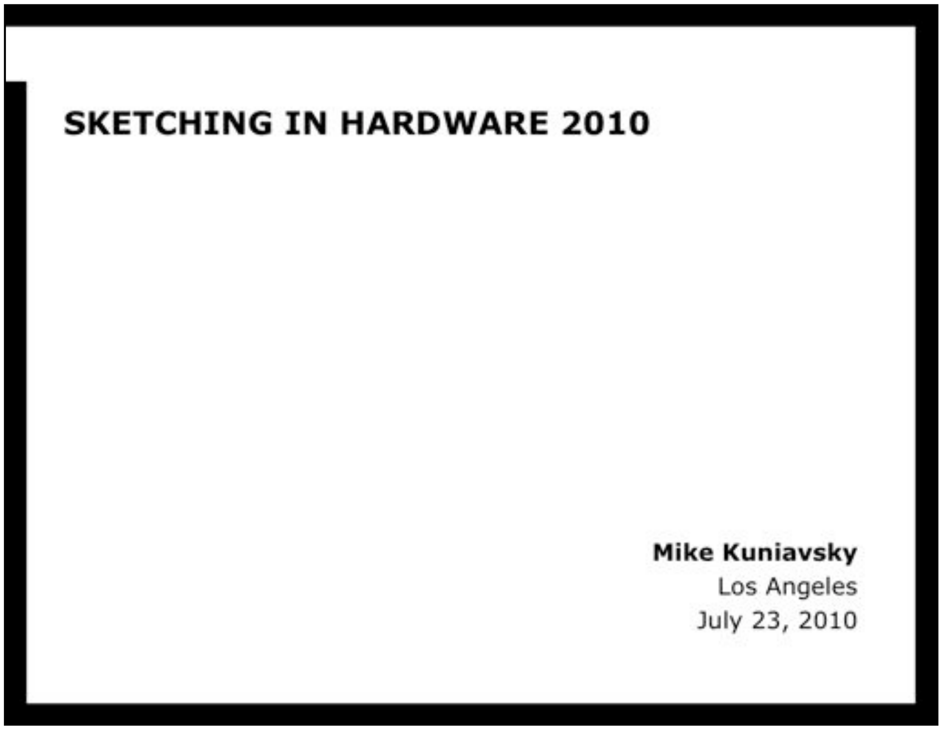


Welcome to Sketching in Hardware 2010.

Thank you so much for coming. This is the fifth year of this gathering, and it's been quite a ride.

I think that the kind of work, the kind of practice, that this event addresses has grown significantly during this period, and continues to grow. Five years ago the practice of working creatively with digital processing hardware was seen as either the domain of engineers or artists and designers on the far fringe of their field.

Now, although it's not commonplace, it's much more THINKABLE than it was five years ago. This period marks what I believe is a very important transition in people's relationship to digital technology.

Before I get too much into that, I would first of all like to thank the folks who helped this happen.

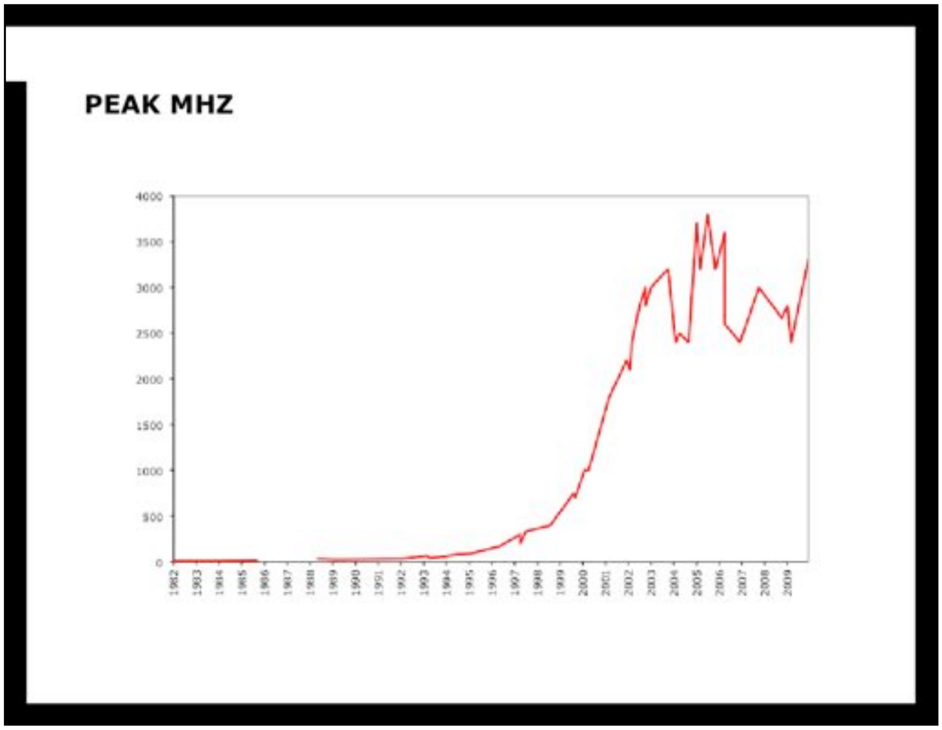
The Media Design program at Art Center is our co-host this year, and I'd like to thank Phil Van Allen for all the work and support he's given Sketching over the last 4 months. Phil and Art Center are doing great work introducing physical computing into a traditional design context.

