

interface[®]



California Institute for Telecommunications
and Information Technology

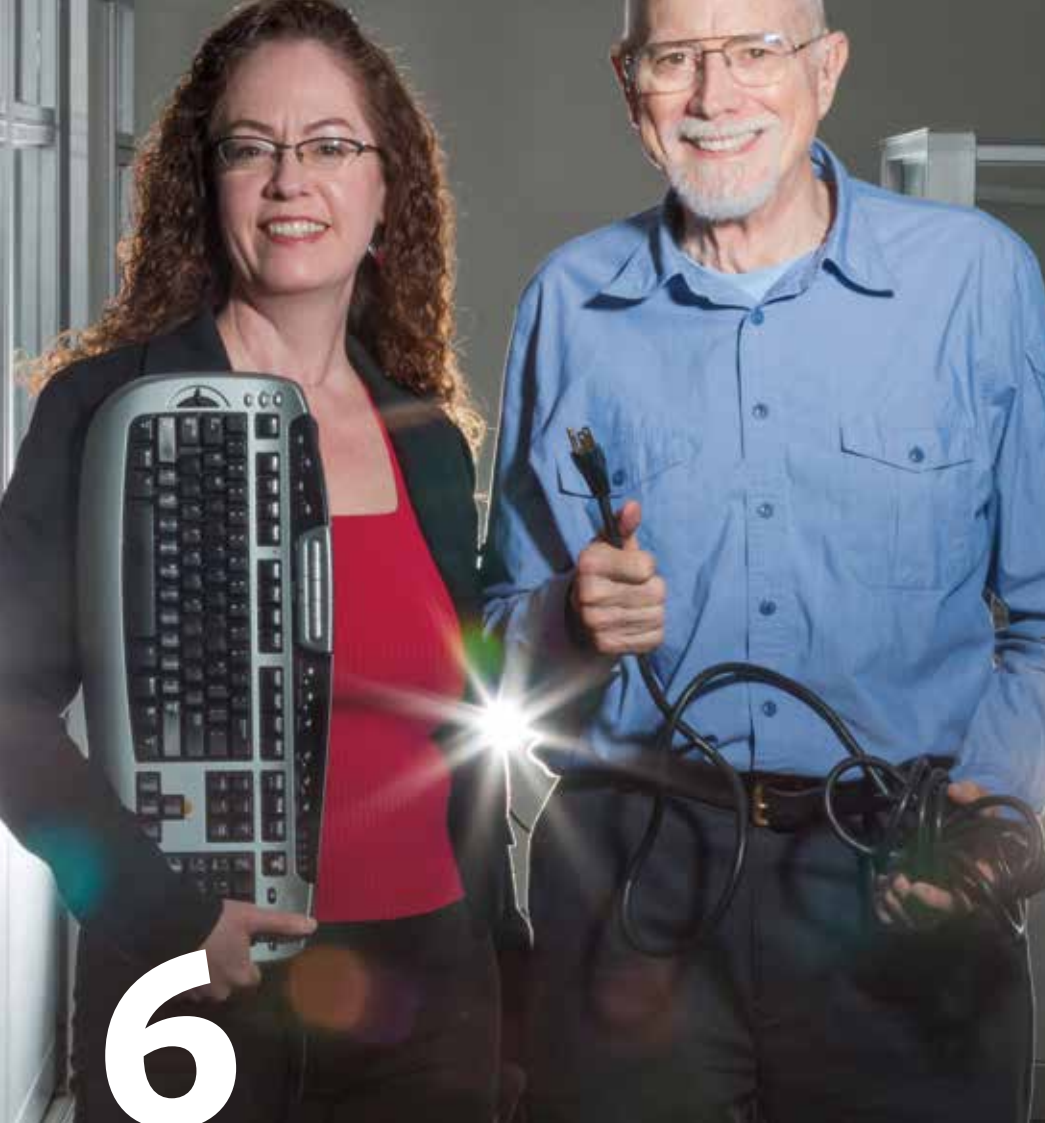
Calit2

Volume 10 | Issue 2 | Spring 2015

University of California, Irvine

It's Hippo**Time**





features:

2 Worker-Centric

The Internet of Things is revolutionizing manufacturing, and Calit2 plans to be part of it

6 Office Hog

CalPlug discovers an energy outlaw may be sitting right next to you

12 Interactive Play

Undergraduate projects aim to help children with autism

departments:

18 Face of Calit2

A man of many interests embarks on his next entrepreneurial journey

24 Entrepreneurial Spirit

Startup company investigates novel cell sorting techniques

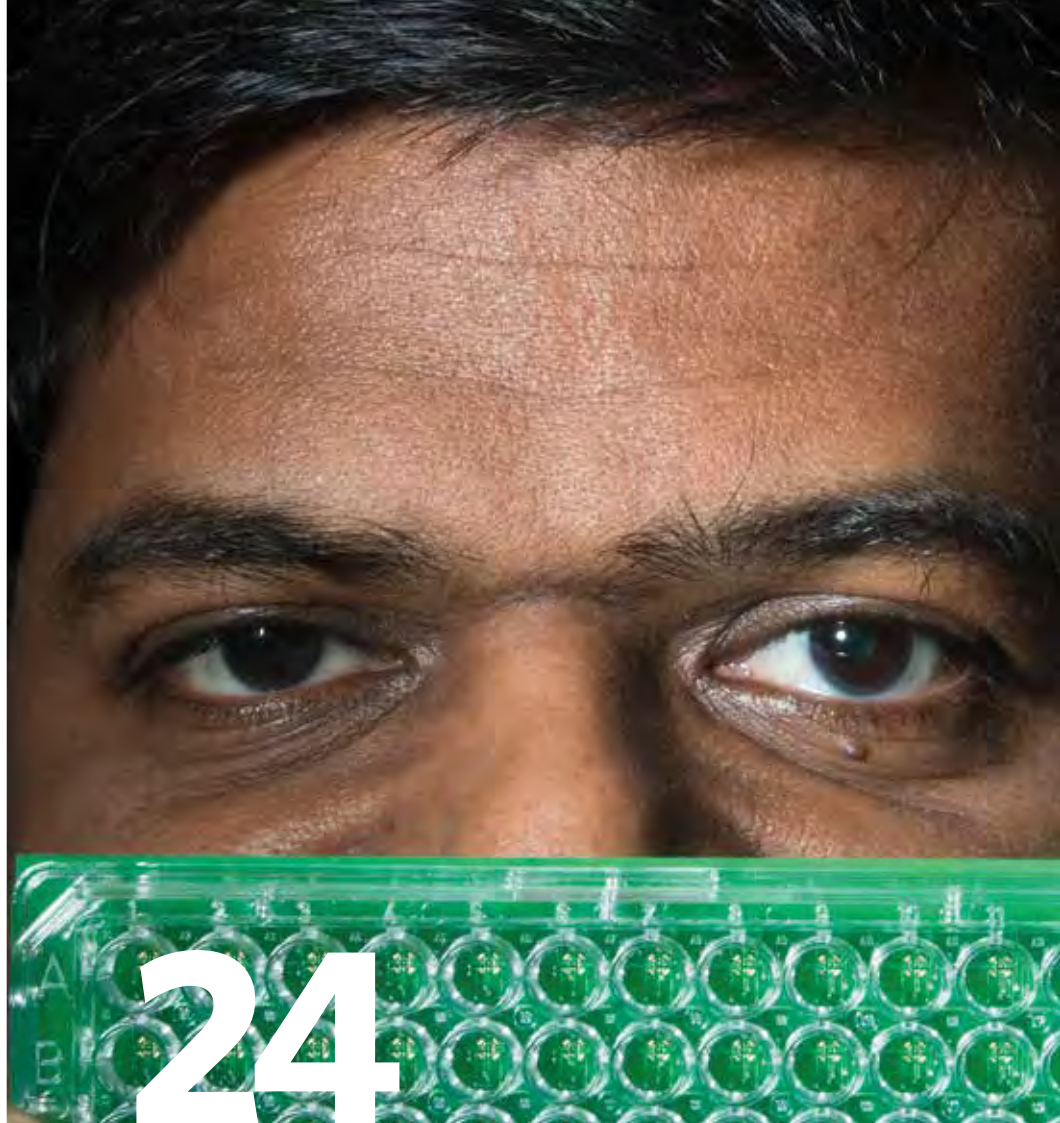
30 What's Trending Digitally

The latest YouTube craze begs the question why and who cares

34 Bits and Bytes

A pictorial timeline of Calit2 visitors, lectures, presentations and events

On the cover: *HippoTime*, a game developed by undergraduate students, features a purple hippo who guides children through an adventure, designed to help them calm down when upset. Art: Sara Foreman



Printed with soy-based ink on paper that is 30 percent post-consumer waste, 55 percent recycled and FSC-certified. Calit2's *Interface*:



