Mensch-Maschine-Interaktion 2

Interactive Environments

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Interactive Environments

context and task

**challenges**

input technologies

challenges in interaction design

output technologies
Environment

context and task

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challenges in interaction design

output technologies

Card’s Design Space

Descriptive Power

![Diagram](image-url)
Card’s Design Space

Predictive Power

Mental preparation

Hand from keyboard to mouse or vice versa

Point the mouse to on-screen object

Button press or release (mouse)

Select on-screen object with the mouse after typing text on the keyboard:

1.20 s

0.40 s

1.10 s

0.10 s

2.80 s
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Card’s Design Space

Generative Power

Analysis of the Design Space of Input Devices.

Fig. 4. A broad range of input devices plotted on the taxonomy. Devices previously classified by Foley, Wallace, and Chan [15] and by Baecker and Buxton [4, 7] are indicated by triangles, squares, and hexagons. Hexagons indicate devices included in both previous taxonomies. Other devices, indicated by circles, include the radio devices described previously and some unusual devices to demonstrate the generality of the taxonomy.

To demonstrate the coverage of the taxonomy, we have reclassified the devices listed by Foley, Wallace, and Chan [15] and by Buxton and Baecker [4, 7] (see Figure 4). With the exception of voice, we have been able to position all of the devices considered so far. Furthermore, it is possible to generate potential new devices by placing circles in various cells of the taxonomy.
Challenge: body involvement

- BodyScape
- Involvement of body parts
- Relationship between the body and the interactive environment
Involvement of Body Parts


design

task

challenges in interaction

input technologies

challenges

motor

Y. Guiard

Kinematic Chain

motor = body part that contributes to the overall performance of a movement

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Involvement of Body Parts

• **Input** motor assembly: a group of motors that handle a specific interaction task.

• **Output** motor assembly: a group of motors that is responsible for bringing the eyes into an appropriate position to enable visual perception of output.
Body-environment Relationship

Input Motor Assembly

Environment

- context and task

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<table>
<thead>
<tr>
<th>body-relative</th>
<th>world-fixed</th>
</tr>
</thead>
<tbody>
<tr>
<td>external display</td>
<td>directed input motor assembly</td>
</tr>
</tbody>
</table>

Body-environment relationship diagram:
- Input motor assembly
- External display
- Directed input motor assembly
- Body-relative (left)
- World-fixed (right)
Environment

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Body-environment Relationship

Output Motor Assembly

body-relative

world-fixed

visual output coordination
output motor assembly
input motor assembly

external display
Classifying Interaction Techniques

- **Challenges**: context and task, input technologies, challenges in interaction design, output technologies.

- **Visual Output**: relative to the body, fixed in the world.
  - **Input**: mid-air, touch.
  - **Output**: free, restricted.

- **Examples**:
  - **a**: mid-air, relative to the body, free.
  - **b**: touch, relative to the body, restricted.
  - **c**: mid-air, fixed in the world, free.
  - **d**: touch, fixed in the world, restricted.
  - **e**: mid-air, touch, free.
  - **f**: touch, fixed in the world, restricted.
  - **g**: mid-air, fixed in the world, free.
  - **h**: touch, fixed in the world, restricted.

- **Environment**: allows for different interaction designs based on the available context and task requirements.
Generating Power of the Design Space

- **Environment**
  - context and task
  - challenges
  - input technologies
  - challenges in interaction design
  - output technologies

- **Generating Power of the Design Space**

- **Number of Involved & Affected Body Parts**
  - Vertical axis: 1, 2, 3, 4, 5

- **Input**
  - On-body Touch
  - Armura
  - Virtual Shelves
  - PUB
  - SkinInput
  - Handheld Touch
  - Charade

- **Output**
  - PinStripe
  - VIDEOPLACE
  - Shoemaker
  - Mid-Air
  - Multitoe
  - Barcode
  - Pick & Drop
  - Touch Projector

- **Body Restriction in the Environment**
  - free
  - restricted

- **5 groups of body parts**

- Classification of Body-centric Interaction Techniques
  - a) Virtual Shelves [22]
  - b) Skinput [16]
  - c) Body-centric interaction for large displays [31]
  - d) PalmRC [9]
  - e) Scanning

- Figure 2. BodyScape presents a taxonomy of atomic body-centric interaction techniques.
Environment

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Composing Motor Assemblies

IMA_1 → IMA_2

in series

IMA_1 \rightarrow IMA_2

separated

IMA_1

IMA_2

overlapping

IMA

IMA = Input Motor Assembly

→ = pointing

= select

IMA_1

IMA_2
BodyScape

• Body’s involvement
• Relationship between the body and the interactive environment
• Categorize related work
• Generate and analyze new compositions
Challenge: limited attention resources

• We have seen change blindness as an example
  – limited visual attention
  – reasons physiological and cognitive

• Attention is generally a limited resource
  – various parts of the environment may compete for our attention
  – how does the mind decide what to pay attention to?

