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Ubicomp 2012 Conference Report

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The 14th ACM International Conference on Ubiquitous Computing (Ubicomp 2012) was held in September 2012 in downtown Pittsburgh. It was the last conference under that name, following a merger of the Ubicomp and Pervasive conferences, which will continue next year as the ACM International Joint Conference on Pervasive and Ubiquitous Computing (abbreviated as UbiComp 2013, as a nod to Mark Weiser's seminal work in the field).

Ubicomp 2012 was a dual-track conference over three days that attracted approximately 410 attendees. Also, a 10-year impact award was presented to Roy Want for his UbiComp 2002 paper, "The Personal Server: Changing the Way We Think about Ubiquitous Computing," which has significantly influenced the ubicomp community and related research.

KEYNOTE: THE FUTURE OF ROBOTICS

The main conference program opened with a thought-provoking talk by Steven Cousins, CEO of the robotics company Willow Garage. He presented his vision for the future of personal robotics by recalling the historical shift from mainframe to desktop computing, calling industrial robots as the "mainframes of our time" and inspiring the audience to define the robotic equivalent of the PC.

To advance this agenda, Cousins' team is investing in open source software, called the Robot Operating System (ROS), and open hardware (the PR2 robot platform) and giving it to top research institutions for free to lay the groundwork for personal robotics applications. Cousins says several grand challenges must be addressed before personal robotics become mainstream—in particular, issues related to perception, planning, and robot dexterity.

The talk made an appropriate opening for Ubicomp 2012, as many of the conference discussions centered on whether a similar shift in mainstream computing—from desktop to ubiquitous—has come and, if so, where that leaves future research in the field. Cousins also discussed the impact that high-quality, well-documented, and freely available robotics platforms (such as his ROS and PR2) can have on reducing the start-up engineering time necessary for new research projects. Although ubicomp engineering costs might not be as high, the ubicomp community could still learn from the robotics field in terms of identifying ways to keep high upfront costs from becoming research barriers.

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METADISCUSSION: THE STATE OF UBICOMP

Two vision papers, from two different sessions, were a hot topic of discussion outside the talks. In the first session, Gregory Abowd from Georgia Tech presented, "What Next, Ubicomp? Celebrating an Intellectual Disappearing Act." Abowd kept his talk brief, leaving 15 minutes for discussion, but the discussion lasted throughout the rest of the conference. He argued that ubicomp as a paradigm has become so accepted—becoming a part of computing in general—that as a research area, it might have ceased to be fruitful. He also noted that many researchers who perform work that's ostensibly ubicomp research don't publish at the Ubicomp conference, and he doesn't expect this to change in the future.

Paul Dourish of UC Irvine presented his own critique in "Ubicomp's Colonial Impulse" (a best-paper nominee). He likened the academic tradition within ubicomp to 18th and 19th century European colonialism—saying that one ubicomp premise is that knowledge is unequally distributed (concentrated in research labs) and should be pushed out into the broader world. Another premise is that that the present state of research (the "developed" world) must represent the future state of the rest of the world (the "developing" world). Dourish

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argued that this "logic of lack" is disempowering, suggesting that researchers should avoid the rhetoric of center versus periphery and try to better understand historical or institutional reasons for the way things are. He also suggested banning the word "user" to better engage with people on their own terms.

Related metadiscussions continued into the town hall meeting at lunch on the second day of the conference, focusing on ubicomp's viability as a community and how to attract researchers who publish relevant research at other venues. Several suggestions involved variations of including invited talks or demos, such as awards for the best (or most influential) ubicomp paper not published at Ubicomp.

A.J. Brush of Microsoft Research, chair of the new SIGCHI UbiComp Community, invited attendees to join the ACM SIGCHI Ubicomp Community (www.sigchi.org/communities/ubicomp) to advocate for ubicomp-specific panels and workshops at CHI and for possible funding opportunities for the ubicomp community.

