Responsive Public Space - Performative Immersive Setting in Public Environments

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Abstract

Responsive Public Space (RPS) is a performative spatial environment integrating audio-visual composition responsive to the engagement of participants among themselves. In an interdisciplinary collaboration architects, artists, composers and computer vision specialists developed an environment in which participants can enter, move around, and - through interaction with each other - experience different fragments of a space-sensitive soundscape and its visual representation (sonification). A high-end tracking system allows multiple participants to be reliably tracked.

Keywords: Trans-disciplinary collaboration, human-human-machine interaction, immersive composition, tracking, responsive environment, public space, LED pixel installation

Responsive Public Space (RPS) is an interactive light- and soundscape installation in a public setting, designed to encourage engagement between participants. *RPS*, which includes a light surface that hangs over participants and a corresponding soundscape, tracks and evaluates participants' behaviour and translates this information into light and sound. In contrast with interactive artworks in which participants interact directly with the work (for example visually [1] or audibly [2]), here participants can only activate an 'active space' if they work closely together. Passers by are invited to react to the light- and soundscape, and so to each other's actions and reactions within the space. The experience becomes more intense as the number of participants increases, and the character of their interaction is represented through a space-sensitive architecturally constructed audio-light surface. Participants' collective behaviour, and the way in which they manage their spatial relationships, influence the quality of experience for each participant by determining the degree to which they transform the active space around themselves.

Instead of focusing on the relationship between human and machine, *RPS* investigates inter-human relationships, encouraging participants to create their own 'performative space' by interacting, and working, with their fellow participants. *RPS* investigates 'connection / disconnection' and 'isolation / togetherness' in urban environments in the information age; the audience enacts social 'nearness' as the main control parameters of the light-audio composition. The aim is to generate an immersive audio-spatial experience of 'nearness' that is enacted by participants' imaginary and novel sense of embodied space.

Concept

RPS responds to the curatorial theme 'Resistance is Fertile' with the proposition that technology has arrived at such cultural and technological maturity that it allows us to go back and explore physical intimacy by exploiting the aesthetic and social potentials of pervasive technologies. Through constant redefinition of the virtual environment, participants are able to develop a novel collective sense of space, and reinvent and expand their everyday perception of public spaces [3]. This work aims to take the virtual reality experience further, by generating an information space in which well known technologies are combined with great consistency to generate intimate human reflections.

The experience intensifies with the number of actors within the space and their collective behavior, and the quality of their relationship is represented by a space-sensitive soundscape and its visual representation on the architectural construction. By attaching new meaning to urban spaces, it fosters human intimacy and collective engagement. As the technology is invisible to the participants, it allows a different sensibility within the performative space and the musical performance itself, as compared with environments in which participants interact overtly with the technology.

RPS is a follow-up project of *Sensitive Space* [4], which processed the results of tracking and visually representing information derived from the relationships between participants (inter)acting within a certain space. In *Sensitive Space,* valuable information based on tracking data could be used for video/audio composition. *RPS* goes one step further and investigates how the space can be responsive to participants' behavior, and how the derived information can be re-applied to transform the space's characteristics and affect participants' experience. The open space is generated by the ever-changing dynamic feedback of the environment in architectural, visual and acoustic transformations. The objective is that a spectacle of simplicity and contradiction, action and reaction is created, in which one learns to find balance in a constantly changing, collectively created, non-haptic environment. Behind the interaction and enjoyment of the music, *RPS* seeks to allow a further, intangible level of psychological experience for the participant.

