Robot see, robot do for socially apt machine

By Andrew Nelson
Staff Writer

Within the 200,000 square foot Technology Square Research Building, the Socially Intelligent Machines (SIM) Lab is developing the next revolution in advanced human-machine interaction: robots that learn from socializing.

"First, we revolutionized the office and the home using dumb terminals, but now we have embodied agents that can automate things in the real world. This may have major implications for automating and changing the world around us without direct human intervention," said Nick dePalma, CS graduate student and research assistant at the SIM Lab.

Most modern robots have been employed as relatively simple, user-programmable vacuums or in industrial automation like car assembly lines, where tasks are repetitive and there is very little chance of interference.

"A critical issue is that we will not be able to preprogram these robots with every skill they will need to play a useful role in society; robots will need the ability to interact and learn new things 'on the job' from ordinary people," according to SIM Lab's website.

SIM Lab is a research group within the College of Computing's School of Interactive Computing. The goal is to develop machines that can function in social, dynamic human environments. Since its inception in 2007, research has led to the creation of Simon, an upper-torso robot with a socially expressive head.

"The main focus of my group right now is socially guided machine learning. We're interested in designing algorithms and interfaces to allow robots to learn interactively from everyday people," said Dr. Andrea Thomaz, Assistant Professor with the School of Interactive Computing and director of the SIM Lab.

The lab has been working on two projects on the Simon platform: social attention and interactive task learning.

When Simon is in a busy environment, the lab made sure it could react in an appropriate manner. First, Simon recognizes the most important aspects of its environment via visual and auditory stimuli and assigns a value of importance to each.

"Everything is fighting for the robot's attention. If a loud sound is perceived the robot might glance in that direction, and then look back to see people trying to get the robot's attention by waving objects," Thomaz said.

Simon learns by demonstration and interaction; this can be accomplished by assigning it tasks. A human partner can tell Simon to grab an object and then tell it what should be done with the object. Simon can learn a model in just a few examples, and then the human partner can introduce new objects and they will be sorted into their proper locations.

"Additionally, the teacher can let Simon ask questions by saying 'Do you have any questions?' Then Simon will scan the workspace looking for any objects that it is uncertain about," Thomaz said.

"If such an object is found, this will lead to a query like, 'What should we do with this one?'" Thomaz said.

Simon's first venture out of the lab at the premier international human-computer interaction conference allowed him to interact with over 100 people, including the attendees' kids. This positive child interaction is a good sign for the future of Simon's class of robots. Its body, proportioned to a 5'7" woman, is designed to work side-by-side with human counterparts and be unimposing and people-friendly. One of Simon's eventual uses could be acting as a counterpart to teachers in classrooms.

"I try to analyze how people prefer teaching robots, and develop ways in which robots can improve a teacher's instructions, for example by asking useful questions," said Maya Cakmak, a Ph.D. student in Robotics and graduate student assistant with the SIM Lab.

Other robots already in service in schools have been lauded for feats like connecting with autistic children and teaching languages.

Simon is the latest incarnation of previous robot projects Junior, Jimmy and Jenny. Junior, built from Trossen Robotics' Bioloid kit—a user-friendly advanced modular robotics system—and a webcam, interacts with people and objects in a simple environment. Jimmy and Jenny are Juniors with wheels, able to navigate the workspace and allow the lab to study peer learning and other biological characteristics as they work together.

Other Tech faculty collaborate with the SIM Lab for their own research relevant to human-robot interaction. Gil Weinberg, Director of Music Technology and Associate Professor with the Music Department, worked with the lab to develop the social work of his robotic musician, Shimon, that plays the marimba. Rosa Arriaga, Senior Research Scientist with the School of Interactive Computing and Director of Pediatric Research with the Health Systems Institute, is investigating how theories of developmental psychology and some of its seminal findings can be applied to the field of human robot interaction.

Current or incoming students can work with the SIM Lab by doing an Undergraduate Research Opportunities in Computing (UROC) project, contacting Dr. Thomaz for an independent study project or by taking Dr. Thomaz's graduate courses in human-robot interaction and then joining as a graduate research assistant. The SIM Lab is also hiring a postdoctoral researcher in the areas of human-robot interaction and machine learning.

