

C.S. and the City

Intel's Eric Paulos and the edges of urban computing.

By David Pescovitz

There's a bomb inside Eric Paulos' storage space. It's not your typical homebrew explosive, though. This is an information bomb. If you happen to walk by when Paulos fires it off, you may not even notice right away. But your wristwatch will probably stop. Your credit cards certainly will no longer be readable. Your cellphone will instantly become a paperweight. Carrying a laptop computer? Hopefully, you have a recent backup. With the press of a single button, the I-Bomb unleashes a powerful electromagnetic pulse that kills electronic devices and corrupts all storage media within several meters.

Paulos has demonstrated the I-Bomb at places like the San Francisco Museum of Modern Art, but he'd be ill-advised to show it off at work. Not to say that his colleagues wouldn't appreciate it. In fact, projects as unusual and provocative as the I-Bomb landed Paulos his job in the first place. Still, he works for a company where fried chips are particularly distasteful.

A BIZARRE MACHINE LABELT

Paulos is a computer scientist at Intel Research Berkeley, a corporate "labelt" in the penthouse of a downtown office building where a dozen or so scientists explore the edges of computing and networking technology. When Paulos joined the lab several years ago, the first thing he did was set up a machine shop with lathes, scopes, and assorted prototyping tools. The laser cutter took a bit more wrangling but is finally due to arrive this week. A computer science Ph.D., Paulos can hack C++ with the best of them, but he's really a lifelong maker who made a career out of building bizarre machines.

As a graduate student, he designed groundbreaking telerobots that enabled people to physically explore

remote spaces over the internet. His work at UC Berkeley bled into years of collaboration with infamous San Francisco machine performance group Survival Research Laboratories. In 1997, Paulos and SRL director Mark Pauline invited anonymous web users from around the globe to remotely aim and fire a massive air launcher loaded with concrete-filled soda cans. It was the first time lethal machinery was operated over the internet. Paulos' own tech-art collective, Experimental Interaction Unit, has exhibited around the world.

At Intel Research, Paulos directs the Urban Atmospheres program, a group exploring technology in the cityscape, from Bluetooth-enabled phones to ad hoc networks of tiny sensors. While many companies are developing urban computing applications — from location-enabled restaurant recommendation systems to real-world buddy lists — Paulos says he prefers to look between the cracks in the asphalt for research topics. After all, entire conferences are already devoted to the likes of location-enabled services and Geoweb technology.

"There are certainly moments in life for productivity and efficiency, but there are also moments for wonderment and reflection," he says. "I'd like to use technology to celebrate non-places, non-events, non-activities that actually matter a great deal to the emotional experience of urban life."

ONE MAN'S TRASH IS ANOTHER MAN'S RESEARCH PROJECT

Urban Atmospheres aims to illuminate the most subtle characteristics of city living, like the relationships you have with people you see every morning at the train station but never acknowledge, the invisible cellular infrastructure you move across, even the



Photography by Emily Nathan

For Paulos, every city is an ideal laboratory to test what he calls "objects of wonderment."



Left: Jabberwocky is a mobile phone application that detects “familiar strangers” nearby. To avoid privacy issues, the color and motion of the blocks on the display provide information about crowds rather than specific individuals.

Right: One prototype for the Connexus project is a “friendship bracelet” containing superbright LEDs that display a range of color and tactile outputs based on input from another bracelet wearer. Another version mimics the form factor of a wristwatch. Surrounding the Connexus devices are several “motes,” coin-sized wireless sensors. The matchbooks were part of an experiment about anonymous text messaging.



public trash cans you walk by on the way to the office.

