

Profiles in IE

Intersecting art and technology

By Monica Elliott



Artistic vision: Associate Professor Ken Goldberg specializes in robotics at the University of California at Berkeley. In his spare time he's a well-respected artist, with installations in museums across the United States.

Arguably, art and engineering are unusual bedfellows. But that is not an argument one can make with acclaimed artist Ken Goldberg. As associate professor of industrial engineering and operations research, and electrical engineering and computer science at the University of California at Berkeley, he mixes paint and scientific pedagogy with astonishing success.

It makes sense that the son of an engineer father and a painter mother who are both teachers would turn out this way. Growing up in a household that emphasized building model rockets and go-carts along with visits to the Museum of Modern Art prepared Goldberg for the diverse environment at Berkeley.

Fellow IEOR Professor Lee Schruben

says he was instantly impressed when he met Goldberg. "Ken brings an artistic spirit and rare breadth of interests to Berkeley industrial engineering. Berkeley's IEOR department is a small but incredibly diverse group. [Because of that], we encourage collaboration with other groups on and off campus. Ken is exemplary at this. He is creative and enthusiastic," says Schruben.

One of Goldberg's projects was a Web site that recommends a selection of jokes to visitors through the use of collaborative filtering and linear algebra. Goldberg explains, "We use Eigen vectors to categorize people based on their tastes and to project for dimensionality reduction. All your ratings

give you a point in a high dimensional space, and then we use Eigen vectors to reduce the dimensionality. This time we use them to recommend jokes, but they can also be used to recommend books or artworks — anything where the quality of something is difficult to quantify. That project was an interesting application for applying mathematics to art — in this case the art of humor."

Goldberg specializes in robotics, which he finds a logical match with industrial engineering. "In my mind, what the IEOR department is about is applying mathematics and algorithms to problems of manufacturing and industry. So that marriage makes perfect sense. Robots fit perfectly in that," he says.

Schruben asserts that one of Goldberg's strengths is his ability to apply theory to practical problems. One of those practical problems is part feeding, a method of orienting parts used in manufacturing lines. Parts used in manufacturing frequently have to be oriented before they are used, and a vibratory bowl is commonly used for that purpose. Parts are dumped into the bowl, shaken, and come out onto a rack neatly arranged in single file. "The way those bowls are designed is by human guesswork, basically. It was trial and error: i.e., it wasn't scientific." Goldberg began working on the science of that process as a graduate student and continues to unravel it.

It was only a matter of time before Goldberg's artistic instincts came through in his robotics work. While a graduate student at Carnegie-Mellon University, Goldberg began programming robots to paint.

"In the art world, a big issue was, what is the role of the hand of the artist? And that has to do with the authenticity of an artwork. That whole issue is fundamental in art, especially as we move into the digital realm. And that was also something we could explore with a robot because the robot was using physical materials within a digital copy. And yet you could program the robot to execute the same painting over and over and over, and no two would be alike. So I was very interested in this idea of repetition in the context of art. Obviously, repetition is an important aspect of IE." Some of his robot-assisted paintings hang in his department's conference room.

With the advent of the Web in the early 1990s, Goldberg had an entirely new platform on which to work, which led to the development of "telerobots."

“Of course, there are many Web cams out there. What became interesting to us was if there’s a Web cam, why can’t there be a Web robot?” Goldberg posited. “So that’s when we set up the first online robot in 1994 ... called the Mercury Project.”

A camera was placed on a robot sitting in a sandbox with tools. Those who went to the Web site could move the camera by clicking the screen, and the robot would move and dig in the sand. But Goldberg wanted a robot that could run 24 hours a day, seven days a week, with no one in the lab.

