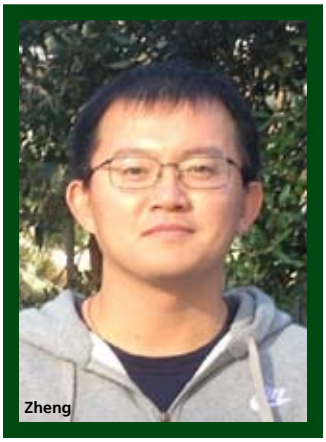
ISR Connector

INSTITUTE FOR SOFTWARE RESEARCH / UNIVERSITY OF CALIFORNIA, IRVINE

HOT RESEARCH

Making Automatic Change Mapping Happen: 1.x-Way Architecture-Implementation Mapping

With the wide adoption of UML modeling tools, software architecture plays an increasingly important role in the development of complex software systems. It represents a set of principal design decisions made about a software system, and facilitates program comprehension, software reuse, and software evolution. The further application of software architecture, however, is challenged by the fact that the architecture of a software system, over time, is often found to not be conformant to its implementation during software development. This is primarily caused by frequent changes made to both artifacts, which are located at separate abstraction levels and are usually expressed using different conceptual constructs. In general, software architecture can easily become out of date if the cost of maintaining its conformance to code significantly exceeds that of working on code directly.


Zheng

ISR Ph.D. student **Yongjie Zheng** and his advisor ISR Director **Richard N. Taylor** have focused their research on architecture-implementation mapping, a process of converting architecture to and from implementation with the goal of maintaining their conformance with respect to certain criteria. They started from a survey of architecture-implementation mapping in model-based software development, and identified some important issues in this area [see ISR Technical Report UCI-ISR-11-5]. On the one hand, mapping of architecture changes to code is weakly supported by existing approaches. At best, complete code regeneration with primitive merge support (e.g. JMerge of the Eclipse Modeling Framework) is applied, leaving conflict resolution as another challenge not well addressed. In most cases, programmers need to manually map architecture changes to code. This is not only time consuming, but also error prone. On the other hand, mapping code changes back to architecture is essentially a problem of machine-based abstraction, and is hard to fully automate as well. Significantly, most existing approaches are structure oriented, and cannot support the mapping that goes beyond structural information, e.g. system dynamics.

Zheng and Taylor developed a new architecture-implementation mapping approach called 1.x-way architecture-implementation mapping. It only allows changes to be initiated in the architecture ("1") and a separated portion of the code (".x"), with architecture-prescribed code updated solely through code generation. This is different from existing approaches, which are classified as one-way mapping and two-way mapping depending on which artifacts can be manually changed. 1.x-way mapping includes a new code separation mechanism that decouples architecture-prescribed code from user-defined details, an architecture change model, architecture-based code regeneration, and architecture change notification. Based on these mechanisms, mistaken changes of architecture-prescribed code are suppressed. Architecture changes can be recorded, classified, and automatically mapped to code in specific ways. In particular, the

RESEARCH BRIEFS

Prof. **Bonnie Nardi** has been awarded $503,883 by NSF for her project "Collaborative Research: Information Technology, Remote Socialization, and the Development of Occupational Identity."

Profs. **André van der Hoek** and **David Redmiles** have been awarded $475,542 from the NSF for their project "Collaborative Research: Large-Scale Human-Centered Coordination Systems to Support Interdependent Tasks in Context."

Prof. **Walt Scacchi** has been awarded $100,000 from the Naval Postgraduate School (NPS) for his research on "Acquisition of Secure Systems Based on Open Architectures." This is the 5th consecutive year Scacchi has received funding through the NPS Acquisition Research Program.

Prof. **Cristina Videira Lopes** has been named 2011 Distinguished Scientist by the Association of Computing Machinery (ACM). Distinguished Member (Scientist, Engineer, Educator) awards recognize members with at least 15 years of professional experience who have made significant accomplishments or achieved a significant impact on the computing field. For more on Lopes, see page 4.

