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School of Engineering

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DEAN'S MESSAGE

Santa Clara University is well known for its Teacher-Scholar model. Teaching is primary here, and while it is our mission to educate engineers with the highest level of technical prowess, it is also our goal to educate the whole person. So, much of our curricula serves to develop an engineer's "soft skills"—communication, ethics, integrity, global perspective, et cetera.

But a lot of learning takes place outside the engineering classrooms, as well, and Bronco engineers are active in many activities. Twenty-seven of our undergraduates are student athletes, representing SCU in ten different sports; and a dozen of our graduate engineering students operate video cameras at Bronco athletic events. A new interdisciplinary team is working on designing SCU's entry for California's inaugural Tiny House Competition (more on that in months to come). Some students are collaborating with far-flung social enterprises to solve problems around the world, and others regularly share and glean knowledge at professional society conferences.

Through a variety of experiences, students prepare to step into their careers after leaving SCU. In this edition of *Engineering News*, we provide just a tiny sample of how our students and faculty are extending their reach beyond the engineering classroom, plus a feature on just how far the reach extends for one of our alumni.

Happy reading!

Godfrey Mungal
Dean
School of Engineering

Charged Up

Since he first came to SCU, mechanical engineering junior David Lyons had a yearning to put his talents to good use. In his sophomore year, he and electrical engineering teammate Nathan Garvey designed, built, and installed an off-grid solar tracking system to power small microscopes and water pumps for San Jose's Guadalupe River Park Conservancy's (GRPC) Outdoor Environmental Science Program—a challenge they took on to satisfy requirements for their Engineering for the Community class (ENGR 110).

The following summer, David was off to Ghana as a Levey School of Business Global Fellow, where he took on an internship at a local social enterprise. Additionally, he was tasked with installing a system similar to the one he and Nathan had designed for charging lights and cell phones in the community, which lacked electricity. "I had very few parts, very little money, and no solar connections in Ghana, whatsoever," he said. Countless Google searches yielded local contacts, an impromptu Kickstarter campaign led to funding, and emails with Nathan in Santa Clara established the specifications. A fellow student who was traveling from Lithuania to Ghana brought transformers, adaptors, and other hard-to-find parts in her suitcase. "Luckily, she packs light," quipped David.

The whole project was thrown into peril when David, lacking a hammer, substituted his wire cutter and bent it beyond use. "This was before I had cut any wire. I was freaking out, rummaging around the house, looking through all the kitchen drawers, when I suddenly remembered I'd brought nail clipper scissors. I used those for cutting wire for the entire system. After that, it went a lot smoother than I thought it would. It took about six hours to wire the thing—Nate had sent a picture of a wiring diagram—and I only saw one spark flare; I just did it."



Photo: Courtesy of David Lyons

David Lyons' 16 flips the switch on his solar-powered charging station in Ghana.

David is especially pleased with the design he and Nathan came up with. "The cool thing is, it's modular; you can take it apart by unplugging two switches. The solar panel and frame are weatherproof, and all the electrical components are on a shelf that can be removed and taken inside. The battery stores energy so lights or phones can be charged indoors if it's raining."

Using every penny of the more than \$1,500 he'd crowd-sourced, David bought 20 rechargeable lights for the village. "I was surprised when they kept maybe five and gave the rest to the surrounding communities, distributing the wealth. Improving safety and communication for them is very rewarding."

In summing up his experience, David said, "It's been weird being back. I almost feel like I dreamt up this project. It doesn't feel like I put a lot of effort into it because I was so passionate about it. It completely dominated everything I was thinking about at the time, and then it kind of vanished. I had to have faith in the system when I left."

Read more about his experience in David's blog. scu.edu/engineering/lyons

Is there an engineer in the House?

