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Pen-Based Interaction

Michael Haller

Overview

- Motivation
- Technology
  - 3D-approach
  - 2D-approach
- Applications
  - ButterflyNet
  - ModelCraft
  - Shared Design Space / INTOI

Motivation

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Background

A digital world with 1000 interfaces

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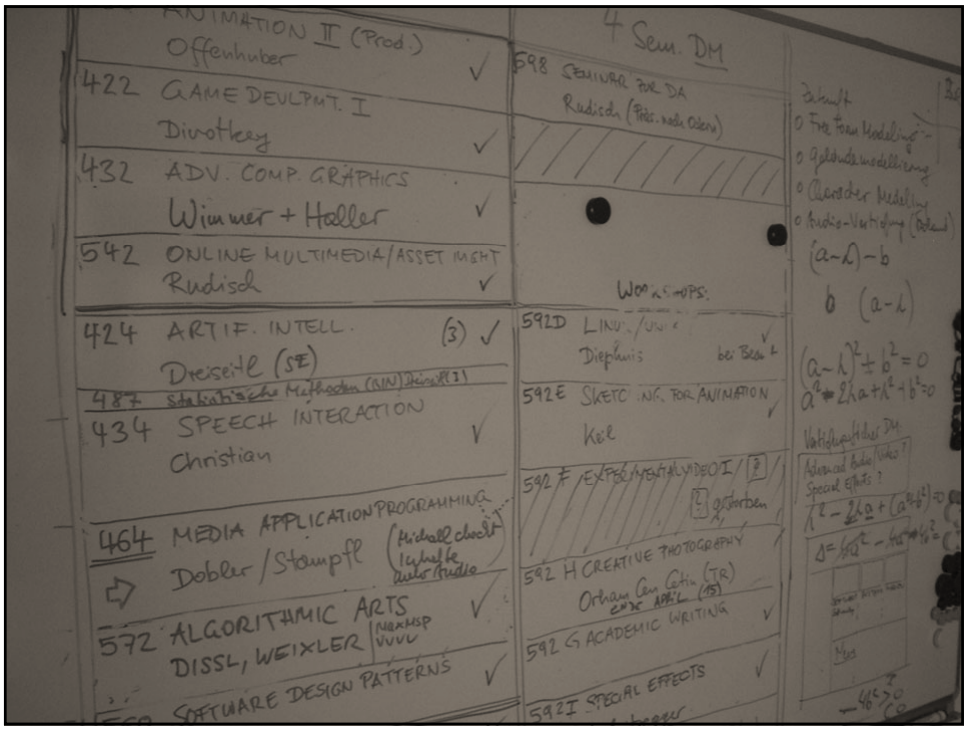
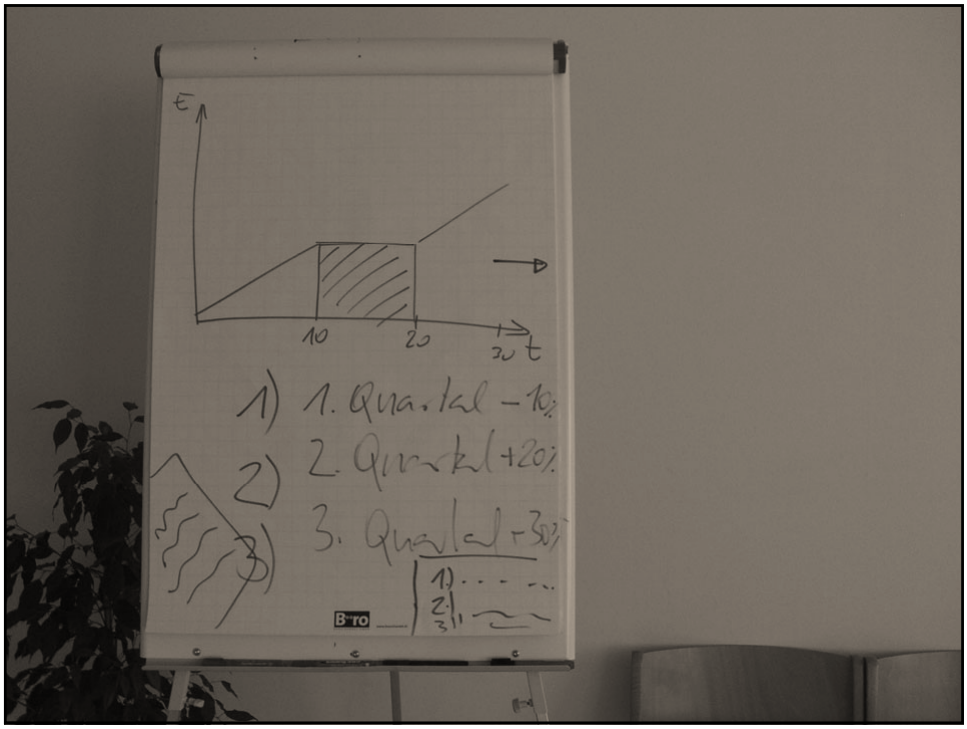