• Visual stimuli might be out of sight

• Acoustic stimuli might drown each other out
  – cocktail party effect may help us
Negative Example (from Minority report)

http://www.youtube.com/watch?v=7bXJ_obaiYQ
A Model of Human Attention

- http://books.google.de/books?id=dIagIraXHPUC

A Simple Model of Attention: The Filter and the Fuel

TOP DOWN

Expectancy  Value

Events

Salience  Effort

BOTTOM UP

Multiple Resource Model of Divided Attention 'The Fuel'

Resources

Limits of Multi-tasking

Information Processing Perception Cognition Action

Descriptive? Predictive? Generative?
SEEV model of influencing factors


**S: Salience:** The bottom-up attention capturing properties of events, bright flashes, sounds, etc. The salient runway line in the Singapore Airlines crash.

**Ef: Effort:** Inhibits the movement of attention across longer distances: bigger scans, head movements. Failure of drivers to “check the blind spot” before lane changing.

**Ex: Expectancy:** The likelihood of seeing an event at a particular location: a top-down cognitive factor that is calibrated to the **bandwidth** (frequency of occurrence) of events that occur at that location.

**V: Value:** The importance (value) of tasks served by the attended event, as well as the **relevance** of the event to a valued task. Also top-down.

Probability of attending $P(A) = s*S - ef*EF + \frac{ex*EX + vV}{(ex*EX * vV)}$
Mini-discussion on SEEV:

• remember: change blindness examples (flicker)
• remember the moonwalking bear?
  – (a.k.a Simon‘s gorilla: http://www.theinvisiblegorilla.com)
• other effects you‘ve come across?

Probability of attending $P(A) = s*S - ef*EF + \frac{ex*EX + vV}{(ex*EX * vV)}$. Which one?
Example: unexpected warnings

- F. Lauber, A. Butz: In-Your-Face, Yet Unseen? Improving Head-Stabilized Warnings to Reduce Reaction Time, CHI 2014

- driving scenario with a secondary visually demanding task
- warnings in HUD and HMD
- Warnings in the main field of view (HMD) were not faster than in the constant location (HUD)
- After introducing a visual marker for the place where warnings would appear (expectancy), they were faster!
Example: notification in ambient soundscapes

• known effect: we recognize known sounds
  – even when they are played in the background
  – crosses the border from subconscious to conscious

• idea: use this to notify people of events
  – play an ambient piece of music
  – to notify, mix in a motif known to that person
  – ...or a specific instrument

• effect: remains unnoticed to other people
Notification in Ambient Soundscapes
[Butz, Jung, IUI 2005]
Notification in Ambient Soundscapes
[Butz, Jung, IUI 2005]

- Core music always present
- Notification in a musically fitting way
  - Learned by target person
- Crosses the border to conscious perception by the target person
- Ignored by other people
- Quantitative user study
  - Audio Workshop at Pervasive 2005
Challenge: Social interaction & awareness

• Instrumented environments are no longer single user
  – users might collaborate locally
  – users might compete for resources locally
  – users might collaborate remotely

• Users need to be aware of technology
  – discoverability: How do I see what I can do?

• Technology aware of users
  – Example: proxemic interactions
  – Example: group mirrors

http://www.smart-future.net/13.html
A spatial model for social interactions: F-formations


• Images taken from Nicolai Marquardt's PhD thesis:
Proxemic interactions based on F-formations

• extend spatial relationship concept to machines
  – F-formations between humans and Displays
• remember proxemic media player shown earlier...
**Take-away Message**

- Instrumented environments involve us (plural! ;-) with our entire body and all senses.

- This poses new research challenges, e.g.
  - describing whole body involvement
  - models for limited cognitive resources
  - describing (and creating) social collaboration

- Interaction with these environments brings back some of the richness of the physical world
Lecture Evaluation: Discussion

• Thanks for graceful judgements ;-) Main points:

• Selection of topics interesting
• Level of detail and difficulty OK

• Too much workload in exercises
  – have you at least learned something useful?
• More structure and crossreferences!
• Too many videos
• Language mix is disturbing
• Filming is problematic
  – light disturbing, video of us not really needed ;-)