

MobiSys 2016 Conference Report

The 14th ACM International Conference on Mobile Systems, Applications, and Services (MobiSys 2016) took place from 23-30 June in Singapore and was co-located with the first Asian Students Symposium on Emerging Technologies (ASSET). This year's MobiSys attracted 351 attendees and featured 31 papers, 20 posters, 35 demos and 8 workshops including the first MobiSys Women's Workshop. The papers spanned a range of themes and domains -- privacy and security emerged clearly as an important topic this year but the best paper award focussed on a new reactive technique for autonomous control of drones (Bregu et al; more details in the summary of conference session 4).

This year's MobiSys was one of a number of conferences helping to recognise SIGMOBILE's inaugural Test-of-Time awards for papers that have had a sustained and significant impact in the SIGMOBILE community over at least a decade. Two presentation sessions were held in which Mahadev Satyanarayanan ("Disconnected operation in the Coda file system"), Roy Want and Andy Hopper ("The active badge location system"), and Victor Bahl together with Venkata N. Padmanabhan ("RADAR: An in-building RF-based user location and tracking system") gave interesting insights into the story behind their awarded publications, and about the impact their work caused within the research community.

Keynotes

MobiSys was opened by Ravi Jain, the Chief Technology Officer at Vulcan Inc. describing how modern technology can be used to address complex challenges in the world with the ultimate goal of making the world better. With case studies ranging from elephant counting using drones for wildlife preservation, understanding marine ecosystem, to preventing viruses spreading around the world, Jain showed concrete and impressive examples of technology use for these use cases and pointed out some lessons learnt such as the importance of creating simple solutions and cooperation with local collaborators for training.

The second day of MobiSys was opened by Peeyush Ranjan, Chief Technology Officer at Flipkart, with a keynote giving insightful information on technical challenges and opportunities which companies like Flipkart are facing in developing market like India. The majority of the population only have little access to the internet, mostly limited by both cost and bandwidth of mobile data combined with low household incomes. This creates "leapfrogging opportunities" for innovative technical solutions that can overcome such limitations and be applicable for other parts of the world.

Conference Sessions

1 Smart Environments

The first session was chaired by Eduardo Cuervo and focussed on supporting systems for smart environments in domestic spaces and at scale.

Rajesh Balan opened the session with “LiveLabs”, a large-scale mobile sensing platform developed at Singapore Management University and deployed in multiple locations, including the conference convention centre. Balan described the challenges in creating and deploying a production-ready system to support research while simultaneously providing benefit to stakeholders.

Focussing on the reidentification of people, Grosse-Puppendahl (Microsoft Research) presented “Platypus”, a system that re-identifies people by measuring changes in their electric potential through sensors deployed in the floor. While constrained to room-level localizations, Platypus has proven to identify people with an accuracy of over 90%. Next, Shangquan(Princeton) presented “MobiTagbot”, a sorting robot able to operate in very narrow spaces densely populated with RFID tags, such as libraries or supermarkets, and detect the exact spatial order of tagged objects.

Targeting smart homes and IoT deployments which are designed to measure daily life activities, Kodeswaran (IBM Research) presented a system for sensor failure detection called “Idea”. Assuming multiple sensors are deployed for detecting the same activity, *Idea* is able to predict the impact of a failing sensor with regard to a reliable activity detection and identifies deployments requiring maintenance.

2 Frontiers in Sensing

The second conference session, "Frontiers in Sensing" was chaired by David Kotz and opened with Romit Roy Choudhury's "Listening through a Vibration Motor", a work together with student Nirupam Roy (University of Illinois at Urbana Champaign). The paper demonstrated how a device's vibration sensor could be used as a proxy sound sensor with high accuracy -- offering new capabilities for compact devices that don't traditionally include a microphone (e.g. activity-tracking wristbands) but also introducing security concerns for devices not currently considered to be capable of “eavesdropping”.

Next up, Dartmouth’s "StarLight" (presented by Tianxing Li) provided environmental monitoring of human activity using only low-cost LED panels and light sensors. Detection of blocked light allows skeletal reconstruction for a moving human. StarLight could enhance

existing activity tracking and provide a new approach for whole-body interaction (e.g. in virtual-reality systems). Another opportunity for motion tracking was presented by Sheng Shen (University of Illinois at Urbana-Champaign). Their “ArmTrak” system uses a smartwatch to track the 3D posture of the wearers arm (e.g. for gesture-based systems). Similarly, the final paper, “BodyScan”, used wearables as a means of sensing human activity. This joint work between Michigan State University and Bell Labs was presented by Biyi Fang and uses radio to detect a range of activities including fine-grained biological behaviours such as breathing.