Experimental Results

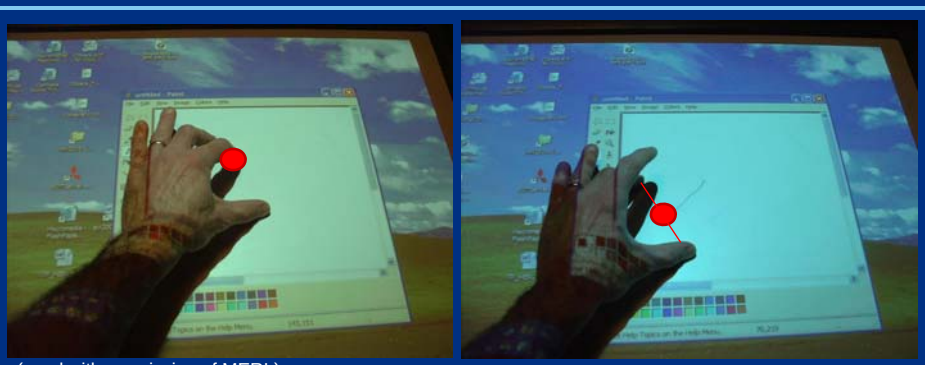
(used with permission of Smart Technology)

- **Finger-operated touch screen**
  - Best in speed and worst in accuracy (Albert, 1982)
- **Stylus(Pen)-operated touch screen**
  - Comparable to a mouse on both speed and accuracy measures (Mack & Lang, 1989)

Finger-operated touch screens

- Pros:
  - No special hardware requirements
  - Really intuitive (especially for novices)
  - Fast & Direct Input
  - Finger is usable, any pen is usable
- Cons:
  - The user‘s finger may obsure parts of the screen
  - The screen gets dirty from finger prints
  - Less precise without pen

Touch-Interaction (Fluid DTMouse)



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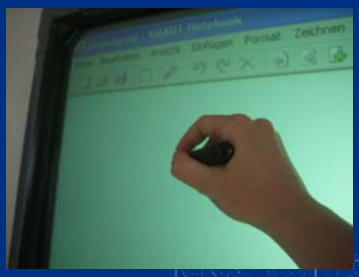
Esenther, A. and Ryall, K. Fluid DTMouse: Better Mouse Support for Touch Based Interactions. in *Proc. of Advanced Visual Interfaces* (Venezia, Italy, May 23 - 26, 2006), ACM Press, New York, NY, 112-115.

Touch + Pen != Pen + Touch

- Finger-operated touch screens often support pen input (e.g. SmartBoard)
- Pen-operated touch screens mostly do not support finger touch



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3D approach

Pen-based 3d interfaces

- Tracked Wand
  - Reflecting balls
  - ART-tracking
  - Lower accuracy
  - Fraunhofer IGD

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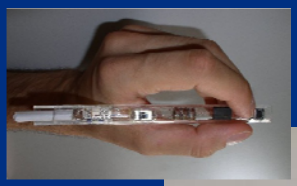
- Wireless Pen
  - Reflecting balls
  - IMS, TU Vienna



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Interacting in 3d space

- Hardware that allows the user to communicate with the system
- Input device vs. interaction technique (e.g. zoom)
- Video

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Technology

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2D approach

Pen-based Tablets

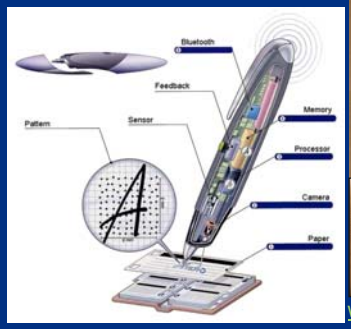
- Wacom tablets
  - Very precise input
  - Absolute values in 2d coordinate space
  - Direct touch on display
- MAX 6DOF stylus from Terminal Display System