Thus, the Telegarden was born. The project, which has been online for six years, allows participants to plant and water seeds by manipulating the robot’s movements with their computers. “We’re using the standard interface of your browser,” explains Goldberg. “We give you images and a schematic — a top view of the robot. And when you click with your mouse, we use that information to move the robot and give you the images. So that’s why the interface is very simple; it’s two-dimensional. We had to design the system so that you could, with that simple interface, be able to control the robot. We take the data that comes in when you click on an image, and we get the coordinates of where your mouse was. We interpret those coordinates, and then we send a command to the robot to move, snap a new camera image, and then we send that back to you.”

In order to plant a seed, registered users must have at least 100 hits in the garden. “We want to only let people who have made a certain commitment participate,” says Goldberg. “But if you’ve done that ... when you click on a plant, it sets up a sequence of motions where the robot actually digs a hole, collects a seed, drops it in, closes the hole, and then waters the seed. In that way, it’s a little bit of autonomous behavior.”

Goldberg further demonstrates the compatibility of art and technology with his lecture series “The Art, Technology, and Culture Colloquium.” He explains, “If you look at the union of art and technology and culture, that pretty much covers everything

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Education: B.S.E. electrical engineering, University of Pennsylvania; B.S.E. R&D management, University of Pennsylvania; M.S. computer science, Carnegie Mellon University; Ph.D. computer science, Carnegie Mellon University.

Favorite book: *The Present Age* by Søren Kierkegaard.

Favorite movie: *Casablanca*

Favorite thing to do: Cook

IE, therefore I am: “We have robotic window shades because my wife likes to wake up in the light, and I need it to be dark when I sleep. Our compromise is that I rigged up our window shades on a timer. So we put them down at night, and it’s nice and dark so I can sleep. And then at 6:00 in the morning they go up automatically, so we wake up and it’s light. So we kind of solved that problem. I think that’s an application of engineering to life.”

A grandmother’s love: “My grandmother asked me [what the Joseph Engelberger Award is], and I said, ‘Well, it’s kind of the Nobel Prize for robotics.’ She then told her bridge club that I had won the Nobel Prize.”

Ken Goldberg

that’s going on. But if you look at the intersection, that’s much smaller. What is something that really intersects all three? Over the past five years we’ve brought in 40 speakers, and we just got funding ... to continue it for next year.”

Projects like the lecture series have been a labor of love for Goldberg because of the opportunities they provide. “It’s a way for me to connect to many departments, from

art to philosophy to all the branches of engineering. Art and technology come together at a place like Berkeley where it really has strength in both, and to the faculty’s credit, tries to encourage people to do both. There’s that trans-disciplinary spirit that I think is really key.”

Goldberg credits that same spirit with helping him find his wife. “I had read a book called *Art and Physics* ... written by a man named Leonard Shlain. When I moved here, I heard that he was giving a lecture, so I went to his talk, and that’s when I met his daughter. It was love at first sight. She’s a filmmaker and also runs an award show for Web sites called the Webby Awards, so that’s a nice combination because she’s interested in art and technology and so am I.”

Goldberg can attribute the trans-disciplinary spirit with additional career successes. Of his many professional achievements, he is most proud of receiving the Joseph Engelberger Award from the Robot Industries Association in 2000. In 1990, his work *Ouija 2000* was displayed at the Whitney Museum of American Art’s Biennial Exhibition. Participants control a virtual Ouija board with a computer mouse and ask questions of the supposedly telepathic entity.

But Goldberg’s art is not relegated to the Internet. “I’m very interested in art that addresses contemporary experience — human experience. So since we live in a technological world, I’m interested in that reality, and the Internet is just one of those technologies,” he says.

Goldberg seems to have this mélange of art and technology down to a science. “One of the things I find about having this mixture [of interests] is sometimes it helps me do research because I’m thinking about problems that are not strictly within the engineering box,” he says. “I think that doing art makes me a better engineer, and I also think that doing engineering makes me a better artist.” ♦

Tell us your story

If you or someone you know has an interesting career in industrial engineering, let us know. Contact Monica Elliott at (770) 449-0461, ext. 112, or e-mail melliott@iienet.org.