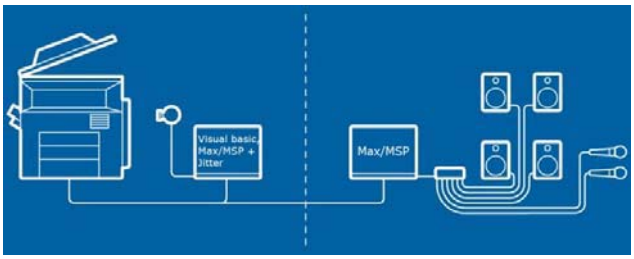

Figure 3: Schematic overview of the final system

The left part of Fig. 3 shows the location of the printer on floor 2. The following components can be identified:

- A webcam, attached to computer 1; This live webcam-feed was used to extract the direction of people moving towards and away from the printer
- Computer 1, attached to the network, displaying the print queue, visual basic with textcaptureX, maxmsp with jitter and cv;

The right panel of Fig. 3 depicts the system components located at 'Workspace Zero' on floor 0:

- Computer 2, attached to network, running maxmsp; this computer renders the continuously changing soundscape.
- Audio interface, attached to computer 2;
- Two microphones, attached to the audio interface, detecting the present level of ambient noise;
- Speakers, attached to the audio interface. The speakers are positioned high in the room so that the sound is equally distributed throughout the room, resulting in a similar perceived loudness at all desks.

The actual sound design consisted of in-depth explorations, iterations and improvements of the audible output of the system to tailor it to the real world situation. The final soundscape contained five components:

- A filtered pink noise bed, to prevent complete silence;
- Two sinus tones, indicating the status of the connection of the system;
- Event sounds that are triggered if there is movement in front of the printer/copier, derived from the ticking against a wine glass, with a pitch difference indicating movement towards and away from the machine;
- An event sound that signals changes in the print queue, lower pitched but still derived from the ticking against a wine glass;
- A chord that has its absolute amplitude and rhythmic speed mapped to the total number of pages in the queue;

Discussion

Abstracting from the specific printer case, the system could be classified as a 'calm' auditory information display. The context in which the system will be placed defines its meaning to a large extent: if the installation would be placed in a museum, for example, it loses all but the aesthetical values of the soundscape. People that experience the soundscape in this way might appreciate it, but the informative aspects of the system only become apparent if the presented information is of value to the listener. If this is not the case, the system is reduced to decoration.

This information doesn't have to be valuable to all people in an environment at all times, as long as there is a clear purpose and benefit in having this system. Because of its subtlety, it might take a while before people understand the system and make use of it, just as it would take time to be able to distinguish one bird from another. It requires people to become skilled. If there are multiple systems like this, people will specialize, mastering the systems that are the most relevant for them, while only partly understanding others.

Zooming out even further, you end up at the notion of an informative environment, where multiple layers of information are unobtrusively embedded into a space. This is part of the vision on pervasive computing. Within this area, the philosophy of calm technology is already more than twelve years old. Yet, projects and products practically

implementing this as concrete and tangible designs are still rather scarce. The same is true for auditory output that is designed both from an aesthetics and an information point of view. The 'Mediated Intuition' project implemented both approaches.

'IrisBox' by David Menting

The focus of this project is on the availability and willingness of people to communicate with others, i.e. people's interruptability [4]. With the current multitude of available communication channels and people's busy schedules it seems interesting and relevant to know if someone indeed is available for communication or not. The goal of the project, therefore, was to design a system that uses sound to present continuous information about the availability and location of people close-by, in order to stimulate social interaction.

The system that was designed, the IrisBox, uses an always-present soundscape as output medium. The soundscape carries information on specific people in your environment. The information displayed consists of two components: the person's openness (or: willingness to communicate with the outside world), and the person's location (physical or abstract). The goal of this system is to provide a form of connectedness, lowering the threshold for face-to-face social interaction.

Throughout the project 'the door' was used as a metaphor. Rooms have doors, and everyone knows how to use them. A closed door keeps out unwanted influences: strangers, weather, and noise. When open, the door provides a channel of access between one space and another. But it was not this primary function of access we wanted to focus on. A door has a semantic function as well. By looking at the position of a door, people can judge whether they can come in or not. In most cases, a closed door means: don't come in or at least knock. But the information can be richer and more subtle. A slightly opened door can have different meanings for different people. In these cases correct interpretation is not only linked to the absolute position of the door, but also determined by the behavior and context of the 'owner' of the door. If someone slams a door, it could mean a big 'do not disturb', but the specific context could equally well disambiguate this event into a signal that indicates your music is being played too loud. 'Reading' such cues can become natural, almost subconscious. But actions that provide input to the system can become almost subconscious as well. If you want to close yourself off and work concentrated you close the door without even thinking about it. And vice versa, if you want to feel connected to your environment, the door can be set wide open. Throughout the design process, this metaphor proved to be a valuable aid in searching for possibilities and making decisions.

