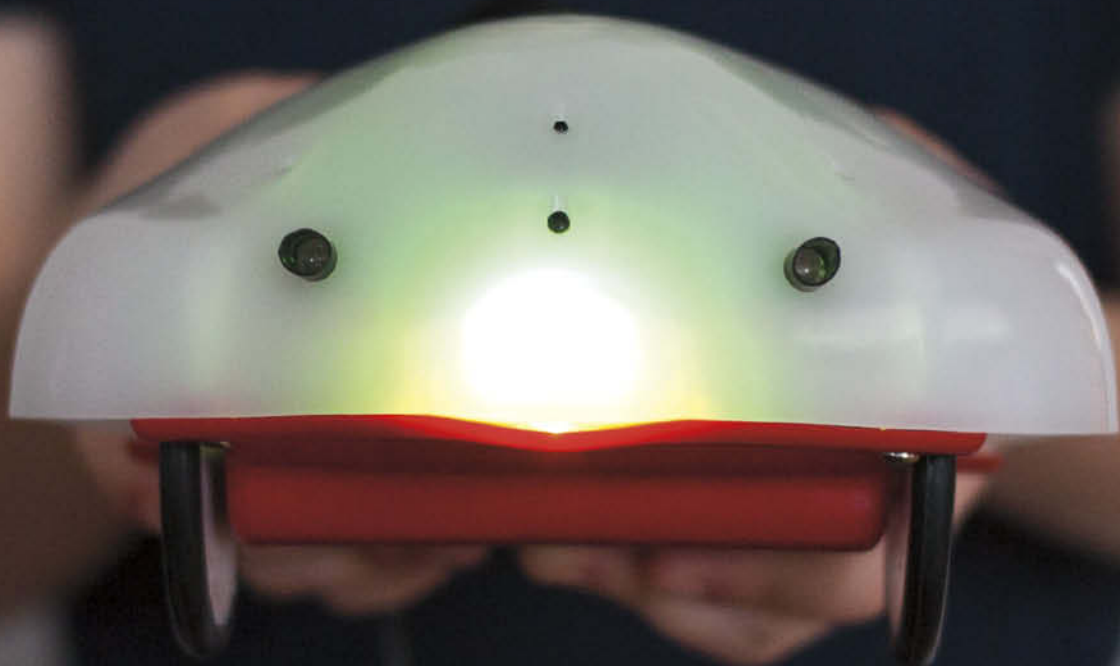




Finch

Finch is a robot designed by Carnegie Mellon University's CREATE Lab to give an interactive and engaging boost to computer science education. With components that include a motor, buzzers, and light, temperature and obstacle sensors, The Finch enables students to learn about writing computer programs and to see first-hand how well their results zip by.

GADGETS & GIZMOS & COMMUNITY GAIN

Jennifer Cross crouches over a table as she helps three seventh-grade girls at Springdale Junior-Senior High School, northeast of Pittsburgh, troubleshoot the robot they are building. The robotics doctoral student from Carnegie Mellon University juggles some wires. Then Elizabeth Puskar, one of the 12-year-old programmers, does a test run and watches the lights blink on cue.

"Yes! It worked!" Elizabeth calls out, pumping her fist triumphantly.

Mind you, this middle school robot doesn't look like a cyborg. It resembles your typical school craft project: a pumpkin-patch diorama inside a cardboard box, illustrating the Carl Sandburg poem "There in Yellow." And the robotics training isn't taking place in technology class, but during a coed honors language arts class. Even so, Elizabeth and her two teammates are learning how to use motors, sensors and LEDs to program their diorama pumpkin to spin around to reveal an illuminated jack-o'-lantern face, timed to poetic meter.

"I didn't like robots before," says Bre Cummings, 12, who recorded the poem using a computer program. But the project has helped her warm up to robotics, she explains, while giving her a deeper understanding of the Sandburg poem.

