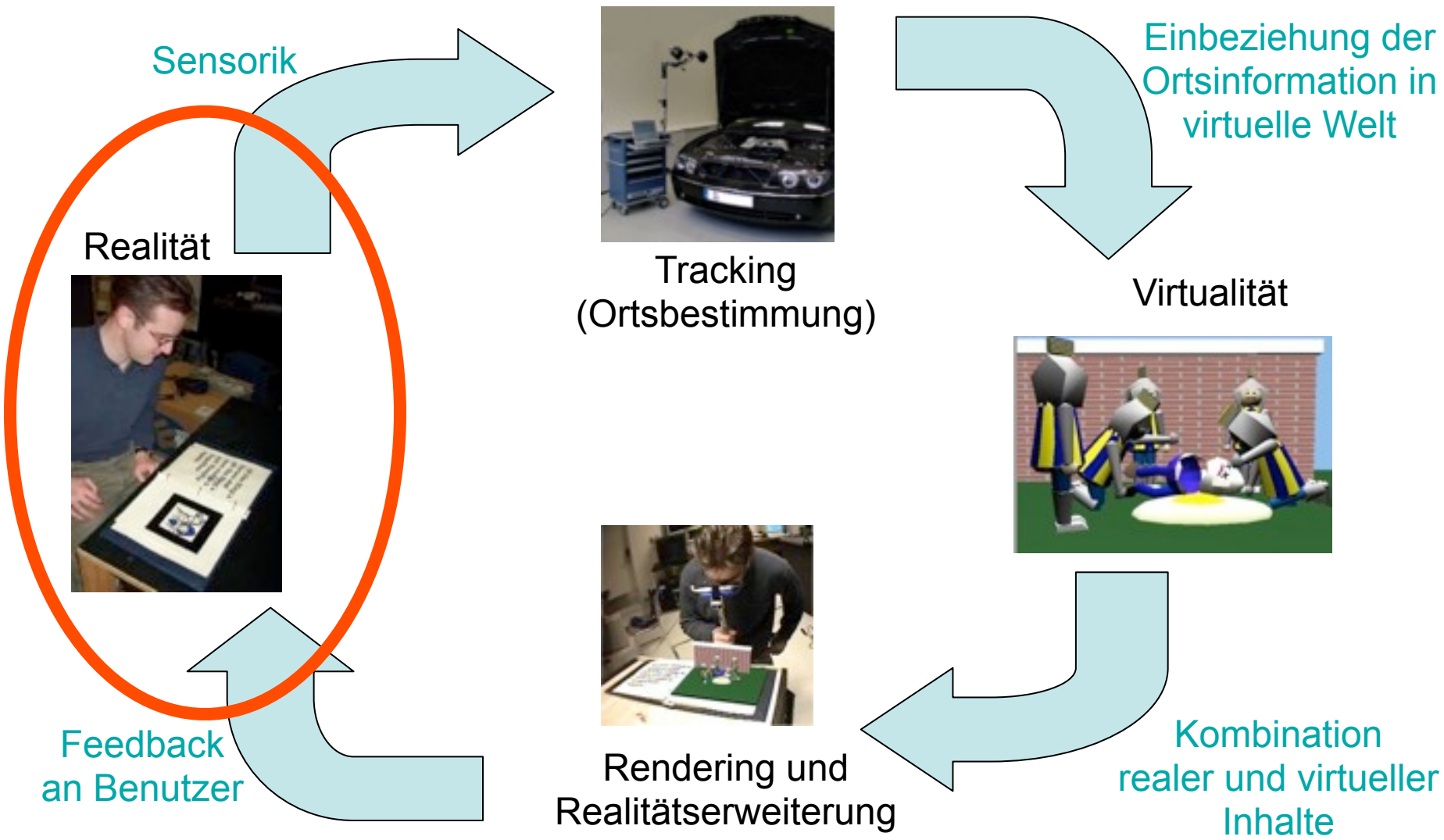
Interaction techniques for AR

Vorlesung „Augmented Reality”
Andreas Butz

Ein Generisches AR-System

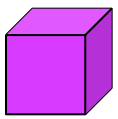


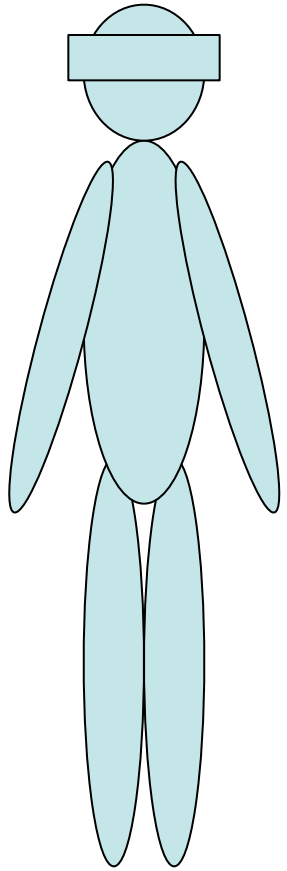
Interaction techniques for AR

- 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 ;-)

