



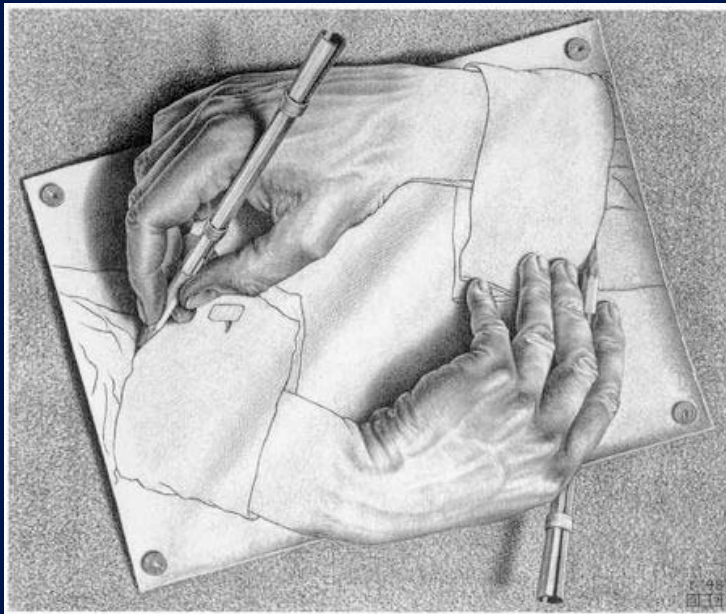
## MAS.834 Tangible Interfaces

## MAS.834 9/11/13

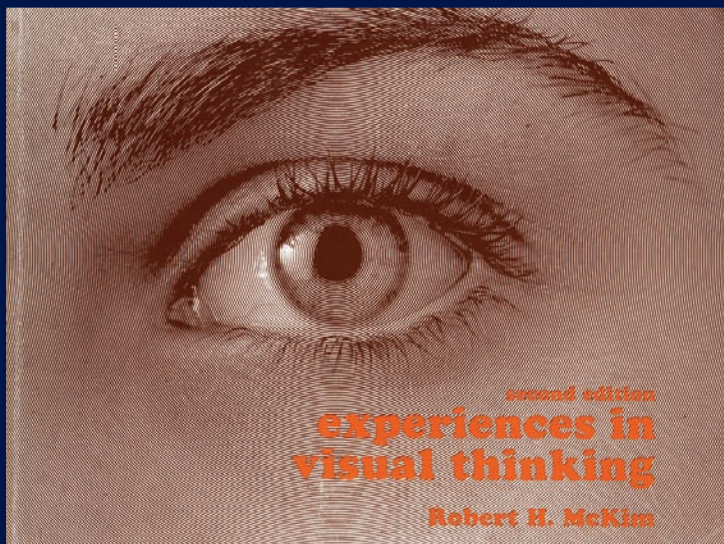
Announcement of Solo [Project 0: COLLABORATIVE IDEATION](#) ► Due September 18. Presentation by individual student in Pecha-Kucha format on 09/18.

