
CONTACT INFORMATION	<p>Embedded Systems Laboratory (ESL) School of Electrical and Computer Engineering Purdue University West Lafayette, IN 47907</p>	<p><i>Mobile:</i> +1-765-714-5223 <i>E-mail:</i> lee992@purdue.edu http://www.woosuklee.com</p>
RESEARCH INTERESTS	<p>Hardware/software co-design, Embedded systems design, Ultra-low power design, Reliability engineering, Multi-disciplinary engineering (e.g., biomedical engineering, industrial automation), Network systems and communication software (stack) development, Standardization of technologies (e.g., IEC, ISO)</p>	
EDUCATION	<p>Purdue University, West Lafayette, IN, USA</p> <p>Ph.D., School of Electrical and Computer Engineering, Summer 2016 (expected)</p> <ul style="list-style-type: none"> – Specialization: Embedded systems – GPA: 3.71/4.00 (as of Aug 2015) – Advisor: Professor Vijay Raghunathan <p>Hanyang University, South Korea</p> <p>M.S., Electronics, Electrical & Instrumentation Engineering, Feb 2009</p> <ul style="list-style-type: none"> – Specialization: Control networks – Thesis Title: Design and Implementation of a KNX-ZigBee Gateway – GPA: 4.00/4.00 – Advisor: Professor Seung Ho Hong <p>Hanyang University, South Korea</p> <p>B.S., Electronics and Electrical Engineering, Feb 2007</p> <ul style="list-style-type: none"> – <i>Cum Laude</i>, With Honors in Engineering – GPA: 3.54/4.00 	
PROFESSIONAL /RESEARCH EXPERIENCE	<p>Purdue University, West Lafayette, IN, USA</p> <p><i>Research Assistant</i> Jan 2011 ~ present</p> <ul style="list-style-type: none"> – Embedded Systems Lab, supervised by Professor Vijay Raghunathan – Research on various aspects of embedded systems with an emphasis on reliable system design, low power design, and micro-scale energy harvesting. <ol style="list-style-type: none"> ① Long-lived wireless sensor devices for implantable medical applications ② Micro-scale energy harvesting systems that operate at microampere level ③ Continuous computation in transiently powered computers ④ A co-processor augmented HW/SW architecture for reliable embedded systems 	

Microsoft Applied Science Group, Redmond, WA, USA

Research Intern

May 2015 ~ Aug 2015

- Research intern at Microsoft ASG (Applied Science Group), Redmond, WA, USA (Mentor: Dr. Flavio Ribeiro)
- Proposed and designed a low power communication channel for human-machine interaction devices (*details are not available due to NDA*)

Microsoft Applied Science Group, Redmond, WA, USA

Research Intern

Jun 2014 ~ Sep 2014

- Research intern at Microsoft ASG (Applied Science Group), Redmond, WA, USA (Mentor: Dr. Flavio Ribeiro)
- Developed a human-machine interaction device, which is fully optimized for low power operation (*details are not available due to NDA*)

Microsoft Research, Redmond, WA, USA

Research Intern

May 2012 ~ Aug 2012

- Research intern at SERG (Sensing and Energy Research Group), MSR (Microsoft Research), Redmond, WA, USA (Supervisors: Dr. Jie Liu, Dr. Bodhi Priyantha)
- Involved in the project CLEO for CO-GPS (Cloud-Offloaded GPS) technology
- Developed a GPS-sensing hardware/software front-end suite that enables three orders of magnitude lower energy consumption compared to the conventional GPS solution.

Ubiquitous Sensor Network Research Center (USNRC), South Korea

Researcher

Feb 2009 ~ Jul 2010

- Mainly focused on energy efficient smart-grid
 - ① DR (Demand-Responsive) for smart-grid
 - ② AMI (Advanced Metering Infrastructure) for smart-grid
 - ② Building/Home Wireless Sensor Networks (WSN) technology for Smart-grid
 - ③ Developed a redundancy master controller for industrial network PROFIBUS DP for IGCC (Integrated Gasification Combined Cycle) power generation plant control.