Photo: Courtesy of Mahantesh Hiremath



Hiremath, right, with Congressman Lamar Smith, chair of the Committee on Science, Space, and Technology

Of the 535 legislators serving in the U.S. Senate and House of Representatives, how many do you think hold an engineering degree? Think again; it's six. A scary thought when you consider the degree to which technology drives our world. But Mahantesh Hiremath, deployment subsystems manager for Space Systems Loral (SSL), located in Palo Alto, California, and lecturer in the Department of Mechanical Engineering, says we have no reason to fear. Our representatives are well supported by bright and tireless staffers and a corps of Fellows from various engineering professional societies who are selected annually to lend their expertise.

Hiremath spent a year on Capitol Hill (September 2013 through August 2014) as ASME Congressional Fellow and Technical Advisor to the U.S. House of Representatives' Committee on Science, Space, and Technology. Selected from a pool of highly qualified (all Ph.D.) candidates through a competitive nationwide process, he was the only one chosen who is still actively working (most were from academia). ASME and SSL split the cost of his salary for the year.

An intensive three-week orientation prepared the Fellows to jump right in as productive team members, and Hiremath immediately found himself assisting the Energy and Environment Subcommittee: preparing for hearings, writing position papers and briefing notes, studying and documenting critical issues, drafting legislation, and calling on his extensive network of ASME industrial experts for background information and as key witnesses for committee hearings, particularly in the areas of carbon capture and sequestration, compressed air energy storage, and fourth generation nuclear reactors.

"In Silicon Valley we work with lots of smart people; it was very encouraging to see that Washington is so full of smart people, too. It was not unusual to see Nobel Laureates sitting with legal staffers making a case for funding for research going on in the national labs. I learned it is critical that scientists and technologists are able to articulate the value of their research effectively so that policy makers can make good decisions on society's behalf," he said.

"Having observed this world from such a close vantage point, it was clear to see the importance of involving engineers in the policy world. Imagine if we engineers had better insight into the thought process of our legislators who are concerned with consumer safety and whether a product is beneficial to society in general. We need to encourage our students to consider taking a minor in public policy as an alternative to economics or business; being conversant in the policy-making world would be invaluable to their future and society as well. We should also encourage them to become involved in their professional societies—teach them to volunteer, to earn their credentials, to get involved."

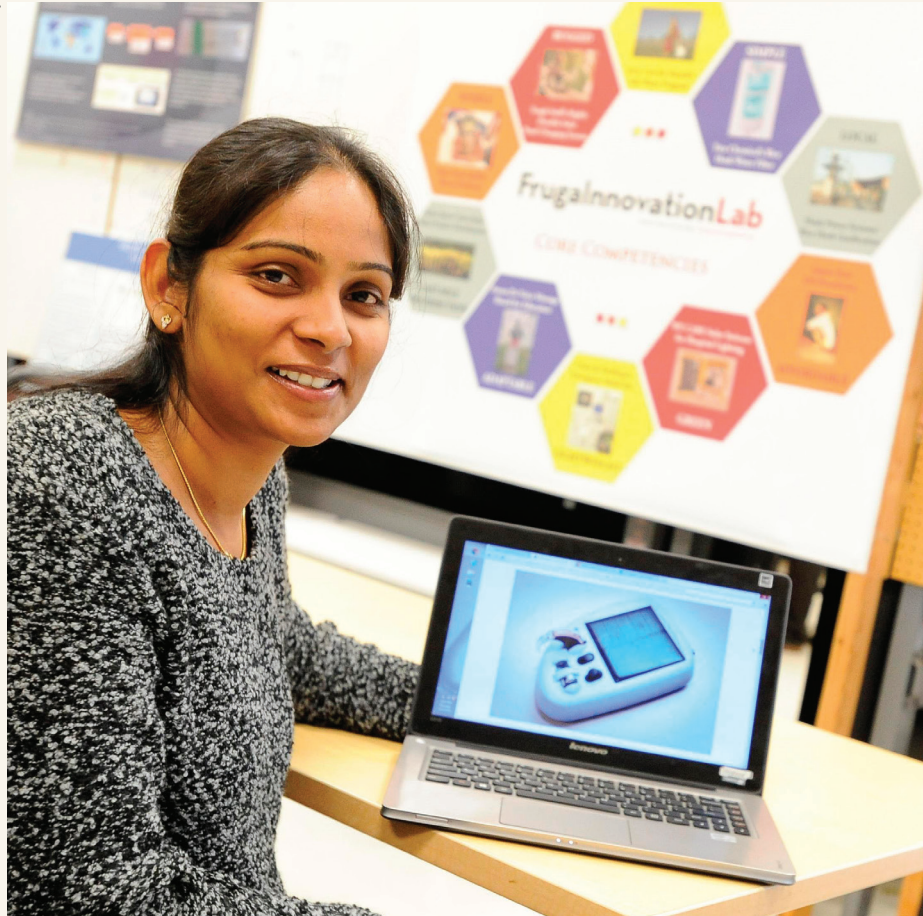
Visit asme.org to learn more about the Congressional Fellowship Program.

