When young Alper Bozkurt trekked to the local bakery in his native Turkey, he usually wore what he liked to call his “old-man sweater” with argyle patterns and his old-school large-framed glasses.

“Ah, it’s the Professor,” the man behind the counter frequently said.

It was a nickname that stuck with Bozkurt through middle school, high school and college. On his first day of engineering classes at Istanbul’s Bogazici University, the MIT-trained chair of Bozkurt’s electrical engineering department asked his class of first-year students who was interested in pursuing a career in academia.

Bozkurt’s arm shot up. Then he looked around and saw everyone else sitting still, staring at him. He couldn’t understand why the others weren’t raising their hands.

Now the lauded researcher and assistant professor of electrical engineering at NC State is finally on the verge of earning the lofty title he’s answered to since he was a child. Scientific research is “what I was destined for, I believe,” he says.

Bozkurt was recently named one of Popular Science’s “Brilliant 10” for his work on building the foundations of what he calls the “Internet of bionic things,” from remote-controlled cockroaches used by first responders to smart diapers that can monitor the vital signs of infants and toddlers.

Independent Thinker

Bozkurt used to think he might follow in his father’s footsteps and become a physician. In high school, his light reading consisted of his father’s biomedical textbooks and journals. “I’ve always been fascinated with how the body works,” he says.

In talking with his father’s medical colleagues, however, Bozkurt learned a disturbing truth: Doctors deal with things that fail. He wanted to create things that work.

“The thing I discovered was that instead of appreciating how the body worked, you tried to solve problems,” he says. “Instead of focusing on the beauty, you spend more time on all the reckless work of the body — all the diseases, all the problems, all the suffering.

“There are all sorts of algorithms you follow: If the patient’s body temperature is high, if there is coughing, if there are white sores in the throat, you give these antibiotics or vitamins or medicines. While helping people is very satisfying and important, there’s not much space for creativity.”

Bozkurt’s highest dream was to help people by expressing his creativity. He eventually discovered that electrical engineering gave him that opportunity.

He discovered biomedical engineering as a graduate student at Philadelphia’s Drexel University, and he made use of facilities at nearby research hospitals. He also developed an interest in microsystems and began studying in the electrical engineering doctoral program at Cornell University.

Soon after Bozkurt started his doctoral program, his advisor left for the Pentagon’s Defense Advanced Research Projects Agency in Washington, D.C. As they maintained their academic relationship from afar, Bozkurt appreciated the experience of being trained in microsystems without being micromanaged.

“My advisor was gone for four of my six years at Cornell,” Bozkurt says. “Although it was difficult at the beginning to work alone, it gave me independence. It helped me grow tremendously as a researcher by learning how to define problems and offer solutions all by myself.”

OUT-OF-THE-BOX RESEARCH

When Bozkurt set up his Integrated Bionics Microsystems lab at NC State in 2010, he had ideas he wanted to explore — such as his groundbreaking work with insect cyborgs, which he helped start as a graduate student — but to do so, he needed to tap the expertise of researchers in other fields. He reached across departmental boundaries to collaborate with researchers in computer science, entomology, the College of Veterinary Medicine, the College of Textiles and even the medical schools at Duke and UNC-Chapel Hill.

On his first day of faculty orientation at NC State,
Bozkurt and computer scientist David L. Roberts fell into conversation about the possibility of expanding Bozkurt’s cyborg insect research to rescue dogs. The idea came to Bozkurt after seeing the Disney movie *Up*, and Roberts also had the same idea based on earlier work on the topic. The two freshly minted Ph.D.s became fast friends and began looking for ways to work together.

Working with Barbara Sherman of CVM’s Department of Clinical Sciences, they developed a comfortable harness that allows trainers to observe dogs’ behavior and body language remotely. Using an array of sensors that measure heart and respiration rates, the harness can communicate the information wirelessly to a smartphone, track the physical and emotional well-being of the dogs and, they believe, help reduce the stress service dogs often experience.

“Dr. Bozkurt is a true innovator who sees beyond the present and into the future,” Sherman says. “He is able to think outside the box to envision future applications and invent working devices that will make his vision a reality.”

His work has caught the eye of scientists across the country, and his unique solutions have often been mentioned in pop culture and mass media. His cockroach backpacks even were an answer on the TV game show *Jeopardy!*

He also was an advisor for Disney’s 2009 animated film *G-Force*, adapting his remote-controlled cockroach research into the character Agent Mooch, a robotic housefly. He talked about the possibility of a zombie apocalypse on the Science network documentary series *Through the Wormhole*, narrated by Morgan Freeman.

He and his students take their work to school kids at events such as BugFest at the North Carolina Museum of Natural Sciences, reaching a variety of audiences that aren’t often exposed to scientific research.

“There’s no doubt he’s had significant impact on various research communities, and on the general public through outreach and the media,” Roberts says. “His recognition is well-deserved.”

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**IMPROVING INTERFACES**

Working with animals has been enlightening, Bozkurt says, but he now wants to return to his original goal of using microsystems to improve the lives of human beings.

He’s doing that with help from Tushar Ghosh, a professor in the College of Textiles. The two are working together to develop durable, washable fabrics that can collect data from built-in biomedical sensors. They recently received Bozkurt’s second award from the NC State Chancellor’s Innovation Fund to help move a prototype to market.

Bozkurt is particularly interested in developing improved electronic interfaces that allow communication between patients and synthetic fabrics.

Soon, keeping an eye on personal health, monitoring pregnancies, improving athletic performance or even reading newborns’ vital signs could be as simple as putting on a shirt.

Bozkurt’s first award from the Chancellor’s Innovation Fund was for a wearable bandage that monitors sleep more accurately. SleepiBand is currently under clinical testing in Duke’s Sleep Lab.

He also contributes as a testbed leader to one of NC State’s two National Science Foundation Engineering Research Centers: Advanced Self-Powered Systems of Integrated Sensors and Technologies, known among business partners as ASSIST. He combines the research products of more than 20 researchers to develop prototypes of body-powered wearable sensors that monitor health and environment simultaneously. One application is managing the wellness of asthma patients.

“This is the kind of high-impact research I believe I was destined to do,” Bozkurt says. “Here at NC State and in the Triangle, I’ve found great collaborators, amazing students, a supportive department and a fertile ecosystem to keep growing in this direction.”

— Alper Bozkurt

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