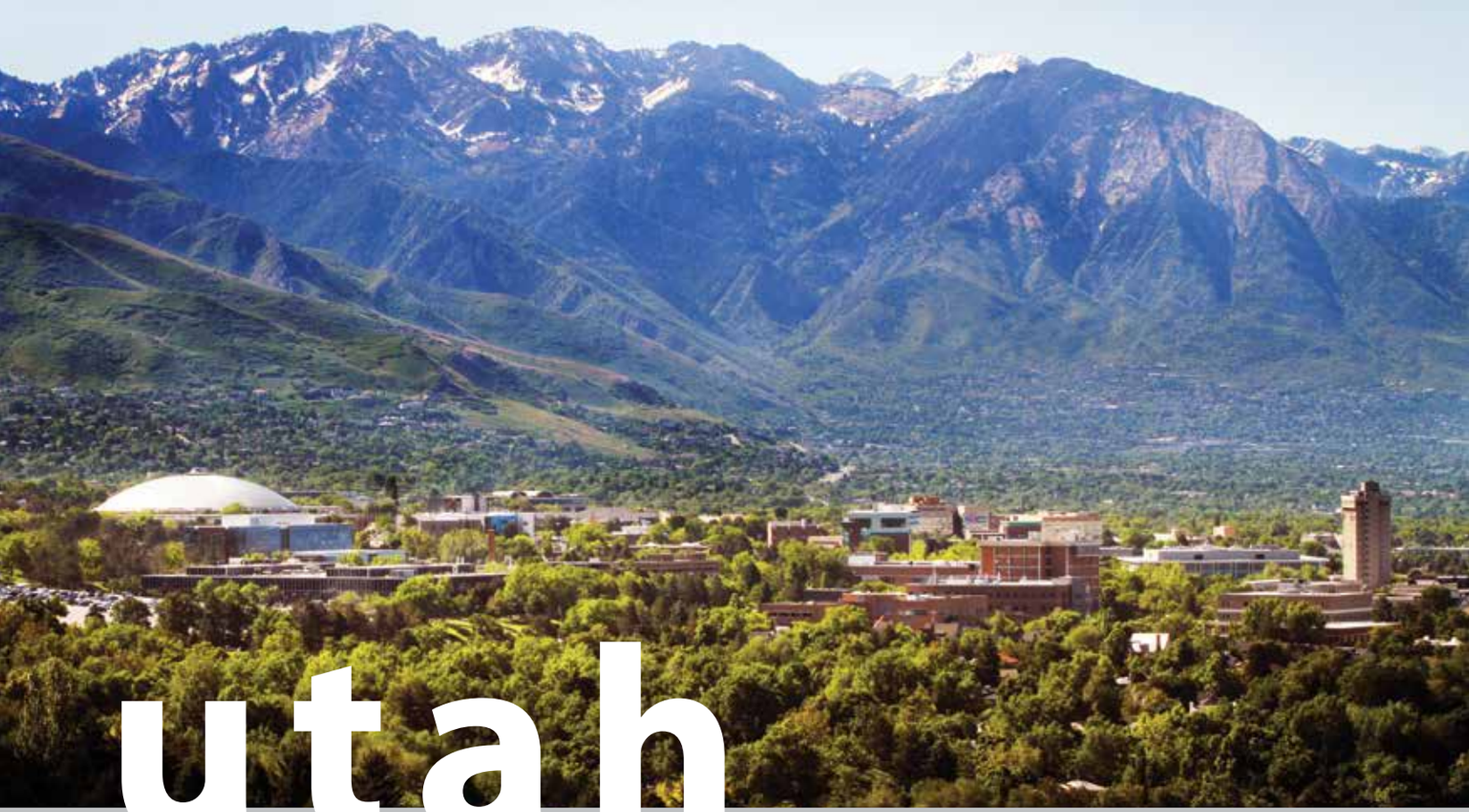


utah ENGINEERING

EYES ON THE FUTURE

THE UNIVERSITY OF UTAH • COLLEGE OF ENGINEERING NEWSLETTER

SPRING 2017

VISION OF THE FUTURE

University of Utah electrical and computer engineering professor Carlos Mastrangelo saw that the solution for people wearing bifocals was crystal clear. Those who suffer from both near and farsightedness don't need two lenses sharing the same eyeglasses frames. Why not have one set of lenses autofocus on what the person is seeing?