- **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



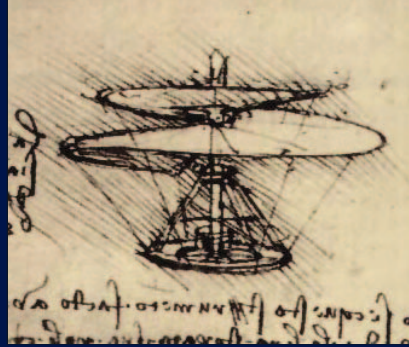
# Visual Thinking Robert H. McKim



# 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

© 2012 MIT Media Laboratory, Hiroshi Ishii

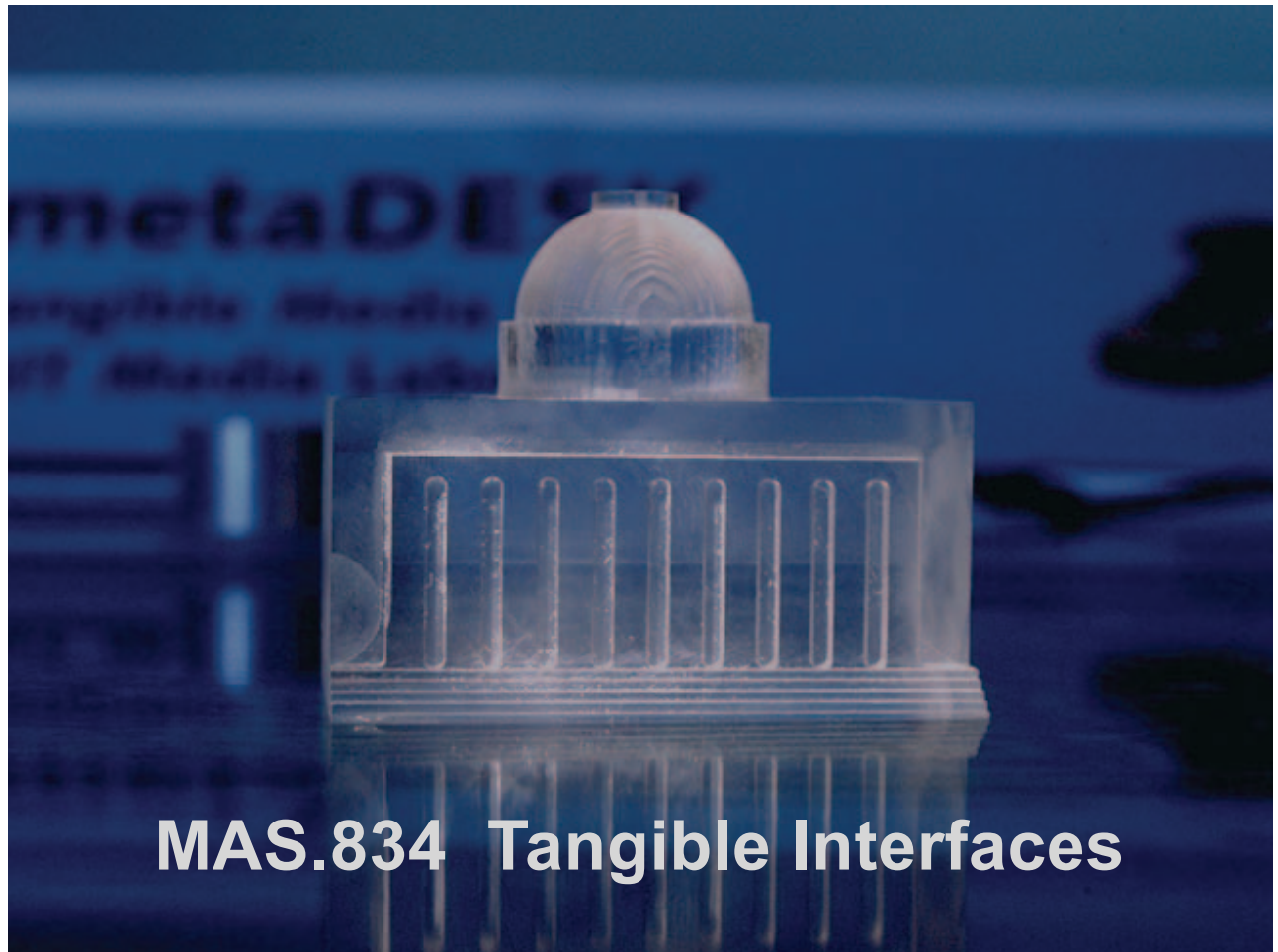
# ClearBoard

Seamless integration of  
interpersonal and shared drawing spaces



Ishii and Kobayashi, 1992  
NTT Human Interface Laboratories

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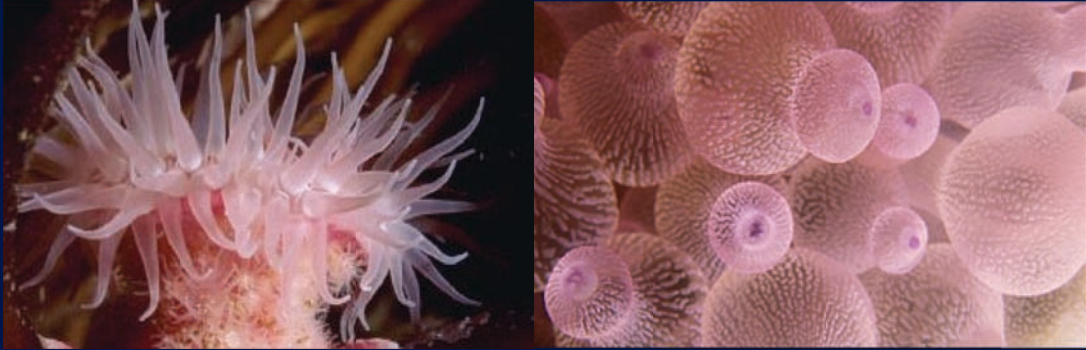
## MAS.834 Tangible Interfaces

### At the Border



Where the land meets the sea,  
there is a border.

