Tangible Interaction / Augmented Reality

Scott Klemmer

12 October 2004
BayCHI tonight: Don Norman

User Experience: Why Do So Many Organizations Believe They Own It?

Kresge Auditorium, 7:45-9:45PM
Human Subjects

- http://www.stanford.edu/dept/DoR/hs
- Email me before class on Thursday that you have read and understand the guidelines
- For much of our research, we can ask for an exemption or for expedited review, but we do need to ask
“The future is already here. It is just not uniformly distributed”

—William Gibson

mentioned in
http://www.time.com/time/covers/1101041011/nextessay.html
Graphical User Interfaces

- Potato, keyboard, small "desktop"
- Seated, single-user
- Structured tasks (word processing, spreadsheets, ...)

[Image of a potato, a typewriter, and a small desk with chair]
Tangible User Interfaces

- Augment the physical world, integrating digital information with everyday physical objects
- Generally, physical input controls graphical or audio output
Three main types

- Everyday (*no actuation*)
- Mechatronic (*actuated*)
- Ambient (*actuated*)
Web Design Practice

- Interviews with 11 professional designers [Newman DIS 2000]
- Post-It notes on large surfaces
  - affinity diagrams
- Brainstorming
  - collaborative
  - solo
- Advantages
  - persistent
  - immersive & haptic
  - fluid, informal interface
- Difficulties
  - hard to edit
  - ...to share
  - ...to make digital
See what I’m saying?

There was a particular stroke of genius early in this brainstorming session. Microsoft® Visio® allows you to quickly and easily organize your ideas and present a clear-cut plan of action. Create crystal-clear flowcharts, timelines, organizational charts, even detailed floor plans, all in an intuitively designed, easy-to-use program. With Visio your ideas become easily understood solutions. And with the flexibility to save Visio diagrams as Web pages or to use them in Microsoft Office documents and e-mail, you can get your point across just about any way you choose. To give it a try, visit microsoft.com/visio or go to Internet Keyword: Microsoft Visio. Software for the Agile Business.
The Designers’ Outpost

- Combining... affordances of **paper** and advantages of **electronic media** to support design practice  
  [Klemmer et al, UIST 01]
- Electronic wall surface (180 cm diagonal SMART Board)
- Regular Post-it notes
- Computer vision, stylus, & physical tools UI
Vision System

Rear Camera Vision (640x480, 7fps)
Vision System

Rear Camera Vision (640x480, 7fps)

1. Current frame $f$
2. Temporal average $\mu_{t-1}$
   
   \[ \mu_t = (1-\alpha)\mu_{t-1} + \alpha f, \quad \alpha = 0.04 \]
3. Perspective correction and frame differencing
4. Image segmentation via connected components
5. Verify size, conduct EM line fitting, and verify fit
6. Send notification to UI over socket

Front Camera Vision (2048x1536, when requested. Top speed 0.5fps)

1. Waiting Requestors
2. In Transit Requestors
3. Completed Requestors
4. Raw Front Capture
5. Note11.jpg rectified and saved
Geo-referenced I/O
### INPUT TECHNOLOGY
- Electronic tags
- Barcodes
- Image analysis
- 2D pointing
- 3D pointing
- Audio capture
- Speech reco

### SPATIAL
- Augmented Surfaces
- Collaboration
- DigitalDesk
- Designers' Outpost
- Rasa
- Illuminating Light
- Urp
- Senseboard
- The metaDESK

### TOPOLOGICAL
- Paper Flight Strips
- Triangles
- mediaBlocks
- Palette
- Video Mosaic

### ASSOCIATIVE
- Audio Notebook
- WebStickers
- Books with Voices
- Electronic Tags
- DataTiles
- Listen Reader
- Marble Answering Machine

### FORMS
- Community Info Sharing
- Paper PDA
- Paper User Interface

### TANGIBLE INPUT
- Wall
- Table
- Document
- Book
- 3D object

### ELECTRONIC OUTPUT
- Wall
- Table
- Desktop PC
- Web
- Printer
- Handheld
- Audio only

### I/O Coordination
- Geo-referenced
- Collocated
- Non-collocated
- No visual output
Collaborage [Moran et al, UIST99]

Illuminating Light [CHI98]

Rasa [McGee et al, CHI02]

Augmented Surfaces
Collaborage
DigitalDesk
Designers' Outpost
Rasa
Illuminating Light
Urph
Senseboard
The metaDESK

Input Technology
- Electronic Tags
- Barcodes
- Image analysis
- 2D pointing
- 3D pointing
- Audio capture
- Speech echo

Tangible Input
- Wall
- Table
- Document
- Book
- 3D object

Electronic Output
- Desktop PC
- Web
- Printer
- Handheld
- Audio only
- Geo-referenced
- Collocated
- Non-collocated
- No visual output

I/O Coordination

Spatial

Out In Comments

Who First Day Out First Day Back Comments

At Student back @ 4

8/11 8/18 vacation

9/1 9/7 conference

Leaving at 4:30 today
<table>
<thead>
<tr>
<th>TOPOLOGICAL</th>
<th>INPUT TECHNOLOGY</th>
<th>TANGIBLE INPUT</th>
<th>ELECTRONIC OUTPUT</th>
<th>I/O Coordination</th>
</tr>
</thead>
<tbody>
<tr>
<td>MediaBlocks</td>
<td>Electronic tags</td>
<td>Audio capture</td>
<td>Geo-referenced</td>
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Paper Flight Strips [Mackay et al, CHI98]  
Palette [Nelson, CHI99]
### Input Technology

<table>
<thead>
<tr>
<th>Input Technology</th>
<th>Audio Notebook</th>
<th>WebStickers</th>
<th>Books with Voices</th>
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### Tangible Input

- **Audio Notebook** [Stifelman, CHI01]
- **Listen Reader** [Back, CHI01]
- **Books with Voices** [CHI03]
The following MailQ card requires your attention:

To: JOE MARKS

JOE:
ARE YOU GOING TO BE ACCEPTING VISIT PAPERS A LITTLE LATE THIS YEAR? IF SO, HOW LATE CAN THEY BE?

THANKS

Please enter the recipient’s address(es):

To: business@cmu.edu

CC: k@andrew.cmu.edu

Send  Discard

20
Tangible Media Group

ambientROOM

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- Forbes, Washington Times and others picked up UPI’s story on Wireless without worries. (8/01)
- The Economist’s renowned Technology Quarterly covers our new category of product. Background Illumination (06/14)
- Metropolis covers the Orb in its review of cutting edge lighting design. (06/06)

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