Vikram Gupta

CONTACT INFORMATION

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RESEARCH INTERESTS

Networked Embedded Systems, Wireless Sensor Networks, Cyber-Physical Systems, Embedded Operating Systems, Distributed Systems, Real-Time Embedded Systems, Wireless Communications

EDUCATION

Doctor of Philosophy, Carnegie Mellon University **August 2008 - present**

Ph.D. Candidate in the Dual-Degree Carnegie Mellon-Portugal Program, jointly enrolled at *Electrical and Computer Engineering, Carnegie Mellon University, Pittsburgh, USA* & *Faculty of Engineering, University of Porto, Portugal*

(expected graduation: Oct 2014)

- Dissertation Topic: "On the Optimization of Multiple Applications for Sensor Networks"
- Co-advised by **Prof. Ragunathan (Raj) Rajkumar**, Carnegie Mellon University. & **Prof. Eduardo Tovar**, Director, CISTER/INESC-TEC Research Center, Polytechnic Institute of Porto, Portugal

Master of Science, Carnegie Mellon University **August 2008 - May 2010**

Department of Electrical and Computer Engineering, under the supervision of **Prof. Ragunathan (Raj) Rajkumar** (Cumulative QPA: 3.64/4.00)

Bachelor of Technology, Visvesvaraya National Institute of Technology **July 2003 - May 2007**

Department of Electronics and Communication Engineering at Visvesvaraya National Institute of Technology (V.N.I.T.), Nagpur, India (CPI: 8.28/10.00)

ACADEMIC EXPERIENCE

Carnegie Mellon University, Pittsburgh, Pennsylvania, USA &
CISTER/INESC-TEC Research Center, Polytechnic Institute of Porto

Graduate Research Assistant **August 2008 - present**

Addressed various challenges that arise with multiple applications running on a sensor network mainly with respect to the application development, installation and execution. Following key projects were undertaken as a part of the graduate research with overall focus on supporting multiple applications on a sensor network:

- **Harmonizing Protocol for Low-Power Networks**: Designed an efficient and low-overhead protocol [1, 3] for coordinating communication in multi-hop wireless sensor networks. The protocol batches packets throughout the network from multiple applications. It is implemented for the Contiki operating system and shown to be highly energy efficient.
- **Feature-Identification in Dense Networks**: Worked on several research projects aimed at optimizing large scale data-collection and feature extraction of physical phenomena in highly dense sensor networks through information processing [2] and novel networking-infrastructure design [4].
- **Deploying Multiple Applications on Sensor Networks**: Developed a programming and management framework called *Nano-CF* [9, 10] that can allow programming and deployment of sensor networking applications by independent applications. This project is a step towards a larger goal [7, 8] of making sensing an infrastructure technology with multi-purpose sensor networks, and helping in enabling the vision of *Internet of Things*.

- **Redundancy Elimination Across Applications**: Proposed an approach (REIS) [6] for finding and eliminating redundant sensor sampling across applications running on a sensor device. This approach helps in saving energy and optimizes the overall resource consumption on a resource-constrained sensor mote.
- **Time-Synchronization in Sensor Networks**: Developed a hardware-module [12] and a corresponding protocol that wireless-ly uses the energy radiating from AC power lines as a common clock-synchronization signal for devices deployed inside buildings. This approach is a few orders of magnitude energy efficient compared to message passing clock-synchronization approaches.
- **Energy Harvesting in Sensor Networks**: Conducted a feasibility study on harvesting ambient energy radiating from AC powerlines for powering very low duty-cycle sensor networks [11].

Research Associate

Indian Institute of Technology (IIT), Delhi, New Delhi, India
Research Associate **Jun 2007 - Jun 2008**

Worked on a project titled *Assessment of WiMAX (802.16) Technology for Performance, Manageability and Interoperability on a Campus Area Test-Bed* supervised by **Prof. Huzur Saran**. My responsibilities included surveying the campus for finding the locations for deployment of base stations and conducting performance experiments on the deployed test-bed.

Summer Internship

Indian Institute of Technology (IIT), Kanpur, Kanpur, India **May 2006 - Jul, 2006**
Implemented and studied error correcting codes with an emphasis on *Simulation of Turbo Codes and Analysis of Iterative and BCJR Decoding Algorithms* under the mentor-ship of Prof. K Vasudevan, Department of Electrical Engineering.

