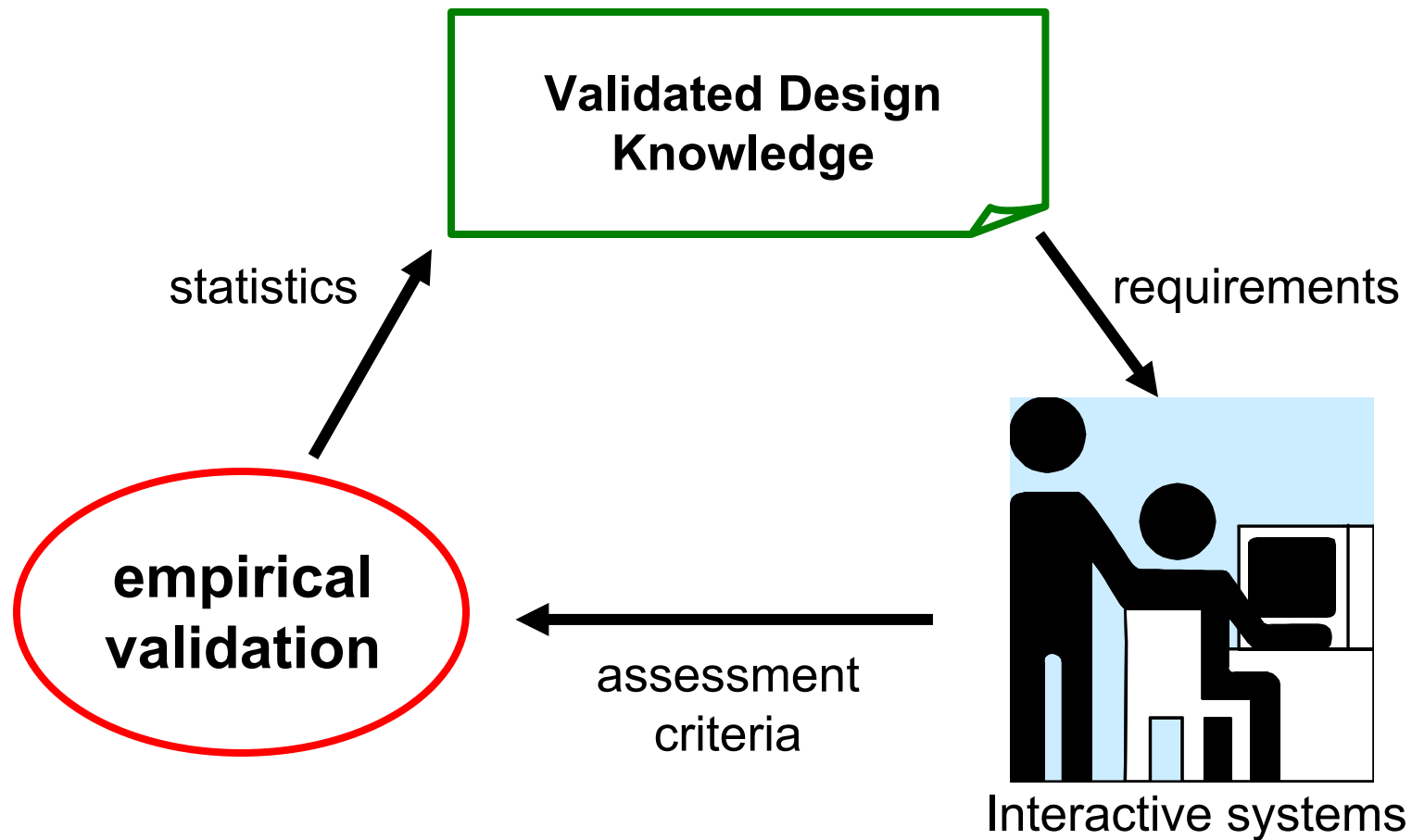


TUI's: design challenges

Matthias Rauterberg
Department Industrial Design
Technical University Eindhoven
2004