Prof. **Walt Scacchi's** paper "Modding as an Open Source Approach to Extending Computer Game Systems' received the Best Paper Award at the 7th IFIP International Conference on Open Source Systems in Salvador, Brazil, in October.

More Research Briefs on page 4.

IN THIS ISSUE:

MESSAGE FROM THE DIRECTOR

Substance, Immediacy, and Focus

Social media thrives on immediacy. Whether a tweet, a Facebook update, or a post to a Google+ stream, the focus is "what's going on now." The seductive character of immediacy, or at least of social media, unfortunately often seems to foster shallow relationships and shallow thinking. Students walking around campus today are often less aware of their surroundings, and of each other, for many seem glued to staring at their "smart"phones while listening to music. I frequently receive requests to become "friends" with someone on Facebook whom I have never heard of; stories abound of people who have hundreds of Facebook friends, yet are lonely for meaningful human relationships.


Taylor

The siren character of immediacy plays out in technology development, too. One year ago in this forum I needled the research community for failing to consistently address deep, critical problems, attributing this failure at least in part to the current nature of publication processes and funding mechanisms which incentivize work done under the lamppost – because the results are more immediate. Corporate technology initiatives, though, perhaps deserve the prize for succumbing to the siren call of immediacy: the lemming-like rush to the latest buzzword or technology makes responsible engineers blush. Whether it be XML, virtualization, "the Cloud," "Cyber", social media, SOAs, Web 2.0, open source, crowd-sourcing, or out-sourcing, the line forms quickly behind whatever is the latest thing, for that "thing" will surely be the ticket to fixing the organization's problems and lead to commercial success. Indeed, as a technologist, you're expected to embrace technology almost unconditionally. Any caution — that maybe just because it's new doesn't mean it's the best solution to all known problems — is seen as backwards and Luddite.

The crazy thing is, everybody knows this is crazy. If you ask someone what their company is doing, you'll hear about the latest silver bullet, followed by an apologetic admission, sotto voce, that everyone knows the silver bullet is a plastic slug. Nonetheless the corporate troops must dutifully salute the slogan, all the while trying to identify genuinely appropriate technologies (including novel ones!) and incrementally improve what's been proven.

The mission of ISR – and corporate technology leaders – has to be to keep the focus where it should be: on the deep, hard, lasting-value topics. Researchers in a university have an amazing privilege, and responsibility, to keep such a focus (yet must battle the publication and funding forces to do so!). I would argue that companies must do the same, for their long-term success. Recent tributes to Steve Jobs sometimes point this out: he earnestly strove to get a design right, and invested deeply in study that led to Apple's terrific designs. He did not follow the slogans; he did not succumb to the siren call of immediacy. He did create the new, but the focus was not the immediate.

My chief priority for ISR in the coming years is to focus on design. Design has proven to offer continuing deep challenges for research, yet nonetheless yields rich fruit along the way. Design is an engine that can power corporate strength. Its challenges range from the very technical to the social. I trust you will read more about our work in design in future issues of the **ISR *Connector***. Design is worthwhile, and design challenges require sustained focus. Now excuse me while I go update my Facebook page…

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

behavioral architecture-implementation mapping is supported with modeled system dynamics generated into a program construct that is not manually modifiable by programmers.

Figure 1 (page 3) shows an overview of 1.x-way mapping. It is assumed that all the development activities shown in the figure take place in an integrated software development environment (IDE), where the tools used for creating and managing the system at different abstraction levels are able to communicate with each other and share information. A typical example of such an environment is the Eclipse platform. Software architecture in 1.x-way mapping is modeled as a configuration of components with executions of significance (i.e. behaviors) defined by UML-like sequence diagrams and state diagrams.

As shown in the figure, the implementation of each architecture component is separated into two independent program elements (e.g. classes): architecture-prescribed code and implementation details. The former is automatically generated. It codifies all the externally visible information of a component that is specified in the architecture, including its identity, interfaces, and properties. The latter represents the internal implementation of a component that is to be manually developed by programmers. In addition, user-defined code provides a set of low-level operations, or primitive operations, from which high-level operations in architecture-prescribed code are constructed. Meanwhile, available architecture resources (e.g. required interfaces) are passed to user-defined code in the implementation of those low-level operations.

