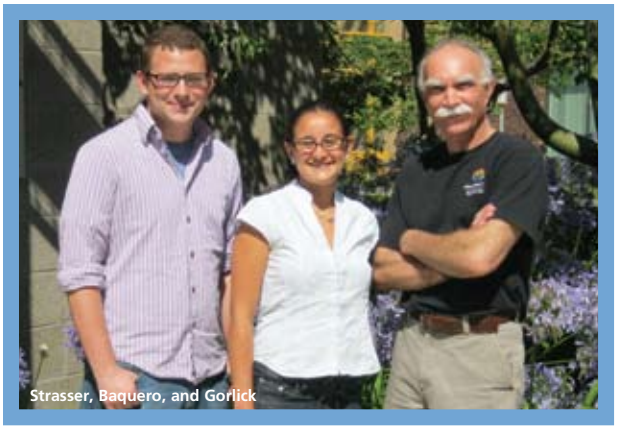
ISR Connector

INSTITUTE FOR SOFTWARE RESEARCH / UNIVERSITY OF CALIFORNIA, IRVINE

HOT RESEARCH

CREST: An Architectural Style for the Computation-Centric Web

The World Wide Web evolved from humble beginnings to become a cornerstone of almost all facets of modern society, embracing activities as diverse as finance, communications, entertainment, and commerce. ISR alumni have made fundamental contributions to the design and evolution of the Web, including **Roy Fielding's** definitions of the Representational State Transfer (REST) architectural style and the HTTP/1.1 protocol, ISR Prof. **Jim Whitehead's** WebDAV distributed authoring mechanisms, and **Rohit Khare's** ARRESTED family of REST-derived styles, as well as Fielding's work on the Apache Web Server and **Justin Erenkrantz's** work on the Subversion configuration management system.



Strasser, Baquero, and Gorlick

As Web technologies evolved, however, innovations like Ajax, mashups, and Web Services pushed web applications beyond the REST constraints, which provided theoretical and practical guidance to system developers. ISR alumni Erenkrantz and **Girish Suryanarayana**, and Ph.D. student **Michael Gorlick** (R. Taylor, advisor), responded to this disparity by articulating a set of theoretical principles called Computational REST (CREST), which explained and extended the emerging importance of computational activity and transfer — as opposed to content exchange — between clients and services.

Through initial exploratory prototyping, it became clear that CREST was not merely an explanatory mechanism for newer Web applications, but a distinct architectural style suitable for novel resilient, adaptive and decentralized systems. Last summer, Erenkrantz and Gorlick, along with ISR Ph.D. students **Yongjie Zheng** and **Alegria Baquero** (R. Taylor, advisor to both), built a dynamic, adaptive feed reader, in which lightweight data processing widgets can be graphically reconfigured on-the-fly to perform collaborative data extraction and display on news feeds (Figure 1). ISR Director **Richard N. Taylor** presented the application as part of his ESEC/FSE 2009 keynote to great reception, and Erenkrantz graduated with his dissertation, "Computational REST: A New Model for Decentralized, Internet-Scale Applications" in September, 2009.

Since then, Gorlick, Baquero, and Ph.D. student **Kyle Strasser** (R. Taylor, advisor) have been at work exploring the implications of the CREST principles and building a new generation of infrastructure to support more sophisticated forms of computational exchange. They are also building exploratory applications that will allow investigation of common design patterns, methods for system design, notations to describe CREST systems, and the need for further infrastructure features and tool support. Current exploratory projects include collaborative video-tagging and real-time video editing, a platform for recasting service-oriented architectures and Web Services in e-commerce, and situational awareness services.

RESEARCH BRIEFS

Director **Richard N. Taylor** has been awarded the title of Chancellor's Professor. This title is used to recognize scholars who have demonstrated unusual academic merit and whose continued promise for scholarly achievement makes them of exceptional value to the university.

Prof. **Cristina Lopes** has been elected a Senior Member of the Institute of Electrical and Electronic Engineers (IEEE). Senior Member status is conferred only on those who have outstanding research achievements and who have performed great service to the scientific community.

Prof. **Walt Scacchi** has been awarded $120,000 from the Naval Postgraduate School for his research on "Investigating Advances in the Acquisition of Systems Based on Open Architecture and Open Source Software."