# Living at the Border



**Harsh, but also fertile environment.**

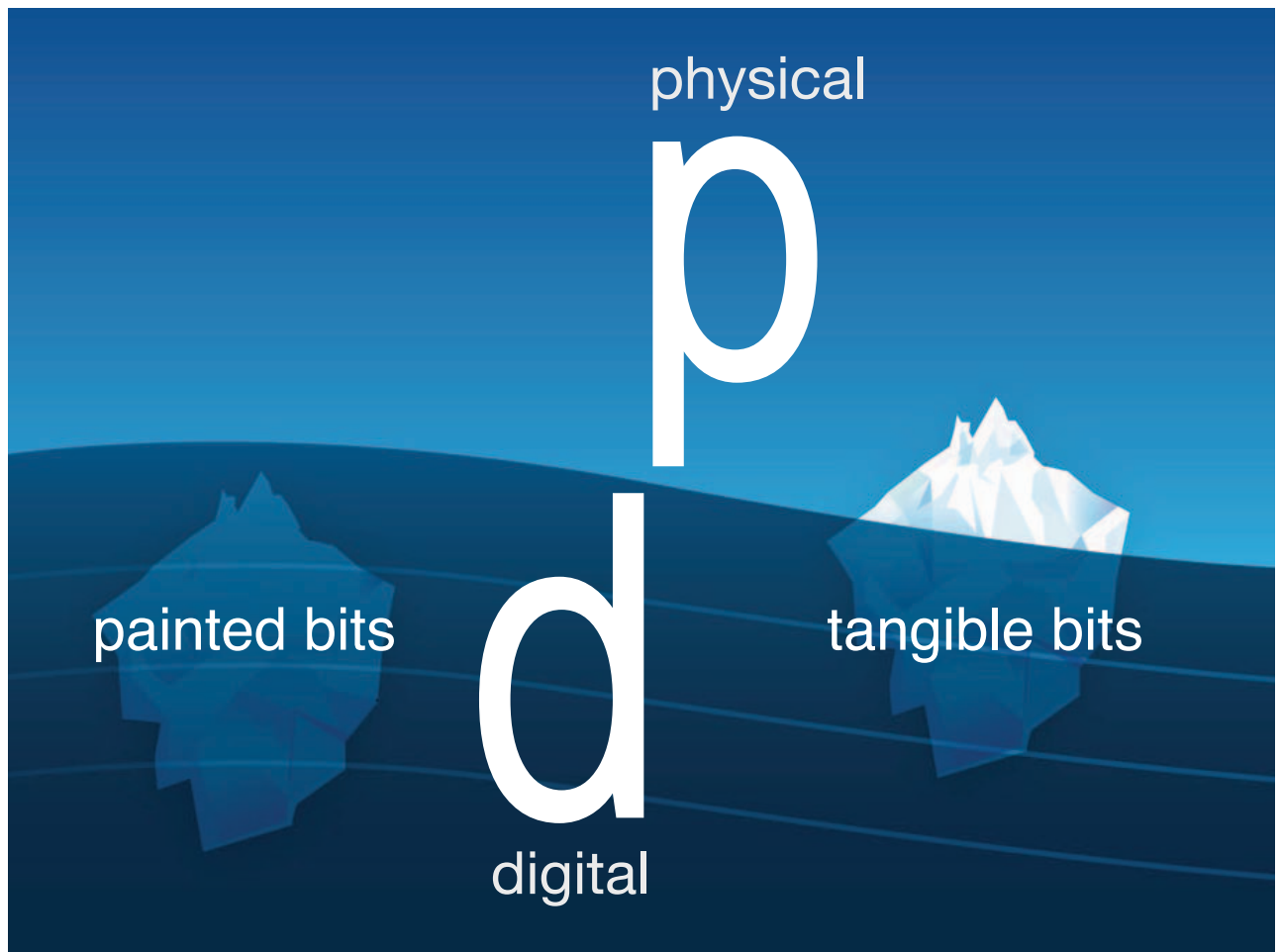
# At the Border between Physical and Digital



