RADICAL ATOMS
VS
GREY GOO

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STARTED PHD IN 2007, ETA OCTOBER 2012

JOBS ANYONE???
SIMPLE HAPTICS
SKETCHING PERSPECTIVES FOR HAPTIC INTERACTION DESIGN

DANIEL FÄLLMAN, INTERACTIVE INSTITUTE UMEÅ
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RADICAL ATOMS VS GREY GOO

A personal critique
Radical Atoms: Beyond Tangible Bits, Toward Transformable Materials

Cover Story by Hiroshi Ishii, Dávid Lakatos, Leonardo Bonanni, and Jean-Baptiste Labrune
Radical Atoms: Beyond Tangible Bits, Toward Transformable Materials

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Graphical user interfaces (GUIs) let users see digital information only through a screen, as if looking into a pool of water, as depicted in Figure 1 on page 40. We interact with the forms below through remote controls, such as a mouse, a keyboard, or a touchscreen (Figure 1a). Now imagine an iceberg, a mass of ice that penetrates the surface of the water and provides a handle for the mass beneath. This metaphor describes tangible user interfaces: They act as physical manifestations of computation, allowing us to interact directly with the portion that is made tangible—the “tip of the iceberg” (Figure 10).

Radical Atoms takes a leap beyond tangible interfaces by assuming a hypothetical generation of materials that can change form and appearance dynamically, so they are as reconfigurable as pixels on a screen. Radical Atoms is a vision for the future of human-computer interaction, in which all digital information has a physical manifestation so that we can interact directly with it—as if the iceberg had risen from the depths to reveal its sandbox mass (Figure 1a).

From GUI to TUI
Humans have evolved a heightened ability to sense and manipulate the physical world; yet the digital world takes little advantage of our capacity for hand-eye coordination. A tangible user interface (TUI) builds upon our dexterity by embodying digital information in physical space. Tangible design expands the affordances of physical objects so they can
clouds & atoms
Grey Goo
Eric Drexler, 1986

Ecophagy from self-replicating robots

Utility Fog

Radical Atoms
Grey Goo

http://www.youtube.com/watch?v=eumDcge_Ozo
Grey Goo
Eric Drexler, 1986

Ecophagy from self-replicating robots

Utility Fog
Josh Storrs Hall, 1993

“Car seatbelt replacement”

Radical Atoms
Similar idea

**Utility Fog** - Dr Josh Storrs Hall (1993)

Similar idea

**Utility Fog** - Dr Josh Storrs Hall (1993)

Grey Goo
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Ecophagy from self-replicating robots

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“Car seatbelt replacement”

Radical Atoms
I. Ishii, 2012
“Future (of CAD) interfaces”
Radical Atoms: Beyond Tangible Bits, Toward Transformable Materials

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Graphical user interfaces (GUIs) let users see digital information only through a screen, as if looking into a pool of water, as depicted in Figure 3 on page 40. We interact with the forms below through remote controls, such as a mouse, a keyboard, or a touchscreen (Figure 1a). Now imagine an iceberg, a mass of ice that penetrates the surface of the water and provides a handle for the mass beneath. This metaphor describes tangible user interfaces: They act as physical manifestations of computation, allowing us to interact directly with the portion that is made tangible—the “tip of the iceberg” (Figure 1b).

Radical Atoms takes a leap beyond tangible interfaces by assuming a hypothetical generation of materials that can change form and appearance dynamically, so they are as reconfigurable as pixels on a screen. Radical Atoms is a vision for the future of human-computer interaction, in which all digital information has physical manifestation so that we can interact directly with it—as if the iceberg had risen from the depths to reveal its solid mass (Figure 1c).

