

Table of Contents

MobiSys 2017 Symposium-Conference-Workshop Organization	xi
--	-----------

MobiSys'17 Sponsors & Supporters.....	xiv
--	------------

Keynote Address

• Augmenting the Human Experience	1
<i>Pattie Maes (Massachusetts Institute of Technology)</i>	

PAPER SESSION1: Acoustic Sensing

Session Chair: Nicholas Lane (*University College London and Bell Labs*)

• BackDoor: Making Microphones Hear Inaudible Sounds	2
<i>Nirupam Roy, Haitham Hassanieh, Romit Roy Choudhury (University of Illinois at Urbana-Champaign)</i>	
• Strata: Fine-Grained Acoustic-based Device-Free Tracking	15
<i>Sangki Yun, Yi-Chao Chen, Huihuang Zheng, Lili Qiu, Wenguang Mao (The University of Texas at Austin)</i>	
• SoundSifter: Mitigating Overhearing of Continuous Listening Devices	29
<i>Md Tamzeed Islam, Bashima Islam, Shahriar Nirjon (University of North Carolina at Chapel Hill)</i>	
• BatMapper: Acoustic Sensing Based Indoor Floor Plan Construction Using Smartphones	42
<i>Bing Zhou, Mohammed Elbadry (Stony Brook University), Ruipeng Gao (Beijing Jiaotong University), Fan Ye (Stony Brook University)</i>	

PAPER SESSION1: Deep Learning on Mobiles

Session Chair: Matthai Philipose (*Microsoft Research*)

• MobileDeepPill: A Small-Footprint Mobile Deep Learning System for Recognizing Unconstrained Pill Images	56
<i>Xiao Zeng, Kai Cao, Mi Zhang (Michigan State University)</i>	
• DeepEye: Resource Efficient Local Execution of Multiple Deep Vision Models using Wearable Commodity Hardware	68
<i>Akhil Mathur (Nokia Bell Labs), Nicholas D. Lane (Nokia Bell Labs & University College London), Sourav Bhattacharya, Aidan Boran, Claudio Forlivesi, Fahim Kawsar (Nokia Bell Labs)</i>	
• DeepMon: Mobile GPU-based Deep Learning Framework for Continuous Vision Applications	82
<i>Loc N. Huynh, Youngki Lee, Rajesh Krishna Balan (Singapore Management University)</i>	

PAPER SESSION: Light ensing and Communications

Session Chair: Xia Zhou (*Dartmouth College*)

• Enabling High-Precision Visible Light Localization in Today's Buildings.....	96
<i>Shilin Zhu, Xinyu Zhang (University of Wisconsin-Madison)</i>	
• POLI: Long-Range Visible Light Communications Using Polarized Light Intensity Modulation	109
<i>Chun-Ling Chan, Hsin-Mu Tsai (National Taiwan University), Kate Ching-Ju Lin (National Chiao Tung University)</i>	

- **Card-stunt as a Service: Empowering a Massively Packed Crowd for Instant Collective Expressiveness** 121
Chungkuk Yoo (*Korea Advanced Institute of Science and Technology*), Inseok Hwang (*IBM Research - Austin*),
Seungwoo Kang (*KOREATECH*), Myung-Chul Kim (*IBM*),
Seonghoon Kim, Daeyoung Won (*Korea Advanced Institute of Science and Technology*), Yu Gu (*IBM*),
June-hwa Song (*Korea Advanced Institute of Science and Technology*)
- **CELLI: Indoor Positioning Using Polarized Sweeping Light Beams** 136
Yu-Lin Wei, Chang-Jung Huang, Hsin-Mu Tsai (*National Taiwan University*),
Kate Ching-Ju Lin (*National Chiao Tung University*)