On top of the separated code, three tools (represented by ovals in the figure) work closely in the IDE to map architecture changes to the code. Architecture Editor is responsible for the manipulation of architecture models. In particular, it maintains an explicit change model that records and classifies all the considered architecture changes. Mapping Tool is able to automatically map most of the changes to code without requiring manual work on the code, given that all the information about the kinds of changes is recorded in the change model. For those

architecture changes that may require modifications to user-defined code, change notifications are sent to Code Editor. In response, warning messages are prompted in the code to highlight changes that have to be made. To reduce the number of unnecessary notifications, a plug-in can be built to allow programmers to register for particular kinds of architecture changes. This is a future task for Zheng and Taylor, thus it is represented by a dashed line in the figure.

To this end, an architecture-implementation mapping tool of 1.x-way mapping has been built and integrated into ArchStudio 4, an Eclipse-based architecture development environment that was developed by ISR alumnus Dr. **Eric M. Dashofy**, now at The Aerospace Corporation. The initial research results of 1.x-way mapping have been published and presented at the International Conference on Automated Software Engineering (ASE 2011) in November and the International Conference on Software Engineering (ICSE 2011) in May. Further results are currently under submission.

For more information on Zheng and 1.x-way architecture-implementation mapping, visit:

http://www.isr.uci.edu/~zhengy/

Zheng can be reached at zhengy@ics.uci.edu.

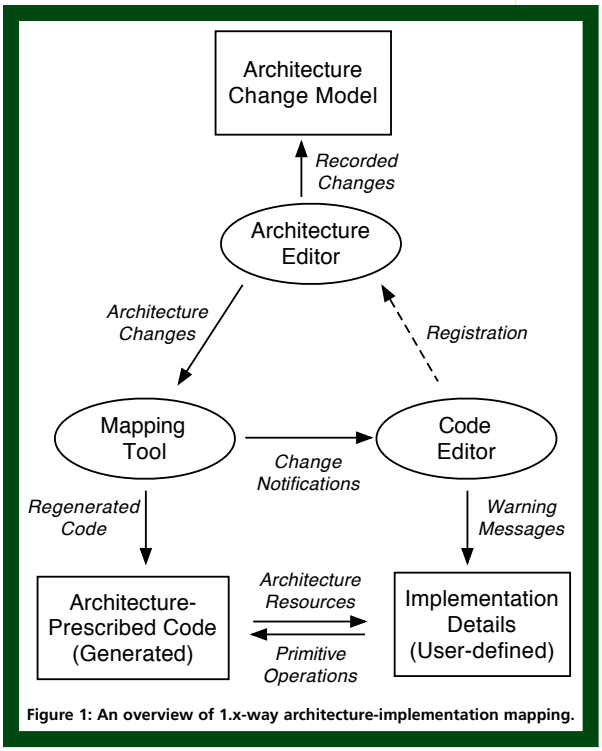


Figure 1: An overview of 1.x-way architecture-implementation mapping.

FOCUS ON FACULTY

Meet Software Sleuth Prof. James A. Jones

Whereas many view software system complexity, immensity, and dynamism as formidable difficulties, ISR Professor **James A. Jones** views these traits with excitement. "Software is a living artifact — constantly changing — full of complexities and intricacies that are fascinating to imagine" says Jones. He puts such imagination to work through his research, which assists developers in understanding how programs are behaving — both correctly and incorrectly — for performing maintenance tasks and for finding and fixing bugs.

According to Jones, the fundamental artifact to study for software is its source code. Unlike artifacts such as requirements, formal specifications, and design documents, the source code is nearly always present and available to its developers, regardless of the diligence, maturity, or conformity of the development organization. Also, unlike those other artifacts that are often not kept up-to-date, source code is practically guaranteed to be an accurate and current representation of the actual functionality of the software. Moreover, the source code contains rich information such as embedded documentation, in the form of source-code "comments" and identifier names.

