

INSTITUTE FOR SOFTWARE RESEARCH / UNIVERSITY OF CALIFORNIA, IRVINE

HOT RESEARCH

End Users as Developers in the World of Smart Things

The Internet of Things (IoT) refers to the emerging concept that everyday objects and environments become enriched with computing and networking capabilities in order to be more responsive to our needs. Specialized sensors (e.g. motion, temperature, video) monitor and detect specific



interest and then stream data about them over the Internet for further processing, including triggering further actions in the physical environment through

conditions of

devices that can automatically control lighting, temperature, door locks, etc. By combining different specialized devices, our environments can become more responsive and "smart."

Internet of People

Several technical, human, and social challenges are introduced by the emerging IoT



infrastructure. Scalability, connectivity, and compatibility are some of the technical challenges that need to be addressed as the amount and types of interconnected devices increase. As

for human and social challenges, questions arise about how users will prefer to interact with and be able to make effective use of these technologies. In this emerg-

RESEARCH BRIEFS

- Interim Director **Cristina Videira Lopes** is leading a research project on code cloning on GitHub described in the paper "DéjàVu: A Map of Code Duplicates on GitHub." The paper was presented at SPLASH 2017 - OOPSLA in Vancouver, Canada in October. The artifact produced for the paper won the Distinguished Artifact Award, and the research has been covered by numerous tech publications, including *The Register, BleepingComputer, the morning paper, Slashdot, Developpez* (in French), *OpenNET* (in Russian), *Toutiao* (in Chinese), and *Sohu* (in Chinese). The paper is authored by Lopes, Petr Maj, Czech Technical University in Prague, Assistant Project Scientist **Pedro Martins**, Ph.D. students **Vaibhav Saini** and **Di Yang**, Jakub Zitny, CTU Prague, alumnus **Hitesh Sajnani**, Microsoft Research, and Prof. Jan Vitek, CTU Prague. Learn more at: http://mondego.ics.uci.edu/projects/ dejavu.
- Prof. **Gloria Mark** is a co-PI on a recently awarded \$1.26 M grant from NSF CHS on Managing Stress in the Workplace: Unobtrusive Monitoring and Adaptive Interventions. The goal of the grant is to study *in situ* factors that cause workplace stress and to develop interventions to reduce stress among information workers. Her co-PIs are Prof. Ricardo Gutierrez-Osuna, Texas A&M University and Prof. Ioannis Pavlidis, University of Houston.
- Prof. **Paul Dourish** is a co-investigator on a three-year a \$473,000 grant from the Australian Research Council on #thismymob: Digital Land Rights and Reconnecting Indigenous Communities. This research study is the first to apply the framework of Postcolonial Computing to guide the design and leadership of a national-scale, Indigenous-led technology development project in Australia.
- Prof. **Alfred Kobsa** gave an invited presentation titled "Design Trade-offs in Personalization versus Privacy" at the Design Trade-Offs for Quality of Life: Exploring Grand Challenges Symposium held at Herrenhausen Castle in Hanover, Germany in October.

More Research Briefs on pages 8.

ing context, users will need to perform an important role in order to tailor their own technologies to their specific needs, preferences, and contexts of use, as well as then understand automated behaviors. From

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12-ISR Events security settings to custom functionality, end users will be left in charge of the task of paving "the last mile" and fine-tuning software and hardware to their needs. This will happen not only during the initial setup of a new device or system, but throughout the entire time that the technology is being used because users' preferences, needs, and contexts change over time. For instance, in a family household, routines change due to the yearly school schedule, temperature preferences can change with the seasons or because you get sick, holidays and trips are planned, emergencies happen, etc. If this kind of technology is to support the numerous and varied situations we face in our everyday lives, it will need to support ways of continuous adaptation and modification,

MESSAGE FROM THE DIRECTOR

For all who read the ISR *Connector* newsletter, you will notice that this space has a new author: me. As of July 1st, 2017, Prof. **Richard (Dick) Taylor** retired from the directorship; I have the honor of being Interim Director for this academic year. Under



Dick's leadership, ISR was a solid rock that supported important research in software engineering and computer-supported cooperative work; it gave faculty, students, alumni, industry, and friends a sense of community. I plan to continue what Dick started, and will support research in topics that are especially relevant today. Cybersecurity is one of those topics. Cybersecurity is a vast field, with many angles to it, from policy all the way to cryptography. Currently, ISR's expertise falls within architectural perspectives to Cybersecurity – the idea that the way we put secure components together may result in security vulnerabilities that need to be understood and caught. UCI's School of ICS is hiring two faculty this year in Cybersecurity. The School is also hiring a third position in Software Engineering, broadly construed. These three new faculty are expected to be affiliated with ISR, expanding and deepening our expertise.