That's the idea behind Arts & Bots, one of the many innovative projects developed by Community Robotics, Education and Technology Empowerment Lab, known as CREATE Lab. Available now to students of both genders in elementary through high school, this integrated approach to technology originally targeted girls in their tween years. Girls often enter middle school as excited as boys about robots and computers. But somewhere between sixth and eighth grade, at a time of hormones, peer pressure and emerging identities, their interest in technology often fades.

Rekindling that enthusiasm is among the real-world challenges tackled by the 30 scientists, engineers and other staff at CREATE Lab. They use their considerable brainpower to reach out into the community and create robot-flavored answers to problems as diverse as air pollution, water quality and the dearth of girls in technology.

With deep-pocket support from foundations, the technology wizardry brewing within Carnegie Mellon University's CREATE Lab is addressing social challenges in ways that empower individuals and communities as well as assist them. By Cristina Rouvalis

“This is a lab, but it’s not your normal kind of lab,” says Illah Nourbakhsh, founder and director of CREATE Lab and a professor of robotics at Carnegie Mellon. “It’s a lab that is always tinkering and experimenting and partnering with the organizations. We are averse to technology for technology’s sake. We want to develop technology for humanity’s sake.”

CREATE Lab also differs from most research labs in that it doesn’t accept short-term funding from government or corporations, instead relying mostly on long-term grants from foundations. “We want longer-term money that lets you take risks,” Nourbakhsh says. “We don’t take Department of Defense funding. If you work on war robots, you work on robots you hope don’t get used. We work on technology that we hope gets used.”

To that end, The Heinz Endowments has awarded CREATE Lab more than \$1 million over the last five years for a variety of leading-edge inventions. Among the Endowments-supported educational projects are Arts & Bots and the Finch, an interactive instructional robot for computer programming courses. Environmental efforts the foundation has funded include Speck, a low-cost particle pollution monitor, and Breathe Cam, imaging technology that helps people visualize air quality.

This is a lab,
but it’s not your
normal kind of lab...
We are averse to
technology for
technology’s sake.
We want to develop
technology for
humanity’s sake.”

Illah Nourbakhsh, founder and director of Carnegie Mellon University’s CREATE Lab



Ryan Callahan



Carnegie Mellon University

“CREATE Lab is one of the most exciting sources of innovation we have in the city,” says Endowments President Grant Oliphant. “They do a fabulous job of working at the intersections of disciplines to create new ways of problem-solving.”

The gadgets dreamed up in CREATE Lab also can be an economic generator, spawning spinoff companies that manufacture them. For example, BirdBrain Technologies, started by CREATE Lab alumnus Tom Lauwers, sells a robot kit called Hummingbird to Allegheny Valley School District in Springdale, northeast of Pittsburgh, and hundreds of other school systems. More than 10,000 students across the world have used a Hummingbird kit, which contains a controller, motors, LEDs, sensors and cables.

Similar to Arts & Bots, Hummingbird was developed for girls, but is popular among boys, too. Cross and other CREATE Lab employees have trained teachers in Pennsylvania and West Virginia how to use the technology. But they never tell them what to do with it. They leave that to the teachers’ imagination. One physical education teacher had his students build a human arm out of craft supplies and use Hummingbird robotics to spring it to life.

The ideas that give birth to Hummingbird, Arts & Bots and other projects are honed inside CREATE Lab’s space on Carnegie

Mellon’s campus, where robotics engineers and computer scientists puzzle out problems in an open room filled with commuter bikes, errant gizmos and zany craft materials. The vibe in this office seems three parts brainy, one part whimsical.

During a recent staff meeting, 20 employees, many in their 20s, sat in a large circle with no table and took turns giving updates on their projects. Nourbakhsh offered encouragement as he cut and served ice-cream cake to celebrate three recent birthdays, including his own.

Tall, thin and effusive, Nourbakhsh is the epitome of the right-brain/left-brain synergy of CREATE Lab. Born in Iran, Nourbakhsh moved to Kansas City, Mo., at age 9 and was raised in a household of technological innovation. His father, the late Dr. Mahmoud Nourbakhsh, was a pioneer in laparoscopic surgery, and he used to take young Illah with him on Saturdays to watch operations.