**SAVES
40 trees**

*a year's worth
of oxygen for 20
people*



**SAVES
17,128
gallons of
water**

*enough for 1,016
eight-minute
showers*



**SAVES
28,560,000
BTUs of
energy**

*power for the average
household for nearly four
months*



**ELIMINATES
116 pounds
of water-
born
pollutants**



**ELIMINATES
1,895
pounds of
solid waste**

*enough to fill
more than 400
garbage cans*



**ELIMINATES
3,731
pounds of
greenhouse
gas**

interface

Spring 2015
Volume 10 | Issue 2

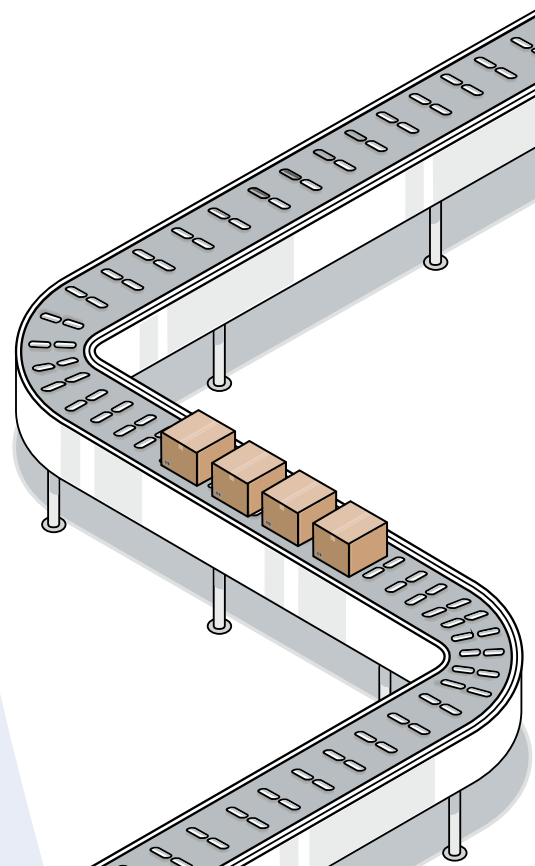
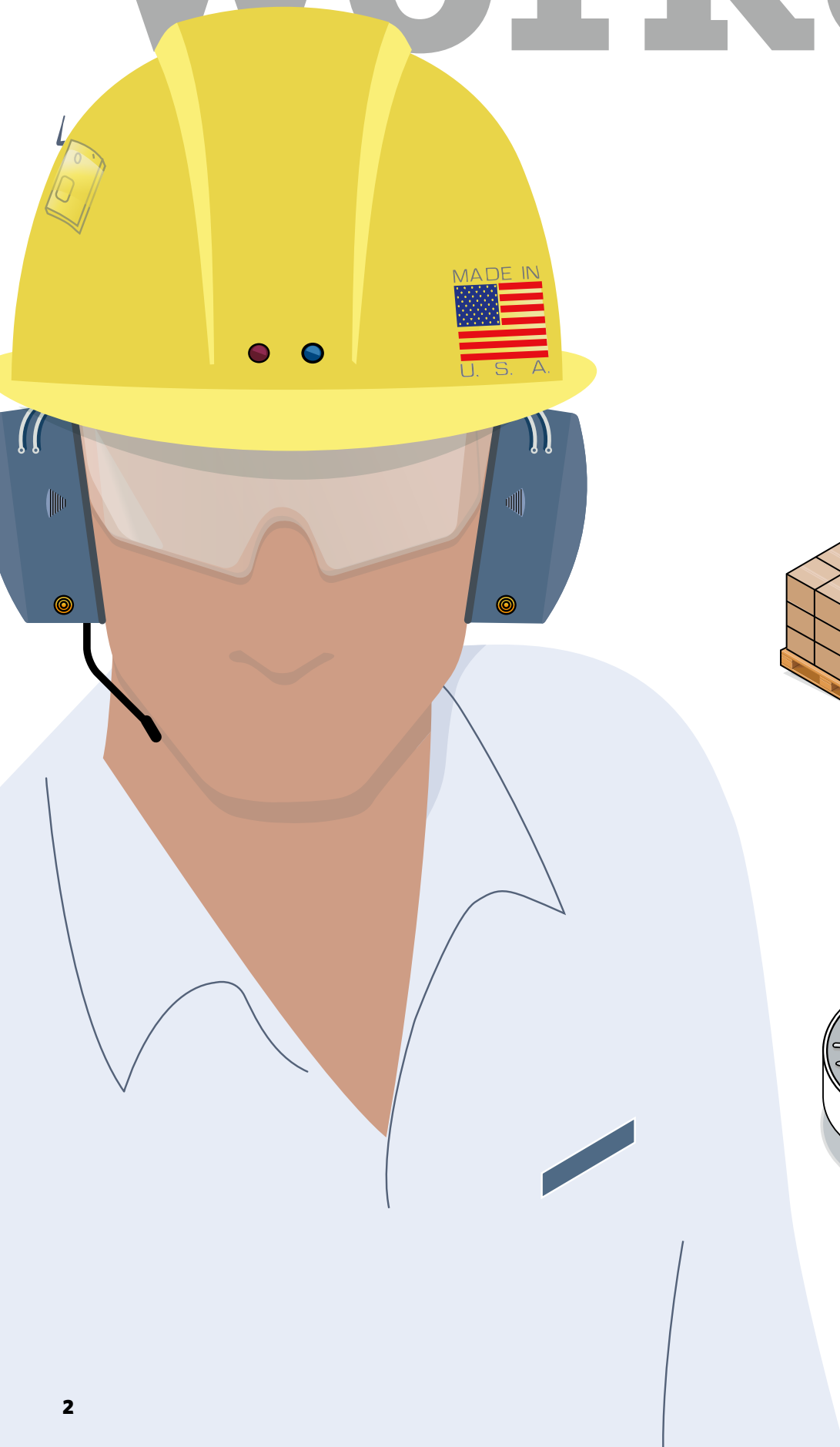
Interface is published semiannually by UC Irvine's
Calit2 Communications Department.

Executive Editor: Shelly Nazarenes
Managing Editor: Sharon Henry
Contributing Writers: Lori Brandt, Anna Lynn Spitzer
Art Director: Michael Marcheschi, m2design group
Photography: Michael Kitada
Publisher: Mike Delaney, Meridian Graphics

Calit2

University of California, Irvine
4100 Calit2 Building
Irvine, CA 92697-2800
(949) 824-6900
www.calit2.uci.edu
info@calit2.uci.edu

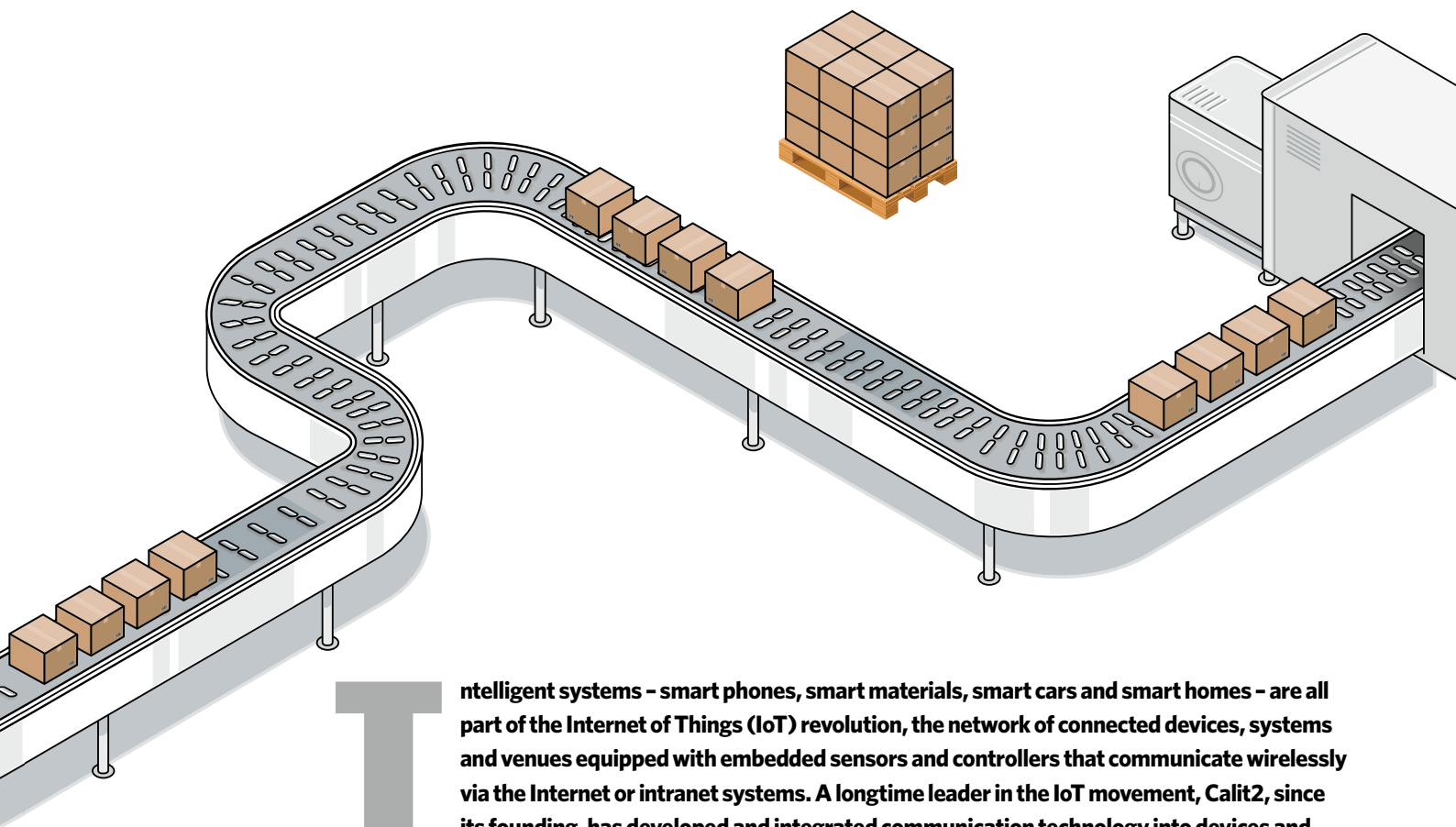
Worker-



Centric

Employing a front-line approach to advanced manufacturing

Graphics by Sharon Henry



Intelligent systems – smart phones, smart materials, smart cars and smart homes – are all part of the Internet of Things (IoT) revolution, the network of connected devices, systems and venues equipped with embedded sensors and controllers that communicate wirelessly via the Internet or intranet systems. A longtime leader in the IoT movement, Calit2, since its founding, has developed and integrated communication technology into devices and applications for improving the ways we live, work, play and care for ourselves and others.

The institute focuses its multidisciplinary expertise in the areas of energy, healthcare, the environment and culture – all with an emphasis on the end user. “We don’t develop technology for the sake of developing it,” says Director G.P. Li. “Our strength has always been technology solutions for empowering people.”

When President Barak Obama launched the Advanced Manufacturing Partnership in 2011 to help the U.S. regain its global leadership position, Li saw it as an opportunity to apply Calit2’s IoT and people-centric approach.

From the digitization of equipment and processes to three-dimensional printing to materials with custom-designed properties, a whole host of novel design, production and business capabilities are leading the way to new types of manufacturing, collectively referred to as advanced manufacturing.

Most of the smart systems and capabilities employed in this new paradigm have to do with making innovative products and processes, allowing manufacturers to improve quality and price competitiveness. But technology-intensive advanced manufacturing requires skilled workers to perform at high levels and compete globally.

Want to learn more about the SMART worker?


Register for Calit2's May 28, 2015 Igniting Technology panel presentation.

Visit www.calit2.uci.edu for details.

That is why Li is proposing a focus on the worker. "Humans have five senses," he says. "So, from a worker's point of view, is there anything that can extend the reach of his five senses? How can we equip workers to extend their abilities and ensure their safety, productivity and efficiency?"

In January, Calit2 hosted a workshop for manufacturing professionals from around the U.S. to explore how UC Irvine researchers might use their resources and IoT expertise to increase strategic and competitive opportunities for the nation's industrial sectors.