A significant grant from the National Science Foundation's Creative IT Program has underwritten the whole conference. They're really one of big reasons you're here today. Thank you to Pamela Jennings, of the NSF, for personally shepherding the proposal through the process.

The Studio for Interactive Media did our Web design and t-shirt design for the second year in a row. Thank you Justin and Greg.

Sparkfun sponsored the first round of drinks tonight. Thank you Peter, Ryan and Nathan.

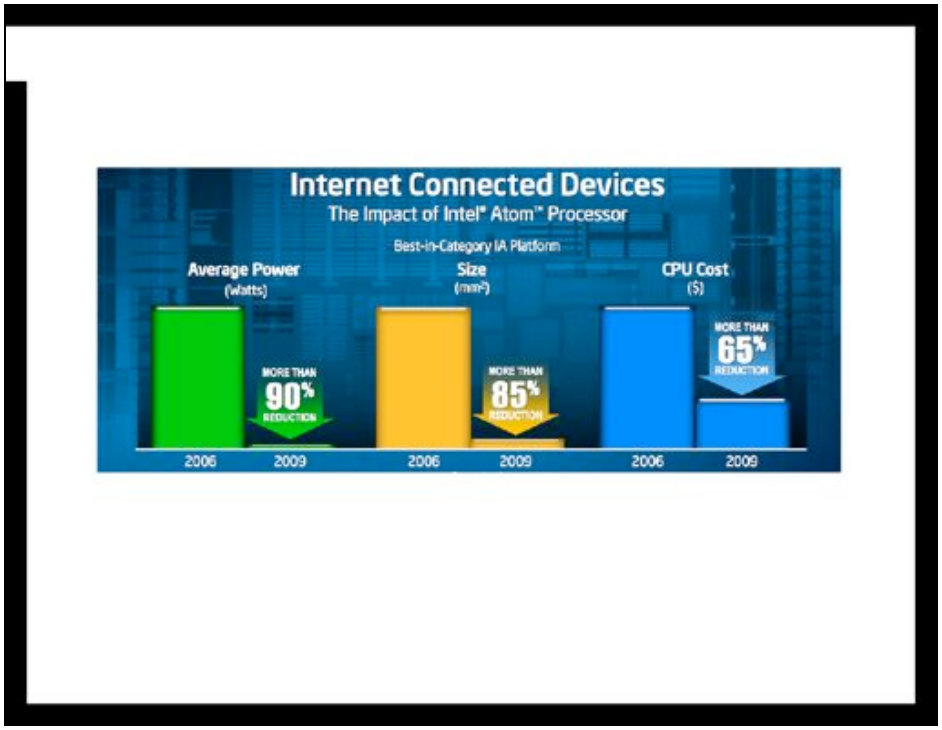
I would also like to thank the ThingM team: Kim Karlsrud, who was in charge of logistics on the ground here, Alexandra Creighton, who managed the hotel, food and Internet negotiations, and Tod Kurt, my business partner in ThingM, who tolerated all the chaos.