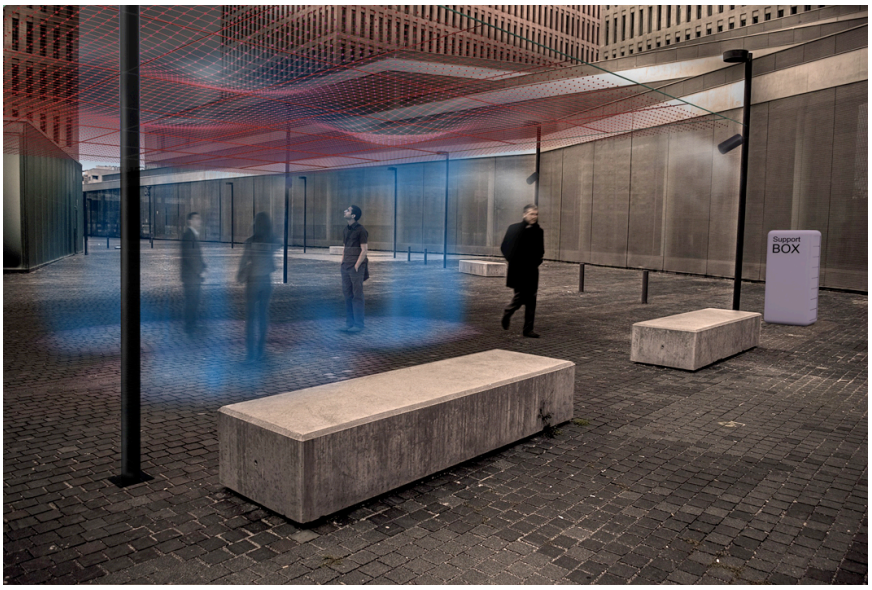

Fig. 1. Concept Image of the kinetic audio-light surface of *Responsive Public Space*, with participants (© ORTLOS).

The closeness of the participants to one another determines the size of their cognitive-scope. When two individuals meet, both their according light projections and their acoustic tracks melt together into one; when they part, each regains their own visually represented soundscape.

The technical background consists of four components: (1) The tracking system, which uses infrared to exclude distractions from the projections and detect only people in the open space; (2) The 'information cloud' above: a visual surface, made up of light-weight steel construction with LED Pixel elements which serve as projection screens, allowing participants to move freely in the space underneath; (3) the soundscape, generating acoustic 'relational feedback' of the movements in the space; and lastly, (4) the immersive environment, the visual representation itself, i.e. the implementation and integration of all included components.

Interaction and Composition

RPS is driven by a 'metamachine' which uses high-end 3D tracking software to provides a data stream for the evaluation of participants' movement and nearness (according to *RPS*'s interactivity concept), and distribute it between the light and audio systems. This interactivity concept refers to interactions, or 'nearness', in 4 states (Fig. 2). In each state the audio and light (kinetic surface, intensity of lights) has a particular mode of reactivity to the participant. The system also incorporates a rule that regulates the reaction of the light to the soundscape. The system aims to generate the greatest transformation from the greatest relative 'nearness' of people in the given space.

The sound composition is produced by a generative system which aims at providing 'relational feedback' to the participants' movement and activity within the space. Concrete, electronic, instrumental, and even historically referenced sound events are constantly remixed through regenerative combinations, while the activity and passivity of current participants defines the weighting of the composition details at any moment.

The system of the sound scape measures the number of participants, their distances from one another, and their positions and movement patterns. This data is transposed in real-time into a number of musical parameters which influence the density, harmonics, dynamics, style, duration, rhythm, tonality, and so on of different compositional layers. Pre-defined modulation methods and sounds are assigned to each participant, and their interaction is observed by the tracking system. The participants can transform the space through their direct involvement, influencing, for example, interpretation, remix, audio samples,

