

SenSys 2013

**Proceedings of the 11th ACM Conference on
Embedded Networked Sensor Systems**



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Message from the General Chair

It is my great pleasure to welcome you to ACM SenSys 2013, the 11th ACM Conference on Embedded Networked Sensor Systems, which takes place in Rome, Italy on November 11-14 2013.

The conference, the eleventh of a series of successful meetings of researchers and practitioners from both academia and industry, has been established to serve as the premier forum within ACM to discuss systems issues raised by emerging trends and paradigms in the area of embedded, networked sensing systems.

Distributed sensing systems—broadly defined to include mobile sensing, body sensing, Kinect, camera networks, instrumented smart materials, sensing through cooperative robotics and vehicles, RFID, and many other topics—allow for an instrumentation of the physical world at an unprecedented scale and density, thus enabling a new generation of monitoring and control applications. SenSys provides a cross-disciplinary venue for researchers addressing the rich space of networked sensing systems, and outreaches to related areas such as low power embedded systems design, machine learning and data analytics, and cyber physical systems by means of a rich program that includes a hands-on research exhibition and four workshops.

Landon Cox and Kamin Whitehouse have put together a high quality and exciting technical program. They have been helped by an exceptional cohort of experts. I express my sincere thanks to both TPC co-chairs, who have helped shape this years edition of SenSys, and to the TPC members for the valuable high quality feedback they have provided to the authors, which has helped improve the quality of the selected papers.

The conference could not be as successful as it is if not for the contribution and tireless work of the members of the Organizing Committee.

Poster chairs Chenyang Lu and Luca Mottola, and demo chairs Emiliano Miluzzo and Amy Murphy's excellent work has allowed SenSys to put together an impressive research exhibition featuring seventy posters and demos addressing an extremely wide set of topics. As traditional at SenSys, the research exhibition will be a core component of the technical program, providing the discussion space for presenting in-progress ideas and results. Involvement of industrial researchers and developers has been secured by the industry liaison chairs Jie Liu and Adam Wolisz, who have also provided stimulating ideas on the format and organization of the conference.

Workshop chairs, Luca Benini and Deepak Ganesan, with the support of the ACM SenSys steering committee, have provided key contributions to the success of this years edition, by identifying new areas to target for SenSys workshops. In addition to the successful and growing BuildSys, and to the Doctoral Colloquium, this year we have initiated two new workshops: ENSSys, on Energy Neutral Sensing Systems, and SenseMine, on the integration of Sensing and Big Data Mining. All workshops have been quite successful, attracting a large number of high quality submissions. I would therefore like to thank Luca and Deepak, as well as the organizing committees of the workshops—Cecilia Mascolo for the Doctoral Colloquium; Karl Henrik Johansson, Michael R Brambley and Prashant Shenoy for BuildSys; Davide Brunelli and Geoff V Merrett for ENSSys; Emiliano Miluzzo and Deepak Turaga for SenseMine—for their excellent job and for the enthusiasm with which they have pursued the objective to enlarge the scope and areas covered by SenSys.

Wendi Heinzelman, our publication chair, has provided precious support to all the members of the organizing committee, interfacing with ACM on many different aspects. Her help and dedication to the success of the event has been exceptional.

The local arrangement co-chairs Francesca Cuomo, Gaia Maselli, and Andrea Vitaletti have done a superb job overseeing all aspects of meeting planning and organization. Laura Galluccio and Dora Spenza, our registration co-chairs, and Rasit Eskicioglu, the finance chair, did an excellent job developing and managing the conference budget, and helping authors with the registration process. I also would like to acknowledge the invaluable efforts and contributions of David Boyle, our web chair, and of Stefano Basagni, Alberto Cerpa, Salil Kanhere and Mike Chieh-Jan Liang who coordinated and implemented publicity for the conference in different parts of the planet!

I would like to thank NSF for providing support for graduate students to attend the conference. I welcome these students to the conference and thank Radu Stoleru and Pedro Marron, our student travel awards chairs, for a superb job. I would also like to thank Niki Trigoni, our N²Women chair, who has further enriched opportunities for students to learn and be trained for a successful research career by involving a

strong group of leading female researchers in this years mentoring event.

Finally, my deepest thanks go to the steering committee of ACM SenSys, John Stankovic (Chair), Jan Beutel, Andrew Campbell, Rasit Eskicioglu, Deepak Ganesan, Koen Langendoen, Philip Levis, Jie Liu, Chiara Petrioli, Sylvia Ratnasamy and Kay Roemer, who have followed closely each edition of the conference, and immensely contributed to its lasting success. For the 2013 event, their contribution to the organization of the conference has been essential, in terms of supporting the conference organization and the selection of co-located events.

