interface

California Institute for Telecommunications and Information Technology

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University of California, Irvine

Technology to the ResCUE

interface-2-face

Technology Partnership

During the past 18 months, the City of Ontario (Calif.) Fire Department has collaborated with the University of California, Irvine's ResCUE project to enhance our city's disaster response capabilities. Specifically, the fire department is serving as a test bed for a new Web-based "Disaster Portal" in development at Calit2. The portal will allow city officials and first responders to interact with the community before, during and after a disaster. Residents will obtain the latest shelter and city facility status information, and will benefit from new family-reunification and donation-management technology.

The cutting-edge family-reunification technology will enable residents in the community to quickly locate friends and families in area shelters. Previously, family members had to visit multiple Web sites to find loved ones. This new search engine, however, will browse all post-disaster databases that store information on the whereabouts of disaster victims, saving time and potentially, lives.

The donation management technology is another valuable feature of the portal, allowing community organizations and businesses to interact directly with emergency managers. This easy interface will facilitate the donation of critical items like generators, bulldozers and medical supplies.

The Ontario Fire Department also will serve as a test bed for other technologies as they are developed by the ResCUE team. We're pleased to be a part of this important Calit2 partnership; it will strengthen our city's post-disaster situation awareness while simultaneously enhancing the fire department's ability to respond to any community crisis.

Jacob Green, UCI '05
Emergency Manager
City of Ontario

Interface
Fall 2006

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On the cover: *Off-the-shelf tilt-pan-zoom cameras are customized with 802.11 wireless network technology that enables them to send images and audio rapidly from a disaster site to an emergency operations center.*

Project ResCUE

Disasters Drive Call to Action

September 11 and Hurricane Katrina are universally recognized as recent history's most deadly U.S. disasters. The details differ dramatically, but the events share an important distinction: experts agree that communication systems failed miserably, increasing the death toll and level of destruction.

by Anna Lynn Spitzer

"We design technologies to help first responders assist victims (and) help decision-makers manage the crisis better."

Calit2 researchers at UC Irvine and UC San Diego are working to ensure that this type of failure never reoccurs. They are collaborating on a National Science Foundation-funded project called ResCUE – Responding to Crises and Unexpected Events – in conjunction with a host of subcontractors and partners, to design reliable, scalable infrastructures that can access, share and disseminate critical information to first responders in a timely manner.

"If we can get the right information to the right people at the right time, it will result in a faster, better response," says ResCUE director Sharad Mehrotra, UCI professor of computer science. "Lives and property will be saved, additional damage will be prevented and catastrophe may be avoided."

Developing Effective Tools

ResCUE, a massive, five-year, $12.5 million project administered by Calit2, encompasses five other university partners as well as ImageCat, a Southern California company (see page 8). The project also involves several city and first-responder organizations, and a dozen or more corporate partners. The collaborative, multidisciplinary venture, now in its fourth year, brings together

(continued, page 2)

computer scientists, engineers, social scientists and disaster science experts to explore technological innovations that will radically transform information flow in crisis response networks.

"We've worked very closely with first-responder partners to meet their specific needs."

The team's effort is three-pronged. Researchers study the ways in which organizations and individuals respond in emergency situations, design technology to improve emergency response and test that technology in four increasingly sophisticated test beds.

Social science is a key research component, helping researchers understand what technology will work most effectively in which situations. "You can't design technology in isolation," says Carter Butts, UCI assistant professor of sociology. "Understanding human behavior and the factors that allow humans to organize in adverse circumstances is essential to improving *(continued page 4)*

At left and above: At a recent emergency drill, ResCUE team members Naveen Ashish (left) and Anton Popov track images sent by the autonomous mobile sensing platform, which "reads" the label on a mock spilled chemical container. At right: Chris Davison guides the sensing platform while watching its progress in his goggles.

Humans as Sensors

Evac-Pack Enables Two-Way Crisis Communication

It looks like futuristic hiking gear. Instead, the Evac-Pack contains high-tech tools that one day may save lives in a high-rise building.

The wearable, wireless, multimodal communication system will enable first-responders in emergency evacuations to maintain constant two-way communication with an emergency operations center.

Gearing Up

The GPS/Bluetooth-equipped apparatus consists of a backpack-transported computer, video camera, wearable keyboard and wireless mouse. An eyeglass-mounted visual display, and full-duplex audio microphone and earpiece enable the wearer to communicate in real-time with crisis managers in emergency control centers. A gas sensor detects and communicates levels of oxygen, carbon monoxide and other gases present in an environment, while an avionics-designed helmet incorporates compass, accelerometer and thermometer to transmit images and data back to the control center.

"Evac-Pack allows... an intelligent search, cutting search time tremendously."

The prototype device is powered by two independent 12-volt power supplies.

ResCUE principal investigator Sharad Mehrotra conceived the apparatus; Chris Davison, ResponSphere's technology manager, assembled it using off-the-shelf components.

The prototype grew from an earlier iteration that incorporated a Compaq i-PAQ pocket PC and a set of goggles. The mini-Evac-Pack system could receive information from a control center, but did not permit two-way communication.

Constant Contact

"Evac-Pack employs 'human-as-sensor' technology that benefits first responders in emergency situations as well as crisis control centers trying to analyze the extent of a disaster," Mehrotra said. "It helps get important information to the right people as quickly as possible."

In wired "smart buildings," instrumented with an 802.11 network layer, the system can "push" a map of each floor into the wearer's eyepiece, with blue dots indicating occupied rooms and movement of occupants. This continually updated map can save the rescuer valuable time by prioritizing room-to-room searches.

"In an evacuation, floor wardens go room-to-room, searching for stragglers," Davison says. "Evac-Pack allows them to do an intelligent search, cutting search time tremendously."

Adding an 802.11 router card and a CDMA data card allows information to be transmitted outdoors over Verizon local networks. This feature allows the Evac-Pack wearer – aided by remote-controlled autonomous sensing platforms that beam real-time video images from crisis sites – to view potentially dangerous situations from afar.

Evac-Pack has been tested in numerous emergency drills, most recently a replicated chemical spill on the Hewitt Hall loading dock. In that exercise, a remote-controlled sensing platform was dispatched into a fenced area, where it took video images of the spill and sent them directly to the Evac-Pack-wearing first-responder. From the images, the responder was able to determine that the spill was only moderately toxic – knowledge that influenced his actions.

"This was a great example of the partnership between technology and first-responders," says Davison. "The information gleaned as a result of this technology impacted the first-responder's decision-making process."

the response process."

Actual products – researchers call them system artifacts – are under development. These tools, ranging from wearable tracking devices to remote-controlled sensing platforms to customized communication software, can help emergency responders gather, analyze and disseminate essential information.

"Artifacts are (the place) where the rubber hits the road," says Mehrotra. "We've worked very closely with first-responder partners to meet their specific needs."

Researchers Sharad Mehrotra and Nalini Venkatasubramanian head up the UCI ResCUE team.

Degrees of Disaster Management

Emergency communications encompass a wide range of action. More than just the contact between first-responders and their emergency operations centers during a crisis, the term also refers to the process of gathering relevant data and conveying it concisely to crisis managers in order to improve their decision-making ability.

