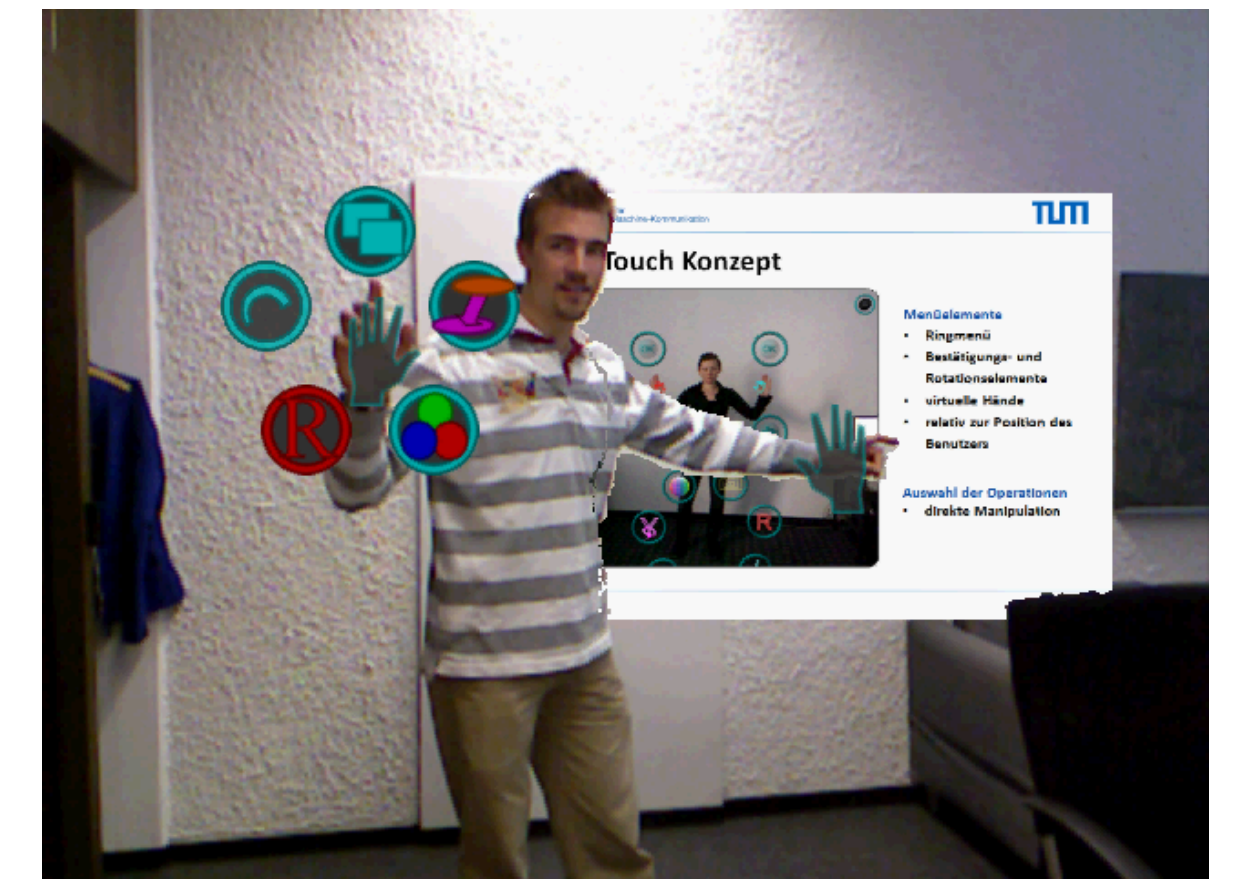
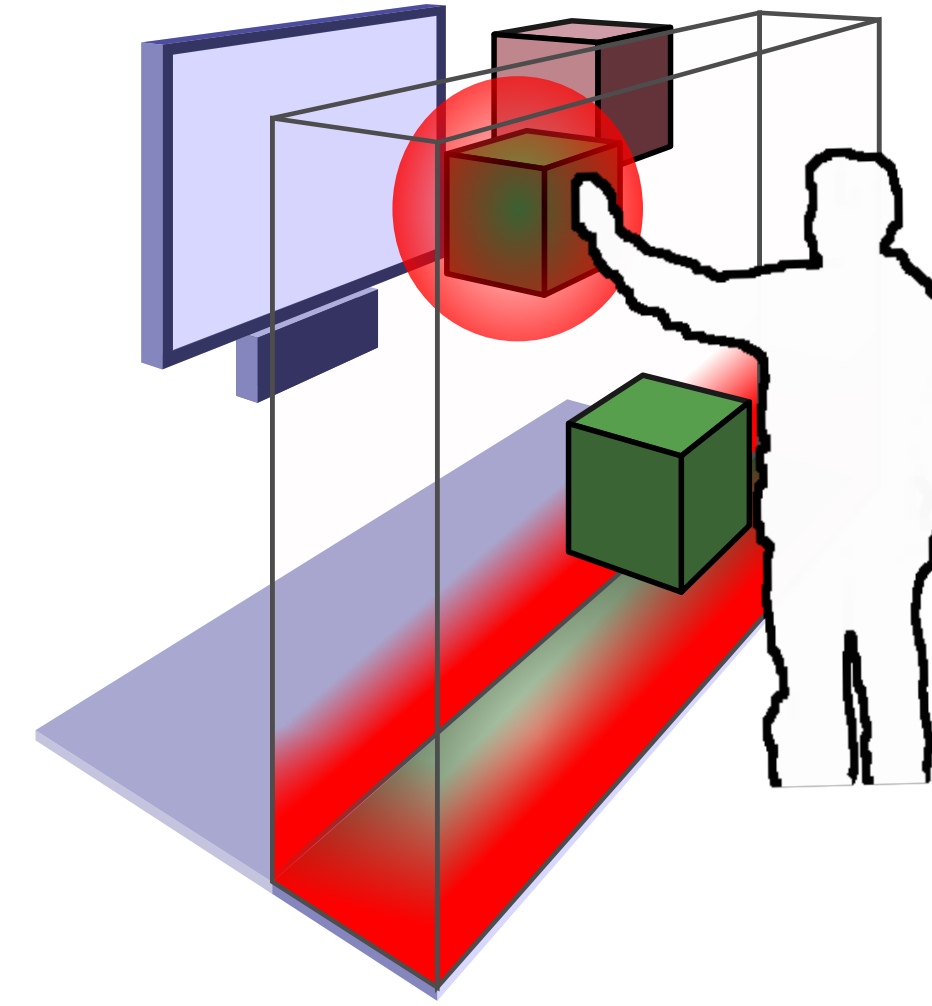