International Electrotechnical Commission (IEC), Geneva, Switzerland

Korean delegate

Aug 2006 ~ Jul 2008

- Standardized an industrial Ethernet protocol 'RAPIEnet' as an international standard IEC/PAS 62573
- The IEC/PAS 62573 played a seminal role in subsequent standardization and now (as of Dec 2013) 'RAPIEnet' holds several IEC standards listed below
 - IEC 61158-3-21
 - IEC 61158-4-21
 - IEC 61158-5-21
 - IEC 61158-6-21
 - IEC 61784-2
 - IEC 62439-7

Korean Agency for Technology and Standards (KATS), Gwacheon, South Korea

Organizing secretary

Aug 2006 ~ Jul 2008

- Organized IEC National Committee (NC) meetings held in Korea.

Hochschule Esslingen, University of Applied Sciences, Göppingen, Germany

Participant for summer school

Jun 2006 ~ Jul 2006

- Study on theory and applications of industrial networks

Hanyang University, South Korea

Research Assistant

Mar 2006 ~ Feb 2009

- Ubiquitous Network Systems Laboratory, supervised by **Professor Seung Ho Hong**
- Research on control networks to untangle the intricate nature of diverse communication protocols
 - ① Architecture and protocols of WSNs for home/building automation
 - ② Building/Home wired-wireless unified network solution for Smart-grid

Republic of Korea Army, Seoul, South Korea

Enlisted soldier - Sergeant

Jan 2002 ~ Feb 2004

- Served military duty for 26 months and discharged as a sergeant

TEACHING
EXPERIENCE

Purdue University, West Lafayette, IN, USA

Teaching Assistant

Jan 2015 ~ May 2015

- ECE 568: Embedded Systems

BOOK CHAPTER

- [1] Younghyun Kim, Woo Suk Lee, Anand Raghunathan, Vijay Raghunathan, and Niraj K. Jha, “Reliability and Security of Implantable and Wearable Medical Devices,” in *Implantable Biomedical Microsystems: Design Principles and Applications*, Elsevier, 2015.

JOURNAL
PUBLICATIONS

- [2] Jie Liu, Bodhi Priyantha, Ted Hart, Yuzhe Jin, Woo Suk Lee, Heitor S. Ramos, Antonio A.F. Loureiro Qiang Wang, and Vijay Raghunathan, “Energy Efficient GPS Sensing with Cloud Offloading,” *IEEE Transaction on Mobile Computing (TMC)*.
- [3] Hrishikesh Jayakumar, Arnab Raha, Woo Suk Lee, Vijay Raghunathan, “QUICK RECALL: A HW/SW Approach for Computing across Power Cycles in Transiently Powered Computers,” *ACM Journal on Emerging Technologies in Computing Systems (JETC)*, Special Issue on Advances in Design for Ultra-Low Power Circuits and Systems in Emerging Technologies.
- [4] Woo Suk Lee, and Seung Ho Hong, “Design and Implementation of a KNX-ZigBee Gateway,” *Journal of Institute of Control, Robotics and Systems (JI-CROS)*, Vol. 17, No. 7, pp.720~729, Jul 2011 (Korean Journal).