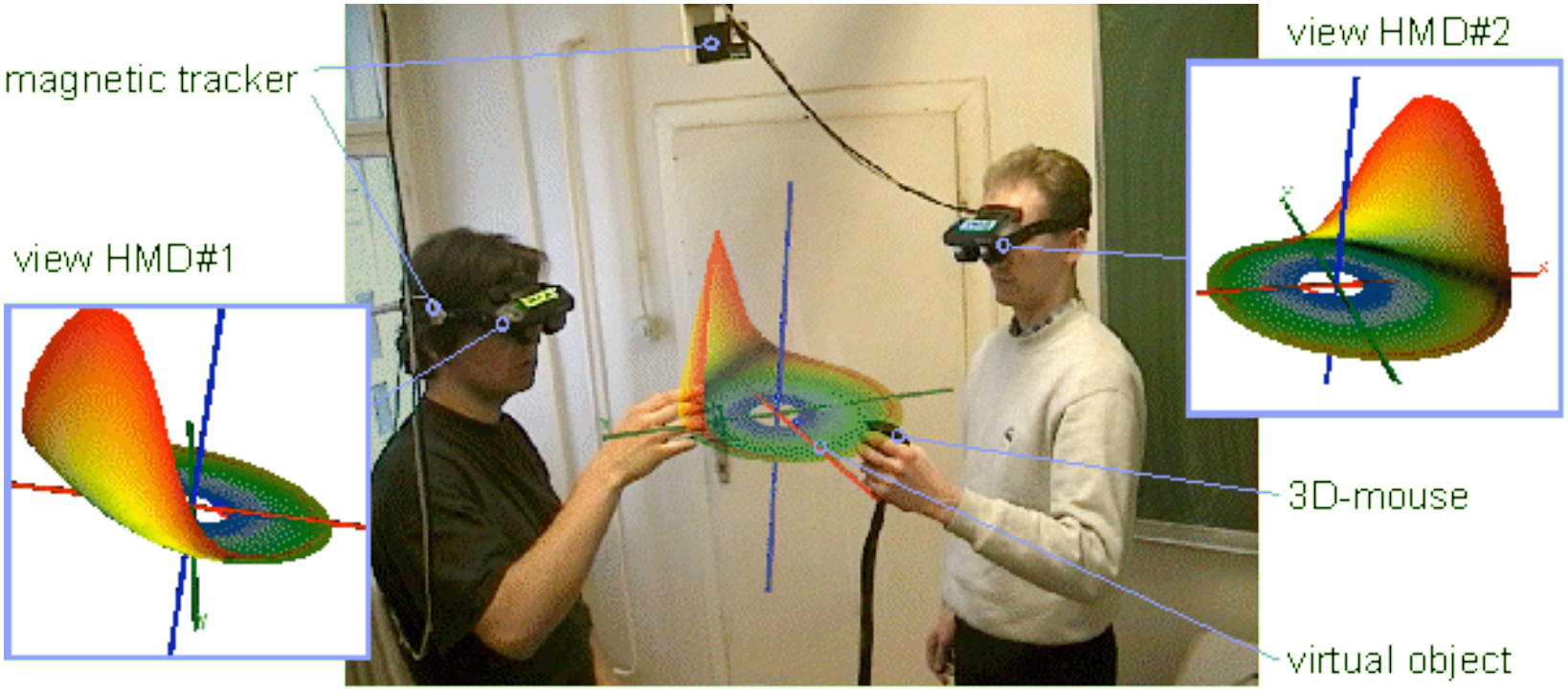




Dimensionalities of interaction

Medium → Content	2D	3D
2D	2D Screen interfaces, windows	PIP, billboards, screen stabilized
3D	Fishtank VR	Full 3D interaction in AR & VR

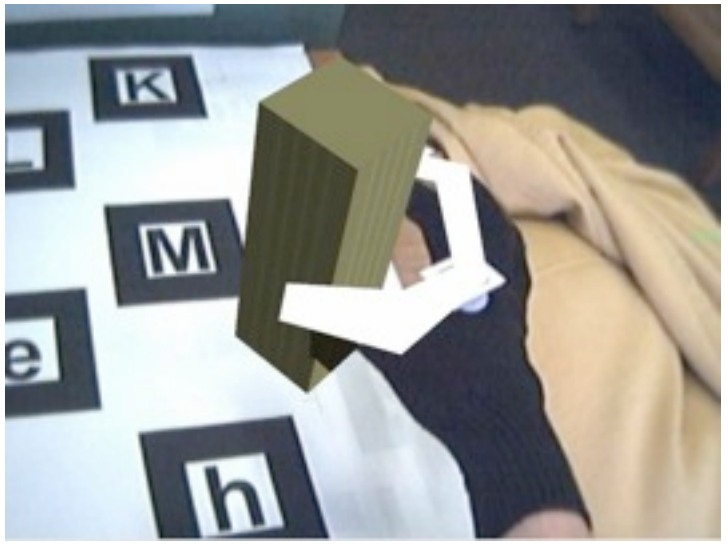
3D mouse: example from Studierstube

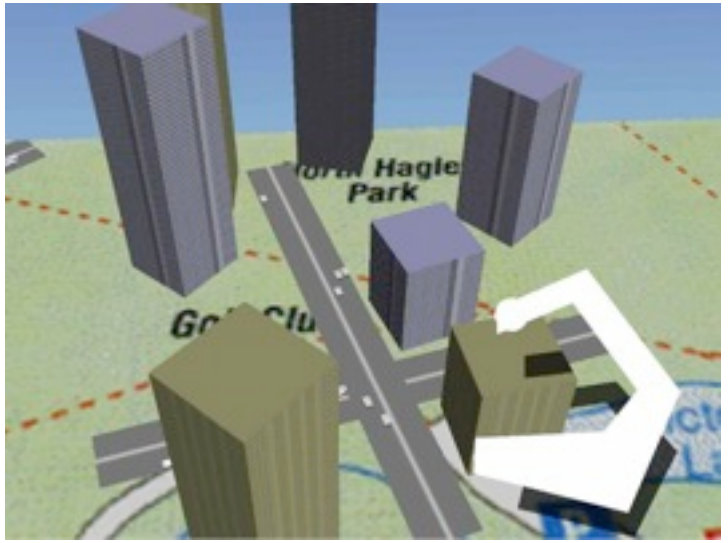


Video

FingARtips [Buchmann et al. 2004]

- Glove with 3 AR Markers
- Interaction by gestures
  - Grab objects
  - Move grabbed objects
  - Let objects go
  - Scale objects
- Applicatin: 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

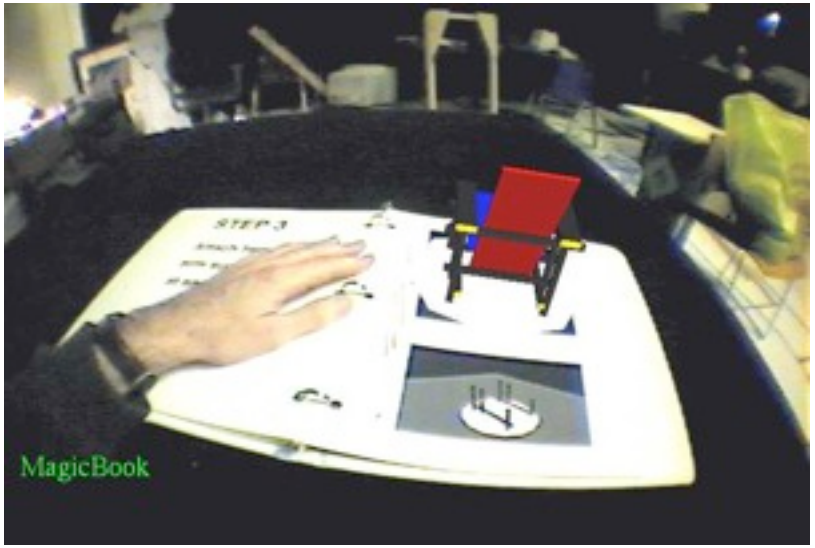
Video through the HMD

Video from outside

The Magic Book [Billinghurst 2000]