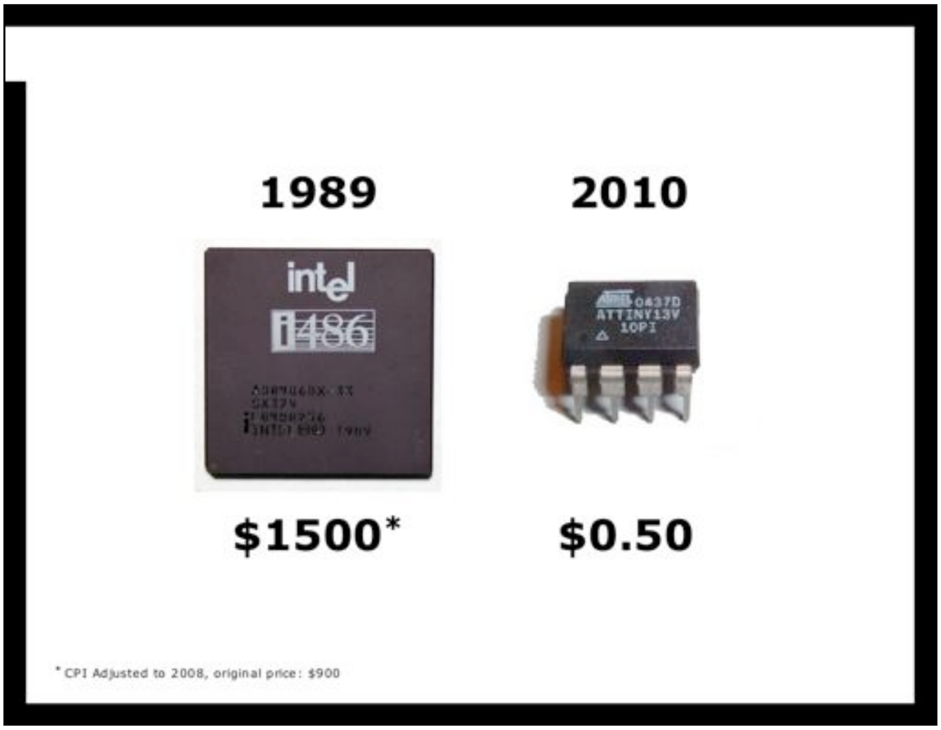
I want to start by mentioning a curious phenomenon. You may have noticed that the clock speed of today's new CPUs is basically the same as that of CPUs from five years ago, around the time Sketching started. For those of us who used computers in the 80s and 90s, this is very confusing. After 20 years during which clock speed of microprocessors increased by 3 orders of magnitude, suddenly clock speed abruptly stopped going up in 2004. The industry went from exponential growth in clock speed to no growth, zero growth, in one season. It's like someone slammed the emergency brake.

I call this phenomenon Peak MHz, and I think it's one of the indicators that there's something very significant happening in small scale information processing right now.

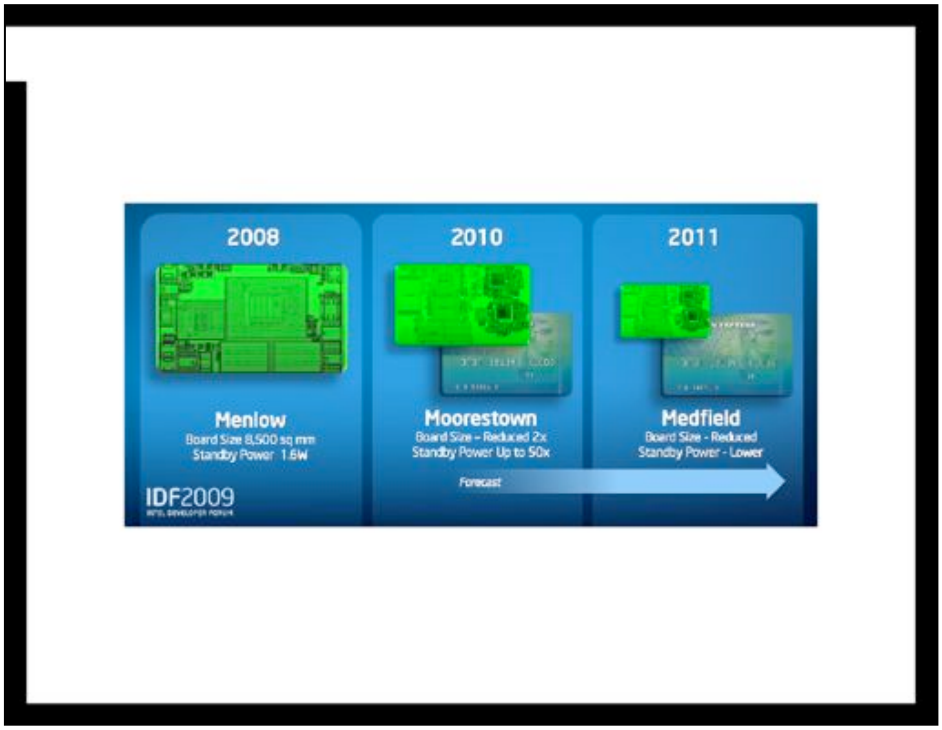
Unlike oil, we're not literally running out of CPU clock cycles, but we are seeing a reevaluation of how we understand the value that computers provide. This has resulted in a shift in the strategy of microprocessor makers, consumers and, increasingly, designers. What happened in 2004 was, broadly speaking, that chip manufacturers saw that we were running out of uses for big, energy-hungry, hot processors, and they shifted the game. Since 2004 the competition has shifted from raw CPU to making smaller, cooler, cheaper chips that can do as much work as older chips, while using fewer resources.