***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



# Materialize

digital information to  
interact with directly

painted bits

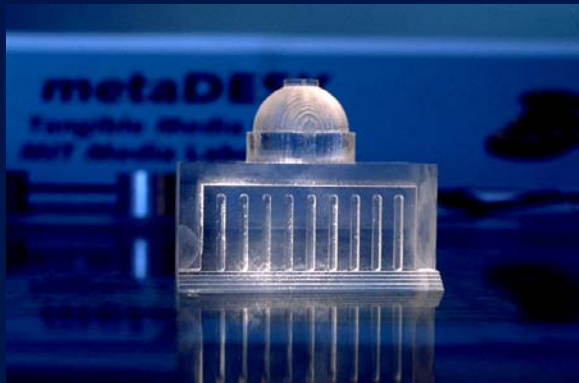
GUI

tangible bits

1997

TUI

## Tangible Bits



Physical embodiment of  
digital information and  
computation



**Eyes are in charge,  
but hands are underemployed.**



**Eyes are in charge,  
but hands are underemployed.**

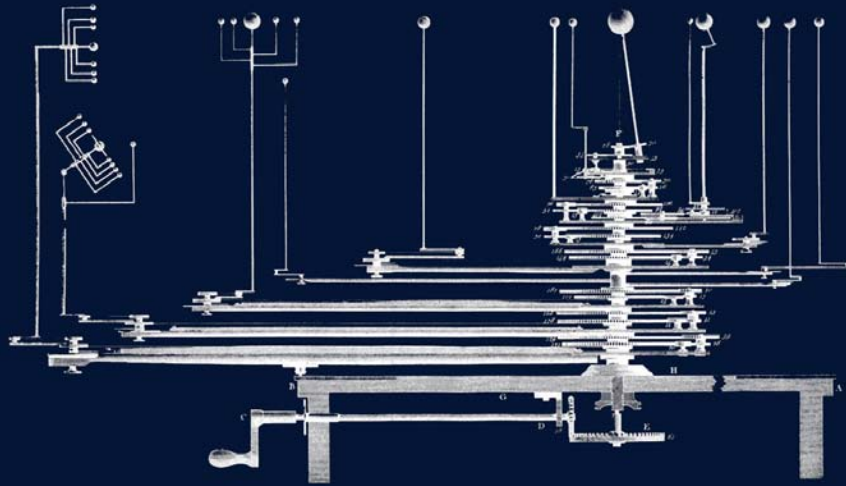
*By pointing, by pushing and pulling, by picking up tools, hands act as conduits through which we extend our will to the world.*

*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.