CONFERENCE
PUBLICATIONS

- [5] Woo Suk Lee, and Seok Chul Park, “Energy Saving in Building/Home Lighting Control Systems by using ZigBee,” *Journal of Intelligent Building*, Vol. 1, No. 1, Jun 2008 (Korean Journal).
- [6] Younghyun Kim, Woo Suk Lee, Vijay Raghunathan, Niraj Jha, and Anand Raghunathan, “Vibration-based Secure Side Channel for Medical Devices,” *Design Automation Conference (DAC 2015)*, San Francisco, California, USA, June 2014.
- [7] Hrishikesh Jayakumar, Arnab Raha, Woo Suk Lee, and Vijay Raghunathan, “Qube: An FRAM-based, Low Power, Modular Platform Architecture for Wireless Embedded Systems,” *VLSI Design (VLSID 2015)*, Bangalore, India, Jan 2015. (*Design Contest Winner*)
- [8] Woo Suk Lee, Albert Kim, Babak Ziaie, Charles R. Powell, and Vijay Raghunathan, “Up-Link: an Ultra-Low Power Implantable Wireless System for Long-Term Ambulatory Urodynamics,” *IEEE Biomedical Circuit and Systems Conference (BioCAS 2014)*, Lausanne, Switzerland, Oct 2014.
- [9] Woo Suk Lee, Hrishikesh Jayakumar, and Vijay Raghunathan, “When they are not listening: harvesting power from idle sensors in embedded systems,” *International Green Computing Conference (IGCC 2014)*, Dallas, Texas, USA, Nov 2014. (*This is the full paper version of the research that won the prize in ISLPED 2014 Design Contest*)
- [10] Hrishikesh Jayakumar, Kangwoo Lee, Woo Suk Lee, Arnab Raha, and Vijay Raghunathan, “Powering the Internet of Things,” *ACM/IEEE International Symposium on Low Power Electronics and Design (ISLPED 2014)*, La Jolla, California, USA, Aug 2014.
- [11] Woo Suk Lee, Hrishikesh Jayakumar, and Vijay Raghunathan, “When they are not listening: harvesting power from idle sensors in embedded systems,” *ACM/IEEE International Symposium on Low Power Electronics and Design (ISLPED 2014)*, La Jolla, California, USA, Aug 2014. (*Submitted for design contest entry*) (*Design Contest Winner*)
- [12] Woo Suk Lee, Bodhi Priyantha, Ted Hart, Gerald DeJean, Yan Xu, and Jie Liu, “Demo Abstract: The CLEO mobile sensing platform,” *demo in the 10th ACM International Conference on Embedded Networked Sensor Systems (SenSys 2012)*, Toronto, CA, Nov 2012. (*This is a demo version of SenSys 2012 'Best Paper' named "Energy-Efficient GPS Sensing with Cloud Offloading"*)
- [13] Mohammad Sajjad Hossain, Woo Suk Lee, and Vijay Raghunathan, “SPI-SNOOPER: a hardware-software approach for transparent network monitoring in wireless sensor networks,” *Proceeding of the 8th IEEE/ACM/IFIP International Conference on Hardware/Software Codesign and System Synthesis (CODES+ISSS 2012)*, pp.53-62, Tampere, Finland, Oct 2012.

- [14] Seok Cheol Park, Woo Suk Lee, Se Hwan Kim, and Seung Ho Hong, Peter Palensky, “Implementation of a BACnet-ZigBee Gateway,” *IEEE International Conference on Industrial Informatics (INDIN 2010)*, pp.40-45, Osaka, Japan, Jul 2010.
- [15] Seok Cheol Park, Woo Suk Lee, Ki Myeung Kim, and Seung Ho Hong, “Zig-Bee Sensor & Actuator Configuration for Lighting Control Systems,” *Korea Automatic Control Conference (KACC 2009)*, pp.866-869, Busan, Korea, Sep 2009.
- [16] Woo Suk Lee, and Seung Ho Hong, “Implementation of a KNX-ZigBee Gateway for Home Automation,” *IEEE International Symposium on Consumer Electronics (ISCE 2009)*, pp.545-549, Osaka, Japan, May 2009.
- [17] Woo Suk Lee, and Seung Ho Hong, “KNX-ZigBee Gateway for Home Automation,” *IEEE International Conference on Automation Science and Engineering (CASE 2008)*, pp. 750-755, Washington D.C., USA, 23-26, Aug 2008.
- [18] D. K. Park, W. S. Lee, S. H. Hong, and Luca Domenico Luigi Mazzon, “Development of a KNX/EIBbased Lighting Control System,” *KMITL International Conference on Engineering, Applied Sciences, and Technology (ICEAST 2007)*, pp.33-36, Bangkok, Thailand, Nov 2007.
- [19] D. K. Park, W. S. Lee, S. H. Hong, and T. Y. Hwang, “Development of a KNX/EIB-based controller,” *IEEK/KIEE Information and Control Symposium (ICS 2007)*, pp. 420-422, Jeonju, Korea, Apr 2007. (Korean)

