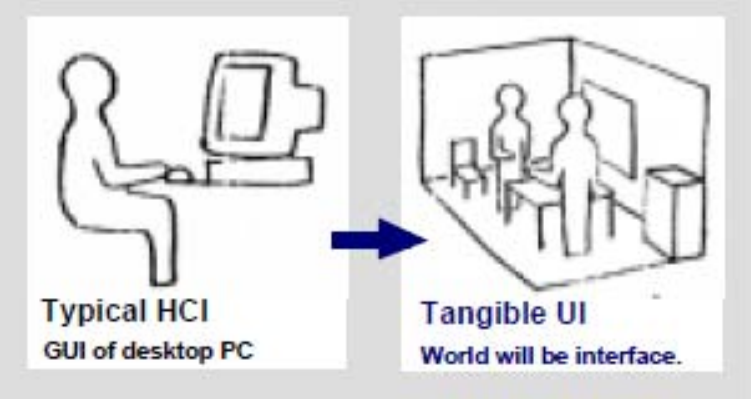
LFE Medieninformatik • Anna Tuchina

Prototyping of Interactive Surfaces

For mixed Physical and Graphical Interactions

Medieninformatik Hauptseminar
Wintersemester 2009/2010
„Prototyping“

TUI allows direct manipulation of digital objects through physical objects



GUI and TUI in comparison [1]

Properties of Tangible User Interfaces (TUIs)

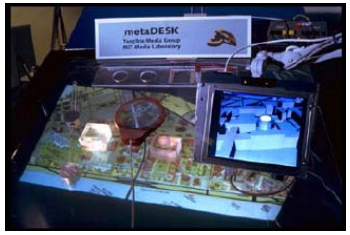
- Direct manipulation of digital objects through physical representations
- Two handed interaction (simultaneous alteration of position and orientation)
- Collaborative interaction techniques
- Designed to be the ideal interface for one specific task
- Support human interaction skills

[1] H. Ishii and B. Ullmer. Tangible bits: towards seamless interfaces between people, bits and atoms.

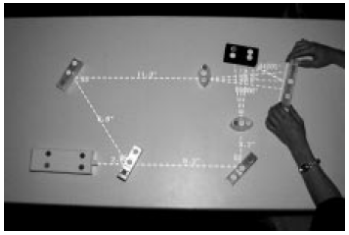
Low and high fidelity prototyping have different advantages and disadvantages

	Low Fidelity Prototyping	High Fidelity Prototyping
Advantages ⊕	• Quick, cheap and easy to create and to alter • Can be used to run usability tests • Convenient to test general concepts	• Fully interactive with core functionality • Can be used to run usability tests • Convenient to test interaction techniques
Disadvantages ⊖	• Limited or no functionality • Cannot respond to user input automatically • Inconvenient to test interaction techniques • Testing requires a lot of staff and time	• Development requires expert knowledge and much time • Alteration often not possible/ time consuming • Inconvenient to test general concept ideas

Comparison of prototyping examples raises several questions



Tangible Geospace [11]



Urban Simulation [12]

From Sensetable to Audiopad [8]

Collaborative Musical Instrument [3]

Main Questions

- What kind of prototyping was used for the development?
- How time-consuming and complex was the construction of the prototype?
- What findings have been provided using it?
- Could better insights have been gained by a different approach?

[11] B. Ullmer and H. Ishii. The metadesk: models and prototypes for tangible user interfaces.
[12] J. Underkoffler and H. Ishii. Illuminating light: an optical design tool with a luminous-tangible interface.
[8] J. Patten, B. Recht, and H. Ishii. Interaction techniques for musical performance with tabletop tangible interfaces.
[3] S. Jordà, G. Geiger, M. Alonso, and M. Kaltenbrunner. The reactable

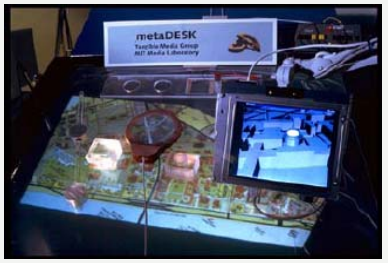
Prototyping for research of the desktop metaphor: Tangible Geospace – metaDesk [1] [11]