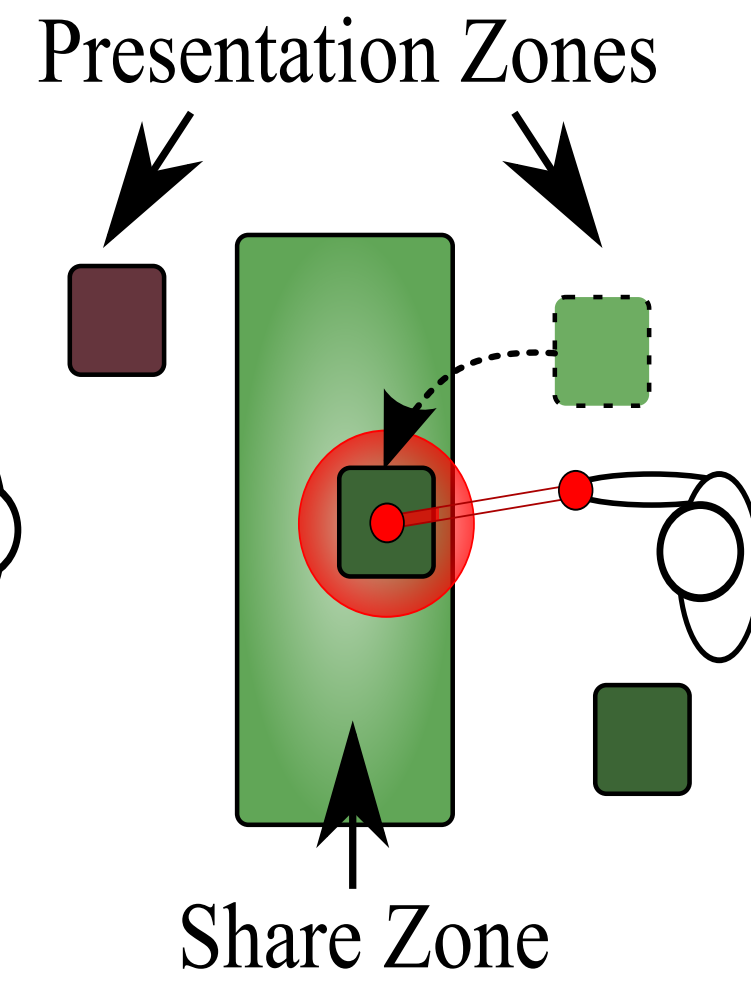