A PIECE OF THE PUZZLE

“642 million people suffer from hearing loss; 80% live in low and middle income countries; < 1 in 40 have access to hearing aids”

— www.wwhearing.org

Photo: Charles Barry



Sushma Devarapalli at work in the Frugal Innovation Lab

“Coming from India, where resources are constrained, I was always interested in Jugaad,” said graduate software engineering student Sushma Devarapalli, referring to the Hindi-Urdu colloquialism for finding creative work-arounds. “So when I came to SCU, I took the class Mobile Labs for Emerging Markets, and then became a research assistant in the Frugal Innovation Lab [FIL], working with Dr. Silvia Figueira [computer engineering associate professor].” Devarapalli’s first task was to help Solar Ear, a social enterprise that puts hearing-impaired youth in Africa to work assembling digital rechargeable hearing aids and solar battery chargers.

As a result of participating in Mobile for Humanity (M4H), an online course sponsored by Cisco through the Frugal Innovation Lab and Santa Clara’s Global Social Benefit Incubator (GSBI), Solar Ear was able to identify a key need. The organization already had a great product and sustainable business model, but it lacked a way to gather test results and demographic information from customers in the field into a database.

“They wanted to use an open source tool to enable information gathering via SMS, or text messaging. This created a challenge for them because there was an overwhelming array of options available and they were not tech

savvy enough to find a viable, sustainable solution. That’s where we came in,” Devarapalli said.

She got to work matching Solar Ear’s requirements to the best available software. “One tool, Magpie, had it all. It is easily customizable so they will be able to adapt the solution to meet their needs now and in the future. We wanted to empower them to make changes so they would not have to rely on us. Another organization, World Wide Hearing, also operates in emerging markets, and they wanted an inventory management and sales consolidation tool. I tweaked Magpie to fit their needs, too. The whole point of frugal innovation is to leverage the open

source tools out there to create optimum solutions,” she said.

“SCU is on the cutting edge of developing mobile technologies for social benefit. Dr. Figueira has a lot of experience in this field and it feels so good to be part of this work. We’re just a piece of the puzzle for these organizations, but it feels so good to be part of helping them create the bigger picture.”

A DECADE OF ELECTRON DEVICE DEVELOPMENT



Photo: Heidi Williams

EDL students and graduates, seated, from left: Constant Bossou, S.J., Abdus Sattar, Mark Barycza; standing: Krunal Patel, Norman Gunther, John Rose Santiago, S.J.

For the past ten years, the Department of Electrical Engineering's Electron Devices Laboratory (EDL) has advanced research in the areas of electronic devices, materials, and their manufacturing technologies, conferring ten Ph.D. degrees along the way.

While Santa Clara University may not have the advanced labs or large cohort of internationally known scientists and highly qualified support technicians that a Research 1 university can offer, the EDL has at its helm Associate Professor of Electrical Engineering Mahmudur Rahman, a dedicated scholar and mentor, who guides students through the daunting task of identifying a research topic and advises them as they perform original research worthy of publication by a top-tier technical journal and produce more than two conference papers of sufficient

quality to be accepted for exposition at national and international technical conferences.

