

SENSORY THREADS

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Abstract

Sensory Threads is a pair of interlinked experiences, which explore the way in which sensing can give us insight into how our bodies are a part of their wider environment.

Sensory Threads seeks to investigate what happens when wearables move beyond being technologies designed for individuals and are transformed into tools of 'collective sensing'. It aims to stimulate participants' behaviours through their own emergent and unpredictable actions in an environment, not by pre-defined choices determined in advance by the project's makers or by 'interesting' geographic sites.

This article describes the design of this artwork, which is currently in prototype form.

Introduction

As we move through our environment, we are bombarded by a mass of sensory information such as sound, light, smells, and also other less perceptible things such as high and low frequency sound and non-visible light. The Sensory Threads project considers our bodies as a vital part of this environment, by using both environmental and body sensing technologies, to allow us to explore how we are part of our environment, and the complex patterns and rhythms that occur in the reactions between our bodies and their environment.

Sensory Threads comprises of two elements, firstly a group expedition through a city, using wearable technology and real-time audio feedback in order to allow participants to explore this combined environment. Secondly, a gallery based installation allows for the replay of the sensory experience, using a combination of tactile feedback, visuals and audio.

Exploration

Groups of 4 people are sent out on a mission to explore the city using a set of 4 wearable sensing devices. Each of these is worn by a single person, and records data from one type of sensor. Each person's individual sensor stream is sent to a 'heart' computer carried by one of the explorers. The 4 sensor streams are then used as input to an interactive soundscape which is produced by the heart computer, and then output on wireless headphones to each of the explorers. The heart computer also re-

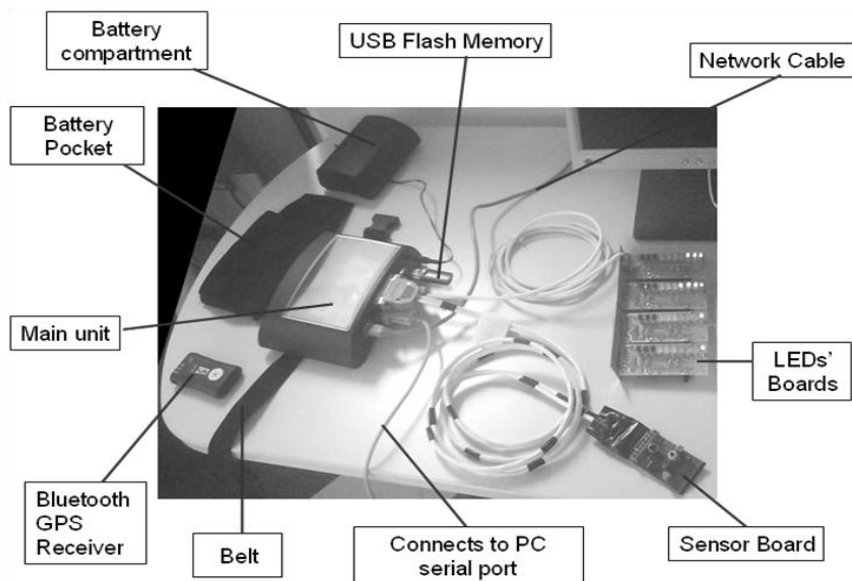


Fig 1. Snout Sensing Platform

records a GPS track of where the explorers are going.

Each of the sensors influences a different aspect of the generated soundscape. This means that people are able to experiment with how their sensors affect the sound being created.

As each sensor responds to its environment differently, a complex group dynamic is created; each explorer is more motivated to explore things that their sensor responds to, but will have to move with the rest of the group and negotiate between each other where to go, as all explorers must stay close together (within 5m) or the soundscape fades out.

The Sensors

This section describes the sensors carried by each of the explorers. These are mounted on specially made costumes. These use a version of the Snout Sensing Platform [1], a specially designed Linux based hardware sensing platform for participatory sensing (see Figure 1). The way in which the sensors are configured is described below.

One explorer is designated the heart, and wears a heart rate monitoring strap, and carries a special heart computer (a small netbook style laptop in a backpack). The heart computer records the sensor data from each costume, and creates the soundscape, which is then output to the explorers via wireless headphones. This creates a feedback loop, with the explorers able to move around with the sensors, and hear how the soundscape responds. Figure 2 shows a diagram of the system.

The heart computer also records the position of the group of explorers, and

all the sensor data, and transmits it to a server, for use in the installation experience.

The heartbeat of a person is intimately linked to their speed of movement, and the terrain which they are moving over, so creates an interesting bridge between the heart's body and the environment in which it is moving.

One of the explorers has a noise meter on their costume. This detects ambient noise levels around the explorer. This is affected by many things, such as crowds, traffic, or conversation with the other explorers.

