SPRING 2014

MIT EECS CONNECTOR

Annual News from the MIT Department of Electrical Engineering and Computer Science

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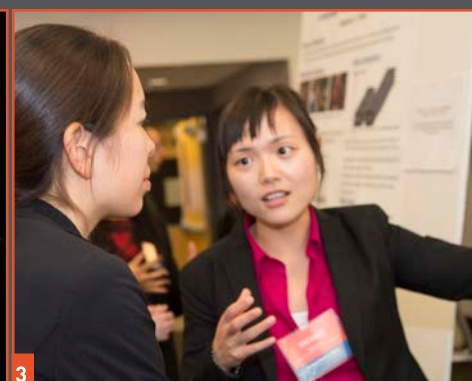

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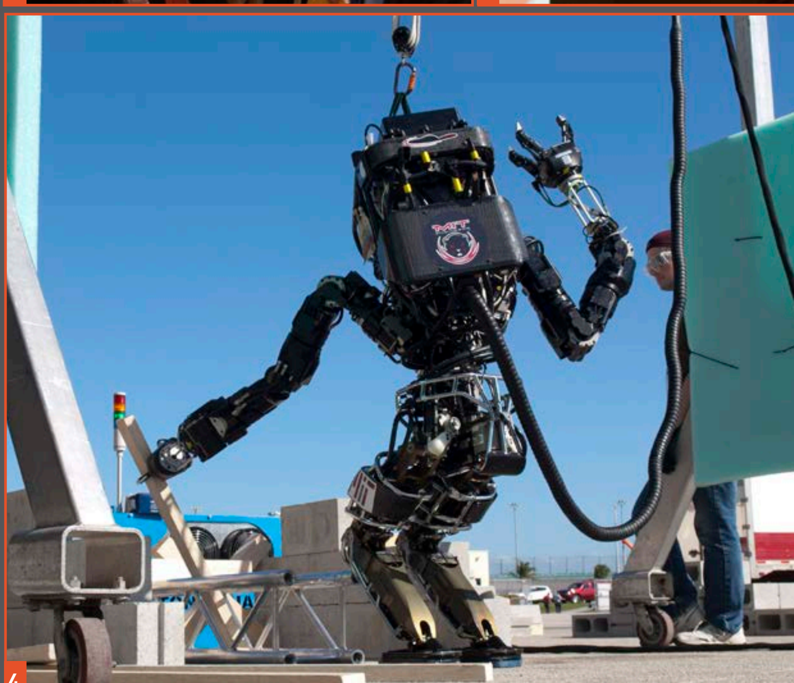

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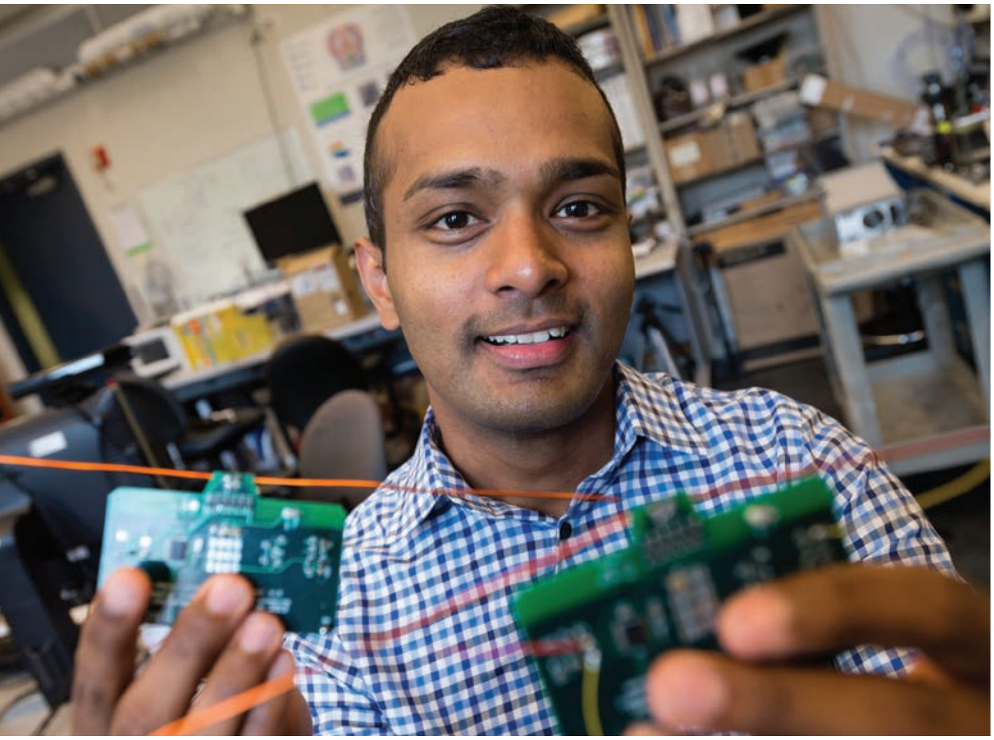
Shyam Gollakota, PhD ‘12

Wherefore go the networks?