3 Next Generation Mobile OS

Monday’s final session, “Next Generation Mobile OS”, was chaired by Jason Flinn (University of Michigan). Amit Levy (Stanford) began with "Beetle: Flexible communication for Bluetooth Low Energy". Beetle provides an operating system service that uses the GATT protocol to overcome current constraints on applications accessing BLE peripherals, e.g. to allow simultaneous access by multiple applications or to enforce specific security policies.

Haichen Shen (University of Washington) presented their joint work with Microsoft Research, “MCDNN: An Approximation-Based Execution Framework for Deep Stream Processing Under Resource Constraint”. The paper addresses Deep Neural Network execution on resource-poor devices — their runtime schedules a catalog of model variants across device and cloud to maximise accuracy within the resource bounds. Resource poverty was also a key consideration in Intel’s “TaskFolder: Dynamic and Fine-Grained Workload Consolidation for Mobile Devices.” Their observation that equal sharing of workload across CPU cores did not transfer well into the Android platform, led to an alternative approach that schedules only over the minimum number of cores required to achieve performance, saving up to 48% of CPU power. Whilst Android and other mobile platforms are now mature enough to have attracted considerable research attention, the final paper, from Purdue ECE looked to apply this scrutiny to wearable OS platforms. Their paper “Understanding the Characteristics of Android Wear OS” profiles the behaviour of Android Wear to yield a series of lessons.

4 Transit and Mapping

Tuesday’s first session was chaired by Robin Kravets and focused on mapping and transit of locations in mobile systems.

Yang (Zhejiang University) started the session presenting how mobility models retrieved from historic bike movement patterns can be used to predict future bike distributions. This approach will help providers to improve the (often uneven) distribution of bikes across a network and ultimately increase the user experience.

Next, Wang (UC Santa Barbara) presented security flaws of crowdsourced maps. Their team was able to manipulate Waze at scale by creating virtual vehicles, even allowing them to track movements of other users—jeopardizing user privacy and trust. The work has drawn significant media attention and led Waze to deploy measures against these kinds of attacks. Crowdsourcing, despite its risks and challenges is an important mechanism for improving maps as presented by Elhamshary (Osaka University). “TransitLabel” automatically detects user activities (such as ticket vending machines or elevators) through smartphone sensors and maps these activities to a crowd-sourced indoor map

In the last talk of the session, Mottola (Polytechnic University of Milan) described an alternative, reactive-based control approach for autonomous drones—awarded as Best Paper. Instead of constantly reading sensor values and triggering actuators, the authors propose a “reactive control” mechanism that only triggers controlling components if actual changes in sensor values were observed (which are still constantly monitored). Mottola et al. showed this approach lead to an increased control accuracy and improved flight time.

5 No More Leaks

The theme of the fifth session was preventing leaks from mobile phone applications and sensitive user data and was chaired by Ben Greenstein (Google).

Peng Huang (UC San Diego) began the session presenting “DefDroid”, a system aiming to prevent poor app behaviours (e.g. frequent notifications or high data consumption) by constantly monitoring app activities. Unusual behaviour is prevented by gently blocking specific actions of the app without breaking its overall functionality.

Next, Paarijaat Aditya (MPI-SWS) showed “I-Pic”, a mobile image capture and preference management application. The app allows anyone to specify privacy preferences which are broadcasted through Bluetooth to other users. I-Pic automatically blurs faces of bystanders captured in the image according to their preferences. When taking images in a corporate setting, apps accessing the camera view can capture potentially sensitive information. Srivastava (Duke University) presented a system that allows users to mark areas (e.g. faces) that can be captured and accessed by other apps, while hiding other sensible information in real time.

The last talk on Wednesday was by Mirzamohammadi (UC Irvine) introducing “Viola”, a system addressing the issue of apps accessing sensors in the background without the knowledge of users. It prevents such attacks by monitoring sensor access on a lower system level, and providing trusted notifications to the user. The app itself is secured through constant runtime verification tests to ensure its functionality.

6 Better Mobile Interfaces

The sixth session was chaired by Inseok Hwang (IBM Research) and focussed on developing innovative interfaces for mobile devices.

Yu-Chih Tung (University of Michigan) presented the first paper in the session titled “Expansion of Human-Phone Interface By Sensing Structure-Borne Sound Propagation” which estimates the user-applied force on a smartphone with no force sensor by utilizing the sound transmitted through subtle vibrations of the device body.

Kevin Boos (Rice University) presented the next paper “FlashBack: Immersive Virtual Reality on Mobile Devices via Rendering Memoization.” Since storage is cheaper than graphical computation, FlashBack pre-computes and caches all images that a VR user might encounter and at runtime displays the relevant images from the cache and thus offering full-quality VR experience on weak mobile devices.