Prof. **Gloria Mark** has received a $15,650 Discover award from Northrop Grumman Intelligence Systems to seed a collaborative project on applying multi-tasking collaboration and audio/visual sensory methods to enhance information management within a complex data space.

More Research Briefs on page 7.

IN THIS ISSUE:

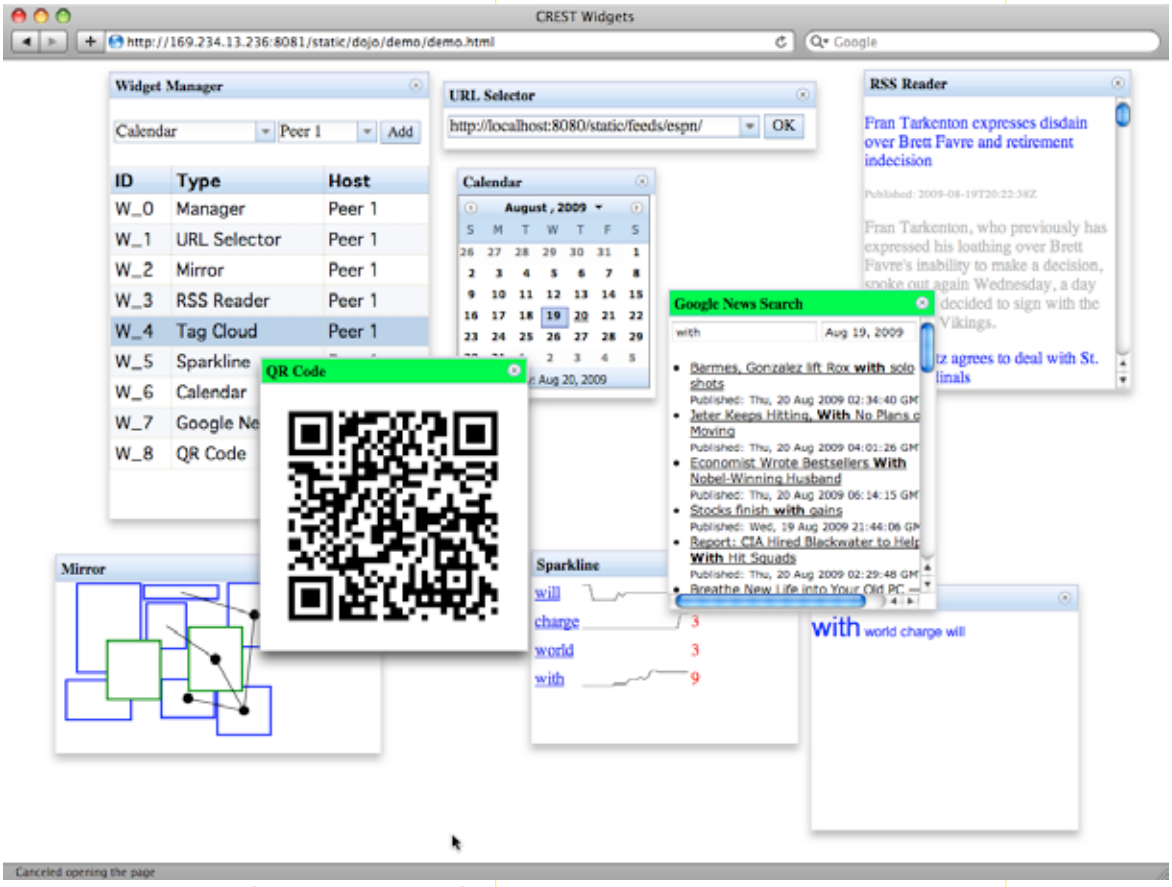


Figure 1: An adaptive, dynamic feed reader that uses reconfigurable text-processing widgets.

CREST Foundations and Technology

Whereas current Web architecture uses URLs to locate information resources – represented by content like text, images, video, and music – CREST extends URLs to locate active computations and their execution environments. Computations shape and mold their environments by adding features provided by other peers through code mobility, and by instantiating new, recursively embedded execution environments. Active computations may migrate from one computational locus to another seamlessly, resuming in place without losing track of their context and state.

The current model allows for mobility of static code, active computations, and whole binding environments. The next generation of infrastructure will support full mobility by generating serialized continuations, a well-known functional programming control mechanism, and closures, which provide elegant modes of state encapsulation. Transferred continuations and closures will spawn new computations in open peers, add additional features to their binding environments, and direct them to the use of previously undiscovered services.