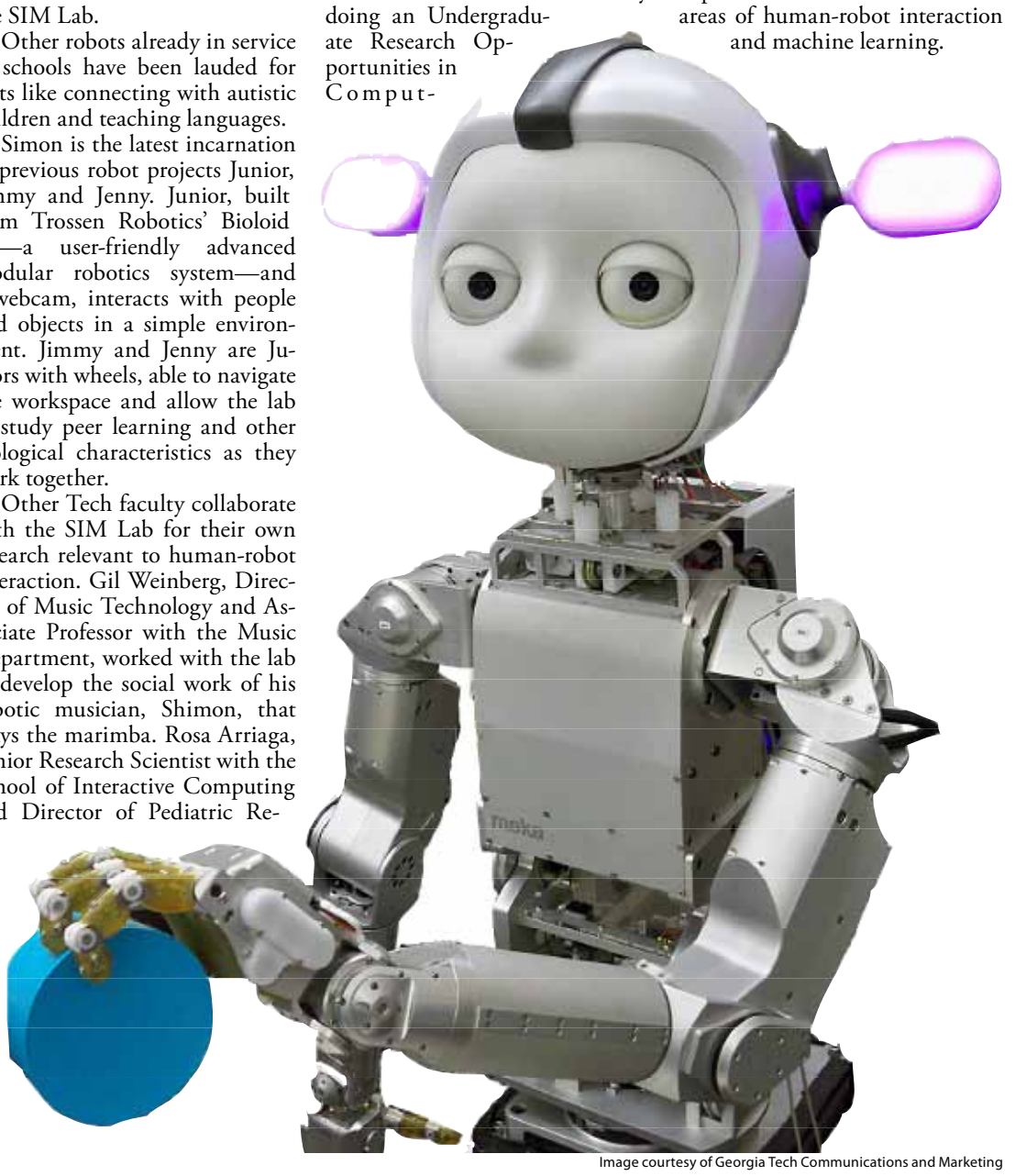

Image courtesy of Georgia Tech Communications and Marketing

The social robot Simon can conduct basic human functions such as recognizing audio and visual stimuli. Simon may eventually be useful for service in schools to assist classes with autistic children.

Wind-powered vehicle propels self into record books

Image courtesy of Emilio Castaño Graff

The Downwind Faster Than the Wind (DWFTTW) vehicle, previously perceived to be a mere pipe dream, is now a reality.

By Harsha Vempati
Contributing Writer

A complex riddle that has baffled and enraged experienced engineers will be put to rest if a team of engineers, including Rick Cavallaro AE '84, successfully ratify the record from a wind-powered vehicle that travels downwind faster than the propelling wind.

"[Many] thought I was a complete moron," Cavallaro said of his original project plan, about which he expected interested and understandably skeptical responses.

The project began humbly as an experiment he posted on internet forums, intrigued by the concept of a Downwind Faster Than the Wind (DWFTTW) vehicle.

The ensuing discourse between Cavallaro and critics transformed a curious possibility into a raging debate spanning thousands of pages.

"It's so counter intuitive to so many people. People on the internet are saying it can't be done," Cavallaro said in a press release.

Belittled by many scholars, including a Tech professor, but confident that his designs were mathematically correct, Cavallaro built a miniature model. This did little to assuage the doubts of internet posters, so he began to seek sponsors, including Joby Energy and Google. In collaboration with the San Jose State Aerospace Engineering Department, Cavallaro began a full-size vehicle to finally end the issue of the legitimacy of a DWFTTW vehicle.

After over a year of efforts, including design, fabrication, numerous trials and various redesigns, the vehicle dubbed 'Blackbird' was completed. The materials came from various sources, and some parts were even donated, ranging from highly accurate sensors to windsurfing masts. The vehicle itself is a highly aerodynamic 3-wheeled device with a 17 foot long propeller attached to a tower on the back. It is ultralight and seats one, and from this sparse construction arises much of the misconception about the vehicle. It is powered by neither battery nor motor, but instead the wheels turn the propeller that moves the vehicle, in turn spinning both wheels and the propeller faster.

