# The Wandering Gadgeteer

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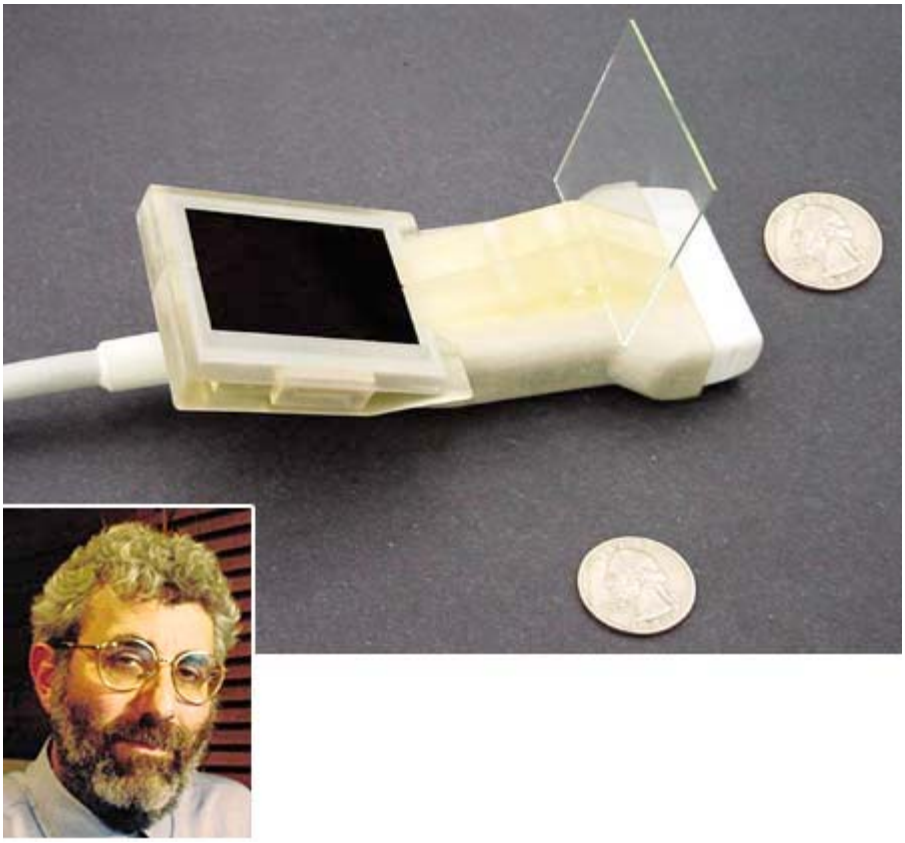

Biomedical engineer George Stetten's Sonic Flashlight [above] lets doctors view ultrasound images directly over the part of a patient's body that's being scanned.

GEORGE STETTEN

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# The Wandering Gadgeteer

## From music to engineering to medicine and back again, George Stetten has followed his passion for designing devices

**By David Kushner**

Wouldn't it be nice to have X-ray eyes? That's what George Stetten thought back when he worked as a hospital intern. "I hated putting long needles in people without seeing where I was going," he recalls. A decade later, now working as a biomedical engineer, he finally landed on the solution: the Sonic Flashlight, a handheld imaging device that lets doctors literally see under a patient's skin.

It's just the latest product devised by a man whose passion for "gadgeteering," as he calls it, has taken him down some widely divergent paths. It all began with a broken microphone. Like many a teenage boy growing up in the suburbs, Stetten fancied himself an aspiring rock star. But he also started fixing his own sound equipment and making his own electronic instruments, and that whetted his appetite for invention.

In the decades since, he's designed and built a computer for a deep-sea vessel, a telemetric egg for studying endangered birds, and, of course, the Sonic Flashlight. And Stetten still finds time to work on music, which is really not so different from engineering, he says. "They're both about repetitions and variances," he says. "It's what's expected and what's not expected." Much like Stetten's career.

### Doing the unexpected

As a young man, Stetten seemed destined to become a doctor, just like his parents, both medical researchers at the U.S. National Institutes of Health (NIH) in Washington, D.C. But he was bored to tears by pre-med classes and the hours of rote memorization. Instead he studied electrical engineering at Harvard, graduating in 1976, and then joined the Massachusetts Institute of Technology's experimental music studio (now part of the Media Lab), where he helped build one of the first music synthesizers. He also worked on perfecting his own musical chops, studying piano improvisation at the New England Conservatory of Music in Boston.

Stetten then got the opportunity to go much deeper, literally, into the field of engineering, when he was hired in 1980 to help build a computer system for the U.S. Navy's Alvin, a manned deep ocean research vessel operated by the Woods Hole Oceanographic Institution. Since its deployment in the mid-1960s, Alvin had been making waves, scouring the ocean floor off the Spanish coast for an abandoned hydrogen bomb and bringing the first humans to survey the remains of the Titanic.