"When you design technology for a crisis site, your goal is to get just the basic, necessary information to the responder, because he doesn't have time to think, he just has time to act," says Mehrotra. "The further out you get in crisis management, the more important the bigger picture becomes. You're trying to make sense out of very large amounts of information that are coming from multiple sources.

"We design technologies to help first responders assist victims, but we also design technology that can help decision-makers manage the crisis better. For the most effective emergency response, both are critical."

Technology to Aid the Public

Researchers are also developing new avenues for transmitting critical information to citizens – information that may help them evacuate safely and stay apprised of essential updates after the event. For example, the ResCUE team is developing a warning alert system that will send customized earthquake alerts to organizations and individuals seconds after an earthquake begins. Because

Lights, Camera, Action!

Project ResCUE recently made its national television debut. The Calit2 research project was featured on the Sept. 10 Sunday morning edition of NBC's "Today Show." The program highlighted security, situational awareness and emergency response stories to mark the five-year anniversary of Sept. 11, 2001; since these themes are Project ResCUE's focus, it was a natural fit.

A team of UCI student researchers, resplendent in ResCUE T-shirts, demonstrated the Evac-Pack, the autonomous mobile sensing platforms and the privacy-preserving identification platform in the taped piece.

An NBC news crew had spent about six hours earlier in the week with ResCUE principal investigator Sharad Mehrotra, researcher Nalini Venkatasubramanian and the students, learning about the project and watching demonstrations of the cutting-edge technologies.

Venkatasubramanian speaks on-camera with an NBC field producer.

"We're looking at what can be done to encourage citizens to take appropriate actions - not over-respond or under-respond."

seismologists have developed the ability to provide tens of seconds of warning before the shaking has extended a significant distance from an earthquake's epicenter, the warning system can alert schools in the area, potentially saving thousands of lives. It can also keep parents informed about actions taken by schools, such as evacuation and medical triaging. The real-time alert system can also be used in other emergencies that have very short warning periods, like tsunamis and forest fires.

"We're looking at what can be done to encourage citizens to take appropriate actions – not over-respond or under-respond," says Nalini Venkatasubramanian, associate professor of computer science and a ResCUE researcher. This technology is being developed with input from the Natural Hazards Center, the California Office of Emergency Services, the Los Angeles Department of Emergency Preparedness and SBC, a company specializing in school-based communications.

Other natural disasters, such as hurricanes, floods and tornadoes, have longer warning periods. For these disasters, researchers are developing site-specific Web-based emergency information portals that will integrate various sources of information.

"By using customized emergency management software, these portals can bring timely information in the days before and after a crisis to citizens and responders," says Venkatasubramanian.

A prototype is being developed by ResCUE researchers for the City of Ontario, Calif., in collaboration with the city's fire department. In the event of fire, flood, chemical spill or other disaster, the Emergency Information Portal will make available essential information: emergency shelters, evacuation routes, crisis control updates and links for locating missing relatives.

City of Ontario Fire Department Emergency Manager Jacob Green says, "The portal will allow our city to communicate vital information instantaneously to all members of the community. The partnership between the city and the university represents a collaborative effort to ensure that the citizens of Ontario are provided with the highest level of public safety and disaster preparedness."

ResCUE researchers not only design new technologies, they assess their effectiveness in a number of test beds (see page 10.) A recent drill at UCI, coordinated by the campus's environmental health and safety department, incorporated a variety of ResCUE technologies. First responders from the Orange County Fire Authority and the County of Orange

(continued, page 7)

To Act or Not to Act

Social Scientists Play Crucial Role

Humans are remarkable animals. Understanding human behavior is an essential aspect of ResCUE's effort to improve emergency response. "You have to understand the social structure, both at the organizational level and at the individual level in order to design effective IT solutions," says project director Sharad Mehrotra.

Carter Butts, UCI assistant professor of sociology, and his team of students work closely with social science researchers at the University of Colorado, Boulder to understand how humans act and react when facing crises.

"Technical infrastructure allows responders to operate more effectively, but at the end of the day, the work is done by ordinary people," he says. "Understanding how humans organize in adverse circumstances is essential to improving the response process."

Data Collection Yields Insight

The team employs a range of data-collection methods, including field observation, interviews with professional responders and focus groups.

They also employ archival sources, such as transcripts of radio communications, police reports and situation reports issued by organizations that responded to prior events.

Butts and his student researchers studied the Port Authority transcripts from 9-11-2001. The team gleaned some surprising information from those conversations, Butts says. "We found that the kinds of communication patterns exhibited by professional responders, like police, were strikingly similar to those of non-specialist responders, like elevator operators or maintenance personnel."

The lesson learned was that most of the communications that day were performed by a small number of individuals who became ad hoc 'hubs' in the communication network. This finding underscores the role improvisation plays in emergency response, and points toward the need to develop flexible technology that factors in this behavior.

While no one disputes that serious communications failures contributed to the tragic outcome on 9-11, Butts' team made some startling discoveries.

While no one disputes that serious communications failures contributed to the tragic outcome on 9-11, Butts' team made some startling discoveries from the transcripts. When team members analyzed the transcripts using recently developed statistical methods, they determined that many of the responder networks were generally well-connected. "We found within the Port Authority Police Department that communication failures did not lead to a total fragmentation of the responder interaction network," Butts says. "Despite serious problems, responders at the World Trade Center were able to piece together a response that was well-connected in many respects.

Working Together

"This testifies to the ability of human beings to work together during crisis situations and to improvise under extremely difficult conditions," he continues. "This understanding allows us to make more accurate predictions regarding individual and organizational responses to disaster and may help us anticipate where communications will or will not break down in future events."

In the 911 transcripts, many

ResCUE's social science research indicates that individuals will improvise and work together under difficult conditions in emergency situations.

responders, including police, fire and Port Authority personnel, were calling operators with the same questions, such as, "Is the tunnel open?" Every time emergency operators had to answer that question, it prevented them from undertaking more important tasks.

"Some of the ResCUE technologies, such as call-processing automation, call prioritization and push-oriented dissemination, might help alleviate the load of call operators and improve response effectiveness," says Nalini Venkatasubramanian, ResCUE researcher.

"The objective of technology is to obtain actionable information that results in the greatest impact," Mehrotra summarizes. "This can only come from an understanding of the social process."

Health Care Agency, as well as UCI building inspectors, police officers and employee emergency response teams participated in the exercise.

Community Advisory Board Created

Researchers have made significant progress in meeting the project's ambitious goals. In order to keep the momentum, an advisory board, comprised of prominent members of the emergency response community, is an important part of the effort. The Community Advisory Board, chaired by Ellis Stanley, general manager of the Los Angeles Department of Emergency Preparedness, advises and guides ResCUE researchers from the perspective of the first responder and the larger emergency management community.

"The idea is to stay one step ahead of the crisis..."

ResCUE strives to incorporate its research findings into working prototypes, and then test the new technology to determine its role in facilitating emergency communication.