Last year, Paulos and Tom Jenkins, a student at the Royal College of Art, spent countless hours stalking a single garbage can in San Francisco’s Financial District. After their field study, they built what Paulos half-jokingly refers to as “the most expensive trash can in the world” and set it on the corner outside the lab. Called Jetsam, the can is augmented with a variety of hidden sensors, processors, and a video projector. An infrared switch detects when refuse has been tossed into the can (or grabbed out of it), and snaps a digital picture. A highly sensitive scale then weighs the item and a laptop PC categorizes each bit of refuse by time and size. Meanwhile, an evolving visualization of the garbage photos and data is projected out of the can’s opening, creating a rotating galaxy of garbage on the sidewalk.

“Archaeologists dig through trash to learn history, so we looked at what trash can tell us about urban living,” Paulos says. “Is there a lunch binge at noon or a coffee craze at 3:15? If there is a continuous stream of lottery ticket stubs, does that mean the local denizens are risk takers? Instead of hiding trash, we changed it into something that people interact with.”

And they did. A young graffiti artist tagged a piece of paper and then tossed it into the can, projecting his name onto the sidewalk. Later, a businessman exiting a photo developing shop tossed his unwanted double prints into Jetsam’s mouth, creating an instant photo album on the pavement.

“It’s not as if we think Intel should be developing trash cans,” Paulos explains. “But we want to propose research ideas that might feel a little awkward, because it’s from those unusual vantage points that we may see other interesting possibilities.”

“Making things is much harder than programming because there’s no quick Control-Z undo.”

KEEPING TABS ON YOUR FAMILIAR STRANGERS

Indeed, Paulos charts urban territories and dynamics that are invisible, ignored, or taken for granted. Sashay is a mobile phone application he wrote that maps your path through the various cells in a city’s mobile phone network. The point of Sashay, Paulos says, “isn’t to help you get places, but rather cause you to reflect on how you move.” Another project for mobile phones, called Jabberwocky, extended the Familiar Stranger experiments conducted in the early 1970s by social psychologist Stanley Milgram. A familiar stranger is someone who you may see repeatedly, at the bus stop or cafe, for instance, but never interact with. You mutually agree to ignore each other. The Jabberwocky application grabs the

unique Bluetooth identifier of the mobile phones around you, creating a log of people you’ve previously encountered, even if you’ve never talked with them. Later, a quick glance at your handset reveals if any of your Familiar Strangers are nearby.

“You might not want to make friends with everyone you see regularly, but these people color your city,” Paulos says. “Jabberwocky enables you to get a sense of place based on who is there with you.”

A previous project, Connexus, highlights another form of human interaction that’s rarely discussed: nonverbal communication like the friendly smile across the room or a reassuring pat on the back. Connexus is a bracelet meant to contain a wireless radio, sensors, and actuators to facilitate nonverbal communication at a distance. Imagine a couple both wearing Connexus devices and perhaps miles apart. As the woman taps on her bracelet, her husband notices his bracelet glowing softly, not unlike a vintage mood ring. He responds by caressing the bracelet, an input that manifests itself as a gentle heating sensation on the other end. Paulos never managed to stuff all of the Connexus components into as small a wearable device as he’d like, but he says that prototyping is essential to communicating his research goals to others.

ENVIRONMENTAL RINGTONE SOUVENIRS

Right now, he’s fabricating a device that he hopes

will add a layer of audio intrigue to the urban atmosphere. Installed, say, in a public commons area, the small object will grab the Bluetooth identification numbers from the mobile devices of passersby. That data will then be translated into a unique ringtone, creating a souvenir of that location tied to a moment in time and the specific group of people nearby.

The device itself is only one part of the project. Paulos also plans to release a free developer’s toolkit to inspire others to create and deploy their own interactive objects into the urban atmosphere. For Paulos, every city is an ideal laboratory to test what he calls “objects of wonderment.”

“Making things is much harder than programming because there’s no quick Control-Z undo,” he says. “But if you’re explaining your research to someone and can’t present them with an object, they’re likely going to default to talking about things they know. On the other hand, if they can interact with an object outside their realm of understanding, they’re usually more willing to come with you into the conversation.”

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