The light meter detects levels of light falling upon the costume, with a light sensor mounted on a hat. This is affected by people passing by, changes in the weather, by being covered by one of the explorers, overhanging buildings and shadows, and also by changes in posture of the explorer, which may alter the shadowing of the sun or other light sources.

The sonar suit uses 4 ultrasound rangefinders, attached to the front, left, right and back of the suit. These use reflected ultra high-frequency sound to detect the distance of the closest object in their direction. This allows detection of how cramped a space the person is exploring, or can provide a rough estimate of the density of a crowd surrounding them. It is also interesting in that it gives a very directional signal, which can differentiate between situations such as being in a narrow empty corridor (left and right sensors give close readings), and walking amongst a group of people in single file (front and back sensors give close readings).

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Soundscape

The Soundscape for Sensory Threads is an algorithmic composition, generated by a program running in the SuperCollider realtime audio synthesis system [2]. The design of the soundscape involves a careful balancing of clarity of response and the creation of musically interesting sounds. If the soundscape purely responds simply to the sensors, it is very easy for people to play with their sensors and make it change. However, this kind of soundscape soon becomes limited and monotonous. Similarly, if the soundscape is affected in more subtle ways by the sensors, it can be hard for people to interpret it, especially when they are just beginning the exploration. Because of this, Sensory Threads begins by making the soundscape highly responsive, and adds in more complex themes and less direct responsiveness as time goes on.

Playback Interface

The playback interface has two purposes, firstly, it provides a real time stream of explorations as they happen, transmitted from the heart computer via a 3G network. Secondly, when no explorations are ongoing, it provides an interface for exploring the data recorded by all previous explorers, and allowing gallery based visitors to go on their own virtual trips through the mass of sensory data.

When designing the interface it was intended to provide a multi-sensory experience. The current design uses a combination of sound, visuals and touch to replay the explorer's experiences.

The core of the installation is a large box (made from a tea crate). This box has a video screen on the top, which shows a map, displaying the position currently being explored (see Figure 3). The box also contains a large subwoofer speaker. This is used to create very low frequency sounds, which make the box resonate. When the box is touched, a nuanced set of vibrations. This large shaking and booming box also acts to attract people's attention to the installation. As well as the large resonator box, which responds to all the sensor data, 4 smaller resonators are also part of the installation. These are made from computer game control pads with variable rumble support. Each of these mini-resonators vibrates based on the sensor readings from one of the explorers, allowing for an individual to experience a direct connection to the sensing of one explorer. Finally, a set of speakers in the

exhibition space provide an audio playback of the soundscape itself.

In streaming mode, the box is non-interactive. The map display moves to the position of the latest sensor readings (which are displayed as dots on the map), the large and small resonators can be felt to respond to the sensor readings, and the soundscape can be heard.

In exploration mode, the box itself becomes an interaction device. Tilting the box causes the map to move in the direction of the tilting. This allows for the exploration of new paths through the previously recorded sensor readings. The large box means that multiple people can tilt it at once. It is also the case that in order to feel the individual sensor experiences from the miniature resonators, two or more people must collaborate, with one tilting the large resonator whilst the other feels the mini-resonator. This is designed to encourage groups of multiple people to perform their own explorations of the sensor data, in a manner analogous to the outdoor explorers.

Design Process

Sensory Threads is part of a research project exploring the value created by inter-disciplinary collaboration. It involves a highly inter-disciplinary team, from several university departments, working in tandem with Proboscis, an external arts organisation.

Proboscis specialises in publicly authored work. Members of Proboscis were the primary drivers of the conceptual side of the project, and also created the physical costumes and interfaces.

The custom electronics and hardware for the wearable sensors was developed

by computer scientists from Birkbeck College, in collaboration with the Centre for Digital Music, Queen Mary, University of London, where the soundscape was developed.

The installation and the software to run it were designed at the Mixed Reality Lab, University of Nottingham, again with physical design and construction being done in collaboration with members of Proboscis.

The study of the value created by this collaborative work (by the University of Southampton Business School) is currently ongoing. The key result identified so far by this study is the wide range of added values created by this collaboration, beyond the purely financial aspects. In particular, the coming together of several very different organisations and backgrounds has inspired all those involved to consider design and evaluation outside the traditional areas in which they work, and to work in ways which differ from their existing habits and ways of practicing. It has added considerable value in both the practice, and reflection on truly trans-disciplinary collaboration.

Acknowledgements

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Bibliography

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2. *SuperCollider* <http://www.audiosynth.com>

Fig. 3. Map on Top of the Large Resonator Showing Recorded Sensor Data Points