Goals

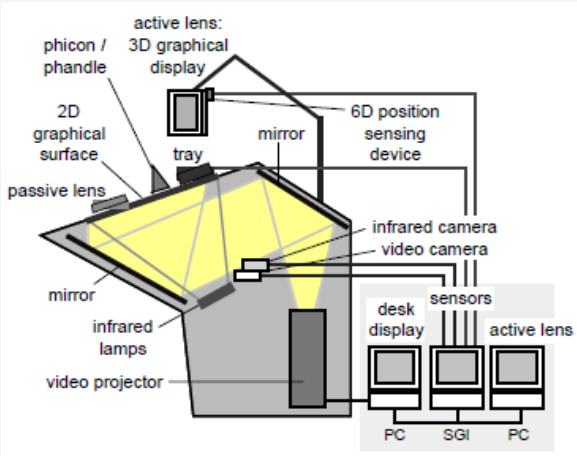
- Research direct interaction with tangible objects
- Proof of concept for the desktop metaphor

Setup and Use

- Very intensive in terms of hardware
- Software Application „Tangible Geospace“
- Construction took probably several weeks/months
- No user studies or experiments conducted



User Interface Elements of the metaDesk [11]



Architecture of the metaDesk [11]

More insights gained into technical details than into new interaction techniques

[1] H. Ishii and B. Ullmer. Tangible bits: towards seamless interfaces between people, bits and atoms.
[11] B. Ullmer and H. Ishii. The metadesk: models and prototypes for tangible user interfaces.

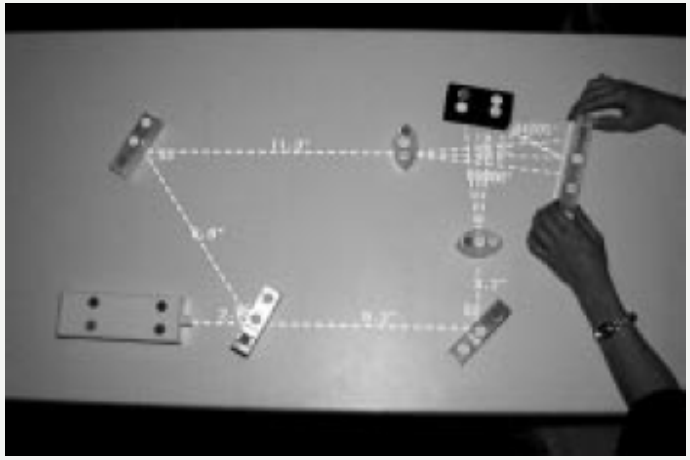
Prototyping of a task specific ideal interface for research of interaction techniques: 1) Illuminating Light [12] [13]

Goals

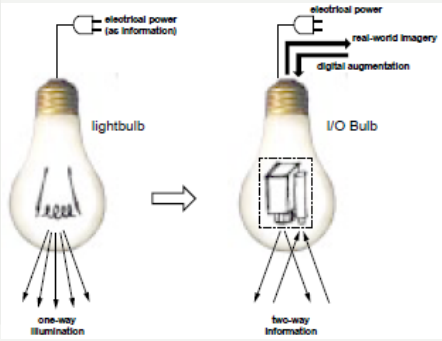
- Research interaction techniques with tangible interfaces
- Create an ideal interface for a specific task

Setup and Use

- Hardware: I/O Bulb and physical objects
- Software Pipeline using available software toolkits
- Construction took approximately one week
- User Study with eight test subjects conducted



Holographic recording setup with the Illuminating Light toolkit [12]



I/O Bulb in theory and practise [12]

[12] J. Underkoffler and H. Ishii. Illuminating light: an optical design tool with a luminous-tangible interface.
[13] J. Underkoffler and H. Ishii. Illuminating light: a casual optics workbench.

