Mensch-Maschine-Interaktion 2

Introduction to Interactive Surfaces

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Introduction and History

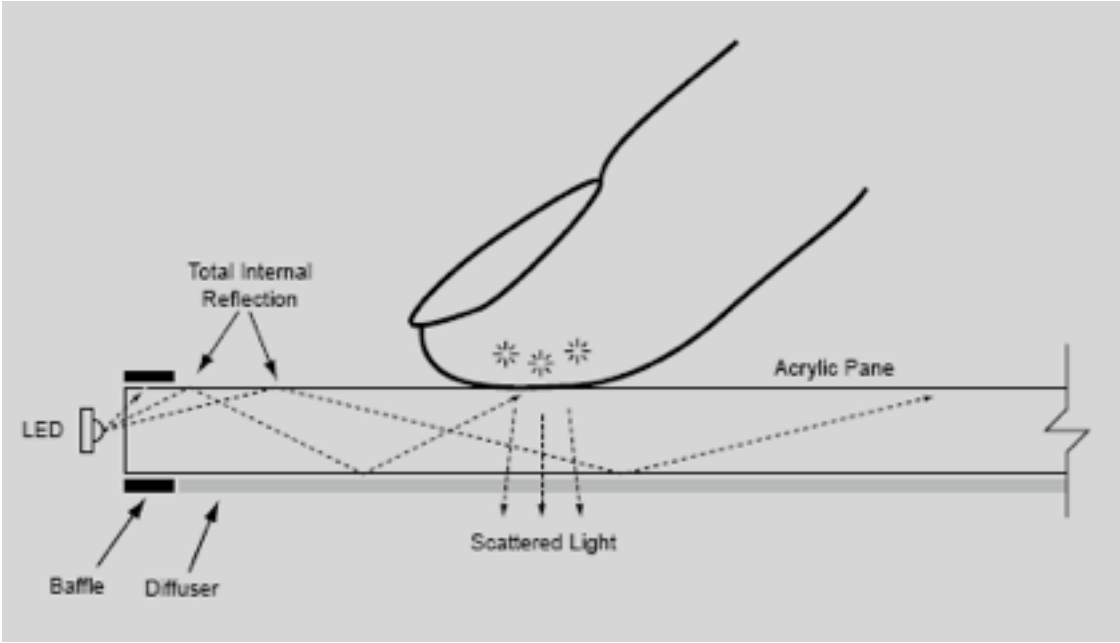
- Motivation, Vision
  - the FTIR hype
  - the SUN Starfire Video
- Early Research
  - The MIT MetaDesk
  - Pierre Wellner‘s Digital Desk

Interactive Surfaces before the FTIR hype

- Interactive Tabletops in research since early 1990ies
  - cumbersome setups, expensive technology
  - commercial prototypes early 2000s
    - e.g., „Roomware“ 2001, photo below from Fraunhofer IPSI
  - did not really catch on at a large scale
- Interactive walls also in the 90ies
  - became commercial products as interactive whiteboards
  - front or back projection
  - sensing of one or multiple pens
  - affordable and widespread today
  - use for presentation, teaching, ...

Jeff Han and the FTIR Hype

- Jefferson Y. Han (NYU): work on a cheap multi touch sensing scheme (http://cs.nyu.edu/~jhan/ftirtouch/)
- Spin-off company „perceptive pixels“
- „FTIR Hype“ started probably with a TED talk, Feb. 2006
- many refinements and DIY projects followed



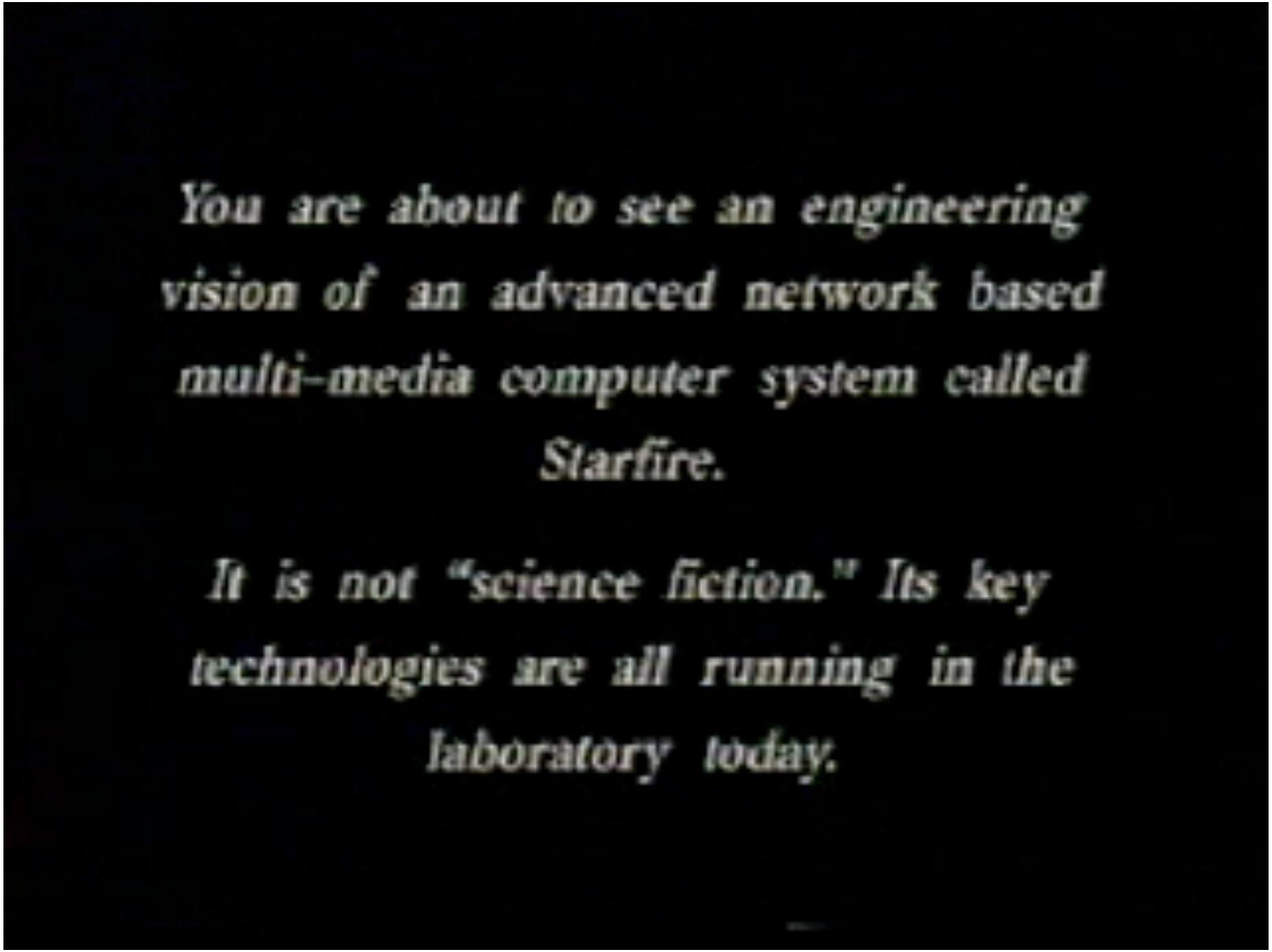
Interactive Tabletops and Surfaces Today