I look forward to an exciting meeting in Rome, and I thank you all for attending the conference and for the strong contributions you have provided to the technical program, which are the prerequisites for making the event a success!

Chiara Petrioli

SenSys 2013 General Chair

Message from the Program Chairs

Welcome to SenSys 2013, the 11th ACM Conference on Embedded Networked Sensor Systems!

As in recent years, the technical program this year explores several new and exciting directions and trends in sensor systems. Topics include personal sensing, mobile sensing, crowdsourcing, intelligent buildings, vehicles and transportation, and many more.

We are thrilled to kick off the technical program with a keynote talk by Shahram Izadi, a senior researcher at Microsoft Research (Cambridge UK), whose multi-disciplinary group is developing new types of cameras, sensors, and displays and pioneering new ways to use them. After the keynote, we have an exciting technical program that includes 21 full length technical papers, selected by the technical program committee (TPC) from the 123 submissions received.

The TPC created the technical program using a rigorous review process that consisted of 3 different rounds of decisions. In the first round, papers were reviewed by 3-4 experts and any paper for which at least one expert recommended acceptance was advanced to the second round, in which it was reviewed by 2-3 more experts, for a total of 5-7 reviews for each paper. At the end of the second round, the reviewers for each paper conferred to decide whether it would be advanced to the third round of decisions. The third round of decisions were made during an all-day face-to-face meeting where the merits of each paper were discussed in detail by the entire committee. After the decisions, some papers were shepherded by a TPC member to ensure that all final manuscripts met the standards of the committee.

Strict precautions were taken throughout the entire review process to avoid conflicts of interest. Furthermore, as the TPC chairs, we did not submit papers to the conference ourselves in order to avoid conflicts of interest.

Creating the technical program for SenSys 2013 was a team effort and we would like to thank the TPC members, external reviewers, and shepherds who worked very hard to understand, review, and provide suggestions to the submitted papers. We would also like to thank the authors for providing exceptional contributions.

We are also grateful to our colleagues who helped organize the conference, including the steering committee, the poster chairs (Chenyang Lu and Luca Mottola), the demo chairs (Emiliano Miluzzo and Amy Murphy), the finance chair (Rasit Eskicioglu), the publicity chairs (Stefano Basagni, Alberto Cerpa, Salil Kanhere, and Mike Chieh-Jan Liang), the publication chair (Wendi Heinzelman), the workshop chairs (Luca Benini and Deepak Ganesan), the industrial liaison chairs (Jie Liu and Adam Wolisz), the N²Women chair (Niki Trigoni), the doctoral colloquium chair (Cecilia Mascolo), the student travel awards chairs (Pedro Marron and Radu Stoleru), the registration chairs (Laura Galluccio and Dora Spenza), and the web chair (David Boyle). We would especially like to thank general chair Chiara Petrioli and local arrangements chairs Francesca Cuomo, Gaia Maselli, and Andrea Vitaletti. Their handling of the conference logistics was invaluable. Finally, we thank our sponsors, ACM SIGMOBILE, and our supporters, Facebook, Microsoft Research, the National Science Foundation, and the University of Rome 'La Sapienza'.

We hope you will find the technical program exciting and thought provoking, and that the conference will provide you with a valuable opportunity to share ideas with others from around the world.

Landon Cox and Kamin Whitehouse
SenSys 2013 Program Co-Chairs

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Jeonghoon Kang (*Korea Electronics Technology Institute*), Su Chang Lee (*Sinbinet*), Hangeol Kim (*Sonnonet*), Sukun Kim (*Sinbinet*), David Culler (*University of California at Berkeley*), Pil-Mhan Jung (*Sonnonet*), Taejoon Choi (*Sonnonet*), Kooklae Jo (*Sonnonet*), and JaeYeol Shim (*Sonnonet*)