Poster/ Demo Session

- **Poster: Multicamera Synchronization for Smartphones using Optimally Modulated Illuminations** 148
Koki Kudo, Masanori Sugimoto (*Hokkaido University*), Takayuki Akiyama (*SOKENDAI*),
Hiromichi Hashizume (*National Institute of Informatics*)
- **Poster: Sdguard – An Android Application Implementing Privacy Protection and Ransomware Detection** 149
Shuangxi Hong, Chuanchang Liu, Bingfei Ren,
Junliang Chen (*Beijing University of Posts and Telecommunications*)
- **Poster: MobiTemplate: A Template-based Rapid Cross-Platform Mobile Application Development Environment** 150
Yimeng Feng, Bo Cheng, Junliang Chen, Bo Cheng, Shuai Zhao, Zhongyi Zhai, Zhaoning Wang, Meng Niu,
Junliang Chen (*Beijing University of Posts and Telecommunications*)
- **Poster: Mobile Power Management Using FreeRTOS-based Uninterruptable Generator Supply** 151
Chulju Lee, Kyungtae Kang (*Hanyang University*)
- **Poster: Charge My Phone As I Instruct** 152
Liang He, Yu-Chih Tung, Kang G. G. Shin (*University of Michigan*)
- **Poster: Docker-Based Self-Organizing IoT Services Architecture for Smarthome** 153
Meng Niu, Bo Cheng, Zhongyi Zhai, Yimeng Feng,
Junliang Chen (*Beijing University of Posts and Telecommunications*)
- **Poster: Improve Push Notification on Smartwatches** 154
Xing Liu, Yunsheng Yao, Feng Qian (*Indiana University Bloomington*)
- **Poster: Mobile Photo Data Management as a Platform Service** 155
Kyungho Jeon, Sharath Chandrashekhara, Karthik Dantu,
Steven Y. Ko (*University at Buffalo, The State University of New York*)
- **Poster: Towards Quick Angular Check to Rebuff Forged Position Attacks in Vehicular Communication** 156
Yongtae Park, Seung-ho Kuk (*Korea University*)
- **Poster: Visual Cue-Based VRU Protection on Smartphones** 157
Taeho Kim, Wongoo Han, Yongtae Park (*Korea University*)
- **Poster: A Lightweight Live Migration Platform with Container-based Virtualization for System Resilience** 158
Jaemyoun Lee, Kyungtae Kang (*Hanyang University*)
- **Poster: Application-Layer Optimization of Performance vs Energy in Mobile Network I/O** 159
Kemal Guner, Tevfik Kosar (*University at Buffalo (SUNY)*)
- **Poster: Vocal Resonance as a Passive Biometric** 160
Rui Liu (*Dartmouth College*), Cory Cornelius (*Intel Labs*),
Reza Rawassizadeh, Ron Peterson, David Kotz (*Dartmouth College*)
- **Poster: Occupancy State Detection using WiFi Signals** 161
Elahe Soltanaghaci, Avinash Kalyanaraman, Kamin Whitehouse (*University of Virginia*)