History has proven that – beginning in the moments before many disasters, through evacuation and rescue procedures, and into the long hours afterwards – effective crisis communication is vital in the effort to save lives and property. "The idea is to stay one step ahead of the crisis," Mehrotra summarizes. "Technology has to get smarter about how it utilizes itself for maximum impact."

From Image to Impact

Corporate Partner Contributes Disaster-Response Expertise

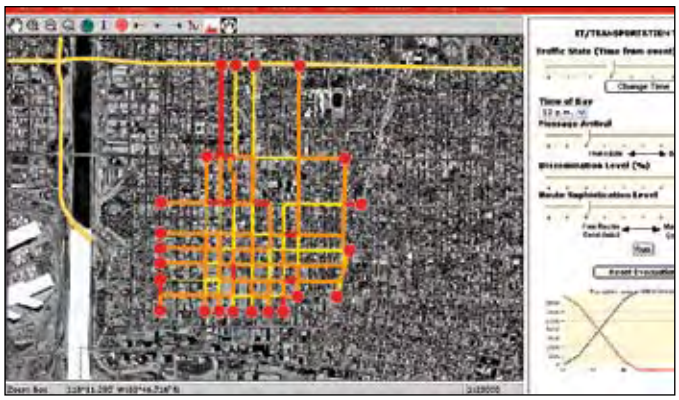
On the day after Hurricane Katrina's 125 mph winds bombarded New Orleans and much of the Gulf Coast, Charles Huyck flew in a three-person Cessna over the devastated area recording images on high-definition video.

by Fran Tardiff

"...you only have to go to one catastrophic event... to know that this work is important."

Even as people on the ground had yet to grasp the extent of the damage, he witnessed the flooding, breached levees, shattered houses, and people waving from rooftops and highways, and trickling into the Superdome. Huyck stayed four days shooting timely, bird's-eye pictures to complement later satellite images. He was there in his role as senior vice president of ImageCat, Inc. a company partnering with Calit2 researchers on the ResCUE project to improve urban crisis response. Taking quick, accurate visuals of a crisis as it unfolds is one part of that multidisciplinary mission.

"Emergency response is all about getting the right information to the right people at the right time," says Huyck. Exploring GIS (Geographic Information Systems) and other technologies to reach that goal has been the focus of Calit2 and ImageCat investigators since 2003 when they began collaborating.



This screen capture from an INLET simulation shows traffic evacuation routes overlaid on high-resolution satellite imagery.

Damage Catalogue

ImageCat President/CEO Ronald Eguchi and Huyck founded the Long Beach, Calif.-based company of scientists, engineers, urban planners, geographers, computer scientists and other experts in transportation, remote sensing and visualization technologies. They are innovators in the field of emerging technologies that assess and manage the complex issues associated with natural or man-made disasters. The name ImageCat derives from the term "image catalogue," as in the existing database of satellite images used to estimate damage, to a city or region, and come up with loss estimates.

The company's relationship with Calit2 began five years ago when Sharad Mehrotra, UCI professor of computer science, and other faculty met informally with ImageCat executives to discuss applying technology to disaster response. "UCI has a lot of expertise in IT solutions and ImageCat is expert in the domain of disaster response," says Eguchi. "It was – and continues to be – a good match."

ImageCat senior vice president Charles Huyck (center) and engineer Sungbin Cho meet regularly with ResCUE student researchers. They are fine-tuning MetaSim, a series of test beds that demonstrate how various technologies might work in a disaster.

Simulating Emergency Responses

Specifically for ResCUE, ImageCat research focuses on loss estimation and transportation routing in order to model disaster impacts – with and without technology integration. Comparing the results can identify which technologies are most likely to be effective, and may be used in learning how to implement the technologies.

ImageCat works closely with students and staff at UCI and UCSD in the development of MetaSim, a series of simulated environments, or test beds, where researchers see how various technologies might work in a disaster, namely an earthquake. In an evacuation scenario, the simulations help to answer questions such as: Would it be better to tell people to take specific roads, or would randomly fleeing the scene be more effective? Are there ways to alert people to potential dangers for more effective evacuation of buildings? Different technologies are simulated, including cell phones, freeway message boards, Internet-based dissemination or a combination.

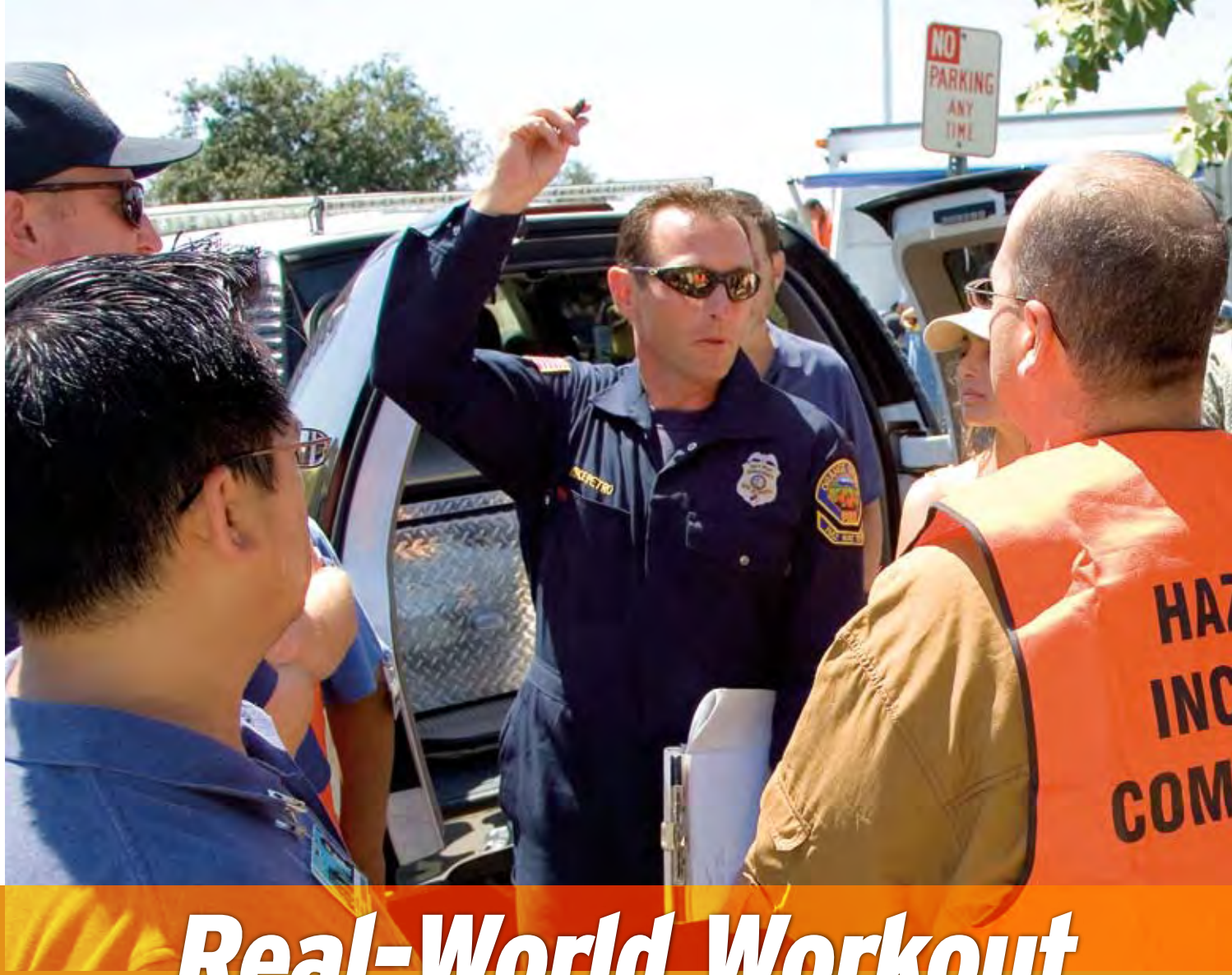
At the core of the company's role in the development of MetaSim is INLET: Internet Based Loss Estimation Tool, the first online tool of its kind. INLET calculates probable damage using custom earthquake scenarios where a user assigns a magnitude and epicenter to any location on a map. If an actual earthquake occurs, INLET can read U.S. Geological Survey-produced ShakeMaps of ground motion intensities and estimate damage within minutes of an earthquake. This information helps to calculate damage over an entire region and the impact on a transportation system, thereby helping first responders and other agencies to better prioritize their activities. The information could also be used in planning before a disaster. "INLET is unique because it's online and integrated with near real-time earthquake monitoring, providing more accessible, thus more usable, information than traditional loss-estimation tools," says Eguchi.