Prof. Jens Palsberg (UCLA) and I hosted a series of workshops recently, one at OOPSLA (Oct. 23, 2017), one at ASE (Nov. 3), and the final one here at UC Irvine (Nov. 17). The goal of these workshops was to gather requirements and ideas for how to scale up and improve benchmarks for research in static and dynamic analysis of programs, particularly for Java. Much tool development can benefit from access to Big Code, namely in the important areas of security enhancement, bug finding, and code synthesis. Small benchmark suites such as DaCapo are good for evaluation of performance-oriented tools, including virtual machines, but problematic for development of many other kinds of tools. Current large datasets such as Boa enable static analysis of projects



but rarely enable execution or search based on dynamic measurements. Our goal is to create what we call the Normalized Java Resource (NJR) that will speed up innovation in the area of software tools. Our vision is a diverse collection of 100,000 normalized Java projects that is executable, scriptable, and searchable. The Java projects stem from our existing Sourcerer collection and we normalize their representation to enable large-scale processing with reproducible results. Such

processing includes execution, static and dynamic analysis, scriptable interaction, and search for projects with specific dynamic characteristics. For each search of the collection, NJR returns both a file with Java projects and a container for a cloud service such as Amazon EC2. Thus, a researcher can run tools on those projects both locally and on a cloud service. Researchers will be both beneficiaries and contributors to NJR. They benefit from searching for Java projects that fit their need, and once their tools run on NJR, they contribute to an ever-increasing collection of measurements. In this way, we hope to leverage from a powerful network effect: the more people run tools on NJR, the more data we get for search, and the more data we get for search, the more people will want to search and run on NJR.

This being my first Message for the *Connector*, I want to publicly acknowledge the incredible work of ISR staff, namely Assistant Director **Debra Brodbeck**, Administrator **Janet Ko**, and Financial Analyst **Anna Chang**. Moreover, I want to let everyone know that ISR is here to stay! There will be changes, no doubt, and I look forward to an exciting future at the helm. I hope to see many of you at the Distinguished Speaker talks that are starting in the Winter quarter, and at the Research Forum which will be held, as usual, at the end of the academic year.

Happy New Year!

ISR Interim Director Cristina Videira Lopes can be reached at lopes@uci.edu.

largely to be performed by the end users somehow.

End-User Development for the Internet of Things

End-User Development (EUD) is an approach to supporting end users (including everyday consumers) in tailoring their technologies on their own. In general, EUD has comprised techniques such as parameterization, programming by demonstration, scripting, and visual programming. Through these means, end users can customize the software they use to varying degrees. Recently, researchers have been look-

ing into how EUD techniques, tools, and methods can be applied in IoT contexts in order to provide end users with tools to tailor their smart environments. Research carried out by Prof. **David Redmiles** and his team goes in this direction and tries to understand, at a fundamental level, what is different about EUD for the IoT compared to the other domains where EUD has been tried, what are the major challenges in this area, and how can these challenges be addressed in the design of tools for this context.

A Human-Centric Computing Framing of EUD for the IoT

Redmiles has always been interested in the human and social aspects of software engineering and development, including how end users can provide feedback to developers and how EUD can enhance collaboration among collaborators. One way to look at EUD is as a collaboration



Figure 1: A framing of EUD for IoT as a (messy) group communication scenario: Who's telling what to whom and how?

between developers and end users through the technology in use. Both parties perform certain development tasks that align to each other and improve the final product. In this perspective, technology development tends to be more inclusive and participatory with the end users having an active role in the development process.

From December 2016 through November 2017, Redmiles hosted **Bruno Azevedo Chagas** as a visiting researcher from Pontifical Catholic University of Rio de Janeiro, Brazil. Chagas is a Ph.D. student advised there by Professor Clarisse de Souza, an expert in semiotics and a novel software technique called semiotic engineering. Chagas has been researching the topic of EUD for the IoT, taking a human-centric computing perspective. In his Ph.D. research, he is applying semiotic engineering in this domain, which fits within the perspective that interacting with computer technologies is a communi-



cation between developers and users.

Initially, they have proposed a framing of EUD for the IoT where interaction in this context is viewed as a group communication scenario where users and developers "talk" to each other indirectly through different system interfaces (Fig. 1).

Breakdowns in EUD for the IoT

By experimenting with some commercially available IoT devices (e.g. the Echo Dot, Philips Hue, and Flic Button, among others), it became clear that disruptions in the interaction process are inevitable and happen whenever a mismatch in expectations is faced and/or mutual understanding is lost. This situation parallels what happens in regular "live" group conversations between people. In regular conversations, people can usually detect and restore these situations by employing repair strategies, such as "Excuse me," "Could you repeat

please," "What do you mean?" and so on. However, when interacting with technology through interfaces, such repairs are limited to the mechanisms that systems developers have anticipated and implemented. Chagas and Redmiles call these disruptions breakdowns to designate the precise moment where the user will become motivated, or at least intrigued, to perform a modification in the system. Therefore, EUD (for the IoT) would be the activity of performing a repair in the technology as a consequence of a breakdown.