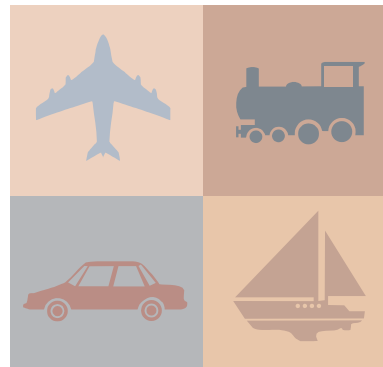
Our Research Approach



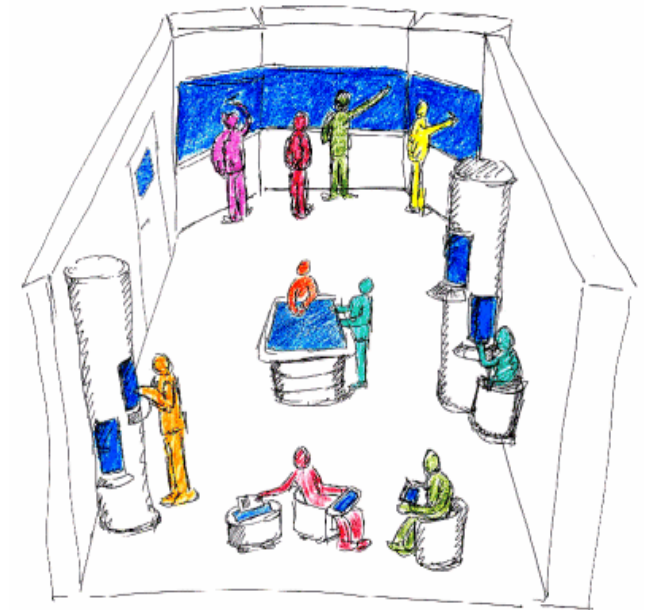
Trends in Interactive System Technology



Mobile computing



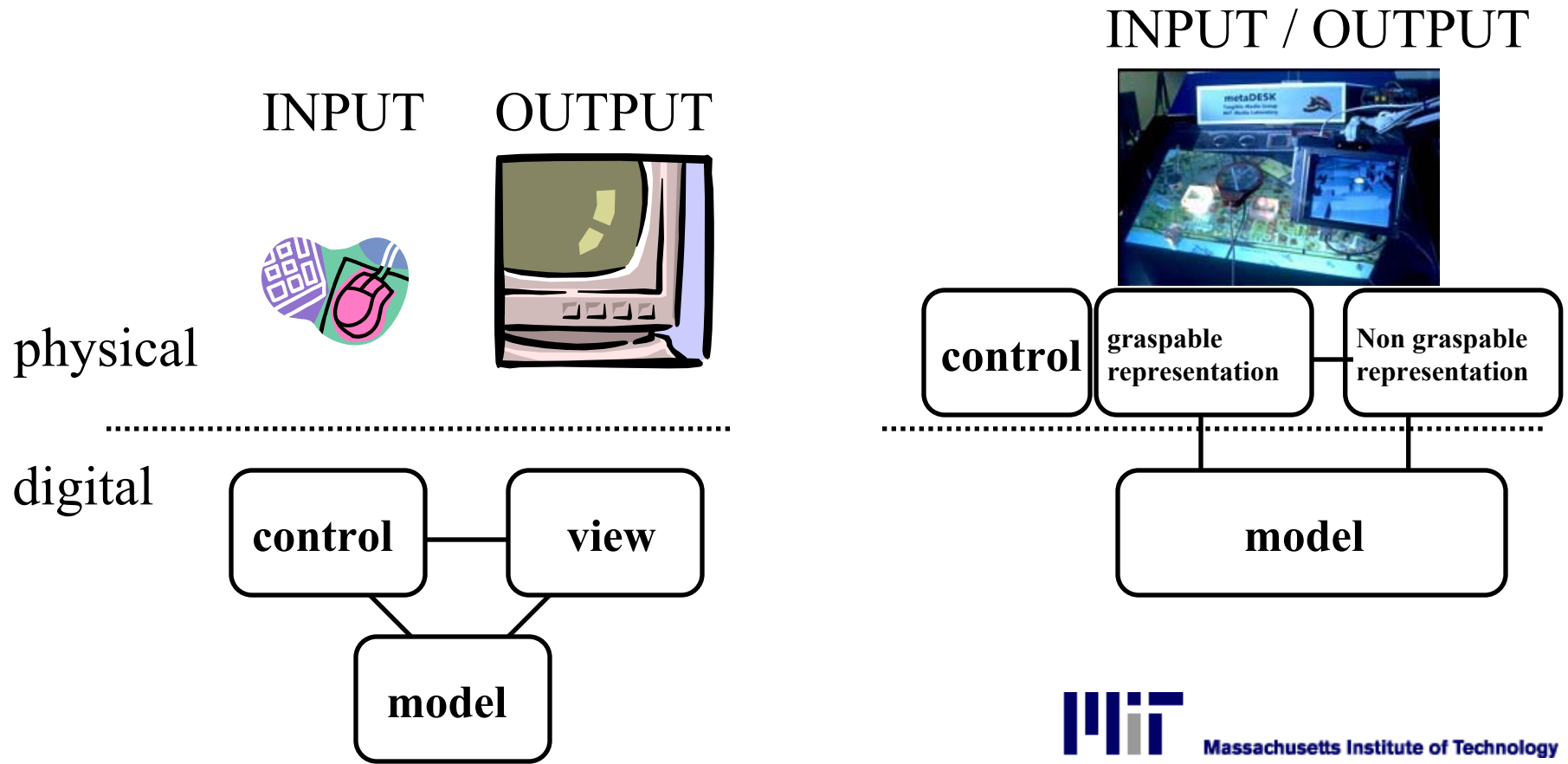
Transport



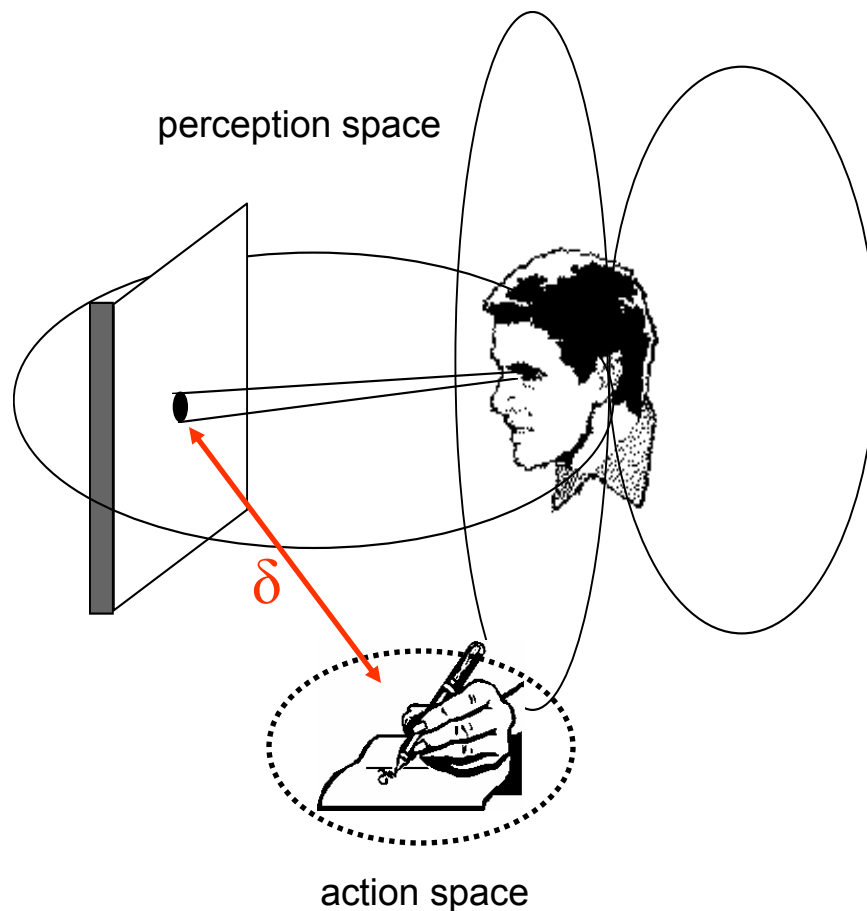
Ambient rooms and
Cooperative buildings

Interaction Models

Ullmer & Ishii, 2000

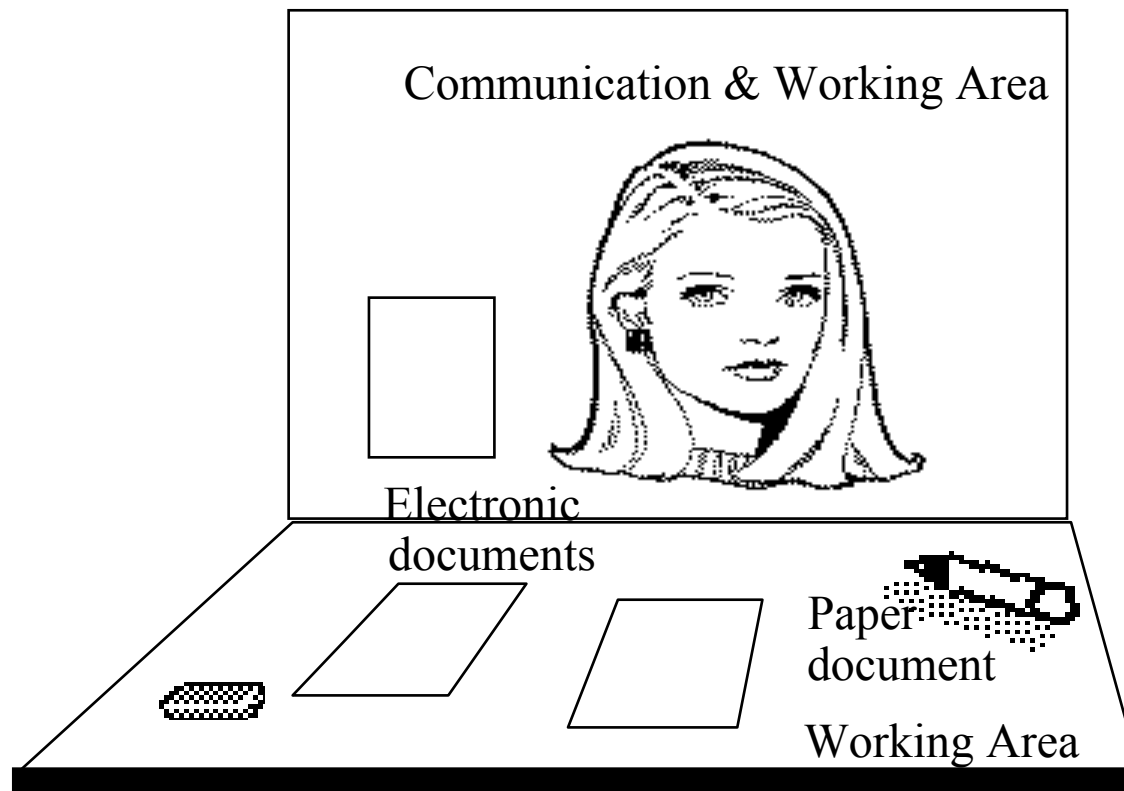