Though suggestive of perpetual motion, the vehicle uses wind as an external power source. Cavallaro and his team made no new discoveries or inventions in building the vehicle, instead cleverly applying existing aerodynamic principles to create an incredible device.

Blackbird was put to official tests on July 2 and 3, in a dry lakebed in El Mirage, Ca., with the National American Land Speed Association (NALSA) to

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oversee the vehicle's bid for the record for fastest DWFTTW vehicle. Cavallaro piloted the vehicle to unofficial top speeds of 53 mph, with a duration average of 2.5 times the wind speed. NALSA has been analyzing data from the vehicle's sensors and verifying if the vehicle's runs meets the NALSA's guidelines to be approved as the record holder.

Given that Cavallaro's team essentially created the category and built the first vehicle to ever qualify for it, Blackbird may hold the record for fastest DWFTTW vehicle by default.

"[It was] a brain teaser gone horribly wrong," Cavallaro said of the machine.

However, Cavallaro has ideas about potential applications of the machine, even if they are purely theoretical and likely some time away from realization.

Modern windmills harness about 69 percent of the energy available from the wind, while a dynamic system using Cavallaro's principles has "theoretically no limit" to how much energy can be harnessed from it. Although limitations stand in the way of creating such a system, there is incredible potential in some of the ideas and principles Cavallaro utilized to develop the next generation of hyper-efficient wind based energy.

"We don't claim it's perpetual motion. We're not saying we've solved all the transportation problems. But these are interesting new applications involving harvesting wind power," Cavallaro said in a press release.

Image courtesy of Emilio Castaño Graff

Rick Cavallaro, AE '84, hopes to set a world record with his vehicle that is designed to travel faster than the wind. Cavallaro and his team believes the invention could lead to a revolution in energy.

Boyd envisions better world from peaks of Appalachians

By Kamna Bohra
Focus Editor

Backpacking through mountain trails, creating a startup company for photobioreactors and participating in undergraduate research are just a few of the interests of the eclectic Will Boyd, fourth-year PHYS and CS, who was recently named to the USA Today Academic All-Stars Team.

The team annually honors 20 undergraduate students across the nation for excelling in scholarship both within and beyond the classroom. Each member of the team receives $2,500 of fellowship money.

The Fellowship Communications program nominated Boyd, who then applied because he felt he had a chance of winning and that the opportunity would be a great way to represent Tech.

However, Boyd was not initially interested in Tech, noting that the school was his last choice until he visited and realized how well he connected with the students.

"Tech is a community I can actually thrive in and enjoy," Boyd said. He noted that his other school choices would have sent him into academia following his undergraduate degree.

Boyd notes several aspects of his Tech career that he felt ultimately qualified him for the honor.

Following his pre-college passion for backpacking and trail building, which he previously did in his hometown in Tennessee, Boyd and several friends created the non-profit organization Trailblazers as an alternative spring break program.

"[We] started the organization to create environmental awareness. I want to do that for people regardless of their political affiliation. One way to do that is to combine the service and the adventure," Boyd said.

He described the first trip as a group of 12 students who traveled up to West Virginia, worked on the Appalachian Trail for a few days and then backpacked up part of the trail.

"With just service, you draw in the hippies and the tree huggers. But when you add the adventure, you draw in people who would otherwise not be that interested," Boyd said.

The organization also conducts year-round projects in Atlanta.

Scientifically speaking, Boyd has conducted undergraduate research, beginning with a two-year stint with Dr. Joseph Perry. Following this, Boyd had the opportunity to conduct research in Switzerland with the European Organization for Nuclear Research (more commonly referred to as CERN), which hosts a particle accelerator.

Finally, Boyd describes the InVenture Prize as an achievement in his career that has had a great impact on his post-Tech plans.

Boyd and his team produced a photobioreactor, and their win resulted in the patent-pending status of their invention.

Although their startup company has since dissolved because the members have gone in different directions, Boyd notes the impact of the invention and its results.

"The way I want to change the world is in research and development and startup companies – not in academia and not in politics," Boyd said. He described his goals as the "ways to enact the kind of change I want to see in the world."

Following the completion of his degree in December, Boyd plans to attend graduate school and to pursue a Ph.D program in plasma physics.

"I think it can help me tie together my interest in startups, renewable energy and my interest in physics," Boyd said.

Boyd wishes to work with nuclear fusion reactors, noting that successful production of these reactors would "revolutionize energy."

Overall, Boyd notes that his passions have driven his accomplishments.

"I don't do things for my résumé; I do it because I'm passionate about it," Boyd said.

Boyd emphasizes that his achievements in college have not been completed alone.

"A lot of my accomplishments have been with teams. Sora was with a team, not just me. I like to run a team as a cohesive unit… A lot of my accomplishments are about bringing people together," Boyd said.

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