• Poster: Smartwatch Knows How Much You Drink	162
Takashi Hamatani, Moustafa Elhamshary, Akira Uchiyama, Teruo Higashino (<i>Osaka University</i>)	
• Poster: EPS – Edge-hosted Personal Services for Mobile Users	163
Pengzhan Hao, Yongshu Bai, Xin Zhang, Yifan Zhang (<i>SUNY Binghamton</i>)	
• Poster: HeartFit – An Intuitive Smartphone Application for Well-being of Hypertensive Patients	164
Syeda Farzia Afroze, Faysal Hossain Shezan, Sadia Sharmin (<i>Bangladesh University of Engineering and Technology</i>)	
• Poster: Flood Monitoring using Computer Vision	165
Bhavana B. Nair, Sethuraman N. Rao (<i>Amrita Vishwa Vidyapeetham Amrita University</i>)	
• Poster: Impact of Ground Truth Errors on Wi-Fi Localization Accuracy	166
Andrei Popleteev (<i>SnT, University of Luxembourg</i>)	
• Poster: Observe. Patternize. Mimic. Leveraging Patterns in Mobile-User Behavior for Enterprise Applications	167
Uma Parthavi Moravapalle (<i>Georgia Institute of Technology</i>), Shruti Sanadhya (<i>Hewlett Packard Labs</i>), Cheng-Lin Tsao (<i>Anthem Innovation Studio</i>), Raghupathy Sivakumar (<i>Georgia Institute of Technology</i>)	
• Poster: RTDroid: A Real-Time Solution with Android	168
Yin Yan, Karthik Dantu, Steven Y. Ko, Lukasz Ziarek (<i>The State University of New York</i>)	
• Poster: Securing Device Inputs for Smartphones Using Hypervisor Based Approach	169
Xin Zhang, Yongshu Bai, Pengzhan Hao, Yifan Zhang (<i>SUNY Binghamton</i>)	
• Poster: Memory Protection in Ultra-Low-Power Multi-Application Wearables	170
Taylor Hardin (<i>Dartmouth College</i>), Josiah Hester (<i>Clemson University</i>), Patrick Proctor (<i>Dartmouth College</i>), Jacob Sorber (<i>Clemson University</i>), David Kotz (<i>Dartmouth College</i>)	
• Poster: Android Malware Detection using Multi-Flows and API Patterns	171
Feng Shen, Justin Del Vecchio, Steven Y. Ko, Aziz Mohaisen, Lukasz Ziarek (<i>University at Buffalo, The State University of New York</i>)	
• Poster: Camera Images Offloading in Low-resource Wireless Networks	172
Wei Xiong, Mariya Zheleva (<i>University at Albany, SUNY</i>)	
• Poster: Redundancy Aided Vehicular Networking	173
HyunJong Lee, Jason Flinn (<i>University of Michigan</i>)	
• Poster: Twirl: On the Benefits of Adapting Orientation of a WiFi Access-Point	174
Yubing Jian, Shruti Lall, Raghupathy Sivakumar (<i>Georgia Institute of Technology</i>)	
• Poster: Online Map Matching for Passive Indoor Positioning Systems	175
Huy Tran (<i>Portland State University</i>), Santosh Pandey (<i>Cisco Systems</i>), Nirupama Bulusu (<i>Portland State University</i>)	
• Poster: Auracle – A Wearable Device for Detecting and Monitoring Eating Behavior	176
Shengjie Bi, Ellen Davernport, Jun Gong, Ronald Peterson, Joseph Skinner (<i>Dartmouth College</i>), Kevin Storer (<i>Clemson University</i>), Tao Wang (<i>Dartmouth College</i>), Kelly Caine (<i>Clemson University</i>), Ryan Halter, David Kotz, Kofi Odame (<i>Dartmouth College</i>), Jacob Sorber (<i>Clemson University</i>), Xing-Dong Yang (<i>Dartmouth College</i>)	
• Poster: Characters vs. Words - Observations on Command Design for Brain-Computer Interfaces	177
Mohit Agarwal, Raghupathy Sivakumar (<i>Georgia Institute of Technology</i>)	
• Poster: Field Testing Vehicular Networks using OpenC2X	178
Florian Klingler, Gurjashan Singh Pannu, Christoph Sommer, Bastian Bloessl, Falko Dressler (<i>Paderborn University</i>)	
• Poster: ARM Errata and their Software Workarounds	179
Nisal Menuka, Lin Zhong (<i>Rice University</i>)	