Here's a slide from a talk Paul Otellini, the CEO of Intel, gave last year. Notice that instead of talking about numbers going up, processor manufacturing has become all about pushing numbers down. Instead of competing on doing more with more, they are now competing on doing more with less.



One of the main effects of this shift is that in addition to pushing the price and energy consumption of the latest CPUs down, it also pushes the price of all previous processing technologies down along with it. For example, at the beginning of the Internet era we had the 486 as the state of the art and it cost $1500 in today's dollars. Today, you can buy that same amount of processing power for 50 cents, and it uses only a fraction of the energy. That is the same 3 orders of magnitude drop as the increase in speed to 2004. This is not unrelated, because both are the product of the same underlying technological changes.



Here's another Otellini slide. It's essentially saying "look, we're making the same thing smaller and cheaper every year."

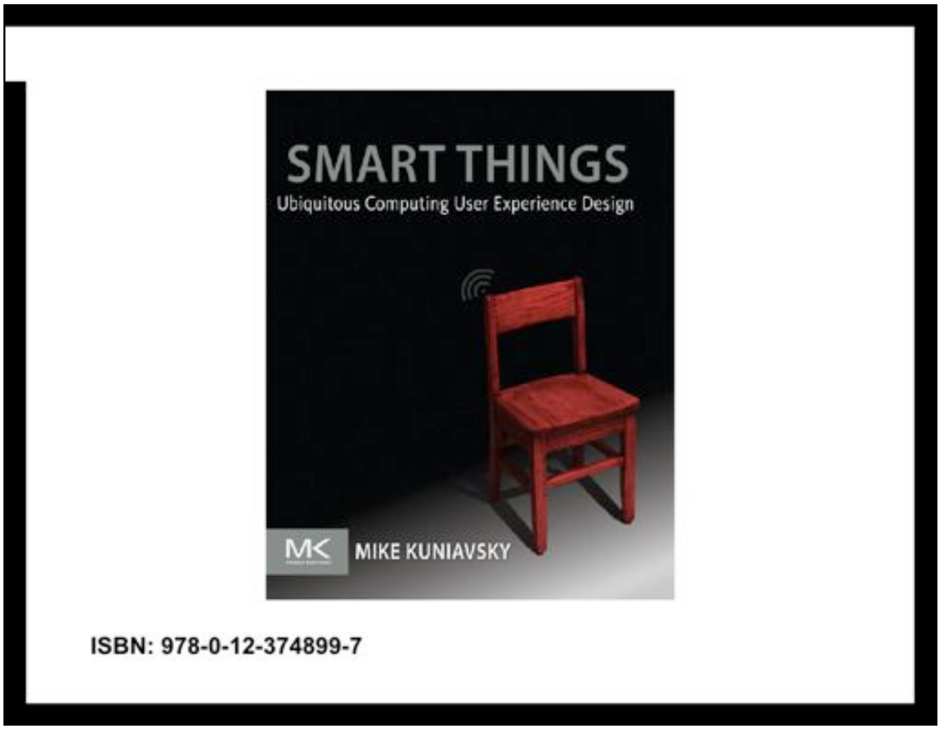
When a technology falls in price this much, it opens up enormous possibilities and creates fundamental changes in society. Steam engines similarly lowered the price of harnessing energy by orders of magnitude…and the Industrial Revolution was born as people found all kinds of new uses for readily-available mechanical energy and new ways of remaking their world.