Each person who 'owns' an IrisBox is represented by a personal sound. Each person's sound has a steady, quickly pulsating rhythm if that person is busy or does not want to be disturbed. If that person is open to communication, his or her personal sound changes to a short and abrupt tone, with a longer pause between the tones. The tones add up to a soundscape of availability information. Individual people can be identified by their sound profile, just as you can tell instruments apart in a song.

Your own level of availability is set by twisting the large ring on the face of the IrisBox (see Fig. 4). When the ring is twisted, people that have you in their contact list hear the rhythm of your sound change, indicating a change in your level of availability. When the large ring is twisted clockwise, an iris diaphragm gradually shuts off the illuminated speaker behind it. The position of this aperture represents your availability visually. At the same time, the soundscape output is lowered and filtered, effectively shutting you off from the outside world. Turning the ring anti-clockwise opens the aperture, increases the output volume and sets your status back to available.

Figure 4: The IrisBox. Left: the owner of this box is available for communication. Right: the aperture is almost closed which indicated a low willingness to communicate.

The aperture acts like a portal for communication with the outside world. The aperture ring is used to set your status to an appropriate level. Just as with a door, the appropriate level will be found in equilibrium between total quiet (when shut off, thus unavailable) and maximum level (allowing you to clearly hear the full soundscape).

System design

The IrisBox houses a loudspeaker, an amplifier, readout electronics and a microcontroller. The IrisBox sends the aperture ring's position to the host computer via USB. In the prototype, a Max/MSP patch on the host computer makes sure that the level of availability is broadcast to the people that have you in their contact list, and at the same time controls the soundscape coming from your speaker.

Every participant in the system has an IrisBox on his or her desk. A unique sound profile is compiled using software on the host computer. The same software allows them to manage the people they want to hear in their soundscape. There is a limit to the number of people you can discern, so the contacts have to be chosen carefully.

Sound is very well suited for informing about continuous status in an unobtrusive way. Therefore, the availability of

others is represented by sound. However, there is a limit to the number of sounds we can distinguish when multiple streams are playing. This limit depends on the dimensions of the sounds and the experience of the listener. There is a trade-off to be made here: tracking the availability of many people in a complex way that requires additional user input (for instance, selecting groups of people), or listening to the status of a small number of important people. The latter option was chosen to guarantee a pure and elegant interaction.

The input for the system is the aperture ring. Just as with the door, the aperture serves two functions: controlling the output level of the soundscape, and determining the level of openness of the user. The input ring and output speaker are directly stacked. This allows for interaction close to the output source. In the design, as much effort as possible was put in reducing the distance from speaker diaphragm to iris diaphragm.

Your own status is represented by the openness of the aperture and the level of damping applied to the output sound. The openness of the aperture acts as a metaphor for your openness to the outside world. The outside world, in this case, is represented by the illumination of the speaker.

Even though the aperture does not actually block the sound effectively, they form a logical augmentation to the damping and filtering of the output sound. To maximize the effect of this visual representation, a matte black aperture blade was used to contrast with the silver of the speaker. Visual and tangible mapping is clear: your own state is immediately visible, and the resulting change in output level is immediately audible.

From literature on interruptability research it is known that people are reluctant to actively input their status if it takes too much effort. Therefore, we have attempted to make the interaction as effortless and inviting as possible. The IrisBox is placed at arm's length, where the large knurled ring begs to be touched due to its shape, size and color. The face of the IrisBox is tilted towards the user, giving it a friendly appearance and making the interaction more accessible.

We tried to prevent that people would see the IrisBox as an ordinary loudspeaker. To differentiate, a speaker without dome was chosen and the speaker's rubber rim was hidden behind the aperture ring. As opposed to a volume control, but more like a faucet, the stream of sound is cut off when twisting the aperture ring to the right.

The IrisBox is about the sound and the aperture, not about the box. The box itself therefore had to have an insignificant appearance, to steer the focus towards the aperture ring and speaker diaphragm.

