Tangible User Interfaces
Basic Idea

• Wind back to early 1990s
• Computers stuck in few form factors
  – Seriously limits the places and times we can use computers
Tech Trends

- CPUs, disks, wireless, cheaper, faster, smaller
  - Can embed computation and communication into almost anything
Ubiquitous Computing

• Tabs, Pads, Boards
  – Break computation away from desktop
  – Embed computation into analogs of physical things
    • Notepad, whiteboard
Ubiquitous Computing

- Push the idea of embedding computation into environment even further
Answering Machine

• By Durrell Bishop
Where the sea meets the land, life has blossomed into a myriad of unique forms in the turbulence of water, sand, and wind. At another seashore between the land of atoms and the sea of bits, we are now facing the challenge of reconciling our dual citizenships in the physical and digital worlds.

Windows to the digital world are confined to flat square screens and pixels, or "painted bits." Unfortunately, one can not feel and confirm the virtual existence of this digital information through one's body.
Bigger Picture

• Tangible user interfaces a reaction against “standard” desktop GUI
  – Computer thinks we can only see, hear, point, click
  – “Caveman user interface” (point and grunt)
Tangible User Interfaces

- Work at MIT Media Lab known as Tangible Bits
  - Make use of our other senses
  - Make use of the fact we live in the physical world
  - Sense of play
  - Aesthetics
More Tangible Bits
Tangible Bits Themes

- Clever use of cameras and projectors
  - Augmenting physical world (AmbientROOM, PingPongPlus)
  - Capturing images (IO Brush)

- Using physical objects as input
  - Brush
  - MetaDESK
  - Topobo

- Aesthetic and peripheral output
  - AmbientROOM
  - PingPongPlus
Some Issues with Tangible UIs

• Work vs aesthetics
  – Is it only for fun and games?

• Reusability
  – All custom built, can we do better?
  – Equivalent to GUI components here?

• Physical objects
  – What does it do?
  – What happens if you lose it?
  – Production and distribution costs
Tangible UIs for Work
Augmented Flight Strips
Tangible UIs for Work

Augmented Flight Strips
Tangible UIs for Work

LabScape

- Augment equipment for cell biologists
Tangible UIs for Work
*Final Scratch*
Tangible UIs for Work

• Augment existing artifacts
  – Paper, pipettes, turntables

• Augment or streamline existing practices
  – Striking right balance between automation and facilitation
  – Striking right balance between what to keep and what not
Some Issues with Tangible UIs

- **Work vs aesthetics**
  - Is it only for fun and games?

- **Reusability**
  - All custom built, can we do better?
  - Equivalent to GUI components here?

- **Physical objects**
  - What does it do?
  - What happens if you lose it?
  - Production and distribution costs
Reusability

DataTiles
Reusability

*Phidgets*

- Physical widgets
Some Thoughts

• Something has to be “smart”
  – Ex. Paper -> Smart paper, smart pen, smart surface
  – Each has different pros and cons (cost, reliability, accuracy)
Some Thoughts

• What happens when things fail?
  – Some paper-based UIs can “fall back” on paper itself
  – Topobo still looks neat without power
Some Issues with Tangible UIs

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• Reusability
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• Physical objects
  – What does it do?
  – What happens if you lose it?
  – Production and distribution costs
MediaCup

- Any guesses what it does?

- Basic HCI design principles still apply
  - Affordances
  - Mapping
  - Convention
Physical Objects

• Requires interdisciplinary teams
  – Hardware, software, industrial design, aesthetics
  – Compare to having a “platform” like Wintel or Mac

• Creating Tangible UIs has design & production issues
  – Compare to software, primarily design
    • Production and distribution are trivial (~ $0 with Internet)
  – Might be useful to compare to microprocessor industry
    • Several companies devoted solely to design
    • Several companies devoted solely to manufacturing
Physical Objects

• What happens if you lose it? Or can’t find it? Or have too many?
Other Examples of Tangible UIs

Buddy Bugs
Other Examples of Tangible UIs

*Doll’s Head for Neurosurgeons*

- Very direct manipulation
Other Examples of Tangible UIs

*Books with Voices*
Other Examples of Tangible UIs

*The Hug*
Other Examples of Tangible UIs

Ambient Inc
Embodied Physical Agents
Summary

• Tangible user interfaces
  – Combine computation and communication with everyday physical objects
  – Aesthetics, augmenting existing practices
• Ongoing research area