Currently, Chagas, Redmiles, and de Souza are trying to gain knowledge

about breakdowns in this context: their kinds, causes, how people react to them, and people's approaches to repairing them. They have just completed a diary study with several participants who were each given a set of 5 commercially available IoT devices for smart homes: a smart plug, a smart motion sensor, a smart wireless physical button, a smart light bulb, and a voice assistant. In order to mimic a heterogeneous IoT environment, devices were all picked from different manufacturers and functional compatibility between them was provided by the free online service IFTTT – If This Then That, which is an EUD tool that allows users to build and use small programs called "applets" using a simplified trigger-action language. This setting enables all devices to be combined with each other and, adding other online services and apps which can also be used with IFTTT (e.g. weather forecast websites, social networks, calendars, etc.), a reasonably large number of functions and variations can be created. Participants were asked to report regularly over four weeks and were interviewed at the end of the study. In so doing, data was accumulated about the typical breakdowns that happen over time and the co-evolution of end users' behavior and fixes to the breakdowns. Stay tuned as analysis of the data is on-going.

For more information, visit Redmiles's Collaboration Research in Action, Design, and Learning (CRADL) group website and de Souza's Semiotic Engineering Research Group website at:

http://cradl.ics.uci.edu/ http://www2.serg.inf.puc-rio.br/

Contact Professor Redmiles at: redmiles@ ics.uci.edu.

Contact Chagas at: bruno.a.chagas@uci. edu and bchagas@inf.puc-rio.br.

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[1] B. A. Chagas, D. F. Redmiles, and C. S. de Souza, "End-user development for the Internet of Things OR How can a (smart) light bulb be so complicated?," in 2017 IEEE Symposium on Visual Languages and Human-Centric Computing (VL/HCC), 2017, pp. 273–277.



Meet Joshua Garcia at the Crossroads of Mobile Security and Software Architecture

For the past two and a half years, Associate Project Scientist Dr. Joshua Garcia, has made his mark at ISR, focussing his research on mobile security, testing, and analysis; software architecture; and software maintenance and re-engineering. Garcia, who is a member of Professor Sam Malek's Software Engineering and Analysis Laboratory, received his Ph.D. in 2014 from the University of Southern California under the advisement of Professor Nenad Medvidović.

Garcia's research utilizes static and dynamic analysis techniques, machine learning, and artificial intelligence to address problems in the area of mobile applications and decay of software architecture. "Both implementation-level artifacts, such as source code and build files, along with other artifacts, such as architectural design documents, are critically important for effectively maintaining a software system," says Garcia. "With that in mind, my work extracts and abstracts from implementation-level artifacts to analyze for important functional and nonfunctional properties, such as security, and architectural abstractions. As a result, my research aids software architects, software engineers, and security analysts from a variety of essential high-level and low-level abstractions and perspectives. "Garcia's research tools and datasets have been used by dozens of researchers, agencies, and companies around the world-including universities in Argentina, Australia, Brazil, Canada, China, Europe and the United States, and by companies and government agencies such as Huawei, Northrop Grumman, Boeing, Bosch, IBM, the FBI, and the Department of Homeland Security. "I'm lucky and privileged to have a variety of institutions throughout the world that use and

build on my tools. I think having the opportunity to impact real world practice is an honor for any software-engineering researcher" says Garcia.

Garcia has worked with mobile and embedded devices over the last ten years. He began studying these devices from a software architectural perspective, dealing with issues of high availability in the face of changing requirements, failures after deployment, and new operational contexts. His early work touched upon issues with dynamically adapting software distributed across mobile and embedded devices to address the need for high availability during maintenance and operation of such software systems.

Along the lines of evolution and maintenance of software systems, Garcia's dissertation studies led him towards a focus on the joint problems of architectural drift and erosion, collectively referred to as decay. Architectural decay occurs when design decisions are introduced to a software system that are different from or in violation of the design decisions made by the system's original architects. Garcia says, "This decay increases the time, effort, and cost of maintaining a software system due to the introduction of architectural defects, additional unnecessary complexity, or misunderstandings of the software system's architecture by its current archi-



Figure 1: LetterBomb automatically generates exploits targeting Android's distributed event-based interface and produces messages, called Intents in Android, and test oracles in the form of instrumentation for a variety of vulnerability types.

tects or engineers."

To address problems of architectural decay, Garcia produced techniques for determining the architecture of software systems from their implementation-level artifacts (e.g., source code) and identifying instances of architectural decay. Specifically, Garcia constructed novel approaches for identifying architectural information from its implementation; and has conducted studies of software architectures of evolving, widely used software systems. The results of his research in this area have produced the first novel approach for recovering architectures based on system concerns (e.g., job scheduling in software for large-scale data processing, or filesystem storage and manipulation), the recovery of architectures of widely used software systems (e.g., Apache Hadoop and the Bourne

Again Shell), and novel insights obtained regarding architectural change and decay across large, popular open-source software systems. The overall workbench of tools resulting from this line of Garcia's research is called Architecture Recovery, Change, and Decay Evaluator. (ARCADE), which has been used by universities around the world and major companies such as Huawei, Northrup Grumman, and Boeing.