• Poster: Extensive Evaluation of Emotional Contagion on Smiling Selfies over Social Network	180
Wataru Sasaki, Mikio Obuchi, Kazuki Egashira, Naohiro Isokawa, Yuki Furukawa, Yuuki Nishiyama, Tadashi Okoshi, Jin Nakazawa (<i>Keio University</i>)	
• Demo: Mobile Contextual Advertising Platform based on Tiny Text Intelligence	181
Jung-Hyun Lee, So-Young Jun, So-Jung Park, Kang-Min Kim, SangKeun Lee (<i>Korea University</i>)	
• Demo: BlueMountain: An Architecture to Customize Data Management on Mobile Systems	182
Sharath Chandrashekhara, Taeyeon Ki, Kyungho Jeon, Karthik Dantu, Steven Y. Ko (<i>University at Buffalo, The State University of New York</i>)	
• Demo: Fusing Mobile Sensors for Paper Keyboard On-the-Go	183
Anh Nguyen (<i>University of Colorado Boulder</i>), Duy Nguyen, Nhan Nguyen (<i>University of Science, Vietnam</i>), Ashwin Ashok (<i>Georgia State University</i>), Binh Nguyen, Bao Pham (<i>University of Science, Vietnam</i>), Tam Vu (<i>University of Colorado Boulder</i>)	
• Demo: sigSocial: A Novel Social Media Aggregation Service using a Tiny Text Intelligence	184
Hyunwoong Bang, Hyunsu Kim, SangKeun Lee (<i>Korea University</i>)	
• Demo: Fully Automated UI Testing System for Large-scale Android Apps Using Multiple Devices	185
Taeyeon Ki, Alexander Simeonov, Chang Min Park, Karthik Dantu, Steven Y. Ko, Lukasz Ziarek (<i>University at Buffalo, The State University of New York</i>)	
• DEMO: DeepMon - Building Mobile GPU Deep Learning Models for Continuous Vision Applications	186
Loc N. Huynh, Rajesh Krishna Balan, Youngki Lee (<i>Singapore Management University</i>)	
• Demo: Card-stunt as a Service: Empowering a Massively Packed Crowd for Instant Collective Expressiveness	187
Chungkuk Yoo (<i>Korea Advanced Institute of Science and Technology</i>), Inseok Hwang (<i>IBM Research</i>), Seungwoo Kang (<i>KOREATECH</i>), Myung-Chul Kim (<i>IBM</i>), Seonghoon Kim, Daeyoung Won (<i>Korea Advanced Institute of Science and Technology</i>), Yu Gu (<i>IBM</i>), June-hwa Song (<i>Korea Advanced Institute of Science and Technology</i>)	
• Demo: AWSense - A Framework for Collecting Sensing Data from the Apple Watch	188
Katrin Hänsel, Hamed Haddadi, Akram Alomainy (<i>Queen Mary University of London</i>)	
• Demo: Riding the Non-linearities to Record Ultrasound with Smartphones	189
Nirupam Roy, Haitham Hassanieh, Romit Roy Choudhury (<i>University of Illinois at Urbana-Champaign</i>)	
• Demo: Detecting Group Formations using iBeacon Technology	190
Kleomenis Katevas, Laurissa Tokarchuk, Hamed Haddadi, Richard G. Clegg, Muhammad Irfan (<i>Queen Mary University of London</i>)	
• Demo: Enabling Dynamic Gesture Mapping with UI Events	191
Chang Min Park, Taeyeon Ki, Karthik Dantu, Steven Y. Ko, Lukasz Ziarek (<i>University at Buffalo, The State University of New York</i>)	
• Demo: iBlink: Smart Glasses for Facial Paralysis Patients	192
Sijie Xiong, Sujie Zhu, Yisheng Ji, Binyao Jiang, Xiaohua Tian (<i>Shanghai Jiao Tong University</i>), Xuesheng Zheng (<i>Xin Hua Hospital Affiliated to Shanghai Jiao Tong University School of Medicine</i>), Xinbing Wang (<i>Shanghai Jiao Tong University</i>)	
• Demo: Reptor: Enabling API Virtualization on Android for Platform Openness	193
Taeyeon Ki, Alexander Simeonov, Chang Min Park, Karthik Dantu, Steven Y. Ko, Lukasz Ziarek (<i>University at Buffalo, The State University of New York</i>)	
• Demo: CELLI - Indoor Positioning using Polarized Sweeping Light Beams	194
Yu-Lin Wei, Chang-Jung Huang, Hsin-Mu Tsai, Kate Ching-Ju Lin (<i>National Chiao Tung University</i>)	
• Demo: Live Video Stream Triggers	195
Lenin Ravindranath, Matthai Philipose, Peter Bodik, Paramvir Bahl (<i>Microsoft Research</i>)	