Digital Pen, Scrivo.1

- Optical navigation & mouse-hover technology, 800 dpi
- No special surface requirements (it does not work on glass surfaces)
- BT-communication

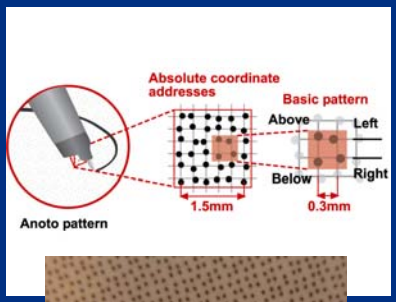
Digital Pen, ANOTO

- Captures position (x, y) in absolute coordinates, time (t), pressure (p), and status (pen up, down)



www.anoto.com

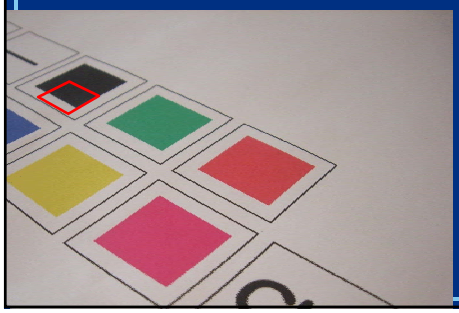
Anoto Digital Pen - 2



- What the pen sees?
- Pen camera use IR light
  - Pattern has to be printed using IR absorbing ink
  - User content should be printed with IR transparent ink

Anoto Digital Pen - 3

- C, M, Y are IR transparent
- Black content has to be printed as C+M+Y, not K



Anoto Digital Pen - 4

- Transferring data to the computer
  - Manual transfer via dock
  - Automatic transfer via Bluetooth
  - The pen provides both page ID and the pen ID

Combining Advantages

Paper Notebook: Robust, Battery, …

Computers: Search, Storage

Different Types of pen

all-in-one pen

Leapfrog, FlyPen

BT-based pen

streaming

Logitech,io2 with BT
Maxell, DP201
Nokia, SU-27W

non-streaming

Logitech,io2
Maxell, DP201
Nokia, SU-1B

Pens for large surfaces

- SmartBoard allows both touch and pen interaction (optical-based)
- Ultrasonic-based tracking setups (e.g. MIMIO, eBeam)
- Digital pens?

Applications

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ButterflyNet

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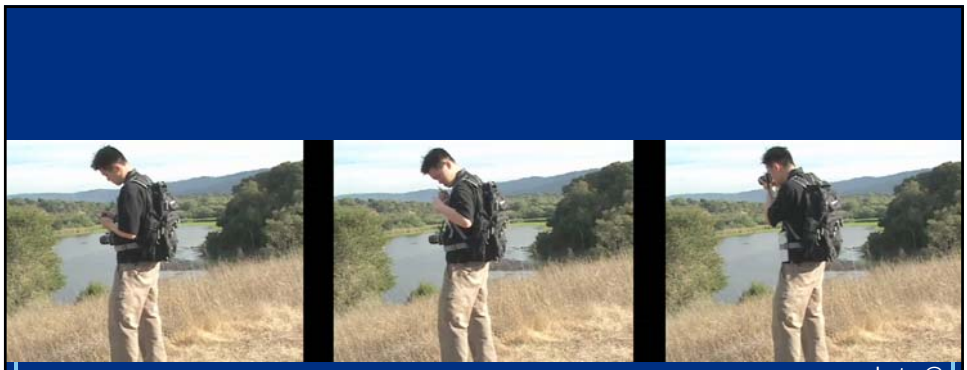