As a computer science undergraduate student at IIT Madras, Shyam Gollakota was well aware that his research interests at the time in security and cryptography would be well served by continuing as a graduate student at MIT. So he applied to the PhD program in the EECS Department in Theory.

Though he had done some networking research as an undergraduate, he was pleasantly surprised when he received a call from Prof. Dina Katabi, who invited him to come study at MIT. "She talked about her interdisciplinary research that bridges theory with practice," he recalls "and we connected immediately. Her energy and drive were palpable even over the phone," he continues. "I decided right then to join MIT and I think it was one of the best decisions I have ever made!"

Now that Shyam Gollakota is Prof. Gollakota at the University of Washington (UW) – a position he accepted following his graduation with a PhD in Computer Science from MIT in 2012 — he looks back at what it was like to be a student in MIT EECS. He says "The drive to achieve big things was contagious at MIT and hard not to catch!" He describes the times he worked with Prof. Katabi as fun and intellectually stimulating — including discussions about research that extended to the early morning hours.

In fact, Prof. Katabi joined her students – including Shyam Gollakota – in taking classes to learn material in other domains such as digital wireless circuit design and compressive sensing. He admits, "It was a cultural shock to me that my advisor would attend classes with me!"

[You can also get some idea of his teaching and the group's research by checking his group's website built by his students. http://netlab.cs.washington.edu/]

Now, he gets to follow in Prof. Katabi's footsteps. "I hope to sustain that kind of drive as a faculty member and motivate my students to do the same," he says.

The ambition and energy inherent in his goals are reminiscent of his EECS roots. He says: "My goal is to change our fundamental understanding of what is possible, by designing and building novel systems that challenge conventional wisdom." By connecting what look like unrelated fields, Gollakota is driven to explore new approaches in his research. "Beyond building prototypes of my research," he continues, "my goal is also to take the research to its logical extreme by building production-quality systems that can be deployed in the wild. I believe this is just as important for systems research as is coming up with new ideas."

Prof. Gollakota also loves working with students, both in the classroom and in the lab. He makes no excuses saying, "Being a great teacher and mentor is also part of the plan."

Another beauty of reaching his status as a researcher and professor at UW CSE is that he can work collaboratively with other faculty across different disciplines. "This has significantly changed the direction of my research," he notes. Gollakota's thesis work was about improving the performance and security of wireless networks. But, since joining UW, his research is now focused on the intersection of wireless and other domains like HCI and power systems.

Waving for wi-fi

For example, at UW Gollakota's group built WiSee, the first system that leverages existing wireless signals (e.g., Wi-Fi) to enable sensing and recognition of human gestures at a large scale (e.g., throughout an office or a home). "Gestures enable a whole new set of interaction techniques for always-available computing embedded in the environment," he states. As an example, he suggests that a hand swiping motion in the air could enable a user to control the radio volume while showering – or change the song playing on the stereo in the living room while you are cooking in the kitchen.

Gollakota says that the approaches offered today to enable gesture recognition – by either installing cameras throughout a home/office or outfitting the human body with sensing devices – are in most cases either too expensive or unfeasible. So he and his group members are skirting these issues by taking advantage of the slight changes in ambient wireless signals that are created by motion. Since wireless signals do not require line-of-sight and can traverse through walls, he and his group have achieved the first gesture recognition system that works in those situations. "We showed that this approach can extract accurate information about a rich set of gestures from multiple concurrent users, "he says.

This work has been covered by the BBC, the Washington Post and Wired and won the Best Paper Award at MobiCom 2013. (You can also join the 300k+ viewers on YouTube to see the group's video demo at: http://www.youtube.com/watch?v=VZ7Nz942yAY

Powering networks out of thin but heavily networked air — in urban areas

In collaboration with Josh Smith and David Wetherall at UW, Gollakota has recently explored connections with research in extremely low-power systems. They asked themselves the question: "Can we enable devices to communicate using ambient wireless signals as the only source of power?"

They reasoned that since ambient RF from TV, cellular and Wi-Fi communications are widely available in urban areas — 24/7 indoors and out, then devices that can communicate using ambient wireless signals as the only source of power could enable ubiquitous communication in smart interactive environments. Such communication would also scale and work in locations previously unfeasible and also be used in personal health and fitness devices and new applications waiting to be created.

The challenge in designing such a communication system, however, is that the simple act of generating a wireless signal for communication typically requires much more power than can be harvested from ambient radio signals. To address this, Gollakota's group recently invented ambient backscatter, a new communication primitive that enables two devices to communicate without either device generating radio waves! "Since this does not require a dedicated power infrastructure and can enable communication between two battery-free devices," Gollakota says, "it brings us closer to the vision of cheap battery-free devices." This work recently received the Best Paper Award at ACM SIGCOMM, 2013 and significant media attention including *Tech Review*, the *NY Times*, and *Scientific American*, and has more than 350,000 views on YouTube at: http://www.youtube.com/watch?v=gX9cbxLSOkE.

Based on Gollakota's vision, traditional wireless networks used primarily for communicating bits from one point to another will become much more pervasive. "I think the future wireless signals and networks are going to be transformed from being just a communication medium to much more," he notes. "This would include being a human-computer interaction sensor (e.g., gesture recognition) and a source of power for battery-free devices. I think this is where the future is heading."

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