With the massive growth of mobile devices and platforms, Garcia returned to conducting research on mobile software in recent years, focusing on mobile application security, testing, and analysis. He produced the first approach for automatically generating exploits for Android applications, called LetterBomb [Figure 1]—which has identified nearly 200 exploits from 10,000 randomly selected apps from Google Play, the official Android app store. LetterBomb leverages static and dynamic program analysis to efficiently and accurately generate exploits for a variety of vulnerabilities types.

Although some mobile apps contain vulnerabilities, an increasing number of malicious Android apps are being deployed onto Android markets, such as Google Play. These apps attempt to steal securitysensitive information, control a user's mobile device, lock or encrypt a device until a ransom is paid, etc. To hide these malicious behaviors, Android malware uses a variety of obfuscations to evade detection. To address the threat of evasive and malicious Android apps, Garcia has produced an approach for Android malware detection and malware family identification called RevealDroid [Figure 2]. To enable efficiency, accuracy, and obfuscation resilience, RevealDroid relies upon lightweight static analysis of Android APIs, reflective code, and native codewith no previous technique leveraging static analysis of reflective and native code for malicious-app detec-

tion. RevealDroid is capable of identifying malware with a 98% success rate, determining a malicious app's family with a 95% success rate, and demonstrates superior accuracy and obfuscation resiliency compared to state-of-the-art malware detection approaches. RevealDroid has been deployed to the Software Assurance Marketplace, a joint venture between the University of Wisconsin-Madison and the Department of Homeland Security, and a paper titled "Lightweight, Obfuscation-Resilient Detection and Family Identification of Android Malware" was recently accepted to ACM Transactions on Software Engineering and Methodology.

To find out more about Dr. Garcia, visit:

http://jgarcia.ics.uci.edu/

Garcia can be reached at: joshug4@uci.edu.



Figure 2: RevealDroid uses machine learning and static analysis of Android API usage, reflective code, and native code to identify malicious Android apps and the families those apps belong to.

ISR STUDENT NEWS

Noopur Raval (P. Dourish, advisor) has been selected as a Technology,



Law and Society Fellow (total 5 fellows) by the UCI School of Social Sciences. Raval will also present her paper "They are like personalized mini-Googles': Seeking

Information on Facebook Groups" at the 51st Annual Hawaii International Conference on System Sciences in January. The paper is co-authored by Dr. Preeti Mudliar, IIIT-B, and has been nominated for the Best Paper Award.

Rahmadi Trimananda (B. Demsky, advisor) interned this summer at Xilinx in San



Jose, CA where he conducted research on the Xilinx Field Programmable Gate Array (FPGA) toolchain and developed a prototype of cutting edge

debugging features (using compiler techniques) in the newly developed SDx tool chain.

Adriana Meza Soria (A. van der Hoek, advisor) has been awarded a



UC MEXUS-CONACYT Doctoral Fellowship. Soria also participated in the UCI Competitive Edge Summer Research Program which supports enter-

ing graduate students from diverse backgrounds who plan to pursue a doctoral or M.F.A. degree.

NTT Visitors Talk Testing with Dr. Joshua Garcia

ISR is pleased to host visiting researcher Dr. **Shinobu Saito**, a Senior Research Engineer at the NTT Software Innovation Center (NTT SIC), Software Engineering Project, in Tokyo, Japan. Dr. Saito's research interests are in software requirements engineering, design recovery, business modeling, and business process management. Since his arrival at UCI in July 2016, Saito's managers and NTT colleagues have also made shorter visits to ISR, contributing to a fruitful relationship between ISR and NTT SIC.

In October, NTT researchers Mr. Haruto Tanno and Mr. Yu Adachi, visited ISR and met with ISR Associate Project Scientist Dr. Joshua Garcia to discuss mobile software



testing issues. Mr. Haruto, Mr. Adachi, and Dr. Saito discussed work they have conducted in UI/screen layout testing and system regression testing, and gave a demonstration of their system. Garcia provided input and advice, and recommended they submit their work to the demonstration track of ICSE. Garcia further discussed solutions for handling challenges involving test input generation and regression testing in the domains of enterprise web applications and mobile

applications. Additionally, he pointed them to relevant related work in relation to their UI testing project.

"It is an honor meeting with industrial researchers like Haruto, Yu, and Shinobu," said Garcia. "It is always a pleasure learning about problems that companies, especially large ones, face in an industrial setting. Sharing ideas among academic and industrial researchers, like those at NTT, is critical for finding the best solutions to those kinds of problems. Luckily, ISR seriously promotes and supports those kinds of academic-industrial interactions."

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:

"An Augmented Reality Interface for Game Based Stroke TeleRehabilitation" Arzang Kasiri and Walt Scacchi UCI-ISR-17-3, June 2017

"Just-In-Time AR-Based Learning in the Advanced Manufacturing Context" Bryce Tham and Walt Scacchi UCI-ISR-17-2, June 2017

All ISR technical reports are available at: isr.uci.edu/publications/



Keynote speaker Prof. Miriam Diamond.