- Rapidly growing research field
- conference ITS 2009 in Banff, Canada:
  - started in 2006 as IEEE tabletop workshop
  - ~150 participants, 30 papers, conference status
  - 2010 will be in Germany (more submissions in 2009 from Germany than from USA)

- Commercial interest since „Perceptive Pixels“ and the Microsoft Surface
- Multi Touch also popularized by the iPhone

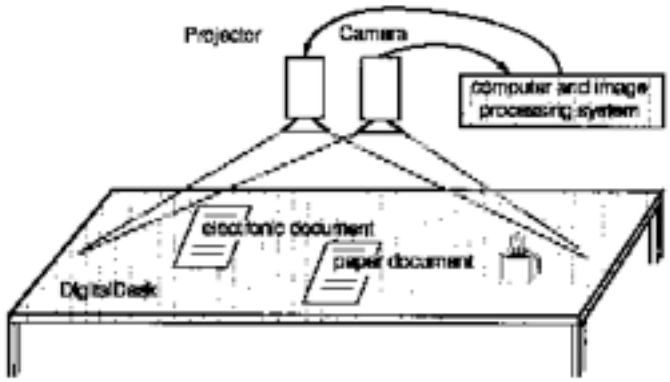
SUN Starfire - an early vision

- concept video produced in 1992
- only shows existing or almost existing technology
- features a curved high resolution interactive surface
- multimodal interaction with the system
- http://www.asktog.com/starfire/


You are about to see an engineering vision of an advanced network based multi-media computer system called Starfire.
It is not "science fiction." Its key technologies are all running in the laboratory today.