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

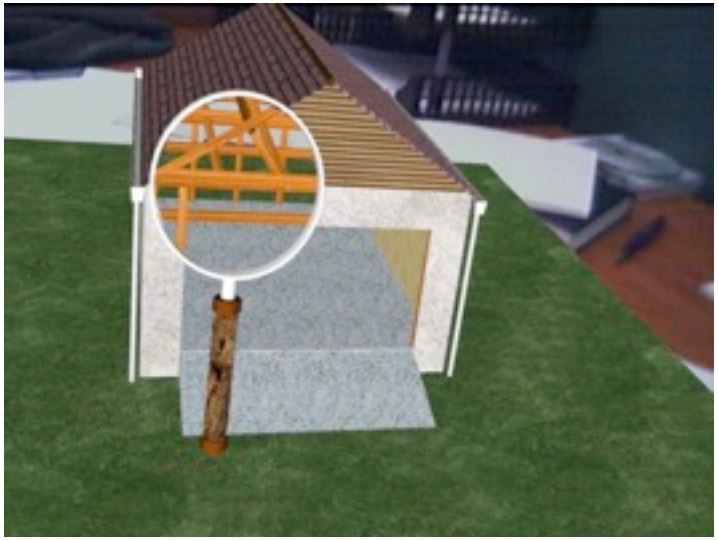
- New version: BlackMagic



3D magic lenses [Looser 2004]

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

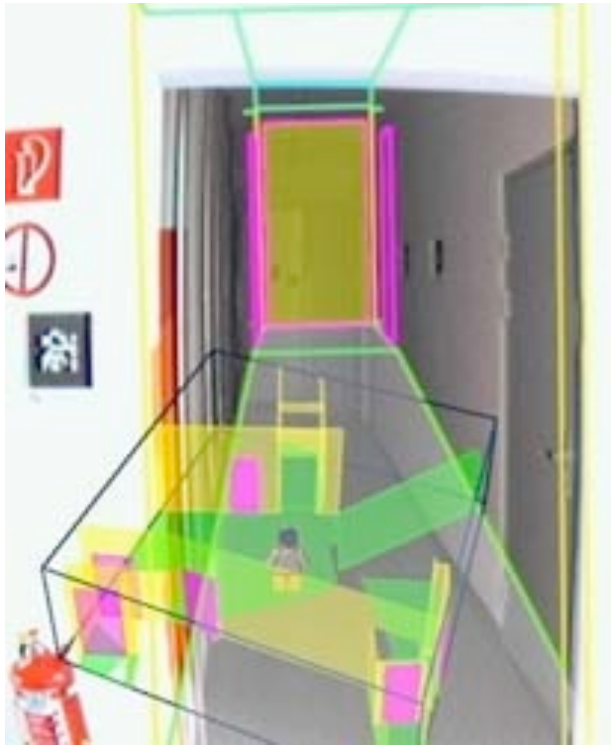
Video



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)

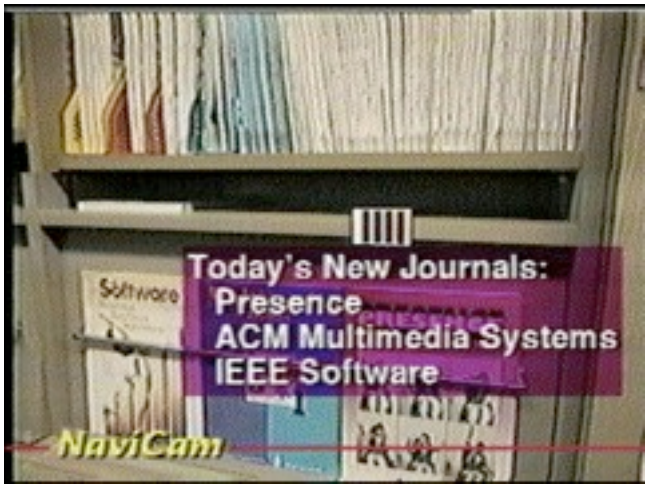


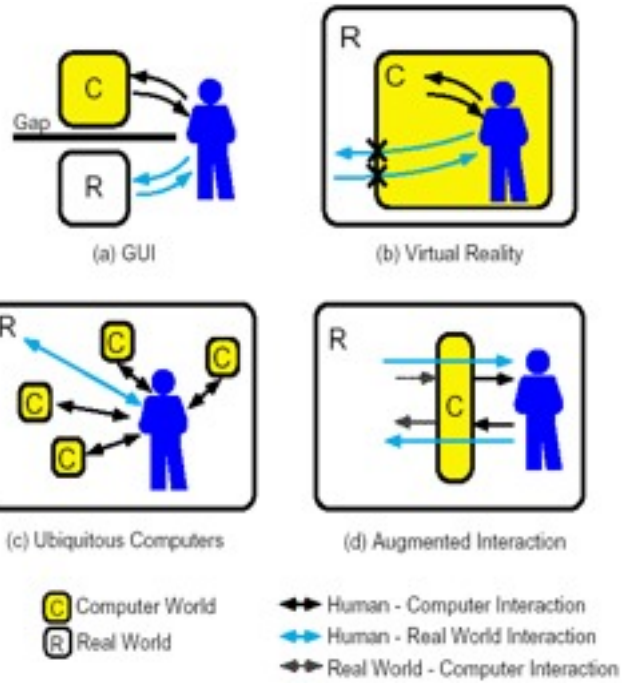
X-ray vision [Bane & Hoellerer, ISMAR 2004]