Stephen T. Blank, CEO of Pennsylvania-based Loman Control Systems, Inc., one of several system integration experts attending the workshop, explains: "By focusing on the workers and making them a part of the smart channel of manufacturing, we will ensure that workers have a future in the evolution of manufacturing."

Calit2 has initiated the Sustainable Manufacturing Alliance for Research and Training (SMART), with the vision of empowering skilled workers to have greater autonomy and decision-making responsibilities – resulting in not only a more satisfied, masterful workforce, but also plants and factories that are more energy-efficient, productive and safer. 

The SMART worker

EMBEDDED WIRELESS COMPUTER

VIDEO CAPTURE

High-speed/slow-motion video camera

HEAT IMAGER

Infrared camera, thermal imaging

AUGMENTED REALITY GOGGLES

Safety glasses, information display

ACOUSTIC HEADPHONES

Advanced dynamic speakers

DIRECTIONAL MICROPHONES

Sensitive up to ultra-sound.
Records frequencies found beyond the range of human hearing

PROXIMITY SENSOR

Detects presence of nearby objects without any physical contact

ID BEACON

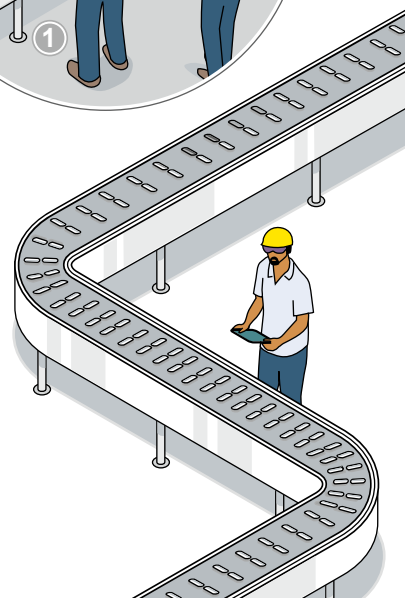
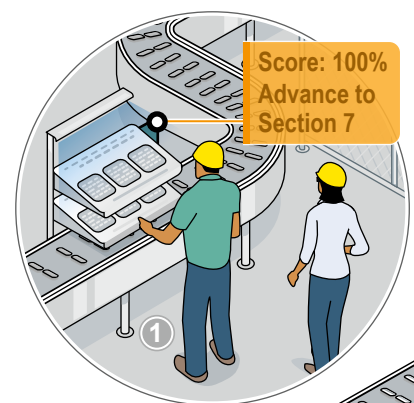
Pings content and real-time information to co-worker and machinery

1

SIMULATOR TRAINING

Instructional environment

with sensors and controls that simulate the actual work station for training scenarios. System provides low-cost, safe, controlled situation-awareness training and more accurately assesses progress.



2

REAL-TIME TRAINING EXPERT ASSISTANCE

Inexperienced workers receive **remote coaching**. Off-site coach has access to data and sensors to see, hear and sense the workspace and provide immediate instructions.

3

CROWD-SOURCED TROUBLESHOOTING

Worker notices problem (loose wiring), takes photo and gathers data via **helmet computer/camera** and uploads for evaluation. Audio can be included. Maintenance and efficiency are improved by encouraging real-time, worker intelligence to solve problems.

4

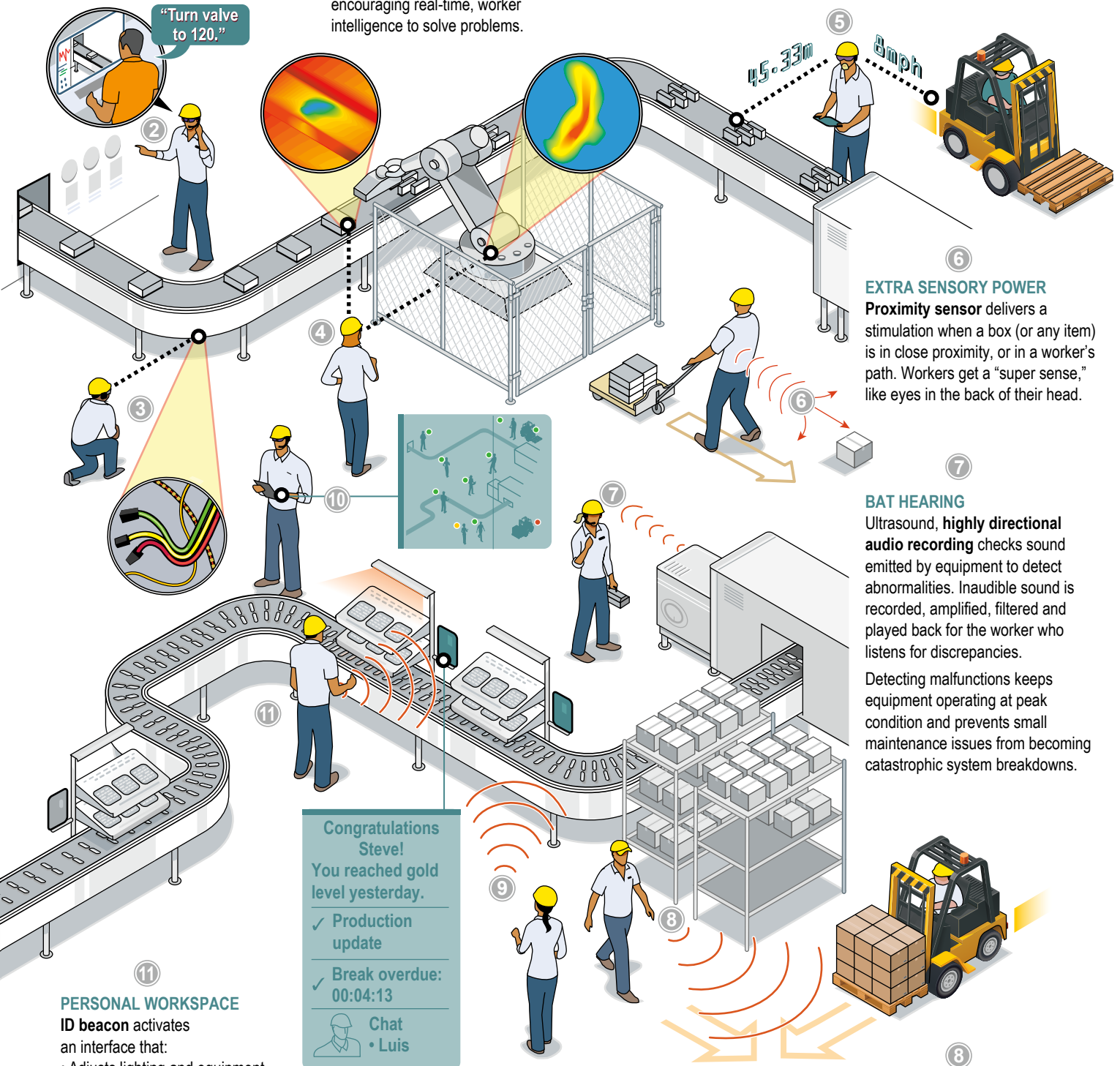
IMAGING ENERGY CONTROL

Infrared, thermal **heat imager** identifies irregular and excessive heat. Irregularities can create stress and product defects. Excessive heat is an energy-waster that also damages machinery.

5

PRECISION EFFICIENCY

Augmented vision records and displays speed and position of any object – from production lines to a moving forklift. Assists in providing greater efficiency and accuracy in reporting output and environmental conditions.



6

EXTRA SENSORY POWER

Proximity sensor delivers a stimulation when a box (or any item) is in close proximity, or in a worker's path. Workers get a "super sense," like eyes in the back of their head.

7

BAT HEARING

Ultrasound, **highly directional audio recording** checks sound emitted by equipment to detect abnormalities. Inaudible sound is recorded, amplified, filtered and played back for the worker who listens for discrepancies.

Detecting malfunctions keeps equipment operating at peak condition and prevents small maintenance issues from becoming catastrophic system breakdowns.

8

LOOK OUT, HUMAN HERE!

ID beacon pings to machinery and vehicles when a human is nearby. Vehicles alert drivers to human obstacles they don't see. Machines can shut off immediately to avoid potential injuries.

9

HANDS-FREE ACCESS

ID beacon ping allows employees access to certain machinery and secured areas for more efficient workflow.

10

PRODUCTIVITY IN PLACE

Real-time data from **ID beacon** shows employees' locations and activities. Allows assessment of workers' well-being and productivity.

11

PERSONAL WORKSPACE

ID beacon activates an interface that:

- Adjusts lighting and equipment.
- Provides team and personal motivational goal-setting.
- Optimizes worker activity and workflow.
- Minimizes energy use by shutting down nonessential equipment when worker leaves area.

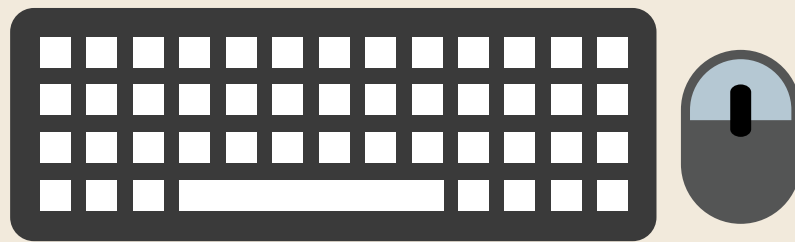
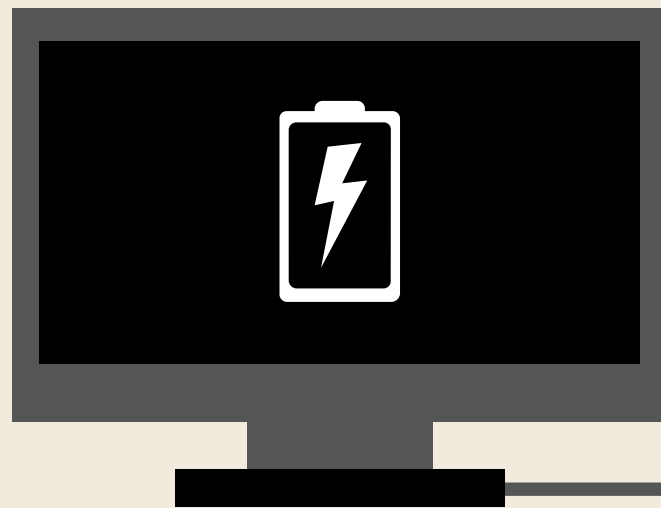
Congratulations Steve!
You reached gold level yesterday.