Nourbakhsh went to Stanford University, where he earned a bachelor’s, master’s and doctorate in computer science, specializing in artificial intelligence. But he had started out studying comparative literature and was always interested in social justice. He became a robotics professor at Carnegie Mellon and, in 1997, founded CREATE Lab. The only other lab Nourbakhsh knows with a similar philosophy is the Lifelong Kindergarten group directed by learning research professor Mitchel Resnick at the Massachusetts Institute of Technology’s Media Lab.

“Illah is one of a kind,” says James Denova, vice president of the Claude Worthington Benedum Foundation, another funder. “He is a computer genius, but he is an extraordinary humanitarian.”

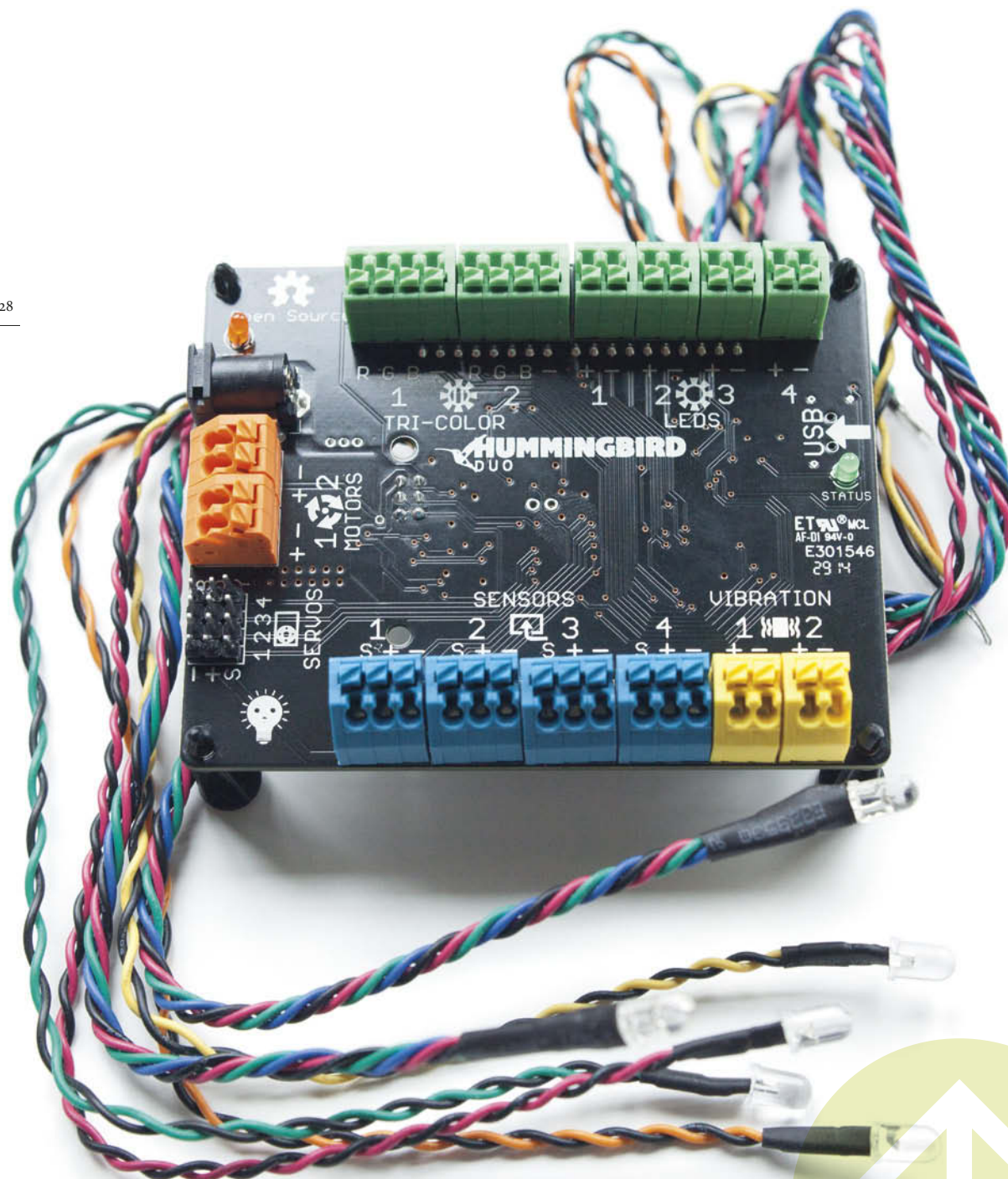
Colleagues say Nourbakhsh has a knack for drilling down complex technology to its simplest truth. “When you think about it, we are making what is invisible visible,” he says, such as the way Arts & Bots makes the words of a poem tangible or the Speck device counts microscopic particles imperceptible to the naked eye.