However, the aspects of completeness and up-to-dateness of the source code come at a cost: this artifact is complex, exhibits myriad behaviors when executed, usually contains bugs, and is ever-changing. As Jones explains, "An instruction in the source code may set the value for variable 'X'. 'X' may be referenced and used in ten other instructions. And that variable, 'X,' might also affect execution paths through five predicates (such as 'if' or 'while' instructions that check its value). So, in this example, the definition of 'X' directly affects 15 instructions, but each of those affected instructions in turn affects another set of statements, and so on. Altogether, the set of ways individual instructions can affect other instructions creates a large and complex web of influence." To further describe such complexities, Jones continues, "...think about the execution of that program — billions of individual instructions firing in the blink of an eye." Additionally, "...the source code is often modified daily, and those modifications change those instructions' relationships in sometimes drastic ways, and other times, in subtle but insidiously destructive ways."

Jones attacks these challenges head-on by gathering all such artifacts, and then processing and analyzing them, using methods borrowed from statistics, compilers, and information-visualization research, to create models of the program and techniques that work on those models. One such technique Jones created, called Tarantula, has become an influential and widely cited body of work for describing where bugs are located. Tarantula works by observing program execution and performing correlation analyses to determine the precise instructions that correlate with program failure. The analysis results are then displayed on a visualization of the program that allows a developer to find the bugs.

A recent example of such work includes techniques and large-scale program models developed by Jones and his research group that enable developers to view and explore the source code. Specifically, the models describe webs of relationships between instructions in programs, and exhibit emergent behaviors of software source code. From such models and techniques, developers can be "steered" through an exploration of the program for such tasks as understanding the root cause of bugs or understanding the preconditions that give rise to the manifestation of those bugs. Additionally, functionalities in the software that cross-cut the structure of the program can be identified and mapped to assist developer comprehension or

ISR STUDENT NEWSBRIEFS

Francisco Servant (J. Jones, advisor) presented his short paper "History Slicing" at the 26th IEEE/ACM Int'l Conf. on Automated Software Engineering (ASE) in Lawrence, KS, in Nov. It was co-authored by his advisor Prof. **James Jones.** Servant spent his summer as an intern at Microsoft Research in Redmond, WA in the Empirical Software Engineering group working on a project to mitigate the complexity of branching within the development process.


Servant

Fang Deng (J. Jones, advisor) presented her short paper "Inferred Dependence Coverage to Support Fault Contextualization" at the 26th IEEE/ACM Int'l Conf. on Automated Software Engineering in Lawrence, KS, in Nov. The paper was co-authored by her advisor Prof. **James Jones.**


Deng

Tiago Proenca (A. van der Hoek, advisor) spent his summer as an intern at Google where he worked with the Google Photos team on Google+ photos. He designed and implemented a new view that shows all people that have been tagged with a given user. Proenca is a recipient of the Miguel Velez Fellowship.


Proenca

inform possible refactoring maintenance.

Another example includes the development of techniques for the exploration and comprehension of the evolution of a program. Jones's group developed models of fine-grained software evolution that track the lineage of each source-code instruction throughout the lifetime of the software system. The goal is to enable developers to query and thus understand of how features of the software were changed, in a fast, easy way that might allow for patterns to be observed in the software evolution. Such patterns can inform many software development and maintenance tasks. One such task that is currently being developed is the recommending of which developer has the most expertise for fixing a bug.

Jones's research group — the Spider Lab — includes Ph.D. students **Francisco Servant**, **Nicholas DiGiuseppe**, and **Fang Deng**, M.S. student **Vijay Krishna Palepu**, and undergraduate student **Theodore Suzukawa**. Jones's research has been funded by grants from NSF, Google, Boeing, and Tata Consultancy Services.

For more information on Jones and his research group, see:

http://www.isr.uci.edu/~jajones

http://spideruci.org

Contact Jones at: jajones@ics.uci.edu.