I believe that we're finally on the cusp of that kind of transformation in information processing. The last twenty years of powerful, but wasteful and expensive monolithic computers is a prologue to the transformation of information processing into a design material.

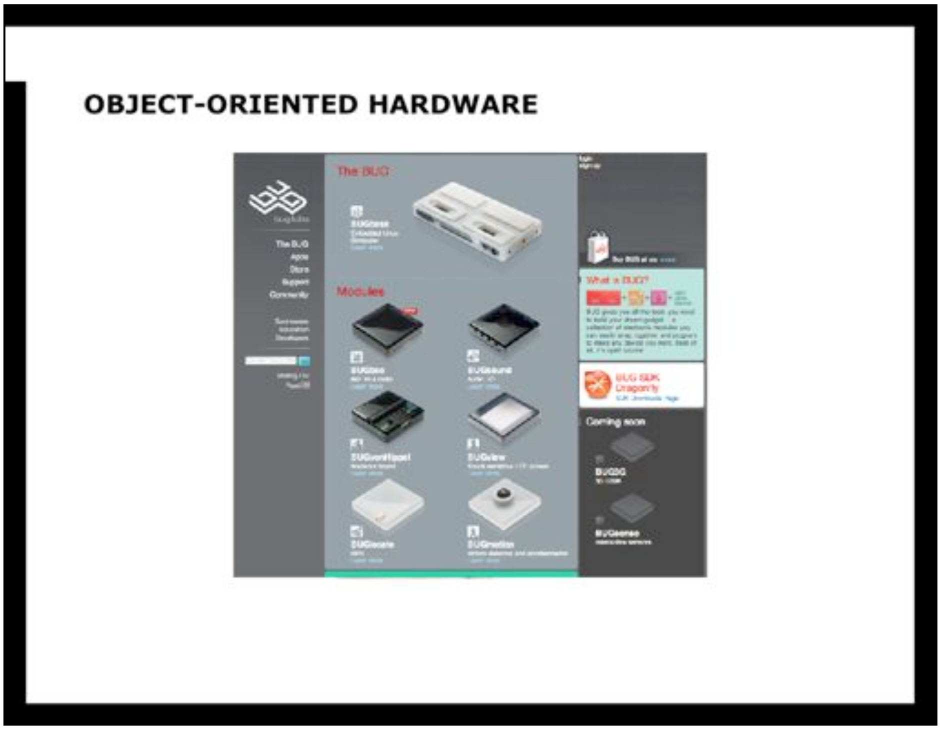
You can see similarly transformative effects if you look at what happened when the price of extracting aluminum dropped by two orders of magnitude in the late 19the century. When something becomes cheap, it quickly joins the toolkit of things we create our world with. It becomes a design material. Sometimes for better and other times for worse.

Because cheap processors have drastically lowered the cost of taking information in, evaluating it, manipulating it, rearranging it, and acting on it, information is very quickly becoming a material to design with. It is no longer unthinkable to have an everyday object use a small embedded processor take a small piece of information—say the temperature, or the orientation of a device, or your meeting schedule—and autonomously act on it.

This capability of everyday objects to make autonomous decisions and act using arbitrary information is as deep an infrastructural change in our world as electrification, steam power, and mechanical printing. Maybe it's as big of a deal as bricks. Seriously, it's a huge change in how the world works, and we're just at the beginning of it.



In my upcoming book, I talk about the properties of information as a material. There isn't enough time to go into them here in detail, but what determines them is that they are not simply information theoretic properties, they are design properties: capabilities and constraints that make it possible for designers of anything to consider embedded information processing the same way they would consider making something out of plastic versus aluminum.



One of the properties of information is that it can abstract knowledge, which allows it to reduce complexity, including the complexity of information technology itself.

Embedded processors make it possible to create an abstraction layer around basic sensing, processing and actuation components to creates building blocks that are meaningful in human terms, rather than just electronic terms. Each block has a CPU and communicates with other blocks over a network. Rather than starting from basic principles of electronics, designers, students or artist will soon be able to focus on what they're trying to accomplish, rather than which capacitor to use. Similarly, object-oriented hardware will turn information from a raw material into a design material.

