Advanced User Interfaces:  
Topics in Human-Computer Interaction

Week 04: Disappearing Computers  
90s-00s of Human-Computer Interaction Research

Prof. Roel Vertegaal, PhD
Week 8: Plan

Disappearing Computers

Ubiquitous Computing
Graspable Interfaces

Tangible User Interfaces

Concepts
Ambient vs. Foreground
Examples
Roomware

material courtesy
Saul Greenberg
Mark Weiser
Shumin Zhai
John Stasko
Hiroshi Ishii
George Fitzmaurice
Week 4: Readings


I. Ubiquitous Computing
Moore Computers?

DILBERT / SCOTT ADAMS, scottadams@aol.com

I FOUND THE ULTIMATE TOOL FOR THE MOBILE PROFESSIONAL.

IT'S A COMBINATION PDA, PHONE, PAGER, DIGITAL CAMERA, FAX, E-MAIL, LAPTOP AND SHREDDER.

IT CLIPS RIGHT TO MY BELT!
Major Trends in Computing (Weiser, 1993) and IDC data 1995

keyboard mouse pen sensor?

Moore’s Law
Making Computers
(and thus the notion of input devices) **Disappear**

Ubiquitous Computing

Many invisible computers everywhere

Mark Weiser (Xerox Parc):

A less-traveled path I call the invisible; its highest ideal is to make a computer so imbedded, so fitting, so natural, that we use it without even thinking about it.

Provide hundreds of wireless computing devices per person per office, of all scales (from 1" displays to wall sized)... It is invisible, everywhere computing that does not live on a personal device of any sort, but is in the woodwork everywhere.
<table>
<thead>
<tr>
<th>Make use of simple shared context</th>
<th>Device participates in user context</th>
</tr>
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<tbody>
<tr>
<td>• space</td>
<td>• is physical</td>
</tr>
<tr>
<td>• time</td>
<td>• is out here with us</td>
</tr>
<tr>
<td>• proximity</td>
<td>• is in many places</td>
</tr>
<tr>
<td>• affordances</td>
<td>• small large and trivial contexts</td>
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Extracted from Mark Weiser’s UbiqCom web site
Insert more on programming these things
Tagged Objects
Graspable Interfaces  (FitzMaurice, UoT)

Time Multiplexing
  GUI
Space Multiplexed Input
  Sound mixing console
Parallel (Concurrent) Input
  Two-handed, Multifinger
Spatial Congruity
  Preserve spatial relationship
Physical Shape
  Expressive gestures
Time-multiplexed Input in GUI
Graspable Interface

Physical Handle (brick)

Virtual Object
Selection

Floor plan
Space-Multiplexed Two-handed Handles
II. Tangible User Interface (TUI)

Pioneered by Prof. Ishii at MIT in 1997

Tangible Bits

  Gives physical form to digital information, seamlessly coupling the dual worlds of bits and atoms.

Tangible User Interfaces

  Employ physical objects, surfaces, and spaces as tangible embodiments of digital information.
Calm computers: cars as preattentive interfaces: there is no interface
<table>
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<tr>
<th>Foreground vs. Ambient Interactions</th>
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<tbody>
<tr>
<td><strong>Differences in Attentional Demands</strong></td>
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<tr>
<td>GUI designed for foreground interactions</td>
</tr>
<tr>
<td>All interactions channeled through screen</td>
</tr>
<tr>
<td>All input channeled through mouse</td>
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<tr>
<td><strong>Ambient Interactions</strong></td>
</tr>
<tr>
<td>High in literal information (ambient sound, shades, moods)</td>
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<tr>
<td>Low in symbolic content (pictures, text etc.)</td>
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<tr>
<td><strong>Calm Computing</strong></td>
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<tr>
<td>Peripheral Display</td>
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<tr>
<td>Soundscapes</td>
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<tr>
<td>Design for Experiences</td>
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</table>
Mark Weiser’s Ethernet Traffic indicator
one of the first calm computers
TUI for Foreground Interactions

Physical Objects as Input
   Object serves as input device
   Tactile-kinesthetic interface

Augmented Surfaces as Displays
   Object serves as display

Connection between atoms and bits
   Remove eye-hand coordination problem
   Proprioceptive and exteroceptive feedback are synchronized
   Remove input/output device barrier altogether
Physical Objects as Input

Marble Answering Machine

Incoming voice messages are physically instantiated as marbles. The user can grasp the message (marble) and drop it into an indentation in the machine to play the message.

The user can also place the marble onto an augmented telephone, thus dialing the caller automatically.
When triangles connect together, they trigger digital events.

These events influence the progress of a non-linear story, or allow users to organize media elements in order to create their own story space.
Triangles: Tangible Interface for Manipulation and Exploration of Digital Information Topography

Matt Gorbet,
Maggie Orth,
Hiroshi Ishii

MIT Media Lab
**Augmented Surfaces**

Wooden Mirror - wooden pixels  Video: SIGGRAPH 2000

Daniel Rozin, NYU
Computational tags track the usage of physical objects.

**TouchCounters** sense activity through magnetic, acceleration, and infrared sensors, and indicate their status on bright LED displays.

**TouchCounters** can be networked to a web server that generates use histograms for each object.
TouchCounters: Designing Interactive Electronic Labels for Physical Containers

(3:34)

Paul Yarin and Hiroshi Ishii

MIT Media Lab
Input becomes output
Interaction closely linked with physical object
Visuals closely linked through projection
Deformation scanned with laser
Physical objects connect collaborators

- awareness of others
- spatial congruency
- haptic communication

Promote richer communication between remote individuals
Features a "reactive table" that incorporates sensing, sound, and projection technologies.

Projectors display patterns of light and shadow on the table; bouncing balls leave images of rippling water; and the rhythm of play drives accompanying music and visuals.
InTouch – Collaborative Haptics
Computer-Augmented Room Elements

Doors, walls, furniture (e.g. tables and chairs) with integrated information and communication technology.
Dynawall
By moving multiple ConnecTables together, they can be arranged to form a large display area. Integrated sensors measure the distance between the ConnecTables and initiate the automatic coupling of the displays.
Questions?