For the past decade, the EDL has been contributing world-class research and scholarship in a wide range of fields. Norman Gunther, who had studied electrical engineering at SCU for two years before changing majors and graduating in 1959 with a bachelor's degree in physics (and, in true Bronco fashion, a minor in philosophy), had a successful career as a nuclear engineer before the bottom fell out of that industry at the end of the 20th century. He returned to SCU to take courses in transistors, liked it, and went on to earn his doctorate in 2004 at age 66. He continues to collaborate with fellow graduates of the program, advancing the methodologies used to characterize surface nanostructures of thin films used in semiconductors, and

advising current graduate students as an applied mathematician. "The people in the program have all been exceptional. It would be impossible to do this work without companionship, and Dr. Rahman has created a very collaborative environment in the EDL. One of the biggest hurdles for any Ph.D. candidate is technical writing—it is not something most of us engineers do well, but Dr. Rahman is quite good at it. Though he was born in Bangladesh, he was introduced to the English language early on through attendance at a Catholic high school. Later, he earned his doctorate at the Tokyo Institute of Technology. He is fluent in a number of languages and is quite an accomplished technical writer, which is so helpful to Ph.D. candidates," said Gunther.

Current doctoral candidate John Rose, S.J., agrees. "Getting published has become immensely difficult due to the large number of STEM [science, technology, engineering, mathematics] graduates being produced from institutions around the world. The resulting pressure for publication has put an enormous burden on the remaining adequately refereed, impactful journals—especially English-language journals. The EDL exists to help prospective Ph.D.s meet these challenges," he said.

Rose, a Jesuit priest from India, who joined the EDL in 2011 and also arranges summer immersion trips for SCU engineering students at the

Jesuit engineering schools in India, proudly notes that a number of papers written by his colleagues were accepted for the Device Research Conference—a highly prized goal among device researchers—and one member won the "Best Student Paper" award at an international conference in Rome. Rose's own paper was recently accepted at yet another first-tier conference in China.

The Lab's most recent Ph.D., Abdus Sattar '14, is putting his research to work at his new start-up company offering a software product that performs analysis of the trench insulated gate bipolar transistor (TIGBT) that is one of the keys to widespread adoption of EV and solar technologies. According to Gunther, Sattar's work "is central to power electronics and terrifically more important with EV autos and alternative sources of electricity needing to be conditioned before they are used."

Summing up the impact of the EDL over the past ten years, Rose commented on behalf of the group, "At the time of our founding, 'electronics' was practically synonymous with 'logic circuits,' 'Moore's Law,' and all that. At the present time, 'all that' has turned into a conflagration of outlandishly difficult technologies that require unimaginable resources to pursue. At EDL, we have discovered talents and resources to model devices for power electronics on the cutting edge. We intend to stay here."

Bioengineers Branch Out

Enriching students' educational experiences through activities outside the classroom is a core value of the bioengineering program at Santa Clara. Here, four bioengineering students comment on their experiences at the 2014 Biomedical Engineering Society Annual Meeting in San Antonio, Texas.



Sabrina Cismas

"I had the opportunity to learn about the diversity of the bioengineering field by browsing through topics not often encountered in classes and those of cutting-edge research that are not yet mature enough for general applications. Through this conference I was not only able to learn more about topics that fascinate me such as organ 3D printing, cardiovascular tissue engineering, and scaffolds/3D printed biomaterials, but also gain inspiration for my research by discovering how other people are applying the materials I work with and the discoveries they've made in similar contexts."



Nicholas Domek

"I was at first a bit overwhelmed by the scale of the conference and the amount of research being presented, but it challenged me to learn and experience what the modern bioengineering field looks like. Attending the oral research presentations, I was able to pick out topics that interested me, including modern medical devices, microfluidic platforms, bioMEMS technology, and tissue engineering. I felt empowered being surrounded by some of the greatest minds in the field, and it gave me a sense that the biomedical engineering field is one of the most important growing fields, and I'm glad to be a part of it."