Perception Space and Action Space



- **Perception Space**
 - The physical space where the user's attention is.
- **Action Space**
 - The physical space where the user acts in.
- **Design Principle:**
 - perception space and action space must coincide! [$\delta=0$]
 - “Interlacing the display and manipulation space”
(Djajadiningrat, 1998, TU Delft)

Architecture of a Natural User Interface (NUI)



Wellner P, Mackay W, Gold R: Computer-Augmented Environments: Back to the Real World. (1993)
Fitzmaurice G, Ishii H, Buxton W: Bricks-Laying the Foundations for Graspable User Interfaces. (1995)
Tognazzini B: Tog on Software Design. (1996)

Tangible User Interfaces (TUI)...

The Build-It System

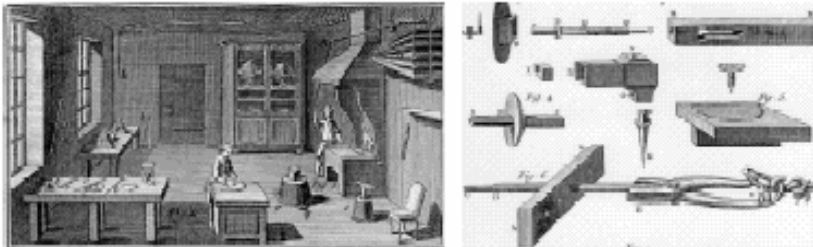
M. Bichsel, M. Fjeld & M. Rauterberg 1997



