Interfacing with sound
Design of music controllers

Design: music controllers
Acoustic vs. electronic instruments

* Acoustic instruments

- Sound source and interface are the same artefact
- Nature of expected sound & laws of physics dictate the instrument's form and how it is designed
- Fixed and relatively transparent mapping
- Acoustic + haptic feedback

Design: music controllers
Acoustic vs. electronic instruments

* Electronic instruments

• Sound soure and interface separated → mapping, interaction and physical attributes are free

• Need for methods and constraints in order to fulfill criteria of expressiveness, transparancy, audio quality

• Need for feedback

Design: music controllers
Issues

* Purpose of design

Users

Experts vs. amateurs?

• Uses

Composition? Performance? Education? Cognitive stimulation?

• Designing an…

Interface? Instrument? Composition tool?

Design: music controllers
Issues

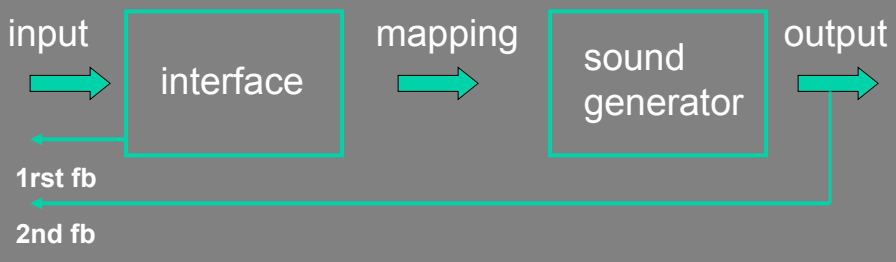
* Criterias

- Relationship between performer and audience
- Physical effort
- Complexity / transparency
- Ergonomics
- Cultural context

It is not just about producing sound, it is about the whole **experience** of producing sound

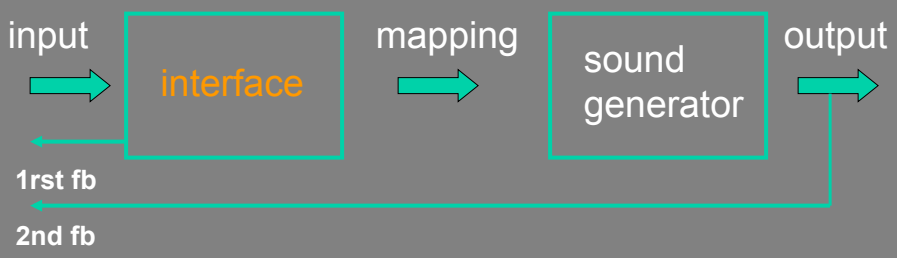
Design: music controllers
Interaction loop

* Simplified model



Design: music controllers
Interaction loop

* Simplified model

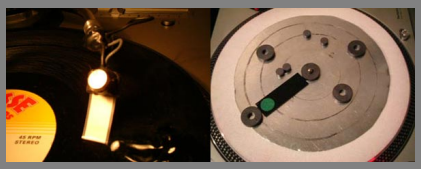


Design: music controllers
Interfaces

* Object-based

Starting with existing instruments
- augmented (hyperinstruments…)
- digitalised (ex: piano synth)
- interface used as controller (ex: MIDI keyboard)

Use metaphor of object



Taku Lippit, ITP/NYU, 2002-03

Machover & Ma, Hypercello, MIT, 1991

Design: music controllers
Interfaces

* Object-based

Repurposed everyday objects and materials: water, fabric, chemicals, vegetables …

Daniel Skoglund, 8Tunnel2

Particles, Horio Kanta, 2003

MIDI Scrapyard Challenge, Brucker-Cohen & Moriwaki, 03-04

Design: music controllers
Interfaces

* Object-based

Take advantage of the material properties of objects f.e.x bendable, conducts electricity, etc

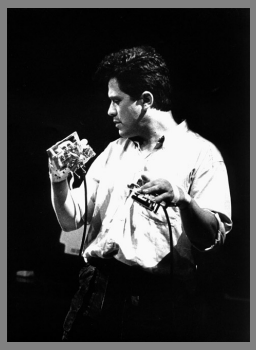
Take into consideration human activities surrounding the objects: build upon it and / or break from it