From GUI to TUI
Humans have evolved a heightened ability to sense and manipulate the physical world, yet the digital world lacks little advantage of our capacity for hand-eye coordination. A tangible user interface (TUI) builds upon our dexterity by embodying digital information in physical space. Tangible design expands the affordances of physical objects so they can...
Figure 1. Iceberg metaphor—from (a) GUI (painted bits) to (b) TUI (tangible bits) to (c) Radical Atoms.
“Radical Atoms is our vision for human interactions with dynamic physical materials that are computationally transformable and reconfigurable. Radical Atoms is based on a hypothetical, extremely malleable, and dynamic physical material that is bidirectionally coupled with an underlying digital model (bits) so that dynamic changes of the physical form can be reflected in the digital states in real time, and vice-versa.”
“Any useful idea about the future should appear to be ridiculous”

Jim Dator, Futurist
Requirements for Radical Atoms

• **Transform** its shape to reflect underlying computational state and user input;

• **Conform** to constraints imposed by the environment and user input; and

• **Inform** users of its transformational capabilities (dynamic affordances).
1) Tear off a piece of perfect red.
2) Roll a ball of clay to let it snap to a perfect sphere.
3) Smash a ball into a perfect cylinder.

4) Draw eight dots and stick a pin into one of them to drill eight holes.
5) Draw a line along the cut and tap it with a knife.
6) Split a piece in two even halves, then the operations performed on one part are mirrored in the other.

7) Carve away shaded area with chisel and mirror it in another piece.
8) Insert materials and put two mirrored pieces together.
9) Final rattle created with Radical Atoms.
“Perfect” Red
<table>
<thead>
<tr>
<th>Physical</th>
<th>Digital</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 m</td>
<td>1 nm</td>
</tr>
<tr>
<td>10 m</td>
<td>10 nm</td>
</tr>
<tr>
<td>1 m</td>
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<td>10 nm</td>
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<tr>
<td></td>
<td>1 nm</td>
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</tbody>
</table>
Physical

Digital
incidental properties/affordances from material, shape, size, sensorimotor memory

physical laws

predictable, learn from invariance
Physical

Physical

incidental properties/affordances from material, shape, size, sensorimotor memory

physical laws

predictable, learn from invariance

Digital

Digital

properties/affordances are explicitly created/defined

mostly artificial laws

transgress real world, time & space*
incidental properties/affordances from material, shape, size, sensorimotor memory

physical laws

predictable, learn from invariance

properties/affordances are explicitly created/defined

mostly *artificial* laws

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properties/affordances are explicitly created/defined

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transgress real world, time & space*
Physical

- incidental properties/affordances from material, shape, size, sensorimotor memory
- physical laws
- predictable, learn from invariance

Digital

- properties/affordances are explicitly created/defined
- mostly *artificial* laws
- transgress real world, time & space*
Physical

Digital

Grey Goo

Weak materiality/physicality

Resource intensive for stability

Difficult to scale

Weak digitality
Radical Atoms?
Radical Atoms?

Programmable matter, can we make it?
*Far out but most likely*
Radical Atoms?

Programmable matter, can we make it?
*Far out but most likely*

Tight coupling of the digital and physical?
*Can we avoid *grey goo* (lowest common denominator)?
Radical Atoms?

Programmable matter, can we make it?
*Far out but most likely*

Tight coupling of the digital and physical?
*Can we avoid grey goo (lowest common denominator)?*

Can we design the interaction?
*I’m not sure. Representation vs Control. Mappings tend to be very arbitrary...*
Interaction Design issues with RA
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1) “All digital information has physical manifestation so that we can interact with it”
Interaction Design issues with RA

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2) All malleable and reconfigurable matter is very problematic for human sense-making (inference mess, no room for breakdown and reflection).
Interaction Design issues with RA

1) “All digital information has physical manifestation so that we can interact with it”

2) All malleable and reconfigurable matter is very problematic for human sense-making (inference mess, no room for breakdown and reflection).

3) Radical Atoms have the same problems and limitations of TUI, just the granularity is smaller.
Implications for IxD & Sketching in Hardware
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One big world after all, **choreography** between the P and D
Implications for IxD & Sketching in Hardware

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The world is not perfect, should embrace its **richness**
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Aesthetics of couplings: animism, “natural”, reality-based, others
Implications for IxD & Sketching in Hardware

One big world after all, **choreography** between the P and D

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Learn to make, make to learn
REMEMBER

ONLY YOU
CAN PREVENT GRAY GOO

NEVER RELEASE NANOBOT ASSEMBLERS
WITHOUT REPLICATION LIMITING CODE

http://www.bloodygoodhorror.com/bgh/files/Smoky_The_Nanobot.jpg

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