Interaction techniques for AR

Vorlesung „Augmented Reality”
Andreas Butz
Ein Generisches AR-System

Sensorik

Realität

Feedback an Benutzer

Tracking (Ortsbestimmung)

Virtualität

Einbeziehung der Ortsinformation in virtuelle Welt

Kombination realer und virtueller Inhalte

Rendering und Realitätserweiterung
Interaction techniques for AR

• Interaction techniques borrowed from VR
  – Virtual Object selection & manipulation
  – 3D widgets, tools, wands,…

• Interaction with physical objects
  – Examples by Sony CSL/Rekimoto
  – Examples from TU Vienna/Studierstube
Reference frames for virtual objects

- **Screen-stabilized**: always in the same screen or HMD position
  - Good for text, menus, status displays
- **Body-stabilized**: always in the same area around the body
  - Example: tool palettes
- **World-stabilized**: always in the same place in the real world
  - Example: labels on physical objects
- **Bound to a tracker target or marker**
  - Examples: see AR exercise projects ;-)}
# Dimensionalities of interaction

<table>
<thead>
<tr>
<th>Medium → Content</th>
<th>2D</th>
<th>3D</th>
</tr>
</thead>
<tbody>
<tr>
<td>2D</td>
<td>2D Screen interfaces, windows</td>
<td>PIP, billboards, screen stabilized</td>
</tr>
<tr>
<td>3D</td>
<td>Fishtank VR</td>
<td>Full 3D interaction in AR &amp; VR</td>
</tr>
</tbody>
</table>
3D mouse: example from Studierstube

Video
FingARtips [Buchmann et al. 2004]

• Glove with 3 AR Markers
• Interaction by gestures
  – Grab objects
  – Move grabbed objects
  – Let objects go
  – Scale objects
• Application: urban planning

Video
The Tinmith glove-based interface [Piekarski, 2002]

- Two gloves equipped with:
  - ARToolkit Markers for position
  - Contacts in the finger tips
- Connecting the fingers can
  - Choose from a menu
  - Select a manipulation mode
- Direct manip. of virtual objects
- Two-handed manipulation

Video through the HMD

Video from outside
The Magic Book [Billinghurst 2000]

- Flipping through a physical book
- Pages contain markers
- On the pages appear virtual objects

- New version: BlackMagic
3D magic lenses \cite{Looser2004}

- Metaphor: magnifying glass
- Can show different visualizations of a virtual object

Video
World in Miniature

• Small 3D model of the environment
• Can be turned and viewed from all directions
• Can be used for selection of remote objects

• Example video taken from the Signpost system (Studierstube)
X-ray vision [Bane & Hoellerer, ISMAR 2004]
Navicam: The world through the computer [Rekimoto & Nagao, UIST 1995]

- Video see-through with a handheld device
- Marker recognition
- Annotation of real world:
  - New journals on a book shelf
  - Appointments on a calendar
  - ToDos on a pin board
  - Labels on a door
  - Navigation signs in the environment
Augmented Surfaces
Jun Rekimoto and Masanori Saitoh, CHI’99

- Combination of mobile devices and projection surfaces
- Interaction techniques:
  - hyperdragging
  - pick-and-drop
  - pick-and-beam
  - digital attachment
    - interaction objects for tangible interaction
    - Camera-based acquisition of images
    - Selection from physical catalogues

Video
Tangible Augmented Reality for Computer Games [Ulbricht 2002]

- Idea: use physical objects (Markers) as a handle for virtual objects
  - Feels like direct manipulation
  - Easy to implement
Studierstube: The Personal Interaction Panel (PIP) [Szalavari & Gervautz, 1997]

- Two-handed interaction
- Metaphor: slate & crayon
- Manipulation of two physical objects
  - Feels „real“
    - Weight of the objects
    - Acting on a surface
    - Familiar interaction
    - Feeling of privacy
  - Easy to attach tracking
  - Arbitrary graphical overlays
Figure 1. Direct selection of objects by inserting the pen into the “floating” model (background illustrates augmentation)

Figure 2. “Drag & Drop” objects from a clipboard in 3 dimensions

Figure 3. In addition to direct manipulation, widgets can be used for exact scaling ...

Figure 4. ... or rotation of objects
**Figure 11.** For scientific visualization the PIP can be used to specify and edit cutting planes...

**Figure 12.** ...or measure simulated parameters at given locations and show instantly their evolution as 3D-graph on the panel

**Figure 13.** Multidimensional parameters at any point are shown using glyphs on the PIP or directly at the measuring point

**Figure 14.** Introducing particles directly in an ongoing dynamic simulation should be very intuitive
Figure 6. Camera positioning with the pen

Figure 7. Enlarged view of a detail
Studierstube: The Personal Interaction Panel (PIP) [Szalavari & Gervautz, 1997]
The Virtual Dressmaker [Keckeisen 2003]

- PIP as a palette and pen as a manipulation tool
- Physical simulation of clothing fabric  Video
  - Interact with the fabric directly
  - Use 3D widgets to manipulate whole model
Studierstube: the iOrb [Reitmayr et al. 2005]

• One-handed spatial input and command
  – 3DOF orientation tracker
  – Switch to trigger actions

• Easy to build
• Easy to use
• Physical object
  – Weight
  – Inertia
  – Elasticity
Studierstube: the iOrb [Reitmayr et al. 2005]

• Widgets for visual feedback
  – Constrained to one axis (a+b+d)
  – Using 3 axes (c)

• See Video
The Designer‘s Outpost
[Klemmer et al. Uist 2001]

- Manipulation of physical sticky notes on a smartboard
- Augmentation by back projection
- Interaction through smartboard
- Additional cameras

- Task: design the structure of a web site
  - Keep the physical process
  - Augment it by technology
The Designer’s Outpost: Interaction Techniques

- **ADD**
- **LINK**
- **REMOVE**
- **INK**
- **MOVE**
- **MENU**
- **SAVE**