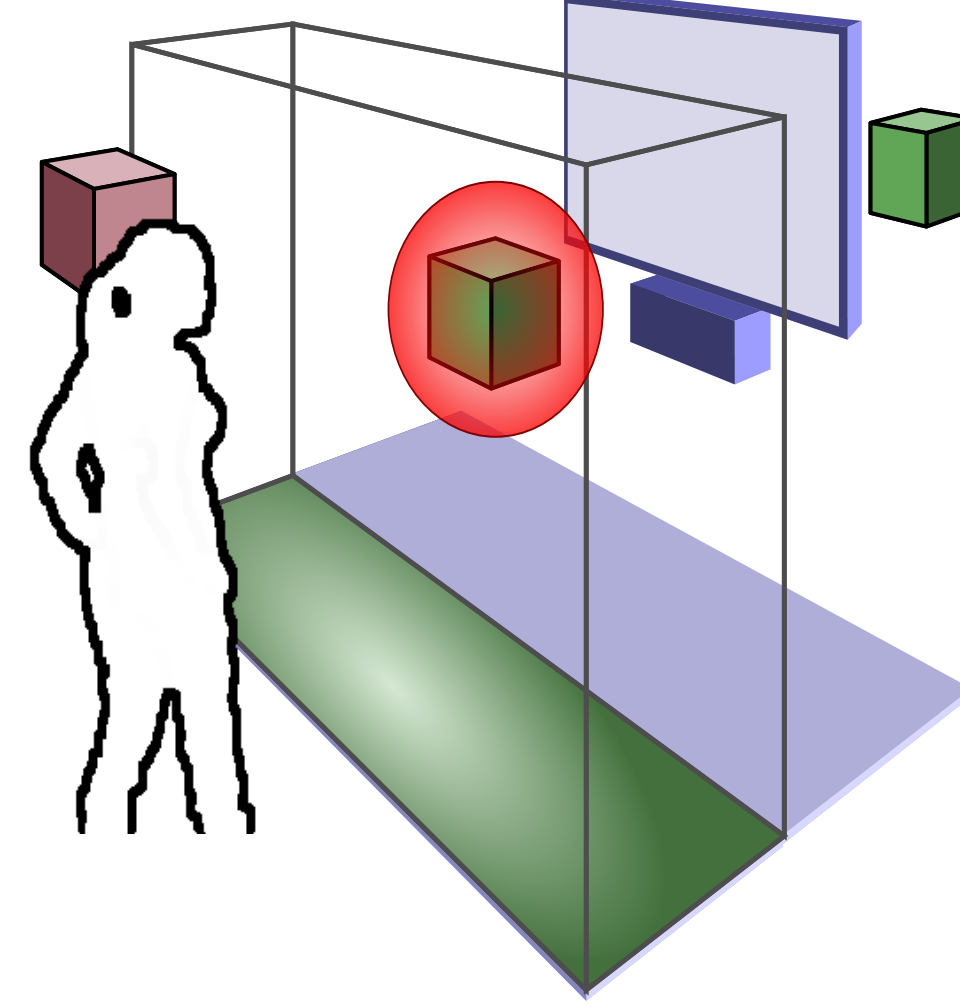
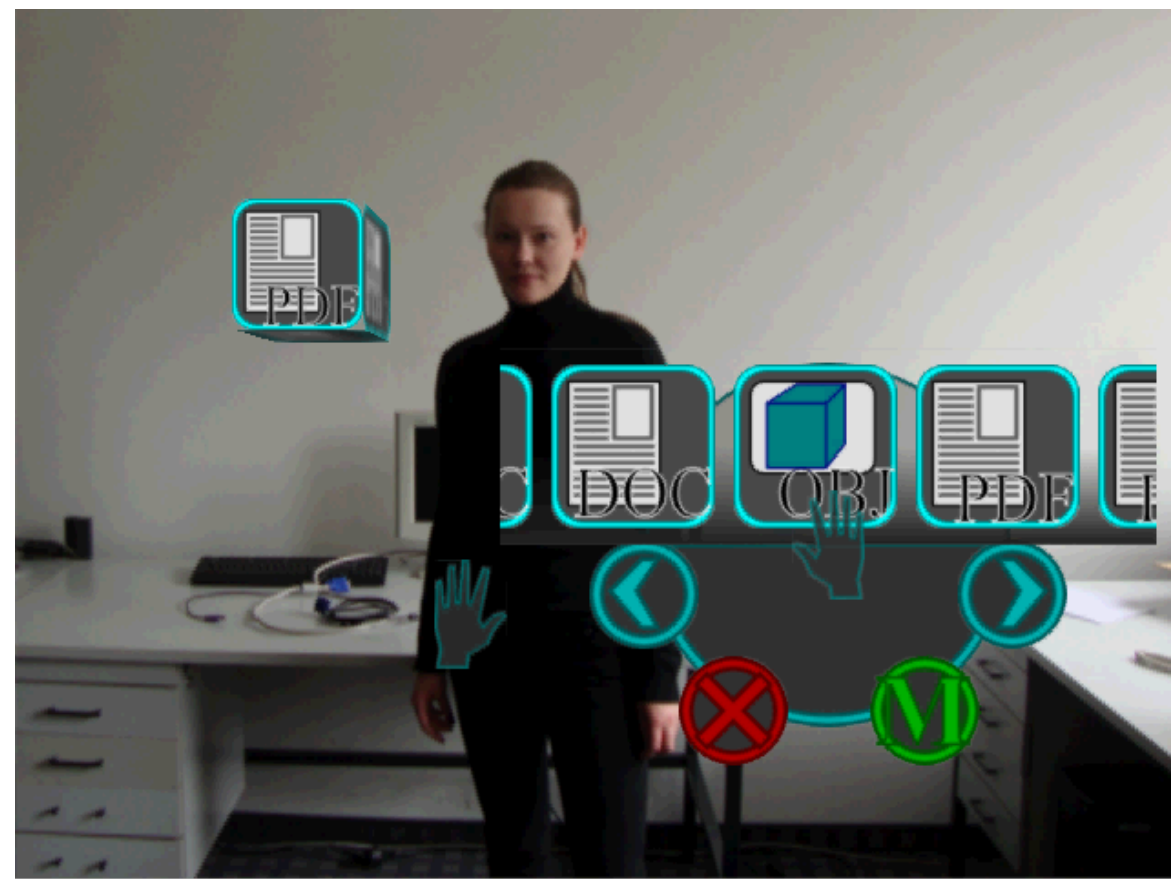