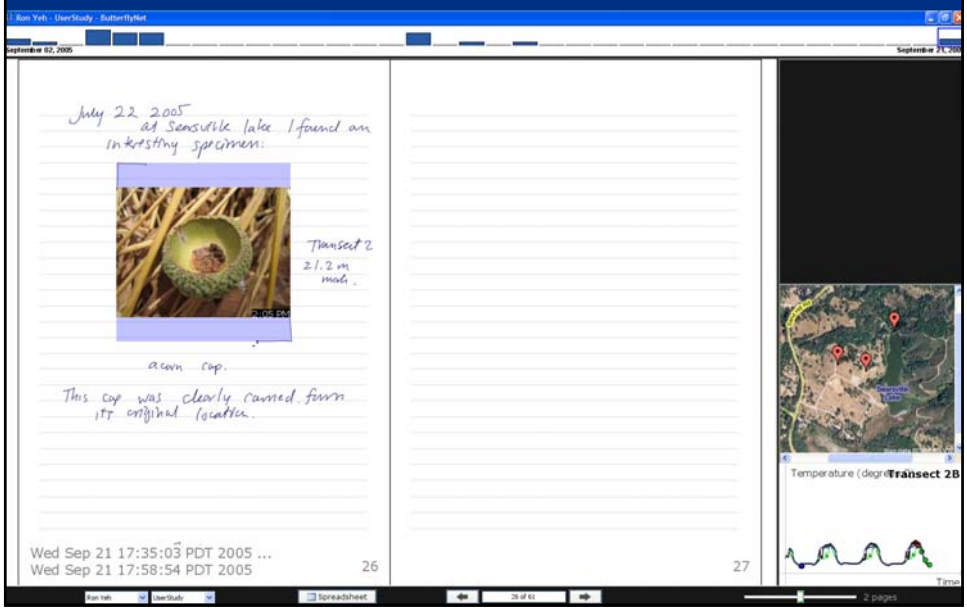
notes @ 4:43pm

photo @ 4:44pm

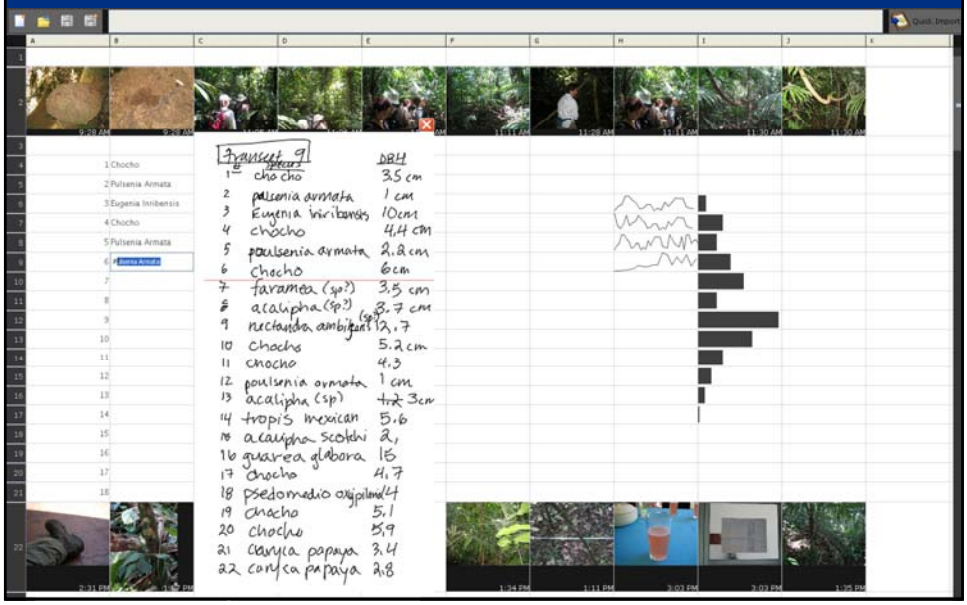
Automatic Association

Notes + Photos associated by Time

Back at the Lab…



Multimedia Spreadsheet



Applications

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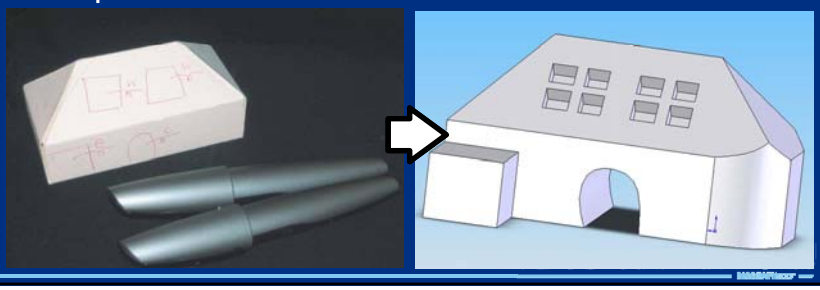
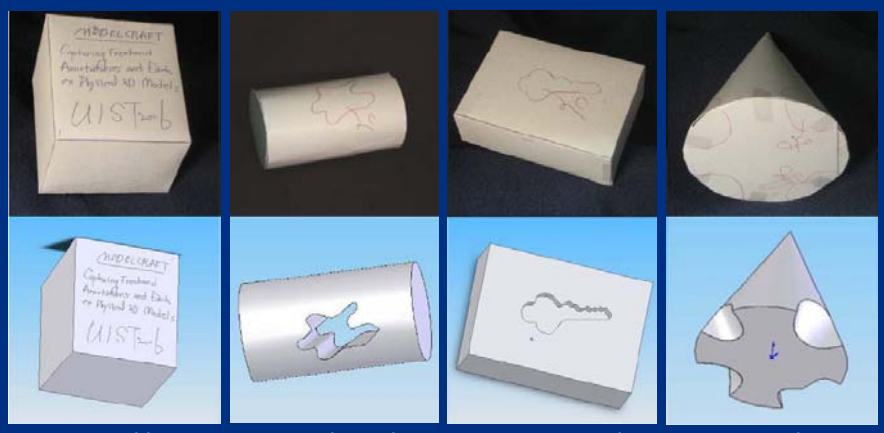
ModelCraft

ModelCraft

- SolidWorks PlugIn
- Digital Pen and Paper models
  - Logitech IO_2
  - Anoto pattern on the surface of the models

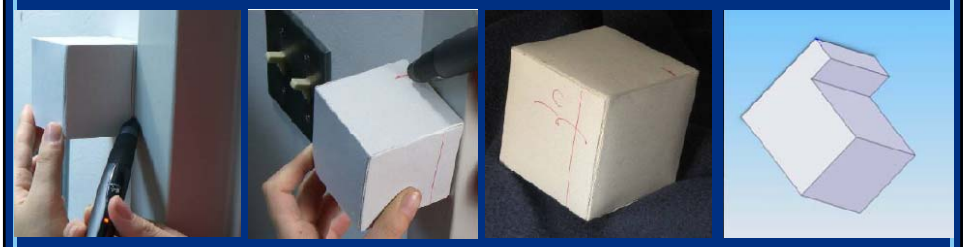


ModelCraft - 2



ModelCraft - 3

- Using External Reference
  - Fitting a cube around a door frame



Song, H., Guimbretière, F., Hu, C., and Lipson, H. 2006. ModelCraft: capturing freehand annotations and edits on physical 3D models. In Proceedings of the 19th Annual ACM Symposium on User interface Software and Technology (Montreux, Switzerland, October 15 - 18, 2006). UIST '06.