Design: music controllers

Interfaces

* Body-based

Human body as start for design



The Hands, Waisvicz, STEIM, 1984

Music controllers

Interfaces

*** Body-based**

Human body as start for design: Expressive qualities of human movements

The Hands, Waisvicz, STEIM, 1991

Design: music controllers
Interfaces

* Body-based

Human body as start for design:
- Ergonomics
- Existing gestures
- Expressive qualities of human movements
- Scale and continuity of movements

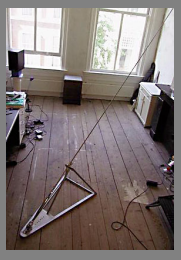
Design: music controllers
Interfaces

* Environment-based

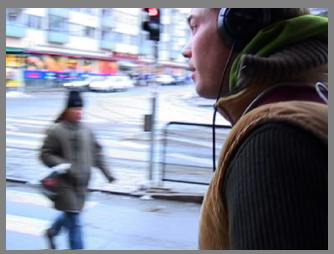
Interactive environments
- Reactive floors
- Digital realm: networked audio

Everyday environments, etc

Magic Carpet, MIT Medialab, 1996



Global String, Tanaka & Toeplitz, 1998



Sonic City, Gaye et al., 02-04

Design: music controllers

Interfaces

* Environment-based

Take advantage of the features of space

- Interactive environments:
many people together, control of interaction parameters…

- Everyday environments:
rich environment, unpredictable, dynamic, heterogeneous

Design: music controllers

Interfaces

* Wearables

Musical jeans jacket
(MIT Medialab, 1992)

Tgarden
(FoAM & sponge, ~2001)

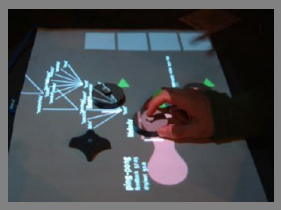
Expressive Footwear
(MIT, 1997-2000)

ensemble (Kristina Andersen, ~2003)

Design: music controllers
Interfaces
* Wearables

Intimate interfaces
Body movement and posture
Theatrical vs. daily life dimensions

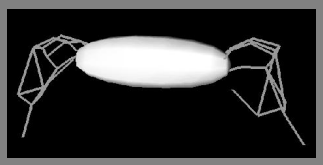
Design: music controllers
Interfaces
* Representations
- Tangible algorithms



Audiopad, Patten, Medialab, 2001

Block Jam, Newton-Dunn et al., Sony CSL, 2002

- Virtual instruments



Mulder, Simon Fraser Univ., 199?

- Screen-based (laptop musicians using MAX/MSP, Pd, etc)

Design: music controllers

Interfaces

* Representations

Taking familiar sound manipulation metaphor and making it tangible, into space.

Design: music controllers

Interfaces

* Circuit bending

Hacking is fun!