✓ Production update

✓ Break overdue: 00:04:13

Chat • Luis

Office



Hog

Study of computer power settings discovers how much energy

by Sharon Henry

is really wasted

IF YOU THINK YOU'VE SET YOUR OFFICE DESKTOP COMPUTER TO AUTOMATICALLY SLIP INTO SLEEP MODE AT NIGHT AND ON WEEKENDS – ENSURING YOU'RE DOING YOUR PART TO CURB FOSSIL FUEL CONSUMPTION – YOU'RE PROBABLY WRONG. AND YOU AREN'T ALONE.

At least that's what a pair of studies, conducted by the California Plug Load Research Center (CalPlug) and sponsored by the California Energy Commission, has determined. Contrary to what users may believe, computers are not entering sleep mode or automatically turning off as often as expected, and they're consuming more energy than most of us realize.

Last month, the California Energy Commission released proposed new standards for computers and monitors, influenced by findings from CalPlug and other studies.

The commission wants the power used by idle desktop computers to be reduced by 50 percent, and power-management features to be improved, starting in 2018. The CEC estimates the proposed changes would save 2,702 gigawatt hours a year, potentially reducing consumers' utility bills by \$430 million annually.

A recent Washington Post story suggested that CEC's proposed groundbreaking standards could become a blueprint for the nation, "given the size of its (California) population and market and also the presence of key parts of the tech community within the state."





Extensive studies on computer power management and user behavior conducted by CalPlug researchers Joy Pixley, project manager for social sciences, and Stuart Ross, a policy analyst, found desktop computers are consuming more energy than most of us realize.

Plugging Into Behavior

CalPlug researchers Joy Pixley, project manager for social sciences, and Stuart Ross, a policy analyst, conducted the extensive studies on computer power management and user behavior.

Their online survey in 2013 gathered detailed usage data on more than 3,000 office and home desktop and laptop computers from 2,081 UC Irvine students, staff, faculty and retirees. Last year they followed up by examining the actual power-management settings of 125 of the participants' office desktops, and remotely monitoring the power states of 119 of them for about one month.

The studies indicated most users are not enabling automatic power-management settings correctly.

Computer power management (PM) – the act of switching a computer to sleep, hibernation, or shutdown mode – can be activated manually or automatically.

Automatic PM is a built-in ENERGY STAR® feature designed to reduce energy use. However automatic PM can be disabled, or in some cases never enabled. A 2010 report from the Consumer Electronics Association estimated that 30 percent of home computers have power management disabled.

Desktop computers can use 60-300 watts of power a day when they are turned on, but energy consumption typically drops to less than five watts when PCs are in sleep mode.

And because computers and their monitors account for nearly six percent of California's residential and commercial-sector electricity use, the California Energy Commission wanted to determine whether users were taking advantage of PM options. "The information from this study will be used to consider future regulations and programs to improve enabling rates in computers," says Laurie ten Hope, CEC deputy director, Energy Research and Development Division.

While previous studies projected possible energy savings from PM for selected computer models, this was the first large-scale study designed to examine users' behaviors toward manual and automatic power management. "We wanted to focus just on the behavioral aspects: how and why people relate to their power management situations," Ross says.

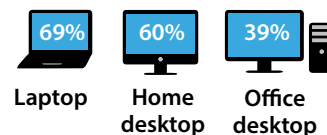
Findings included statistics about the number and types of computers participants reported manually shutting down or putting into sleep mode, the percentage of participants from various groups who have changed their power settings, behavior differences between desktop and laptop computer users, and the average amount of time per week office desktop computers are in specific power modes.

Power of Confusion

The findings are consistent with the idea that users are confused about power-management settings, and wrong about the amount of energy they believe they are saving, Pixley says. An especially large gap emerged between what people said their office desktop computer power-management settings were and how many computers were actually using those energy-saving features. While participants reported enabling automatic PM on 84 percent of office desktops, monitoring in the second study confirmed this to be true for only 20 percent.

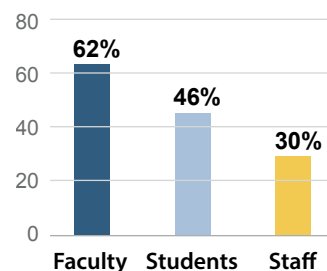
Shut it down

Total computers (by type) reported regularly turned off or manually switched to sleep or hibernation mode when not in use:



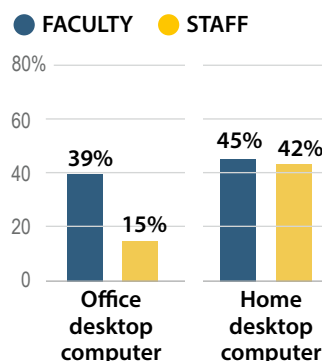
Having control

Participants who reported having control over the automatic power-management settings on their office desktop computer:



Who is changing power settings

Participants who reported changing their computer's power-management settings:



“Made me realize how much I leave my computer on when I’m not using it, and that I should change the settings to better fit my lifestyle at the moment.”

Participants were anonymous, but several shared comments about their user behavior and the survey. “Made me realize how much I leave my computer on when I’m not using it, and that I should change the settings to better fit my lifestyle at the moment,” one respondent commented. Another added, “I always turn off my monitor to save energy when I leave my office, but I did not know how to hibernate the office computer so I can still access it from off campus – if there is a way to do that, I would happily save more energy.”


Next Steps

“It’s not enough to tell people they should save energy. We need to address the reasons why more people aren’t using low-power modes, whether it’s technological problems or confusion about office policy or just forgetting. Make it easier to use sleep mode, and more people will use sleep mode,” Pixley says.

The university recently installed new software that will allow better control and customization of power settings on office desktop computers, says Jeremy Paje, manager, Standard Desktop Support with the Office of Information Technology (OIT).

The next step is to determine how restrictive the power-management profile settings should be for the nearly 2,000 office desktop computers supported by OIT. They will also identify departments that need to be exempt, such as UCI’s central plant and its police dispatch, because they require uninterrupted, 24/7 computer operations.

“Even if we implemented the least restrictive power setting (set computer for standby/sleep mode on weekends), the university would save more than \$22,000 a year,” Paje says. “And the reduction in carbon emissions would be the equivalent of taking 34 cars off the road.”

The CalPlug studies were published by the California Energy Commission and can be viewed online at: <http://bit.ly/Calit2Study> and <http://bit.ly/Calit2Study2> 

myth or reality

Users give a variety of reasons for not enabling energy-saving, power-management features on their computers. Here are a few common myths identified by energystar.gov.

myth: More energy is saved by manually shutting down a computer than by enabling automatic PM settings.

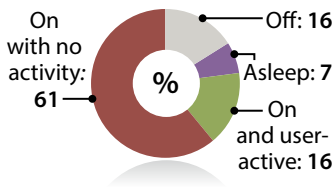
reality: Turning the computer off does save a few watts compared to automatically transitioning to sleep mode, but forgetting to shut down a computer a few times could negate a year’s worth of energy savings.

myth: Putting computers in and out of sleep mode several times a day will decrease their life span.

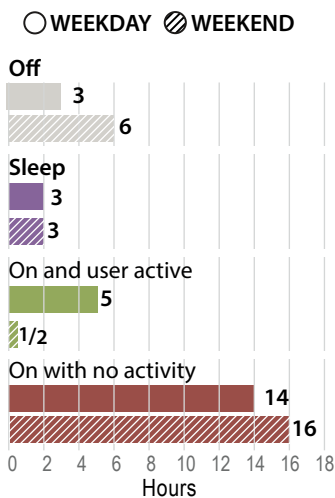
reality: Most computers can handle up to 40,000 on-off cycles before failure. Some studies show it would require cycling on and off every five minutes to damage a hard drive.

Secret life of office desktops

Average time per week office desktop computers spend:



Average hours per day office desktop computers spend:



Power is on, but nobody's in

How office desktop computers spend the day (whether PM enabled):



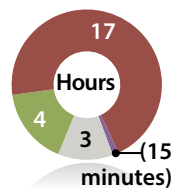
Only 1 in 5

Office desktops has PM enabled.



4 in 5

Office desktops do not have PM enabled.



Sources: *A Survey of Computer Power Modes Usage In a University Population and Monitoring Computer Power Modes Usage In A University Population*, California Plug Load Research Center, University of California, Irvine

Saving Energy on Idle PCs

Another common misconception involves computer monitors. Even if your monitor goes dark when the computer is not being used, the computer might not be set to enter sleep mode; this requires an extra step. Pixley and Ross say they believe survey respondents may have thought their computer was asleep when only the monitor was off. Both Windows and Apple computers allow users to set the amount of idle time that occurs before the device goes into standby or sleep mode.

To view instructions on how to activate power management on your computer, visit <http://bit.ly/CPManagement>.

- myth:** If the computer is sleeping, it can't automatically receive important software updates.
- reality:** There are several ways to ensure that software updates are applied, including waking up computers automatically through the network prior to distributing updates.
- myth:** Because most manufacturers now ship computers with automatic power management already enabled, there is no need to check automatic settings.
- reality:** Default computer settings are often changed by computer resellers, third-party service providers, or IT departments before end users acquire them.
- myth:** Computers and monitors use more energy with power-management settings activated, due to power surges when cycling on and off.
- reality:** The small surge of power created when computers are turned on is far smaller than the energy used by running the device when it is not needed.

Interactive



by Lori Brandt





Undergraduate students help children with autism keep their emotions in check



(opposite page) Nursing professor Yuqing Guo (center) mentors the four undergraduates, from left, Tiffany Yu, Aditi Bhatia, Sara Foreman and Rea Reyes, who are working on applying innovative technology to two toys designed specifically for young children with autism.



It all started

with a soft, furry stuffed anteater. Four students in Calit2's Multidisciplinary Design Program (MDP) were interested in conducting research that would help children with a disability. The stuffed replica of UCI's mascot, equipped with wireless sensors to make sounds when it is touched or hugged, was developed in the institute's eHealth Collaboratory.

The all-female MDP team – Aditi Bhatia, Sara Foreman, Rea Reyes and Tiffany Yu – saw the anteater as inspiration for their project: applying innovative technology to therapeutic toys designed specifically for young children with autism.

According to the Centers for Disease Control, autism spectrum disorder (ASD) is the fastest growing developmental disability in the U.S., with one in 68



children affected. A complex disorder of brain development, it is characterized, in varying degrees, by difficulties in social interaction, verbal and nonverbal communication and repetitive behaviors. The most obvious signs and symptoms of autism tend to emerge between 2 and 3 years of age, and boys are nearly five times more likely than girls to have it.