Saving Lives with Information

"People die from not knowing what's going on in an emergency, where to obtain aid, where to go to be safe," says Huyck whose passionate dedication to this area of research comes from gathering data at many disaster sites – from a 1999 earthquake in Turkey to Hurricanes Katrina, Dennis, Rita and Wilma. He and ResCUE colleagues envision that crisis and transportation modeling systems developed during the project could live on as artifacts, or products, of the work now being done. If their vision is realized, "The legacy of ResCUE will be that research prototypes and tools like INLET will be put into practice by emergency first responders to save lives and property, and minimize economic impact in a crisis," Eguchi adds.

When Huyck first got into the business about 13 years ago, he thought that GIS could be used to save lives. "People said 'no way.' Now we're talking about real-time data and Internet mapping, which everyone recognizes can be used to prioritize crisis response.

"We still have a long way to go," he adds. "But you only have to go to one catastrophic event where entire regions are decimated and people are injured, homeless or dying to know that this work is important."



Real-World Workout

Campus Serves as Test Bed for New Technologies

To the casual observer, the fourth floor project room in UCI's Calit2 Building appears to be a high-tech playground, filled with state-of-the-art toys.

by Anna Lynn Spitzer

"ResponSphere provides a platform where we and our many industry partners can test new software and hardware technologies."

Mobile cameras instrumented with 802.11 interfaces, RFID tags and readers, sensor-equipped miniature cars and human-as-sensor contraptions known as Evac-Packs are just a few of the technologically advanced gadgets researchers are toying with.

But ResponSphere, as this ResCUE component is more formally called, is not just fun and games. It is actually "a proving ground for disruptive technology," according to Technology Manager Chris Davison. Disruptive technology is a new technological innovation, product or service that will eventually overturn existing technology in the market. The "toys" are prototypes developed, tested and refined to aid first responders in crisis situations.

To see how their products perform, researchers have turned a large part of the UCI campus into a living test bed called CAMAS, which they use for emergency drills. Known as "smart areas," these designated spaces have been equipped with wired and wireless networks, cameras, a variety of sensors – acoustic, video, temperature, humidity, light, accelerometers and people counters – and innovative software to interpret the collected data.

Live emergency drills cause major

ResCUE technology was put to the test in a recent on-campus disaster drill that included UCI police, the O.C. Fire Authority, County of Orange Health Care Agency and UCI personnel.

disruptions, so they're held only a few times each year. The CAMAS system is also able to conduct and analyze simulated drills in the smart spaces, using computer-based simulations.

"The idea is that we can't empty out whole buildings every time we want to run a test, but we can test a piece of technology whenever we want in a simulation," Davison says.

In addition to CAMAS and computer simulations, two additional test beds are used to evaluate ResCUE technology. The Gaslamp Quarter in San Diego, Calif. is a three-by-eight-square-block area where ResCUE researchers use the technology to monitor actual events. The city of Champaign, Ill., home to ResCUE partner University of Illinois, is also a test bed. It is used by municipal organizations and researchers who work together to develop crisis scenarios and identify technologies that can help.

Corporate, academic and government partners can also test their prototypes in the test bed, either in live drills or simulations.

Data collected in all drills is kept and cataloged. Building maps, sensor data, response times, temperatures, and audio and video footage are just some of the data that will be available to future researchers when ResCUE's five-year run is completed.

"ResponSphere provides a platform where we and our many industry partners can test new software and hardware technologies," says Davison. "Thanks to all of this data we're keeping, ResponSphere will live on past its life cycle. That will be our legacy when we're done here."

Davison and a complement of undergrad and graduate students design, build and/or monitor technology prototypes that are tested in CAMAS. These potentially life-saving innovations are developed for use in current and/or future ResCUE products, and include:

Mobile Autonomous Sensing Platforms

These "model cars," which have been built in three successively larger sizes, can be sent by remote control into danger zones to assess the situation. The larger versions are equipped with audio, video and gas sensors, as well as an accelerometer, thermometer and onboard computer that can stream data back to the software systems. The smaller versions carry some of those features.

Mobile cameras

Equipped with 802.11 wireless network interfaces, these Linksys tilt-pan-zoom cameras can be sent into dangerous areas; custom software allows them to send back location-specific coordinates along with images and audio.

People Counters

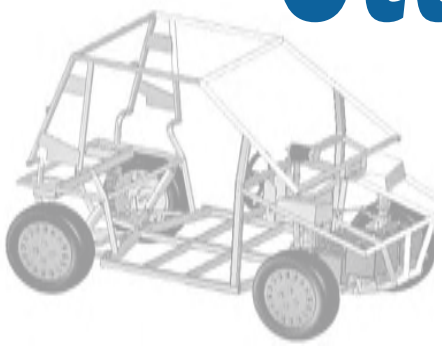
Using low-power lasers and installed at each "smart building" entrance, these devices work in conjunction with mounted cameras to track the number of occupants coming and going.

Evac-Pack (See page 3.)

Location-Based Sensing Technology

These products include Radio Frequency Identification (RFID) tags and readers that enable location-awareness, video people-counting equipment, GPS and other sensor platforms that are utilized for tracking the whereabouts of building occupants and first-responders.

Students Start Your Engines!



How's this for a Cinderella story? Six talented, enthusiastic UCI graduate students, after years of hard work, beat overwhelming odds and send their autonomous car to the finals of the Defense Advanced Research Projects Agency (DARPA) Grand Challenge. Well … it could happen.

By Vivian Yee

"It's been a really great experience...designing things from the ground up and going all the way to implementing the design."

