Designing Design Media: Tangible Bits Approach

Hiroshi Ishii
Tangible Media Group
MIT Media Laboratory
Defy Gravity
Defy Gravity

GUI
• Visual
• General Purpose
• Remote Control

TUI
• Tactile
• Special Purpose
• Direct and Collaborative Manipulation

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Pixels => Tangible

General Purpose => Special Purpose

**PCs**
- Time-consuming
- Requires navigation
- Complex

**Phone**
- Interruptive
- Intrusive

**tangible**
- Direct and collaborative manipulation of digital computation
Tangible Bits

- Designing new design media which blend digital and physical representations
- by giving physical forms to digital information and computation, making bits
  - directly and collaboratively manipulable
- Empowering the collaborative design, learning, and decision making.
Painted Bits (GUI) and Tangible Bits (TUI)

Graphical User Interface
- Intangible representation (pixels on a screen) +
- Generic input devices as "remote-controllers"

Tangible User Interface
- Tangible representation as interactive control mechanism to manipulate the information and computation
- Continuity between physical and digital representation in design
Abacus: Origin of Tangible Bits

Alisa ISHII, born 9/1/04

Hiroshi ISHII, born 2/4/56
Physical Design Media

- Clay
- Cardboard
- Wooden Blocks
- Found Objects

Physical Outcomes
Stata Center 2002

Frank O. Gehry, Architect

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Lack of Continuity Between Physical and Digital Representation in Design

Physical

Ease of manipulation
Clearer communication
Aids spatial understanding

Digital

Greater precision
Easy distribution
Quantitative analysis

How can we merge these media?
Design Workbench
Evolution of Workbench
for Collaborative Design and Tangible Thinking

1997
I/O Bulb

1997-8
Illuminating Light

1996-7
metaDESK

2002
Actuated Workbench

1999
PingPongPlus

1998-9
Urp

2001-02
Senseboard

2000-02
Sensetable

2001-02
Illuminating Clay

2002
SandScape

2000-02
Luminous Table

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Urp: Urban Planning Workbench
Underkoffler and Ishii, 1997 - 1999

light reflections
wind
shadows
Luminous Table
in Urban Design Studio at MIT

Urban Planning Workbench used in the spring 2000 / 2001 MIT courses
Business
IP Network Design Workbench
NTT Comware + TMG

- Event-Driven Simulation + NTT Comware’s network design consulting expertise

- TUI supports cooperative direct manipulation of IP Network simulator.
From Physical World Model to Computational Abstract Model

Principle of Tangible Interface Design

Urp 99

System Dynamics Simulation 03

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Music
Audiopad
James Patten and Ben Recht (Physics & Media)

- A new way to perform electronic music.
- Designed to combine the expressive power of traditional musical instruments with the modularity of a computer
- Based on the Sensetable project.
Architecture
## Sensetable Architecture:
### TUI Platform + Applications

<table>
<thead>
<tr>
<th>TUI Platform</th>
<th>Applications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensetable: TUI platform to track multiple objects and their states on a table with video projection</td>
<td>NTT Comware Sensetable Product 2003</td>
</tr>
<tr>
<td>TMG</td>
<td>Urp (fluid dynamics)</td>
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<tr>
<td>TMG + Intel + Sloan</td>
<td>Supply Chain Visualization (System Dynamics)</td>
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<tr>
<td>NTT Comware + TMG</td>
<td>IP Network Designer (Event Driven Sim)</td>
</tr>
<tr>
<td></td>
<td>Business Process Analysis (Event Driven Sim)</td>
</tr>
</tbody>
</table>

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3D Continuous
Illuminating Clay
Ben Piper, Carlo Ratti & Hiroshi Ishii 01

- 3-D Tangible Interface for Landscape Analysis

1. Physical Manipulation
2. 3-D Capture
3. Computational Analysis
4. 3-D Projection

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SandScape
Ars Electronica Center

Yao Wang,
Assaf Biderman,
Ben Piper,
Carlo Ratti, and
Hiroshi Ishii

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MIT Media Laboratory
Bridging Ideation with Physical and Analysis with Digital Media
Lack of Continuity Between Physical and Digital Representation in Design

**Physical**
- Ease of manipulation
- Clearer communication
- Aids spatial understanding

**Digital**
- Greater precision
- Easy distribution
- Quantitative analysis

How can we merge these media?
Form Giving + Computational Reflection: Refresh Rate of Iterative Design Cycle

Physical
Upper Stream
Rough and rapid form giving with hand for ideation

Digital
Lower Stream
Precise and quantitative computational reflection

simultaneous form giving + computational reflection

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Representation of Idea Matters ...

... because the mental operations are made possible by the representation.
...

GUI/CAD is not for ideation.

e.g.
• Mathematical representation
• Drawings
• Physical models
• Computational models

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Media for Design Thinking

• Visual Thinking
  – sketch

• Tangible Thinking
  – tactile manipulation of physical representations coupled with digital computation
  – design + analysis
Design?

Conceptual “eyeglasses”
– To inspire people’s imagination and creativity

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Thanks!

Hiroshi Ishii
Tangible Media Group
MIT Media Laboratory

QuickTime™ and a TIFF (Uncompressed) decompressor are needed to see this picture.