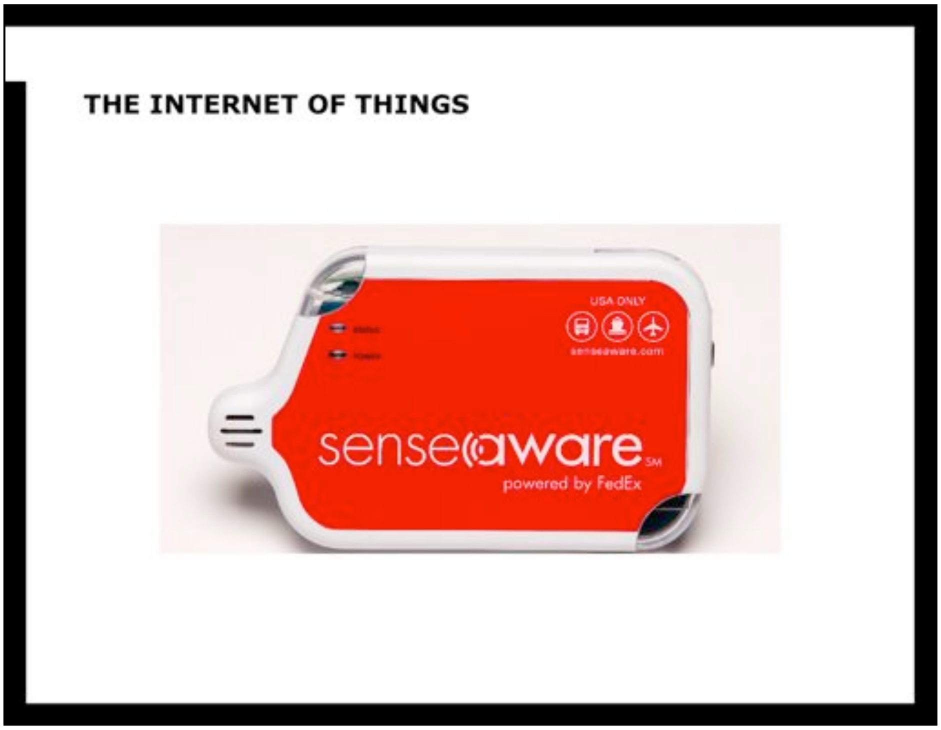
This is where we're at right now, and this has historically been the primary focus of this event, but we're quickly expanding past it. The toolkits are stabilizing, allowing audiences to growing increasingly sophisticated in their understanding of the capabilities of the material.

Most images from Jacob Nielsen's PhD, "User-Configurable Modular Robotics"

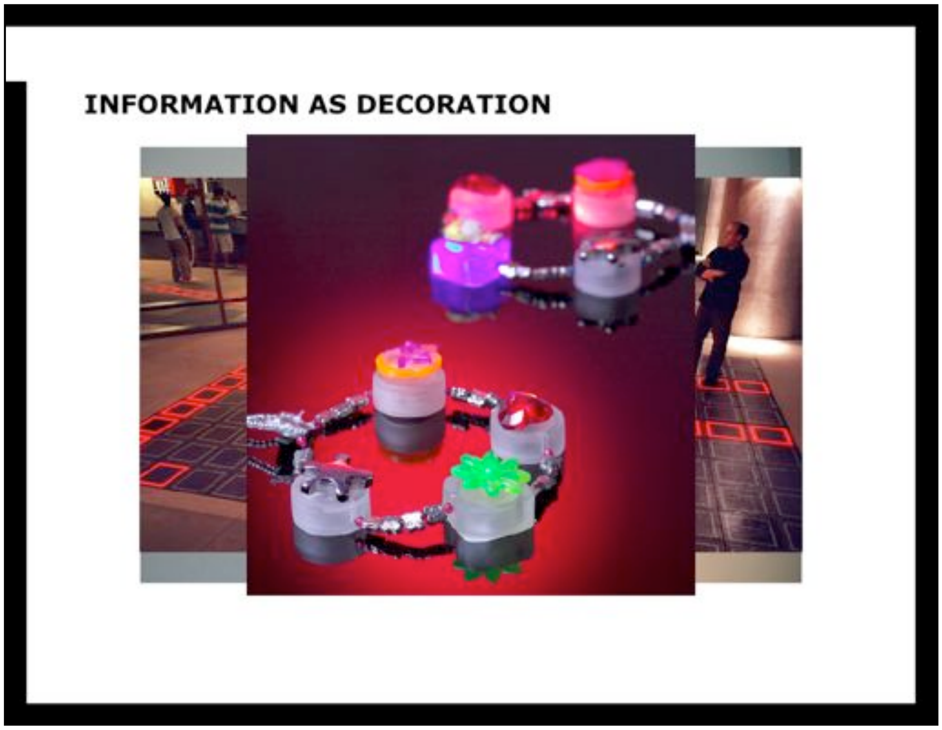
Also LittleBits from Bdeir, Hoefs, et al.

