A MESSAGE FROM THE DEAN

I have often stated that engineers and applied scientists are the magicians behind the curtain of technology. Every day, most of the developed world takes for granted the conveniences afforded through technology. That includes basic services, such as indoor plumbing and an electric grid, to more advanced technologies, such as modern transportation networks, wireless communication, and the Internet.

Mobile devices provide ubiquitous connectivity to the world and have evolved from simple cell phones to portable computing devices reshaping society. For example, the growth of cell phones in the developing world has enabled commerce ranging from simple transactions to micro-loans where local banking is not an option. From this perspective, one could view the cell phone as an access technology; a technology that removes environmental barriers preventing a person from accomplishing something.

The concept of removing barriers has driven much of the technological development we’ve seen. This has been especially apparent in technology for people with disabilities. Assistive technologies provide access and remove barriers, thereby helping us get things done. A case in point is a ramp outside of a building that provides physical access to the building for wheelchair users but also allows mothers with strollers to enter the building more easily. Voice recognition software can provide access to computing for a person with a motor impairment or allow a physician to transcribe notes faster than otherwise possible. Assistive technology is often designed for the “mass market” out of necessity, but we’re increasingly able to personalize technology for small groups and individuals.

The assembly line, pioneered by Henry Ford, was one of the great advances of the 20th century, enabling mass production; however, diversity of products was not a strength of this innovation. New technology and increased connectivity means that society is no longer constrained by a one-size-fits-all approach to product development or manufacturing. Henry Ford once said that a customer could have a Model T “painted any color that he wants so long as it is black.” Just think how far society has moved from that perspective, and how important that transition is to accommodate the incredible diversity of skills, experiences, and abilities.

Movements in open source software and open source hardware are creating opportunities for communities to address the needs of the few as well as the needs of the many. For example, the recent movement in open source prosthetics is aimed at sharing prosthetic designs for a community where innovations have been limited by market size. If the assembly line and mass production transformed the 20th century, perhaps rapid prototyping and additive manufacturing will be among the greatest innovations of the 21st century, whereby hardware can literally be printed at the desktop. These technologies will drive innovation in small markets—like prosthetics—which are traditionally unattractive to corporations looking for large market opportunities that drive shareholder returns.

Here in the Hajim School, we have faculty and students actively engaged in the development of assistive technologies, leveraging a wide range of computational and human resources to assemble communities around projects big and small. This is very exciting and just another important example of research under way here in the Hajim School. In this brief edition of the our newsletter, well see a few topics in assistive technologies that I’m sure you’ll find of interest, and there is no better place to highlight such innovations than in an engineering newsletter. After all, engineering at its core, is the useful application of science and technology for the needs of humanity. At the University of Rochester, we put that statement into practice.

Sincerely,

Rob Clark
Professor and Dean, Hajim School of Engineering and Applied Sciences

Smartphones have become an integral part of many people’s lives. Whether these devices are used to search for driving directions, pull up email, shop on the go, or browse local restaurants, we rarely pause to speculate on how this technology could be used for assistive purposes for people with disabilities, such as people with visual impairments. Navigating the landscape of the sighted world can be daunting for these individuals. While some assistive technologies, such as talking watches and text recognizers, do exist, they are frequently impeded in a predominantly visually encoded world.

To address the need for more effective technology to aid blind individuals, Jeffrey P. Bigham, an assistant professor of computer science, and his colleagues have developed a mobile phone application called VizWiz. This application essentially equips visually impaired individuals with a talking digital assistant at all times, connecting them to remote, sighted workers who can provide answers to their queries.

VizWiz works by allowing a visually impaired person to take a picture, record a question, and receive answers in real time. Bigham reported that this approach is not only “more effective, but also competitive with, or cheaper than, existing solutions.” For someone who is visually impaired, tasks like sorting the mail, reading menus, or understanding cooking instructions can be accomplished using the VizWiz application.

The groundbreaking aspect of VizWiz is that it overcomes the problematic triad of expensive, error-prone, and slow text readers available on the market. By employing an intuitively clever queuing system called quickTurKit, workers are recruited in advance to provide assistance, thereby reducing the wait times for responses to questions that are received. By combining the speed and precision of an automated network with the flexibility of human intelligence, VizWiz has effectively enlarged the scope of problem solving.