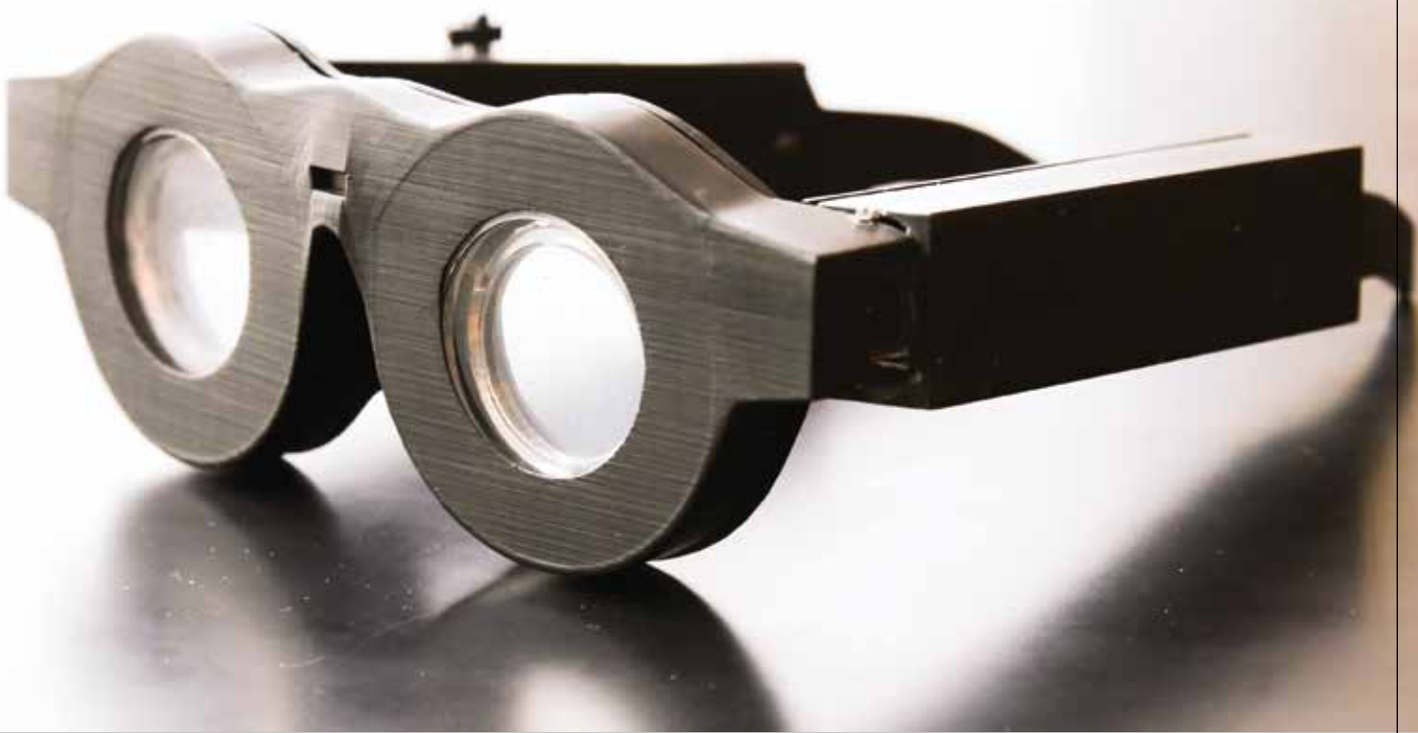
So he and his team of researchers began creating a pair of "smart glasses" equipped with special liquid lenses that automatically focus on the object the wearer is looking at using sophisticated circuitry, servo motors and distance meters.