Tinkerkit from Tinker.it

Bug Labs



I think that what's being called The Internet of Things is an emergent property of cheap technology that's available in abstracted blocks of functionality. FedEx's Senseaware is essentially a cluster of sensors and a GPS unit attached to a phone blob for network connectivity. It's an application of object oriented hardware that's essentially a novel configuration of existing smart nodes than a product of basic electronics or computer science first principles.

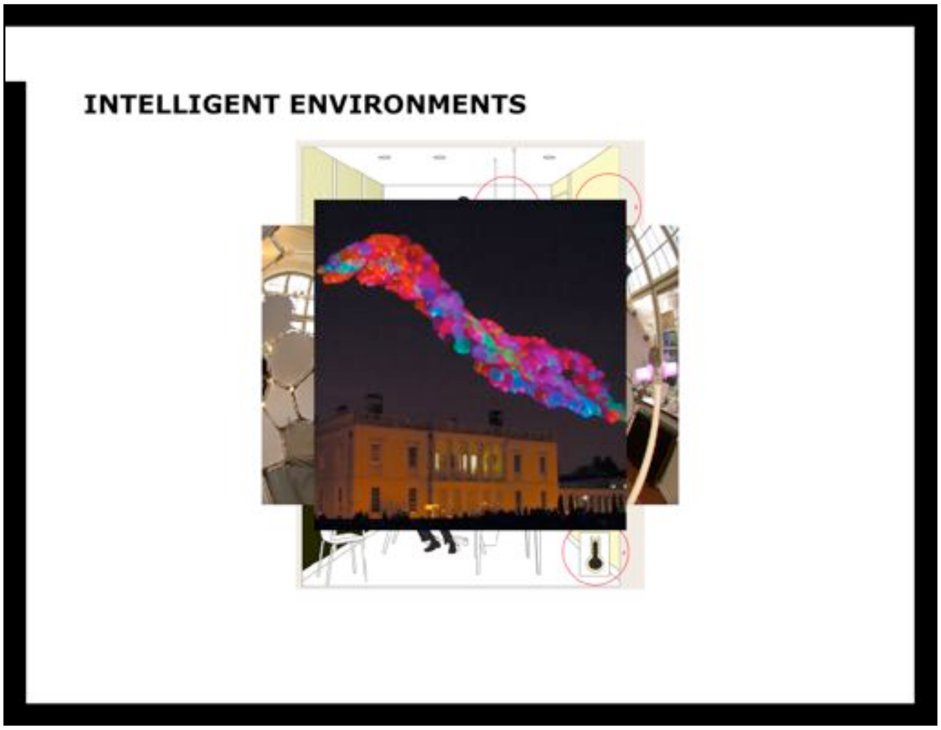


Cheap processing also creates the opportunity to use information as a decorative material. A lot of data visualization today is as much about decoration as it is about information analysis or communication, and that trend is only going to continue. Information is no different a material than any other material. Wood can hold up a house, or you can make a sculpture with it. Information can be used to create incredibly beautiful, profound esthetic experiences. It has already revolutionized music and cinema, but treating as a permanent material, rather than a medium, creates fantastic new opportunities.

Shelf by Jean-Louis Frechin

Floor by Enteractive

Buddy Beads by Ruth Kikin-Gil



When taken all together, all of these changes mean that at a large scale, our environment is growing increasingly information-based on a fractal level. Small information devices make large information devices that combine to form whole environments made with information as a core material.

From Herman-Miller's "Always Building"

TU Delft's Interactive Environment project

Usman Haque's Sky Ear

Hello.Wall

Where will this lead? Well, just as we didn't get our flying cars, but we didn't have to fight atomic hydroplaning Soviet battleships, working with information as a material is a negotiation with the technology the material represents. New materials create both possibilities and problems.

We here at Sketching are engaged in a fundamental new task. We are the ones who are largely defining which capabilities of information as a material to enable, and which to suppress. Semiconductor manufacturers have created the raw material, but we are the ones who are collectively creating the building blocks of the future.

Thus, it is our responsibility to maintain a dialogue about what technology building blocks can do, what they should do, and what they should not.

Mike Kuniavsky
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Thank you.