UBICOMP SESSIONS

Here, we highlight selected papers from the various conference sessions.

Health@Home

The Health@Home session opened with Enrico Costanza of the University of Southampton presenting, "'Honey= Sugar' Means Unhealthy: Investigating How People Apply Knowledge to Rate Food's Healthiness." In this work, people were asked to rate food's healthiness by looking at pictures and provide a list of attributes of the food contributing to their ratings. Costanza and his coauthors identified eight high-level attributes used to make the health judgments—including nutrients, portion size, brand association, and health effect—and suggested moving away from calorie-centric designs in future work toward systems that capture more of these dimensions.

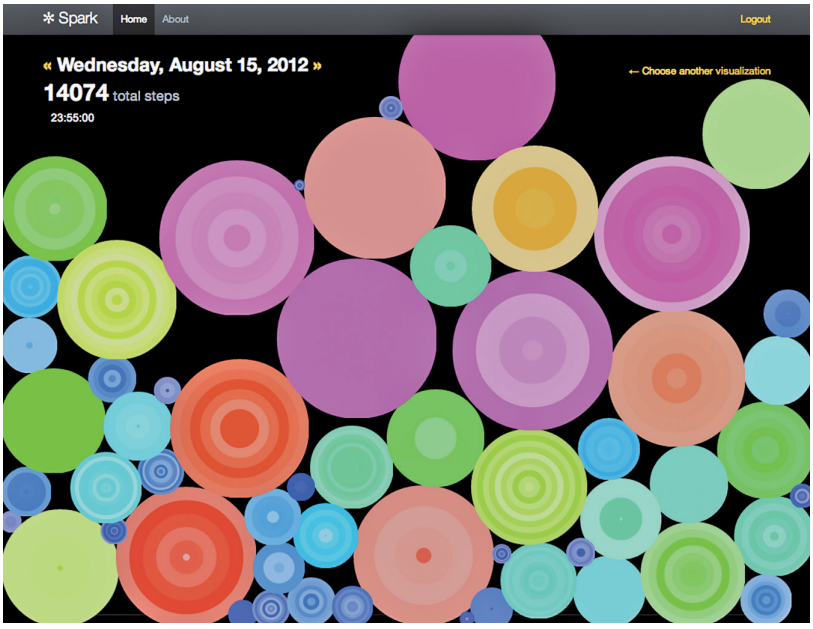

Figure 1. One of four abstract visualizations of physical activity data from the paper, "A Spark of Activity: Exploring Informative Art as Visualization for Physical Activity." (Used with permission.)

In the same session, Chloe Fan presented, "A Spark of Activity: Exploring Informative Art as Visualization for Physical Activity" (a best-note nominee). Fan found that more abstract, artistic visualizations might be preferred over graphs of data or living metaphors (such as flowers) for physical-activity feedback, pushing the community to broaden its idea of meaningful feedback (see Figure 1).

Sensors and Surveillance at Home

This session focused on how homeowners perceive and react to the installation of sensors in their homes, ranging from motion detectors to higher fidelity sensors such as audio and video recording.

Antti Oulasvirta of Max Planck Institute for Informatics presented, "Long-Term Effects of Ubiquitous Surveillance in the Home," a study in which video cameras and other sensors were installed in 10 homes in Helsinki to monitor TV and PC usage for six months. The goal was to understand the participants' stress, anxiety, and privacy-seeking behaviors.

Oulasvirta noted that people view their home as the "final fortress of privacy" and thus don't want much information to be recorded inside of it. The study found that the sensors caused annoyance, concern, and anxiety, but elevated levels of stress couldn't be attributed to the sensors. Participants felt particularly strongly about the capture of nudity, physical appearance, and sex, saying it was a violation of intimacy. The sensors deprived people of the solitude they expect in their home. Yet the concerns decreased after two to three months, leading Oulasvirta to stress the importance of looking beyond this timeframe to understand the effects of sensors in a home.

