



No Boundaries: The challenge of ubiquitous design

By Adam Greenfield

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Sometimes a change in technology has implications that are so epochal that everyone must wrestle with them, accommodate them, or prepare for them. The revolution in information technologies known as “ubiquitous computing” (or ubicomp) is the most recent such change, and it is beginning to impact the practice—and the business—of digital design.

The phrase “ubiquitous computing” was coined by the late [Mark Weiser](#), in work at Xerox PARC that dates back to the late 1980s. He saw ubicomp as the next logical step in our relationship with the digital tools we use, an inevitable consequence of the historic shift from many users sharing one machine to many devices serving one user. As Weiser described it, ubiquitous computing is information processing that has left the desktop behind, and been distributed throughout the built environment: “invisible, but in the woodwork everywhere.”



Everyware icon: This object has imperceptible properties.

Nor was Weiser the only one who had ideas along these lines. Similar efforts were launched at a wide variety of think tanks, corporate “visioning centers” and academic research facilities, where terms ranged from “pervasive computing” to “ambient intelligence” to “tangible media.” I subsume all of these activities into a broader, umbrella category, which I call “everyware.”

Booting up

At the moment, most of the “ubiquitous” projects that have so far seen the light of day consist of one-off, bespoke pieces, prototypes designed by engineers with the needs and predilections of other engineers in mind. Examples include PARC’s early “[tabs](#),” “[pads](#)” and “[boards](#),” Georgia Tech’s transitional [Smart Floor](#) of the late ‘90s, or NTT’s recent [Red Tacton](#) “body-area networking” system—which uses the human body’s own electrical field to convey information wirelessly. They’re proofs of concept more than anything else, nowhere near refined enough for the relentless crush of everyday life.

However, there is now a steady stream of applications that have moved beyond the lab. Since 1997, residents of Hong Kong have been using a single, Radio Frequency Identification (RFID)-equipped smart card called “Octopus” for everything from purchasing rides on the tram and snacks at the corner store, to getting in their front door. A Pittsburgh-based startup called **BodyMedia** offers a wireless biometric monitor little thicker than a BandAid®. The data it collects is interpreted using information-visualization software that creates a “physiological documentary of your body,” which can be shared with your doctor through a secure website. Meanwhile, companies as diverse as Samsung, Intel® and Apple®, sensing unparalleled opportunities in the amorphous area where communication, information, and entertainment converge, are all making a play to own the “digital home.”

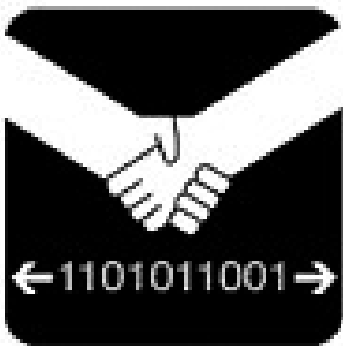
The home, the garment, and the store become sites of processing and mediation. Ordinary objects are reimagined as places where facts about the world are gathered, considered, and acted upon. And all the familiar rituals of daily life—things as fundamental as the way we wake up in the morning, get to work, or shop for our groceries—are remade as an intricate dance of information.



Everyware icon: Information is collected here.

In South Korea, an entire city called **New Songdo** is being built from the ground up with ubiquitous technology incorporated into every door, every bus stop, and garbage can. Ostensibly, a life in New Songdo (or the other “u-cities” even now being planned) will be streamlined and made less burdensome at every turn by the application of information processing to the myriad challenges of everyday life; the measures contemplated include everything from weather forecasts displayed on the bathroom mirror in the morning to garbage that credits your account when properly recycled.

In relying on an infrastructure of wirelessly-communicating, embedded processors, all these systems exhibit the signature interaction style of ubiquitous computing: a transaction between a person and an information-processing system that proceeds automatically without the need for action, intention, or even consciousness of what is taking place—what I might call “information processing dissolving in behavior.”



Everyware icon: Information processing dissolving in behavior.

What are we waiting for?

The current situation resembles the dawn of the World Wide Web, before the global brand agencies and management consultancies launched their interactive units, before browser and markup standards had been hashed out. It's useful to remind ourselves that it took a few years for a community to evolve that was capable of dealing with the web, both institutionally and technically—and that the challenges of everywhere are more complex, by many orders of magnitude.

Providing for acceptably good user experience in the ubiquitous context is also more difficult than it is on the desktop or the web. Every one of the interactions presented by a day in the life of a citizen of New Songdo—from filling the bathtub to getting to work on time to programming the weekly grocery selection—is rife with potential for the kind of breakdowns, crashes, and defaults that we PC users have had to get used to over the past few decades. And this time, they aren't confined to a box on the desktop, but scattered through the most intimate circumstances of our lives.

But technology may be the least of our difficulties. Designing ubiquitous experiences requires a comprehensive understanding of how people differ from one another, and how those differences affect what they want and how they ask for it. This recognition is embodied in the emerging discipline of interaction design, taught at places such as the [MIT Media Lab](#), [Interaction Design Institute Ivrea](#), and [New York University's Interactive Telecommunications Program](#). Ideally, programs like these give their students an understanding of the magnitude of the challenge implied anytime the deployment of information technology in everyday life is contemplated.



Everyware icon: This space is self-describing.