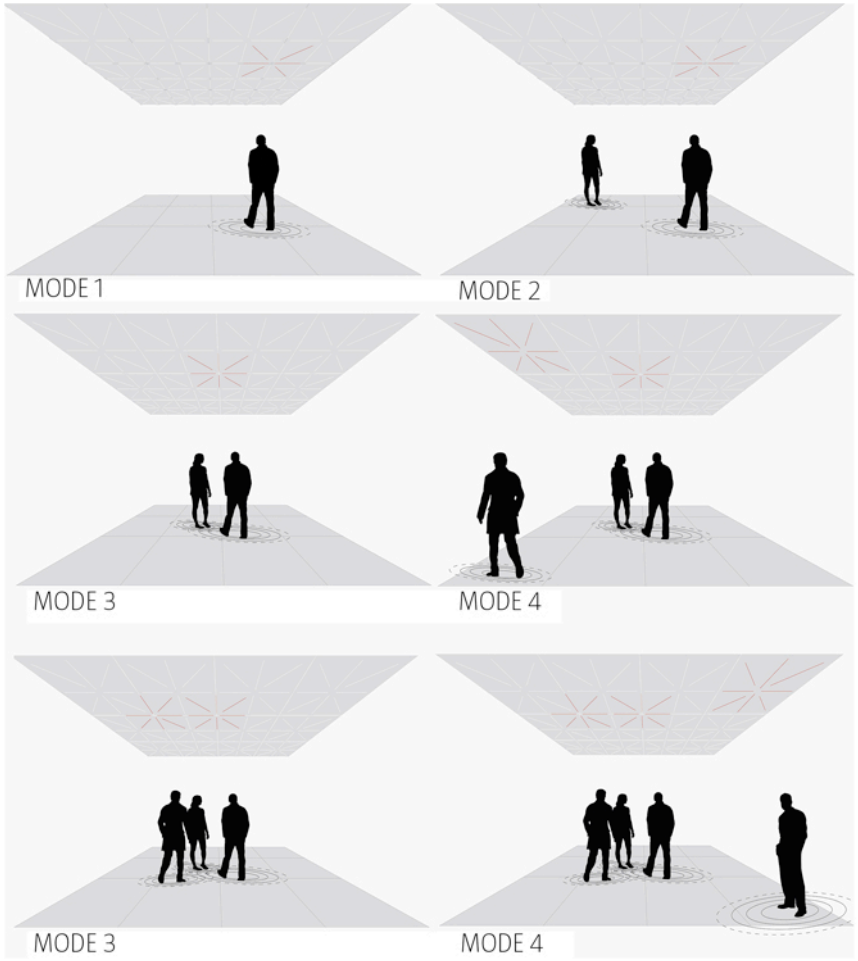

Fig. 2. Interaction rules implemented through the 'meta-machine' showing 3 states of interaction (© ORTLOS)

virtual instruments, groups of instruments, and perspective changes in the composition. The interaction modes are: 0 state = silence, 1 state = noise, 2 or higher state = composition (based the on number of people present).

The major aspects of visual representation are: real-time processing of the participants' positional data, and the visual representations of the physical phenomena of their interactions. The interconnection between sound and visuals investigates the responsiveness of space on both a physical and a virtual level (augmentation). There are several layers of visual information, separated by different surfaces, including tracking data, the intensity of interconnectivity between people, how long they stay close to each other, and so on. The visual representation focuses on the interconnectivity of people, which has to be seen as a feature of participants' immersive experience within the environment.

MAX/Msp/Jitter software is used in combination with the programming language *Processing*. The input data from the tracking device comes in OSC format, and is therefore in sync with the sound; all visuals are triggered live, not pre-recorded; and if a fluid or particle simulation is used, some patches may be prepared as ready-made samples.

The installation explores the social behavior of participants, analyzing relationship patterns; and with a growing number of participants - similar to swarm behavior - also its complexity. Participants can take part by simply walking into the installation space and exploring the audiovisual feedback loop in relation to themselves and to others in the space.

Thus input of behavioral data is processed, analyzed, and made audible as acoustic output, which then interacts again with the participants, through subsequent re-modulations and variations of the music. For each participant there is a range of behavioral possibilities: passive/active, non-conformist/hierarchical, individual/team-oriented, and so on, and and all of these parameters relate to social intelligence.

Participants do not need any previous knowledge of the system, they simply

use their body as an interface. Through the invisibility of its technology, *RPS* aims to produce a distinctively different sensibility in the performative space, a full-body immersion. The anticipated outcome is a multi-sensorial experience in which human movement transforms the soundscape and affects the multi-surfaced visual representations. The open space is generated by ever-changing dynamic feedback from the environment as a form of architectural, visual and acoustic transformation.

Based on the tracking data, the multi-agent simulation defines the following interaction parameters: timescale of movement, timeline of standstill, x/y coordinates of participants, and distances between them. The musical composition supports an impression of private space, and the sense of entering another person's space without permission. Through music-induced movement the private space temporarily expands to a public one. One of the main concerns of *RPS* is the promotion of active communication between participants. Their actions and interactions can dynamically construct and deconstruct the properties of the performative space, take into account their experiences, and dynamically transform the immersive, collective composition.