# Interface Design for an Inexpensive Hands-Free Collaborative Videoconferencing System

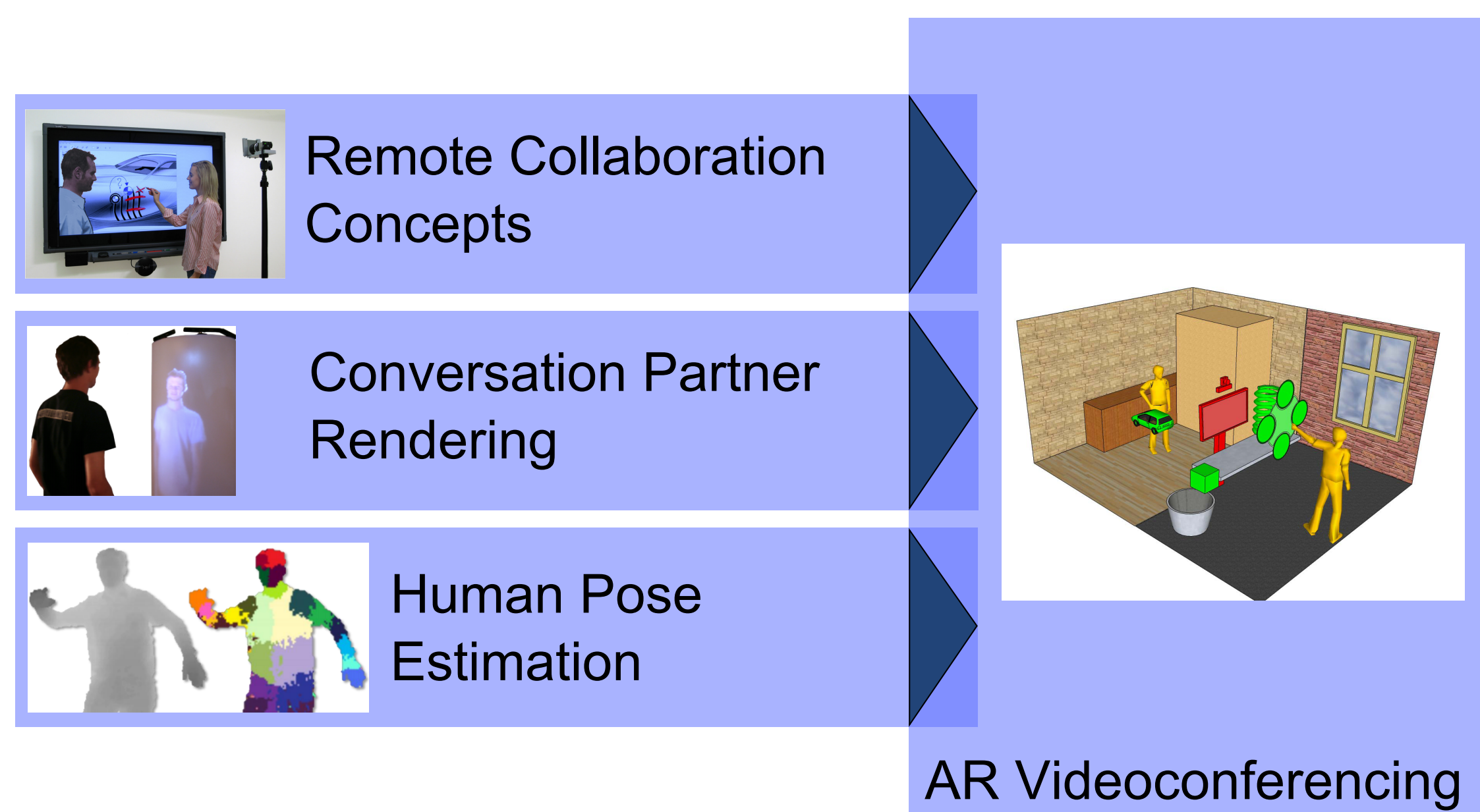