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

Video

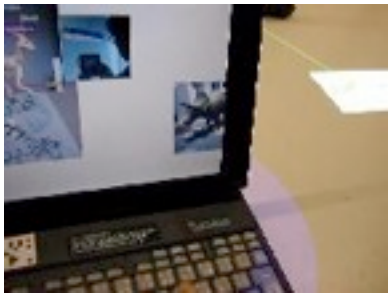


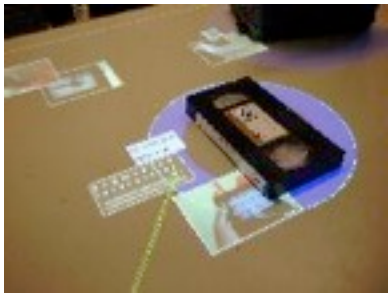


Augmented Surfaces

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

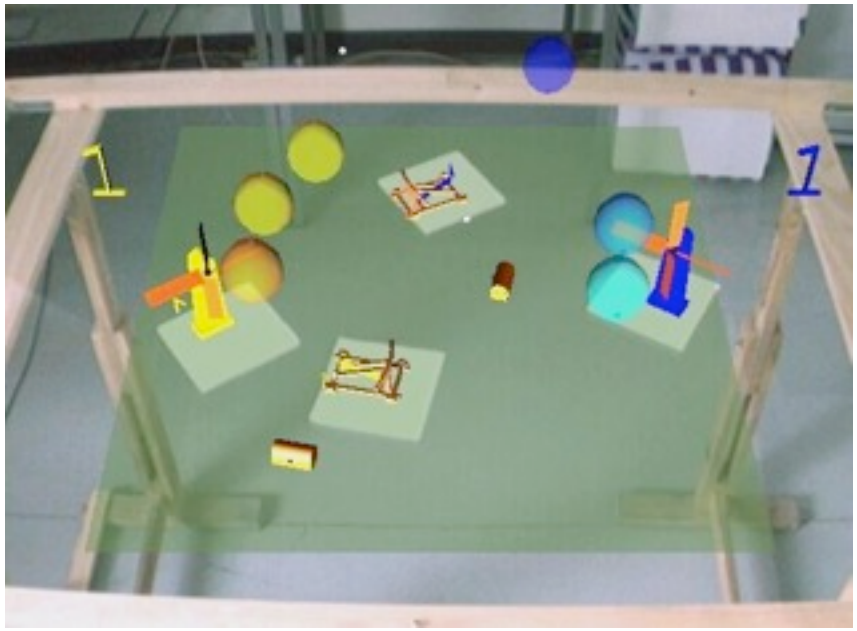




Video

Tangible Augmented Reality for Computer Games [Ulbricht 2002]

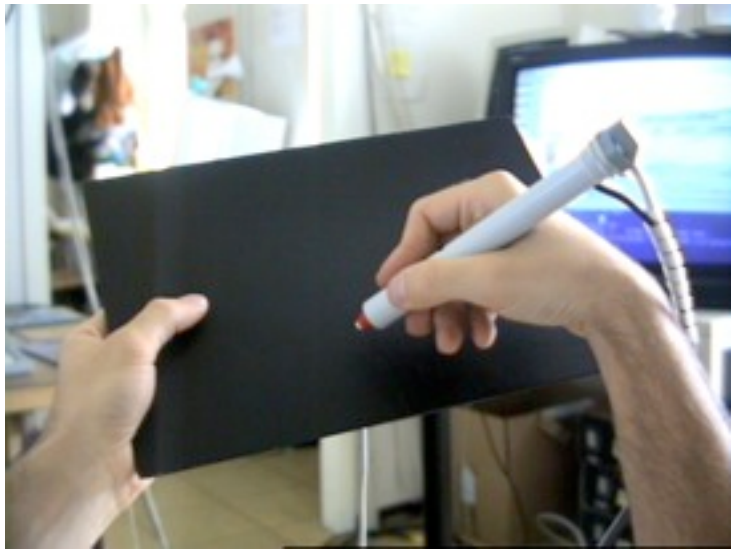
Video

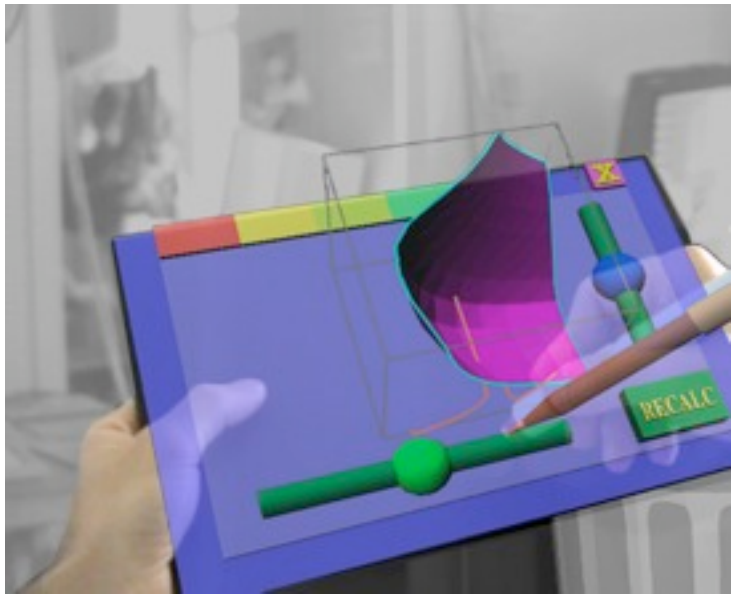


- Idea: use physical objects (Markers) as a handle for virtual objects
  - Feels like direct manipulation
  - Easy to implement

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





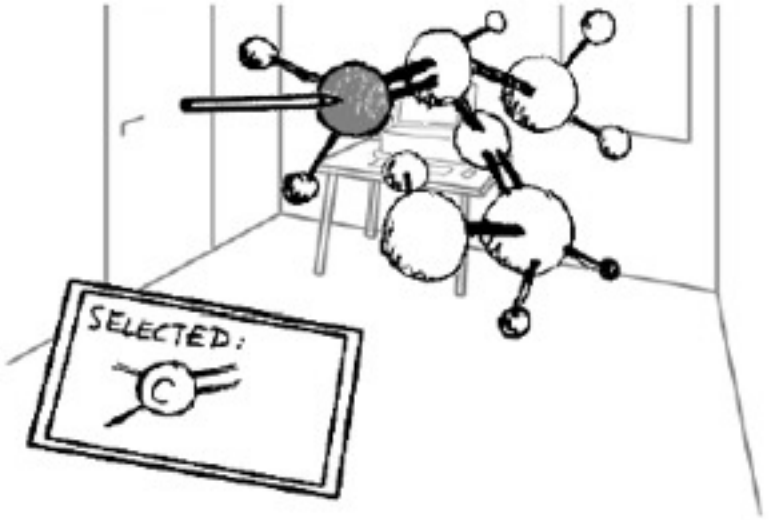


Figure 1. *Direct selection of objects by inserting the pen into the "floating" model (background illustrates augmentation)*