- **Demo Abstract: ProvinciaSense - Extending the Capillary WiFi Infrastructure of Lazio Region with Static and Mobile Sensor Networks**
Tommaso Arzilli (*University of Rome La Sapienza*), Francesco Ficarola (*University of Rome La Sapienza*), Khalil Massri (*University of Rome La Sapienza*), Andrea Vitaletti (*University of Rome La Sapienza*), Francesco Loriga (*Lazio Region*), Ilaria De Marinis (*CINECA*), Andrea Ferraresi (*CINECA*), Riccardo Bloise (*CINECA*), and Maurizio Goretti (*CINECA*)
- **Demo Abstract: Exploring Smartphone-based Participatory Computing to Improve Pervasive Surveillance**
Zheng Dong (*Singapore University of Technology and Design*), Banghui Lu (*Singapore University of Technology and Design*), Liang He (*Singapore University of Technology and Design*), Peng Cheng (*Singapore University of Technology and Design, Zhejiang University*), Yu Gu (*Singapore University of Technology and Design*), and Lu Fang (*University of Science and Technology of China*)
- **Demo Abstract: A Cooja-based Tool for Maintaining Sensor Network Coverage Requirements in a Building**
Lanny Sitanayah (*University College Cork*), Cormac J. Sreenan (*University College Cork*), and Szymon Fedor (*United Technologies Research Center (UTRC) Ireland Ltd*)
- **Demo Abstract: Supporting Interoperability of Things in IoT Systems**
Daniele Mattiacci (*Sapienza University of Rome*), Sokol Kosta (*Sapienza University of Rome*), Alessandro Mei (*Sapienza University of Rome*), and Julinda Stefa (*Sapienza University of Rome*)
- **Demo Abstract: BodySim - A Multi-Domain Modeling and Simulation Framework for Body Sensor Networks Research and Design**
Philip Asare (*University of Virginia*), Robert F. Dickerson (*University of Virginia*), Xianyu Wu (*University of Birmingham*), John Lach (*University of Virginia*), and John A. Stankovic (*University of Virginia*)
- **Demo Abstract: Powering Indoor Sensing with Airflows - A Trinity of Energy Harvesting, Synchronous Duty-Cycling, and Sensing**
Feng Li (*School of Computer Engineering, Nanyang Technological University*), Tianyu Xiang (*School of Computer Engineering, Nanyang Technological University*), Zicheng Chi (*School of Computer Engineering, Nanyang Technological University*), Jun Luo (*School of Computer Engineering, Nanyang Technological University*), Lihua Tang (*School of Civil and Environmental Engineering, Nanyang Technological University*), Liya Zhao (*School of Civil and Environmental Engineering, Nanyang Technological University*), and Yaowen Yang (*School of Civil and Environmental Engineering, Nanyang Technological University*)
- **Demo Abstract: A User-Centric Mobility Sensing System for Transportation Activity Surveys**
Fang-Jing Wu (*Nanyang Technological University*), Hock Beng Lim (*Nanyang Technological University*), Francisco Pereira (*Singapore-MIT Alliance for Research and Technology*), Chris Zegras (*Massachusetts Institute of Technology*), and Moshe Ben-Akiva (*Massachusetts Institute of Technology*)
- **Demo Abstract: Kintense: A Robust, Accurate, Real-Time and Evolving System for Detecting Aggressive Actions from Streaming 3D Skeleton Data**
Shahriar Nirjon (*University of Virginia*), Chris Greenwood (*University of Virginia*), Carlos Torres (*University of Virginia*), Stefanie Zhou (*University of Virginia*), John A. Stankovic (*University of Virginia*), Hee Jung Yoon (*Daegu Gyeongbuk Institute of Science and Technology*), Ho-Kyeong Ra (*Daegu Gyeongbuk Institute of Science and Technology*), Can Basaran (*Daegu Gyeongbuk Institute of Science and Technology*), Taejoon Park (*Daegu Gyeongbuk Institute of Science and Technology*), and Sang H. Son (*Daegu Gyeongbuk Institute of Science and Technology*)
- **Demo Abstract: Plants as Sensing Devices - the PLEASED experience**
Veronica Manzella (*WLAB*), Claudio Gaz (*WLAB*), Andrea Vitaletti (*WLAB and University of Rome La Sapienza*), Elisa Masi (*University of Florence*), Luisa Santopolo (*University of Florence*), Stefano Mancuso (*University of Florence*), Jose J de las Heras (*Advanticsys*), and Diego Salazar (*Advanticsys*)
- **Demo Abstract: Self-Organized Bluetooth Scatternets for Wireless Sensor Networks**
Michael Methfessel (*IHP*), Stefan Lange (*IHP*), Rolf Kraemer (*IHP*), Mario Zessack (*lesswire AG*), and Steffen Peter (*UCI*)