Nicholas Parker

"This was the first bioengineering conference I have attended. I work in Dr. [Zhiwen (Jonathan)] Zhang's lab here at SCU, and I really had nothing to put my research in perspective with regarding other projects and schools until this conference. I attended as many presentations as I could each day, and I found how my research fit in as well as how to create and deliver an effective presentation. This conference really helped me understand the field of bioengineering as well. I learned how academic it is, even for professionals. Many of the industry bioengineers still write and read academic papers."



Amanda Khoo

"As a junior, it can be easy to get bogged down by the multitude of classes and requirements one must take, and it has always been a necessity to look forward into the future and remind myself why I love bioengineering. At the conference, scientists from around the world were invited to speak on topics ranging from new cellular pathways, to improved technologies for 3D printing, to impact of high school football on teenagers' brains. The innovation, passion, and scientific prowess I saw in these presentations inspired and reminded me that our time at Santa Clara is not an end-all, but rather a beginning. It is the beginning of a career. It is a beginning of a lifetime of service. It is the beginning of our time to impact the world for the better in the best way we know how."

Feeding a Hunger for Sustainability

Photo: Courtesy of Makena Wong



Makena Wong drops off a carload of food at Martha's Kitchen.

Makena Wong '17 has always had a passion for advancing sustainability. As a seventh grader she was bothered by the paper being wasted when teachers tore down their bulletin boards, so she started a campus recycling program that continues to this day. Last year, as a freshman, Wong enrolled in SLURP, SCU's Sustainable Living Undergraduate Research Project, where students are challenged to help solve a campus problem related to sustainability.

"I had heard a statistic from the United Nations' Food and Agriculture Organization that nearly one third of the world's food production is never consumed. That really bothered

me; it's an incredible percentage. Knowing that there is a huge amount of food on campus that is over-produced for Dining Services and catered events (a practice that is just part of doing business), I began researching food recovery options."

In May of 2014, she and fellow Bronco Paloma Sisneros-Lobato launched an SCU chapter of the Food Recovery Network, a national organization that has college students fighting food waste and feeding the hungry in their own communities. "I was worried that we might meet with some resistance from Dining Services, but they were immediately on board and everyone has been

really supportive," Wong said.

Here's how it works: Each week, Dining Services packages and stores unused food for Monday and Thursday pick-ups by two student volunteers who have been trained by Wong on food safety procedures. The students then deliver the food to Martha's Kitchen, a local organization that not only feeds the hungry at their door twice a week but also supplies food to more than 35 other nonprofit organizations in Santa Clara County. "Donated food cannot be in the fridge more than five days," said Wong, "so partnering with Martha's Kitchen is a great solution for ensuring that our food doesn't go to waste. It takes the student volunteers about an

hour, so it's not a huge commitment, but it makes a big impact. From May through November we donated over 3,500 pounds of food! It's amazing to think all that food would have been thrown out. It's very good to know it's being used.

"Sustainability has always been in my brain," she continued, "but I never thought of it as a career until I started taking classes at Santa Clara. After my freshman year, I switched majors from economics to civil engineering, and I want to specialize in environmental engineering. Having the technical knowledge and skills will open a lot of opportunities for me."

ENGINEERS ACTING UP

Photo: Charles Barry



Peter Stephens and Benjamin Lynch hone their improv skills.

We're all familiar with the stereotypes of engineers—they are considered by some to be introverted, lacking in social and communication skills, and perhaps a bit rigid. Spend any time in the boisterous study areas of SCU's engineering hallways and you will have a different opinion, but for introverts and extroverts alike, the prospect of public speaking can bring on a bad case of stage fright.