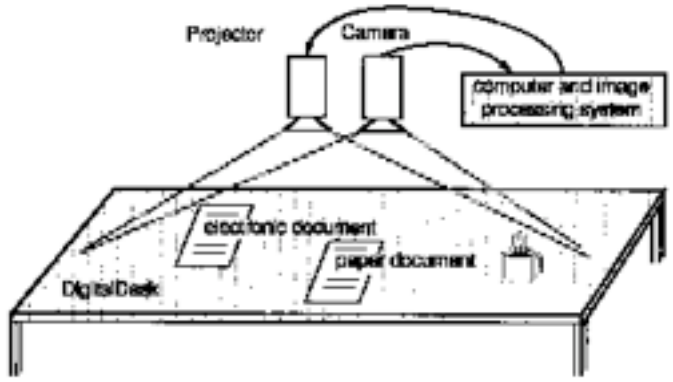
Historic Interactive Surfaces

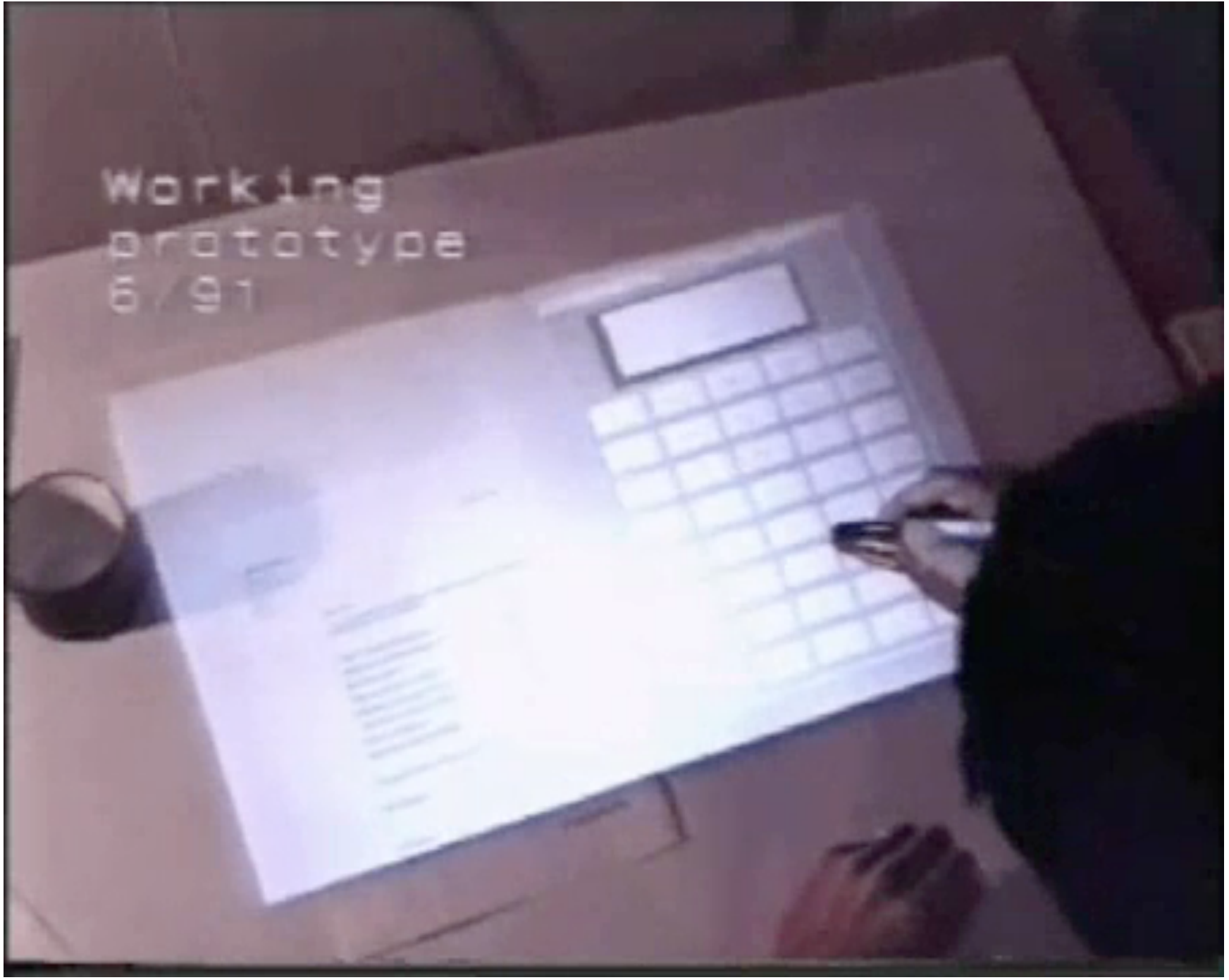
- read http://www.billbuxton.com/multitouchOverview.html !
- early experiments with multi touch in the 1980ies
- For this lecture: 2 prominent historic examples:
  - Pierre Wellner‘s Digital Desk
  - MIT MetaDesk



Pierre Wellner‘s Digital Desk

- Working prototype in 1991
- Regular table with top projection
- Overhead camera to detect fingers
- Camera can also scan paper on the desk
- Interaction with printed paper and digital applications on the same surface




Working
prototype
6/91

The MIT MetaDESK

- Platform for exploring Tangible UIs (Ullmer & Ishii, 1997)
- Also uses top projection
- Various projects built on top of it