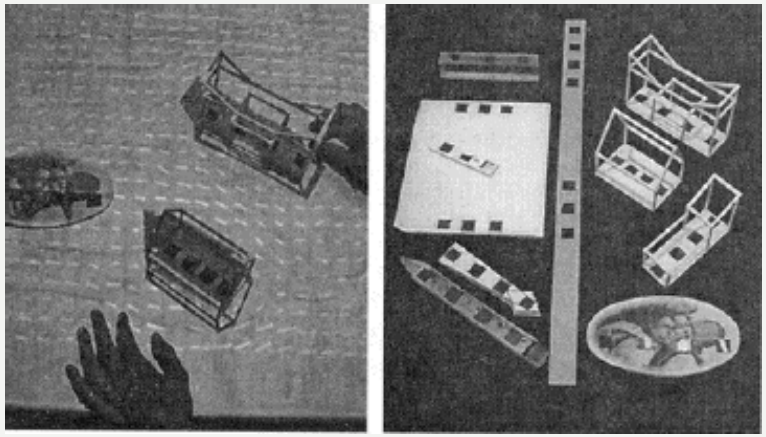
Prototyping of a task specific ideal interface for research of interaction techniques: 2) Urban Simulation – Urp [14]

Goals

- Research interaction techniques with tangible interfaces
- Create an ideal interface for a specific task

Setup and Use

- Hardware: I/O Bulb and physical objects reused
- Software Pipeline reused
- Additional Software: „lattice gas“
- No formal studies but feedback by visitors



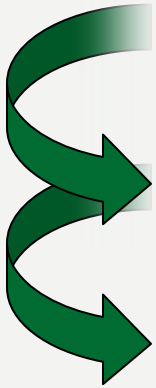
Physical objects and the wind flow simulation used in Urp [14]

[14] J. Underkoffler and H. Ishii. Urp: a luminous-tangible workbench for urban planning and design.

Problems of illuminating light and urp prototypes

Main Problems

- Importance of the design of the physical objects recognized but not investigated
- 3D phenomena represented by 2D views lack information



- Alterations need to be done to solve these problems
- This could interfere with the whole design and make the created prototypes useless
- Altering a low fidelity prototype would have been much easier

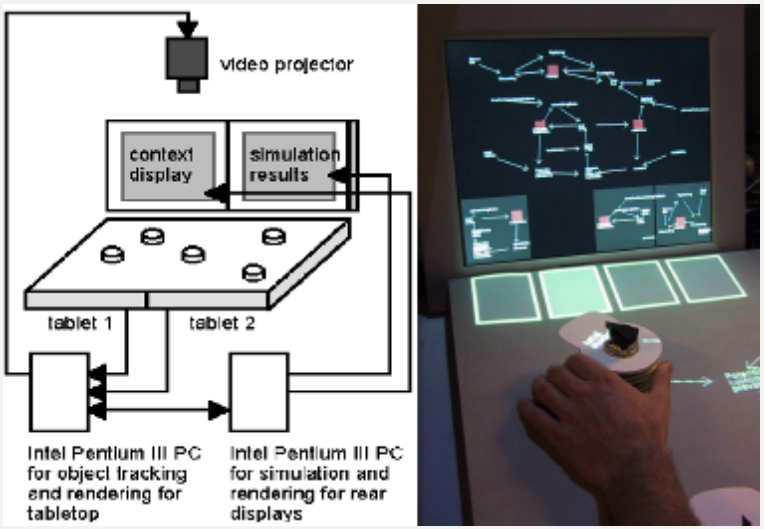
Prototyping for general research on TUI design: 1) Sensetable [6]

Goals

- General research on TUI design
- Create alterable pucks

Setup and Use

- Hardware: Wacom Tablets and pucks
- Software: algorithm to track six pucks
- User Studies conducted
- Several problems occured



Architecture and User Interface of the Sensetable Platform [6]

[6] J. Patten, H. Ishii, J. Hines, and G. Pangaro. Sensetable: a wireless object tracking platform for tangible user interfaces.