Applications

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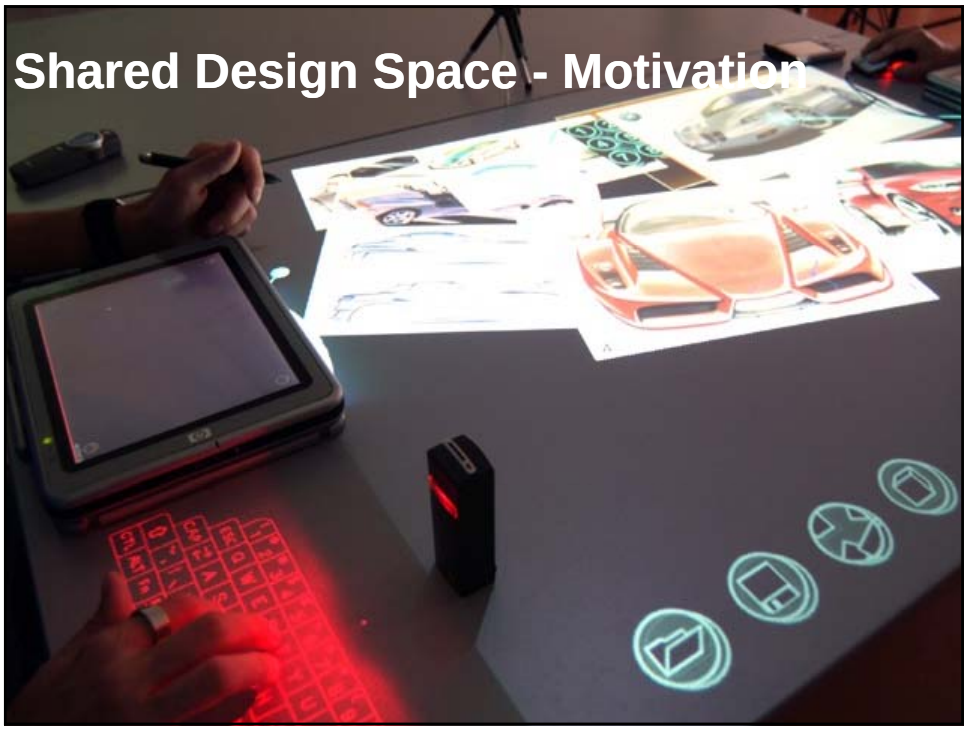
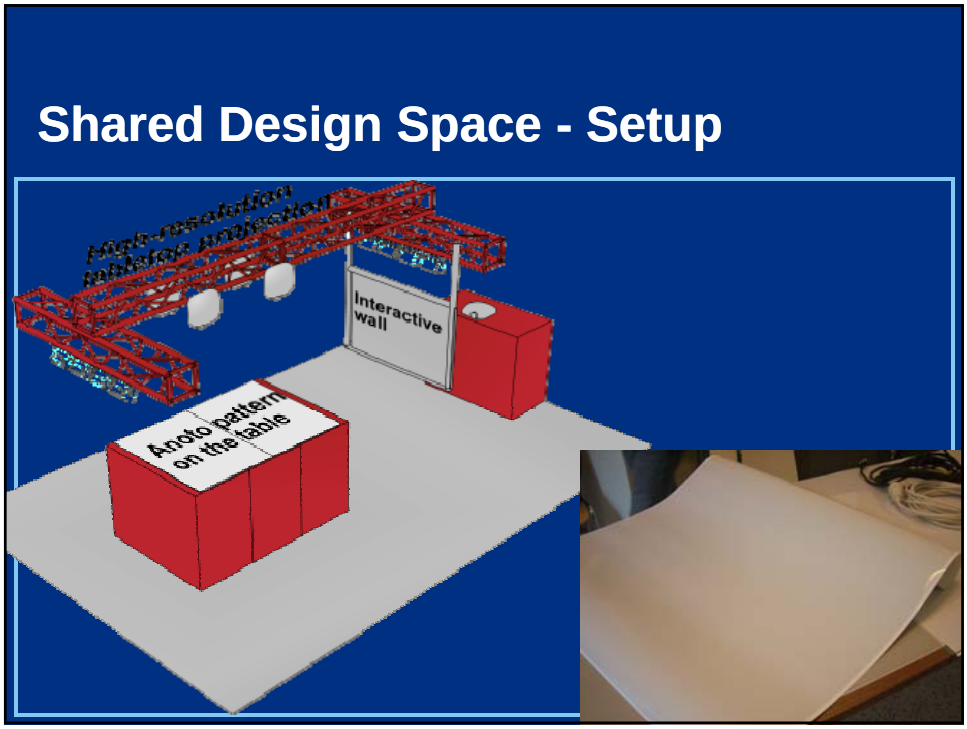
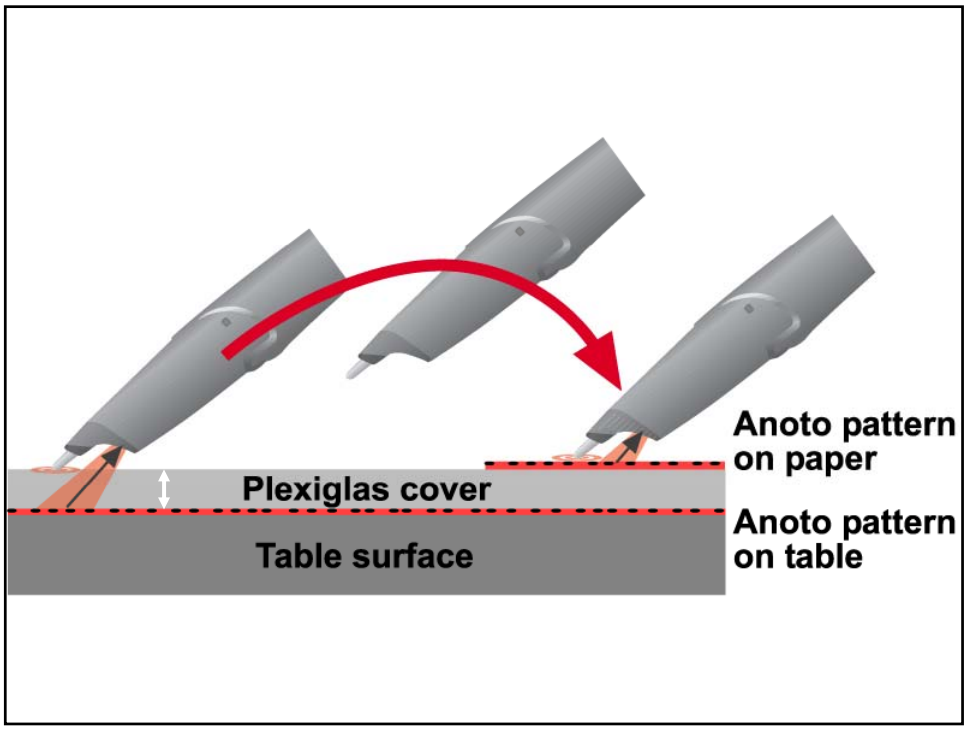
Shared Design Space