The most basic fact of ubiquitous computing is that it takes place out in the world, in a much more volatile, complicated and unpredictable environment than that presented by the relatively bounded arena of the web. People come and go, their needs and desires changing from moment to moment according to a context that is rarely made explicit. Observing ordinary people in the course of their daily activities; modeling their needs with sensitivity, insight, and accuracy; and developing an appropriate vocabulary for their interaction with the technical systems around them is a hurdle no less significant because it is human.

The big screen

The distribution of processing power throughout the environment means that interacting with computational services via the customary combination of screen and keyboard is no longer practical. Ideal for the one-to-one relationship of user and machine implied by personal computing, the screen and keyboard make little sense in the relatively unbounded, fluid, multi-user context of everywhere. New interfaces incorporating touch, gesture, and voice recognition will come into play.



Everyware icon: A gestural interface is available here.

Specifying just how people will use these interfaces is an area in which the practice of design will have to change. How does one design an interactive experience that is not centralized on a screen? Over what is now a full decade of experience with the World Wide Web, designers have become accustomed to a more-or-less standard array of deliverables used in site development, from mood boards through to wireframes and technical use cases. While many of these documents will retain their utility in developing for ubiquitous systems, the challenges posed by the latter case—accommodating the needs of multiple users, each free to move in both three-dimensional space and time, as they deal with multiple interactive systems—suggest that entirely new types of deliverables are becoming necessary. These may have more in common with architectural blueprints, or even choreographic notation, than anything we'd currently recognize as a digital-design document.

A major challenge implicit in modeling ubiquitous interactions is distinguishing utterances and gestures intended to be system commands from other casual behaviors. Systems will constantly be faced with the question: "Are you talking to me?" The user will be engaged in transactions with other people and other co-located technical systems, and there is a constant risk of misinterpretation as their behavior will be inherently less predictable than that of someone seated before a keyboard, engaged in a more-or-less dedicated relationship with a single computer. Both our design practice and the associated deliverables will have to account for this variability.

The potential imperceptibility of ubiquitous services in a given environment is also a challenge. Icons, visual signage systems, or other obvious indicators will need to be developed, simply to explain to the unknowing public that ambient information is available. Some proposed icons along these lines illustrate this article. Alternatively, we may also want to indicate when services are not available. There are many reasons, privacy being not the least of them, why we might wish to escape the network.

We already have a hint as to how signage might interact with ubiquitous system, thanks to the various "spatial annotation" efforts that have cropped up in the last few years such as [Semapedia](#), or the [QR codes](#) so prevalent in Japan. The latter let anyone with a camera-equipped phone (and that's just about everyone) snap a picture of a QR-enhanced sign, or map, or business card, and get taken directly to the relevant website. But, for the most part, these contemporary efforts rely on 2D barcodes to convey information, which presents us with both a problem and an opportunity: beyond the fact that such barcodes are obviously not human-readable, they're simply ugly. A world liberally peppered with 2D barcodes would be an aesthetic affront. Meaningful, aesthetically-pleasing indicators, legible to all kinds of people—perhaps something along the lines of the [Yellow Arrow](#)—would go along way toward making pervasive annotations less problematic. The project only awaits the energy, insight, and talent of the right designer.

Out of the box

Our notion of information technology as being confined to these boxes we call “computers” is changing thoroughly, permanently, and irrevocably. While currently the power of information technology is easily accessible only to a relative few, confined to a comparatively narrow band of circumstances, and used to address only certain kinds of situations, everywhere will invest much of the built environment with processing power, with implications for just about all of the things we do there.

This is why, perhaps surprisingly, I think of everywhere not so much as a computing challenge, but as a social challenge. The consequences of endowing the objects and surfaces of everyday life with processing power will be much bigger than a single industry. Based though it may be on the widely distributed deployment of microprocessors, the concepts most useful for understanding everywhere will be those drawn from the study of social and cultural evolution.

If New Songdo is indeed a valid template for life in the ubiquitous city—and this very much remains to be seen—then information technology will play a prominent role in most of the choices made by most people on most of the days of their lives. Assuming that the inevitable stumbles can be handled by the equivalent of 404 errors or blue-screen crashes is unacceptably naive. We’ll need to do quite a bit better.

The role of designer assumes a new importance in this context—a new responsibility for ensuring that, wherever possible, the ubiquitous systems we make together improve (or at the very least do not unduly burden) the everyday lives of their users. But if everywhere calls upon its designers to act with unusual delicacy, and above all compassion for the needs of a hugely enlarged and diversified user base, it also presents rich opportunities for personal development and growth on the part of those designers. Everywhere extends our efforts in that beautiful, endlessly intriguing, occasionally exasperating, place where we all live and breathe.

ABOUT THE AUTHOR

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RESOURCES

Mark Weiser’s original ubicomp page, <http://sandbox.xerox.com/ubicomp/>
Tangible Media Group, MIT Media Lab, <http://tangible.media.mit.edu>
E-Zpass, <http://en.wikipedia.org/wiki/E-ZPass>
New Songdo City, www.new-songdocity.co.kr/
Xerox PARC, <http://sandbox.xerox.com/parctab/>
Georgia Tech Smart Floor, www-static.cc.gatech.edu/fce/smartfloor/
RedTacton, www.redtacton.com/en/
NYU ITP, <http://itp.nyu.edu/>
Interaction Design Institute Ivrea, www.interaction-ivrea.it
Semapedia, www.semapedia.org
QR codes, www.denso-wave.com/qrfeature-e.html
Yellow Arrow, <http://yellowarrow.net>

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