Photo by Prof. Bill Tomlinson

Computing Within LIMITS

What if computing was serious about the fact that we live on a finite planet? The Computing within LIMITS community, including ISR Prof. **Bonnie Nardi**, explores this question in two ways. First, LIMITS examines how computing itself can use resources more efficiently and produce less waste. Although computing consumes only about 2% of the world's electricity, the voluminous e-waste it generates is dangerous to human health (and other forms of life), and is growing rapidly as devices proliferate. The second, and more



important, way the community engages planetary limits is to apply computing to broad problems such as manufacturing, food production. communication, and transpor-

tation—so that we can achieve a society that is not dependent on increasing use of finite resources and increasing need for waste sinks—at some point more increases will be thermodynamically impossible.

LIMITS researchers have, for example, considered how to reconfigure food production to eliminate the use of fossil fuels, pesticides, herbicides, and fertilizers. (Modern industrial agriculture generates 28% of all emissions.) It turns out there is a subdiscipline of ecology called "agroecology" that has pioneered truly sustainable methods of food production, but these methods have not scaled because a great deal of local knowledge is needed to implement them. LIMITS researchers are working on systems based on "computational agroecology" that would gather and provide detailed local knowledge so that anyone could sustainably grow food almost anywhere, from city rooftops to suburban backyards to commercial farms.

A broad theoretical idea from LIMITS is "disintermediation," that is, using computing to simplify systems so they don't use as many resources. The goal is to eliminate "middle men" whose services require resources. Any simplification potentially reduces resource use and adds to the robustness of a system which may falter under the weight of too much complexity. A big, overall goal is to get as much of our energy from the sun as possible since, in the end, it's the only reliable, safe energy source we have. Humans relied on the sun until only a few hundred years ago. With technology we can do the same, collecting the sun's energy in new ways. Agroecology, for example, is oriented to using simple machines and human labor, relying on the sun as the main energy input. In a world with so much labor and so little fossil fuel (we are already turning to fracking and tar sands since the easy oil is largely gone), this long-term orientation to human well-being is a driving force of LIMITS thinking.

The changes the LIMITS community envisions will require political and economic

ISR STUDENT NEWS

Di Yang (C. Lopes, advisor) interned at SRI International at Menlo Park, CA during the summer, under the supervision of Dr. Natarajan



Shankar. The internship involved mining the most interesting API patterns from API call sequences in Github repos, and mining the most typical answers of the

same category from Stack Overflow posts. Her internship was funded by the DARPA MUSE program.

Yi-xian Ethan Chen (C. Lopes, advisor) interned last summer at Petabi Inc., in Irvine, CA where he: devel-



oped a tool to automate mutation and to enumerate combinations of parameters of controlled attacks; developed a web front end to manage this tool; and devel-

oped an algorithm and software to extract hierarchical structure of text features from corpus and to mine for general synonyms and hypernyms.

Jungyoun Ku (J. Jones, advisor) interned last summer at Google



in Mountain View, CA where she designed new data structures and implemented validators, parsers, and utility functions to support new types of geo-

location surveys.

ISR STUDENT NEWS

Leah Horgan (P. Dourish, advisor) has been named an ARCS Foundation Scholar for 2017-18.



Horgan also presented her paper "The Organizational Infrastructures of Urban Data" at the 5th Innovation in Information Infrastructures (III) Workshop, held in

November in Rome, Italy. The paper is co-authored by her advisor Prof. **Paul Dourish**.

Ted Grover (G. Mark, advisor) presented his poster titled "Digital



Footprints: Predicting Personality from Temporal Patterns of Technology Use" at the 2017 ACM International Joint Conference on Pervasive and Ubiquitous

Computing (Ubicomp 2017) held in Maui, HI in September.

Robert Maldonado (C. Lopes, advisor), an undergraduate student in Director **Cristina Lope's** Modego



research group, gave a presentation titled "Triggers for Relational Types: A Database Management System" at the Society of Hispanic Professional

Engineers (SHPE) National Conference, Engineering Science Symposium held in Kansas City, MO in November.

change. The community thinks people are more ready than ever to think seriously about such change. "Several of us submitted a paper to CACM on the LIMITS work," said Nardi, "and we were surprised when the reviewers came back and said we had not considered the role of capitalism in thinking about how to deal with planetary limits! Our revised paper (still under review) was forthright in suggesting new forms of economy such as the 'steadystate' economy. We think that now is a good moment to be promoting LIMITS ideas given the urgency of the problems science keeps reminding us of, for example, in the recent "World Scientists' Warning to Humanity: A Second Notice" (November 13, 2017).

The LIMITS agenda has been developed through three workshops (2015-2017) convened by the LIMITS community (the latter two in cooperation with ACM). The first two were held at UCI, and the third at Westmont College in Santa Barbara, with funding from the two universities as well as from Facebook and Google. Participants came from institutions in Abu Dhabi, Canada, Hong Kong, Pakistan, Spain, Sweden, Switzerland, the UK, and the US, consistent with the global nature of LIMITS concerns and research. The 2018 workshop will be held in Toronto, co-located with the Fifth International ICT4S Conference (Information and Communication Technology for Sustainability). Prof. Nardi is a co-chair of LIMITS 2018 along with Professor Jay Chen of NYU Abu Dhabi. Nardi has been a lead organizer and served on the program committee since the inception of the LIMITS workshop in 2015. Prof. Debra **Richardson** has also been on the program committee for all the Workshops and continues to provide guidance.

