Responsive Sensate Environments: Past and Future Directions
Designing Space as an Interface with Socio-Spatial Information

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Kirsty Beilharz

Key Centre of Design Computing & Cognition, University of Sydney, Australia
overview
http://www.arch.usyd.edu.au/~kirsty

- sensate spaces, intelligent buildings
  - enabled by embedded sensor technology
  - sensing methods for capturing data
- ambient display - aesthetic sonification as an emerging design domain
  - mapping socio-spatial data to sound
  - aesthetics for sustainable ambient display
- responsive generative sound design
  - real time immediacy
  - relation of design artefact to human (inter)activity
  - evolving/generative design to sustain interest over time
- gestural (spatial) interaction with information
sensate space

- a medium for humans to interact with living- and working-space
  - enabled by embedded sensors
  - display - sonification
- sonic indicators of socio-spatial activity (feedback)
  - number of occupants
  - busy-ness (motion)
  - environmental measurements – temperature, lighting
  - position relative to specific locations in the space
  - proximity to objects (tasks)
  - human flocking (clustering) + eccentric behaviours
interface: active (performative) & passive (embedded) sensing

active

- haptic, tactile (gloves)
- motion capture suits
- wearable
- goggles
- implants
- 6 D.O.F. tracker
- video tracking
- gyroscopic, velocity

passive

- pressure mats
- infra-red
- temperature
- photo-sensors
- video tracking analysis
- MEMS (microelectromechanical systems)
- RFID tags (radio frequency emitting identification) – distributed & networked
background: spatial interaction in performative art

- real time responsiveness
  - immediacy
  - experience design
- invokes and perpetuates user interaction
  - heightened social and spatial awareness
  - learning and understanding metaphors of representation
  - multi-user shared experience
- aesthetic and informative value = ‘infotainment’
  - information as art
Rafael Lozano-Hemmer
http://www.fundacion.telefonica.com/at/rlh/e proyecto.html
Gemeinböck, Blach & Kirisits

üzüme (CAVE)
performative

- enabled by attached sensors
- internet participation

stelarc
blinkenlights germany
http://www.blinkenlights.de/
using your mobile phone the program *blinkenpaint* enabled you to create your own animations (blinkenlights was running for 23 weeks)
background: ambient display
http://www.cs.berkeley.edu/projects/io/ambient/

- monitoring environmental characteristics – socio-spatial
  - can be auditory display (sonification) or visualisation
- peripheral, décor
  - “ambient displays normally communicate on the periphery of human perception, requiring minimal attention and cognitive load”
  - perceptual bandwidth is minimized
  - users get the gist of the state of the data source through a quick glance, aural refocus, or gestalt background ambience
stock data sonification

Fabio Cifariello Ciardi’s sMAX: A Multimodal Toolkit for Stock Market Data Sonification

- online (live) data from stock market environments, in which large numbers of changing variables and temporally complex information must be monitored simultaneously.

- refreshes dynamic data from the network approximately every 200-600 milliseconds

- user interface offers real-time controls of mapping parameters, scaling functions and thresholds

- applicable to any large multidimensional data set

- auditory system is useful for monitoring and analysing multidimensional data
meteorological data sonification
http://www.andreapolli.com/studio/atmospherics/

Andrea Polli – atmospherics/weather works – sonification of meteorological data, designed for museum installation/exhibition with the additional agenda of displaying narrative

Polli maps the location of data sources to corresponding speaker positions in the auditory display
meteorological data sonification

Garth Paine – PLantA
- sonification of meteorological data from a weather station
informative brain sonification

Hermann, Baier and Müller
Polyrhythm in the Human Brain
- multimedia feedback and communication system
sustainability?

aesthetics for ambient sonification

- ‘listenability’ – sustainability
- natural vs. synthetic sounds
- comprehensibility – semantic understanding
- auditory capacity for cognition and differentiation


- generative artefact is an inherent, embedded ‘history’ of socio-spatial conditions that created it
mapping activity to sound

- number of people
- motion
- clustering
- importance
- location

- intensity
- velocity
- spatial audio
- frequency (pitch)
- tone colour

- comprehensibility (meaning)
- orthogonal correspondences (temperature, motion, noise)
responsive sensate configuration

- sentient lab configuration as a test bed for modelling spatial and social interaction design
  - pressure mats under carpet
  - temperature, proximity, bend
  - lighting
  - video tracking

- using Max/MSP & networked MakingThings Teleo Modules
sentient lab
Christa Sommerer & Laurant Mignonneau
www.mic.atr.co.jp/~christa/WORKS/
Lintermann & Belschner Sonomorphis
http://i31www.ira.uka.de/~linter/SonoMorphis/
experimental design using L-system & pressure mats

- temporal and spatial movements manipulate the generation of material
- variables in the generative algorithm currently affect the graphical display, including shape, size, branching and colour
- sonification model provides a parallel process for auditory display
- Lindenmayer System (L-system) integration: chosen for its direct relationship between complexity of the generator function and output
gestural interaction

- gesture controllers to manipulate sonification of data

- Knowledge flows from socio-spatial activities to sensors that capture data, through a computational sonification process to real-time display.
- The loop is completed when gestural controllers are used for spatial interaction to manipulate/investigate the data.
haptic and gesture controllers

Justin Manor’s Manipulable Cinematic Landscapes (Maeda, 2004) is a glove-controlled cinematic landscape interface in 3D space.

Haptic (tactile) manipulable cubes in Reed Kram’s *Three Dimensions to Three Dimensions* (top) are creative tools for expression while sensors attached to digits and limbs can be used as gestural controllers for music (bottom) (Choi, 2000; Pottier and Stalla, 2000; Rovan and Hayward, 2000).
A gestural Cyberglove controller that produces a high degree of accuracy transmitting spatial, position, rotational, gyroscopic, velocity and flex data. The precision facilitates interaction with information representation in 3D space (Bongers, 2000).
Bi-directional (mercury) motion sensors are attached to the calf’s front legs, a gyroscopic sensor on the forehead and accelerometer on his right ear. The pouch hanging around his neck contains the radio frequency transmitter that sends the real time data to the (La Kitchen) Kroonde Gamma wireless UDP receiver (LaKitchen, 2004). It is connected by Ethernet to the computer running the data sonification with Max/MSP object-oriented programming environment.
‘the music without’

Input from the Kroonde captors triggers the auditory representation of motion in the Max/MSP patch. The resulting sound is a sonification of the physical exertion and motion required to produce the solo violin improvisation.

Sensors are attached to the violinist’s left and right hands and arms to capture the physicality of performing: pictures the acceleration sensor and motion direction sensing representing bowing activity.
sonic kung fu @ sydney esquisse

jakovich & beilharz

- gestural interaction with auditory display created in response to colour tracking of the spatial glove motion
sonic kung fu @ sydney esquisse
summary

- responsive environments facilitated by sensors and gesture controllers provide a mode of connection between the physical and virtual (computational) -> computer-aided architectural spaces
- sensate spaces are receptive, information gathering spaces
- gesture controllers enable spatial negotiation of information
- the example works demonstrate spatial interaction with information in dynamic architectural spaces
questions?

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www.kirstybeilharz.com.au
kirsty@arch.usyd.edu.au

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