This latter fact hit close to home for one of the team members, Reyes, who grew up with two younger brothers, now 16 and 18, who both have autism. One brother is non-verbal, and neither is high-functioning.

"Growing up with them was definitely a challenge," says Reyes, a fourth-year chemical engineering student. "I had to mature at a young age, and I had to realize that my brothers are always going to be different and that it was ok for them to be different. I try to help my parents out by just playing with them or taking





Hippotime and Porkiball teams meet weekly in the eHealth Collaboratory. From left: Rea Reyes, Sara Foreman, Aditi Bhatia, Tiffany Yu, Ryan Smith, Yuqing Guo, Kevin Liu and Christina Garibay.

them out to eat or to shop. I help with calming them down as well, whenever they get upset and my parents are having a hard time with diverting their attention.”

That’s the goal of HippoTime, one of the two toys the team is developing to help an upset child calm down and learn to regulate his/her emotions. The other toy, Porkiball, promotes social interaction between child and parent or caregiver.

The students spent several weeks at the Center for Autism and Neurodevelopmental Disorders in Santa Ana observing children, ages 3 to 5, participate in social behavior group therapy. The students also sought advice from Dr. Robin Steinberg-Epstein, a behavioral developmental pediatrician, and Kelly McKinnon, a board-certified behavior therapist and director of behavior intervention at the center, who explained the types of challenges their patients face.

“The students were able to see our Applied Behavior Analysis team teach children with autism how to interact with one another, or play together,” explains McKinnon, who has 20 years of experience working with adults and children with various developmental disabilities. “We explained the types of

difficulties children with autism have, such as direct eye contact, coordinated play with others, calming down when upset, and managing emotions.”

After a year of research and development, the MDP students are getting ready to show their prototypes of HippoTime and Porkiball.

HippoTime is a video game that reacts to biofeedback from a breathing monitor. The idea is for children to wear a breathing band, which ideally would be part of a superhero cape, as the game’s purple hippo takes them through a series of breathing exercises, targeted at calming them down. The exercises are incorporated into an adventure for the hippo, who has to travel through several scenes to get to his birthday party. Children are asked to help inflate a hot air balloon, inhale the sweet smell of flowers, and propel a sailboat to help the hippo reach his destination where he blows out the candles on his cake. The band monitors the user’s breathing rate and communicates with the computer game.

“We use the hippo as a guide through the adventure, and each scene has a challenge for the child,” says Foreman, a biological sciences major, who grew up playing soccer and has spent several years volunteering with AYSO’s special needs soccer team. She was enthusiastic about a project that would help kids with autism as well as allow her to work with students from other disciplines. “I love not being limited by my own major and was really excited about the opportunity to get to know and learn from students in different areas.”

Foreman drew the pictures for the game and Reyes animated the scenes. They recruited electrical engineering and computer science student Kevin Liu to write the computer code and psychology student Christina Garibay to help them understand the clinical characteristics of children with ASD. Ryan Smith, Calit2 software developer for eHealth projects, helped the students with both projects.

Bhatia and Yu worked on the other toy, Porkiball. It uses a ball and a new concept called an experience jockey, or EJ, to encourage social interaction between parents and children with autism. The EJ customizes the environment with sounds, music, lights and vibrations, while inviting the child to interact with a parent.

"We are following the 'Bop It!' concept with our ball," says Yu, who worked on the script and the interpersonal aspects of the game. A psychology and social behavior major, she hopes to pursue a career as an occupational therapist. The EJ issues commands, and follows the Applied Behavior Analysis method of rewarding the child when tasks are accomplished. "The ball is not the main thing; the social interaction is."

Bhatia has been involved with the eHealth Collaboratory since she was a freshman. "I liked this project because it had a lot of applications in hardware and software," says the electrical engineering and computer science major.

A key aspect of these two projects is that the students sought and listened to input from multidisciplinary experts. The team meets weekly with mentors Yuqing Guo, an assistant professor in nursing science, and Mark Bachman, assistant professor of electrical engineering and computer science. Wendy Goldberg, a professor of psychology and social behavior, along with Dr. Steinberg-Epstein round out the team's faculty advisors.

"This is a clinical translational project," says Guo. "When Dr. Steinberg-Epstein and Kelly McKinnon told the team they needed help getting kids who threw tantrums to regulate their emotions, the team decided to integrate biofeedback in a video game to help children with ASD learn emotion

regulation skills. It is these vibrant students who executed the ideas into creative and fun clinical prototypes."


Reyes (below) had been involved initially with the stuffed anteater project and was eager to continue with the concept of incorporating technology into a toy. "I wanted to be part of something that would help me understand how to deal with my brothers better and maybe teach my parents if I learn something new," she says. "What started as a music therapy project has grown to be so much more." 



photo: Debbie Morales





SERIAL INNOVATOR HAS MASTERED THE ART OF JUGGLING IT ALL

Renaissance Man

by Anna Lynn Spitzer

If Mark Bachman were an animal, he'd be a cat: a cool cat, with nine lives, of course. Not lives lived consecutively, mind you, but all crammed into one artistic, enthusiastic, passionate and sometimes messy endeavor.

Bachman, a consummate juggler of proficiencies, is teacher and technologist, innovator and inventor; he's also mentor, musician, actor, entrepreneur, Internet-of-Things evangelist and family man.

As he's the first to admit, that can leave him a little scattered. In fact, his LinkedIn profile states: "Please email. If I don't respond, try again. I often get swamped and I might miss yours."

"I often over-commit," he confesses. "My biggest problem is putting too much on my plate. Sometimes I'm juggling a million things, but it's hard for me to turn my back on people who need my help."

Bachman is about to begin a new – and probably less chaotic – chapter in his saga. On July 1, the UC Irvine electrical and biomedical engineering educator and researcher will wrap up 20 years in academia and segue into a new phase. An inveterate innovator who has collaborated on a string of startup companies, he will devote himself full time to entrepreneurship.

He will guide his newest business, technology firm InXus Interactive; help businesses implement the Internet of Things; and serve as a conduit for other local startups. "There's quite a lot of entrepreneurial activity in Orange County right now and I'm connected with that so I can help them out."

He knows firsthand that bringing a product to market requires time, money, expertise, connections and attention to detail. And, he says, although universities are successful at the basics, from research to prototyping, they're usually not well-equipped to guide projects all the way through the technology-transfer labyrinth.

"I'm at a point where I have to decide which way I want to go," he shrugs. "The market is coming back so strong, and we've been doing such great work at Calit2; I'd like to see some of it get out there."

Bachman is already an accomplished career evolutionist. He earned his doctorate in experimental subatomic physics at the University of Texas, Austin, working for several years as a physicist for the Brookhaven and Los Alamos National Laboratories, as well as TRIUMF, Canada's National Laboratory for Particle and Nuclear Physics.

In the early 1990s, he found himself drawn to nanotechnology and microfabrication, ultimately making the leap into electrical engineering. Soon after arriving at UCI in 1994, Bachman worked hand-in-hand with fellow engineer G.P. Li to open the university's Integrated Nanosystems Research Facility (INRF), one of the first public cleanroom facilities in Southern California.

In the process, the two engineers developed a fast friendship, one that has spanned 20 years, parallel research goals and numerous collaborations, including Calit2.

When Li was appointed director of the Irvine division in 2007, Bachman assumed the mantle of cleanroom operations, opening and overseeing BiON, the institute's bio/nanotechnology cleanroom.





Later, he directed Calit2's eHealth Collaboratory, and assumed an unofficial, but very vocal, role as the institute's IoT evangelist. He enthuses about the Internet of Things to anyone who will listen, plugging Calit2's expertise and accessibility.

"As a colleague, Mark has been instrumental to the success of Calit2, from INRF and BiON to the establishment of the eHealth Collaboratory," says Li. "As a friend, he taught me the art of failure: the importance of learning from it and turning it into success. We always think of the glory of success but Mark taught me that failure is important too."

A popular instructor and intrepid researcher, he is an original thinker and inventor, whose 12 patents reflect both progressive thinking and down-to-earth practicality: a semi-implantable micro-hearing aid that mechanically drives the auditory system; microfluidic devices built from polymers; a super-thin, multichannel microphone, which uses micro cantilevers and light to detect sound; and a micro-pallet array, which allows scientists to isolate and study individual cancer cells. UCI's Office of Technology Alliances named him its 2005 Innovation Award winner.

"Mark is one of the most creative people I have worked with. He has an incredible ability to innovate and develop ideas," says Dr. Hamid Djalilian, an otolaryngologist with whom Bachman has collaborated on several inventions.

Bachman is a tireless crusader for innovation and commercialization, and an outspoken advocate for teaching students how to succeed at both. He founded the ResonanceLab@Calit2, where a dozen handpicked students learn the finer points of

The many lives of Mark Bachman (clockwise, from top left): modeling one of his eHealth inventions, an ear-directed laser therapy hat; starring as King Tut in the CHOC Folies; visiting Yokohama, Japan with G.P. Li; taking a side trip to Kabul University after consulting with an Afghan-American startup company; discussing IT with local social entrepreneurs in Swaziland.



Top: In the Second Law duo, Bachman plays acoustic guitar and sings; chemistry professor Craig Martens handles lead guitar. Bottom: Longtime scoutmaster Bachman and son Harrison.

project management, decision-making, leadership skills and creative thinking. Four of his students have propelled his mentoring straight into their own startup companies.

"Dr. Bachman's mantra is to not be afraid to fail. His philosophy of exploring the unknown and attacking a problem from a fresh direction has undoubtedly helped me realize success as both researcher and now, as president of a medical device company," says former graduate student Nizan Friedman, co-founder and CEO of Flint Rehabilitation Devices.

Another graduate student, Peyton Paulick, earned her doctorate in biomedical engineering last year. "Mark is a mentor who instills immense confidence in his students by empowering and encouraging them to take risks and explore their interests," she says. "[He's] a teacher, an advocate, a support system, a friend and an endless source of knowledge."


Fourth-year biology student Sara Foreman, whom Bachman mentors in Calit2's Multidisciplinary Design Program, also lauds his experience and insight. "He approaches [us] with the conviction that we have the creativity and capability of constructing a product worthy of real-life application, and he gives us room to experiment," she says. "If I ever limit myself, he'll not just give me a task to push those limits, but he'll help me realize that when I don't place boundaries on myself, I can truly accomplish a lot."