"Actually, we're a little more realistic," smiles Anton Popov, the student leader of Team XAR (eXtreme Anteater Racers), which has grown from an undergrad information-and-computer-sciences research project to a multiperson initiative with a full-fledged laboratory on the second floor of the Calit2 Building. "We want to get to the semi-finals, though."

Applying techniques and skills gleaned from their ICS classes, Team XAR students – including Popov, Lorraine Kan, Chad Christenson, Michael Graves, Nick Mangano and Thomas Duerr – have worked diligently to construct an autonomous vehicle capable of navigating a 60-mile urban course in six hours, unassisted, while obeying traffic laws, avoiding obstacles and racing some 200 other teams' challengers.

Setting the Pace

The DARPA Grand Challenge is sponsored by the U.S. Defense Department in hopes of automating one-third of military vehicles by 2015. The upcoming DARPA Urban Challenge takes place Nov. 3, 2007; Team XAR will submit its application over the course of several months beginning this October.

The more high-profile teams vying for the $2 million grand prize – including Stanford University's Racing Team and Carnegie Mellon University's Red Team – employ bewilderingly complicated technology and programming. Popov, however, believes Team XAR may have a better philosophy. "Our car won't be nearly as complicated," he says, explaining that "since we don't have a lot of funding, we're keeping it simple." The thinking goes that a basic vehicle will be easier to maintain, build and most importantly, comprehend; as Team XAR adds more members, new recruits must be able to catch on quickly.

Popov estimates that 70 percent of the project's hardware is complete, including electrical systems, actuators (brakes and steering), lighting, computers and a GPS navigation system. They're just missing, well, a car.

Making a Pit Stop

Although passersby can see Team XAR's 2005 autonomous car, a blue fiberglass contraption rigged with colorful

Michael Graves adjusts the global positioning system, Lorraine Kan fine-tunes the camera system and Anton Popov checks on the XAR-car's battery. The DARPA Grand Challenge offers a $2 million cash prize.

Previous Page: Student Michael Graves designed this 3D skeletal view of the Team XAR car to simplify installation of necessary components.

equipment, in Calit2's loading dock, the students hope to upgrade to another vehicle this year. A SmartCar dealership is coming to California, and Popov is hopeful the business can donate a car and some engineering support.

Meanwhile, the team focuses on completing the vehicle's software. Using advanced research in sensor fusion – the process by which the car melds all of its sensory data into a single, guiding picture – navigation algorithms, control theory and an artificial intelligence neural network, they hope to "teach" their car to act as if it is being driven by a live person who perceives surroundings, and decides where to go and how to get there.

"The programming part is easy," says Popov. "It's just an issue of funding and time." The car itself costs only about $20,000, but the team also needs to buy equipment ranging from cameras and computers to motors for the brakes and steering.

Calit2 provides more than half of Team XAR's funding, along with UCI's Undergraduate Research Opportunities Program (UROP) and the Ted and Janice Smith Family Foundation. Advisors Crista Lopes, assistant professor of information and computer science, and Isaac Scherson, professor of ICS and EECS, handle external relations, as well as some programming and electrical chores.

For the most part, however, the students are given free rein. "We basically have carte blanche to do whatever we want," says Popov. Already busy with full course loads, each of the students puts in around 30 hours a week on the project.

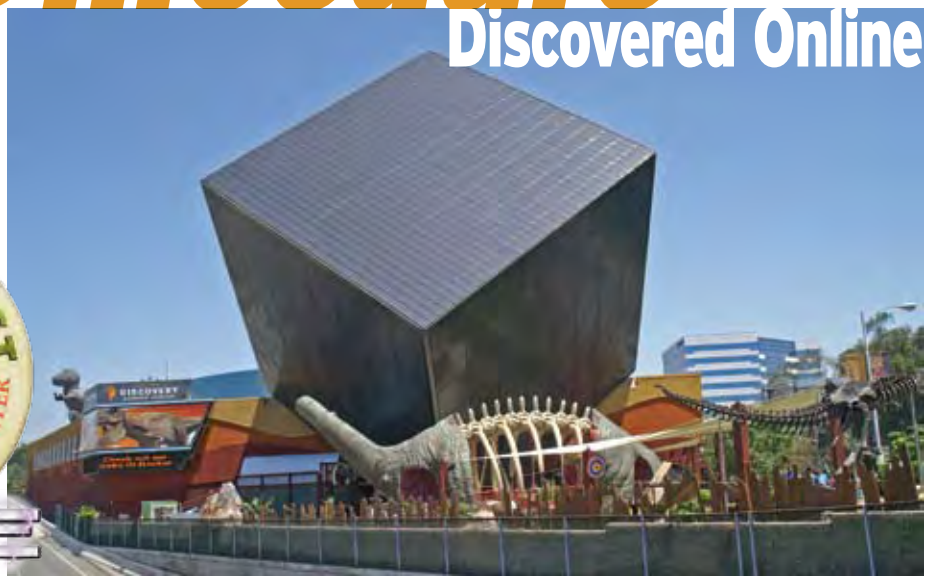
They are hoping their hard work will be rewarded with an improvement over last year's finish. In 2005, the team – which in addition to Popov, Kan and Christenson included since-graduated Titus Sanchez, Hrayr Artunyan, Hussein Sleiman and Phillip Schlesinger – was one of 118 to qualify for and pass the site visit, in which a DARPA official oversaw preliminary vehicle testing. The team hopes to make it to the National Qualifying Event in 2007, a semi-final of sorts that could add $50,000 in funding to their next attempt.

Another Lap to Go

Like many useful projects, however, Team XAR's car isn't just chasing prizes but also practical, real-life applications. The team is working with fellow Calit2 researcher Chris Davison, who specializes in emergency management technology, to adapt the car into a reconnaissance tool for scouting out disaster zones and other emergency situations, providing first responders with invaluable information. XAR also participates in the Blind Driver Challenge, which seeks to develop fully functional vehicles for the blind. Although several team members have graduated, leaving Team XAR understaffed, Popov is confident they will be able to recruit more members. After all, he explains, "It's been a really great experience, working with other people, designing things from the ground up and going all the way to implementing the design.

"At a company, you hardly ever see the results of your work. But here you get to see the results and be amazed."

Dinosaurs Discovered Online



Visitors are flocking to Orange County's Discovery Science Center in Santa Ana, Calif. to experience Dino Quest, an interactive exhibit that brings to life prehistoric dinosaurs.

by Anna Lynn Spitzer

They can walk inside a giant two-story tall Argentinosaurus, view life-size models to explore the heart and digestive systems, and manipulate parts of the dinosaur to learn how body systems work. The encounters with prehistoric creatures don't have to end, however, when guests leave the center. An interactive, online version of Dino Quest, developed by the Game Culture and Technology Lab at Calit2@ UCI allows the learning process to continue at home or school.

Recent studies have indicated that gaming can be a more effective approach to children's learning than classroom lectures...