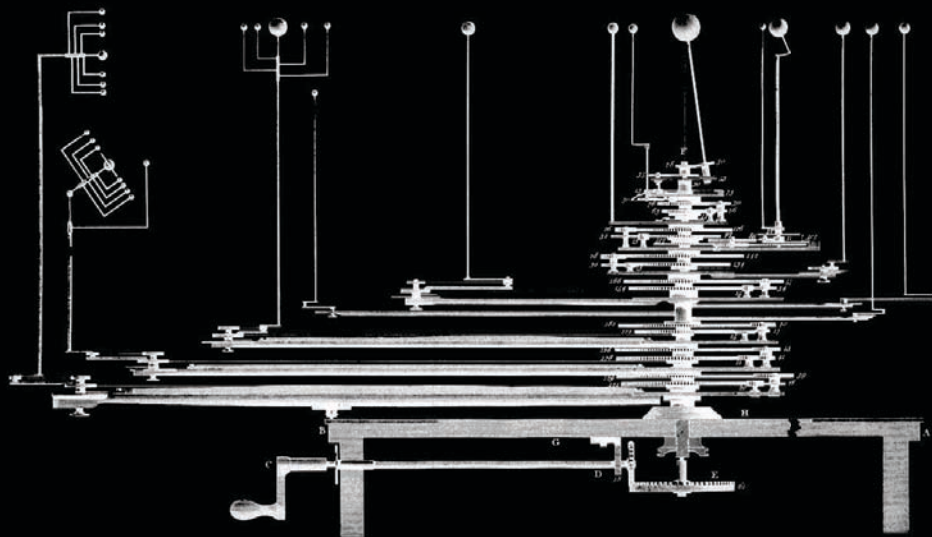
表現

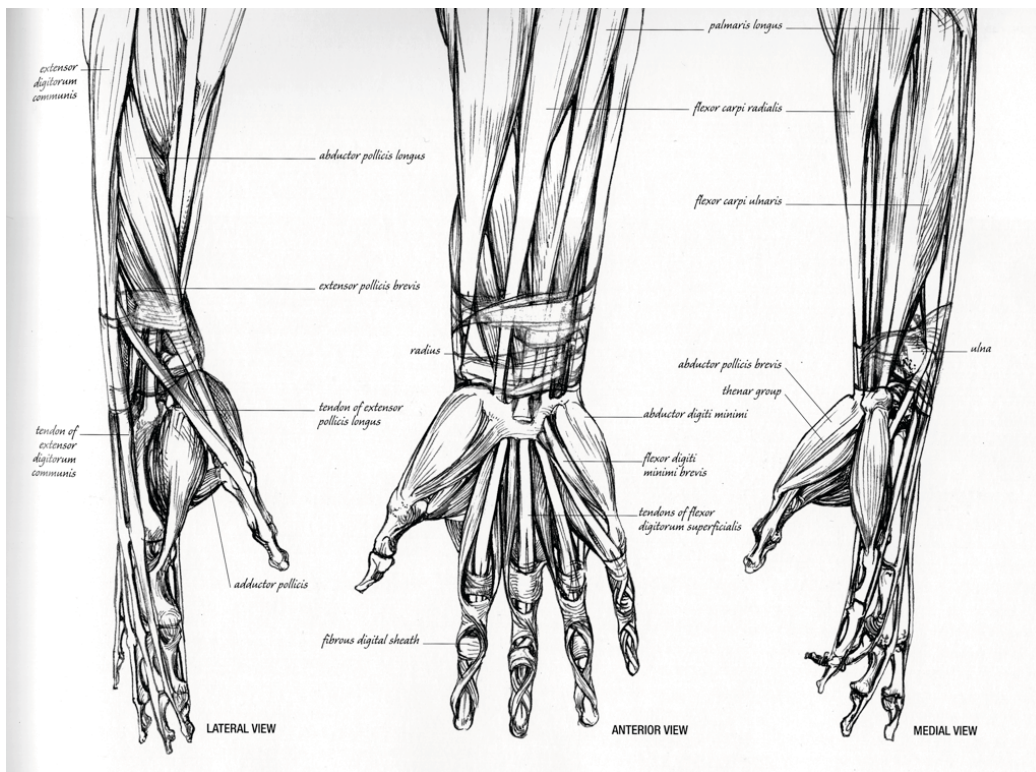