TEACHING EXPERIENCE

Worked as a teaching assistant for two graduate-level courses, as a part of the PhD program responsibilities.

- **18-782 Machine Learning, Fall 2013**: Taught by Prof. Jaime Cardoso, projects and lab assignments were designed and evaluated covering various machine learning tools such as Regression, Neural Networks, Support Vector Machines and Hidden Markov Models.
- **18-648 Embedded Real-Time Systems, Fall 2009**: Taught by Prof. Raj Rajkumar, this course aimed at teaching the basic concepts of Real-Time Embedded Systems to Masters's/Doctoral Students. My responsibilities were designing and evaluating quizzes, exams and lab assignments for about 60 students. Google's Android operating system was used as a basis where we designed a series of experiments which culminated in students being able to build resource-kernel features in a commercial operating system.

PUBLICATIONS

[1] **Vikram Gupta**; Nuno Pereira; Eduardo Tovar; Ragunathan (Raj) Rajkumar, *Network-Harmonized Scheduling for Multi-Application Sensor Networks*, in the proceedings of IEEE 17th International Conference on Embedded and Real-Time Computing Systems and Applications (RTCSA), 2014 to be help in Chongqing, China, 20-22 Aug 2014

[2] Maryam Vahabi; **Vikram Gupta**; Michele Albano; Eduardo Tovar, *Feature Extraction in Densely Sensed Environments*, 2014 IEEE International Conference on Distributed Computing in Sensor Systems (DCOSS) held at Marina Del Ray, USA, pp.143,151, 26-28 May 2014

[3] **Vikram Gupta**; Eduardo Tovar; Nuno Pereira; Ragunathan (Raj) Rajkumar, *Poster abstract: A Harmony of Sensors: Achieving Determinism in Multi-Application Sensor Networks*, in proceedings

of the 13th International Symposium on Information Processing in Sensor Networks (IPSN), pp.299,300, 15-17 April 2014

[4] João Loureiro; **Vikram Gupta**; Nuno Pereira; Eduardo Tovar; Raghu R, *XDense: A Sensor Network for Extreme Dense Sensing*, at the Work-in-Progress Session at IEEE Real-Time Systems Symposium (RTSS) 2013 held in Vancouver, Canada

[5] **Vikram Gupta**; Eduardo Tovar; Nuno Pereira; Ragunathan (Raj) Rajkumar, *From Sensor Networks to Internet of Things: - A Paradigm for Empowering an Infrastructure Technology*, poster presented in CISTER 1st Industrial Workshop on Real-Time and Embedded Systems (CiWork 2013) held in conjunction with 8th IEEE International Symposium on Industrial Embedded Systems (SIES). Porto, Portugal.

[6] **Vikram Gupta**; Eduardo Tovar; Karthik Lakshmanan; Ragunathan (Raj) Rajkumar, *Inter-application redundancy elimination in Wireless Sensor Networks with compiler-assisted scheduling*, 7th IEEE International Symposium on Industrial Embedded Systems (SIES), 2012, held at Kalsruhe, Germany pp.112,119, 20-22 June 2012

[7] **Vikram Gupta**; Eduardo Tovar; Nuno Pereira; Ragunathan (Raj) Rajkumar, *CoS: A New Perspective of Operating Systems Design for the Cyber-Physical World*, In the proceedings of 8th annual workshop on Operating Systems Platforms for Embedded Real-Time applications (OSPERT), July 10, 2012. Pisa, Italy held in conjunction with 24th Euromicro Conference on Real-Time Systems (ECRTS 12)

[8] **Vikram Gupta**; Eduardo Tovar; Karthik Lakshmanan; Ragunathan (Raj) Rajkumar *A Framework for Programming Sensor Networks with Scheduling and Resource-Sharing Optimizations*, (Invited Paper): In proceedings of the Cyber-Physical Systems, Networks, and Applications (CPSNA 2011) held in conjunction with IEEE 17th International Conference on Embedded and Real-Time Computing Systems and Applications (RTCSA), 2011, pp.37,40, 28-31 Aug. 2011

[9] **Vikram Gupta**; Junsung Kim; Aditi Pandya; Karthik Lakshmanan; Ragunathan (Raj) Rajkumar; Edaurdo Tovar, *Nano-CF: A coordination framework for macro-programming in Wireless Sensor Networks*, 8th Annual IEEE Communications Society Conference on Sensor, Mesh and Ad Hoc Communications and Networks (SECON), 2011, pp.467,475, 27-30 June 2011