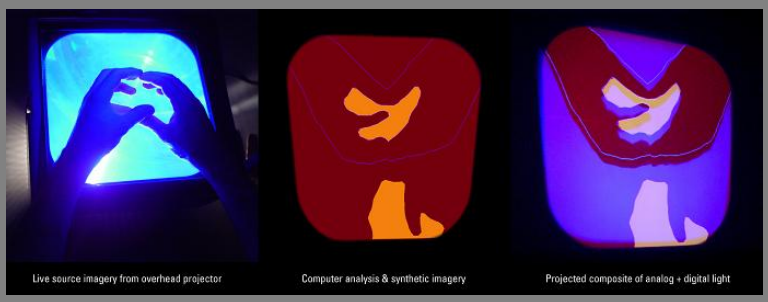
Modified Toy Orchestra

Design: music controllers
Interfaces

* Hybrids

Controlling e.g. audio and visuals together

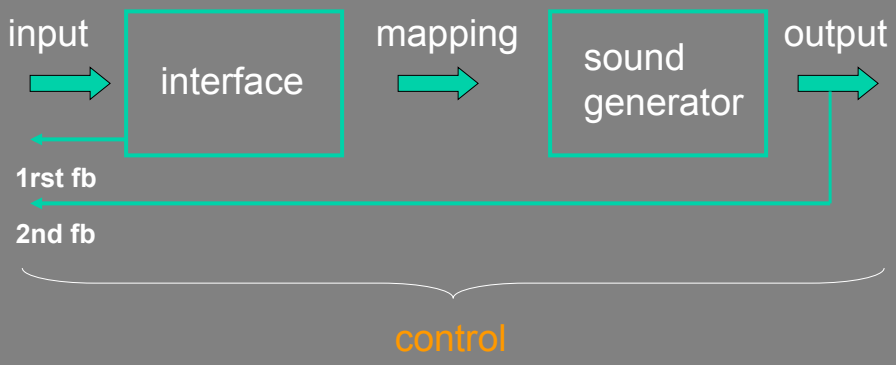
Balancing and adapting interaction so that both dimensions are satisfactory



Manual Input Sessions, Golan Levin, 2005

Design: music controllers
Interaction loop

* Simplified model



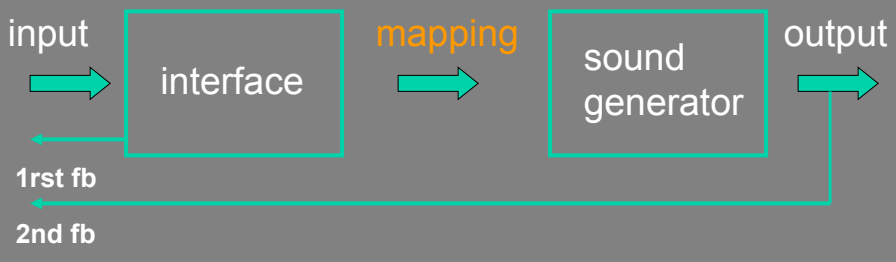
Design: music controllers
Control

Levels of indeterminancy
- Control vs. randomness (→ interactive improvisation)
- Total predeterminancy: push a button → deterministic output
- Total undeterminancy: random machines
- Unexpected vs. expected input / output

Control characteristics
- Continuous vs. discrete control
- Implicit vs. explicit
- Micro- to macro-level control: sound spectrum to details of articulation to overall structure

Design: music controllers
Interaction loop

* Simplified model



Design: music controllers
Mapping

* Issues

• Complexity to stimulate creativity

• Transparency to keep link between input and resulting sound (otherwise, danger of loosing the audience)

Design: music controllers
Mapping

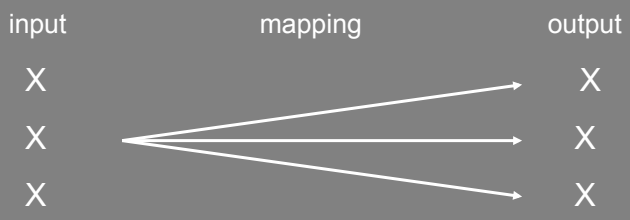
* One-to-one

• Each independent input assigned to one musical parameter

• Simplest mapping scheme, but usually the least expressive

Design: music controllers
Mapping

* One-to-many

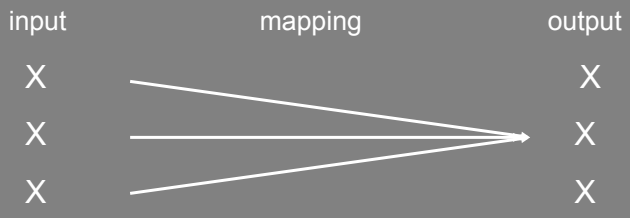


• One input controls more than one simultaneous musical parameter

• Conductor model: provides a macro-level expressivity control, but does not allow access to internal (micro) features

Design: music controllers
Mapping

* Many-to-one



• Many inputs coupled to produce one musical parameter

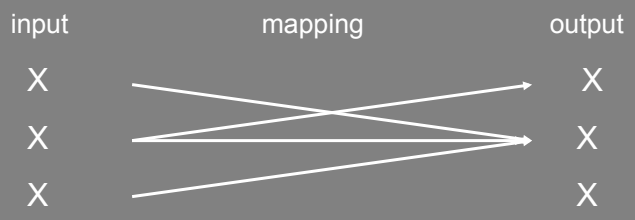
• Requires previous experience with the system in order to achieve effective control