LIMITS 2018 paper submission deadlines are in early February. See the workshop

RESEARCH BRIEFS

- Prof. **Bonnie Nardi** gave a Distinguished Lecture titled "Why I Haven't Learned to Stop Worrying and Love the Bomb or Anthropological Observations on the Political Economy of Digital Technology" at the American Anthropological Association Meetings in the General Anthropology Division in December. Nardi also gave an invited talk, "Computing within LIMTS," at the Workshop on Solutions for Environment, Economy, and Democracy (SEED) held in Siegen, Germany in October.
- Interim Director **Cristina Videira Lopes** has been honored with the 2017 Association Internationale pour les Technologies Objets (AITO) Test of Time Award in recognition of her enduring contributions to the fields of computer programming and software development. Lopes was recognized alongside fellow authors Gregor Kiczales, John Lamping, Anurag Mendhekar, Chris Maeda, Jean-Marc Loingtier and John Irwin for their 1997 paper "Aspect-oriented programming" at the 31st European Conference on Object-Oriented Programming (ECOOP) which took place in June 2017 in Barcelona, Spain.

Prof. Paul Dourish became a fellow of the British Computer Society.

- Visiting Researcher Dr. **Shinobu Saito's** paper "How Much Undocumented Knowledge is there in Agile Software Development?" received the Best Industry Paper Award at the 25th IEEE International Requirements Engineering Conference (RE'17). The paper is co-authored by Yukako Iimura, NTT Software Innovation Center, Japan, Aaron Massey, Georgia Tech, and Annie Antón, Georgia Tech.
- Prof. **Gloria Mark** served as an invited speaker in a session on Tech in the Workplace at the Psychology of Technology Conference, held in Berkeley in November.
- Interim Director **Cristina Videira Lopes** gave a keynote talk titled "Objects in the Age of Data" at the 2017 SPLASH conference held in Vancouver, BC, Canada in October.
- Prof. **Paul Dourish** gave a keynote talk titled "Exploring the Materialities of Digital Information" at the 28th Australasian Conference on Information Systems (ACIS), held in Hobart, Tasmania in December.

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Collaborative efforts. Designated ISR research area. Visitor at UCI. Graduate student research. Large-scale research project.

For more information about ISR Sponsorship, please contact:

Debra A. Brodbeck brodbeck@uci.edu (949) 824-2260

website for details: computingwithinlimits.org.

The 2018 keynote speaker will be Professor Alan Borning, a computer scientist at the University of Washington.

Several papers published in mainstream conferences and multiple research grants have been co-authored by LIMITS participants, sparked by discussions at the Workshops.

At LIMITS 2017, two ISR graduate students presented papers on their research. Maruf Zaber presented "A Study of Hashtag Activism for Raising Awareness about Riverbank Erosion in Bangladesh," which is co-authored by his advisor Prof. Bonnie Nardi and Prof. Jay Chen. Samantha McDonald presented "Political Realities of Digital Communication: The Limits of Value from Digital Messages to Members of the US Congress," which is co-authored by her advisor Prof. Bonnie Nardi and Prof. Bill Tomlinson, Victoria University, NZ. Both papers were wellreceived and the authors are building on the ideas in their graduate work.

The workshop papers are available at: LIMITS 2017: http://dl.acm.org/citation.cfm?id=3080556 LIMITS 2016: http://dl.acm.org/citation.cfm?id=2926676 LIMITS 2015: http://computingwithinlimits.org/2015/

Prof. Nardi can be reached at nardi@uci.edu.

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ISR STUDENT NEWS

Reyhaneh Jabbarvand (S. Malek, advisor) presented her paper



"µDroid: An Energy-Aware Mutation Testing Framework for Android" at ESEC/FSE'17 in Paderborn, Germany in September. The paper is co-authored

by her advisor, Prof. **Sam Malek**. Jabbarvand received a SIGSOFT CAPS travel grant to attend the conference.

Wen Shen's (C. Lopes, advisor) paper "Regulating Highly Automated Robot Ecologies"



won the Best Student Paper Award at the 5th annual Int'l Conf. on Human-Agent Interaction (HAI 2017) held in Bielefeld, Germany in October. It

was also featured in the German IT magazine *Heise online*. The paper is co-authored by Alanoud Al Khemeiri, Abdulla Almehrzi, and Wael Al Enezi of Masdar Institute in UAE, Prof. Iyad Rahwan of MIT Media Lab, and Prof. Jacob W. Crandall of Brigham Young Univ.

Katherine Lo (P. Dourish, advisor)



interned this summer at Instagram in Menlo Park, CA. Lo was a user experience researcher on the Protect and Care team, where she worked with Data Scientist

Jess Kubo.

Alumni News

















Alegria Baquero (Ph.D. 2014, advisor R. Taylor), who is a Software Engineer at ZocDoc in NY, attended the UCI Engineering, ICS, and Physical Sciences Alumni Reception held in New York City, NY on October 23.

