Interface Design for Collaborative Tabletop Systems

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Agenda

Motivation

- Working environments feature one or more tables for face-to-face collaboration

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- Ubiquous digital technology

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- Multitouch technology offering seamless interaction
- First multitouch desks commercially available
- Possibilty to develop unique and rich design pattern and approaches

Master Thesis

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- Case study: an application supporting a meeting like setting for up to 4 persons

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  - Multi modal interaction and collaboration
- Case study: an application supporting a meeting like setting for up to 4 persons
- Implementation for Microsoft Surface and similar upcoming tabletops

Agenda

1991: Digital Desk [20]

- First interactive table interface
- A calculator as case stury
- University of Cambridge Computer Laboratory and Rank Xerox EuroPARC

Abbildung: Digital Desk

1996: Graspable User Interfaces [3]

- First Graspable/Tangible Interfaces,
- Input Research Group at the University of Toronto

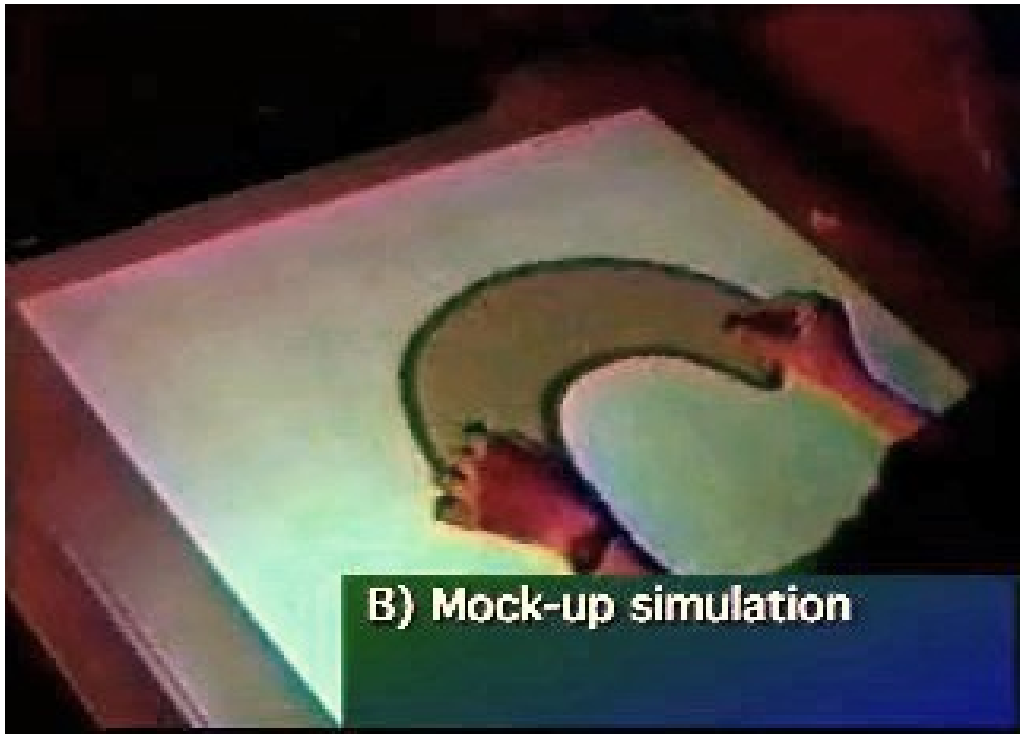

Abbildung: Graspable Interfaces

2001: DiamondTouch: a multi-user touch technology [2]

- Distinction between person's fingers/hands as well as location and pressure
- Various gestures and rich gestures.
- Mitsubishi Research Labs

Abbildung: Diamond Touch

2002: SmartSkin: An Infrastructure for Freehand Manipulation on Interactive Surfaces [11]

- New sensor architecture for recognition of multiple hand positions and shapes
- Introduces several interaction techniques based on that architecture
- Sony Computer Science Laboratories

Abbildung: Smart Skin

2007: Microsoft Surface Computing

- Multitouch desk capable of identifying various objects and their position
- First desk which is commercially available
- Independent from room measures

Abbildung: Microsoft Surface

Discussion

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- Different characteristics of underlaying hardware cause the demand of various design patterns

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Display Space and Item Appearance (1)

- TeamTag: exploring centralized versus replicated controls for co-located tabletop groupware: - CHI '06 - Morris et al [8]
  - Replicated controls are often more preferable than centralized controls
  - Most users want to avoid the contact the other users

