**Critical Making Comes to Campus:**

**Designing, Prototyping and Building in Berkeley’s New Invention Lab**

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"Thirty seconds." Students are drawing frantically as EECS and new media professor Eric Paulos stands at the front of the class keeping time.

"Ten seconds." Then after a long pause, he says, "Eight second bonus." The room, only moments ago solemn with deadline tension, fills with laughter.

Time is up. The partners show the caricatures they have drawn of each other. The results range from recognizable to deplorable, but the actual drawings are not the point.

"I don't know if you were paying attention, but people were giggling in the middle of the exercise," Paulos says. "And play," he adds, "is the greatest resource in a creative economy."
science about the dilemmas and challenges around telepresence. After graduate school, Paulos was the founder of Urban Atmospheres, a research group at an Intel-sponsored lab at Berkeley. As with the telepresence project, Paulos and his colleagues found themselves investigating technologies in 2002. One Urban Atmospheres project looked at interactive experiences between people, places and objects using early mobile phone platforms. By 2006, Paulos joined the faculty at Carnegie Mellon University (CMU), in Pittsburgh, where he directed the Living Environments Lab. His research kept evolving as mobile devices continued to mature, and he started investigating how citizen scientists were using sensor technologies embedded in smartphones. While at CMU, Paulos also ran an energy-focused project, which, like his telepresence work, had multiple layers. In research backed by the National Science Foundation, his team built simple devices that were capable of scavenging and using energy on a small scale. As an extension of the project, Paulos built devices that harvest energy from public places in an award-winning project called “Energy Parasites.” The energy-scavenging parasites, which have since been exhibited in Belgium and Spain, were designed to prompt discussion about energy ownership. Paulos returned to Berkeley as a faculty member in the fall of 2012. He plans to continue investigating the interactions between people and technology, as well as the implications of emerging DIY technologies. “We look at technology, society and the milieu of culture, and we posit a future vision. Then, through the course of studies and formal investigations, we end up making objects that critically address those issues.” Paulos says about the current work of the research group he advises. “That’s the process, and it’s very much in line with what is happening in the critical making class.”

Making space

Clustered in the middle of the Invention Lab are a half-dozen wooden-topped work benches surrounded by tall stools. Along the perimeter of the room are metal shelves containing hand tools and electronics gear, various studies of materials like foam core and acrylic, and digital fabrication tools including a 60-watt laser cutter and a 3D printer the size of a dorm refrigerator. The space opened at the end of 2012 and is already filling up with examples of student work. The lab is a really cool space. Just having all those tools there and available and to come in and make stuff and print things whenever the lab is open is pretty nice,” says Cheng. “The things I learn in my other classes are more like theory or concepts. It is very rare that I get to do something that involves a little bit of programming, a little bit of circuits, a little bit of cutting things with X-acto knives and a little bit of putting things together.”

Third-year EECS major, Brittany Cheng, makes some adjustments to Tea-Rex, a device programmed to steep the perfect cup of tea. Motors connected to an Arduino controller raise and lower the neck of the apparatus.

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The idea of carving out creative spaces that combine the best of a computer lab, art studio and workshop and other collaborative spaces, like the Invention Lab, is something that also resonates with MAKE magazine’s Dale Dougherty, who is working to create similar labs in 15 Bay Area high schools. “Sometimes I feel like the real win is creating spaces where the people are visible, the work is visible, and the tools are visible. The learning in making comes from this idea of iterative process, which leads to critical making. Enjoying that process and enjoying the learning is important.”

The studio-style class attracts students from a wide range of academic disciplines, including computer science, architecture, and media studies. “Counter Culture,” their first major assignment, called for teams to develop a prototype to address kitchen-related problems. Paulos, the founder of Urban Atmospheres, a research group at an Intel-sponsored lab at Berkeley. As with the telepresence project, Paulos and his colleagues found themselves investigating technologies in 2002. One Urban Atmospheres project looked at interactive experiences between people, places and objects using early mobile phone platforms. By 2006, Paulos joined the faculty at Carnegie Mellon University (CMU), in Pittsburgh, where he directed the Living Environments Lab. His research kept evolving as mobile devices continued to mature, and he started investigating how citizen scientists were using sensor technologies embedded in smartphones. While at CMU, Paulos also ran an energy-focused project, which, like his telepresence work, had multiple layers. In research backed by the National Science Foundation, his team built simple devices that were capable of scavenging and using energy on a small scale. As an extension of the project, Paulos built devices that harvest energy from public places in an award-winning project called “Energy Parasites.” The energy-scavenging parasites, which have since been exhibited in Belgium and Spain, were designed to prompt discussion about energy ownership. Paulos returned to Berkeley as a faculty member in the fall of 2012. He plans to continue investigating the interactions between people and technology, as well as the implications of emerging DIY technologies. “We look at technology, society and the milieu of culture, and we posit a future vision. Then, through the course of studies and formal investigations, we end up making objects that critically address those issues.” Paulos says about the current work of the research group he advises. “That’s the process, and it’s very much in line with what is happening in the critical making class.”

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