Justin Erenkrantz (Ph.D. 2009, advisor R. Taylor), is now Senior Vice President, Software Engineering at MLB Advanced Media, L.P. in New York.

Lee Martie (Ph.D. 2017, advisor A. van der Hoek) is now Software Development Engineer at Microsoft in Redmond, WA.

Alireza Sadeghi (Ph.D. 2017, advisor S. Malek) is now a Software Engineer at Google in Irvine, CA. Sadeghi is also the first author on two recent journal publications: "Ensuring the Consistency of Adaptation through Inter- and Intra-Component Dependency Analysis" in *ACM Transactions on Software Engineering and Methodology (TOSEM)*: 26(1), 2017 is co-authored by Naeem Esfahani of Google and Sadeghi's advisor Prof. **Sam Malek**; and "A Taxonomy and Qualitative Comparison of Program Analysis Techniques for Security Assessment of Android Software" in *IEEE Transactions on Software Engineering (TSE)*: 43(6), 2017 is co-authored by Prof. **Hamid Bagheri**, University of Nebraska-Lincoln, Associate Project Scientist Dr. **Joshua Garcia**, and Prof. **Sam Malek**.

Reeta Singh (M.S. 2017) is joining Salesforce.com in San Francisco. Singh was an intern at Salesforce.com last summer where she worked on two projects in Security domain: the Secret Service Client (Python and Java) and the Certificate Service (Python).

Rosalva Gallardo Valencia (Ph.D. 2012, advisor S. Sim), who is a Software Program Manager at Google in San Francisco, lead 11 Googlers from all over the world to her home country of Peru to support Laboratoria with its mission of transforming young women lives via programming training.

Yiran Wang (Ph.D. 2017, advisor G. Mark) is now a User Experience (UX) Researcher at Google in Seattle/Kirkland, WA.

Christine Wolf (Ph.D. 2017, advisor P. Dourish) is now a Member of the Research Staff at IBM Almaden Research in San Jose, CA.

ISR Shines at ESEC/FSE 2017

ISR researchers and alumni made a strong showing at the 11th joint meeting of the European Software Engineering Conference and ACM SIGSOFT Symposium on the Foundations of Software Engineering (ESEC/FSE 2017), held in Paderborn, Germany in September. Three conference papers and a workshop paper were presented, and a conference keynote talk was given reflecting on the 2017 SIGSOFT Impact Paper Award winner "Principled Design of the Modern Web Architecture" by alumnus **Roy T. Fielding** and Prof. **Richard N. Taylor**, from ICSE 2000.

• "Understanding the Impact of Support for Iteration on Code Search" by Lee Martie (Ph.D. 2017, Microsoft, presenter), Thomas Kwak (M.S. 2017, Yelp), and André van der Hoek.

■ "PATDroid: Permission-Aware GUI Testing of Android" by Alireza Sadeghi (Ph.D. 2017, Google, presenter), Ph.D. student Reyhaneh Jabbarvand, and Sam Malek.

"μDroid: An Energy-Aware Mutation Testing Framework for Android" by Ph.D. student Reyhaneh Jabbarvand (presenter) and Sam Malek.

■ "Mining Mobile App Markets for Prioritization of Security Assessment Effort," in the International Workshop on App Market Analytics (WAMA@FSE 2017), by alumnus Alireza Sadeghi (Google), Naeem Esfahani (Google), and **Sam Malek** (presenter).

 Khare, Taylor, Fielding take questions after keynote.

 Keynote: "Reflections on the REST Architectural Style and 'Principled Design of the Modern Web Architecture" by Roy T. Fielding (Ph.D. 2000, Adobe, presenter), Richard N. Taylor (presenter), Justin Erenkrantz (Ph.D. 2009, MLB Advanced Media), Michael M. Gorlick (Ph.D. 2016, The Aerospace Corp.), Jim Whitehead (Ph.D. 2000, UC Santa Cruz), Rohit Khare (Ph.D. 2003, Google), and Peyman Oreizy (Ph.D. 2000, Carezone.com).



Undergrad Sanghun ("Jess") Kim, post-doctoral researcher Ayushi Rastogi, undergrad Seung Sup Kim, Prof. Marian Petre, undergrad Dae Gweon ("Alex") Ko, undergrad Juhyeok ("Dan") Seong, Prof. Andre van der Hoek, Prof. Seok-Won Lee.

Korean Educational Exchange – Crowd Design Research

For Summer and Fall 2017, ISR faculty member André van der Hoek and his research lab (Software Design and Collaboration Laboratory) hosted undergraduate students from two Korean universities - Ajou University and Kookmin University - as part of the UCI Undergraduate Research Opportunities Program (UROP) International Summer Undergraduate Research Fellowship (I-SURF) program. Originally slated to be a three-month summer visit, the research project was such a success that two students staved on for an additional three months this Fall quarter to further the research.