"Mobility" in CREST means the ability to cross agency boundaries, to enact decentralized cooperation, and to adapt in response to context and faults. Spawning and maintaining computations and execution environments at URLs allows cross-domain and cross-organizational use of services. Security measures will ensure that computations are sandboxed inside execution environments, and that execution is governed by security policies, similar to the security architectures for programming languages that run on virtual machines.

A Future for Web Services and Applications

To imagine the power and versatility of a rich ecosystem of computations that are constantly exchanged among peers, we need only envision applications that dynamically adapt in the face of change, that are situationally aware, that are massively distributed, that span agency borders, and that can be shared and branched to act under new conditions or recombined into new services. Once the infrastructure is in place and the theory is solidified, CREST researchers will focus on building realistic and demanding applications in order to demonstrate the power of an infrastructure whose lingua franca is the transfer of rich and expressive computations — for building complex software systems within a wide variety of domains.

CREST's underlying architectural principles aim to unify service access and composition for the complex assortment of services present today and tomorrow on the Web, and to expand the expressiveness, power, and cross-domain reusability of those services. Systems built using CREST tools and infrastructure will range from small-scale applications to huge infrastructures and systems-of-systems. On one end of the scale of potential applications, a commodities trading analyst could dynamically deploy assistant computations that collaboratively analyze, summarize, and correlate news stories, weather forecasts, and financial market updates to lend the most up-to-date advice for trading a commodity type, creating a customized tool with inherent flexibility and reconfigurability. On the other end of the scale, a smart energy microgrid with heterogeneous sources of power and usage requirements could intelligently balance supply, cooperate with other microgrids, and adapt in the face of brownouts, environmental disasters, demand spikes, and other threats to resilience.

Significant work remains. How can the architectural style be formally characterized? What are the methods and tools that will aid engineers in designing their own CREST applications? What programming languages can be supported, and how?

MESSAGE FROM THE DIRECTOR


Taylor

Professional conferences play critical roles in the development of technical fields. They are the venues in which ideas are presented, experiences shared, and "elbows rubbed." One of my east coast colleagues has remarked that he can't help but come home with 5 new ideas to try out, based upon his listening to others present their work at a conference. Do you need some new ideas for your project or your organization? Try listening at a symposium.

Conferences offer other values as well. For presenters conferences are forcing functions to finish up work, to reflect on it to bring out its best and most salient points, and to place a public stake in the ground: "This is what my group has achieved."

ISR has had a long-standing commitment to support the premier conferences in software engineering, and to foster the development of new sub-disciplines through facilitating small meetings and workshops. In the past year or two ISR has played key roles in several meetings, including the 16th ACM SIGSOFT International Symposium on the Foundations of Software Engineering in Atlanta, and FOSS 2010, the Workshop on the Future of Research on Free/Open Source Software, held at UCI (see page 5). This coming year ISR will play a very visible role in two key meetings, ICSE 2011 – the International Conference on Software Engineering and SPLASH/OOPSLA 2011 – Systems, Programming, Languages, and Applications: Software for Humanity.

Since this is a packed issue of the **ISR** *Connector*, I want to highlight here just one key item from ICSE 2011, hopefully encouraging you to actively participate: the "Software Engineering in Practice" track. This track will bring out the best of software engineering practice in diverse fields of enterprise and business – with case studies and experience reports from traditional industries like avionics, finance, energy, telecom, health, engineering and defense to the emerging areas of bioinformatics, life sciences, retail, games, green IT, cloud and grid computing, social networks, sustainability and society, as well as open source, distributed collaboration, outsourcing and crowdsourcing solutions.

Full details about ICSE 2011 are available on the conference website:

http://2011.icse-conferences.org/

Come join us in Hawaii and bring home at least 5 new ideas!

ISR Director **Richard N. Taylor** can be reached at taylor@uci.edu.

How will engineers test applications that rely on a rich, live ecosystem of computations and peers? What system analysis tools are possible and useful, given the dynamism and ever-evolving characteristics of future CREST applications? In what domains will these principles be most useful? Future investigations and collaborations will uncover the answers to these questions.

For more on CREST research, see:

http://www.isr.uci.edu/projects/crest/

For more on ISR Web technology research, see:

http://www.isr.uci.edu/projects/web/

Gorlick, Baquero and Strasser can be reached at: gorlick@acm.org, abaquero@uci.edu, and kstrasse@uci.edu.