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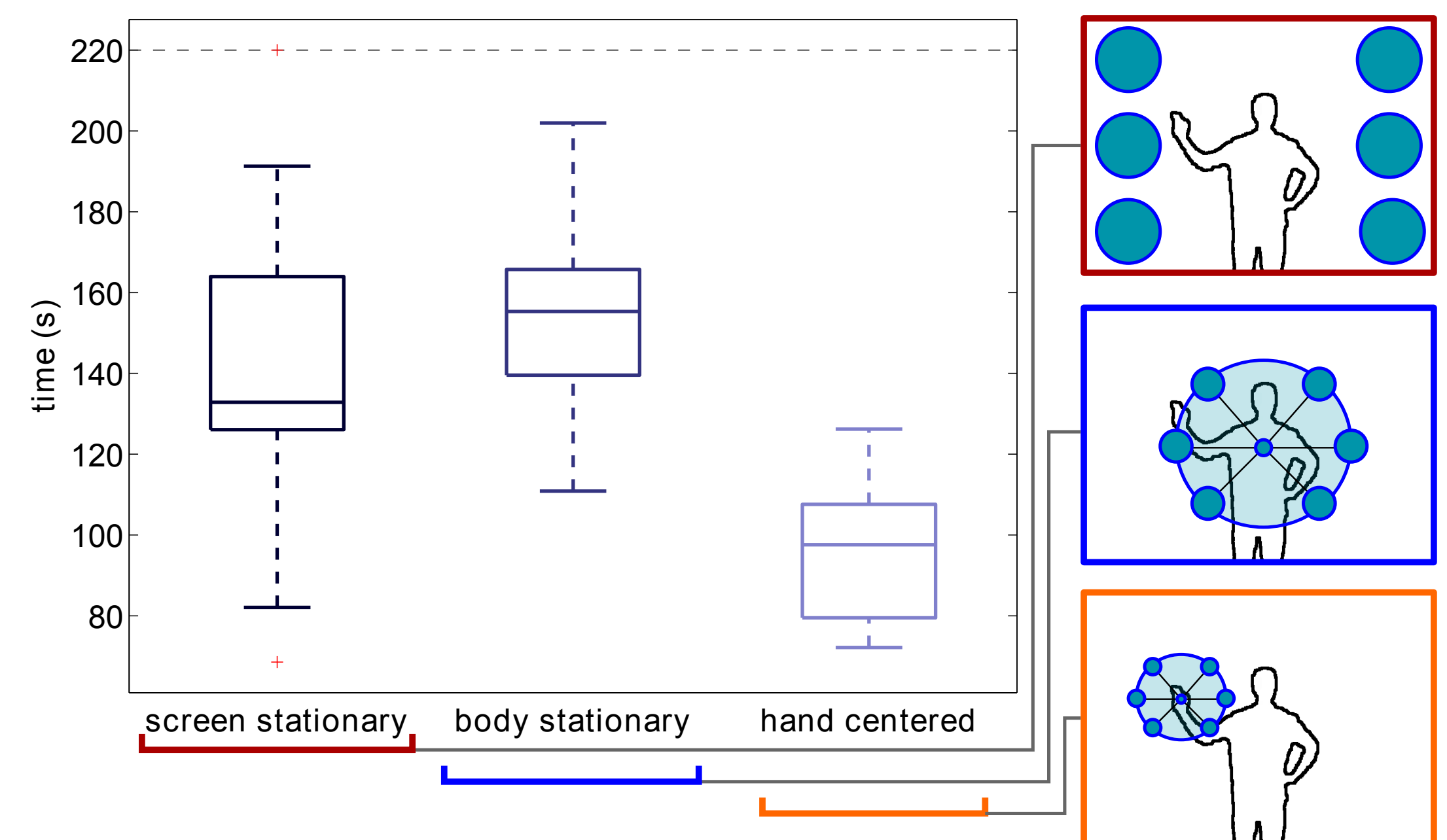