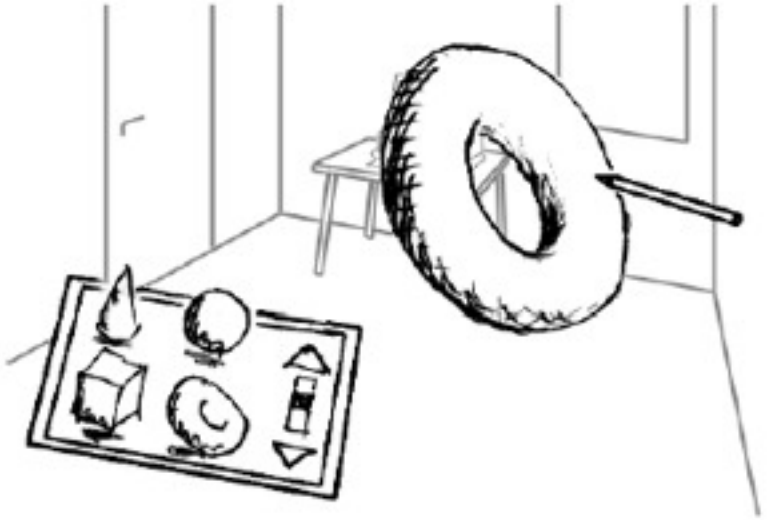


Figure 2. *"Drag & Drop" objects from a clipboard in 3 dimensions*

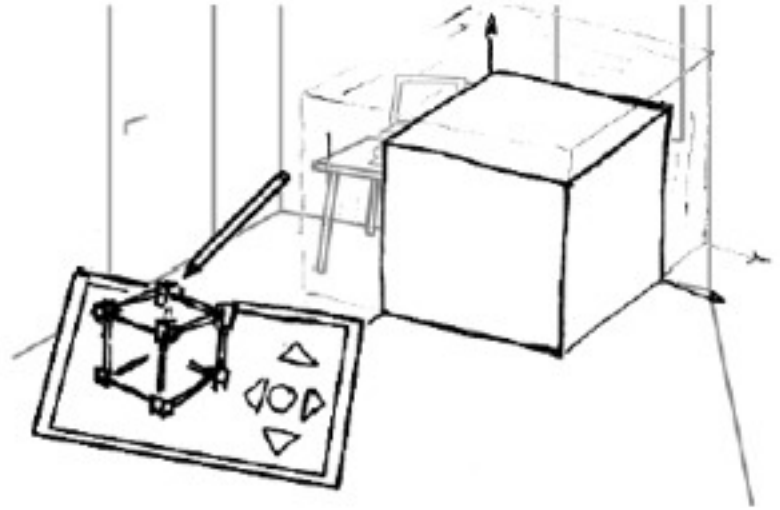


Figure 3. *In addition to direct manipulation, widgets can be used for exact scaling ...*

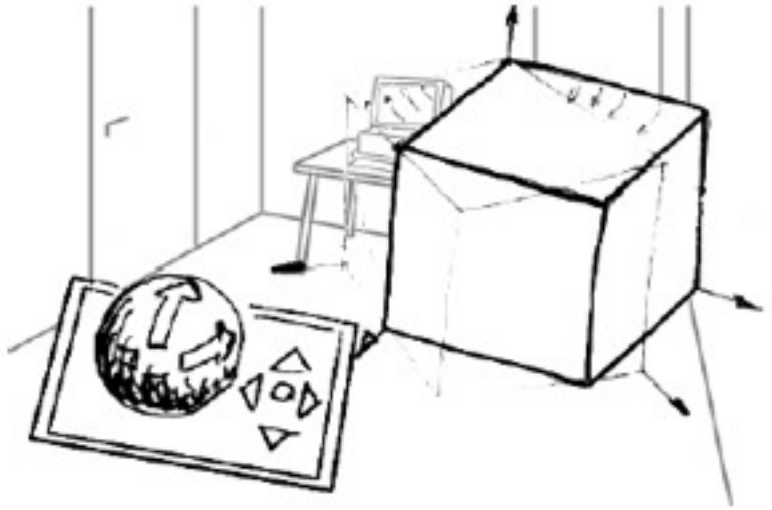


Figure 4. *... or rotation of objects*

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*

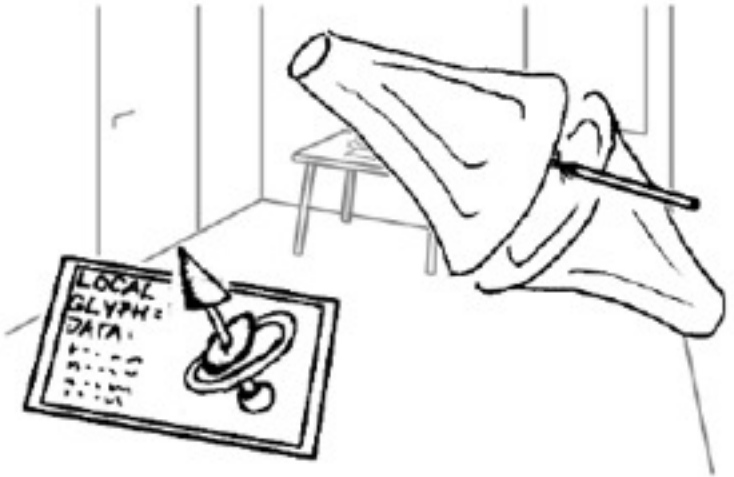


Figure 13. *Multidimensional parameters at any point are shown using glyphs on the PIP or directly at the measuring point*