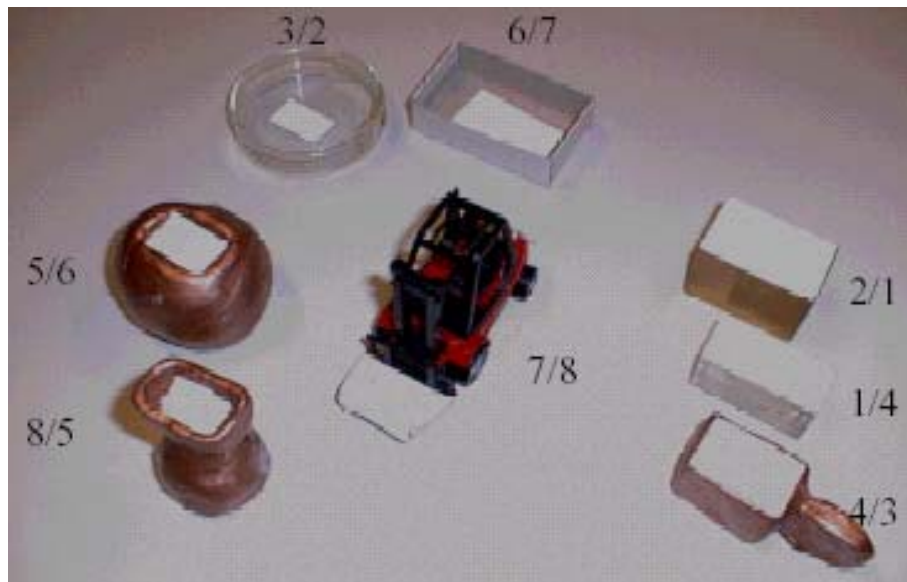
2D interaction:



Interaction Props: user study



18th Century: tool production



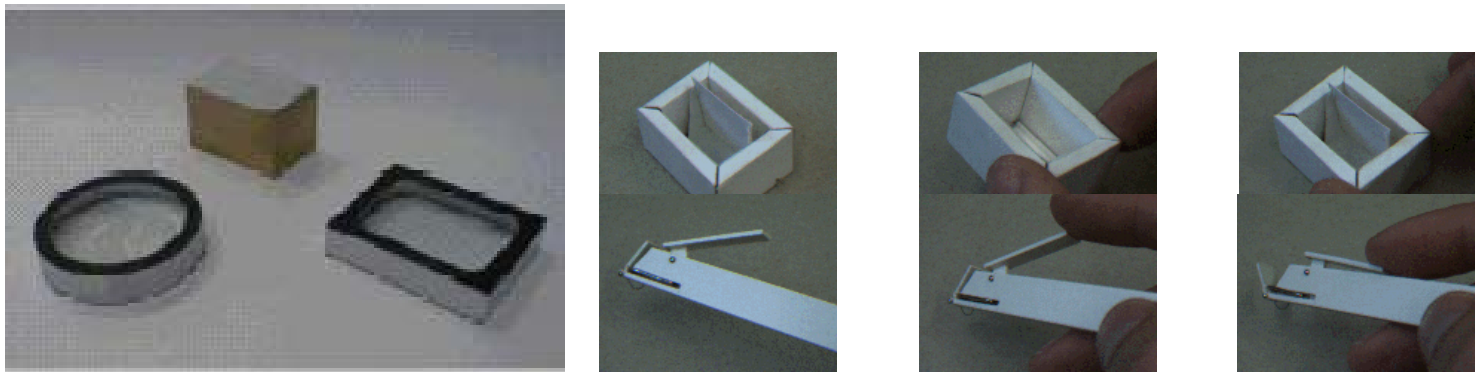
Props design factors:

form, size, material and metaphor:

- An experiment was carried out to explore different design strategies.
- Tasks were based on initial *planning* of an *interior architecture*.
- Focus of the experiment was *subjective opinion* (n=12) about the bricks.
- The bricks were ranked by user performance *before* (first number) and *after* (second number) task solving activity.