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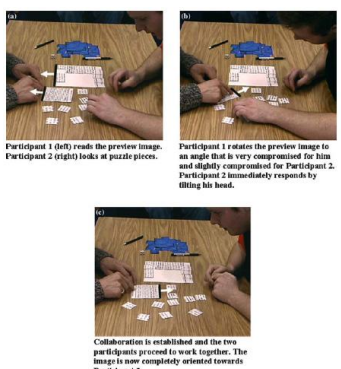
  - Replicated controls are often more preferable than centralized controls
  - Most users want to avoid the contact the other users
- Extending Tabletops to Support Flexible Collaborative Interactions - Tabletop '06 - Rogers et al [12]
  - Extending display space with additional physical objects
  - Most ideas based on top projection

Display Space and Item Appearance (2)

- Perception of elementary graphical elements in tabletop and multi-surface environments - CHI '07 - Widgor et al [21]
  - Information shown on a tabletop display can appear distorted when viewed by a seated user
  - Research on how the distortion affects the perception of the basic graphical elements of information visualization
  - The perception of some graphical elements is more robust to distortion than others
  - Recommendations for building data visualizations for tabletop environments

Display Space and Item Appearance (3)

- Roles of Orientation in Tabletop Collaboration - CSCW '04 - Kruger et al [5]
  - The strategy of reorienting objects to a person's view is overly simplistic
  - The coordinating role of orientation is evident in how people establish personal and group spaces and how they signal ownership of objects
  - Orientation is useful in initiating communicative exchanges



Display Space and Item Appearance (4)

- Exploring the effects of group size and table size on interactions with tabletop shared-display groupware - CHI '06 - Morris et al [13]
  - With different group sizes, people develop different work strategies in achieving the same collaborative goal
  - The distribution of resources strongly influences how people work together for different group sizes
  - The work strategies used by the groups differed depending on the resource distribution

Discussion

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- Orientation and location of items can be used to support collaboration and communication

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- The small display size can be extended by real world objects

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- The way controls and visual elements are presented significantly influences the quality of the user interface
- Group size and distribution of resources influences the work strategies as well
- Orientation and location of items can be used to support collaboration and communication
- The small display size can be extended by real world objects
- Combining controls and real world objects allows most flexibility in number of controls and placement

Agenda

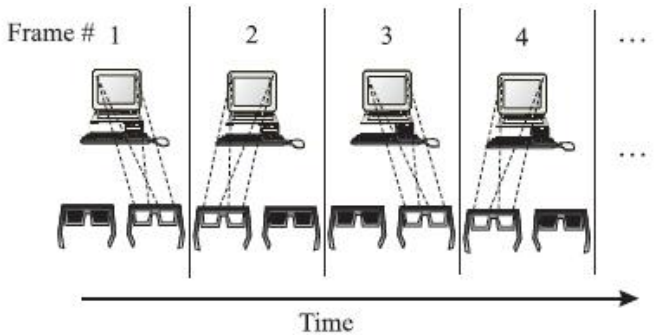
Dealing with Public and Private Information (1)

- The two-user Responsive Workbench - SIGGRAPH '97 - Agrawala et al [1]
  - Depending on viewing angle, different information is shown
  - Demand special digital glasses
  - Only usable with a ealier setup and from a specific angle

- PDAs and Shared Public Displays - '99 - Greenberg et al [4]
  - Handhelds used to display private data
  - Seamless transfer of notes

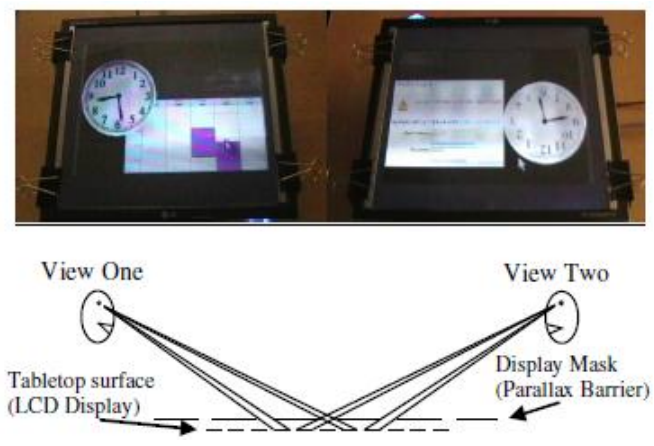
Dealing with Public and Private Information (2)

- Single display privacyware - CHI '01 - Shoemaker and Inkpen - [15]
  - Similar approach as Agrawa et al
  - Every even frame shows information only viewable by the second user
  - Demands special glasses and works only for two people



Dealing with Public and Private Information (3)

- Public and private workspaces on tabletop displays - AUI 2008 - Smith et al [16]
  - Using a lens, situated at the top of the monitor
  - No ealier setup needed, but only usable from a specific angle