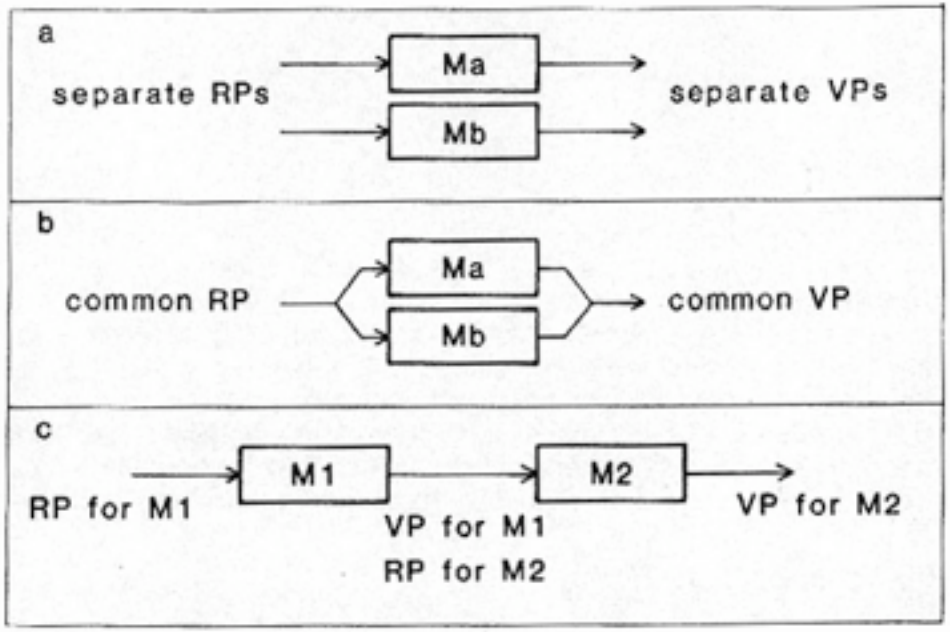
Problems and Particularities

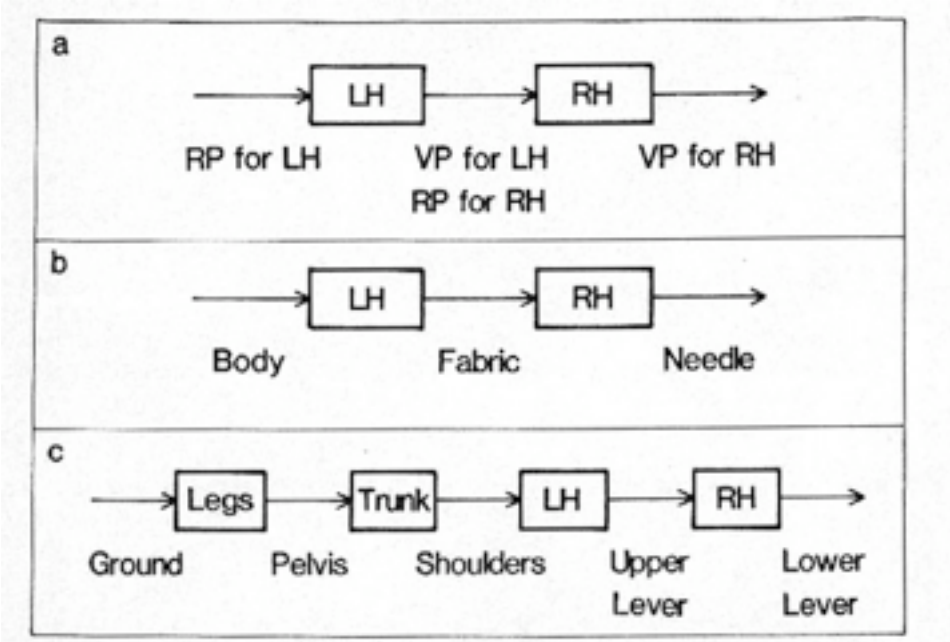
- Asymmetric bimanuality
- Territoriality on tables
- Direction and orientation on tables

- Occlusion Problem
- Fat finger problem

Asymmetric Bimanual Interaction (Guiard 1987)

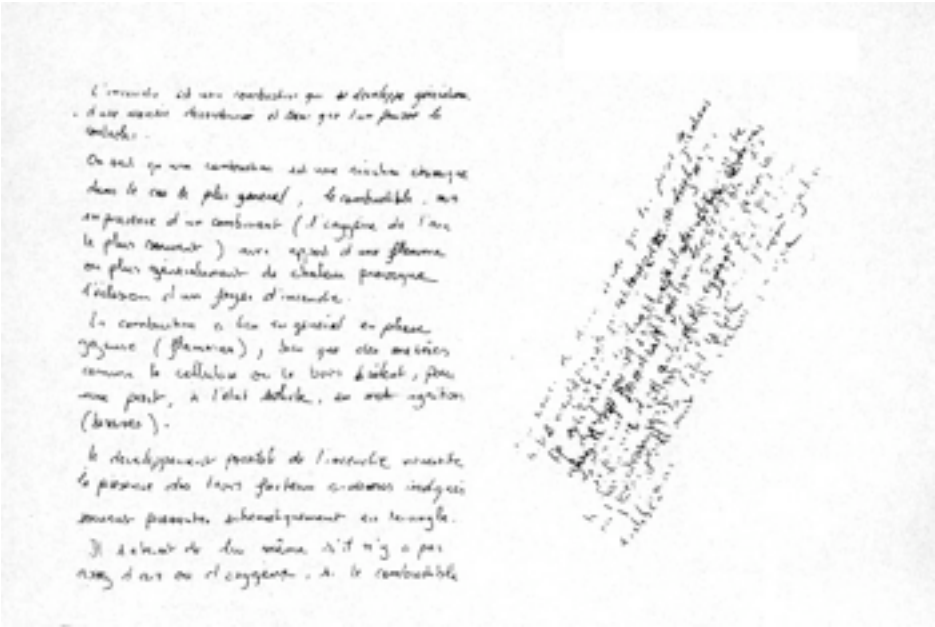
- Human bimanual interaction is largely asymmetric
- Hands are simply regarded as „motors“
  - Non-dominant hand provides a reference frame
  - Dominant hand interacts fine-grained in it
- In this sense, both motors form a logical chain





Example: Handwriting

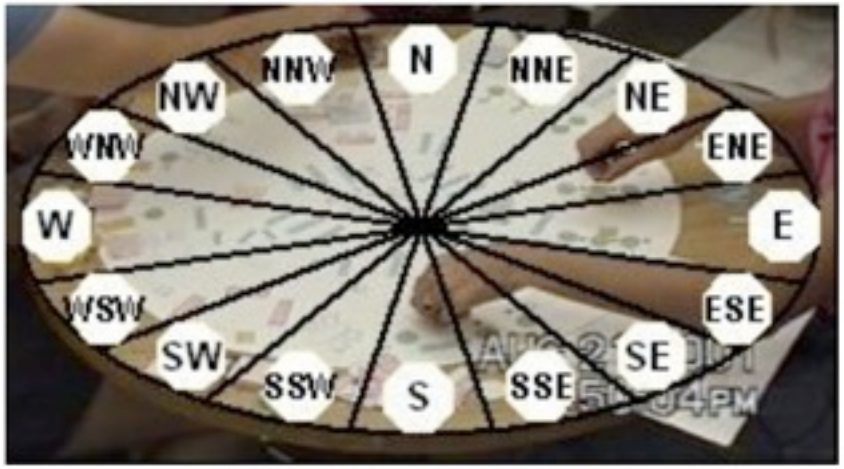
- Recordings of the same handwriting
  - relative to the sheet of paper
  - relative to the table (obtained with the help of carbon paper)