## Conceptual Origins



[3, 1], [4, 2], [5]

## Initial Findings & Lessons Learned



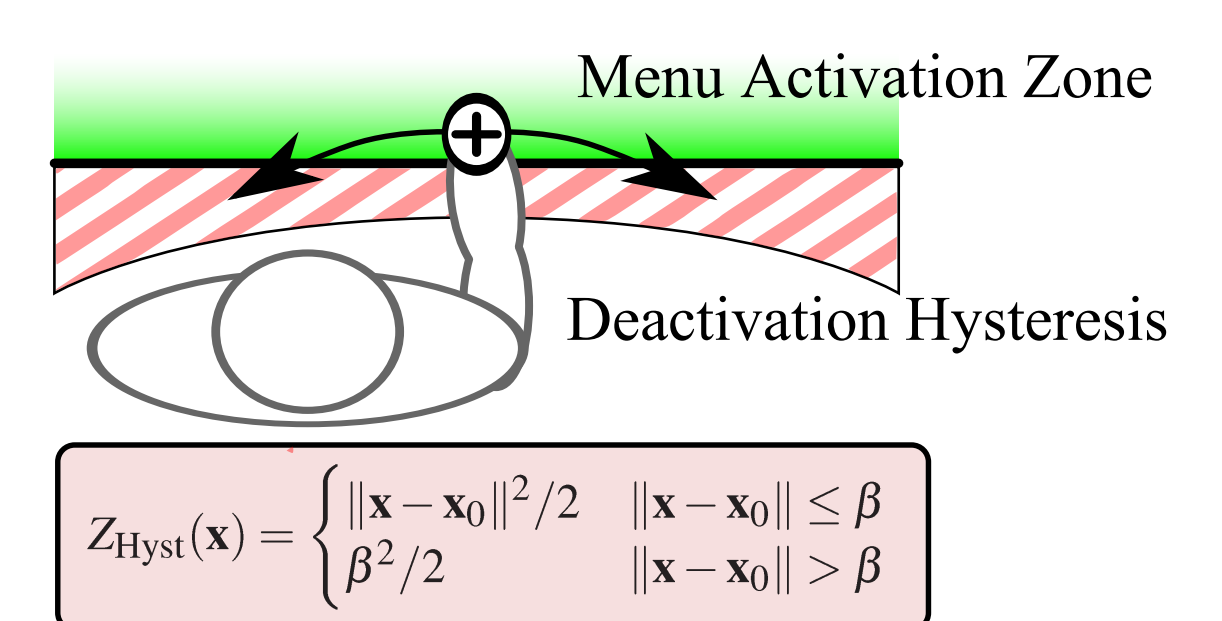
Examination of menu design for remote touch:

- **Test-bench setup** (16 users, combined manipulation & annotation tasks)
- Remote touch interaction, time-based selection of items & tasks
- **Hand centered menus result in lowest execution times and arm fatigue**

**Spatial sharing management found positive response in preliminary trials.**

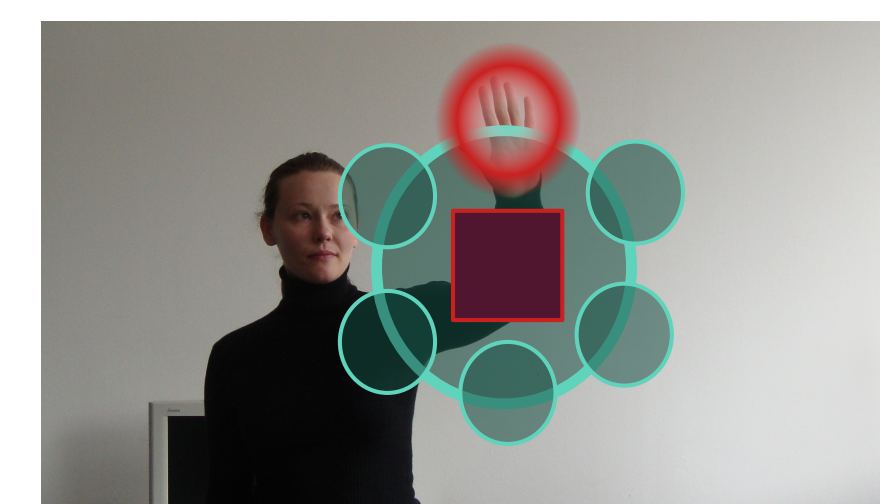
**Problem:** Conversational gestures misinterpreted as control input.