Hear Me, another project funded by the Endowments, makes teenagers’ perspectives visible by creating a stage—rather, stages—for them to present their opinions on political and social issues. Their thoughts about school safety and other concerns are digitally recorded, edited into stories or commentaries of a minute or less, and made available in audio devices placed in separate plastic boxes



Ryan Callahan

Illah Nourbakhsh, a Carnegie Mellon robotics professor, combines his technical knowledge with humanitarian interests and a bit of whimsy as he directs the work of CREATE Lab, which he founded in 1997.



Hummingbird

No technical experience is needed to use the Hummingbird, but the educational robotics kit developed by CREATE Lab brings technology to life for students as young as 11. By animating arts-and-crafts creations with lights, sensors and motors, Hummingbird shows students how robotics can be used to communicate thoughts, feelings and ideas.





Jessica Pachuta



Hear Me uses multimedia projects such as voice boxes and online interviews to capture the perspectives of children and youth and to share their voices with adults who can make a difference. These elementary school gifted students from the Wilkinsburg School District visited CREATE Lab and told stories about their most favorite and least favorite aspects of their community. The interviews were placed on the Hear Me website.

with the students' first names on them. Anyone can listen to the teenagers' voices by hitting a button on the boxes, which are displayed in coffee shops, museums and libraries across Pittsburgh.

Endowments Education Program Director Stanley Thompson explains that his program has supported Hear Me and Arts & Bots because they take learning "beyond prescribed textbooks to real-world applications."

"Subsequently," he says, "students seem to be empowered to venture outside the more confining and critical places of learning to a freer and satisfying space."

Jessica Kaminsky, project manager of Hear Me, agrees that teenagers, who often feel unheard, are empowered by seeing their voice boxes displayed in prominent places. She has interviewed teenagers at high schools on issues ranging from the new Pittsburgh police chief to school technology policies. Sometimes their audio files are sent to local officials or legislators and help shape public policy. Four have been placed at the U.S. Department of Education.

"It was awesome to tell students, 'Your voice is in D.C.,'" Kaminsky says. "They were super excited."

Kaminsky is struck by the impassioned opinions of teenagers. After the 2012 school killings in Newtown, Conn., students were asked whether they would be in favor of arming school resource officers. "No. No. No. No," a teen girl can be heard insisting, her adamance reverberating from the recording.

Often even the most disinterested student will relish the opportunity to share an opinion when the recorder is rolling. "I have seen some students who were total goofballs, not listening to anyone," Kaminsky recalls. "But given the opportunity to talk, they give a very honest view."

The Endowments-funded Speck, formerly called AirBot, is an air-quality monitor that makes the invisible visible by detecting fine particulate matter, pollution particles about 1/30th the diameter of a human hair that can be inhaled deeply into the lungs and

cause serious health problems. Readings are refreshed every second, and the device uses a color code to indicate risk level. Users also can see the particle levels recorded for recent hours.