CREST was previously featured in the Fall/Winter 2007 issue of the **ISR** *Connector* which is available online at:

http://www.isr.uci.edu/newsletter.html


Demsky

FOCUS ON FACULTY

Meet Brian Demsky, Parallel Software Specialist

ISR Prof. **Brian Demsky's** research applies techniques from programming languages and program analysis to a wide range of real world problems. He holds an appointment as an Assistant Professor in the Department of Electrical Engineering and Computer Science at the University of California, Irvine. Demsky's research in this area began with his Ph.D. studies in the Program Analysis and Compilation Group at MIT. Demsky joined ISR in 2007.

Demsky's current research interests include software development for many-core processors, developing new tools for building more robust software applications, and protecting the privacy of personal information.

With the impending arrival of many-core processors, software developers must write parallel software to realize the benefits of continued improvements in microprocessors. Developing parallel software using today's development tools can be challenging. Demsky's group is exploring a wide range of approaches to simplify many-core software development.

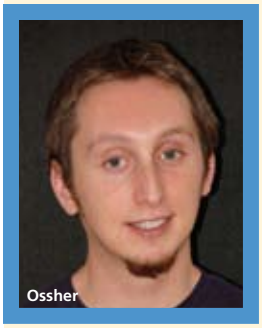
In contrast to today's desktop software developers, hardware designers routinely design systems that are composed of millions of parallel components (gates). The hardware design process relies on tools to analyze, modify, and synthesize designs in response to challenging constraints such as timing, power, and reliability. Demsky's Bamboo project applies ideas from hardware design to developing parallel software. The language component of

ISR STUDENT NEWSBRIEFS

Sushil Bajracharya (C. Lopes, advisor) organized the 2nd International Workshop on Search-driven development: Users, Infrastructure, Tools and Evaluation (SUITE) at ICSE 2010 in South Africa in May. Bajracharya also organized the first edition of this workshop, held at ICSE 2009.


Bajracharya

Joel Ossher (C. Lopes, advisor) presented his paper "Automated Dependency Resolution for Open Source Software" at the 7th Working Conf. on Mining Software Repositories (MSR 2010) at ICSE 2010 in South Africa in May. He also presented the paper "Searching API usage examples in code repositories with Sourcerer API Search" at SUITE 2010, also held at ICSE 2010. Both papers were co-authored by Ph.D. student Sushil Bajracharya and their advisor Prof. **Cristina Lopes.**


Ossher

Xinru Page (A. Kobsa advisor) presented her paper "Navigating the Social Terrain with Google Latitude" at the 2010 iConference in February. The paper was co-authored by her advisor Prof. **Alfred Kobsa**.


Page

For more information on students:
http://www.isr.uci.edu/people.html

Bamboo combines features from a data-centric programming model with a traditional imperative, object-oriented model. The Bamboo compiler integrates the language component with a high-level simulation component that it uses to synthesize implementations of parallel programs that are optimized for the specific target processor.

Out-of-order Java is another approach Demsky's group is exploring for parallel software development. The goal of out-of-order Java is to enable average programmers to gain the performance benefits of parallel execution while avoiding the correctness challenges associated with concurrency. In out-of-order Java, a programmer annotates blocks of code that the programmer believes should be executed in parallel with the main thread. Out-of-order Java guarantees a parallel program has the exact same behavior as the corresponding sequential version, which eliminates the possibility of concurrency bugs. The out-of-order Java compiler automatically extracts dependencies between the annotated blocks. The compiler then communicates these dependencies to the developer, who may then choose to modify the program to eliminate dependencies and improve parallelism. The runtime system then uses this information to execute the annotated blocks as soon as their dependencies are resolved.

Another major direction of Demsky's research is building robust software systems. Society increasingly relies on the correct operation of software. Software already plays a critical role in the control of aircraft, air traffic control systems, surgical systems, and control of cars. As software is deployed in more sophisticated roles, these new roles often require more complex behaviors from software in an environment in which failures can cause damage to property or even loss of life. Even with the best software development practices, software bugs are inevitable. Demsky's group is exploring tools for building software that is robust even in the presence of bugs. The basic idea is that developers expose the high-level design of the software to the compiler and runtime system, and when a failure occurs the runtime system uses this high-level design information to reason how to recover.

For more on Demsky's research, see:

http://demsky.eecs.uci.edu/

Demsky can be reached at bdemsky@uci.edu.

