Questioning Invisibility

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Should invisibility be the guiding design goal for ubiquitous computing?

A good tool is an invisible tool. By invisible, I mean that the tool does not intrude on your consciousness; you focus on the task, not the tool.

– Mark Weiser

The invisibility of today’s technology is often a blessing. My laptop can be used as a word processor, TV, and stereo without changing shape, and I’m grateful that I don’t have to think about transistors, compilers, and operating systems while I use it. However, is invisibility always a good thing?

When Invisibility Fails

Benjamin Mako Hill has been examining instances where the invisibility of technology breaks down. His website, revealingerrors.com, documents occasions when a crash or error makes one of the invisible technologies underlying our lives alarmingly visible, forcing us to confront its technological innards. Figure 1 shows a few examples.

The crashed ATM with its exposed Windows desktop and the GPS system that locates itself in the ocean are self-explanatory errors, but the third example requires some elucidation. The text at the top of the webpage should read “Gay eases into 100 final at Olympic trials,” Gay being the surname of athlete Tyson Gay. This strange headline reveals the fact that the website posting the news feed, a conservative network called One News Now, uses a program to adjust the language of AP news stories. Here we see that part of their program replaces instances of the word “gay” with the word “homosexual.”

Hill argues that such breakdowns
aren’t necessarily bad. Though inconvenient and frustrating, they can reveal the inelegance, fragility, and questionable practices behind technological systems. I can use that information to make more informed decisions; I might very well change banks if I knew more about my favorite ATM’s operating system.

Does this mean we should start designing error-prone systems? Of course not. But it does raise a question about the narrow design goal of invisibility. Systems that vanish into the background aren’t inherently good ones. The examples in Figure 1 are troubling demonstrations of some of the things invisibility can hide.

LEVERAGING VISIBILITY FOR EDUCATION

The errors documented on Hill’s website are funny, fascinating, and enlightening; consequently, they provide wonderful opportunities for teaching and learning.

Imagine the curiosity and delight that an encounter with one of these broken systems could inspire in a young person. There are two facets to this appeal. First, the errors are engaging—they surprise us and force us to notice technology we might have otherwise ignored. Second, they introduce legibility to technology—they reveal interesting information about how it works.

In the research group I direct at the MIT Media Lab (hlt.media.mit.edu), we design educational technology that is deliberately engaging and legible. We exploit these properties to get students excited about technology. Our particular approach focuses on using new and unusual physical materials to create compelling and comprehensible systems.

For example, during the past several years we have been working in the emerging field of electronic textiles, or “e-textiles,” integrating electronics, computers, and textiles. We began by tackling a fundamental engineering challenge: How do you attach computers to fabric? Once we had developed robust solutions to this problem, we focused on making the domain accessible to students.

The result of our efforts was the LilyPad Arduino (L. Buechley et al., “The LilyPad Arduino: Using Computational Textiles to Investigate Engagement, Aesthetics, and Diversity in Computer Science Education,” Proc. 26th Ann. SIGCHI Conf. Human Factors in Computing Systems, ACM Press, 2008, pp. 423-432). As the leftmost image in Figure 2 shows, this toolkit consists of a set of sewable electronic modules—similar in spirit to Lego Mindstorm modules—that users can stitch together with electrically conductive thread to make interactive textile-based computers.

In a series of courses and workshops, we found that this very visible new technology could uniquely capture the imagination of teenagers and teach them the fundamentals of computer science and electrical engineering. Interestingly, young women were especially excited about this blend of textiles and computing. The other two images in Figure 2 show a young woman from one of our workshops first constructing and then modeling her course project, an interactive light-up jacket with an ambient thermometer.

We’re now expanding this approach to another unusual material, paper—exploring how we can blend paper and paint with computers and electronics. We’ve designed a paper computing kit that consists of magnetic sensors, actuators, microcontrollers, and wireless devices; ferrous paper, to which the modules stick; and a jar of conductive paint, which is used to connect the modules across the paper. Students can use the kit to paint beautiful, functional electronic devices onto paper. Figure 3 shows images of a prototype kit and a construction example: an electronic pop-up book built by Jie Qi, an undergraduate researcher in our lab.

We’ve just begun to hold workshops to explore how we might employ this kit to teach embedded computing (J. Qi
INVISIBLE COMPUTING

Figure 3. Paper computing kit. Left: Prototype kit. Right: Electronic popables.

The Living Wall is a flexible ubicomp system. However, it also functions as a decorative element in a home. Like the other examples mentioned here, it wasn’t designed to be invisible; it elicits and rewards attention.

Invisibility is a narrow design goal. It’s not necessarily a bad one, but it doesn’t capture the full range of technological or creative possibilities. If we as computer scientists and engineers only strive to build invisible systems, we’ll neglect to build important technology that is educational, engaging, and beautiful. We should expand our focus and our rhetoric.

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