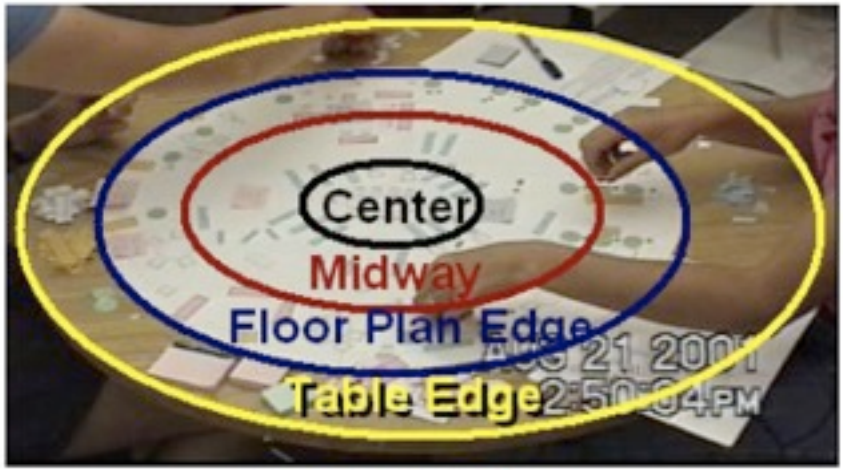


- Translation movements for writing lines were made obliquely on the table: slant of the paper
- Rectangle within which right-hand motion (relative to the table) was confined = roughly 1/3 of the page
  - Movement of the pen tip from the first to the last line (24 cm)
  - upward displacement of the page (16 cm)
  - downward displacement of the right hand (8 cm)

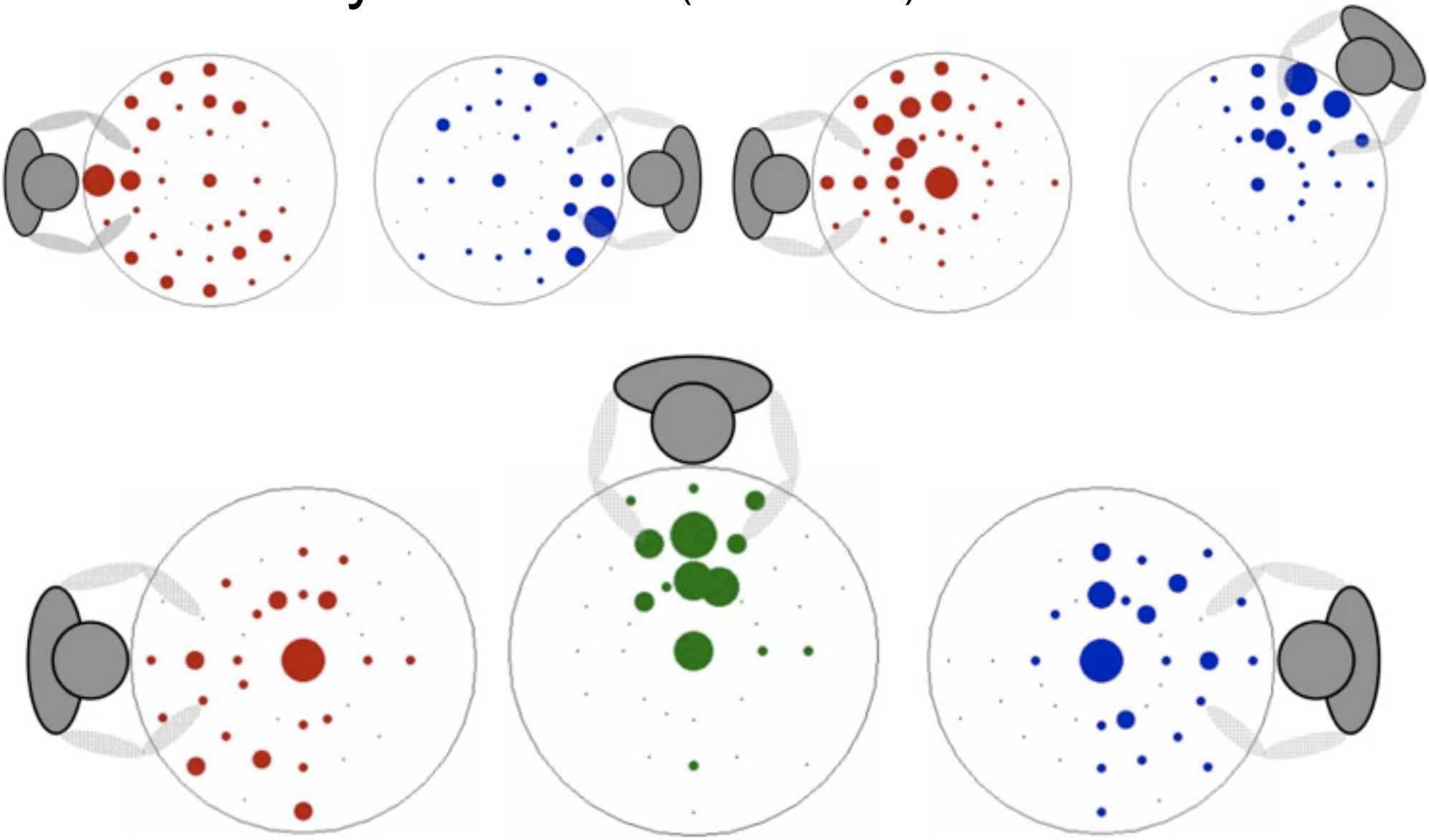
Territoriality on tables (Scott 2004)

- Studies on how people use the space on a table
  - puzzle, game, Lego activities + room planning on round tables
- Different areas on the table surface
  - personal space (directly in front of person)
  - group space (reachable by all members)
  - storage space (in the periphery)
- Boundaries between areas are flexible





Territoriality on tables (Scott 2004)