ISR Technical Reports Available Online

ISR technical reports present information resulting from student and faculty research carried out under the auspices of the Institute. They showcase early results not available in print elsewhere. ISR technical reports are available in PDF on the ISR website. Recent reports include:

"Disjoint Reachability Analysis"
James C. Jenista, Yong Hun Eom, Brian Demsky
UCI-ISR-10-4, June 2010

"The Infrastructure of a Computational Web"
Michael M. Gorlick, Justin R. Erenkrantz, Richard N. Taylor
UCI-ISR-10-3, May 2010

"Gaze Awareness for Distributed Work Environments"
Benjamin Koehne
UCI-ISR-10-2, May 2010

"Applying Software Design and Requirements Engineering Techniques to System Conception"
Leyna C. Cotran, Richard N. Taylor
UCI-ISR-10-1, March 2010

All ISR technical reports are available at:

http://www.isr.uci.edu/tech-reports.html


Dynamic discourse at FOSS 2010 workshop.

ISR Hosts Workshop on the Future of Research on Free/Open Source Software Development

Even though Free/Open Source Software (FOSS) is widely used, much of the Computer Science research community has yet to fully recognize its potential to change the world of research and development of software intensive systems across disciplines. Tens of thousands of FOSS projects are up and running world-wide, and millions of end-users of computing increasingly rely on FOSS-based systems. Growing numbers of research projects in physical, social, and human sciences, as well as the cultural arts are now routinely expecting to develop or use FOSS-based systems to best meet their needs. Similarly, growing numbers of businesses and government organizations are now looking to develop and use mission-critical software applications that are built with FOSS components. Why and to what ends?

In February 2010, ISR hosted a three day workshop, sponsored by the Computing Community Consortium, to develop an agenda for future research in free/open source software development (FOSSD), in order to better understand the interest, diversification, and widespread growth of FOSS systems, projects and related practices. The goal of this workshop was to engage researchers from academia and industry in the U.S. to help develop a broad perspective as to emerging areas for potential research investment over the next 3-10 years.

The workshop was organized by ISR Prof. **Walt Scacchi**, University of California, Irvine; Prof. Kevin Crowston, Syracuse University School of Information Studies; Prof. Greg Madey, University of Notre Dame; and Prof. Megan Squire, Elon University. A follow-on meeting was held in June to coalesce the workshop results. Forty-eight people from the research community, including academia, industry, and members of the open source community participated.


Scacchi

The final report from this workshop elaborates four core research areas for study, as well as the research infrastructure and data needed to support empirical studies of the artifacts, work practices, development processes, project and community dynamics that characterize FOSSD. The four areas cover FOSSD and Software Engineering (SE), collaborative development work, FOSS ecosystems, and FOSS evolution.

This workshop was supported by a grant from the Computing Community Consortium (CCC) to Walt Scacchi/ISR.

More information on FOSS 2010, including the final report, is available at:

http://foss2010.isr.uci.edu/

ISR STUDENT NEWSBRIEFS

Francisco Servant (J. Jones, advisor) presented his paper "CASI: Preventing Indirect Conflicts through a Live Visualization" at the 3rd Int'l Workshop on Cooperative and Human Aspects of Software Engineering (CHASE) at ICSE 2010 in South Africa in May. The paper was co-authored by his advisor Prof. **James A. Jones** and Prof. **André van der Hoek**.


Servant

Nick Mangano (A. van der Hoek advisor) presented his paper "Inkus: A Freehand Method for Creating Business Process Models" at the 7th Eurographics Symposium on Sketch-based Interfaces and Modeling (SBIM), held jointly with the 8th Int'l Symp. on Non-Photorealistic Animation and Rendering in Annecy, France in June. The paper was co-authored by Noi Sukaviriya of IBM Research. Mangano has returned to IBM T. J. Watson Research Center for his third consecutive summer internship.


Mangano

Kristina Winbladh (D. Richardson, advisor) was one of two Ph.D. students at UCI to receive the Most Promising Future Faculty award. Winbladh has accepted an Assistant Professor position at the Univ. of Delaware.


Winbladh

So How Do Software Engineers Really Design?

In February, ISR Professor **André van der Hoek**, along with Professor Marian Petre from the Open University, and UCI/ISR Ph.D. student **Alex Baker** (A. van der Hoek, advisor), hosted the 2010 Studying Professional Software Designers workshop at UCI. This workshop was the first of its kind in the world of software engineering research, bringing together experts from a variety of design research fields to study how software developers design.