The final paper of the session was “uLink: Enabling user-defined deep linking to app content”, presented by Oriana Riva (Microsoft Research). As mobile apps do not have URLs, it is difficult to navigate between pages. To address this challenge, *uLink* allows users to bookmark pages inside the mobile app and similar to web bookmarks, these can be retrieved later.

7 Small and Large Scale Networking

This session focused on addressing various challenges in networking and was chaired by Xia Zhou (Dartmouth College).

Frederik Hermans (Uppsala University) presented “FOCUS: Robust Visual Codes for Everyone” which splits visual codes’ information across the frequency domain and decoded data quality depended on the decoding camera’s quality. This approach increases decoding distance at least 2x times.

The next paper “Practical Bluetooth Traffic Sniffing: Systems and Privacy Implications” was presented by Guoliang Xing (Michigan State University). Bluetooth has an adaptive hopping behavior which makes packet sniffing difficult. The authors show that it is possible to sniff bluetooth packets using a dual radio architecture system.

Next, Kaixin Sui (Tsinghua University) presented “Characterizing and Improving WiFi Latency in Large-Scale Operational Networks” showing findings of inadequacy in AP selection mechanisms in a campus with 47000 mobile devices. With three practical solutions, the authors reduced latency by half in many devices.

Jingjing Ren (Northeastern University) presented the session's last paper on "ReCon", a system which can reveal smartphone user's personally identifiable information leaks and allows users to control information that applications can obtain.

8 Application Security and Privacy

The final session of the conference, "App Security & Privacy" was chaired by Landon Cox (Duke) and began with Long Lu (Stony Brook University) describing joint work with IBM Research. Their CASE patching tool allows provides additional security to mobile application (Android) developers when using third-party code. Evaluation shows compatibility with 420 popular Android applications with minimal performance overhead (~5%). Addressing the issue of authentication to mobile devices, Urs Hengartner presented "Targeted Mimicry Attacks on Touch Input Based Implicit Authentication Schemes," a work completed with his student Hassan Khan and Prof. Daniel Vogel (all from the University of Waterloo). Touch IA schemes (relying on finger movement patterns generated during mobile use) have previously been proposed as a useful biometric for authentication. In this work the researchers find that targeted mimicry attacks (as opposed to the random methods usually assumed) can yield very high success rates and thus limit the usefulness of Touch IA for secure authentication.

Next, a joint work from the Max Planck Institute and University of Maryland proposed the use of "Privacy Capsules" as platform for mobile applications that forces execution into two sequential phases: the first allows access to network resources but not sensitive input, whilst the second gives full access to sensitive input but prevents use of untrusted resources. The authors evaluate Privacy Capsules using a prototype Android implementation.

The final paper of the conference "Regulating ARM TrustZone Devices in Restricted Spaces" was a joint piece from TU Darmstadt and Rutgers University. The work looks to address space-specific security concerns (e.g. restricting data capture) through a check-in process that allows space hosts to examine and modify device configuration to prevent unauthorised behaviour.

ASSET

A three day symposium (ASSET) designed to introduce Asian Students to various research horizons and a forum to expand their research horizons, peer networks, and professional careers was organised as part of Mobisys and was attended by 103 students and 10 mentors.

On the first day of the symposium students were grouped based on research interest and after attending seminars on scientific writing and presentation, each group was given a topic

based on the group's overall research interest which they had to present the next day. The first day ended with students presenting research posters.

The second day had four tutorials by four eminent speakers: Prof Nigel Davies, who spoke about future of digital public displays, Prof Romit Roy Choudhury, who spoke about the importance of location in context aware services, Prof Suman Banerjee, who spoke about novel applications and services of edge computing and Prof Lin Zhong highlighted the importance of the scientific process of system building research. The day also featured 1 minute presentations by student groups.

The last day of the symposium started with a presentation by Prof Steve Miller and was followed by a tour of JTC launchpad which homes multiple incubators, accelerators and startups. Interaction session with a startups was organised to explain the process of setting up a startup in Singapore. The completion of the launchpad tour marked the successful completion of the first ASSET symposium.

Summary

This year's MobiSys conference featured very insightful keynotes and a large variety of papers — attracting a very international set of attendees from all over the world, including large numbers from North America and Asia. Many scholarships allowed especially students from developing countries to attend the conference and make a significant contribution to the community with posters, demos and interesting discussions.

We are looking forward to next year's MobiSys conference, chaired by Tanzeem Choudhury (Cornell) and Steve Ko (University at Buffalo), taking place in the Niagara Falls area in New York state.