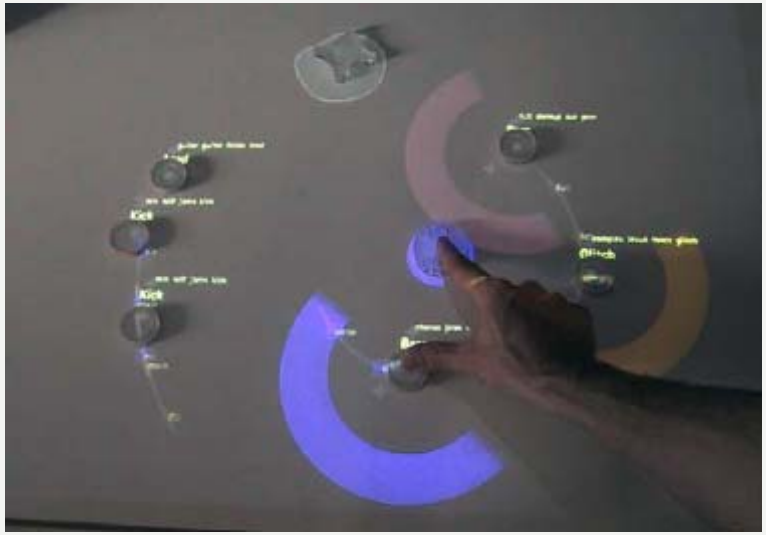
Prototyping for optimum interface for musical performance: 2) Audiopad [7] [8]

Goals

- Design an optimum interface for musical performance

Setup and Use

- Hardware: one sensing surface and smaller pucks
- New types of pucks added
- RF tags to determine orientation of the pucks
- User Studies conducted
- New problems occured



The final interface of Audiopad [8]

[7] J. Patten, B. Recht, and H. Ishii. Audiopad: a tag-based interface for musical performance.
[8] J. Patten, B. Recht, and H. Ishii. Interaction techniques for musical performance with tabletop tangible interfaces.

Design issues discovered - but not in an efficient way

- Many design and interaction issues discovered
- Implementing some of the changes can cause the need for a completely new prototype
- Possible that these problems could have been exposed by a low fidelity prototype

Prototyping for a collaborative musical instrument: reacTable [2] [3] [4]

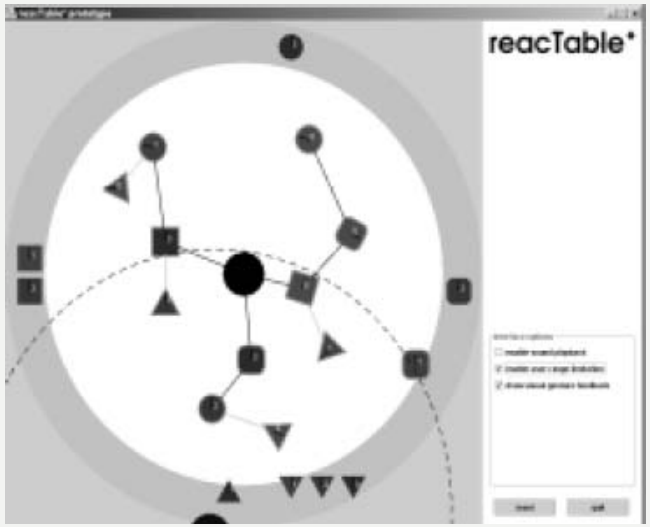
Goals

- ideal interface for a modern musical instrument
- easy to use for beginners - creative freedom for professionals

Setup and Use

- testing of basic concepts and interaction ideas with the reacTable simulation on PC
- Complex table hardware and software
- Pucks with different shapes and markers
- No user studies but showed at several occasions

The reacTable in collaborative use [3]



reacTable simulation for PC [2]

[2] S. Jordà. Sonigraphical instruments: from fmol to the reactable.
[3] S. Jordà, G. Geiger, M. Alonso, and M. Kaltenbrunner. The reactable
[4] M. Kaltenbrunner, S. Jordà, G. Geiger, and M. Alonso. The reactable*: A collaborative musical instrument.