In improving the accessibility of visually impaired individuals to their environment and empowering them with greater independence, VizWiz has already generated considerable media attention, winning the best paper prize at the Association for Computing Machinery’s 23rd symposium on User Interface Software and Technology, as well as receiving coverage in New Scientist. Bigham himself was also recognized as one of the top 35 researchers in the world under the age of 35 in the September/October issue of Technology Review, a publication published by the Massachusetts Institute of Technology.
In today's world, music is a constant facet of our daily experiences. We hear tunes humming in the background of stores while we shop; we listen to the radio when we drive; we cannot imagine a workout without an MP3 player. It is a running soundtrack of our lives, so pervasive that we may not even notice the music all around us. Laurel Carney, professor of biomedical engineering, believes that music and other experiences of the audio world shouldn't be limited to individuals with normal hearing.

Part of Carney's work focuses on hearing aids, and specifically on developing novel algorithms that may allow people with hearing loss to experience and enjoy music. However, Carney's unique approach improved the experience of music for people with hearing loss. The key lies in using technology to compensate for the frequency mixing that occurs with hearing loss, instead of simply amplifying sounds. As filters in the ear broaden, frequencies mix, which in turn makes it more difficult to hear and discern sounds. The hearing aid algorithms created in the Carney lab narrow some frequency bands while discarding others so they can no longer mix as they enter the ear. The result is greater clarity in the sounds that people are able to perceive.

For people with normal hearing, sounds heard through the hearing aid with this algorithm are just as good as the original sounds. For people with hearing loss, this setting is preferred, especially when it comes to listening to music.

This was not an initial focus of the research however, and Carney was surprised to discover that algorithms initially aimed at improving speech intelligibility were more successful in improving the perception of music. Multissetting digital hearing aids allow people to adjust settings based on the ambient noise in the environment, but music has always presented a challenge. Hearing aids are largely optimized for speech recognition, arguably the most important task a hearing aid can serve, though it limits the range of other sounds that can be experienced.

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Professor Henry Kautz, chair of the Department of Computer Science, has a vision for the future of assistive technologies. Kautz and a team of his students are leading research in pervasive computing systems that will act as personal assistants to support independent living by the elderly and persons with disabilities. These “smart home” computing systems—which will adapt to user and environmental cues and provide assistance in routine tasks such as meal preparation—sound like technology of the distant future. But with help from Intel and collaboration among several universities, Kautz’s vision may be closer than we think.

The University of Rochester, whose participation will be led by Kautz, is joining five other research universities to form Intel Labs’ new Science and Technology Center (ISTC). With the University of Washington operating as the hub, the ISTC for pervasive computing brings together researchers from the Georgia Institute of Technology, Cornell University, UCLA, and Stanford University in addition to the University of Rochester. ISTC will focus on the sort of pervasive computing technology that Kautz and his team are researching, which will offer richer, more personalized assistive experiences to consumers.

“The next generation of pervasive computing systems will continuously learn environments, objects, schedules, and preferences of users,” says Limor Fix, Intel’s director of academic programs and research. “These future apps will be capable of supporting complex tasks, such as cooking a soufflé or building a complicated piece of furniture. Consumers will have a far richer experience than the technologies of today can offer and will be able to spend far more time achieving their goals than figuring out how to make the technology work.”

The ISTC for pervasive computing will specifically develop three concept applications:

• Mobile health and well-being systems that help consumers identify, manage, and reduce stress in their daily lives
• Family coordination systems that track everyday activities and assist families with planning
• Task space and smart kitchen systems that help with physical activities that don’t typically involve computers, such as cooking a complex recipe or building furniture
University of Rochester officials joined U.S. Representative Louise Slaughter (NY-25) on August 26, 2011, to mark the opening of the Integrated Nanosystems Center, URnano, dedicated to researching and fabricating materials on a smaller than microscopic level.

The new center will bring together experts in physics, optics, chemistry, biomedicine, and bioengineering to expand the research and technology commercialization of fuel cells, biosensors, and other high-tech devices important to industry, medicine, national security, and the economy.

“The Nanosystems Center offers unprecedented capabilities in nanoscience research that will build on our historic strengths, encourage the development of new technologies, and facilitate collaborations with industry,” said University President Joel Seligman.

The Integrated Nanosystems Center consists of a 1,000-square-foot metrology (measurement) facility and a 2,000-square-foot clean room fabrication facility. The clean room lab was designed and equipped in a way that ensures it is virtually free of dust, foreign particles, and chemical vapors. A total of $4.4 million in federal money was secured to make the project possible.

“The University approached me with the dream of having a state-of-the-art clean room and lab that would allow them to train the next generation of scientists and engineers in nanotechnology and contribute immediately to our knowledge in this important area,” said Slaughter. “I’m particularly excited because I know that this lab will create jobs, not only in the lab itself, but also in new companies catalyzed by the research taking place in the lab.”