The Build-It System: tangible props

2D



[design by Fred Voorhorst]

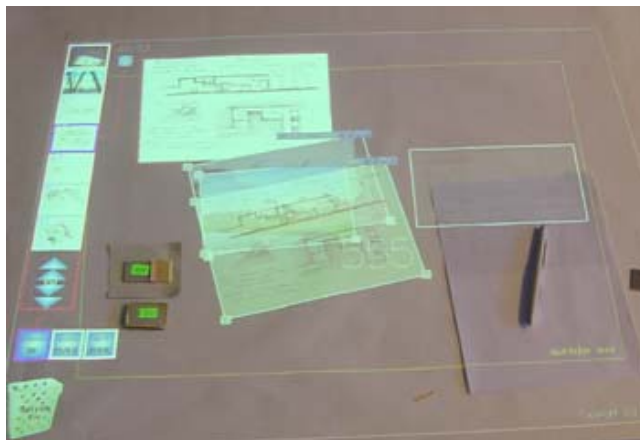
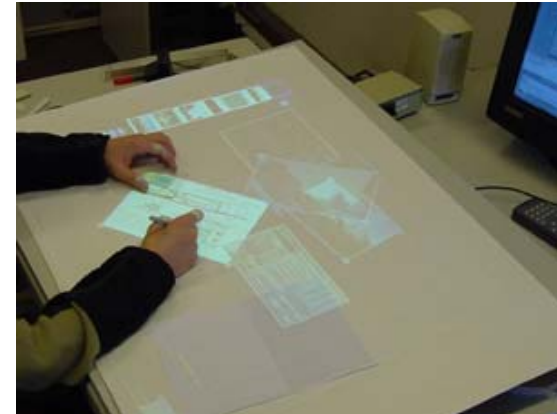
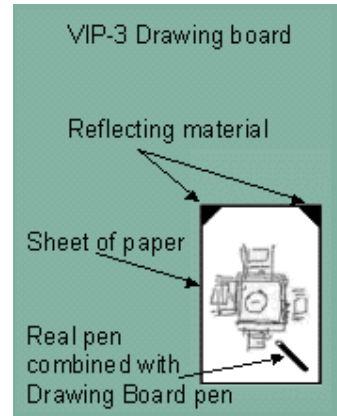
3.D



PhD Thesis (2001) from Morten Fjeld



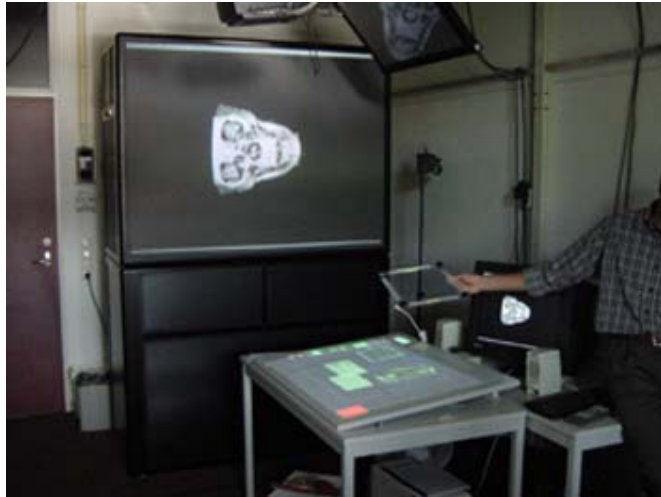
2D Interaction Props



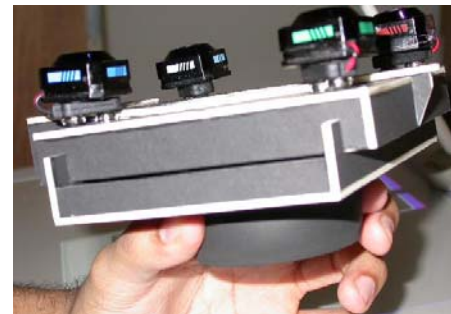
PhD Thesis (2003) from Dima Aliakseyeu



3D Interaction Props



RISP:
Rigid
Intersection
Selection
Prop



PhD Thesis (2004) from Sriram Subramanian



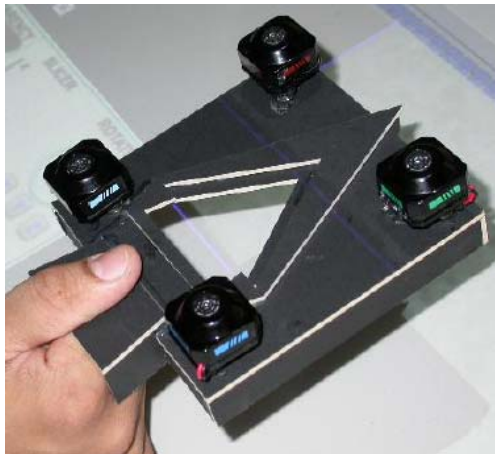
Different Prop Designs...