In preparation for this workshop, van der Hoek and Baker traveled to six major software development companies throughout California. At each, they took two of the company's best designers aside and presented them with a design problem: to develop a traffic flow simulator according to a particular set of specifications. They then videotaped the designers while they worked and interviewed them about their process. From this data, a set of three primary videos were chosen and sent to the participants of the Studying Professional Software Designers workshop.


van der Hoek

Over the following months, the workshop participants individually studied these videos, and each wrote a paper and presented their findings during the 3-day workshop.


Michael Jackson, Mary Shaw, Fred Brooks and others discussing the designers actions.

The result was a diverse set of observations about software design, including detailed studies of the designers' decision-making processes, discussion of the designers' communication patterns, framing of the sessions in terms of established models of design, and intricate analyses of the software problem itself. Each day was concluded by a panel tasked with summarizing the day's observations and laying out a roadmap for studying software design.

Notable workshop participants included: Fred Brooks, Michael Jackson, Nigel Cross, Barbara Tversky, Linden Ball, Francoise Detienne, John Gero, Gerhard Fischer, Mark Gross, Janet McDonnell, Kumiyo Nakakoji, Mary Shaw, and others.

For more about the workshop, please visit:
http://www.ics.uci.edu/design-workshop/

In addition, a special issue of the *Design Studies Journal* is in preparation, as well as a special issue of *IEEE Software*, and a book with revised versions of the workshop papers.

NSF funding was graciously provided by Dr. Greenspan.

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Affiliate—Grad Student	$60,000	Graduate student fellowship.
Partner	$100,000 or more	Large-scale research project.

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Cotran, Dashofy, Jensen, Zheng, and Brodbeck at GSAW.

ISR Participates in Ground System Architectures Workshop (GSAW 2010)

Each spring, ISR enjoys participating in the Ground System Architectures Workshop, sponsored by long-time ISR supporter The Aerospace Corporation.

ISR has regularly contributed to GSAW's Architecture-Centric Evolution (ACE) Working Group, which promotes the central role of software architectures during the acquisition and development of software-intensive systems. This year ISR alumni **Eric Dashofy** and **Scott Hendrickson**, both now at The Aerospace Corporation, served as organizers and Chairs of the ACE working group. Ph.D. student **Yongie Zheng** (R. Taylor, advisor) gave a presentation in the working group titled "A Survey of Model-Based Software Development," enabling him to gain valuable input on his research and make connections in the GSAW community. GSAW serves as an excellent resource for informing and grounding ISR's research.

Ph.D. student **Leyna Cotran** (R. Taylor, advisor) has attended GSAW for 5 years as an ISR representative. Cotran says "GSAW continuously offers information useful to my research from experts in government and civilian organizations. I always come back, and continue to enjoy my interactions at GSAW."

ISR alumnus and post-doctoral researcher **Chris Jensen** (W. Scacchi, advisor) and ISR Technical Relations Director **Debra Brodbeck** also attended. "I value the opportunity to both establish new relationships, and connect with long-time colleagues," noted Brodbeck. ISR looks forward to GSAW 2011!

RESEARCH BRIEFS

In Prof. **Bonnie Nardi's** newly published book, *My Life as a Night Elf Priest: An Anthropological Account of World of Warcraft*, Nardi provides an analysis of one of the most popular online world games. Published by the University of Michigan Press, the book is in the Technologies of the Imagination series, edited by Mimi Ito.

Prof. **Scott Samuelsen** has received the UCI Medal, which confers lifelong recognition to extraordinary individuals who have made exceptional contributions to the vision, mission, and spirit of the University of California, Irvine. It is the university's most prestigious award.

Professors Michael Goodrich, **Alfred Kobsa** of ISR, and Gene Tsudik have been awarded $300,000 by the National Science Foundation for research on Usable Location Privacy in Geo-Social Networks.

The book "Computerization Movements: From Mainframes to Ubiquitous Computing", co-edited by ISR Research Specialist **Margaret Elliott** and Ken Kraemer, has been named as a winner of the *Choice Magazine 2009 Outstanding Academic Title Award*.