Sound design

According to Buxton, Gaver and Bly [3], sounds that provide status information should consist of sustained tones or repeating patterns. We decided to use such repeating patterns to express availability. Initially we used a short sine tone to represent a person, and we used a repeating two-tone motif. The two tones were subsequently played at an interval. The interval served as an indicator for availability. This approach had two pitfalls. Firstly, it turned out to be difficult for people to identify other people on the basis of the absolute pitch of the pure sine tone. Secondly, using an interval to map information makes it necessary to listen to multiple tones before being able to judge someone's availability.

The sound mapping had to be changed so that the sounds themselves carried information. We decided to keep the rhythm mapping, as it is easily understandable and recognizable by people. Availability information was no longer coded as an interval, but it was represented by manipulating the attack and decay times of the sound. A person who is not available is represented by a faster repetition of tones (= busy) but the envelope of the individual tones is characterized by a slowly rising and slowly falling sound (=not demanding attention). An open IrisBox results in an abrupt tone, i.e. fast attack and decay times (=demanding attention), but with a slower repetition of the individual tones (=not busy).

Discussion

The IrisBox is a prototypical example of tangible interaction. Both input and output means are tightly coupled at the same physical location. In this way, the portal function of the IrisBox intimately links two distant partners and the tangible interaction seems to offer a natural and intuitive way of controlling the partner's mutual concerns about interruptability (availability and willingness to be disturbed).

In the current implementation only two IrisBoxes were built and informally tested. In this situation the identification of a person is not really a problem. Future research is planned to study alternative sound mappings to allow for a more substantial amount of people that connected to a larger set of IrisBoxes. When a network of IrisBoxes is emerging, new functionality is needed to effectively control the next generation IrisBox. For example, a means to select people from your contact list is a function that immediately comes to mind.

At the moment, the IrisBox can be considered a powerful platform on which alternative implementations can be explored. Other applications, for example, like instant messaging, mobile phone or email can be integrated with the current functionality. New multimodal extensions, in which sound is integrated with other modalities like smell, light and/or touch, are envisioned.

'Holaire' by Wouter Widdershoven

In this project the 'Holaire' system was designed. Holaire is a small awareness system clicked on regular acoustic guitar. The name is a combination of the Spanish words: Hola and Aire, meaning hello and tune (melody). This guitar is

placed at the entrance of an office or indoor public space (a bank, or city counter). In our case, Holaire is designed in our design studio (Workspace Zero) and placed at the entrance.

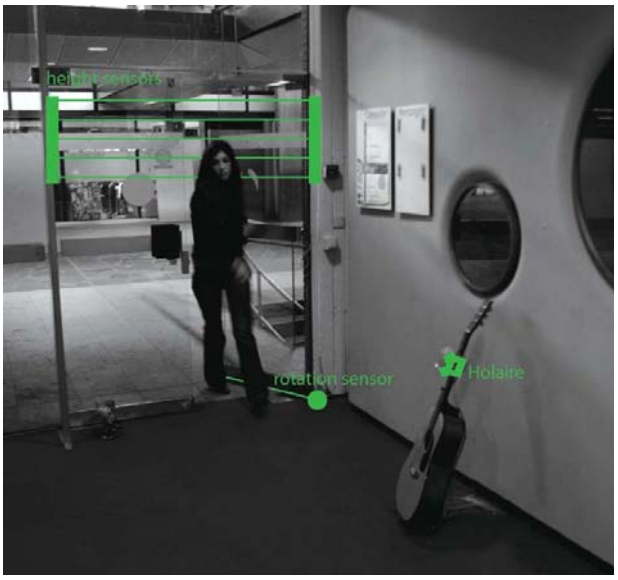

Figure 5: Door sensors provide input for Holaire.

Holaire listens to the door through simple sensors. It is focused on what kind of people enter and how they enter. Infrared beams tell Holaire if someone is tall or short. A variable resistor connected to the door hinge gives info on how the door is handled in terms of speed and pattern.

This information is sent to the little device on the guitar neck. The device rolls over the strings to play a chord that fits the entering person. An extra actuator (a solenoid) can be activated to make it a suspended (sus4) chord. An arm unfolds under the body, hitting the strings with a pick. The strings vibrate harmonically and are amplified by the guitar body. The sound coming from the guitar welcomes the passing person. The other people in the environment (who cannot see the person entering) hear what happens. They recognize the typical sound. After welcoming, Holaire shortly plays a short history of people that just entered before, giving an impression of what just happened. This play of the past lets the person who enters know what to expect and how to position oneself in the context.