Nanotechnology is important to a wide range of fields, including the development of energy systems and biosensors. Advanced fuel cell and battery designs, which promise greater portability and less frequent recharging, can be applied to mobile communications, GPS systems, computers, and night-vision devices. Biosensors with embedded nanosystem components can be used to detect biological warfare agents, such as anthrax, at very low concentrations.

“Nanotechnology programs at the University of Rochester are unique because they allow for the production of high-temperature nanomaterials and incorporate the University’s expertise in optics and optical device technology,” said Nicholas Bigelow, the Lee A. DuBridge Professor of Physics, chair of physics and astronomy, and director of URnano.

University opens multimillion-dollar nanosystems facility: URnano

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Laurel Carney
Laurel Carney, professor of biomedical engineering, was recognized by the Students’ Association as the Engineering Professor of the Year at the prestigious annual University of Rochester Undergraduate Research Symposium.

Vikram Dogra
Vikram Dogra, professor of imaging sciences, biomedical engineering, and urology, has been named editor-in-chief of the *Journal of Clinical Imaging Science* (JCIS). The publication is peer reviewed and multidisciplinary as well as open access, making its imaging research widely available, including to readers in developing nations.

Philippe Fauchet
Philippe Fauchet, the department chair and professor of electrical and computer engineering, was named a fellow of the Materials Research Society for his research on the optical properties of nanostructured and disordered silicon and their use. Fauchet is also the recipient of the William H. Riker University Award for Excellence in Graduate Teaching.

Wayne Knox
Wayne Knox, professor of optics and of vision science, formally assumed the role of associate dean of education and new initiatives. As a capstone to his service in the Institute of Optics, Knox was also awarded the 2010 Rochester Regional Photonics Cluster (RRPC) Leadership Award.

Duncan Moore
Duncan Moore, the Rudolf and Hilda Kingslake Professor of optical engineering was elected president of the International Commission for Optics (ICO), which currently provides support for optics and photonics in developing economies.

Michael Scott
Michael Scott, professor of computer science, received one of the four annual University Dean’s Award for Meritorious Service in PhD defenses, which recognizes professors who have served as chairs for PhD defense committees.

Ching Tang
Ching Tang, the Doris Johns Cherry Professor and recently named department chair of chemical engineering, received the Wolf Prize in chemistry in recognition of his pioneering work in organic light-emitting diode technology.

Brian J. Thompson
Brian J. Thompson, provost emeritus, received the SPIE Chandra S. Vikram Award in Optical Metrology.

The future looks bright, especially if you ask Ching Tang, the Doris Johns Cherry Professor and Chair of the Chemical Engineering Department. Tang is the inventor of the organic light-emitting diode (OLED), which brings remarkable clarity, efficiency, and contrast to the latest cell phone, television, and computer displays. According to the Gadgetwise blog of the New York Times, “With rich colors and a contrast ratio so high that the black areas of the screen seem to disappear, OLED is the current gold standard of television displays.”

Aside from their application in displays, OLEDs are also expected to play a role in the next generation of energy-efficient lighting. Tang, along with chemistry professor Lewis Rothberg has been charged with advancing OLED technology with $1.3M in funding from the U.S. Department of Energy. The funding represents one of several grants awarded nationally by the D.O.E. to help develop the next generation of high-efficiency lighting. If Tang and Rothberg are successful, OLEDs could one day replace fluorescent and incandescent bulbs.

This is not the only accolade Tang has received this year for his work with OLEDs. He is also the recipient of the Wolf Prize in chemistry, an annual award given by the Wolf Foundation that is widely regarded as second in prestige to the Nobel Prize. He shares the prize with Stuart Rice of the University of Chicago and Krzysztof Matyjaszewski of Carnegie Mellon University.

Tang is a member of the National Academy of Engineering and a fellow of the American Physical Society and the Society for Information Display. He holds more than 70 U.S. patents and has published more than 70 papers, one of which—his seminal paper on OLED technology, published in 1987 in *Applied Physics Letters*—has been cited by more scientists than any other paper in the history of the journal.

The next generation of lighting and displays...
distinguished alumni

Charles D. Smith
BS Chemical Engineering ’50
Retired Director of Manufacturing, Fluorocarbon Business Unit, Allied-Signal Corp. (Now Honeywell)

“At age 20, my degree was my ticket into the chemical process industry. The first phase of my career was spent at six plant locations, where I gained valuable experience. At age 30, I was given the opportunity to fill the plant manager position at a complex organic chemical plant. This University of Rochester graduate was rated number one out of 27 plant managers with respect to technical ability.