Prof. Cristina Lopes Reflects on Producing SPLASH 2011

I had the honor of chairing the ACM Conference on Systems, Programming, Languages and Applications: Software for Humanity (SPLASH/OOPSLA) this year (http://splashcon.org). That means that I was like a Producer, and got to do all the work behind the scenes to make the conference come to life. After a year and a half of "programming," I pressed "run" on October 21. It's a little crazy if you believe in agile. A whole year and a half of designing and "programming," with no testing whatsoever, no small chunks, just a long process of envisioning, estimating, guessing, coordinating, signing contracts, making decisions; then we unleash the event over 5 days with almost 600 people and hope for the best!


Lopes

RESEARCH BRIEFS

Prof. **André van der Hoek's** Software Design and Collaboration Laboratory is now moderating and administering the ACM SIGSOFT SEWORLD email list which serves the software engineering community through dissemination of time-sensitive information relevant to the field of software engineering research (http://www.sigsoft.org/seworld/).

Prof. **Gloria Mark** has received $30,000 from Northrop Grumman for her research on human cognition mechanisms, multitasking collaboration skills and multimedia audio/visual sensory methods to enhance intelligence analysts' performance and efficiency in a multi-source, multi-session chat environment.

Prof. **Walt Scacchi** gave the opening keynote address on "Free/Open Source Software Development as an Approach to Global Software Engineering" at the 6th. Int'l Conference on Global Software Engineering, in Helsinki, Finland in August. He also gave a talk on "Advances and Challenges for Decentralized Command and Control Systems Based on Computer Games and Virtual World Technologies" at Northrop Grumman, Redondo Beach, CA in December.

Prof. **Alfred Kobsa** gave a talk on "Personalization and Privacy" at Microsoft Research, Redmond, WA in August.

So what's involved in producing a conference like SPLASH?

For the most part, there is a huge amount of coordination work that needs to be done. The producer coordinates with the ACM (sponsor), the hotel/venue, the A/V and Internet people, external restaurants/entertainment, industry supporters, and the registration people, among other miscellaneous services. This is the administrative, logistic, and operational side of the conference. For these aspects, I brought in ISR's Technical Relations Director **Debra Brodbeck**, who is an absolute maniac when it comes to getting things done. We're so very lucky to have her at UC Irvine...!

There are also strategic and content aspects to producing a conference. When I accepted the role of General Chair, I realized the conference was in flux trying to find its position in a context that is quite different from that of the 90s, when OOP was the big thing and everyone wanted to go to OOPSLA. It was this strategic challenge that enticed me. My goal was to formulate a mission statement for SPLASH that goes beyond catchy, meaningless groups of words, and that truly captures the uniqueness of this community.

So, what is the uniqueness of SPLASH? Why would someone attend SPLASH as opposed to, say, RubiConf, EclipseCon, Goto, Qcon, or academic conferences like PLDI, POPL, and the like? SPLASH sits right at the edge of these two types of conferences. Indeed, for about two decades or so, OOPSLA has been right on the edge where academic and industrial research meets advanced development. It's a balancing act at that edge, and SPLASH continues in this vein. This year, the first keynote speaker was Turing award winner Ivan Sutherland; the third keynote speaker was Mr. JavaScript Brendan Eich; the keynote speaker in the middle was a Swiss academic, Markus Puschel, with some pretty wacky ideas on performance/productivity. Where else could we possibly find this combination of keynote speakers in one conference?!

This edge is not for everyone. Many people are better served if they go to conferences that have only Eich, Sutherland, or Puschel types of speakers, but not the combination of the three. And that's ok. But this is the uniqueness of SPLASH: it's a hybrid, a melting pot of software development approaches. As you go from session to session you may have the

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:

"A Rationalization of Confusion, Challenges, and Techniques in Model-Based Software Development"
Yongjie Zheng, Richard N. Taylor
UCI-ISR-11-5, August 2011

"Mapping Software Architecture Styles and Collaboration Patterns for Engineering Adaptive Mixed Systems"
Christoph Dorn, Richard N. Taylor
UCI-ISR-11-4, June 2011

"The Future of Research and Challenges in Computer Games and Virtual World Environments"
Walt Scacchi, Magda El Zarki, and others
UCI-ISR-11-3, June 2011

All ISR technical reports are available at:

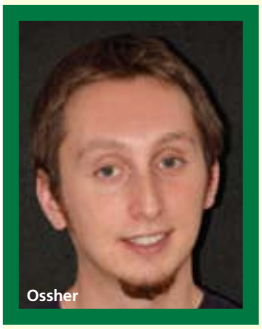
http://www.isr.uci.edu/tech-reports.html

ISR STUDENT NEWSBRIEFS

Hitesh Sajnani's (C. Lopes, advisor) paper "Application Architecture Discovery: Towards Domain-driven, Easily Extensible Code Structure" received the Best Paper Award in the industrial track at the 18th Working Conference on Reverse Engineering (WCRE), Limerick, Ireland in Oct. The paper was co-authored by Ravindra Naik (Tata, India) and his advisor Prof. **Cristina Lopes**. Also, Sajnani served as a student volunteer at SPLASH 2011 in October.


Sajnani

Joel Ossher (C. Lopes, advisor) presented his paper "File Cloning in Open Source Java Projects: The Good, The Bad, and The Ugly" at the 27th IEEE Int'l Conf. on Software Maintenance (ICSM) in Sept. The paper was co-authored by Ph.D. student **Hitesh Sajnani** and his advisor Prof. **Lopes.** Also, Ossher served as Student Volunteer Co-Chair for SPLASH 2011 in Oct.


Ossher

Nicholas DiGiuseppe (J. Jones, advisor) presented his paper "Fault Interaction and its Repercussions" at the 27th IEEE Int'l Conference on Software Maintenance in Williamsburg, VA in Sept. The paper was co-authored by his advisor, Prof. **James Jones**.

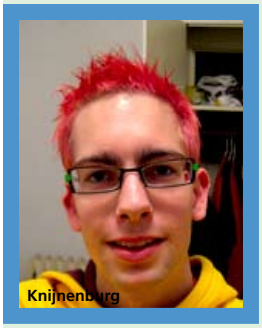

DiGiuseppe

ISR STUDENT NEWSBRIEFS

Silvia Lindtner (P. Dourish, advisor) is a recipient of the China Scholarship Council's Chinese Government Scholarship. Additionally, she will present her paper "Cultural Appropriation: Information Technologies as Sites of Transnational Imagination" at the ACM Conference on Computer Supported Cooperative Work in February, in Seattle, WA. The paper is co-authored by Ken Anderson (Intel) and her advisor Prof. **Paul Dourish**.


Lindtner

Bart Knijnenburg (A. Kobsa, advisor) presented his paper "A Pragmatic Toolbox to Support the User-Centric Evaluation of Recommender Systems" at the 5th ACM Conference on Recommender Systems, in Chicago, IL in October. The paper was co-authored by Martijn C. Willemsen (Eindhoven Univ. of Technology, The Netherlands) and his advisor Prof. **Alfred Kobsa**.


Knijnenburg

Thomas Debeauvais and **Arthur Valadares** (C. Lopes, advisor) presented their poster "RCAT: a RESTful Client-scalable ArchiTecture" at the 2011 International Workshop on Network and Systems Support for Games in Ottowa, Canada in October. The poster was co-authored by their advisor Prof. **Cristina Lopes.**

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

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Partner	$100,000 or more	Large-scale research project.

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impression you are traveling between distant planets!

The rest of the [vast] program reflected this hybrid combination, with academic research papers woven with experience reports, idea-papers and demonstrations. Even the three TechTalk speakers were a hybrid bunch: Jesper Richter-Reichhelm geeked out on "How to handle 1M daily users without a cache;" Dave Thomas entertained with a rant on "Why modern application development sucks!;" and Kresten Krab Thorup told a more personal story of his involvement with Erlang. Let's not forget the self-hybrid Guy Steele doing a live demonstration of singing calls in square dancing! The days preceding the main conference were also full of interesting talks and events with the same hybrid characteristic: from the Dart people, who have just unleashed one of the largest programming language design experiments ever over all of us, to Brad Myers, who studies the human aspects of programming in relatively controlled environments, to the AWS Hackathon.