ISR STUDENT NEWSBRIEFS

Nithya Sambasivan's paper "Intermediated Technology Use in Developing Communities," co-authored y E. Cutrell, K. Toyama and her advisor **Bonnie Nardi**, was nominated for Best Paper at the ACM Conference on Human Factors in Computer Systems (CHI 2010).


Sambasivan

Yong Ming Kow and his advisor Prof. **Bonnie Nardi** have edited *User Creativity, Governance, and the New Media: A Special Issue of First Monday*. This issue of the online journal, published May 3, features a multi-disciplinary perspective of the emergence of user creativity in new media.


Kow

Ruy Cervantes (B. Nardi advisor) received a mini-grant from the Cross-Campus Collaborative Graduate Student Research program at the UCLA Institute for Research on Labor and Employment for his research on engineers' social network practices in Mexico. This research project will begin in Fall 2010.


Cervantes

For more information on students:
http://www.isr.uci.edu/people.html

Science and Art: Bringing Virtual Driving into the Real World

Post-doctoral scholar **Garnet Hertz** has recently joined ISR where he is directing the OutRun project, a mixed reality computer game system. The project, begun in 2009, combines a classic arcade driving game and an electric vehicle to create 'a video game that you actually drive.' Using a 1986 Sega OutRun car-shaped, "sit down" video game cabinet and a standard golf cart, Hertz is creating a sensory experience that explores the overlap between the physical world and game environments.


Hertz

Promotional poster for the OutRun project.

In a paper Hertz presented at the 5th Int'l Conf. on the Foundations of Digital Games, he outlines his inspirations for the OutRun project: as driving a car becomes more game-like through the use of technologies like GPS navigation, and playing a video game becomes more life-like through the exploitation of hyper-realistic simulations, OutRun explores the discrepancies that arise with such convergence.

Though still in development and scheduled to be released in October 2010, OutRun has already received press in outlets such as the *Orange County Local News Network* and has been featured on video game, automobile and general technology blogs across the Internet including *Joystiq*, *Otaku*, *Jalopnik*, *Engadget*, and *SlashGear*.

Hertz's OutRun computer vision system strives to render the real world like the original eight-bit video game: a camera looks in front of the vehicle, visually identifies objects, and draws a real-time representation of the world in the style of the classic video game. The project uses computer vision libraries in Max/MSP/Jitter with a custom vision filtering system built in Java for its vision-based component, with an existing Adobe Flash-based renderer. The result is a real time rendering of the real world as if playing a retro video game.

While a system like this could function as a true navigational device, the purpose of the OutRun project is to probe the problems that arise with the use of augmented technologies in both gaming and driving. The OutRun project is humorously reminiscent of stories of people driving their cars off bridges and into buildings due to disparities between GPS directions and actual road conditions.

This research into video games and the blending of virtual and real worlds is timely. In 2009 the UCI Center for Computer Games and Virtual Worlds was created and beginning in Fall 2010, undergraduate students will have the opportunity to major in Computer Games Science through the Donald Bren School of Information and Computer Science. With ISR Prof. **Walt Scacchi**, Research Director at the new Center, Hertz has been setting up the new Computer Game Science Lab, also set to open this Fall in conjunction with the new major – and the OutRun project has provided an important opportunity for undergraduates to gain interdisciplinary research skills and experience.

Hertz's work with ISR is primarily funded by the National Science Foundation grant, "Decentralized Virtual Activities and Technologies: A Socio-Technical Approach." This initiative focuses on investigating strategies for engaging in collaborative activities around the use of decentralized practices, and in the case of the OutRun project, particularly as it relates to mixed reality research that links physical and virtual worlds.

The OutRun project will be unveiled in an exhibition at the Otis College of Art and Design in Los Angeles in October 2010.

For more information on Hertz, see:
http://www.conceptlab.com

He can be reached at garnethertz@gmail.com.

ISR EVENT SCHEDULE

Mark your calendars now!


Kellogg

October 1, 2010
ISR Distinguished Speaker: Wendy Kellogg
IBM T. J. Watson Research Center
"Social Intelligence for a Smarter Planet"

ISR's complete **2010-11 Distinguished Speaker Series** will be announced in late summer. Thank you for making the 2009-2010 Distinguished Speaker Series a success!

For more information: *http://www.isr.uci.edu/events.html*

SPECIAL THANKS

The UCI Institute for Software Research is generously supported by:

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Northrop Grumman
Panasonic Shikoku Electronics
The Aerospace Corporation

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