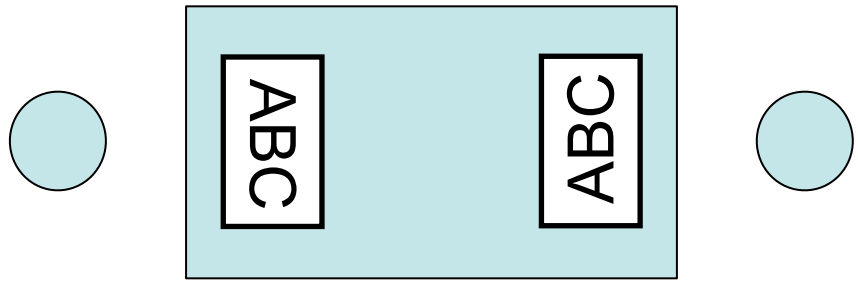


Territoriality on tables (Scott 2004)

- Design Implications:
  - Provide visibility and transparency of action
  - Provide appropriate table space
  - Provide functionality in the appropriate locality
  - Allow casual grouping of items and tools in the workspace

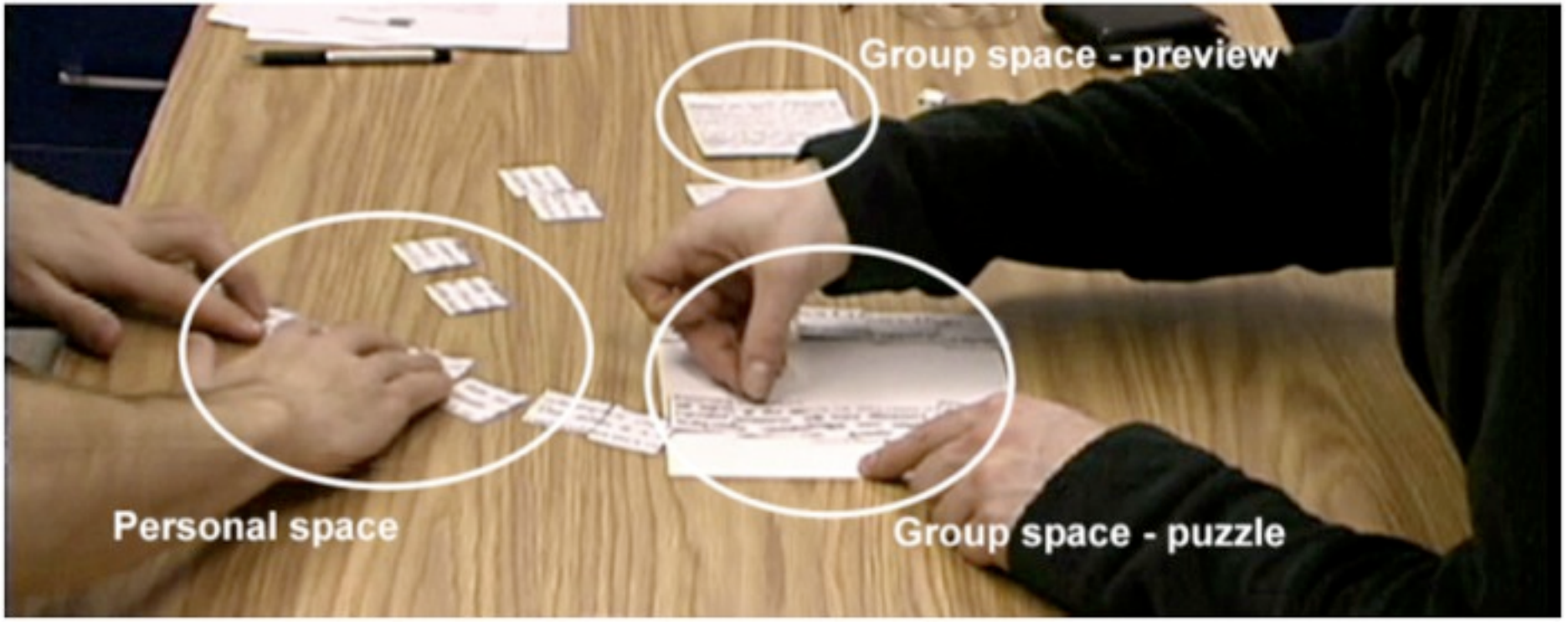
Orientation on tables (Kruger 2003)

- Basic problem: no clearly defined „up“ direction when interacting with multiple users around a table
- Known approaches:
  - Fixed orientation
  - Manual orientation
  - Person-based automatic orientation
  - Environment-based automatic orientation



Orientation on tables (Kruger 2003)

- Variant orientation can serve as a collaborative resource:
  - Using someone else's alignment conveyed support
  - Orientation could establish the intended audience
  - Orientation was also used to create a personal space.

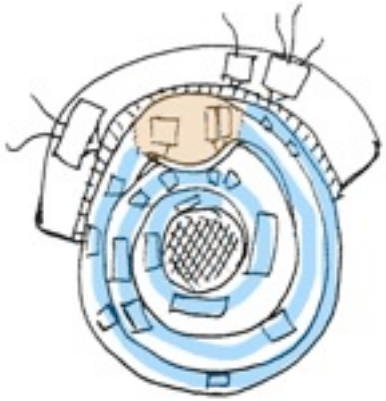


Orientation on tables (Kruger 2003)