"Most people who get reading glasses have to put them on and take them off all the time," says Mastrangelo, who also is a professor for USTAR, the Utah Science Technology and Research economic development initiative. "You don't have to do that anymore. You put these on, and it's always clear."

The human eye contains a lens that adjusts the focal depth depending on what you look at. But as people age, the lens loses its ability to change focus, which is why many people ultimately require reading glasses or bifocals to see objects up close and regular eyeglasses to see far away, also known as farsightedness and nearsightedness, respectively.

So Mastrangelo and doctoral student Nazmul Hasan have created eyeglass lenses made of glycerin, a thick colorless liquid enclosed by rubber-like membranes in the front and back. The rear membrane in each lens is connected to a series of three mechanical actuators that push the membrane back and forth like a transparent piston, changing the curvature of the liquid lens and therefore the focal length between the lens and the eye.

The lenses are placed in special frames, also invented by Mastrangelo and his team, with electronics and a battery to control and power the actuators. In the bridge of the glasses is a distance meter that measures the distance from the glasses to an object via pulses of infrared light. When the wearer looks at an object the meter instantly measures the distance and tells the actuators how to curve the lenses. If the user then sees another object that's closer, the distance meter readjusts and tells the actuators to



reshape the lens for farsightedness. Hasan says the lenses can change focus from one object to another in 14 milliseconds. A rechargeable battery in the frames could last more than 24 hours per charge, Mastrangelo says.

In order to customize the glasses to the person wearing them, the user inputs his or her eyeglass prescription into a smartphone app that then calibrates the lenses automatically via a Bluetooth connection to the frames. They only need to do this once until their prescription changes over time. That means the wearer would never have to buy another pair of glasses again because these smart glasses would easily adjust to a person's changing eyesight.

So far, the team has constructed a bulky, hardly fashionable, set of charcoal-colored frames, but they expect to slim the design to something lighter and more stylish. A consumer product could land on store shelves within as little as three years. A startup company, Sharpeyes LLC, was created to commercialize the glasses.

"Once we have a consumer-acceptable prototype, then we'll look for additional funding, maybe through Kickstarter," Mastrangelo said.

The idea and the team's first prototype has caught the world by storm, with stories about the glasses published in *The Wall Street Journa*l, The Discovery Channel, The Verge tech blog, and in newspapers from around the world. Mastrangelo also is scheduled to demonstrate his glasses to the U.S. Congress on May 5, one of only eight breakthrough medical technologies in the country that will be presented.

"I received requests for information about the device from all over the world," Mastrangelo said. "It is very clear that these devices can help restore vision for millions of people."

FISHING FOR THE RIGHT SOLUTION

Sometimes, doctors have mere hours to transport a human organ to a hospital and implant it in the patient. Even blood platelets used in transfusions can only be stored about five days before they are of no use.

University of Utah bioengineering assistant professor Jessica Kramer believes she can one day freeze and store such delicate human tissue for years, not hours, making the need for a waiting list for organ donation a thing of the past. Her answer lies in the unique chemistry of certain fish and ticks.

Kramer and her team of researchers are creating a synthetic form of proteins similar to those found in Arctic cod and certain species of ticks in the Rocky Mountains. These proteins protect tissue cells from harmful ice crystals due to freezing temperatures. Extracting these proteins from fish or the ticks is impractical — it's expensive, doesn't yield much and could be contaminated with other bacteria. But by making their own "antifreeze proteins" in a lab, researchers could mass produce them to freeze human tissue safely.

"We don't know how they work but we know that nature has evolved to make them work," she said. "We know they work for fish and ticks. We do know the structure of the protein, and my lab has already figured out how to make that structure. We can mimic what nature does."

The problem with freezing human cells is that ice crystals can form and puncture the tissue and the cell membrane. As a result, cell types such as stem cells used for regenerative medicine or insulin-producing cells that could one day be transplanted into diabetic patients can't be grown on a mass scale, frozen and shipped to hospitals. But these animal proteins Kramer is studying seem to bind around the surface of the ice crystals to keep the crystals from growing. They also cover the cell membrane surface and stabilize it from rupturing and leaking when it freezes.