Territoriality (1)

- Territoriality in collaborative tabletop workspaces - CSCW 2004 - Pinelle et al [14]
  - Examines the natural work practices that people use during tabletop collaboration with traditional media
  - Trys to adress issues like whether these systems should automatically orient workspace items or enforce ownership of workspace content
  - Design recommendations for collaborative digital tabletop workspaces

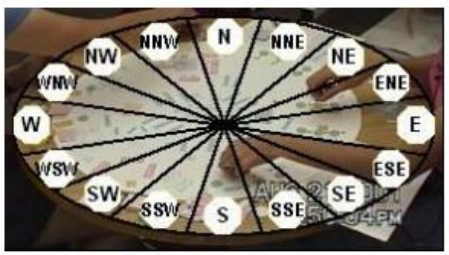


Figure 1. Directional Zones.

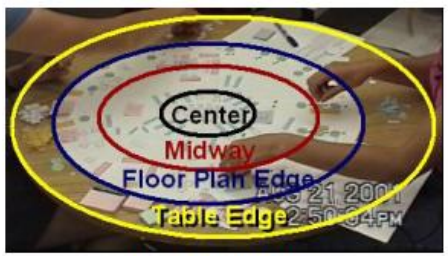


Figure 2. Radial Zones.

Territoriality (2)

- Supporting effective interaction with tabletop groupware - Tabletop '06 - Morris et al [6]
  - Evaluation how gestures can be used to release and protect items from unauthorized access
  - Recommends private areas with special behavior for private data
  - Relies on the user recognition offered for example by the DiamondTouch
- An evaluation of coordination techniques for protecting objects and territories in tabletop groupware - CHI '09 - Pinelle et al [10]
  - Using indirect techniques may let Conflicts arise because they reduce territorial behavior
  - Introduction of three new tabletop coordination techniques for reducing such conflicts
  - While still allowing users the flexibility of distant object control

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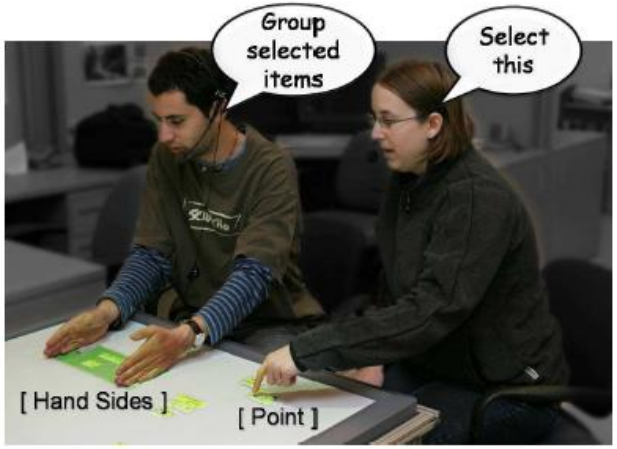
Multi Modal Interaction (1)

- Exploring true multi-user multi modal interaction over a digital table - DIS '08 - Tse et al [18]
  - Establishing a gesture and speech based interaction
  - Covers four emerged key design issues of multi modal interaction



Multi Modal Interaction (2)

- SLAPbook: tangible widgets on multi-touch tables in groupware environments - TEI '09 - Weiss et al [19]
  - Blends the tangible qualities of physical objects with the dynamic characteristics of virtual graphics
  - Tries to support and enhance group and individual activities
  - Different shared and personal widgets can be used in a guestbook example