[10] **Vikram Gupta**; Eduardo Tovar; Luis Miguel Pinho; Junsung Kim; Karthik Lakshmanan; and Ragunathan(Raj) Rajkumar. 2011. *sMapReduce: A Programming Pattern for Wireless Sensor Networks*. In Proceedings of the 2nd Workshop on Software Engineering for Sensor Network Applications (SESENA '11), held in conjunction with International Conference on Software Engineering (ICSE) 2011

[11] **Vikram Gupta**; Arvind Kandhalu; Ragunathan (Raj) Rajkumar, 2010, *Energy harvesting from electromagnetic energy radiating from AC power lines*, In Proceedings of the 6th Workshop on Hot Topics in Embedded Networked Sensors (HotEmNets '10) held at Killarney, Ireland

[12] Anthony Rowe; **Vikram Gupta**; Ragunathan (Raj) Rajkumar, *Low-Power Clock Synchronization using Electromagnetic Energy Radiating from AC Power Lines*, **(Best paper award)**, In Proceedings of the 7th ACM Conference on Embedded Networked Sensor Systems (SenSys '09) held at Berkeley, USA

PAPERS IN PREPARATION

Vikram Gupta; Nuno Pereira; Eduardo Tovar; Ragunathan (Raj) Rajkumar, *Network-Harmonized Scheduling for Multi-Application Sensor Networks*, under submission to IEEE Transactions on Industrial Informatics (TII) Journal

Maryam Vahabi; **Vikram Gupta**; Michele Albano; Eduardo Tovar, *Feature Extraction in Densely Sensed Environments*, under submission to IEEE Internet of Things (IoT) Journal

Vikram Gupta; Eduardo Tovar; Karthik Lakshmanan; Ragunathan (Raj) Rajkumar, *Inter-application Redundancy Elimination for Resource Management on Sensor Networks*, under review at International Journal for Embedded Systems (Inderscience)

Professional Services

- Web-Chair for the prestigious 12th European Conference on Wireless Sensor Networks (EWSN 2015) to be held from 9-11 February 2015 at Porto, Portugal
- Program Committee Member for 8th Junior Researcher Workshop on Real-Time Computing (JRWRTC 2014), to be held in conjunction with the 22nd International Conference on Real-Time and Network Systems (RTNS 2014)
- Reviewer for European Conference on Wireless Sensor Networks (EWSN 2014, 2013, 2012)
- Reviewer for the IEEE Transactions on Industrial Informatics (2011)
- Reviewer for the IEEE Real-Time Systems Symposium (RTSS 2010)
- Reviewer for the Euromicro Conference on Real-Time Systems (ECRTS 2011-2013)
- Reviewer for the IEEE International Conference on Embedded and Real-Time Computing Systems and Applications (RTCSA) 2014
- Co-reviewer for other prestigious conferences such as ICDCS-2011, CPSNA-2014, SIES-2014
- Co-advised several students in their Master/Bachelor thesis

Honours and Awards

- Second-place award (among 30 teams) in a programming contest on the Contiki Operating System held as a part of CONET Summer School in Bertinoro, Italy in Jun 2011.
- Best paper award at Sensys 2009 for the paper: *Low-Power Clock Synchronization using Electromagnetic Energy Radiating from AC Power Lines*

Technical Skills

Experience of programming and designing embedded software systems and Linux kernel programming and languages like C, C++, and Java

- Programming embedded devices such as Gumstix, Android G1 phone and several sensor networking platforms such as Firefly, TelosB with Atmel ATMEGA1281 and MSP430 microcontrollers respectively.
- Experience of working with and designing several communication and networking protocols for low-powered embedded systems.
- Extensive experience with the Linux operating system and sensor networking operating systems such as Contiki and Nano-RK.
- Used C extensively for kernel programming on Android and Linux kernel, and developing applications and protocols for sensor networks.
- Experience with C++, Java through various course projects.
- Extensive experience with simulation tools like Matlab, and Network Simulators like COOJA and NS2
- Moderate knowledge of hardware description language VHDL, and tools ModelSim, Xilinx ISE

Mailing Addresses

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References

Available on Request.