When Bachman's not in the lab or the lecture hall, he's often found behind a guitar or on a stage. Several years ago, he and UCI chemistry professor Craig Martens discovered that their musical styles meshed; they formed Second Law, performing at local coffee shops, bars and private events with a playlist ranging from Elvis to the Eagles, Johnny Cash to the Moody Blues.

"Mark's a consummate performer," Martens says. "Just as he has unlimited energy in his work life, he's the same on stage. When he teaches, he does more than lecture to students; he really likes to connect, and that's what he does when he sings, too."

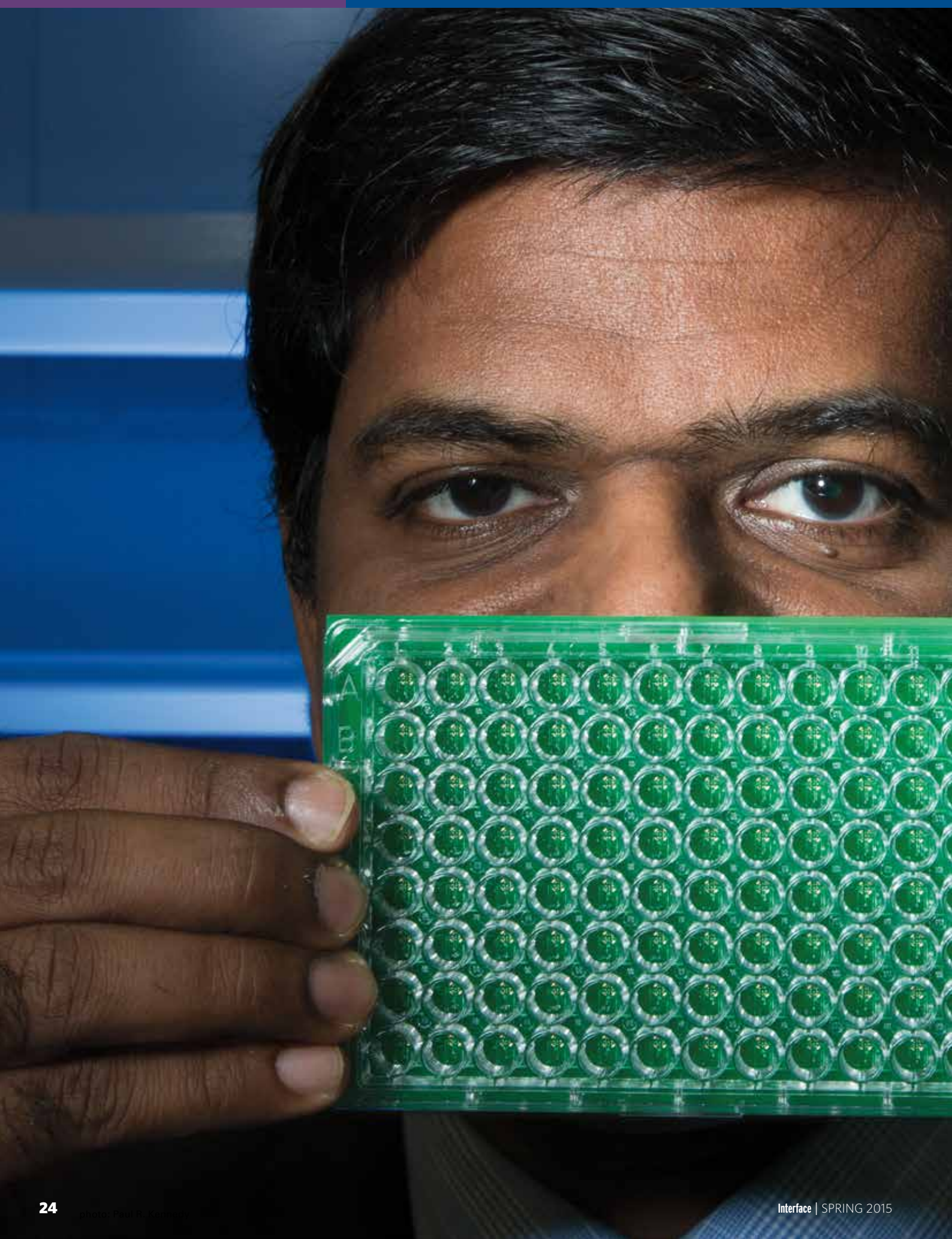
"We have a lot of fun. It's a good way to let off steam and it's a great way to share with other people," says the affable Bachman, who also dabbles in musical theater. Last year, he starred in a local theater adaptation of "Jesus Christ Superstar," his "all-time favorite" musical. "When I was a kid I memorized the entire thing," he marvels. "So for me to play the lead role was a dream come true."

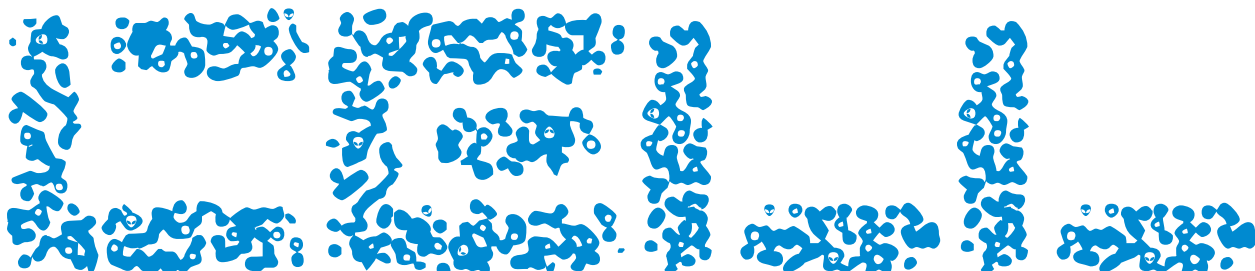
Going full throttle on his artistic and professional lives, however, does not diminish his focus on what Bachman calls his highest priority – his family: wife Kari, and kids Dale, 24; Harrison, 18; and Josie, 16. He beams as he describes traveling, scouting (he was a scoutmaster for many years), theater experiences and other family fun. A few years ago, Kari and Harrison took a year-long educational trip that spanned the globe; Bachman and Josie met them in the Florida Keys and in Japan. "That just illustrates the kind of family we have; we're real supportive of those kinds of things," he states, adding, "When we always play things safe, we don't do anything. So my feeling is, 'go for it.'"

As he begins to write his next chapter, he is determined to do just that. He recalls attending a friend's funeral many years back, where the eulogy focused on one career accomplishment after another. "That didn't resonate with me," he says. "I'd much rather [when I die] that people say, 'He created things. He inspired people. And he made a positive impact on the world.'" 



“I’m at a point where
I have to decide **Which**
way I want to go.”