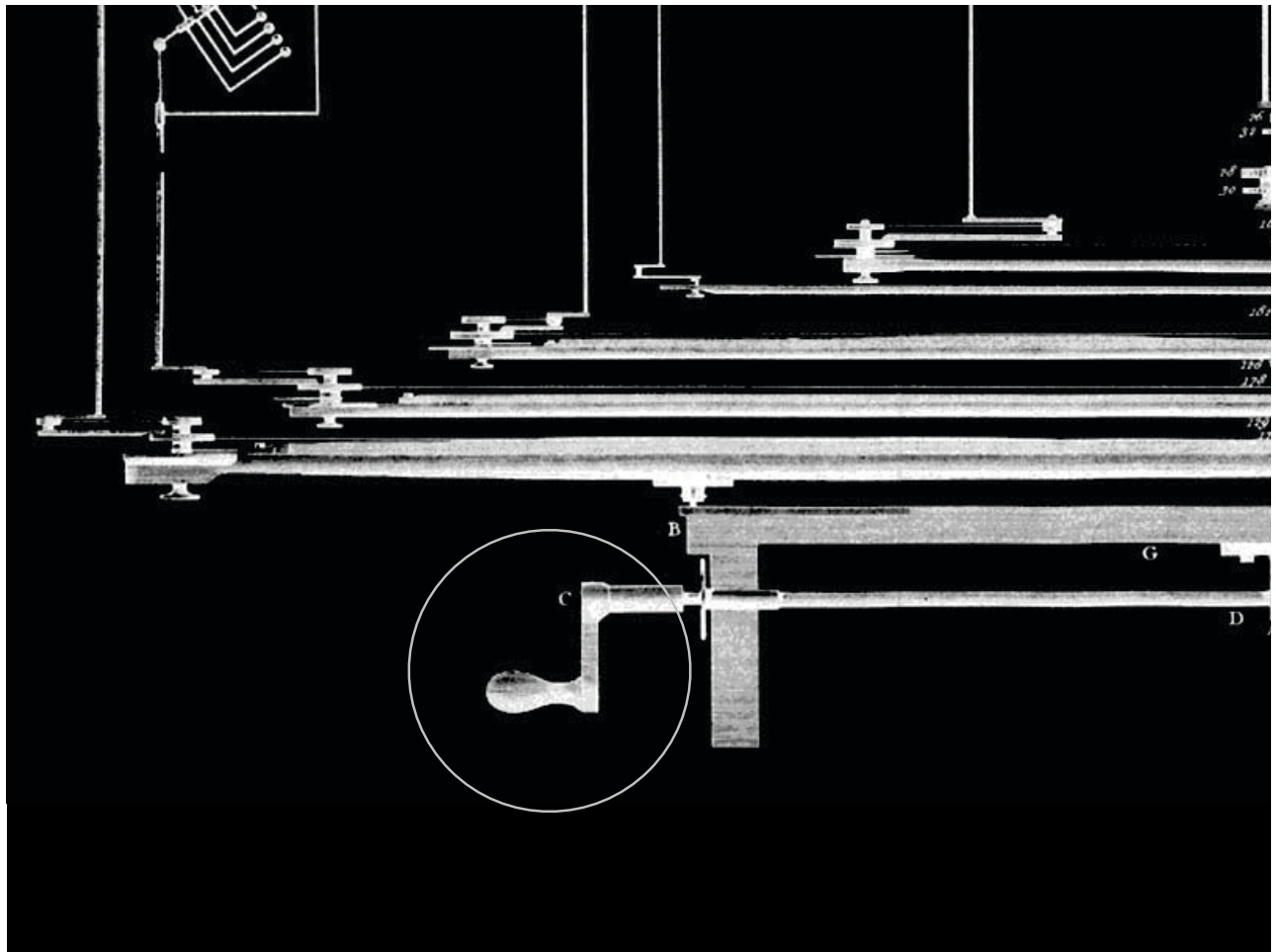
representation