You can probably sense the pride that I have in having been the producer of this wacky hybrid conference. And I am extremely grateful to the organizers and committee members who helped put this conference together. As many said before me, the most important thing for a team leader to do is to put in place a great team and move him/herself out of the way!

Lopes can be reached at lopes@ics.uci.edu.

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Brodbeck

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ALUMNI PROFILE

Dr. Rohit Khare, 2003 graduate

"Has it really been fifteen years?!," **Rohit Khare** exclaimed. "I first heard about Professor **Richard Taylor's** unique research team at UC Irvine in the mid-90's, from his students working at the World Wide Web Consortium — and that pretty much determined the course of my career ever since."

Indeed, within a few years the future Dr. Khare had moved from MIT to Irvine to enroll as a new graduate student, collaborated on several new research themes at ISR, and helped bring them to market as an entrepreneur. His first venture-backed startup, KnowNow, was a direct spinoff of his doctoral research; while his latest startup, Ångströ, was recently acquired by Google. In between, he helped re-launch CommerceNet as a research lab and incubator around the theme of decentralization, something he began investigating seriously in Prof. Taylor's research group and continues to drive his work today.

Centralized systems are easy to identify, since there's one person, one company, or one computer 'in charge.' Distributed systems make that model practical by sharing control across a network of machines, nowadays made popular as 'cloud' computing. Decentralized systems, by contrast, promise 'software that works the way society works:' acknowledging that in a peer-to-peer system, the best we can do is track what everyone else is doing and stop waiting for the "true" value for prices, inventories, contact information, and the like.

"Consider your humble 'little black book,'" Dr. Khare offered by way of example. "You could jot it all down in a central Rolodex, but you probably distribute copies across your PC, your laptop, and your phone and then try to keep them all in sync." "In the real world, though, that contact info you stashed away may already be out of date. The really interesting data is your 'social graph,' and that lives in pieces on Facebook, LinkedIn, Google+ and lot of other sites where each of your hundreds of contacts are constantly updating their status," he explained.

His solution to that problem is what caught Google's eye as they were assembling the team behind Google+. Part of the reason they acquired Ångströ last Fall was its software for coping with the fact that people may have many relationships with overlapping communities on multiple social networks. "Rather than building yet another address book to trap your data, we decided to put users back in control by knitting together your existing social graph, on-the-fly," he added.

In the mid-90's, while working on Internet standards at W3C with Tim Berners-Lee and later at MCI with Vint Cerf, he kept running into some "deeply informed and deeply committed" graduate students from Prof. Taylor's group, including Dr. **Roy T. Fielding**, of HTTP, Apache, and REST fame and ISR Prof. **E. James Whitehead**, who helped extend the Web to support Distributed Authoring and Versioning (WebDAV). "I was impressed that there was a research group out there that took standards and protocol design at the application layer seriously," he recalled. So he began his studies in earnest by enrolling at the Bren School of Information and Computer Sciences at UC Irvine in 1997. As the past editor of the *World Wide Web Journal*, Khare had a broad knowledge of issues facing Web developers from fonts to payment protocols, so as Prof. Taylor recalls "It is hard to overstate what a challenge it was to keep Rohit focused!"

By 1998, he worked to help convene the Workshop on Internet-Scale Event Notification (WISEN) at UCI. He presented a survey of the field that covered dozens of new and established real-time update protocols in collaboration with Adam Rifkin, a colleague from his undergraduate days at Caltech.

Part of earning a graduate degree is learn-

ISR STUDENT NEWSBRIEFS

Leyna Cotran (R. Taylor, advisor) presented her paper "Developing Requirements in an Established Domain Using Tags and Metadata" at the Workshop on Requirements Engineering for Systems, Services, and Systems-of-Systems at the Int'l Requirements Engineering Conf. in Trento, Italy in Sept. The paper was co-authored by her advisor ISR Director **Richard Taylor**.

Benjamin Koehne (D. Redmiles, advisor) interned at Microsoft Research Asia in Beijing, China. With the HCI research group, he studied globally distributed teams that work across time zones. In a joint project between MSR Redmond and MSRA Beijing, he investigated time-shifted collaboration practices using a novel conferencing tool.