Ref: Napier (1956) classified grips into 2 different categories 'precision grip' and 'power grip'.

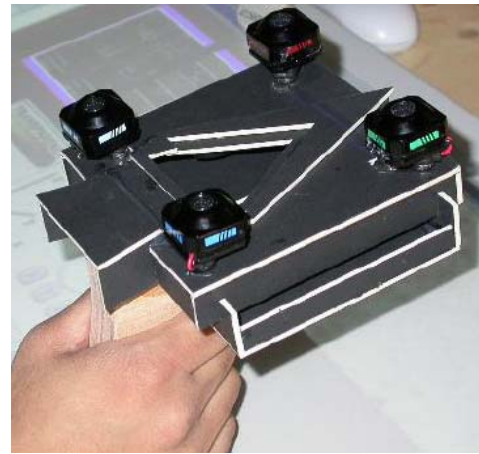


RISP := **R**igid **I**nter-**S**ection **P**rop

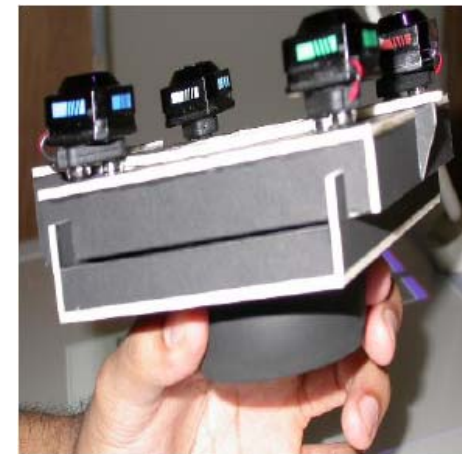
RISP Thumb



RISP Power

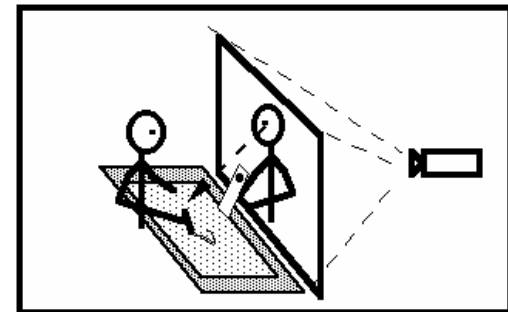
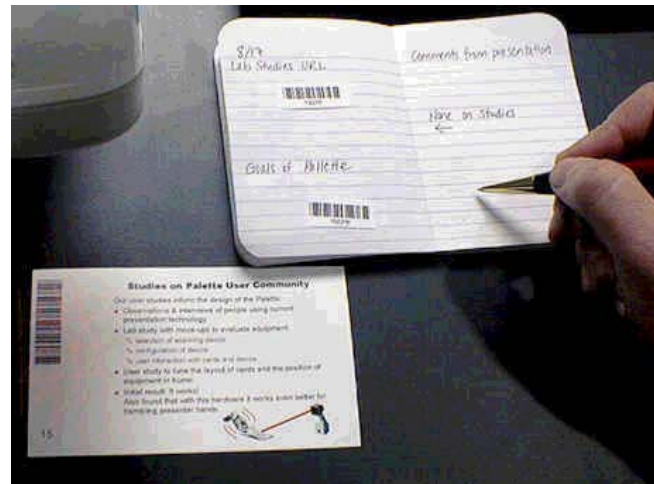


RISP Round



The Next Steps

- full-duplex audio connection
- additional interaction techniques, e.g. speech, handwritten input
- more 2 and 3D interaction possibilities
- video conferencing functionality for distributed cooperation



Future Directions...

Further research questions:

- ? gaze/eye contact with remote partner
- ? variation of interface prop designs
- ? additional input technologies
- ? presence supported by full-duplex audio connection

And how to analyze human behavior in
2/3D space & time over a longer period?

Thank you for your attention.