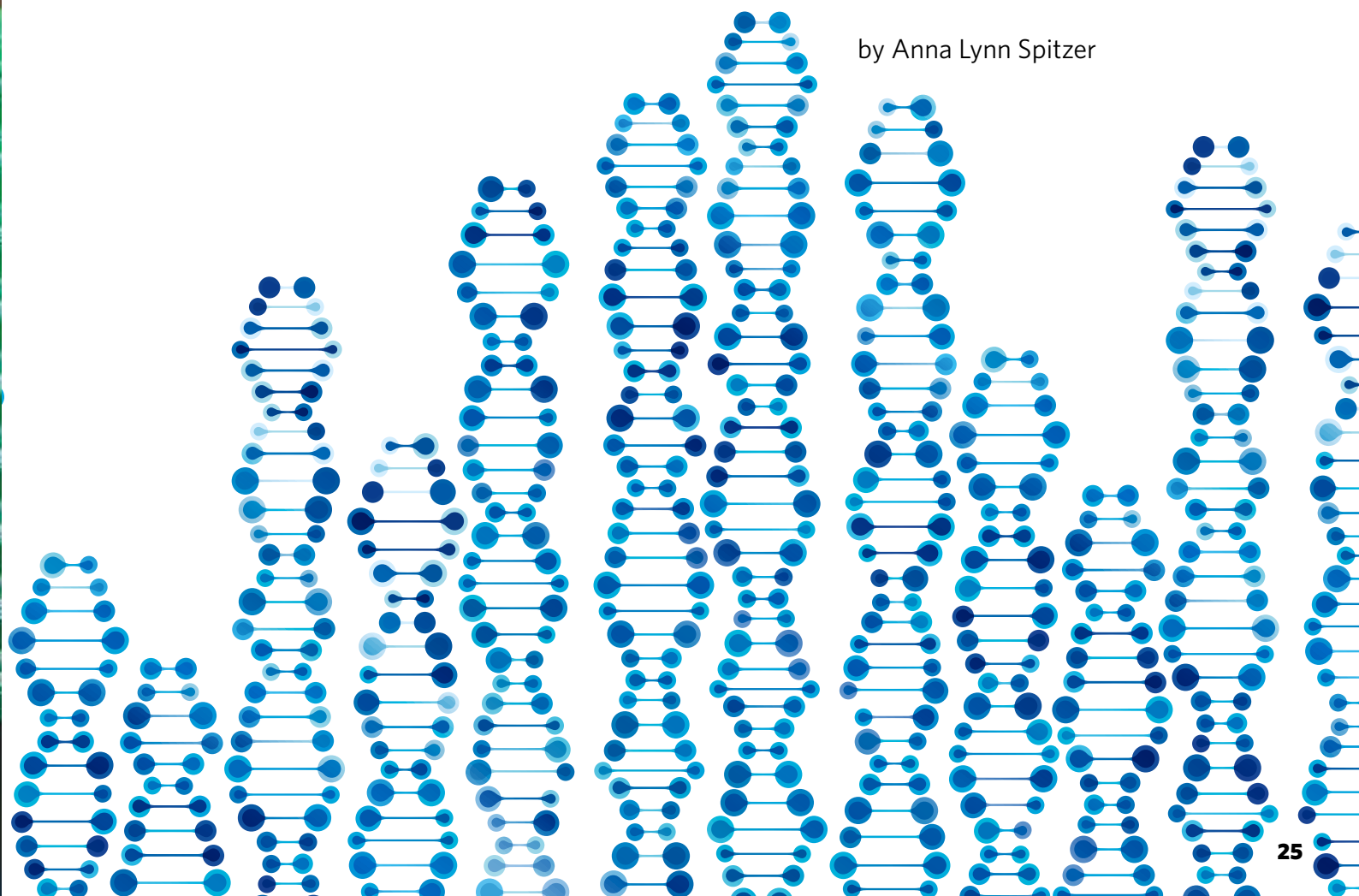


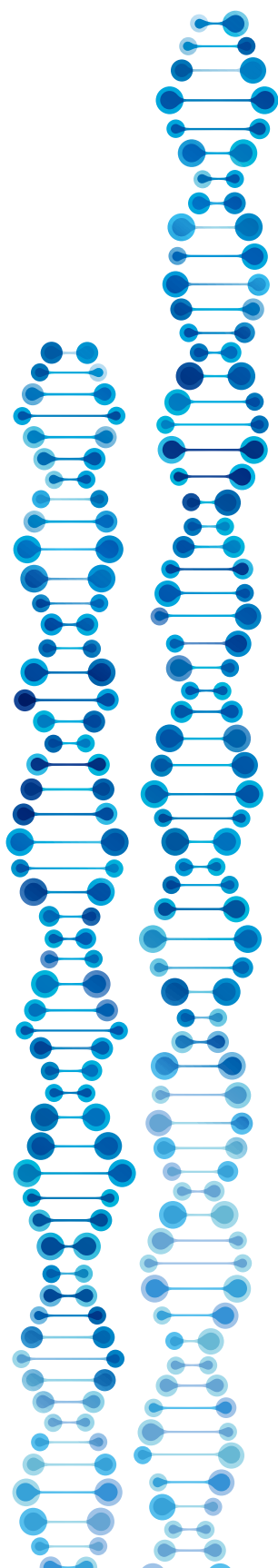


INSPECTOR

Startup company's
product offers novel
stem cell sorting technique

by Anna Lynn Spitzer





E

Envision a small rectangular building whose front door opens onto multiple hallways, each equipped with sensors capable of detecting hair color. A large crowd waits outside. As the door opens and the throng surges into the hallways, individuals are guided to their destinations based on sensor data. Brunettes are herded in one direction, blondes in another, and redheads and gray-haired folks are directed down different corridors.

Now, imagine that the building is a 1x3-inch microfluidic chip, and the crowd is a batch of stem cells that ultimately will be used in therapeutic or pharmacological applications. In a new technology under development at Calit2's TechPortal, startup company Biopico Systems Inc. seeks to characterize and sort those stem cells using tiny electrodes built into the chip's multiple channels. These nanosensors will be able to detect signals from the cells as they flow through in a liquid solution, and sort them according to their physiological characteristics.

According to John Collins, Biopico's founder and director of research and development, the novelty of the company's cell cytometer lies in its capacity to sort cells without damaging them. Cell cytometers currently on the market use fluorescent or magnetic labeling in the sorting process, often leaving the cells impaired. Characterizing the cells based on their electrical signals, however, leaves them healthy enough to be used in healthcare applications.

The company, which launched in 2011, is now testing its ability to characterize and sort stem cells. This technology could unlock stem cells' potential to treat a wide range of human diseases and conditions, from neurological diseases to muscular diseases to congenital heart conditions.

First, a quick cell biology lesson: Induced Pluripotent Stem (IPS) cells treated to a biochemical "cocktail" can be directed to differentiate into various types of cells. Some become neural cells, which grow into neurons (central nervous system cells). Others become cardiomyocytes and develop into heart muscle cells.



Unfortunately, the differentiation process is not foolproof; a certain percentage of cells will differentiate after undergoing the process while others will not. Because stem cell testing and therapy applications require 100 percent pure differentiated cells, sorting is imperative.

"The cells that go to an end user have to be completely homogenous," says Collins. "We are trying to fill the gap, where we can sort these cells into completely differentiated cells – which can be used for specific clinical applications. Or, there could be different sub-states. That's what we're trying to understand."

Collins, who was a UC Irvine postdoctoral researcher from 2000-2006, launched Biopico with a \$150,000 Small Business Innovation Research (SBIR) Phase 1 grant. The company, which is awaiting the outcome of its Phase 2 funding application, currently operates on a \$500,000 grant from the NIH's National Heart, Lung, and Blood Institute, and \$700,000 from the National Institute of Mental Health.

Biopico's collaborators think the company is on the right track. "Biopico has developed technologies that merge the power of microelectronics, microfluidics, cell biology techniques and multiphysics simulations for

(previous page) Biopico founder John Collins and the company's latest chip. Below: Collins (seated, center) and company members. From left, Himanshi Agrawal, Johar Kohana, Henry Wong, Raymond Koosha, Tanya Samuel, and Shrutilaya Karunanidhi.

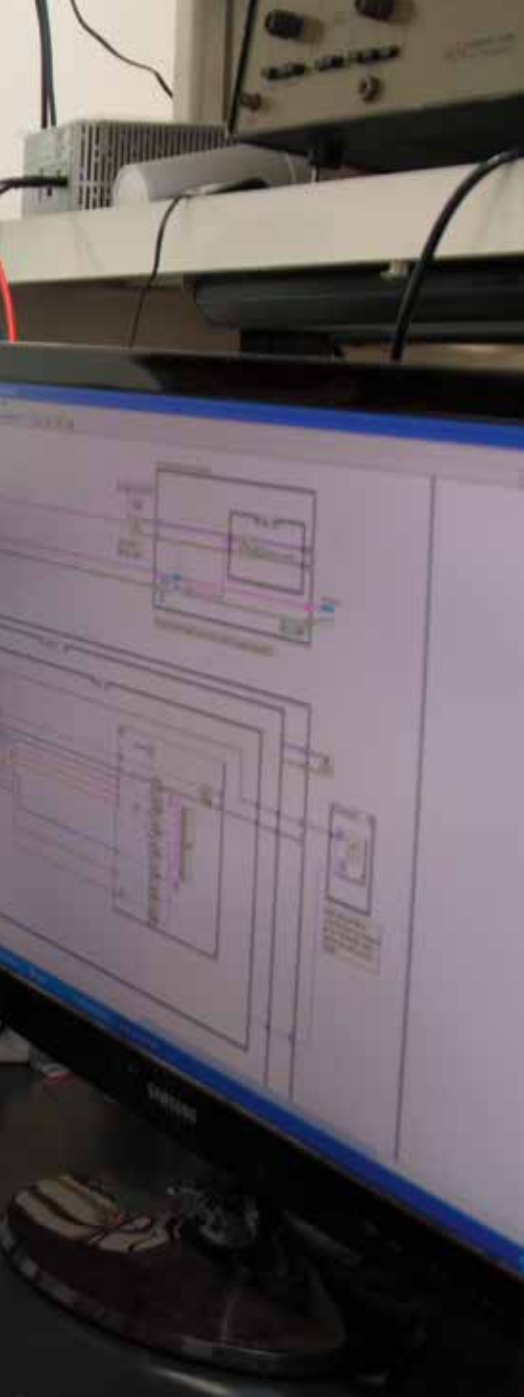




“Now, we can flow hundreds of thousands of cells that can be examined, and we still have very high-speed signal acquisition.”

advanced cell analysis and point-of-care diagnostics applications,” says Abe Lee, a UCI biomedical engineering professor who was Collins’ postgraduate advisor. “Most other methods are one-dimensional and lack the vertical integration of these different technologies.”

Another biomedical engineer and Biopico partner concurs. Bill Tang, whose lab supplies the cardiomyocytes used in chip testing, says the novel use of electrophysiological techniques has important implications for rapid diagnosis and cell-based therapies. “The work ... has been one example of how complementary skills from different collaborators can critically promote the advances of multidisciplinary research.”



The fledgling firm has seven employees. Chips are manufactured in UCI's INRF cleanroom as well as at outside foundries. Collins, who says Biopico manufactures approximately 25 chips per month for testing purposes, also is investigating the possibility of using roll-to-roll technology to manufacture the chips.


"This sorting technology is very novel," he says. "Biopico filed its patent without any collaboration with academia." While the company awaits its second patent, it continues testing with human stem cell-derived neural cells and cardiomyocytes.

A prototype should be ready within a year, and Collins hopes that will help the company obtain additional funding.

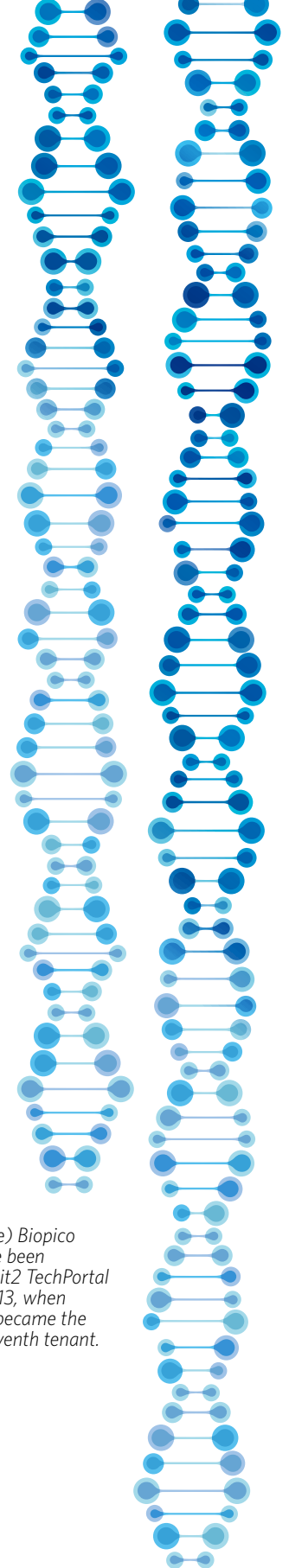
"Venture capitalists are not sure where stem cell technologies are going; they think it's very high risk," Collins says. "Once we have a working system, we think we can convince the VCs to get some additional funding."

Progress is steady. Over the last six months, the company has advanced from depositing cells on top of the electrodes in order to measure their signals, to flowing them through the channels and past the device's 16 electrodes. (Future plans include expanding to 64 electrodes.) "Now, we can flow hundreds of thousands of cells that can be examined, and we still have very high-speed signal acquisition," says Collins.

Philip Schwartz, who directs the National Human Neural Stem Cell Resource center at Children's Hospital of Orange County, supplies neural stem cells to Biopico for testing. The longtime collaborator of UCI's biomedical engineering department says the innovative technology allows for a high-throughput method to measure the electrical activity of human neurons. "This will allow us not only to screen for potential therapeutic nervous system drugs but also to assess how the environment plays a role in nervous system function," he says.

Biopico's ultimate goal is to develop a system that can continuously sort cells by taking single-cell electrophysiological measurements as they flow by – a system it could sell to hospitals and surgical suites for cell-based therapy applications and to pharmaceutical companies for drug testing. "Once we are able to deliver the cells to preclinical markets, we can take the device into clinical testing," Collins says, adding that the company hopes to sell the sorted cells as well as the devices. "We're trying to solve the missing piece of the puzzle. Then we can make this available to everyone." 