Kyle Strasser presented a poster titled "CREST: Principled Foundations for Decentralized Systems" at SPLASH 2011 in Oct. The poster was co-authored by Ph.D. students **Michael Gorlick** and **Alegria Baquero** and their advisor ISR Director **Richard Taylor**. Strasser also served as a SPLASH 2011 student volunteer.

ing how the research funding process works. "After the success of WISEN'98, Prof. Taylor started suggesting new themes our team could investigate with respect to wireless networking, particularly real-world applications using "low-tech" pager networks," Dr. Khare recalled. So when the NSF rejected their next research proposal as "too commercial," it was no surprise that in the full-flower of the dot-com boom, Dr. Khare took that as a sign to 'drop out' and launch KnowNow with his friends, fellow UC Irvine alumnus Dr. **Peyman Oreizy** and Mr. Rifkin.

According to Mr. Rifkin, "Ultimately, we raised over $50M over 8 years pursing the Enterprise market for real-time event notification across the Internet, when it turned out that the 'killer app' for advanced Web apps turned out to be consumer applications such as Gmail and Twitter. Today, the sort of capabilities we struggled to emulate by writing a miniature Web server in JavaScript are now baked right into HTML5 and the BrowserChannel — there's a big lesson to be learned about the difference between being right, and being at the right time and the right place."

For Dr. Khare, though, the KnowNow journey was shorter than he expected — after another year as CTO, he decided to resign from the Board and return to pursuing his doctorate at Irvine full-time. Over the following two years, he finished his dissertation, building upon Dr. Roy Fielding's seminal work on the REpresentational State Transfer (REST) architectural style to describe how technology like KnowNow's could help developers of decentralized systems, winning a Best Paper award at the 2004 International Conference on Software Engineering (ICSE).

By 2006, Dr. Khare had spun off his own startup to revisit the market for publish/subscribe event notification in the age of Facebook. Ångströ asked, "What if people could follow news about people and companies that matter to them?" Obviously, existing approaches such as Google Alerts are flummoxed by the existence of people with the same name, but with the advent of LinkedIn profiles and the like, Dr. Khare began developing algorithms to disambiguate names based on user feedback — and to rank which topics were most interesting, too.

As the Ångströ team iterated through different products and services for social information mining, ranging from photos to games to marketing analytics, one common platform component that kept improving was our decentralized social graph matching engine. Rather than building its own universal list of all the newsworthy people in the world, Ångströ imported bits of users' social graphs from other sites (as well as the occurrence of news articles tying people together in the same context) to build a unified model, able to map a number to a name to a LinkedIn title, Facebook status, Flickr photo, and more.

Today, at Google+, Dr. Khare is responsible for similar aspects of their friend finding and suggestion tools. He is committed to helping to build a more open social Web by contributing to a Google+ Platform and APIs that help other developers accommodate a multilateral marketplace, not just tying their identity and event systems to one company or another.

"At Google+ we talk about fixing 'sharing on the web' so it works 'like it does in the real world' — pretty much a straight line from the mission Dr. Taylor and I worked out years earlier, to 'build software that works the way society works.' And I can see myself still working to the same goals for years to come."

Dr. Khare can be reached at rohit@khare.org.

ISR EVENT SCHEDULE

Mark your calendars now!

December 2, 2011
ISR Distinguished Speaker: Margaret M. Burnett
Oregon State University
"Males and Females Developing Software: Are Programming Tools Getting in the Way?"


Garlan

February 3, 2012
ISR Distinguished Speaker: David Garlan
Carnegie Mellon University
"End User Architecting"

March 2, 2012
ISR Distinguished Speaker: John Riedl
University of Minnesota
"The Effects of Diversity on Productivity, Member Withdrawal, and Decision Quality in a Social Production Community"

May 18, 2012
ISR Distinguished Speaker: Betty H.C. Cheng
Michigan State University
"Model-based Development of High-Assurance Dynamically Adaptive Systems"

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

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