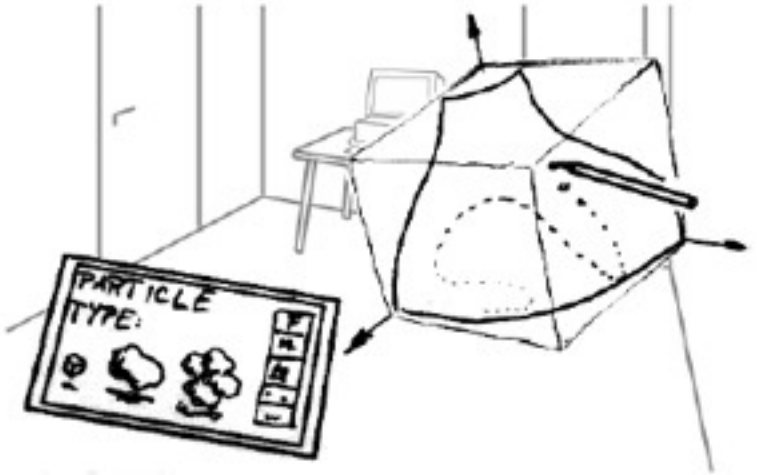


Figure 14. *Introducing particles directly in an ongoing dynamic simulation should be very intuitive*

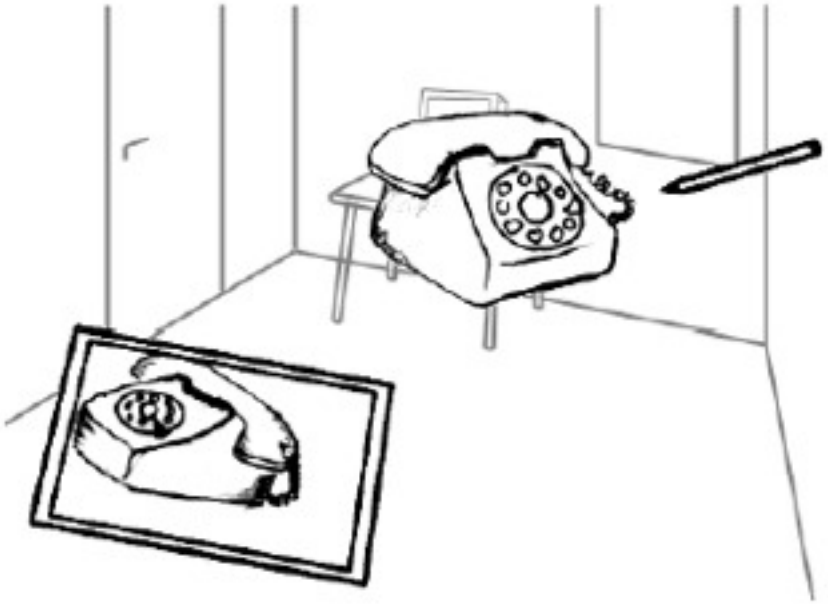


Figure 6. *Camera positioning with the pen*

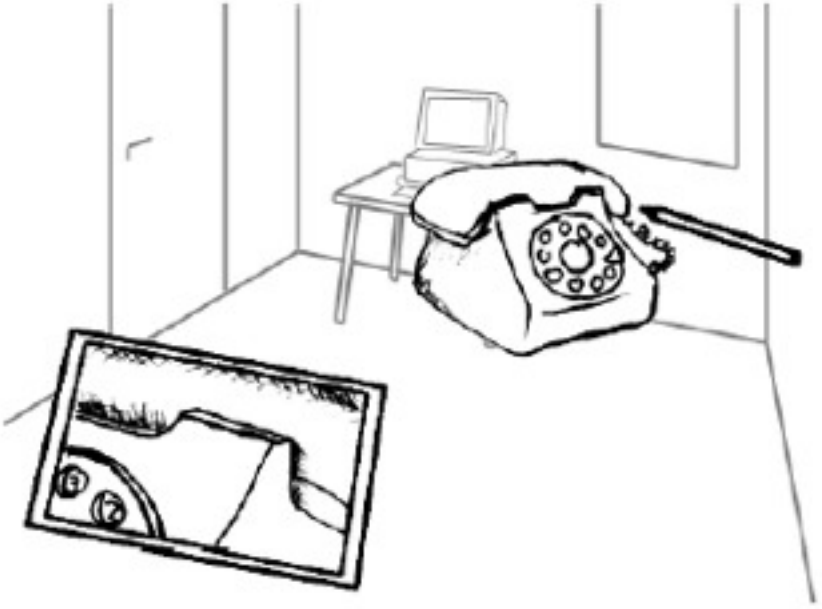
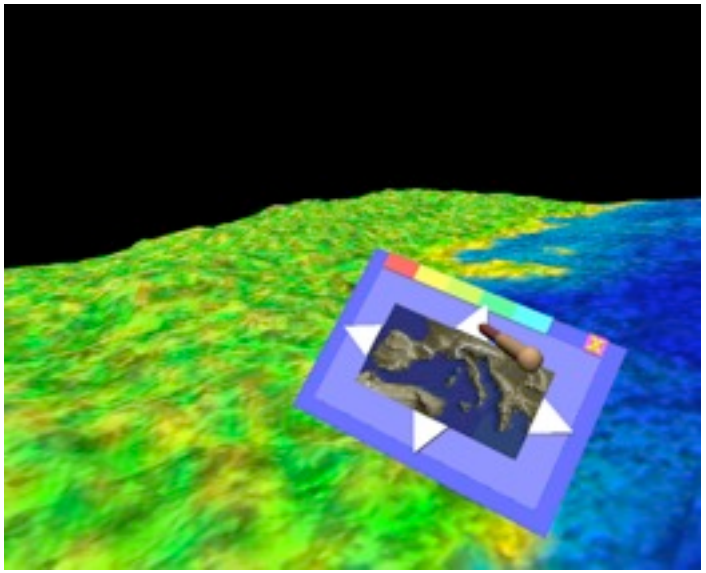
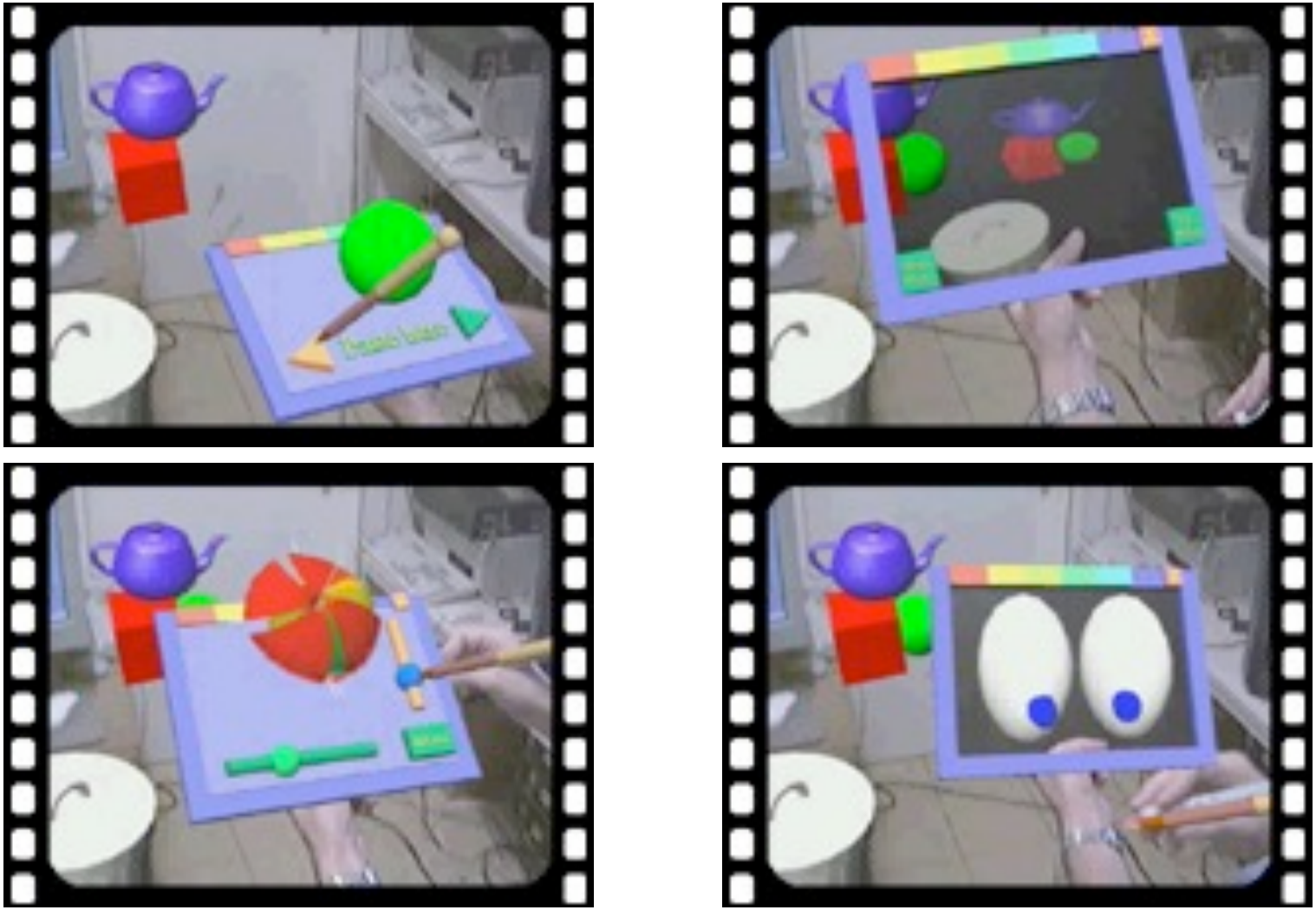