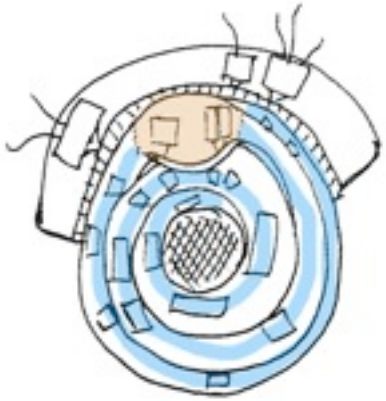
- 3 main roles of orientation:
- Comprehension
  - Ease of reading
  - Ease of task
  - Alternate perspective
- Coordination
  - Establishment of personal spaces
  - Establishment of group spaces
  - Ownership of objects
- Communication
  - Intentional communication
  - Independence of orientation

Concept: Hybrid widgets

- How can we bring tangibility to interactive surfaces?
- Graphical UI widgets are only virtual (i.e., graphical) objects
- Tangible UI are only physical objects
  - Sometimes combined with a screen, tabletop (see MetaDesk, DataTiles)
- Take the concept of a GUI widget, but make part of it physical
  - Tightly coupled physical and virtual parts
  - supports asymmetric two-handed interaction
  - provides visual and haptic stimulus
- Several prototypes currently developed



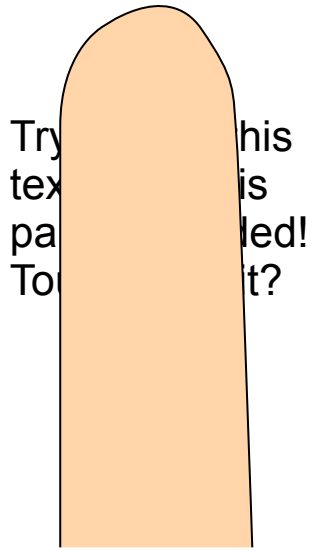
Example: PhotoHelix

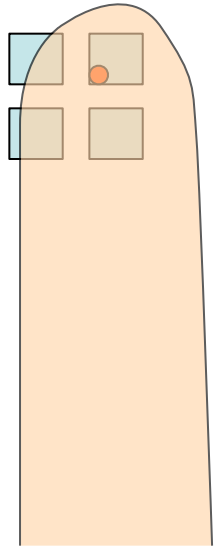


Example: PhotoHelix

Occlusions and the Fat Finger Problem

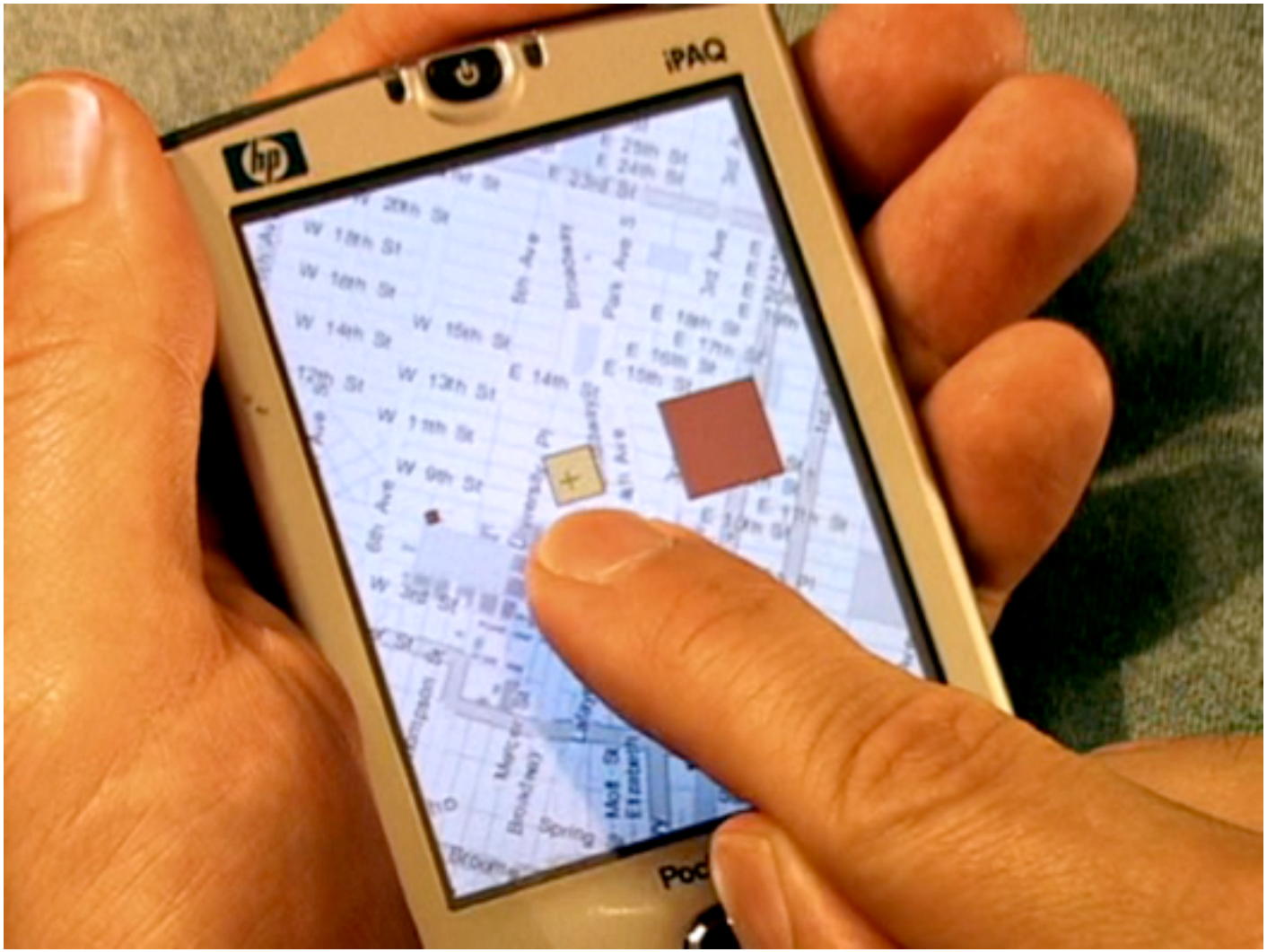
- Fingers and hands can occlude screen objects
  - minimize by choosing a good screen layout!
- fingers may hit several small objects
  - just use large objects ;-)
- exact hit point is occluded