On the Body and On the Move

Although many sensing papers presented at the conference applied to sensing on the human body, this session focused on techniques that either used humans in the loop for machine

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learning or had clever sensing using the human body.

Thore Fechner from Muenster University presented, "Attacking Location Privacy: Exploring Human Strategies." He found that human strategies for de-anonymizing and re-identifying location data (encouraged by gamification) can be a privacy threat comparable to more researched computational attacks. Fechner and his colleagues concluded that because humans can rely on common sense and reason about spatial data, they pose a serious threat to location privacy, encouraging applications and security designers to take these factors into account when location privacy is important.

Gabe Cohn of the University of Washington presented, "An Ultra-Low-Power Human Body Motion Sensor Using Static Electric Field Sensing" (a best-note award winner). He showed an ultralow-power method for passively sensing body motion using static electric fields by measuring the voltage at any single location on the body. His proposed sensing hardware consumes only 3.3 microwatts of power, while the lowest-power commercially available accelerometers consume 400 to 1,000 microwatts. The hardware could detect various body motions, including resting, walking, and jogging.

Sensemaking, Scholarship, and Science

This session began with Deana Brown presenting, "Takes a Transnational Network to Raise a Child: The Case of Migrant Parents and Left-Behind Jamaican Teens." This paper describes the (common, due to high migration) networks of educators, parents, and guardians that raise children in Jamaica when their parents have migrated elsewhere. These networks spread responsibility for children among family and the community. The authors found that technology can affect the structure of these relationships.

For example, children who have a personal cellphone (and thus can decide when to contact their parents) can undermine the authority of local guardians. Brown stressed that in this context, it's important to consider the effects of technology on all of the people involved in the child's well-being—beyond just the parent-child relationship.

Energy at Home and In the Car

The second day of the conference opened with Johannes Tulusan from the Institute of Technology Management presenting, "Providing Eco-Driving Feedback to Corporate Car Drivers: What Impact Does a Smartphone Application Have on their Fuel Efficiency?" Tulusan showed that a smartphone application can improve fuel efficiency, even when monetary incentives aren't given (the car drivers didn't pay for fuel). They found, through a 50-driver study, that their application can improve overall fuel efficiency by 3.23 percent.

A soon-to-be-released Android application [will] detect dangerous driving behaviors and driver fatigue.

Next, Enrico Costanza introduced his work, "Understanding Domestic Energy Consumption through Interactive Visualisation." He found that when 12 participants used his interactive visualization tool, FigureEnergy, it not only engaged the user to relate energy consumption with activities but also helped the user discover electrical appliances that consumed more energy than expected. Both of these papers advanced the growing literature of work in the field of eco feedback: the design and study of interfaces to persuade users to become more aware of their energy consumption, motivating them to reduce their usage.

The last presentation of the session was a video presentation by Chuang-Wen You of Dartmouth College. It described a soon-to-be-released Android application that uses the front-facing and rear camera on a dashboard-mounted smartphone to detect dangerous driving behaviors and driver fatigue. It detects abrupt lane changes and when a driver is following another car too closely, and it monitors the driver's eye-blinking rate to gauge fatigue. Audible and visual alarms provide early warning to help prevent accidents.

Physiological Sensing

Measuring physiological responses through low-cost sensors has long been a focus of ubicomp. Jin-Hyuk Hong of Carnegie Mellon University opened this session with his work on using various on-body sensors, presenting, "Understanding Physiological Responses to Stressors during Physical Activity." Unlike past research, Hong and his coauthors investigated the influence of physical activity as an important confound on stress recognition in real-world situations. Their approach modularized stress models instead of building a general stress model. Their experiments showed promise, with stress-recognition accuracies between 82 and 87 percent, representing a 5 to 10 percent improvement when compared to approaches that don't consider physical activity.