There are two types of users in the scenario: the person being greeted and informed and the present person only being informed. The focus in the current system is put on the person who is being greeted friendly while passing the door. This also is the person who interacts with the system and who decides about the character of this interaction. The interaction can be playful or people can even cheat. Other people in the workplace can only experience the sounds produced by the Holaire system. Although Holaire is aiming at playful interaction, it is also supposed to be a system that would fit the everyday working environment.

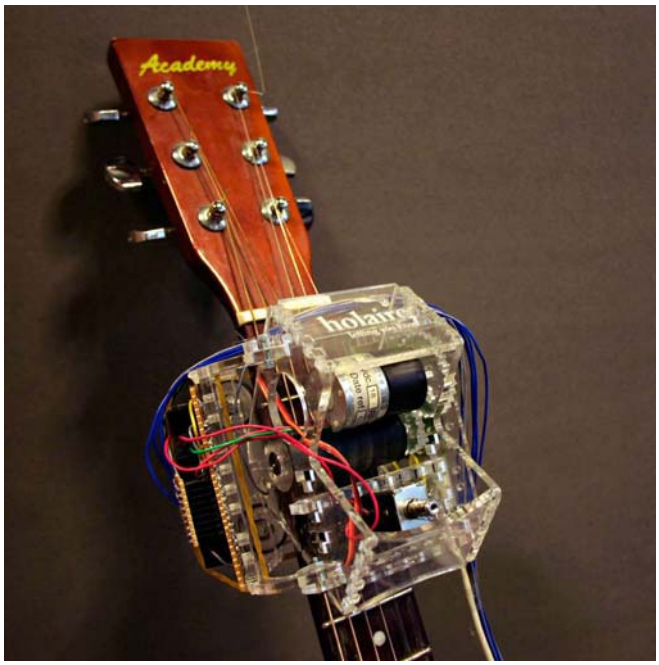

Figure 6: Holaire attached to the neck of an acoustic guitar.

Holaire is connected to an acoustic guitar with the goal not to change it into a robot. Holaire is supposed to be an add-on. To not overwhelm people and to accentuate the inherent beauty of the guitar's shape and materials, Holaire's construction is kept minimal. The entire shape also points towards (and focuses on) the guitar while folding elegantly its curved arms around the guitar neck.

The prototype of Holaire is laptop based. A Phidget interface is used in combination with multithread Flash action script.

Discussion

We could only observe Holaire in real life for a relatively short period of time. This makes it difficult to envision how Holaire would change the environment in the long run. Informal comments seem to indicate that the inhabitants of our workspace got attached to Holaire and considered it is fun to play with the door. When Holaire was removed from its position at the door, people remarked they missed the system in their entering routine. Some people were more skeptical about Holaire questioning its added value to their daily routines. Some people indicated they just got used to the sound playing at their door.

Whether or not Holaire is a 'calm' system that creates awareness at a subconscious level is difficult to say. However, we can definitely state that Holaire influenced people's behavior inside the workspace or at the door.

Some people played with the system; expressing themselves to other people like they would have done through other means like clothing or handshakes. Others tricked the system (or their peers) by, for example, holding up their arms to look taller. Potentially people can differentiate themselves by entering the workplace in personalized ways.

Holaire showed that you can combine the information providing functionality of an ambient awareness system, with a friendly design that is attractive to people and that elicits playful interactive behavior. Holaire seems to rise to the level beyond interactive and is becoming a social presence in the space.

CONCLUSION

In three different design projects we explored the design of environmental auditory information displays. In the precursor project 'Birds Whispering', it was shown that a soundscape can not only serve as an information carrier, but that the sounds can also have a decorative value. This aspect was further explored in the 'Mediated Intuition' project. The resulting soundscape was developed and implemented in a shared workspace. Its informational and aesthetic qualities got their meaning in this workspace and were appreciated by its inhabitants. In the original 'Birds Whispering' project people could control the background/foreground characteristics of the soundscape through their behavior. By making noise the birds would move to a distant location and silence remained. The possibility to actively control this moving back and forth between background and foreground was further explored with the 'IrisBox'. A tangible interface was developed which offers a natural and intuitive way of controlling two partner's mutual concerns about interruptability. Playful interaction with the auditory information display was observed in the 'Birds Whispering' project and further explored in the 'Holaire' project. 'Holaire' allowed people to express themselves by generating personalized variations of the soundscape.

All design activities have been carried out in the same workspace in which the final designs are supposed to be installed and operate. This design in context has had a great impact on the final results.

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