Tangible air

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Tangible Air: An Interactive Installation for Visualising Audience Engagement

Thomas Röggla[1]**, Chen Wang**[1]**, Lilia Perez Romero**[1]**, Jack Jansen**[1]**, Pablo Cesar**[1,2]

[1]Centrum Wiskunde & Informatica, [2]Delft University of Technology

The Netherlands

{t.roggla, c.wang, l.perez, j.jansen, p.s.cesar}@cwi.nl

ABSTRACT

This article presents an end-to-end system for capturing physiological sensor data and visualising it on a real-time graphic dashboard and as part of an art installation. More specifically, it describes an event where the level of engagement of the audience was measured by means of *Galvanic Skin Response* (GSR) sensors and of the presenter through a sweater fitted with GSR, ECG and acceleration sensors. The gathered data was presented in real-time through a visualisation projected onto a screen and a physical electro-mechanical installation, which would change the height of helium-filled balloons depending on the atmosphere in the auditorium. Thereby trying to create a tangible way of making the invisible visible.

ACM Classification Keywords

H.5.m. Information Interfaces and Presentation (e.g. HCI): Miscellaneous

Author Keywords

Sensors; cultural experiences; GSR; shared experiences; interactive art; physical installation; data visualisation

INTRODUCTION

There exist numerous publications which use sensors such as *Galvanic Skin Response* sensors to assess a person's reaction to media items like movies, music or live performances such as theatre plays [2]. Most of these studies however, are conducted in laboratory settings and often also with a single participant at a time [1]. In the work presented in this article, we decided to go a few steps further and use different sensor technologies to visualise the engagement of a number of people during a live event. In addition to that, we also wanted to find a way to make emotion and engagement more tangible by transporting these abstract concepts into the physical world.

The system made use of a custom-built group of wireless GSR sensors as seen in Figure 2, which were used to capture the engagement of 36 members of the audience at an event. Moreover, the presenter of the event wore a specially designed

Figure 1. Installation with balloons at different heights during the event, with speaker and graphic visualisation on the left

sweater integrated with sensors measuring skin conductivity, heart rate and acceleration. All the data from the audience as well as the presenter was gathered and processed at a central server and relayed to a graphic visualisation projected onto a wall. This way, every attendee could see the amount of engagement in the audience and the state of mind of the presenter. Additionally, the data of ten audience members selected at random by the system was fed into a physical installation entitled *Tangible Air*, depicted in Figure 1, which would represent the level of engagement of these ten audience members physically by altering the height of helium-filled balloons, popping the ones whose level of engagement would underrun a certain threshold. Thereby creating a moment of shock and thus hopefully eliciting a newly increased level of engagement in the audience.
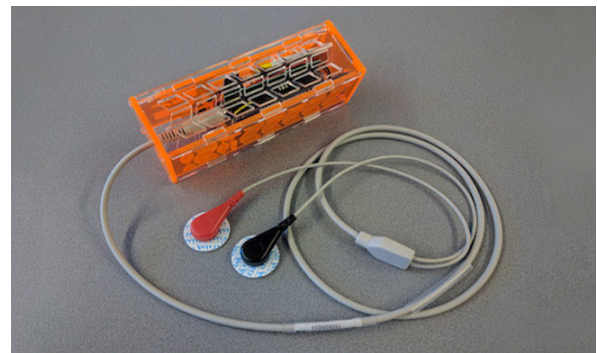