"My lab is using a chemistry technique to make these proteins in our lab, an artificial version that is pretty much identical to what we get from fish," she said.

Now that Kramer and her team have been producing these synthetic proteins, they will test them with various cells, including blood platelets, red blood cells and insuloma cells to see if they can be frozen and revived successfully. One day, she believes this process could be used on whole human organs.

Kramer, who graduated from the University of Utah with a bachelor's in chemistry before earning her doctorate in organic chemistry at UCLA in 2012, returned to her alma mater to advance the science of synthetic proteins.

"If I'm in bioengineering," she said, "I have a better chance of making a product that helps somebody's life or makes a difference in society."

ALUMNUS SPOTLIGHT
THIAGO IZE

And the Oscar goes to . . . another University of Utah College of Engineering alum.

For the second time in as many years, a member of the College's alumni has taken home an Academy Award for distinguished technical work designed to make movies more awe inspiring. This time, School of Computing graduate Thiago Ize received the award for his work on making the unbelievable believable through computer graphics, or CGI.

Ize, who also worked at the U's Scientific Computing and Imaging Institute (SCI), works on the "Arnold Renderer," a program used by many visual effects and animation companies that draws computer generated images for films and television. For his work, Ize, along with a team of four other software engineers, was awarded a Scientific and Engineering Academy Award during a ceremony in February. Also named for the award were the software's creator, Marcos Fajardo, as well as Chris Kulla and Clifford Stein of Sony Pictures Imageworks, and Alan King of Solid Angle.

Ize, who still lives in Salt Lake City, is a principal software engineer for Solid Angle, a software company based in Madrid, Spain, that develops the Arnold Renderer (which was oddly named after movie star and former governor Arnold Schwarzenegger). The program takes scenes created by artists and renders them in a computer one frame at a time to ultimately produce a visual effect for motion pictures, television shows, video game trailers and commercials. The advantage with Arnold over other software renderers is that it can do the job more efficiently and with less computer memory and less time. Producing a single frame of a computer-generated visual effect can often take hours, but the Arnold Renderer can do it much more quickly.

"I'll do whatever it takes to make Arnold better," he said about his job. "The key parts are to make it more efficient. That can be done with fancy algorithms all the way to micro-optimizations."

His software has been used by visual effects artists for such blockbusters as "Gravity," "Arrival," "Fantastic Beasts and Where to Find them," "Deadpool," "The Martian," "Game of Thrones" and "Star Wars: The Force Awakens."

He said his success with Solid Angle is in large part due to his experience at the University of Utah. Born in Mexico City and raised in Virginia, Ize received his bachelor's in mathematics and computer science at the University of Virginia and then moved to the University of Utah's famed School of Computing where he earned his doctorate in computer science in 2009.

Colette Mullenhoff, who earned a master's degree from the U in computer science in 1998, won an Oscar in 2015 for her work on Industrial Light & Magic's Shape Sculpting System, digital animation software that allows artists to change the shape or face of a CGI character on the fly so they can see the results instantly.

IN BRIEF

SAVING ENERGY AND MONEY

University of Utah chemical engineering assistant professor Kody Powell and mechanical engineering assistant professor Amanda Smith know how businesses can save energy, and therefore, money.

The pair have launched the new Intermountain Industrial Assessment Center, an energy auditing program in which expert faculty and students evaluate local manufacturing businesses and come up with the best ways these companies can save energy. The group has received a $1.8 million, five-year grant from the U.S. Department of Energy to launch the center.

“It’s no cost to the facility to use this,” said Powell, who is a co-director of the center with Smith. “We spend one working day in the facility taking measurements, collecting data and evaluating the functionality and efficiency of the systems.”

Both graduate and undergraduate students as well as faculty members look at a variety of manufacturing operations, including the compressed air system and boilers to make sure they are operating well. The team of engineers also looks at heating and air conditioning units and production and electrical systems to see if they are operating efficiently.

After the day, the group then spends several weeks making engineering and economic calculations and produces a report recommending what the company should do to save more energy, how much it can save each year based on those recommendations and how much it will cost to implement the improvements.