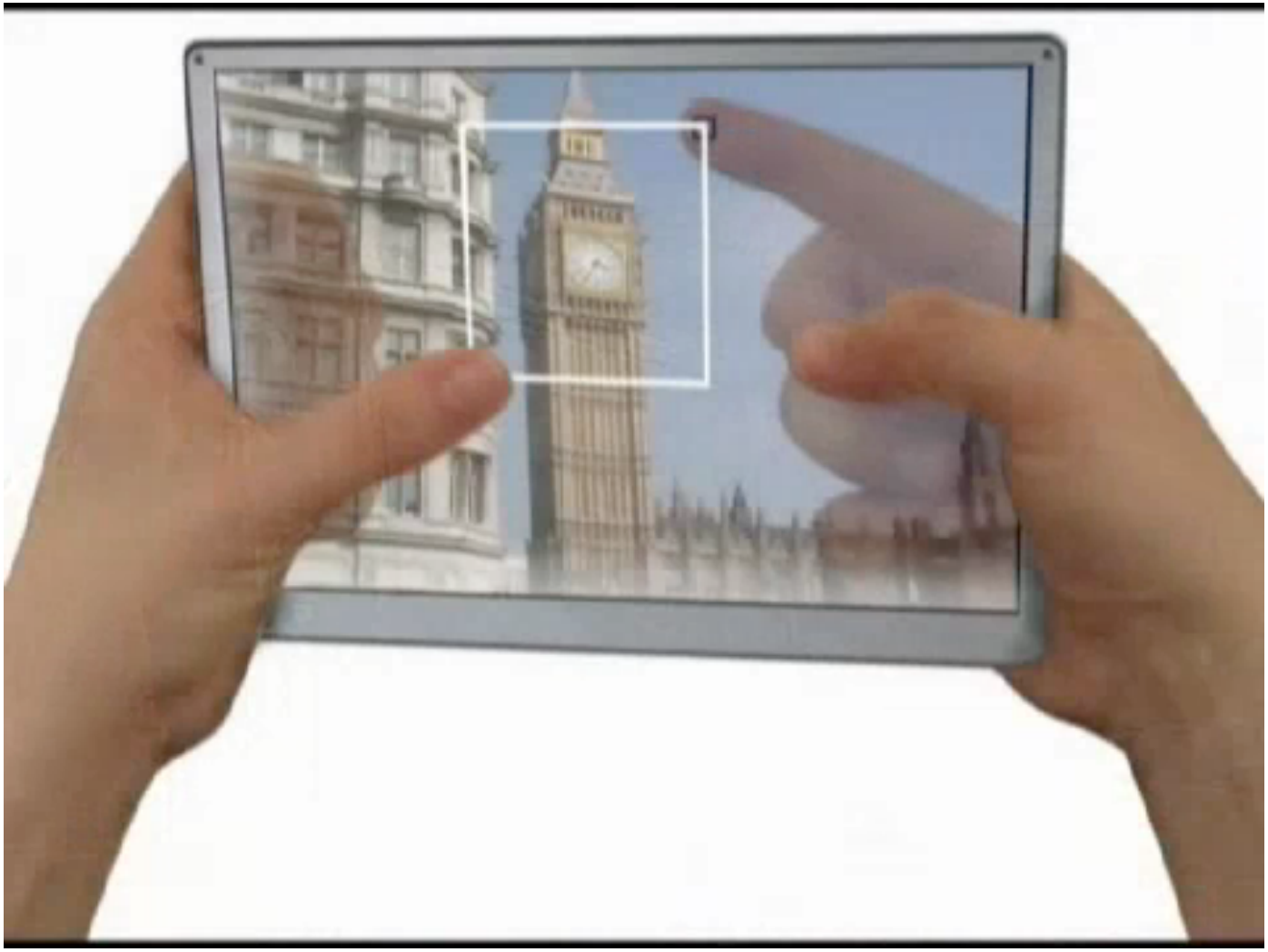
Example: Shift (Baudisch 2007)

- http://www.patrickbaudisch.com/projects/shift/



Example: Lucidtouch (Baudisch 2007)

- http://www.patrickbaudisch.com/projects/lucidtouch/



Literature

- Guiard, Yves (1987). Asymmetric Division of Labor in Human Skilled Bimanual Action: The Kinematic Chain as a Model. Journal of Motor Behavior, 1987, 19, 486-517
- Scott, S.D., Carpendale, M.S.T, & Inkpen, K.M. (2004). Territoriality in Collaborative Tabletop Workspaces. In Proceedings of the ACM Conference on Computer-Supported Cooperative Work (CSCW)'04, November 6-10, 2004, Chicago, IL, USA.
- Russell Kruger, Sheelagh Carpendale, Stacey D. Scott, Saul Greenberg. How People Use Orientation on Tables: Comprehension, Coordination and Communication. In: ACM GROUP 2003
- Vogel, D. and Baudisch, P. Shift: A Technique for Operating Pen-Based Interfaces Using Touch. In Proceedings of CHI 2007
- Wigdor, D., Forlines, C., Baudisch, P., Barnwell, J., Shen, C. LucidTouch: A See-Through Mobile Device. In Proceedings of UIST 2007