“The second career phase began when I was transferred to corporate headquarters, where I had several solo assignments to eliminate losses in business units and at plant locations. At one time, I was director of commercial development in the division research and development group.

“Finally, I was selected for the position of director of manufacturing in the fluorocarbon business unit. Out of 30,000 employees in the company, this University of Rochester chemical engineer was on the list of 200 key employees.

“These jobs were not easy, often requiring long hours. But, they were fun jobs. If you don’t have some fun once in a while in your job, then get another one.”

Berry J. Sanders
BS Chemical Engineering ’83
President and Chief Operating Officer, American DG Energy Inc.

“While I do not use my thermodynamics much anymore, I developed greater lifetime skills through engineering coursework and classes, such as learning, thinking, preparing, analyzing, collaborating, presenting, persevering, and, yes, competing. The University of Rochester and the School of Engineering and Applied Sciences prepared me for many of my professional challenges.”

Jennifer Bunis
BS Optics ’86
Executive Vice-President, Synrad Inc.

“As a typical high school graduate uncertain about what field I wanted to study in college, I chose the University of Rochester for one primary reason: a solid engineering school that was equally well known for its liberal arts curriculum. I was fortunate to discover the Institute of Optics midway through my freshman year and spent four years not only obtaining a BS in optical engineering but also taking a broad range of liberal arts classes. My engineering studies prepared me for the initial research and “hands on” phase of my career, while my liberal arts background prepared me for the management phase of my career, in which writing, problem solving, analyzing, leadership (thanks, Keidaeans!), and communication have all been essential skills learned at the University of Rochester but applied daily in my present position.”

Supporting the Hajim School

George Landberg, senior advisor at Scott-Mason and former president and CEO of Drexel Industries and Valcor Engineering, respectively, knows just how important it is to support education by contributing to the Hajim School Annual Fund. Landberg, a 1961 alumnus of the University of Rochester, received his undergraduate degree in mechanical engineering with the help of a scholarship from the George F. Baker Foundation and a NYS Regents grant.

The value of this gift was immediately apparent to Landberg when his pursuits in the real world revealed the superior-quality education he received at the University of Rochester. Today Landberg and his wife, Melody, who are members of the George Eastman Circle, continue the tradition of “paying it forward,” contributing to both the Annual Fund and to a scholarship named in memory of their son Peter, a 1987 chemical engineering alumnus.

In addition to George and Melody’s scholarship fund, their contributions to the Hajim School Annual Fund increase hands-on experiences in our classrooms and laboratories, keep our equipment current in a fast-paced environment of ever-changing technology; facilitate collaborative, multidisciplinary initiatives such as our Energy Research Initiative; and support a variety of student-led organizations that compete nationally and internationally, such as our computational science teams, the student-built Mini-Baja vehicle team, and our Solar Splash team.

Your participation is truly an investment in the future and, in the words of George Landberg, a vote that you cast in confidence of the success of the Hajim School and its students. With benefits that extend far beyond graduation, the Hajim School Annual Fund affords opportunities to bright young students who will one day change our world for the better.

To learn more about how you can support the Hajim School, please contact Eric Brandt at ebrandt@alumni.rochester.edu or (585) 273-5901.

Visit meliora.rochester.edu
FAST FACTS

- Home to the Institute of Optics: founded as the first Optics education program in the United States in 1929 through a grant from Kodak and Bausch & Lomb
- Laboratory for Laser Energetics, a national resource for research in inertial confinement fusion, is led by Robert McCrory, a mechanical engineering faculty member.
- Advantageous undergraduate student to faculty ratio of approximately 10:1
- Percentage of master's degrees awarded to women by school: Ranked 7th @ 35.2%
- Percentage of doctoral degrees awarded to women by school: Ranked 9th @ 34.1%

AWARD COUNTS

- 12 NSF CAREER Awards
- 1 PECASE Award (from Department of Defense)
- 3 National Academy memberships
- 10 Fellows
- 43 Fellowships accepted
- 5 Presidential Young Investigator Awards
- 2 Alexander von Humboldt Fellows
- 5 Alexander von Humboldt Awards
- 4 Fulbright Fellowships
- 5 IBM Fellowships
- 1 Willis E. Lamb Award for Laser Science and Quantum Optics
- 1 ONR (Office of Naval Research) Young Investigator Award
- 1 NIH Director's Innovator Award
- 1 Wolf Prize in Chemistry
- 8 American Association for the Advancement of Science (AAAS) Fellows