In *RPS* the tracker assigns an identity to each detected individual, and saves their last positions (x/y coordinates), their distances from one another, and the angles from the middle of the image to each participant). These parameters are sent (as OSC data) for each person and feach frame. Based on the participants' proximity to each other, the 'meta-machine' triggers generative audiovisual compositions which intensify the level of intimacy between participants. The system only produces feedback when at least two participants are interacting with the environment. In the case of overlap, the two tracks are fused; when a track splits - i.e. two participants close together separate again - a new track is generated, and assigned to one of the two.

Fig. 3. Possible implementation of *Responsive Public Space* in a relatively small public square; here the construction is suspended from trees, which define the performative space. All elements, such audio speakers, tracking camera, etc., are incorporated within the primary construction layer – a grid which can be adapted to the site (© ORTLOS)

Hardware

RPS is an outdoor light surface (Fig. 3) consisting of a lightweight architectural structure made up of two layers. The first layer is a rigid grid which has the function of bearing the loads; it is adaptable to different locations, and the second layer, an LED net which is attached to the grid. This LED net incorporates a great number of individually controlled LED lights (pixels). The grid surface is mounted to existing objects found on the specific site (for example light masts, trees and existing walls).

The installation measures approximately 6x4m (planned version), although an 8x6m version is also possible for tracking of 5 to 7 people.

The tracking system uses 3D camera sensing systems for accurate and consistent tracking of multiple participants (e.g. Microsoft Kinect).

The sound component consists of a matrix of 12 speakers, intended to achieve an ambient soundscape. Site-specific tests are crucial for the final set-up, for review of volume, noise level, weather conditions and so on.

The equipment is housed in weather-proof boxes.

The LED net of 2240 RGB Pixels with WS2801 chip on each one, controllable through ArtNet protocol by meta-machine running in Processing, is connected in series, and the light intensity of the LEDs is adjusted to the site specifics.

The installation can only be operated during the evening/night or during the cloudy weather, since the infrared-light tracking device is sensitive to daylight.

Fig 4. Photograph of the RPS installation premiere in Graz, late September 2013. Five people have created a group with a new participant approaching. This is the Mode 4 according to the interaction rules. The advanced version of the meta-machine operates differently depending on whether a group of participants is present in the system or not. This improvement encouraged participants to create groups and come together even more. (© ORTLOS)

Setting up and testing the installation

A workshop at *ISEA2013*, a prominent international symposium on electronic art and ideas which took place in Sydney

[5], provided a platform on which we have been able to realise the first functional prototype of *RPS*. All system components were successfully tested: the Kinect tracking device and tracking software, the meta-machine for control of visual and audio output, and the programmed acoustic composition triggered by predefined interactive rules. It was shown that a covered space with dimensions 6x4m, and a maximum of 5 participants, are suitable limits. However, outdoor conditions, particularly regarding infrared levels in daylight (one of the major issues with this tracking system) couldn't be tested. The participants of the workshop received their own version of control software in *Processing and MAX/MSP*, which they were able to experiment with, modify and even improve.

The final project has be premiered in late September 2013 in Graz, Austria, as a public, outdoor installation over a period of seven days, during which it was monitored and evaluated.[6] Generated data of users' behaviour on the three consecutive days will be visually represented in order to gain knowledge about human behaviour within such an environment, with a focus on social interaction between participants. The results will be published in a follow-up publication.

Acknowledgments

Production of RPS:
Conception and Interface Design: ORTLOS, Ivan Redi, Andrea Redi, Brigitta Zics, Gudrun Jöller, AT/UK
Programming: NIRI, Marko Smiljanic, Radica Velinov, Obrad Stajic, SRB
Composition and Audio Programming: Hubert Machnik, D
Hardware Development of Visual Space: Sinisa Hristov, SRB
Tracking: Martin Kampel, Computer Vision Lab, University of Technology Vienna, Austria
Responsive Public Space *is kindly supported by:*
The Austrian Federal Ministry for Education, the Arts and Culture / The Country of Styria, Economy, Europe and Culture / The City of Graz, Culture, Environment and Health

References and Notes

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