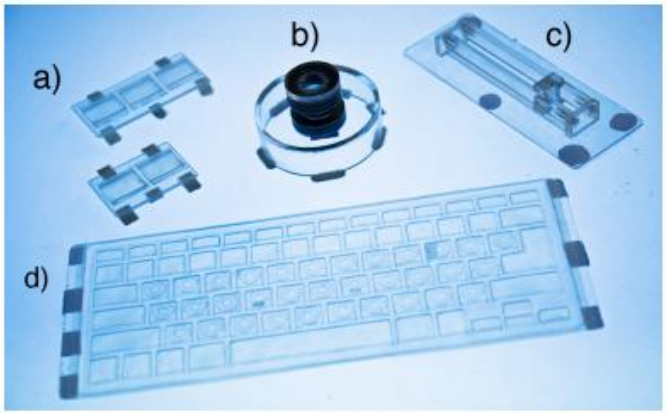
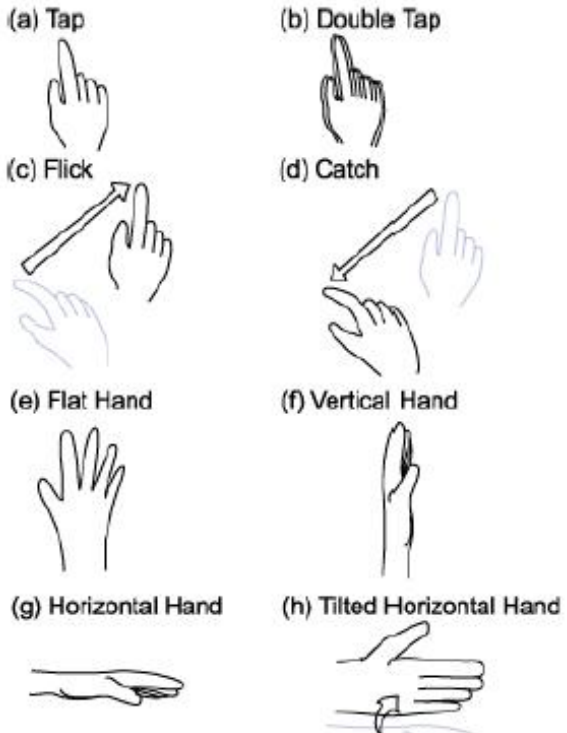


Figure 1. SLAP Widgets. a) Keypads with two and three buttons. b) Knob. c) Slider. d) Keyboard.

Interaction Techniques and Collaboration (1)

- Multi-finger and whole hand gestural interaction techniques for multi-user tabletop displays - UIST '03 - Wu et al [22]
  - Presents variety of multifinger and whole hand gestural interaction techniques
  - Extends the types of actions that people perform when interacting on real physical tabletops



Interaction Techniques and Collaboration (2)

- Collaborative coupling over tabletop displays - CHI 06 - Tang et al [17]
  - Observational studies of pairs completing independent and shared tasks that investigate collaborative coupling
  - Individuals frequently and fluidly engage and disengage with group activity
  - Description of the consequences on interface design
- TeamSearch: Comparing Techniques for Co-Present Collaborative Search of Digital Media - TABLETOP '06 - Morris et al [7]
  - A collaborative photo search
  - Explores how different constributions to the task should be interpreted
  - Examines how the UI design can enhance collaborative tasks

Interaction Techniques and Collaboration (3)

- The effects of interaction technique on coordination in tabletop groupware GI '07 - Pinelle et al [9]
  - Exploratory study to determine how several different types of interaction techniques affect coordination in different tabletop tasks
  - Depending on the task, performance and preference differed significantly

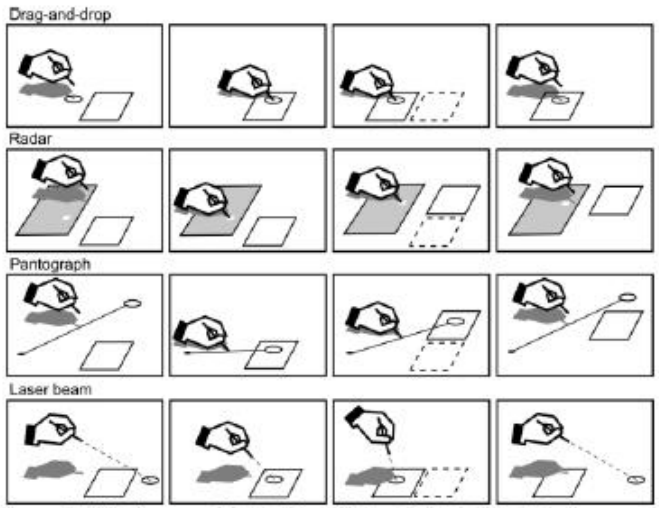


Figure 3. Moving an object with different interaction techniques. The circle in rows 1, 3, and 4 represents the cursor; the grey rectangle in row 2 is the radar's workspace miniature. Telepointers (not shown) is identical to Pantograph but without the line connecting the cursor to the pen tip.

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- Tangible interfaces can be enhanced if combined with other type of interaction, like speech or real objects
- The selection of the interaction type is very important for performance and preference of the user, even if they are quite similar

Contents

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Conclusion

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- Especially but not only due to hardware differences
- Tabletop interface design for is quiet complex due to the impact of peoples habit how they communicate and work on traditional tables
- As well as different settings and boundary conditions like group size and kind of task

Further Work

- Evaluate which approaches are useful under the existing technological limitations (Microsoft Surface)

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- Enrich them with newer concepts
- Implement case study which consideres the four key issues of tabletop interface design presented today and the conceptualised approches

Questions

Thanks for the attention!

Resources I


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