• But far more expressive than the simpler unity mapping

Design: music controllers

Mapping

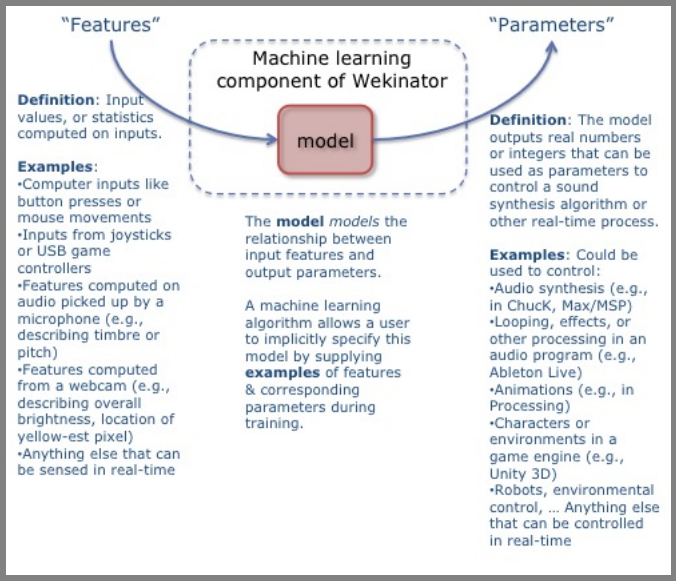
* Many-to-many



- Many inputs coupled to many musical parameters
- Control on different levels

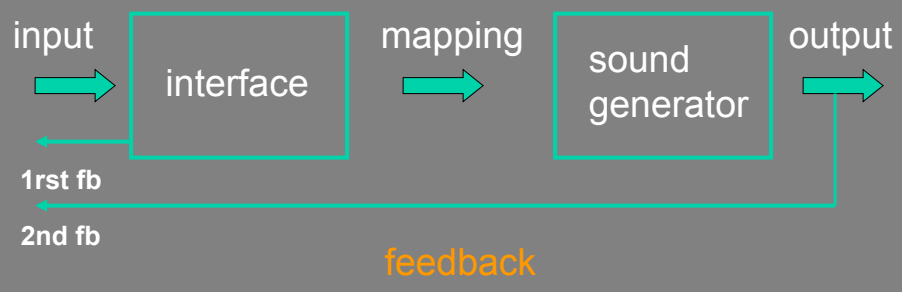
Design: music controllers

Mapping:



Design: music controllers
Interaction loop

* Simplified model



Design: music controllers
Feedback

Feedback

- Helps articulating control
- Passive vs. active
- From mono- to multi-modal (modalities: audio, haptic, visual)
- 1rst FB: from interface
- 2nd FB: audio

Feedforward

- Guides user by providing information about the internal state of the system (as opposed to information from output)

Design: music controllers
Interaction loop

* Simplified model

Design: music controllers
Output

* Mechanical

Guitarbot
(Eric Singer et al., LEMUR, 2003-)

* Tactile output (haptics)

Cutaneous Grooves
(E. Gunther, MIT Medialab, 2001)

Design: music controllers
Output

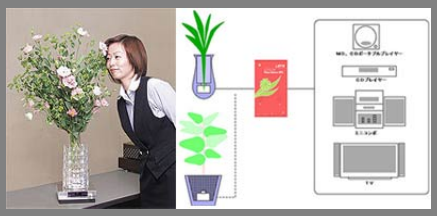
* Alternative speakers

SoundbugTM speakers & piezos

Spherical speakers (Curtis Bahn)

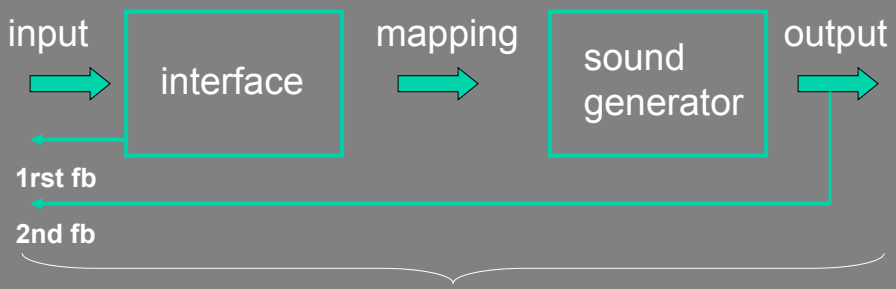
Flower Speakers (LET'S corporation, Japan, 2004)