Infrastructure Allows Integration

Aligned with California science education standards for grades K-6, the $5.5 million physical exhibit combines an interactive search for information with life-sized models to encourage hands-on learning. Recent studies have indicated that gaming can be a more effective approach to children's learning than classroom lectures, and drill-and-practice assignments. In fact, says Walt Scacchi, senior scientist at UCI's Institute for Software Research, games will increasingly compete with traditional educational methods.

Dino Quest Online, which will debut this fall, not only allows visitors to continue studying dinosaurs and their life systems, but to jump in at home where they left off at the exhibit.

Visitors to the science center presentation become "research assistants," receiving transmitters that allow them to interact with Dino Quest Headquarters. As they solve challenges, the transmitter – aided by a network of sensors embedded in the exhibit – tracks each player's progress, allowing him/her to continue online or in a subsequent visit to the center.

"We designed a network information infrastructure to tie these two systems together," says Scacchi. "The objective was to achieve seamless integration of the physical exhibit and the online world."

Unique Expertise Benefits Collaboration

The UCI/DSC partnership began in late 2004, when Scacchi and Robert Nideffer, associate professor of studio art and informatics, submitted a proposal to Discovery Science Center. "Kids

Girls search for fossils in the shadow of a giant dinosaur. Their progress is charted and they can begin the online game where they left off at the venue.

Previous page: Life-size dinosaurs greet visitors to the Discovery Science Center's Dino Quest exhibit.

love dinosaurs and games. When you combine them in innovative ways, it's a win-win situation," says Nideffer.

DSC funded the online game with a $300,000 grant, and Nideffer and Scacchi developed a series of prototypes. "We put a lot of work into designing the game and game infrastructure," says Scacchi.

The free online game can be played by anyone with an Internet connection and Flash capability. It's not imperative that players visit the DSC first, but those who do get a richer online experience.

The collaboration has been mutually beneficial. "The Discovery Science Center understands the California State Science Content Standards and what works with teaching kids, but they've never done online games before," says Scacchi. "The main goal of the collaboration was to take advantage of each other's expertise."

That sentiment was echoed by Joe Adams, DSC president. "We liked the breadth of what Calit2 and the Game Lab brought to the project," he says. "They're in the know about game development, what's unique and different, and they understood what we wanted to accomplish."

Learning for All Ages

User-friendliness was another consideration. "Everything has to be experienced in ways that utilize little or no text," says Scacchi. "Part of the target audience is kids in kindergarten, first and second grades, and maybe even some pre-readers. You can't expect them to read instructions before they start to play." Another challenge was making the online game appeal to different age groups or skill levels. The solution was to allow more capable users to attempt more difficult tasks that require using knowledge acquired at earlier game levels.

Visitors to Dino Quest Online begin by retrieving a message from the game's message center. It's here they meet "Professor Digwell," who tells them what research missions they need to complete.

Players begin in the dig pit, where they learn how to play the game and dig up dinosaur fossil bones. From there, they can visit the ecology lab to learn about prey-predator and food-chain relationships among dinosaurs; or to the reconstruction lab, where they try to assemble fossil bones into dinosaur skeletons.

Carefully Crafted Characters

To guarantee cohesiveness, the physical exhibit and online game share a back story, introductory scenes and characters. The diverse characters were carefully designed to communicate the universality of science and learning through collaboration. "Since we can reach a global audience with the online game, we thought carefully about how the characters were depicted in terms of gender balance, nationality, expertise and collaboration," Scacchi says.

The success of the UCI/DSC collaboration is paving the way for additional partnerships, according to Janet Yamaguchi, vice president of education at the science center. Future exhibits that may be tied to online games include those on the water cycle and space exploration. "Students can learn more at a conceptual level through the game format," she says. "It is a really compelling learning environment."

FUNDING NOTES

by Stuart Ross

Calit2 helps faculty members obtain support for projects that have a significant IT component – particularly multi-investigator and multidisciplinary projects. The ITR program that funded Project ResCUE is no longer accepting proposals, but many other funding sources are available for related work. Listed below are some upcoming government funding opportunities relevant to emergency management, along with their proposal deadlines.

Small Business Innovative Research (SBIR), Small Business Technology Transfer Research (STTR), National Science Foundation
December 4, 2006

– Solicitation # 06-598

The SBIR/STTR Program provides initial funding for small firms to undertake cutting-edge, high-quality research with good potential for economic payoff. Initial awards up to $100,000 are available for the initial phase of research; larger amounts are available for successive phases of product development. The research is usually undertaken in cooperation with a university. Several other federal agencies also support SBIR and STTR programs; the National Institutes of Health has a Nov. 6 deadline and other 2007 deadlines will be announced in the near future.

Information and Intelligent Systems, National Science Foundation
December 6, 2006

– Solicitation #06-572

The research themes include human-centered computing, robust intelligence, information integration and informatics, and information privacy and security. Specific topics include, for example, extraction of structured information from unstructured sources, multimodal interfaces or affective computing. Curriculum development proposals are also welcome. The December deadline applies to projects less than $450,000; larger proposals must meet October and November deadlines.

Advanced Technologies, Defense Advanced Research Projects Agency
December 31, 2006

– Broad Agency Announcement #05-13

DARPA supports research on several topics that apply to urban emergency management: novel approaches for the development and implementation of heterogeneous networks of humans and human-operated or autonomous sensors; novel microprocessor/computing architectures to support secure computing; trustworthy computing in mobile environments; and advanced electronic vision and situation-awareness devices, algorithms and systems.

Networking Technology and Systems (NeTS), National Science Foundation
January 10, 2007

– Solicitation # 06-516

NeTS seeks to advance networking capabilities in areas such as privacy and security, subnetworks, wireless, sensor systems, heterogeneous platforms and future Internet designs. NSF anticipates a wide range of project sizes, with awards as high as several hundred thousand dollars available.

Communications and Networking; Digital Media, UC Discovery Grants
January 19, 2007

The UC Office of the President offers funding to assist faculty in obtaining research support from corporations. Research of interest to this program includes projects related to security, multimodal communications and adaptive networks, for example. UC funding must be matched by industry funding; the total from UC and industry can range from $50,000 to $2 million. Proposal acceptance rates are much higher than for federal programs.

National Institutes of Health Behavioral and Social Research on Disasters and Health
February 1, 2007

– Solicitation # PA-06-452

NIH encourages research on the long-term health consequences of disasters, especially for children, the elderly and vulnerable groups. Information technology research applied to simulations, models, social networks and databases would be welcome. Projects are limited to two years and $275,000 in total direct costs.

Cyber Trust, National Science Foundation
February 5, 2007

– Solicitation #06-517

Cyber Trust is concerned with the security of computer applications, networks and systems. Their research interests include topics such as access control, enhanced storage devices, network architectures, prediction of attack path and more. Relevant behavioral and social science research is also welcome. Three categories of awards are offered – up to $2 million over four years.

For more information on these and other government programs, consult the sponsor Web sites or Stuart Ross at stuross@calit2.uci.edu. For information on coordinating research with corporate sources, contact Tanya Zabalegui at tanyaz@calit2.uci.edu

YouTube

Peter Krapp is an associate professor in the Department of Film and Media Studies. He is also the director of the Ph.D. program in visual studies and a faculty member in the ACE – Arts Computing Engineering – program.