So, keeping in mind that a requirement for graduation for SCU engineers is participation in the Senior Design Conference where teams present their progress on year-long capstone projects in front of an audience of alumni, parents, and Silicon Valley leaders, and in keeping with our Jesuit commitment to educating the whole person, the

School of Engineering offers Improv for Engineers (ENGR 170) to juniors and seniors each winter quarter.

Brenda Woolley, an actor with 30 years' experience in theatre, has an affinity for teaching the craft of acting and improvisation to non-actors. "People fear public speaking more than death. Acting is an abstract art form that gives rise to a great deal of fear, but I find engineers to be really open to thinking outside the box, and they are courageous in delving into the imagination."

Through trust games and exercises in breath, relaxation, voice, and improvisation, students focus attention and energy on a part of the brain that may be under-stimulated in their more technical classes,

building confidence in creating and performing in public as they learn to see things through the eyes of a different person.

"For those who take on this challenge, the payoff is sublime; it's a joy that gives birth to something deep down inside that they always wanted to bring out. It's a gem inside and that is inspiring to me," said Woolley.

Benjamin Lynch and Peter Stephens took the class last year in preparation for Senior Design. "Putting on a different face when doing a presentation helps with the jitters," said Lynch, who subsequently also found it easier to give a quick spiel to potential employers about himself at career fairs. Stephens agreed, "It really

helped me prepare for Senior Design—getting in front of people and improving my ability to think on my feet was a big plus. Knowing that I had been there before and knew how to attack being on stage took some of the fear away. Beyond Senior Design, it's important for engineers to have a wide variety of skills in the global workplace."

The Jesuit University in Silicon Valley



CIVIL ENGINEERING ALUM LEADS \$2B PROJECT

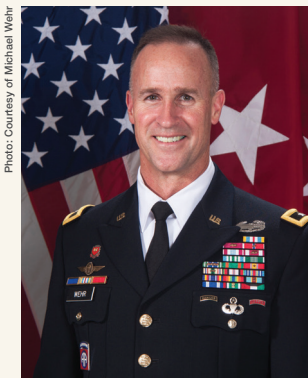


Photo: Courtesy of Michael Wehr

Major General Michael C. Wehr

place and people who shaped me at an early age for the career that led to this day," he said. His parents, Art and Margaret Wehr, had the honor of participating in the ceremony, while his Santa Clara sweetheart, Deborah Kalisz Wehr stood by his side.

Among other highlights, his career has included four combat tours, most recently serving as the Theater Engineer for Afghanistan. As a two-star general, Wehr is now in command

Santa Clara University hosted a number of illustrious visitors and events in 2014 (the Dalai Lama comes to mind!), but one was particularly meaningful for the School of Engineering—the U.S. Army Corps of Engineers' frocking (or promotion) ceremony of SCU civil engineering alumnus Michael C. Wehr '85 to the rank of major general. Last September, Wehr received his second star at his alma mater, where his career began in the ROTC program. "It feels great to come back to the

of the Mississippi Valley Division in Vicksburg, Mississippi, where he is responsible for a \$2 billion civil works program and plays a vital role in managing the Corps' water resources program in the Mississippi River Valley. To give you some perspective on the scope of his assignment, this division encompasses the third largest watershed in the world—trailing only the Amazon and Congo Rivers in size—and is the most navigable and most connected to arable land on Earth.

Less than 50 percent of one-star generals earn their second star. Leading the ceremony, Lieutenant General Thomas Bostick cited Wehr's compassion, decisiveness, work ethic, and engineering prowess that, coupled with a calm, strong leadership style makes him one of the Army's best.

Responding humbly, Wehr said, "It takes a lot of little things to make something big happen. It's a real honor to celebrate this moment here at Santa Clara. It is a gift to get to lead. It's about living, learning, loving, and leaving a legacy—carrying a torch, but thanking those who handed it to me and those who will receive it." Wehr also recognized the incredible importance of mentoring, specifically thanking his Santa Clara ROTC professor of military science, Lieutenant Colonel (Retired) Robert E. Camors.