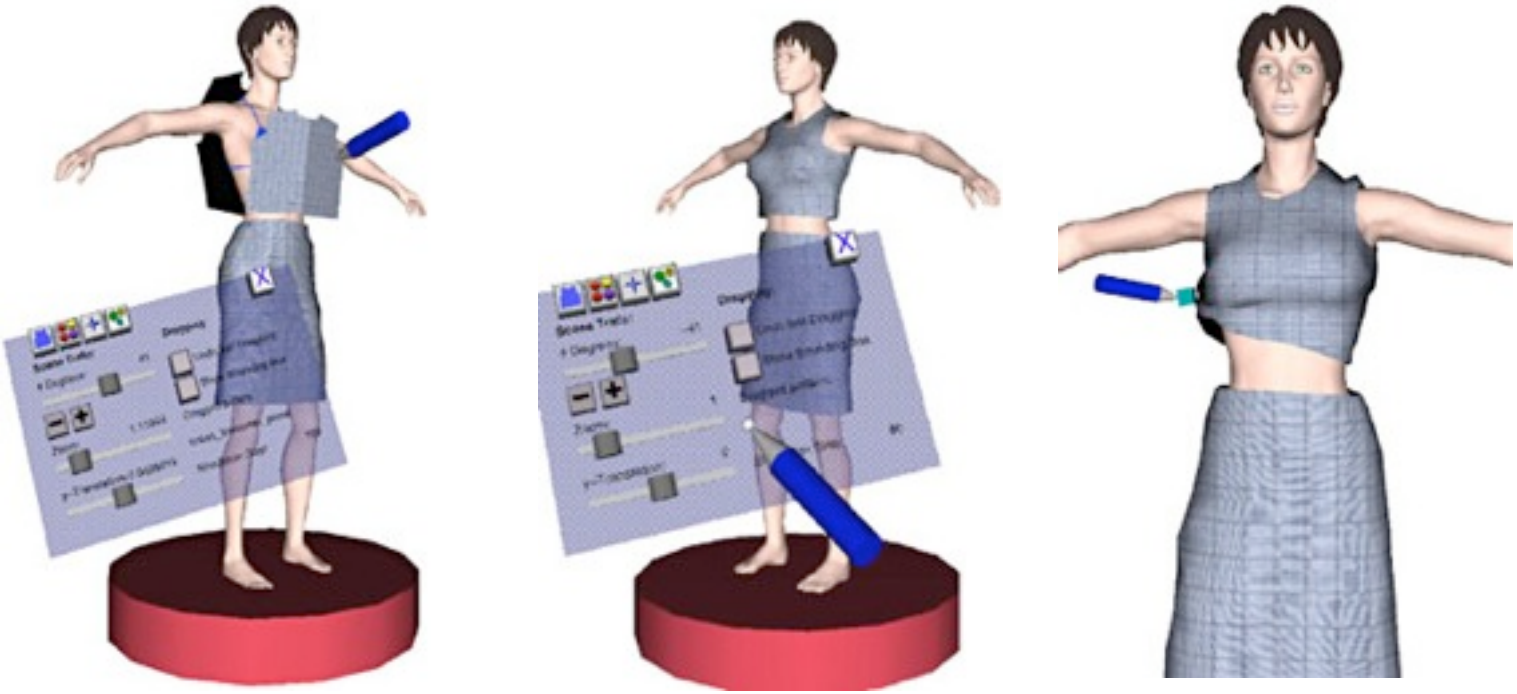
Figure 7. *Enlarged view of a detail*



Studierstube: The Personal Interaction Panel (PIP) [Szalavari & Gervautz, 1997]