INTOI, Digital Flipchart



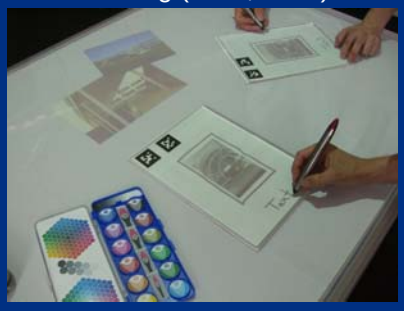

Shared Design Space - Setup
High-resolution tabletop projection
Interactive wall
Anoto pattern on the table


Anoto pattern on paper
Plexiglas cover
Anoto pattern on table
Table surface

Real vs. Digital Paper

Real Paper

- Real Ink + Digital Ink
- Tracking of paper
  - ARToolKit (Kato, 2001), ARTag (Fiala, 2005)



Digital Paper

- Stylus tip
- Digital Ink

Shared Design Space

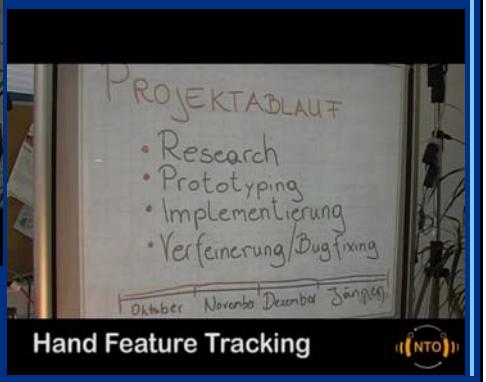
- 8 pens on a single BT dongle at 50 Hz
- Large table sizes are no problem (accuracy is not depending on the size) – 3 to 4 projectors mounted on the ceiling
- Occlusion & shadow problem
- Hand interaction

Rear-projection setup

- Experiment 1: Transparent foil
  - Good tracking, problems with image
- Experiment 2: Lee filter
  - White diffusion (used for spot-lights)
  - Good tracking, bad image
- Experiment 3: Backlit foil
  - great diffusion of projected imaged
  - Perfect tracking

INTOI, Interchanging Ideas

www.officeoftomorrow.org



INTOI – Feedback

- HP Colorlucent Backlit UV foil
- Protecting acrylic glass (<4mm)
- Features:
  - Multi-User Interaction
  - Simultaneous interaction
  - Scalable
  - Combination of touch and pen-interaction

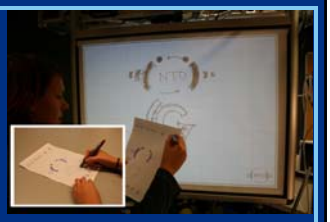
Real and digital data

- **Pick-and-move**

  Pick data from a printed document and move it to the interactive surface.

- **Paper device**

  The paper as an alternative control device



- **Sketch-and-send**

  Draw & store sketches and send it to the table/wall display during a presentation

Thanks

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Questions

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