[http://en.wikipedia.org/wiki/File:Grand\\_orrery\\_in\\_Putnam\\_Gallery,\\_2009-11-24.jpg](http://en.wikipedia.org/wiki/File:Grand_orrery_in_Putnam_Gallery,_2009-11-24.jpg)

# Orrery

Tangible Representation of Knowledge





hands



**collaboration**

[http://en.wikipedia.org/wiki/File:Wright\\_of\\_Derby\\_The\\_Orrery.jpg](http://en.wikipedia.org/wiki/File:Wright_of_Derby_The_Orrery.jpg)

**計算**

**Compute**

# Abacus: Origin of Tangible Bits



Hiroshi ISHII, born February 4th, 1956

# 起源

origins

# metaDESK and Tangible Geospace

Ullmer and Ishii, 1997

activeLENS



passiveLENS



phicons  
(physical icons)



# metaDESK and Tangible Geospace

Ullmer and Ishii, 1997



# ambientROOM

## Architectural Space as Interface

Ripple shadows on ceiling

Light projection on side wall

Bottles as containers of bits

Open a bottle to release bits into air



Ambient sound of rain drops

Clock to navigate time



# ambientROOM

## Architectural Space as Interface





# Tangible Bits

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



# 2

ambient

# Tangible Bits



Physical embodiment of  
digital information and  
computation

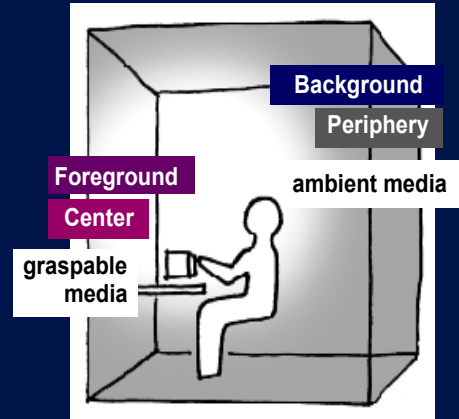
# 周縁

peripheral awareness

# Center and Periphery

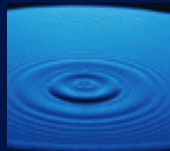
## Architectural Space as Interface

- **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

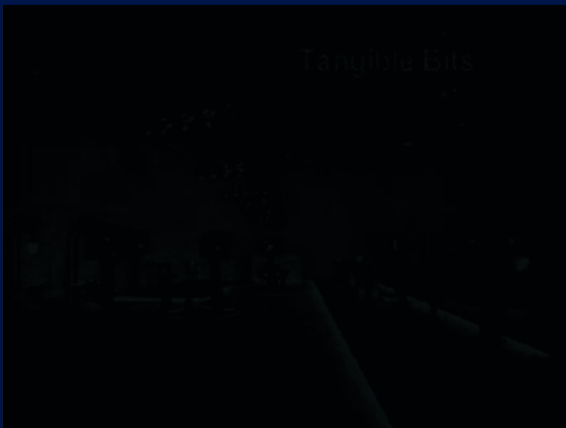


# 風

wind

## 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.

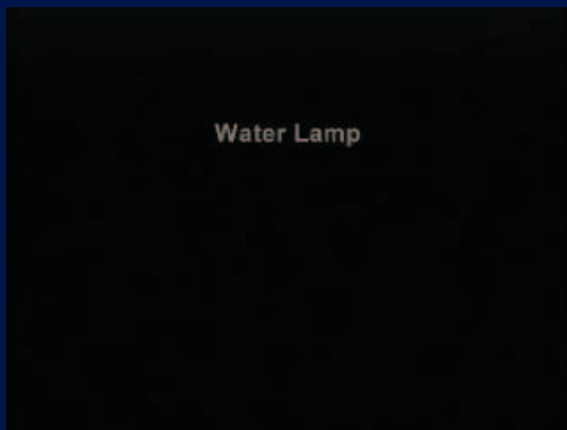


雨

rain

## Water Lamp: rain of bits

Dahley and Ishii, 1997



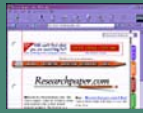
Water ripple shadow  
created by a "rain of bits."



# Foreground --> Background

## Peripheral Awareness using Ambient Media

PCs



Time-consuming  
Requires navigation  
Complex

phone



Interruptive  
Intrusive

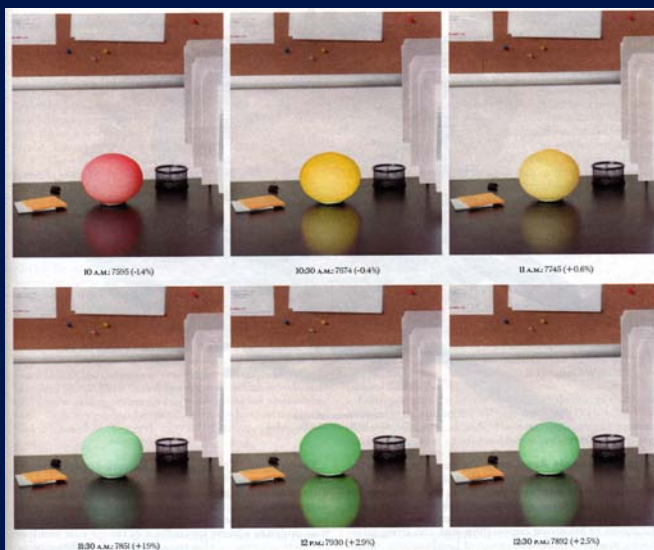
ambient



Always on, real-time  
Peripheral awareness  
Seamless with environment

## Orb by Ambient Devices (Media Lab Spinoff)

[www.ambientdevices.com](http://www.ambientdevices.com)



- 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.

New York Times Magazine, Dec. 2002

# Ambient Devices

<http://www.ambientdevices.com/>

Give the gift of simplicity



**EXECUTIVE DASHBOARD**  
analog needles meet digital information  
\$150

[more info](#) [buy now](#)

<p><b>STOCK ORB</b> calm your cash nerves \$150</p>  <p><a href="#">more info</a> <a href="#">buy now</a></p>	<p><b>WEATHER FORECAST BEACON</b> perfect for weather buffs \$179</p>  <p><a href="#">more info</a> <a href="#">buy now</a></p>	<p><b>5 DAY WEATHER FORECASTER</b> never trust that weatherman again \$99 from radioshack</p>  <p><a href="#">more info</a> <a href="#">buy now</a></p>
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# Ambient Devices

<http://www.ambientdevices.com/>

ambient*all*

## WeatherWizard

5-day forecasts in 5 cities!  
The most accurate weather station in the world!