(opposite page) Biopico scientists have been working in Calit2 TechPortal since early 2013, when the company became the incubator's seventh tenant.



GOOD MORNING YOU TUBE

What's magical about the mundane?

by Sharon Henry

If you have a teenager in your house, you probably know about the latest digital trend. Teens – especially young women – are creating, watching and commenting on “My Morning Routine” videos.

A YouTube search returns about 1.6 million videos of (mostly) girls waking up, washing their faces, brushing their hair, petting their dogs... (yawn) millions of videos, celebrating nothing particularly interesting or surprising, many of them garnering well over a million views.

We asked Mimi Ito, a cultural anthropologist at the Bren School of Information and Computer Sciences and an expert in young people's use of digital media, about the craze.

Mimi Ito, a cultural anthropologist of technology at the Bren School of Information and Computer Sciences, explains the popularity of “morning routine” videos.



photo: Paul R. Kennedy

Q: What sort of social learning happens when teenagers create and share YouTube videos?

A: A lot of peer-to-peer learning is really about young people connecting with others whom they feel a sense of affinity with. And we know that when kids connect [in that way] the learning is much more engaging, profound and resilient. In this case you're seeing young women sharing something they live with every day. They're curious about what other girls are doing.

Q: Are young people today learning to adapt to a new kind of socializing?

A: I think young people have the opportunity to have a public identity much earlier, on a stage that never existed for them before. Morning routine videos might raise concerns about privacy, but young people are also experimenting with public life in a lot of other ways where they may be anonymous. This is just one corner of a much broader trend of young people being able to participate in public spaces at an early age, if they choose.

Q: Is there educational value in viewing something as seemingly ordinary as other people's morning routines?

A: This gets back to affinity and identity. Things that may seem unimportant or trivial to some people are actually profoundly interesting to others. It all depends what matters to you. When camera phones first came out, I started snapping pictures of the lunches I packed for my kids, and people were really interested. With these user-generated-content sites, you don't have to be an expert. You don't have to publish something profound or super creative. But there's a lot to be learned by how people manage the mundane details of their everyday lives. It's really fascinating because it's something we all confront every day. You're not just getting the explicit content of what they're doing, but you're getting all that contextual information. This girl has a particular style, in a room that's decorated a particular way. It's not just about brushing hair. You're getting to understand who this person is, and are you like her? Is she like you? It's that context that is rich and also incredibly authentic.

Q: Do young people learn specific skills from online networks of friends and acquaintances?

A: The skills that kids develop by having public profiles online are incredibly important in a digitally networked age. It can be as simple as which details [to] disclose online, or how to deal with haters. There are a lot of norms about online behavior that are really important, not just for young people, but for all of us to learn how to navigate.

Q: Do you have any thoughts on why “My Morning Routine” has become such a popular theme on YouTube?

A: I think there has always been a genre of Internet video that is really focused on glimpses into everyday, mundane life. We’re fascinated by that.

Q: “My Morning Routine” most often features teenage girls. Do boys and girls create and share online content differently?

A: Girls have always led on social media, whether it’s texting or Facebook, or back in the day, MySpace. Boys tend to lead on the more gaming-oriented media. I’m not surprised that “morning routine” features more girls than boys because of the content. The fact that girls are probably more thoughtful about their morning routines than boys – that’s not surprising.

Q: So, what’s part of your morning routine?

A: I pack my kids’ lunches still, even though they’re in high school. I used to pack cuter lunches when they were little. You know Japanese bento boxes? They’re a little more aesthetic. Now my daughter just wants her salad. My son gets a sandwich – it’s not as photogenic as it used to be. (Ito’s bento box lunches pictured below. See more at <http://www.flickr.com/photos/mimiito/tags/bentoblog>)



Here's a sampling of other Calit2 affiliates' morning routines:

"I drink Arabic coffee with my wife and parents, as my 4-year-old Yara and Omar (almost 2) play. Arabic coffee is like espresso but with cardamom."



Said M. Shokair
director of UCI's
Undergraduate Research Opportunities Program

"I have two cups of coffee with Irish creamer every morning before I leave the house. I have to have the creamer."



Irma Rodriguez
financial analyst
Calit2 Irvine

"In the morning, when I see one of my (four) roommates, I always high-five him and say, 'We got this!'"



Mark Tameta
administrative assistant
Calit2 Irvine

"I stop at Java City for a double cappuccino (\$2.69) on the way to the office."



Athina Markopoulou
associate professor
Samueli School of Engineering

"I always start my day with a 16-ounce glass of milk, whatever flavor of Activia yogurt is in the refrigerator and a piece of banana."



G.P. Li, director
Calit2 Irvine and professor
Samueli School of Engineering

"When I wake up, I give my husband a kiss and grab my iPhone to check for messages. I always make sure to do it in that order, of course... you know, secret to a happy marriage."



Shelly Nazareus
communications director
Calit2 Irvine and Samueli School

OCTOBER

- 10** During a tour of CalPlug, Director G.P. Li points out improvements in the Wall of Power project to a delegation from Southern California Edison.



- 13** Representatives from Cedars-Sinai Medical Center spend the day learning about the eHealth Collaboratory and preview prototype demonstrations.

NOVEMBER

- 5** The program "This is What a Scientist/Engineer Looks Like" debuts for women and underrepresented minority students interested in STEM careers.



- 6** Undergraduate researcher Melissa Valdez presents her work on the 1kWh Challenge project at the semiannual CalPlug workshop.

DECEMBER

- 5** The IEEE CPMT Orange County Chapter and Calit2 co-host a full-day workshop on the Internet of Things, providing design engineers an in-depth overview of IoT challenges.



- 16** A UCI administrative delegation led by Judy Stepan-Norris, vice provost for academic planning, tours Calit2 to learn about student engagement in the institute's various projects.

22

The 12th annual International System-On-Chip Conference takes place in the Calit2 Building, featuring innovative SoCs that empower the communications market.



29

Professor Aditi Majumder gives administrators of the Tustin Unified School District a tour of the Visualization Lab.



13

All of the buzz about the Internet of Things draws a standing room only crowd to Calit2's signature Igniting Technology event, featuring five industry presenters.



27

Assistant Professor Mark Bachman travels with Director G.P. Li to give a plenary talk at the annual meeting of the Materials Research Society of Korea.



17

Director G.P. Li travels to Japan to meet with representatives at Kwansei Gakuin University and participate in a three-day medical device conference.



16

The table centerpieces served as popular door prizes at the holiday appreciation lunch for Calit2 Building occupants and affiliates.



18

As the fall quarter comes to an end, Calit2 staff enjoy an early evening karaoke session, leading into a well-deserved winter break.



JANUARY

- 7** The TechPortal Oversight Committee meets to review and discuss applicants for the technology business incubator in the Calit2 Building.



- 14** In the second installment of "This is What a Scientist Looks Like" series, Michelle Foley explains internship opportunities in STEM offered through UCI's Career Center.



- 13** Another year of participants in the Multidisciplinary Design Program gather for an orientation session before embarking on a two-quarter team project.

- 9** Bjorn Millang, CEO of Swedish company Avancee, demonstrates the SEM™ Glove at Calit2's first International Symposium on Technology for Biomedical Devices.



FEBRUARY

- 17** Rish Ghatikar, deputy leader for grid integration research at the Lawrence Berkeley National Laboratory, discusses sustainable IT practices.



- 2** Representatives from the Agenica Espacial Mexicana (Mexico's Space Agency) learn about the work that Professor Aditi Majumder is doing in the Visualization Lab.



- 10** Attendees of the CENIC conference held at UCI, end their day with tours, lab demonstrations and a reception in the Calit2 Building.

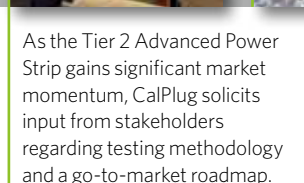


MARCH

- 4** As the Tier 2 Advanced Power Strip gains significant market momentum, CalPlug solicits input from stakeholders regarding testing methodology and a go-to-market roadmap.



- 12** Visiting scholar Professor Andrew Steckel from the University of Cincinnati discusses the research progression of organic electronics made with natural materials.



22

As the recently appointed UCOP senior advisor on innovation and entrepreneurship, Regis Kelly gives a presentation on the new technology transfer and investment paradigm.



30

Art Hitomi, chief technology officer and co-founder of Numecent, gives a presentation on cloud-paging environments for the Internet of Things.



20

Members of the Irvine Health Foundation learn about the eHealth Collaboratory's approach to personalized well-being solutions.

27

Calit2 hosts a pre-proposal workshop with representatives from the automated manufacturing and systems integration sector to discuss the smart worker concept.

17

After the ceremonial cutting of the ribbon, FABWorks, a maker space, opens for business on the second floor of the Calit2 Building.



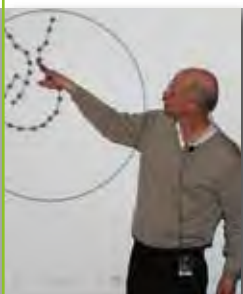
20

Simulcast mesh networking via multiple physical transports is the topic of a talk from Dan Cregg, CTO of Insteon, Inc.



13

UCI's Data Science Initiative hosts a one-day symposium on recent research advances in network modeling and analysis.



20

With 20-plus years of experience in application software infrastructure products, Abhijit Manushree explains how to leverage the Internet of Things for energy management.



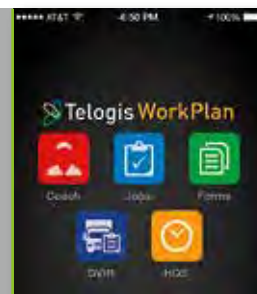
16

UC Regent Sheldon Engelhorn spends some time in the newly opened FABWorks to learn more about the maker space capabilities available to students.



26

Tim Taylor, CSO at Telogis, presents a cloud-based connected intelligence software platform that optimizes mobile assets and critical data to connect people, places, things and work.



Under the direction of Professor G.P. Li, Calit2@UCI develops information technology-based innovations in a multidisciplinary research environment. By integrating academic research with industry experience, the institute seeks to benefit society, incubate new technology companies and ignite economic development. Calit2 focuses on the digital transformation of healthcare, energy, the environment and culture.

University of California, Irvine
California Institute for
Telecommunications and
Information Technology
4100 Calit2 Building
Irvine, CA 92697-2800

NONPROFIT ORG.
U.S. POSTAGE
PAID
Santa Ana, CA
Permit No. 1106

Calit2