SIGMOBILE Outstanding Contribution Award

- **ALOHA to the Web** 196
Norman Abramson (*University of Hawaii*)

SESSION PAPER 4: Security and Privacy I

Session Chair: Kyle Jamieson (*Princeton University*)

- **SchrodinText: Strong Protection of Sensitive Textual Content of Mobile Applications** 197
Ardalan Amiri Sani (*University of California, Irvine*)
- **Matthan: Drone Presence Detection by Identifying Physical Signatures in the Drone's RF Communication** 211
Phuc Nguyen, Hoang Truong (*University of Colorado Denver & University of Colorado Boulder*),
Mahesh Ravindranathan (*University of Colorado Boulder*),
Anh Nguyen (*University of Colorado Denver & University of Colorado Boulder*),
Richard Han (*University of Colorado Boulder*),
Tam Vu (*University of Colorado Denver & University of Colorado Boulder*)
- **System Service Call-oriented Symbolic Execution of Android Framework with Applications to Vulnerability Discovery and Exploit Generation** 225
Lannan Luo (*The Pennsylvania State University*), Qiang Zeng (*Temple University*),
Chen Cao, Kai Chen, Jian Liu, Limin Liu, Neng Gao (*Chinese Academy of Sciences*),
Min Yang (*Fudan University*), Xinyu Xing, Peng Liu (*The Pennsylvania State University*)

PAPER SESSION 5: RF Sensing

Session Chair: Lin Zhong (*Rice University*)

- **Enabling Gesture-based Interactions with Objects** 239
Longfei Shangguan (*Princeton University*), Zimu Zhou (*ETHZ*), Kyle Jamieson (*Princeton University*)
- **Position and Orientation Agnostic Gesture Recognition Using WiFi** 252
Aditya Virmani, Muhammad Shahzad (*North Carolina State University*)
- **Object Recognition and Navigation using a Single Networking Device** 265
Yanzi Zhu, Yuanshun Yao, Ben Y. Zhao, Haitao Zheng (*University of California, Santa Barbara*)
- **BreathPrint: Breathing Acoustics-based User Authentication** 278
Jagmohan Chauhan, Yining Hu, Suranga Seneviratne (*Data61, CSIRO, UNSW*), Archan Misra (*SMU*),
Aruna Seneviratne (*Data61, CSIRO, UNSW*), Youngki Lee (*SMU*)

PAPER SESSION 6: Offloading and Sharing

Session Chair: Robin Kravets (*University of Illinois at Urbana-Champaign*)

- **Glimpse: A Programmable Early-Discard Camera Architecture for Continuous Mobile Vision** 292
Saman Naderiparizi (*Microsoft & University of Washington*),
Pengyu Zhang (*Microsoft & University of Massachusetts, Amherst*),
Matthai Philipose, Bodhi Priyantha, Jie Liu (*Microsoft*), Deepak Ganesan (*University of Massachusetts, Amherst*)
- **Accelerating Mobile Audio Sensing Algorithms through On-Chip GPU Offloading** 306
Petko Georgiev (*University of Cambridge*), Nicholas D. Lane (*University College London*),
Cecilia Mascolo (*University of Cambridge*), David Chu (*Google*)
- **Enabling Cross-ISA Offloading for COTS Binaries** 319
Wenwen Wang, Pen-Chung Yew, Antonia Zhai, Stephen McCamant (*University of Minnesota, Twin Cities*),
Youfeng Wu, Jayaram Bobba (*Intel Labs*)
- **Mobile Plus: Multi-device Mobile Platform for Cross-device Functionality Sharing** 332
Sangeun Oh, Hyuck Yoo, Dae R. Jeong, Duc Hoang Bui,
Insik Shin (*Korea Advanced Institute of Science and Technology*)

PAPER SESSION 7: Wearables and CPS

Session Chair: Aruna Balasubramanian (*Stony Brook University*)