Figure 2. Wireless GSR sensor used at the event in custom laser-cut case
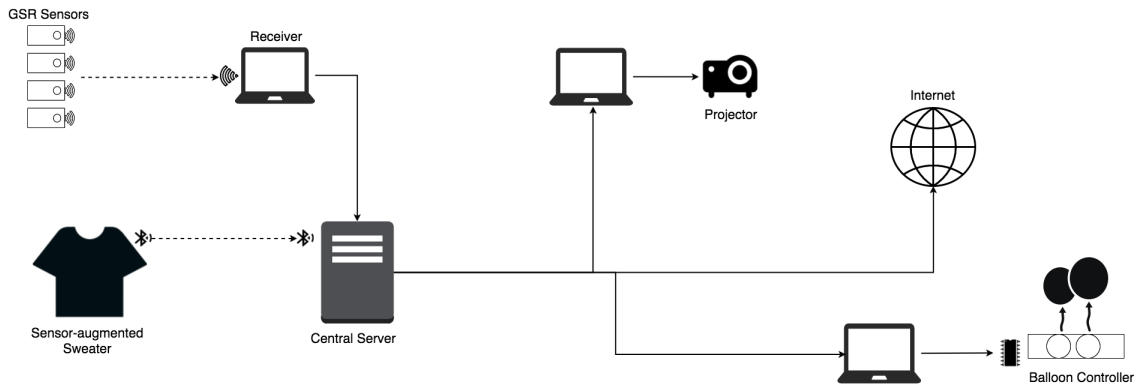
Figure 3. Layout of the entire system deployed at the event. On the left, data collection from the audience through wireless GSR sensors and from the sweater via Bluetooth and on the right visualisation on a screen and on the Internet and the installation with the balloons.

What we would like to showcase in this demo is a simplified version of the system that was used during the live event accompanied by supplementary material, such as a video and a poster describing the system and the event in greater detail. Participants can try the sensors and experience a scaled-down version of the installation and the visualisation.

SETUP

The system as depicted in Figure 3 was set up and used during a networking event with various talks. In one of the talks about wearable technology given by the Dutch fashion designer *ByBorre*, 36 members of the audience received one of our GSR sensors to use at the 20 minute talk, during which we collected around 106000 data points, which were stored for later analysis.

The system is centred around a central server, which takes in data from the audience via the local network and from the sweater via a Bluetooth connection. The raw data is then distributed to client machines through a publish-subscribe model. Data from the sweater as well as all audience data is fed to a machine connected to a projector, which projects the visualisation depicted in Figure 4 onto a screen. Further, the raw data from ten randomly selected audience members is fed to another client machine, which in turn is connected to an *Arduino* microprocessor which is responsible for converting the engagement values into height adjustments for the balloons and controlling the stepper motors accordingly. Finally, the central machine also runs a web server, which serves a scaled-down version of the visualisation to browser-clients.

More specifically, the data gathered from the sensors was visualised in two ways: the first one being a real-time visualisation of the data, which showed on one side the level of engagement for each audience member using one of the sensors, as well as the engagement of the speaker, his heart rate and how much he was moving. All of these data streams were projected onto a screen during the presentation. In addition to that, audience members could access a simplified version of the same visualisation on their mobile devices through the Internet.

Perhaps more tangible was the second way the data was visualised. An installation dubbed *Tangible Air* by its creator,

Figure 4. Visualisation showing audience engagement (left half) and sensor readings of the presenter (right half).

artist Lilia Perez Romero consisted of ten big white helium balloons placed next to each other. The balloons were held in place by strings connected to spools that would wind or unwind according to the data received from a set of sensors randomly selected from the audience members. The level of engagement measured by the sensors, was translated to the length of string attached to each individual balloon. The more engaged the audience members would become, the higher the balloons would fly and vice versa if the engagement should fall. When an audience member became completely disengaged, the balloon linked to their data stream loses height, potentially reaching the ground where a row of needles awaited. If a balloon touched a needle it would burst and the noise would inevitably capture the audience's attention and renew their level of engagement, thus pulling the balloons back to a high position. This action-reaction behaviour formed a closed feedback loop demonstrating how an environment can be shaped according to physiological data obtained through wearable technology.

In summary, the goal of this project was to explore new ways with which we could make emotion, which is ever-present yet completely abstract, more present and tangible in the physical world by transferring it into a physical medium through the use of technology and artistic expression.

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