[Learn more](#) ➔



8:30 AM		ambient <i>all</i>	
TODAY	HI 40°	LO 34°	CURRENTLY 40° BOS
PM			
T	W	T	F
HI 36°	HI 53°	HI 56°	HI 66°
LO 30°	LO 36°	LO 52°	LO 55°

# 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

3  
touch



# 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.

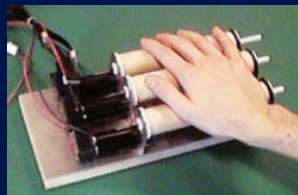
# inTouch: Tangible Telepresence

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”

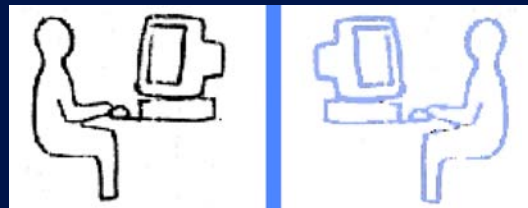
tangible telepresence



shared physical work space

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

traditional remote collaboration systems



user A's physical space

user B's physical space

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.

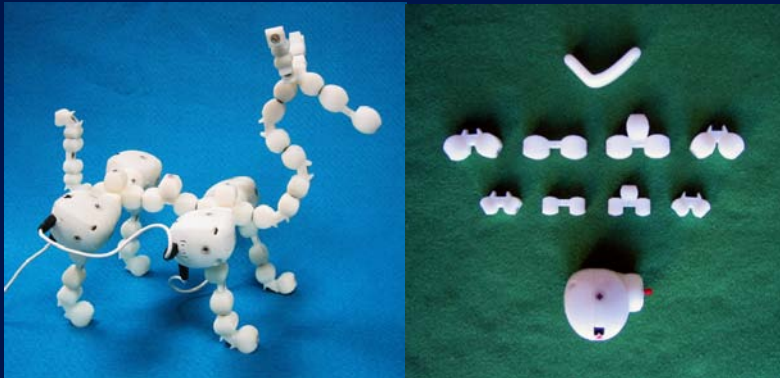


# topobo

## 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

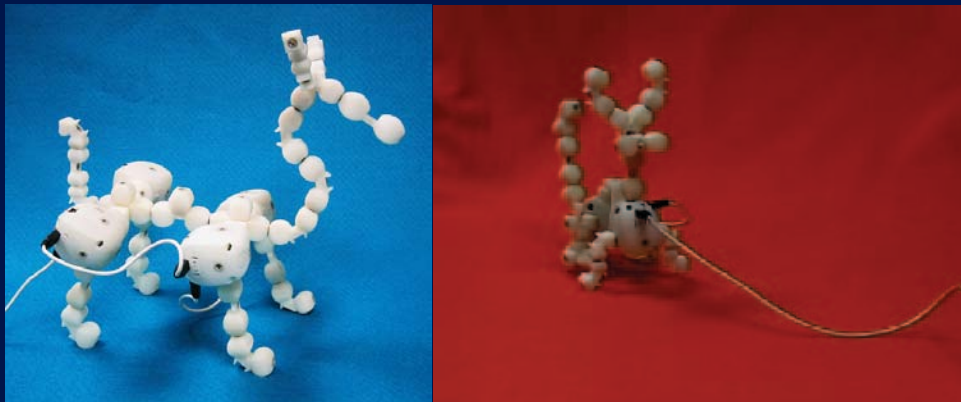


# topobo

## Building Blocks with kinetic memory

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# 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



# Coincidence of input and output spaces

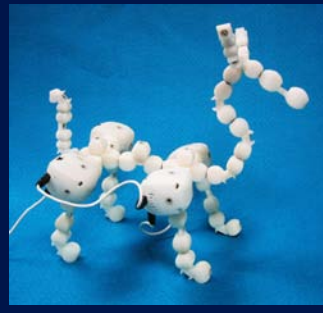
## Principle of Tangible Interface Design



**inTouch 98**  
interpersonal  
communication



**curlybot 00**  
mathematics and  
expression / narrative



**topobo 04**  
building block with  
kinetic memory