- **Solution:** Depth triggered interactions & menu appearance.
- **Note:** Simple depth thresholding  $\Rightarrow$  inadvertent closing. Talwar-based hysteresis compensates non-linear arm movement.



**Problem:** Risk of socially inappropriate control gestures (e.g. accidentally "flipping the bird").

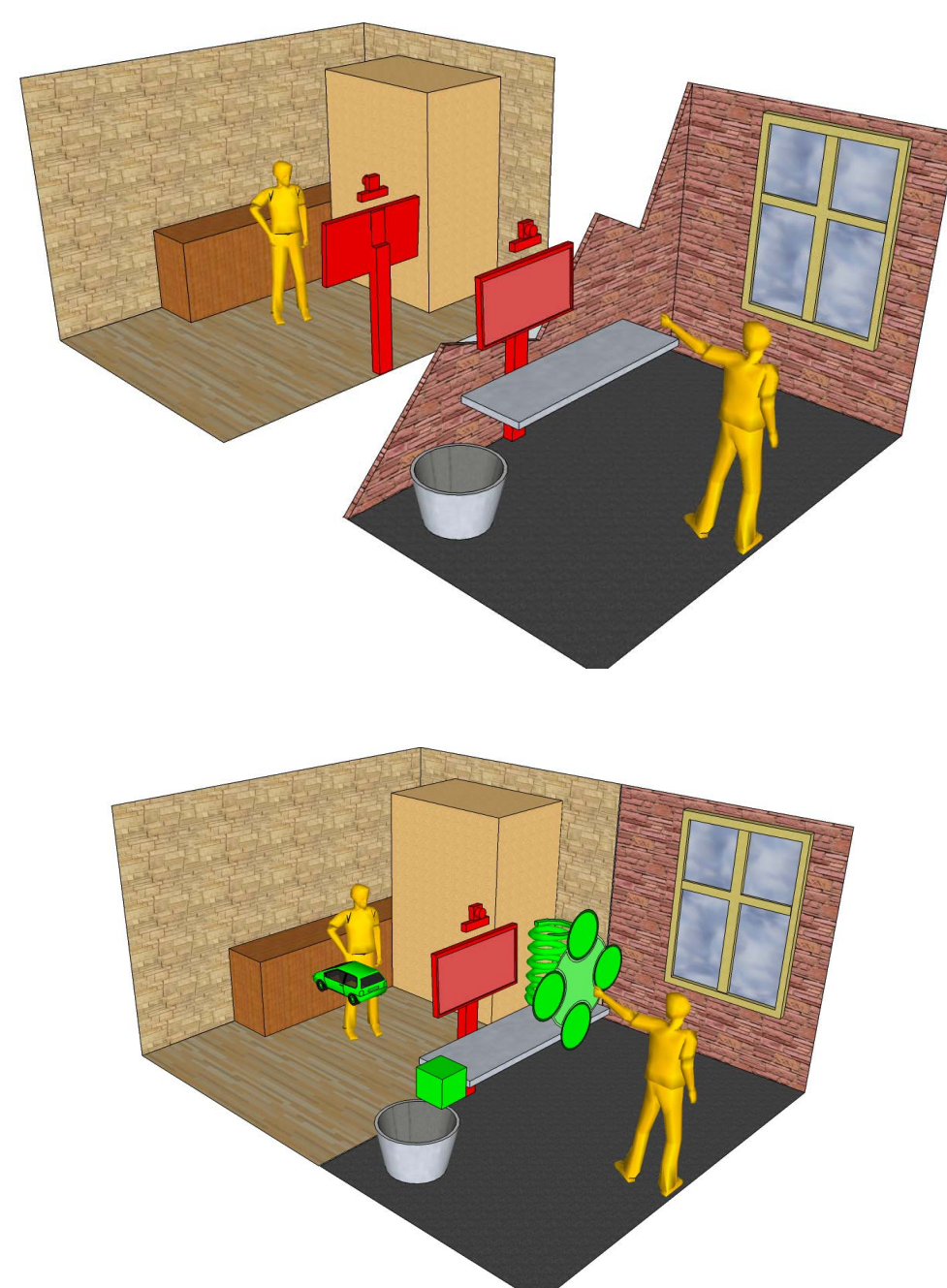
- **Solution:** Clear indication of ongoing interaction to conversation partners (e.g. showing menu outlines)