- **Demo Abstract: Plug&Play Site Management or, Why Your Solar Panel Should Be Like Your Webcam**
Ettore Ferranti (*ABB Corporate Research*), Alessandro Montanari (*ABB Corporate Research*), Yvonne-Anne Pignolet (*ABB Corporate Research*), and Igor Zablatchi (*ABB Corporate Research*)
- **Demo Abstract: Introducing the MagoNode Platform**
Ugo Maria Colesanti (*Sapienza Università di Roma*), Antonio Lo Russo (*Sapienza Università di Roma*), Mario Paoli (*Sapienza Università di Roma*), Chiara Petrioli (*Sapienza Università di Roma*), and Andrea Vitaletti (*Sapienza Università di Roma*)
- **Demo Abstract: Adaptive Cross-Layer Routing for Underwater Acoustic Sensor Networks with the SUNSET Framework**
Chiara Petrioli (*University of Rome “La Sapienza” - WSENSE s.r.l.*), Roberto Petrocchia (*University of Rome “La Sapienza” - WSENSE s.r.l.*), and Daniele Spaccini (*University of Rome “La Sapienza”*)
- **Demo Abstract: Disambiguating Household Energy-Harvesting Energy Meter Data Streams**
Bradford Campbell (*University of Michigan*), Samuel DeBruin (*University of Michigan*), and Prabal Dutta (*University of Michigan*)
- **Demo Abstract: Building Embedded Applications via REST Services for the Internet of Things**
Floris Van den Abeele (*Ghent University - iMinds*), Jeroen Hoebeke (*Ghent University - iMinds*), Isam Ishaq (*Ghent University - iMinds*), Girum K Teklemariam (*Ghent University - iMinds*), Jen Rossey (*Ghent University - iMinds*), Ingrid Moerman (*Ghent University - iMinds*), and Piet Demeester (*Ghent University - iMinds*)
- **Demo Abstract: Bliss Buzzer, a System to Monitor Health and Stress with Real-time Feedback**
Giorgio Quer (*UC San Diego*), Anthony Nwokafor (*UC San Diego*), Arindam Ganguly (*UC San Diego*), Nafi Rashid (*UC San Diego*), John Zhu (*UC San Diego*), Dheeraj Navani (*UC San Diego*), and Ramesh R. Rao (*UC San Diego*)
- **Demo Abstract: Extrapolation from Participatory Sensing Data**
Hengchang Liu (*UIUC*), Siyu Gu (*UIUC*), Chenji Pan (*UIUC*), Wei Zheng (*UW-Madison*), Shen Li (*UIUC*), Shaohan Hu (*UIUC*), Shiguang Wang (*UIUC*), Dong Wang (*UIUC*), Tanvir Amin (*UIUC*), Lu Su (*UIUC*), Zhiheng Xie (*UVA*), Ramesh Govindan (*USC*), Amotz Barnoy (*CUNY*), and Tarek Abdelzaher (*UIUC*)
- **Demo Abstract: Securing Data Provenance in Body Area Networks using Lightweight Wireless Link Fingerprints**
Syed Taha Ali (*University of New South Wales*), Vijay Sivaraman (*University of New South Wales*), Diethelm Ostry (*CSIRO Computational Informatics*), and Sanjay Jha (*University of New South Wales*)
- **Demo Abstract: Understanding the Effects of Carrier Frequency Difference in Concurrent Transmission**
Yasutaka Yamashita (*The University of Tokyo*), Yukou Tashiro (*The University of Tokyo*), Makoto Suzuki (*The University of Tokyo*), Yoshihiro Hase (*The University of Tokyo*), and Hiroyuki Morikawa (*The University of Tokyo*)
- **Demo Abstract: ThermoSense: Thermal Array Sensor Networks in Building Management**
Varick L. Erickson (*University of California, Merced*), Alex Beltran (*University of California, Merced*), Daniel A. Winkler (*University of California, Merced*), Niloufar P. Esfahani (*University of California, Merced*), John R. Lusby (*University of California, Merced*), and Alberto E. Cerpa (*University of California, Merced*)
- **Demo Abstract: HeartSense - Estimating Blood Pressure and ECG from Photoplethysmograph using Smart Phones**
Anirban Dutta Choudhury (*Innovation Labs, Tata Consultancy Services*), Aishwarya Visvanathan (*Innovation Labs, Tata Consultancy Services*), Rohan Banerjee (*Innovation Labs, Tata Consultancy Services*), Aniruddha Sinha (*Innovation Labs, Tata Consultancy Services*), Arpan Pal (*Innovation Labs, Tata Consultancy Services*), Chirabatra Bhaumik (*Innovation Labs, Tata Consultancy Services*), and Anurag Kumar (*Indian Institute of Technology, Delhi*)

- **Demo Abstract: Twonet - Large-Scale Wireless Sensor Network Testbed with Dual-Radio Nodes**
Qiang Li (*University of Houston*), Dong Han (*University of Houston*), Omprakash Gnawali (*University of Houston*), Philipp Sommer (*CSIRO*), and Branislav Kusy (*CSIRO*)

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