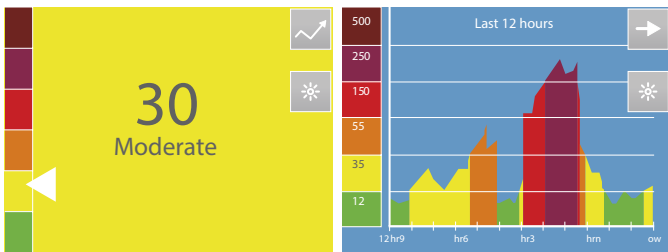
Nourbakhsh is trying to raise venture capital funding so that CREATE Lab can mass-produce the Speck for about \$100 to meet international demand for the product as global concerns about air pollution mount. Meanwhile, the lab has been lending Speck sensors to interested groups, including the Southwest Pennsylvania Environmental Health Project, which addresses the health of people living near Marcellus Shale natural gas drilling sites. For a month at a time, residents in proximity to the gas fields can use the Speck to monitor the air quality inside their houses.

"They will call us if it is in the 'red,'" says Ryan Grode, the project's environmental health educator. If the warning level persists for a few hours, Grode might advise them to leave their homes for a while. With the help of the Speck, other residents have taken steps to protect their indoor air with filters and other measures. In fact, Grode says, people get so attached to their Specks that many don't want to give them back at the end of the month.

A Speck also is on loan to the City-County Building in Downtown Pittsburgh, with plans for more monitors to be put in city offices to make local government a living laboratory on indoor air quality and how it is affected by ambient air pollution.

"They are empowering citizens to measure their environment in a way that doesn't require expensive equipment and science," says Philip Johnson, the Endowments' interim Environment Program director. The hope is to turn Speck into an app so that people can monitor air quality wherever they go.

Air pollution is no small issue in Pittsburgh, which ranks among the worst 13 percent of U.S. cities for average annual particle pollution and also has dangerous levels of cancer-causing air toxics and other pollutants like smog and sulfur dioxide. The city is celebrated for its gorgeous skyline, but on many days, there is not a



Speck

With its emphasis on community empowerment as well as community improvement, CREATE Lab produces devices that enable people to gather information on their own about their environment. An example is Speck, an indoor fine particulate monitor that's being developed as a low-cost tool people can use to determine their personal exposure to public health hazards and take control of their air quality.

clear view of Downtown and other scenic vistas due to a veil of white or brown haze hanging in the air.

Raising awareness about this problem is why the Endowments' Breathe Project—an initiative launched in the fall of 2011 to help improve air quality in southwestern Pennsylvania—collaborated with CREATE Lab to develop Breathe Cam. Panoramic cameras are used to see the Pittsburgh skyline from various sky-high vantage points. CREATE Lab software stitches those images together to create video time lapses along with a real-time camera feed. With a click of the mouse, users can zoom in on various locations and see pollution on the horizon, and make comparisons by time or date. Breathe Cam debuted in December on the Breathe Project website, <http://breatheproject.org/learn/breathe-cam>.

"It is the most sophisticated air-quality visualization in the country," Johnson says. "You can zoom in and see things on the horizon, such as how often smokestacks emit plumes, or train activity through the city. It's a powerful tool to engage people on what good air looks like and what bad air looks like."

Breathe Cam and CREATE Lab's other accomplishments so far are just the start of what Nourbakhsh hopes to do. He loves sending his small army of socially conscious techies into schools, city halls and neighborhoods facing environmental challenges.

"These engineers and computer scientists could get fantastically well-paying jobs in corporate America," Nourbakhsh says. "Instead, they stay in relatively modestly paying positions here because they like the mission. It's exciting to create a space where engineers get paid enough to make ends meet and feel like their days are being spent doing something worthwhile." *h*

Breathe CAM

Another tool that puts information about the environment in the hands of individuals is Breathe Cam. The online program uses a zoomable live camera feed to provide high-resolution panoramas of Pittsburgh's skyline and other views in the region so that people can better observe and understand the air they are breathing.



Scott Goldsmith