## System Overview

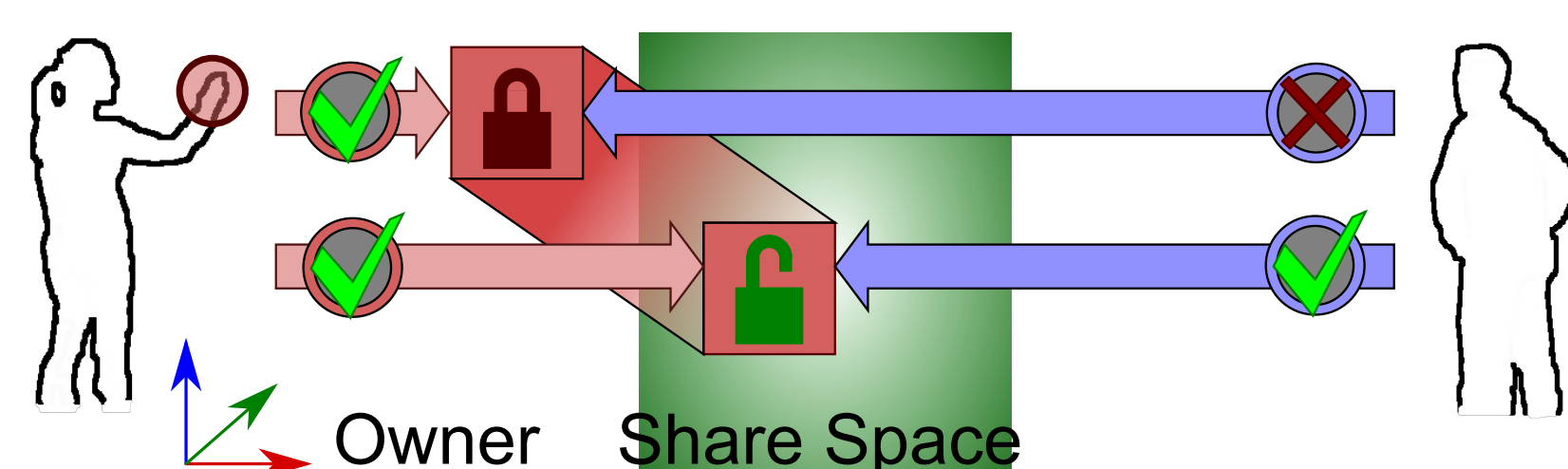
### Basic System

- Video conferencing setup extended by
  - **depth camera** for pose tracking and depth sensing [5]
  - module for **rendering and manipulating virtual objects**
- **Data represented by virtual 3D objects** rendered onto the displays
- Data manipulated by **remote touch interfaces**
- Background modelling for **occlusion** and **environmental collision handling**
- Data representations occluded by user for realistic rendering



### Mixed Reality Concept

- Data managed in **joint virtual workspace**
- Screens as reference frames for workspace fusion
- Spatial sharing management
- Face-to-Face conversation



### Interaction Concept

Interaction managed by **depth triggered marker menus**

- **Remote touch menus**, since gesture recognition becomes unreliable at higher distances.
- **Optical feedback** signals system states, such as item selection or menu appearance.
- Dragging objects with 1-to-1 mapping of hand movement.
- Rotation by a fixed degree-per-second ratio (dependent on the hand's screen position).
- Menu navigation processed in 2D, object manipulation performed in 3D.

## Outlook

- Integration of **parallax rendering** for increased immersion.
- **Fusion of disparate remote user spaces** with different layouts into a common virtual workspace. Treatment of discontinuities between user spaces.
- Display of spatially arranged data on a limited surface (e.g. a computer screen).

## References

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- [3] Martin Kuechler and Andreas M. Kunz. Collaboard: A remote collaboration groupware device featuring an embodiment-enriched shared workspace. In *Proceedings of the 18th ACM international conference on Supporting group work*, pages 211–214, 2010.
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- [5] Jamie Shotton, Andrew Fitzgibbon, Mat Cook, Toby Sharp, Mark Finocchio, Richard Moore, Alex Kipman, and Andrew Blake. Real-time human pose recognition in parts from a single depth image. In *Computer Vision and Pattern Recognition, IEEE Computer Society Conference on*, pages 945–952, 2011.