Design: music controllers
Interaction loop

* Simplified model



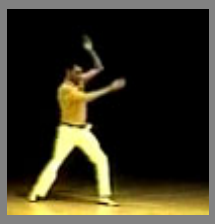
General forms of interaction

Design: music controllers

Interaction

* User movement

- Choreographed body movement
- Traditional instrumental gesture
- Novel gestures



Dark around the Edges, Winkler, 1997

Machover & Yoyo Ma, Hypercello, 1991

The Hands, Waisvicz, STEIM, 1984

Design: music controllers

Interaction

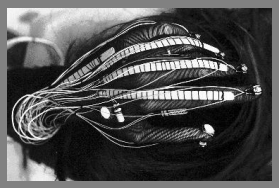
* User movement

- Full-handed gesture

Unfoldings, Interactive Inst., 2003

Stranglophone, Sharon, ITP/NYU, 03

- Empty-handed gesture



Lady glove, Bongers & Sonami, 1991

+ Unvoluntary movements, embodied actions...

Design: music controllers

Interaction

* Real-time music

Improvising new music

vs. interpreting existing one
(conductor model)

Radio Baton, Max Mathews, 1987

vs. navigating through non-linear musical narratives

Design: music controllers

Interaction

* During performance

Interaction with environment,
audience, etc

- Performer-performer

- System-audience

- Performer-system-audience

Tooka, Fels et. Al, UBC, 01-03

Crackle-family, STEIM, 1976

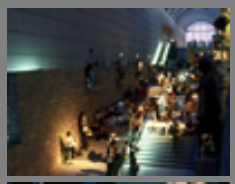
Dialtones, Golan Levin, 2001

Design: music controllers

Interaction

* During performance

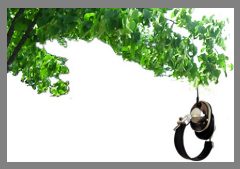
- Audience as collaborative performer



Sine Wave Orchestra, Tokyo, 2003-04

- Private performances in public spaces

…or over the internet



Le Placard headphones concerts

Interfacing with sound: Performance/installations vs everyday use

Properties of sound in everyday life

- Ubiquitous (sometimes obtrusive)
- Dynamic and transient
- Broad yet subtle information carrier (emotions, data)
- Socio-cultural meaning
- Strong link to space and time
- Physicality (body and space)
- Additive: layers
- Foreground vs. background awareness -> implicit vs. explicit interaction

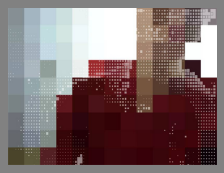
Sound in everyday interactions

Audio as input

Examples from art & research

Blendie
(Kelly Dobson, MIT Medialab, 2003-04)

Context Photography
(FAL, Viktoria Institute, 2003-04)



-> physicality, cultural meaning…

Sound in everyday interactions

Outputing sound

* Ambient audio displays

- Street crossing auditory displays etc
- Sonification of network activity: AmbientROOM
(Hiroshi Ishii et al., MIT, 1996-97)

-> Peripheral awareness

Mobile music and locative audio

Mobile music and locative audio
Locative audio in public space

* Motivations

Sound as public display

Peripheral awareness

Community re-appropriation of public space

Mobile music and locative audio
Locative audio in public space

* Space annotation

Hear&There
(Rozier, MIT Medialab, 1999)

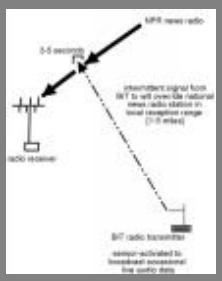
Tactical Sound Garden
(Mark Shepard, 2004)

Tejp / Audio tags
(PLAY & FAL, 2003-04)

Mobile music and locative audio

Locative audio in public space

* Radio pirates



Bit Radio
(Bureau of Inverse Technology)

Key Chain Radio Station
(Rikako Sakai, Ivrea, 2004)

Mobile music and locative audio

Mobile Music Technology

Music technology meets mobile computing. Devices used anywhere, with awareness of place, in distributed / ad hoc networks…
Device follows user's displacement and connects to the world (physical, social, located virtual)