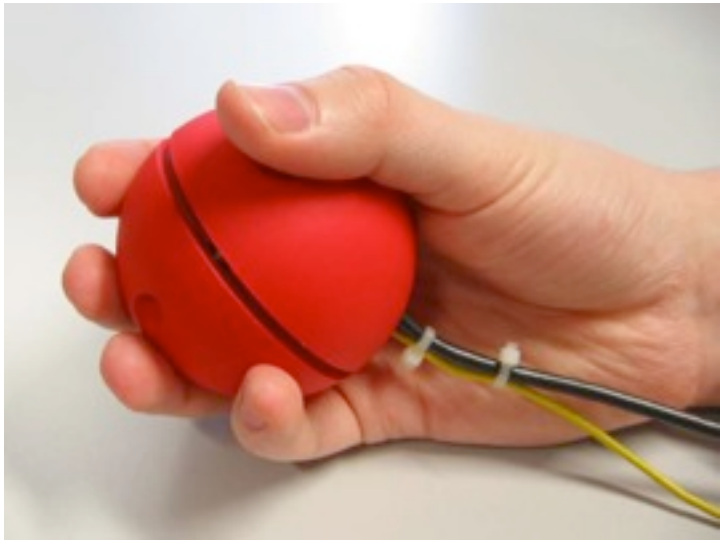
The Virtual Dressmaker [Keckeisen 2003]



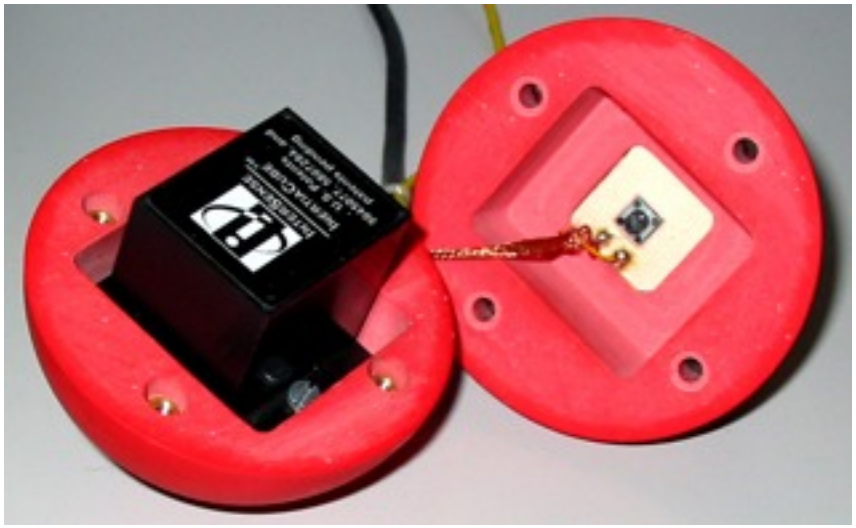
- PIP as a palette and pen as a manipulation tool
- Physical simulation of clothing fabric Video
  - Interact with the fabric directly
  - Use 3D widgets to manipulate whole model

Studierstube: the iOrb [Reitmayr et al. 2005]

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



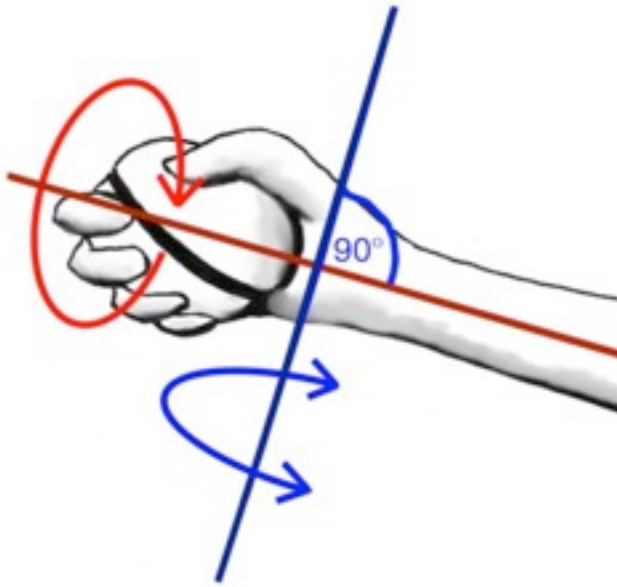
- Easy to build
- Easy to use
- Physical object
  - Weight
  - Inertia
  - Elasticity



Studierstube: the iOrb [Reitmayr et al. 2005]

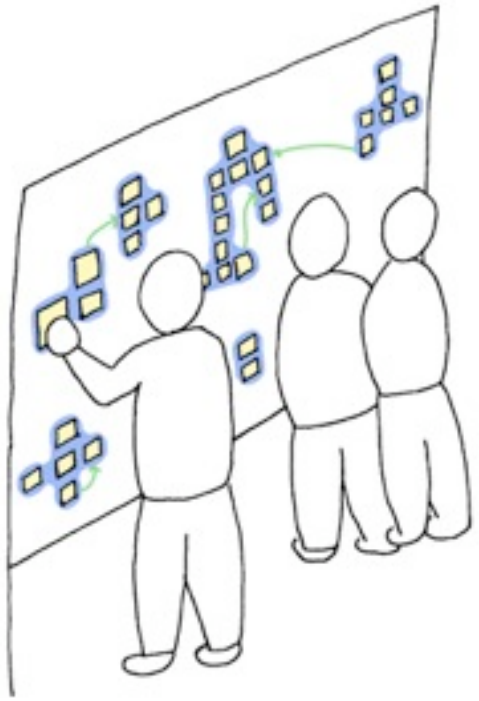
- Widgets for visual feedback
  - Constrained to one axis (a+b+d)
  - Using 3 axes (c)

- 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