PC Simulation provided an improvement of the concept with low effort

- ReacTable simulation offered an easy possibilty to test and modify the concept
- The final prototype could benefit from the findings on the simulation
- Low fidelity prototyping could have been even more beneficial

TUI development can benefit from low and high fidelity prototyping

Conclusions from projects

- High fidelity prototypes had to be replaced for further concept development
- Focus on technical implementation details and not on conceptual advancement

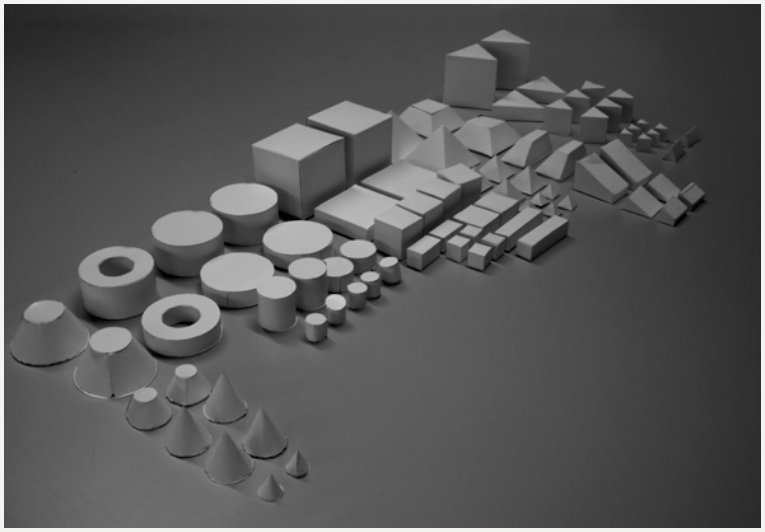
Conclusions for prototypes

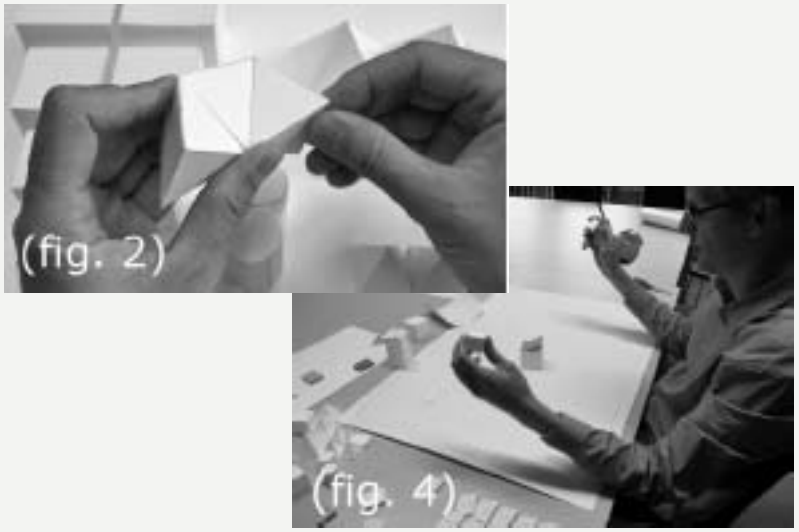
- High fidelity prototypes not suitable for concept Development, but useful to analyze interactions in a realistic way
- For different concept ideas low fidelity prototypes better, but not possible to investigate interaction techniques in a realistic way

Recommendations for appropriate TUI prototyping

- Use lo-fi prototypes especially in the early phase of the concept development
- Where details need to be refined, hi-fi prototyping can build upon the lo-fi prototype

Paperbox 3D – Low Fidelity Prototyping Toolkit for TUI development





TUI Elements in Paperbox3D

- Has all the advantages that are associated with common paper prototypes
- Enhance two dimensionalpaper prototypes by offering the 3D shapes that are needed for TUI

References

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[3] S. Jordà, G. Geiger, M. Alonso, and M. Kaltenbrunner. The reactable: exploring the synergy between live music performance and tabletop tangible interfaces. Pages 139–146, 2007.
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[13] J. Underkoffler and H. Ishii. Illuminating light: a casual optics workbench. Pages 15–20, 1999.
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[16] M. Weiser. Ubiquitous computing. http://sandbox.parc.com/ubicomp/, 1996. visited 08.12.2009.