- Mobile music making, listening, sharing
- Wearable audio
- Sound walks, etc

Mobile music and locative audio

Mobile music

* Mobile music sharing

Social aspect of mobile computing: ad hoc networks, distributed social networks, etc

-> spontaneous and situated music sharing with people in public space

Mobile music and locative audio

Mobile music

* Mobile music sharing

SoundPryer (Mattias Östergren, Interactive Institute, 2001)

TunA

(Arianna Bassoli et al., Medialab Europe, 2002)

Push!Music (Håkansson et al., Viktoria Institute, 2005)

Mobile music and locative audio

Mobile music

* Mobile music sharing

Bass Station
(Mark Argo & Ahmi Wolf, ITP/NYU, 2003)

Mobile music and locative audio

Mobile music

* Mobile music making

Music making away from computer screen or performance setting: in the everyday

Sensor technology + GPS -> situated music making

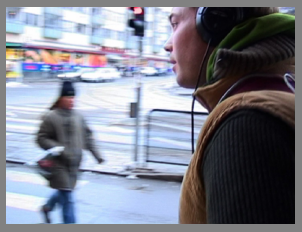
Ad hoc & distributed networks throughout the city -> collaborative music making

etc

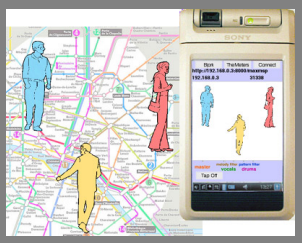
Mobile music and locative audio
Mobile music

* Mobile music making

Sonic City
(Gaye et al., FAL & PLAY, 2002-04)



Malleable Mobile Music
(Atau Tanaka, Sony CSL, 2004)



Mobile music and locative audio
Mobile music

* Mobile music making

Sound Mapping
(Mott et al., Reverberant, 1998)

Sonic Interface
(Akitsugu Maebayashi, 1999)

Mobile music and locative audio

Mobile music

* Mobile music making

CosTune
(Nishimoto, ATR, 2001)

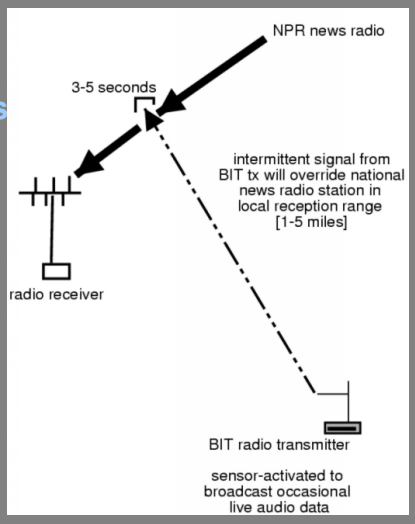
Sound Lens
(Toshio Iwai, 200?)

Mobile music and locative audio

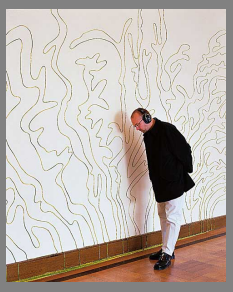
Locative audio in public space

* **Radio pirates:**
sensing environmental factors

Bit Radio
(Bureau of Inverse Technology)



Mobile and locative sound
”Walking through sound” (D. Toop)



* Sound-art installations

Electric walks
(Christina Kubisch)

Drift
(Rueb)

* Walking through digital space

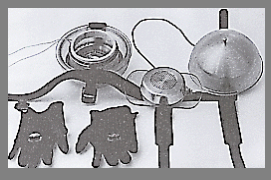
Seven Mile Boots
(Beloff et al., 2003-04)

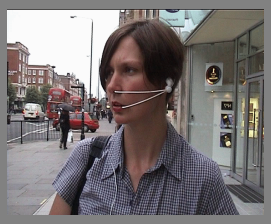
* Non-linear audio narratives

The Case at Kulturhuset (Knifeandfork, 2004)

Mobile and locative sound
Wearable audio

”Personal instruments”
(Krzysztof Wodiczko, 1969)





(Chelle Hugues, RCA/CRD, 2000)

Mobile and locative sound

Wearable audio

Nomadic Radio

(Nitin Shawney, MIT Medialab, 1998)

Sonic Fabric

(Alice Santaro, 2002)