What is YouTube and how does it work?

YouTube is a video-sharing Web site *(www.youtube.com)* that allows users to view, comment on and distribute clips. Founded in February 2005, its popularity surged last December when it hosted a "Saturday Night Live" clip, and it is now one of the 20 most popular destinations on the Web. YouTube is a social Web application, meaning its site structure highlights videos that other viewers have rated highly.

Is any special computer equipment or a subscription required?

Other than a current Web browser and Adobe Flash multimedia capability, no special equipment is necessary. Ninety percent of computers connected to the Internet have Flash 6, which works equally well under different operating systems, so YouTube content is compatible with Windows, MacOS, Linux, FreeBSD, etc.

No subscription is necessary. To post your own videos, you create a user ID and confirm it via email. To upload, choose a title and description for your file and set its privacy settings, depending on how widely you intend to share it; you are asked to identify categories it might fit into and provide tags to help sort it. Generally, uploading will take 2-3 minutes per MB on a high-speed connection; clips are limited to 100MB in file size and 10 minutes in length.

A special feature of the site is that the videos are easily embedded into blogs. Why is this important?

You can copy and paste the short code offered by each YouTube page into your blog, MySpace page or Web site, and it will load the clip. The perceived benefit of a video-sharing site is that it allows you to access clips without having to host your own files. The significance of acquiring links to (and positive comments on) your YouTube clips cannot be overstated; popularity is the organizing principle of the site. Less popular videos are much more difficult to find and negative feedback may cause a clip to be marked inappropriate or blocked.

What similar sites has YouTube spawned?

There are more than 200 video-sharing sites; the closest competitors to YouTube are MySpace and Google Video, as well as AOL Uncut and Yahoo Video. None is growing as fast as YouTube, which excels at the social networking aspect of online video; each clip can be evaluated by every visitor to the site. YouTube has almost a third of the U.S. online multimedia entertainment market, according to Web measurement data from Hitwise. YouTube videos account for 60 percent of all videos watched online, while MySpace accounts for about 20 percent. Reuters estimates that approximately 6 million people view clips on YouTube each day; according to Nielsen/NetRatings, YouTube attracts around 20 million users per month. The site is increasingly used for promotional purposes – TV trailers, film project excerpts, and marketing and advertising campaigns.

How does the site handle copyright issues?

YouTube prohibits the posting of copyrighted video by anyone but the copyright holder. Nonetheless, active restrictions are proving difficult, in part because of the sheer volume. In February, NBC asked YouTube to remove video from the 2006 Olympics, as well as the "Saturday Night Live" clip that propelled YouTube to fame. NBC has since forged an alliance with YouTube, showcasing preview clips for "The Office" and other NBC promotions.

How does the rating system work?

Viewers can give a clip as many as five stars, as well as leave a comment or upload a video response. The site always foregrounds the most recent or most-viewed, top-rated, most-discussed or most-linked videos. The average viewer spends 28 minutes on the site, so it is not surprising that YouTube uses advertising banners to offset the cost of immense traffic. In March 2006, advertising was launched on YouTube, and as of April 2006, the site also started using Google AdSense. The company is said to spend as much as $1 million a month on bandwidth; growth might be inhibited because broadband providers are trying to claim the right to be paid according to what is being transferred.

Calit2 *Welcomes* New Emulex Graduate Fellows

2006-07 Calit2-Emulex Graduate Fellows include (seated from left): Shan Jiang, Yue Zhang, Aniketa Shinde, Jui Ramaprasad and Tiffany Chua. Standing: Garnet Hertz, Yu-Hsiang Hsu, Karim El Defrawy, Brett Ryan Goldsmith, Serdar Soyoz and Debasish Sen. Not pictured: Albert Tsung-Hsi Hsieh, Eric Baumer, Gregory Elliott, Koel Das and Pablo Diaz-Gutierrez.

Calit2's multidisciplinary mission is well represented by the 16 new graduate students chosen as 2006-07 Calit2-Emulex Graduate Fellows.

The new fellows are affiliated with a wide range of campus schools and departments, including the Donald Bren School of Information and Computer Sciences, The Henry Samueli School of Engineering, the ACE interdisciplinary program, the School of Physical Sciences, the School of Humanities, the Paul Merage School of Business and the School of Medicine.

The students will use the one-year awards to advance their work on Calit2-related dissertations or theses.

They were chosen from a pool of 90 applicants, the largest in the graduate fellowship program's history. Funding for the program was provided by Costa-Mesa, Calif.-based Emulex Corp., a Calit2 corporate partner that manufactures storage networking devices.

The new fellows were welcomed into the Calit2 family at an orientation held Sept. 7. They met Calit2 Division Director Albert Yee, got acquainted with each other, discussed means to encourage group cohesiveness and learned how best to get involved at the institute.

The graduate fellows program was revamped this year in order to more fully integrate the graduate students into Calit2. In addition to participating in ongoing Calit2 seminars and activities, they will present their work to their colleagues at monthly brown-bag seminars.

In addition, the students will help organize and participate in the Graduate Student Interdisciplinary Workshop held during the spring quarter. At the end of the school year, each fellow will report on the progress of his/her thesis or dissertation.

Yee urged the students to get to know one another and find ways to collaborate. "Learn each other's languages," he told the students, "and I don't mean English or Korean or Chinese. Learn the jargon that your colleagues use in their work so that you'll be able to communicate with each other."

Surfing the Research Realm

Undergraduates Gain Multidisciplinary Research Experience

by Tina Rivers

Seventeen UC Irvine undergrads recently completed a summer of hands-on learning and exploration in SURF-IT – the Summer Undergraduate Research Fellowship in Information Technology.

Organized by Calit2 and UCI's Undergraduate Research Opportunities Program, the second annual SURF-IT program funded the students for 10 weeks as they conducted research under the guidance of UCI professors in a variety of multidisciplinary IT-related projects. The program was funded by Emulex Corp., a Costa Mesa, Calif.-based manufacturer of storage networking devices.

SURF-IT extends Calit2's mission of bridging disciplines and connecting university research with real-world applications, so the projects were multidisciplinary and excitingly relevant. They were also diverse, expanding the IT rubric from working with carbon nanotubes to understanding the politics and aesthetics of new media in Southeast Asia.

Sharing through Seminars

The program was punctuated by a series of lunchtime seminars delivered by faculty mentors. These presentations were key to the learning experience, both as general edification and more importantly, lessons in presenting potentially obtuse research endeavors to a wider audience.

Included in each student's research experience was an informal interview with the program's blogger, who kept an updated Internet account of their research efforts.

While the summer was productive in terms of exposing students to the realities of research, and polishing their academic and professional skills, the Calit2 staff ensured that fun was a factor. An ice cream social and an evening sailing expedition were just two of the events that allowed SURF-IT students to get better acquainted.

Praise for the Program

The program got an affirmative appraisal from participating students and staff.

"I thought SURF-IT was a wonderful interdisciplinary experience that gave me a good look at what it is like to do research in the 'real world,'" says student Chris Trezzo. "It was a lot of work, but I would do it again."