The International Summer Undergraduate Research Fellowship program brings outstanding international undergraduates to UCI to both experience and contribute to cutting-edge research. van der Hoek saw in this program an opportunity to expand on his ongoing research into crowdsourcing and design in the context of a large NSF grant he shares with his collaborator and former PostDoc Thomas LaToza at George Mason University.

In previous work, with his former M.S. student **Consuelo Lopez** (who, at this time, is a product manager at Flybondi – a new Argentinian airline – developing its reservation system), van der Hoek demonstrated that a crowd of workers from

Amazon Mechanical Turk can rapidly create a broad range of alternative solutions to small design problems. For each such design problem, termed a decision point, Lopez and van der Hoek found that the collection of alternatives produced by different workers not only is highly diverse, but also contains innovative and high-quality solutions. Compared to what an individual software designer could produce in the same time, a crowd of workers offers a rich variety of alternatives, with out-of-the-box solutions and, at times, great amounts of detail.

The challenge that van der Hoek asked the Korean students (Sanghun ("Jess") Kim, Seung Sup ("Sup") Kim, Dae Gweon ("Alex") Ko, and Juhyeok ("Dan") Seong) to address is the step that comes before the generation of the alternative solutions: is it possible to take a requirements document and use the crowd to turn it into a set of decision points that, together, form the core of the design problem underneath the requirements document? Taken at face value, this seems like a daunting challenge. Even experts typically will spend weeks, if not months, on a task like this.

van der Hoek and the visiting Korean students' approach, however, seeks to leverage the wisdom of the crowd in addressing this problem. They specifically are exploring a two-stage process in which a first crowd identifies 'important words' in the requirements document and a second crowd designs, iteratively improves, and eventually ranks decision points for different pairs of words. The idea is that,

ISR STUDENT NEWS

Mengyo Zhao (D. Redmiles, advisor) spent Summer and Fall quarters as a



design research intern at Uber in Seattle. Zhao worked in the Rider Expansion program helping the team understand riders' mental models and decision

making processes for prioritizing transportation methods for activities such as travel, commuting, and attending events.

Hosub Lee (A.Kobsa, advisor) interned last summer at Intel Labs in Santa Clara, CA where he



designed and implemented a novel webbased system called IoT Service Store, which enables users to understand the privacy implications of nearby IoT services

and accordingly control the inference and usage of their sensitive personal information. Lee plans to deploy IoT Service Store at UCI in ICS Donald Bren Hall and conduct field experiments with real users to collect and analyze their privacyrelated behavioral data generated while using the system.

Farima FarmahiniFarahani (C. Lopes, advisor) was awarded an Anita Borg



Scholarship to attend the Grace Hopper Celebration of Women in Computing 2017 which was held in October in Orlando, Florida. by using the masses, pairs of words that are identified by multiple workers tend to be more important and that, by using iteration over multiple workers, initially, rough decision points in draft form can be



refined to be high quality.

To test these ideas, the Korean students have implemented a pair of tools that they are now readying for an actual experiment with Amazon Mechanical

Turk workers. Under the supervision of **Ayushi Rastogi**, a post doctoral researcher in van der Hoek's group, a detailed experiment has been designed and will be executed in January. The Korean students will have returned home by then, but the cooperation and exchange has been so successful that they are committed to seeing the experiment through, actually collecting crowd work, analyzing the results, and producing a paper.

During the stay, Prof. Seok-Won Lee from Kookmin University visited to check on the team, as well as other student teams working with other professors at UCI. His visit happened to take place during the



that van der Hoek's long-term collaborator, Dr. Marian Petre from The Open University in the U.K. visited to work with van der Hoek on outlining their next book on software

same time

design. Having everyone here together led to – in the good tradition of ISR! – designs being discussed, preliminary demos being shown, next steps being debated, and fun being had.

ISR EVENT SCHEDULE

March 2, 2018

May 11, 2018

Mark your calendars!



February 16, 2018 ISR Distinguished Speaker: Miryung Kim Associate Professor UCLA "Interactive and Automated Debugging for Big Data Analytics"



ISR Distinguished Speaker: Xiangyu Zhang Professor Purdue University "Causality Inference during Program Execution for Attack Provenance Tracking"



March 16, 2018 ISR Distinguished Speaker: Atanas Rountev Professor The Ohio State University "Static Analysis for Android: GUIs, Callbacks, and Beyond"



ISR Distinguished Speaker: Anind K. Dey Professor and Dean University of Washington "Routines: How everyday activities can intelligently inform the design of interactive systems"



February 26 – March 1, 2018 Ground System Architectures Workshop (GSAW 2017) Held in cooperation with ISR. *http://gsaw.org*

For more information, visit: http://isr.uci.edu/isr-events

Overall, van der Hoek could not be happier with the exchange: "I have enjoyed it tremendously and am 100% ready to repeat next year. The I-SURF program has brought us fantastic students eager to learn and participate, engaging deeply with the research, contributing key ideas, and producing really important tools helping the research along. Thank you Jess, Sup, Alex, and Dan!"

For more information, contact Prof. van der Hoek at: andre@ics.uci.edu.

SPECIAL THANKS

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