Sensory Threads - Collective Sensory Augmentation

Nick Bryan-Kinns[1], Demetrios Airantzis[2], Alice Angus[3], Robin Fencott[1], Giles Lane[3], Frederik Lesage[2], Joe Marshall[4], Karen Martin[3], George Roussos[2], Jenson Taylor[2], Lorraine Warren[5], Orlagh Woods[3]
nickbk@dcs.qmul.ac.uk

As we move through the world in which we live we are surrounded by a myriad of imperceptible phenomena. We are currently iteratively developing a trans-disciplinary art piece referred to as Sensory Threads in which small groups of collaborators explore imperceptible phenomenon in their environment through live, collective, generative soundscapes. In essence, we augment participants' existing senses with auditory representations of imperceptible phenomena around them. In particular, mobile devices have been developed from the Snout Sensing Platform (Airantzis, et al., 2008) which sense heart rate, light 'warmth', sound 'noise', and spatial density. These readings are transmitted in real time to a central unit which creates an evolving soundscape in realtime which is transmitted back to the participants, and to a gallery space for live interaction and playback. The piece is designed to be used outside, typically in an urban environment where there is a dynamic range of imperceptible phenomena. Our focus is on how to augment our senses with auditory representations of imperceptible phenomena.

The key question we are interested in is: *how do we augment our senses by creating collectively engaging interactive soundscapes from imperceptible phenomena in the world around us?* A number of design 'tensions' arise when creating such experiences including:

Sense of identity versus collective integration. In a collectively engaging experience it is important to be able to appreciate how your actions relate to the imperceptible phenomena, and contribute to the collectively emerging shared soundscape. We are exploring how to augment individuals' senses with collective perceptions.

Sonification versus aesthetic appeal. Conventional data sonification focuses on making clear audio representations of data and typically pays little attention to the aesthetic quality of the sounds produced, whereas interactive sound art focuses on the aesthetic, typically at the expense of the representational power of audio. We are exploring how to represent the imperceptible phenomena in a pleasing yet intuitive manner.

Recognizability versus listener fatigue. In longitudinal audio experiences there is a tension between creating sounds which participants can easily recognise and yet do not become irritating or ignored over the period of the experience. Moreover, participants' movements changes to the data readings, yet, as the readings are of imperceptible phenomena, it may be difficult for participants to grasp the connection between their actions and the phenomena that is represented.

Addressing these tensions has involved a number of research and design challenges in iteratively creating an interactive soundscape driven by four real-time wearable environmental sensor data streams as outlined below.

First, the sense of identity and collective integration is facilitated by using not just different sounds for each data stream, but also different modulations of the sounds. We used mappings of sensor data to: pitch; pulse; filter; density of sound. These were selected and carefully refined through the iterative process to create a soundscape in which different sensor data sounds complemented each other, yet gave participants a sense of their own sensors' contribution.

A key issue arose in the development of the soundscapes with respect to sense of identity: the impact of sensor responsiveness. For participants to gain a sense of identity with their sensor in the collective soundscape, they need to be able to appreciate how physical changes they make affect the sensor. Therefore, sensors are required whose readings may change rapidly, and the

[1]Queen Mary, University of London [2]Birkbeck, University of London [3]Proboscis, London [4]University of Nottingham [5]University of Southampton

environment needs to contain sufficient potential for sensor reading change for the participants to appreciate the effect of their actions. For example, benzine sensors are probably not suitable for the collective audio environment as there may be few sources of benzine in the environment, and changes in sensor readings will be quite small. On the other hand, ultraviolet light sensors in an urban night time environment may be more appropriate as they will respond rapidly to changes in lighting e.g. streetlights, internal lighting, vehicle lighting.

Second, we paid particular attention to the overall aesthetic of the piece whilst ensuring that each data stream was directly mapped to a sound (as discussed in the first piece). The overall aesthetic is ambient electronica with sounds spread across the audio spectrum to create a balanced soundscape. We worked hard to move away from jarring sounds (e.g. noise generators/ sine waves) to create a softer, less confrontational soundscape. A further consideration with selection of sounds was the mapping from sensor type to sound. For instance, it would be tempting to map a noise sensor to the volume of static noise in the soundscape, but whilst this is a literal mapping, it may be confusing as the louder the environment becomes, the louder the static noise in the soundscape would be. Instead, we argue for selecting sounds and modulations that somehow capture the essence of the phenomena being sensed. For instance, we may map sonar readings (proximal density) to intensity of a sound to create a sense of audio claustrophobia when the participants are in a densely populated area. In this way we heighten the perception of the participant by augmenting their usual senses with our audio representations of imperceptible phenomena.

Thirdly, we expect participants may be involved with the soundcape for up to one hour and so introduced some temporal development into the audio to reduce listener fatigue and boredom. In particular, we introduced a generative element to the pitch of one of the sounds. This particular sound is a medium to high pitch tone whose onset is controlled by the value of the data it represents - the higher the data reading, the faster the tone is triggered. Over time a motif is generatively evolved to replace the single tone whilst the onset of the motif is still triggered by the data. In this way we have two dimensions of representation in one sound stream: a primary representation of the sensory data (onset), and a secondary representation of the time elapsed since the experience started (increasingly complex musical motif). There are clearly issues here with selecting appropriate primary and secondary representations which we will investigate further.

Finally, the soundscape will also be used as part of the playback of recorded sensory expeditions through auditory and tactile representations of the recorded imperceptible phenomena. This raises issues of how the piece should develop, or not, over time (our third design tension) when people playback and navigate through the experience. For example, if people navigate directly to the end of the expedition, it is not clear whether the sounds heard should be the sounds heard by the participants at the original time of the expedition, or whether the secondary representations should be relative to the time spent in playback mode. In effect, we are asking whether the sensory augmentation is always live (and so relative to the participant), or whether in playback the augmentation attempts to recreate the recorded experience. This is currently an open issue that we are investigating through our ongoing studies.

To sum up, through our work on the Sensory Threads project we have iteratively identified a set of design tensions concerning sensory augmentation which we would like to bring to the e-sense workshop along with our practical experience of creating a live, collective, mobile, sensory augmentation system.

D. Airantzis, A. Angus, G. Lane, K. Martin, J. Taylor and G Roussos, 2008, Participatory Sensing for Urban Communities, *Urbansense08 Workshop at Sensys 2008*, Raleigh NC, USA.