Next, Eric Larson and Mayank Goel from the University of Washington presented, "SpiroSmart: Using a Microphone to Measure Lung Function on a Mobile Phone" (a best-paper-award nominee). They developed a system that lets people measure their own lung function by blowing into a standard microphone on a smartphone. The researchers ran a 52-user study in conjunction with pulmonologists and found a mean error versus a clinical spirometer of 5.1 percent for common measures of lung function. The presenters also alluded to work in progress that would let people to

"call in" using any phone to perform a similar test, circumventing the need for a smartphone and opening up the possibility of affordable lung function testing for Third World countries.

The last paper in this session was presented by David Sun of UC Berkeley, who described a novel system of building scalable microphone arrays for 2D speaker localization in, "A High Accuracy, Low-Latency, Scalable Microphone-Array System for Conversation Analysis." The system, called SLAAM, was accurate, modular, simple, and easy to use and was built using off-the-shelf components for approximately US$10 per square foot installed. Sun alluded to using this system for emotion detection, classification, and feedback for collaborative teams in office spaces.

Sensing On and With People

Koji Yatani of Microsoft Research Asia introduced, "BodyScope: A Wearable Acoustic Sensor for Activity Recognition," with a compelling live demo showing what the acoustic signal in frequency domain looks like as Yatani ate chips, drank water, and ate cookies—all in the name of research. In addition to being entertaining, the key takeaway was the rich amount of information in the acoustic signal from a microphone placed on a person's neck. Yatani and his colleagues used machine learning to distinguish 12 activities, such as drinking, eating, and laughing, using the BodyScope sensor with an F-measure of 79.5 percent.

In "StressSense: Detecting Stress in Unconstrained Acoustic Environments Using Smartphones," Hong Lu of Intel Labs presented a microphone-based stress-detection system that investigates the adaptation of a one-size-fits-all stress model to individual speakers and scenarios. This work used off-the-shelf smartphones as acoustic sensors and demonstrated an accuracy of 81 and 76 percent for indoor and outdoor environments, respectively.

Ubicomp at Home and in the City

In the final session, Sebastian Weise of Lancaster University presented, "Democratizing Ubiquitous Computing—A Right for Locality," arguing for the need to both localize and democratize ubicomp infrastructure. He explored who controls data in ubicomp infrastructures and asked how individuals should be involved in managing their data at different levels: from local to city-wide to global. He stressed that as urban computing environments are built, we must consider democratization from the beginning to ensure that people's data remains within their control.

POSTERS AND DEMOS

In addition to great talks and high-quality papers, Ubicomp 2012 also had 10 demos and approximately 50 posters, which were well received by the attendees. Posters and demos allowed hands-on experience of research technology and provided a great opportunity to talk to researchers in person, ask questions, and form collaborative ties.

The researchers demonstrated that any everyday object can be turned into a gesture-sensitive surface.

A compelling demo was "Touché: Touch and Gesture Sensing for the Real World," presented by Disney Research, Pittsburgh. Using Electric Field sensing over a wide frequency range, the researchers demonstrated that any everyday object can be turned into a gesture-sensitive surface (one example was a touch-sensitive plant, which played musical tones when the leaves, stem, or flower was touched).

Another compelling demo was presented by Yoshihiro Kawahara of Georgia Tech, "SenSprout: Inkjet-Printed Soil Moisture and Leaf Wetness Sensor." Kawahara and his coauthors used a modified inkjet printer to print circuits, ranging from a moisture sensor to complex RF antennas.

Hsin-Liu Kao from the National Taiwan University presented, "Phone-Based Gait Analysis to Detect Alcohol Usage," for use in rehabilitation programs to detect alcohol use (or abuse). The algorithm uses sensors on a smartphone to infer the user's gait and classify whether the person is under the influence of alcohol. Beyond rehabilitation, Kao and his colleagues are looking to use similar technology to prevent driving under the influence.

UbiComp 2013 will be held 8–12 September 2013 in Zurich, Switzerland. For more information, see www.ubicomp.org/ubicomp2013.

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