The program got a thumbs-up from UROP director Said Shokair, too. "SURF-IT is a one-of-a-kind opportunity for students to gain research experience in an interdisciplinary environment," he says. "Watching these students, who are already among the best and brightest UCI has to offer, learn and collaborate over the 10 weeks is an extraordinary experience."

More information about SURF-IT is available at: *www.urop.uci.edu/surf-it.html* and *http://research.calit2.net/students/surf-it 2006*.

SURF-IT fellows joined up with IM SURE, another undergrad research program, to cruise Newport Harbor on a balmy summer night. Social activities were an important aspect of the program to many students.

Arriba! Calit2@UCI Celebrates Community

In celebration of another successful academic year of new partnerships and thriving collaborations, Calit2@UCI held its annual get-together the last week of May. More than 200 affiliated colleagues socialized over fajitas and festivities in the Irvine building courtyard. The event included a late-night talk show parody by division director Albert Yee titled "Top Ten Ways to Build Calit2 Community Spirit," as well as a group cheer led by institute director Larry Smarr. Guests said the event reflected the strong sense of contagious collaboration the institute brings to campus.

Have Wall Will Travel

Bringing thousands of people at once to view HIPerWall – the Highly Interactive Parallelized Display Wall – in the Calit2 Building would be somewhat difficult, to say the least. So researchers Falko Kuester and Steve Jenks, assistant professors of electrical engineering and computer science, did the next best thing. They took HIPerWall to the 4,200 people from 48 countries who attended this year's Apple World Wide Developers Conference in San Francisco, August 7-11. Actually, it was a mini version of HIPerWall that made the trip. The original HIPerWall is a 50-panel, 23x9-foot display system used for visualizing and manipulating massive data sets; the traveling version, which was assembled at the Moscone Center West, was an 18-tile, 6x3-foot adaptation. "Considering the truly international nature of this event, it generated lots of interest in Calit2 research," said Kuester, a HIPerWall principal investigator.

Emphasizing the Economics of Technology

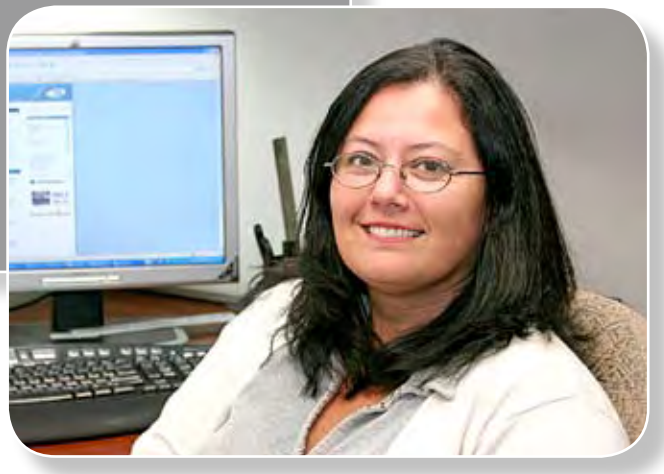
The continuous development of technology – especially nanotechnology, biomedical engineering and computer science – will be critical to the U.S. economy in the coming years, said U.S. Under Secretary of Commerce for Technology Robert Cresanti, who visited Orange County in August as a guest of OCTANe, the Orange County Technology Alliance Network. Cresanti addressed a standing-room-only crowd in the Calit2 Irvine building auditorium. His department's charter is to maximize technology's contribution to the nation's economic growth, creation of high-wage jobs and social well-being. The U.S. is currently in an "innovation-based, knowledge-based" economy that will continue to influence the way business is conducted, Cresanti said. He foresees a time in the near future when all manufacturing will utilize nanotechnology.

Third Annual Seminar in Experimental Critical Theory

Calit2 served as a host location for this summer's UC Humanities Research Institute (HRI) technoSpheres: Futures of Thinking. The two-week seminar at UCI offered participants the opportunity to explore new ways of thinking about technology. Paired conversations between cutting-edge technological innovators and experimental humanists, artists and social scientists were presented. During the first week, Calit2 founding director Larry Smarr was teamed with Craig Calhoun, NYU professor and president of the Social Science Research Council, to discuss social networks/social movements. The seminar also featured demonstrations of new technological devices, their applications and scholarly practices, including several projects in Calit2 labs. HRI director David Theo Goldberg is a member of Calit2's Irvine Division Council.

New Corporate Relations Manager Joins Irvine Division

Calit2@UCI recently welcomed new corporate relations manager Tanya Zabalegui. Tanya brings to her new position nearly a dozen years of UC experience in program management, corporate relations and development. She has spent time at both UCLA and UCSD, including several years with UCSD CONNECT, and also has experience working with technology start-ups. Tanya currently serves as president-elect of the Orange County chapter of the National Latina Business Women Association. She will be striving to facilitate Calit2 Irvine-corporate research partnerships.



Marines Land at Calit2

Two high-ranking members of the United States Marine Corps Pacific Command in charge of emergency response management spent a day in August learning more about Calit2. The visit was arranged by Richard Matthew, UCI associate professor and director of the Center for Unconventional Security Affairs, and a member of the Calit2 Irvine Division Council. The Marines discussed opportunities for collaboration and viewed demonstrations of research projects in areas ranging from situation awareness, information gathering and coordination to emergency communication technologies, visualization and game-based simulation for training. CUSA community advisory board members, representing Orange County businesses, also joined in the discussions.

Telemedicine Comes of Age

Progressive practitioners, a remote-access robot and an intriguing topic drew a crowd from industry, academia and the medical community to Calit2@UCI in September for the third "Igniting Technology" presentation. "Telemedicine Comes of Age: Supporting a New Model of Care with Network Technology" was cosponsored by Calit2 and law firm Knobbe Martens Olson & Bear LLP. Guests got a close-up look at the emerging field that merges medical research and practice with the Internet, robotics and telecommunications. The panel of experts included the CEO of a medical robotics company who joined the three UCI panelists by remote presence from Santa Barbara. He was channeled by RP-7, a company-designed robot from which his face and voice emanated.

Calit2-Emulex SURF-IT Fellow Christopher Larson worked on the project during the summer with Majumder.

Challenge: A life-size, high-resolution, seamless display built by multiple projectors. Must be scalable to any size and reconfigurable to any aspect ratio to enable pack-and-go capability. Will be utilized in mobile science laboratories, and mobile command-and-control units.

Solution: An innovative, completely distributed architecture that utilizes a network of projector-camera systems and custom algorithms. Developed by Assistant Professor of Computer Science Systems Aditi Majumder, this architecture enables the computer-directed projectors-camera systems to communicate with each other to determine projector configurations, align image geometry and remove color variation to create seamless, large, high-resolution imagery.

More Information: Read all about this technological innovation in *Interface,* Winter 2007 issue.

The California Institute for Telecommunications and Information Technology is a two-campus multidisciplinary research institute. In collaboration with UCSD, Calit2@UCI integrates academic research with industry experience to seek innovative IT approaches that will benefit society and ignite economic development.

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