Alvin's data-gathering abilities were limited, though; its crew would rely on programmable calculators because there was no on-board computer. Stetten's team changed that by installing six interconnected RCA computers, for which Stetten wrote the data acquisition and navigation programs. Although the vessel could not relay information to the surface, it could now record data for later retrieval.

### Laying an electronic egg

Stetten's next project took him to New York City's Bronx Zoo. At the time, zoo personnel were desperate to find a way to protect the endangered white-naped crane. Researchers had determined that if they removed eggs from beneath the nesting crane, it would lay more eggs, thereby upping the bird's chances of reproducing. The problem was that the purloined eggs did not do well in incubators.

To divine a solution, Stetten designed a radio telemetric egg that could sense the range of temperatures experienced under the big white-and-black birds, the better to replicate those conditions in the incubator. First Stetten had to build an antenna small enough to squeeze into the egg. Next came finding a way to power the radio

transmitter, operating at 150 MHz for a month and a half. The solution was a special lithium battery.

The team disguised the electronics inside a hollow plastic Easter egg. It convinced the bird. "Birds are dumb," says Stetten. "They don't understand the difference between a real egg and a fake one. We even have footage of the crane defending the fake egg against a raccoon."

## A taste of his own medicine

In 1986 Stetten finally did what until then he'd studiously avoided: he enrolled in medical school at the State University of New York (SUNY) at Syracuse. Even then, though, he managed to mix his medicine with engineering. After graduating from SUNY, he did his medical residency at Duke University in North Carolina, where he got to work with one of the fathers of ultrasound, Olaf von Ramm.

Von Ramm's team was constructing the first machine for doing real-time, three-dimensional ultrasound. For this they needed a faster scanner, one that didn't require mechanically wobbling the transducer, the probe that emits and receives sound waves. Stetten built a prototype of the scanner from scratch, starting with the circuit board. Thus, at the age of 39, he finally found himself exactly where he wanted to be: alone, in a lab, holding a soldering iron. "I took off my beeper and got to work," he says. "I was never happier in my life."

Stetten spent the next eight years developing the technology, which has since been commercialized and is now used by cardiologists. Meanwhile, a grant from the Whitaker Foundation enabled him to complete a doctorate in biomedical engineering at the University of North Carolina at Chapel Hill. In his spare time, he set up an infrared network to link his and his students' Apple Powerbook laptops, thereby creating, in 1994, one of the world's first wireless classrooms.

## Interests converge

In 1999, Stetten, an associate member of the IEEE, joined the University of Pittsburgh's bioengineering department, with a joint appointment at Carnegie Mellon University's Robotics Institute. Soon after arriving, he got the idea for the Sonic Flashlight. The inspiration grew from his frustration with the medical field. While ultrasound can aid in tricky procedures like amniocentesis, in which a long needle is inserted into the belly of a pregnant woman to extract amniotic fluid from around the fetus, the machines have an obvious flaw: the doctor has to keep turning her head to look at the screen, thus taking her eyes off the needle.

A better solution, Stetten realized, would be something handheld that would let a doctor view a spot within the patient's body. It was an intriguing notion, and ultimately not too challenging, Stetten says. "All I had to do was resize the image in real time and find a semi-transparent mirror." He calls the technique real-time tomographic reflection.

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The Sonic Flashlight, still a prototype under development, is about 15 centimeters long and adds only a gram or so to the overall weight of the ultrasound probe [see photo]. The image acquired by the probe is displayed on a flat-panel screen at the flashlight's other end. The displayed image is then reflected by a half-silvered mirror, which sits at an angle to the monitor. As the doctor looks through the mirror, she sees the reflected ultrasound image overlaid on the actual area being scanned.

To insert a needle into a patient's abdomen, for example, a doctor would hold the device against the patient's skin and then use the display of organs and tissue to

better guide the needle. Though it sounds tricky, Stetten says, doctors who have tried it find it "quite natural." The resulting composite view is an example of "augmented reality," in which an image is used to enhance one's view of the real world. The device recently received a U.S. patent (No. 6599247), and Stetten also won funding from the NIH to test the product in humans, probably beginning within the year.

### Back to musical roots

Stetten makes a point of involving students in his pursuits. "Students love being part of an experiment," he says. "They'll put up with inconvenience to do something real." He does it with his first love, music. "Music provides a wonderful tool in the engineering curriculum," he notes. "Devices that produce sound make wonderful demonstrations for students. The overtones in distortion, the impulse response in reverberation, and the data compression in an MP3 file all mean something personal to most students."

Recently Stetten taught a course that his 12-year-old self would have enjoyed: building electronic instruments. One student created a "grimace guitar" that makes music according to the changing expressions on the player's face. "Electronics has introduced an entirely new phylum into the instrument kingdom, producing sound through electromechanics, signal processing, and computer science."

What makes the course work is the passion many students have for music, he adds. "Tapping into this raw passion by incorporating music into the teaching of engineering can help bring the subject to life and generate new respect in the classroom for old rockers like me."

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