“It’s daunting, but we go in and put our heads together, and we come out with five to 10 ideas to help save energy,” Powell said.

FACULTY RECEIVE NSF CAREER AWARDS

Two professors in the University of Utah’s College of Engineering have each received the National Science Foundation’s prestigious CAREER Award, one for developing the use of low-frequency magnetic fields to power medical implants and the other for creating tools to discover new materials for capturing energy. Each award is for five years.

Mechanical engineering assistant professor Shad Roundy (pictured, top) received his award to research a way to use low-frequency magnetic fields to provide electrical power to medical implants such as a continuous blood glucose monitor or a metabolic sensor.

Meanwhile, materials science and engineering assistant professor Taylor Sparks (pictured, bottom) received an award for developing software tools to more safely and effectively discover new materials that could be used to harvest wasted energy.

MASTERING A NEW CAREER PATH

Whether it's because of a dead-end job, low wages, or the lack of challenge in a current job, many people in the workforce want change. The University of Utah's School of Computing wants to help that growing demographic.

The school has created a new Master of Software Development (MSD) program, a unique and rigorous 40-credit-hour curriculum geared for people with no computer science or related degree who suddenly realize they can still shift their career path into software development.

"The Master of Software Development degree is aimed at addressing the critical shortage of well-educated computer programmers in Utah. It also facilitates a career change for people who have a bachelor's degree in some other discipline that has given them a solid analytical foundation," said Richard B. Brown, dean of the U's College of Engineering.

Some two years in the making, this innovative master's degree is an extensive 16-month program that covers everything from writing computer code to data analytics, networking and security. It is now accepting applications for the fall 2017 semester. Information about the new program can be found at msd.utah.edu.

"Our goal is to reach out to an untapped demographic and train bright and diverse non-computer science students to become high-quality software developers," said University of Utah School of Computing professor and director of the program, Sneha Kumar Kasera.

This is the right time to create such a master's degree because "computing is a part of everything we do," he said. "We live in a digital world."

Software developers have become some of the most sought-after employees in any industry. According to the U.S. Bureau of Labor Statistics, the employment of software developers in the U.S. is projected to grow more than twice as fast than the average of all other occupations from 2014 to 2024.

The U's curriculum, which starts in the fall and ends with the following fall semester, will include courses such as Computer Programming, Data Structures and Algorithms, Data Analytics and Visualization, Software Engineering, Database Systems and Applications, and ends with a capstone project.

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STUDENT LIFE
PROFESSIONAL PIVOT

Janaan Lake's career path didn't quite turn out the way she intended.

The 41-year-old Draper mother of three had always wanted to be an engineer since high school but instead graduated in accounting from Brigham Young University after encouragement from her parents and others. She earned a master's in accounting and began her career as a CPA at two firms in Arizona, then in Salt Lake City. But as time marched on and she and her husband had three sons, regret began to creep in.

"I liked having a life outside of being a mom. I liked going to work and being challenged," she said about her accounting job. "But most of the time it felt like glorified organizing."

In 2014, Lake met University of Utah School of Computing professor Martin Berzins at a local gym where he encouraged her to take one computer science class to see what it was like, and she did. Then she enrolled in a second class.

"I absolutely loved it," she said about her new courses. "That's when I decided to make the leap and go for it. I quit my job and decided to go to school full time. I wanted to find something I'm passionate about, something where you come home and still think about it."

With a lot of support from faculty such as Mary Hall and Erin Parker, Lake is now a junior in the School of Computing, working toward her bachelor's in computer science, one of a handful of older students in the University of Utah's College of Engineering who have decided to return to school after a long break due to either work or family.

"My sons think it's pretty cool that their mom is going back to school, and they love that mom has to do homework when they have to do homework," she said, laughing. "But it's great to have everyone at the dinner table with everyone doing homework."

Lake was a member of the team that took second place in last year's Supercomputing Student Cluster Competition in which they had to design and construct a high-performance computer network in 48 hours.

After graduating, she said she may continue on for a master's degree and wants to focus her research on machine learning and data science.