Announcement of Solo Project 0: COLLABORATIVE IDEATION ▶ Due September 18. Presentation by individual student in Pecha-Kucha format on 09/18.

- **Workshop 1**: Sketching and physical prototyping for rapid Ideation (by Xiao Xiao, Ph.D. candidate of TMG)
- Lecture: Introduction of Visual Thinking (by Hiroshi Ishii)
- Lecture: Introduction of TUI #1 (by Hiroshi Ishii)
- Readings: Seamless Media Design, Affordances of Media Spaces for Collaboration, Ishii & Ullmer, Tangible bits: towards seamless interfaces between people, bits and atoms, Ishii, Tangible bits: beyond pixels
Sketching = Thinking

Visual Thinking
Robert H. McKim
Visual Thinking
Robert H. McKim

- Seeing
- Drawing
- Imagining

Robert McKim “Thinking Visually”

My Art Work in 1959
ClearBoard
NTT Human Interface Laboratories

Ishii and Kobayashi, 1992
At the Border

Where the land meets the sea, there is a border.
Living at the Border

Harsh, but also fertile environment.

At the Border
between Physical and Digital

We live on the border where bits meet atoms. In the flood of pixels from the ubiquitous GUI screens, we are losing our sense of body and places. Pixels impoverish human senses.
1
tangible

physical
tangible bits
digital

painted bits
Materialize
digital information to interact with directly

Tangible Bits

Physical embodiment of digital information and computation
Eyes are in charge, but hands are underemployed.

By pointing, by pushing and pulling, by picking up tools, hands act as conduits through which we extend our will to the world.

They serve also as conduits in the other direction: hands bring us knowledge of the world. Hands feel. They probe. They practice.

Malcolm McCullough
“Abstracting Craft: The Practiced Digital Hand” 1996
Orrery: Tangible Representation of Knowledge

Aesthetics which value haptic interaction with specialized physical objects ... but much richness has been lost.

Orrery
Tangible Representation of Knowledge
collaboration

Abacus: Origin of Tangible Bits

Hiroshi ISHII, born February 4th, 1956

origins
metaDESK and Tangible Geospace
Ullmer and Ishii, 1997

activeLENS

phicons (physical icons)

passiveLENS

metaDESK and Tangible Geospace
Ullmer and Ishii, 1997
Tangible Bits

- Giving physical forms to digital information and computation, making bits
directly manipulable with two hands
- Supporting multi-user collaboration and “tangible thinking”
**Tangible Bits**

Physical embodiment of digital information and computation

**Peripheral awareness**
Center and Periphery
Architectural Space as Interface

• to grasp & manipulate bits
  in the center of user's focus by coupling bits with physical objects and surfaces, and

• to be aware of bits
  at the periphery
  using ambient display media such as light, sound, airflow, and water movement.

Ambient Media in Nature
water, sand, wind, light, shadow, cloud
Pinwheels: wind of bits
Ren, Frei, Dahley, Wisneski, and Ishii, 1997-2000

Ambient information display spinning in a "wind of bits."

Architectural space will be an ambient interface.
Water Lamp: rain of bits
Dahley and Ishii, 1997

Water ripple shadow created by a "rain of bits."
Peripheral Awareness using Ambient Media

**Foreground --> Background**

**always**

- Always on, real-time
- Peripheral awareness
- Seamless with environment

**ambient devices**

**Orb** by Ambient Devices (Media Lab Spinoff)

- This light glows different colors to help you monitor your portfolio, traffic on your commute, new snow in the mountains, pollen index, etc.

- The behavior can be remapped to summarize whatever information you’d like in your periphery.

Ambient Displays
Design Principles

• **Browser-less interface**
  – Glance-able, requires no navigation and no analysis, simple.

• **Calm**
  – Non-intrusive, seamless with environment

• **Persistent connection**
  – Information is continuously updated.

• **Decision-driven data**
  – Personalized and summarized data feeds to make a decision.

• **Private**
  – Encoded data
**inTouch:**
Haptic Interpersonal Communication Medium
Brave, Dahley, Frei, Su, and Ishii, 1998

“Reach out and touch someone.”

“Synchronized Distributed Physical Objects” create an illusion of touching the same object using force-feedback technology.

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**inTouch:** Tangible Telepresence
Brave, Dahley, Frei, Su, and Ishii, 1998

“Synchronized Distributed Physical Objects” create an illusion of touching the same object using force-feedback technology.

inTouch-0: mechanical mockup
inTouch-1: early electronic prototype
inTouch-2: distributed prototype
inTouch:
Haptic Interpersonal Communication Medium

illusion of touching the same object using force-feedback technology.

“Ghostly Presence”

tangible telepresence

traditional remote collaboration systems

Movement of local objects suggests the physical presence of remote users.

Remote users remain isolated behind computer screen.
Curlybot
Frei, Su, ishii, 2000

A toy that can record and playback physical motion.

Children establish an affective and body syntonic connection with curlybot, and develop intuitions for concepts such as differential geometry.

Curlybot
Frei, Su, ishii, 2000

• Children readily establish an affective and body syntonic connection with curlybot.
• They can develop intuitions for concepts such as differential geometry, through play away from a traditional computer.
topobo
Building Blocks with kinetic memory
Hayes Raffle, Amanda Parkes, and Hiroshi Ishii

- made of active (motorized) & passive (static) components
- passives geometry based on cubic & tetrahedral crystals
- coincident input & output space
- actives “programmed” by moving, pushing, twisting units
- recorded sequence automatically plays back repeatedly
- distributed computation and networking
**topobo**

3D constructive assembly with kinetic memory

- educational digital manipulative for teaching physics & system concepts
- made of active (motorized) & passive (static) components
- passives geometry based on cubic & tetrahedral crystals
- coincident input & output space
- actives “programmed” by moving, pushing, twisting units
- recorded sequence automatically plays back repeatedly
- distributed computation and networking

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**Coincidence of input and output spaces**

Principle of Tangible Interface Design

- inTouch 98: interpersonal communication
- curlybot 00: mathematics and expression / narrative
- topobo 04: building block with kinetic memory