- **Indoor Follow Me Drone**345
Wenguang Mao, Zaiwei Zhang, Lili Qiu, Jian He, Yuchen Cui (*The University of Texas at Austin*),
Sangki Yun (*Hewlett Packard Labs*)
- **iBlink: Smart Glasses for Facial Paralysis Patients**359
Sijie Xiong, Sujie Zhu, Yisheng Ji, Binyao Jiang, Xiaohua Tian (*Shanghai Jiao Tong University*),
Xuesheng Zheng (*Xin Hua Hospital Affiliated to Shanghai Jiao Tong University School of Medicine*),
Xinbing Wang (*Shanghai Jiao Tong University*)
- **BigRoad: Scaling Road Data Acquisition for Dependable Self-Driving**371
Luyang Liu, Hongyu Li (*Rutgers University*), Jian Liu (*Stevens Institute of Technology*),
Cagdas Karatas (*Rutgers University*), Yan Wang (*Binghamton University*), Marco Gruteser (*Rutgers University*),
Yingying Chen (*Stevens Institute of Technology*), Richard P. Martin (*Rutgers University*)
- **Characterizing Smartwatch Usage in the Wild**385
Xing Liu, Tianyu Chen, Feng Qian (*Indiana University Bloomington*),
Zhixiu Guo (*Chinese Academy of Sciences & Beijing Jiaotong University*),
Felix Xiaozhu Lin (*Purdue University*), Xiaofeng Wang (*Indiana University Bloomington*),
Kai Chen (*Chinese Academy of Sciences & University of Chinese Academy of Sciences*)

PAPER SESSION 8: Mobile Performance

Session Chair: Rajesh Krishna Balan (*Singapore Management University*)

- **Reptor: Enabling API Virtualization on Android for Platform Openness**399
Taeyeon Ki, Alexander Simeonov, Bhavika Pravin Jain, Chang Min Park, Keshav Sharma, Karthik Dantu,
Steven Y. Ko, Lukasz Ziarek (*University at Buffalo, The State University of New York*)
- **iCharge: User-Interactive Charging of Mobile Devices**413
Liang He, Yu-Chih Tung, Kang G. Shin (*University of Michigan*)
- **Accelerating Mobile Web Loading Using Cellular Link Information**427
Xiufeng Xie, Xinyu Zhang, Shilin Zhu (*University of Wisconsin-Madison*)
- **Open Data Kit 2.0: A Services-Based Application Framework for Disconnected Data Management**440
Waylon Brunette, Samuel Sudar, Mitchell Sundt, Clarice Larson, Jeffrey Beorse,
Richard Anderson (*University of Washington*)

SESSION PAPER 9: Security and Privacy II

Session Chair: Ardalan Amiri Sani (*University of California, Irvine*)

- **Heimdall: A Privacy-Respecting Implicit Preference Collection Framework**453
Amir Rahmati, Earlece Fernandes, Kevin Eykholt, Xinheng Chen, Atul Prakash (*University of Michigan*)
- **Trust but Verify: Auditing the Secure Internet of Things**464
Judson Wilson, Riad S. Wahby, Henry Corrigan-Gibbs, Dan Boneh, Philip Levis,
Keith Winstein (*Stanford University*)
- **Techu: Open and Privacy-Preserving Crowdsourced GPS for the Masses**475
Ioannis Agadakos (*Stevens Institute of Technology*), Jason Polakis (*University of Illinois at Chicago*),
Georgios Portokalidis (*Stevens Institute of Technology*)
- **TrustShadow: Secure Execution of Unmodified Applications with ARM TrustZone**488
Le Guan, Peng Liu, Xinyu Xing (*The Pennsylvania State University*), Xinyang Ge (*Microsoft Research*),
Shengzhi Zhang (*Florida Institute of Technology*), Meng Yu (*University of Texas at San Antonio*),
Trent Jaeger (*The Pennsylvania State University*)

- **Author Index**502