HONORS AND AWARDS

- **Winner of VLSID 2015 Design Contest** with “Qube: An FRAM-based, Low Power, Modular Platform Architecture for IoT edge-devices”
- **Winner of ISLPED 2014 Design Contest** with a novel energy harvester based batteryless sensor node design, named “When they are not listening: harvesting power from idle sensors in embedded systems.”
- **Scholarship for outstanding entering graduate student** awarded to the student at 1st place in entering exam to waive most of the tuition-fee for entire M.S. course
- **Academic scholarship** awarded for outstanding GPA by Hanyang University, 2000, 2004, 2005, 2006
- **1st Place Award** for outstanding performance during summer school at Hochschule Esslingen

HARDWARE AND SOFTWARE SKILLS

Programming languages

- C, C#, JAVA, Assembly, BASH, HTML

Embedded and real-time systems

- MSP430 family from Texas Instruments ®
- 8051(or 8052) family from various vendors
- ARM family from various vendors

- AVR family from Atmel ®
- PIC family from Microchip ®
- DSP family from Texas Instruments ®

Wireless networking

- RF systems hardware design (e.g., antenna selection, impedance matching)
- Wireless sensor networks platforms (e.g., Telos, Zolertia, and etc)
- Wireless communication technologies
 - IEEE 802.15.4
 - IEEE 802.11
 - Medical Implantable Communication Service (MICS)

PCB design & simulation

- Altium, OrCAD, PADS, Eagle, PSpice

Numerical and Statistical Analysis

- MATLAB

Version Control and Software Configuration Management

- GIT, SVN, CVS

Documentation

- Microsoft office, Microsoft Visio, Doxygen, T_EX (L^AT_EX, B_IB_TE_X), Adobe Photo-shop, Eclipse, OpenOffice.org, Google Docs

STUDENT MENTORING

Merve Cakar, Luca Domenico Luigi Mazzon and Dejan Bogdanovic

- Undergraduate students participated in the student exchange program between Hanyang University, Korea and Hochschule Esslingen, Germany
- Laboratory support of research on wired-wireless unified building/home networks
- Guided prototype design and implementation
- Primary advisor: Professor Seung Ho Hong. 2007-2009

EXTRA- CURRICULAR ACTIVITIES

Infinite

Chairman

- Undergraduate extracurricular group studying program languages and hardware design
- Designed various types of embedded system prototypes and participated in several domestic competitions

PROFESSIONAL
MEMBERSHIPS

Institute for Electrical and Electronics Engineers (IEEE), Student Member (2008-present)

- IEEE Circuits and Systems Society
- IEEE Communications Society
- IEEE Computer Society
- IEEE Consumer Electronics Society
- IEEE Power & Energy Society
- IEEE Reliability Society
- IEEE Education Society

Association for Computing Machinery (ACM), Student Member (2010-present)

- ACM Special Interest Group on Embedded Systems (SIGBED)
- ACM Special Interest Group on Data Communication (SIGCOMM)
- ACM Special Interest Group on Mobility of Systems, Users, Data and Computing (SIGMOBILE)

COURSES TAKEN **Purdue University**, West Lafayette, IN, USA

Ph.D. program

- Computer architecture - ECE565
- Digital systems design automation - ECE595
- Fault tolerant computer systems design - ECE695
- Systems-on-chip design - ECE695
- Advanced mathematics for engineers and physicists - MA527
- Linear algebra with applications - MA511

Hanyang University, South Korea

M.S. program

- Embedded systems design - CIN8075
- Robotics - DME8002
- Adaptive system theory - ELE7012
- Ubiquitous sensor networks - CIN6027
- R & D strategy - CIN8096
- Sensor application systems - CIN9024
- Discrete event systems - CIN8023
- System engineering - ENE9018

B.S. program

- Micro-processor applications - ENE4041
- Computer architecture - ENE1004
- Chip design and packaging - CSE3021
- Micro-electronic circuit - CSE3021
- Circuit theory - ELE2003
- Digital logic design - CSE3003
- Electromagnetism - PHY3012

- Field and wave electromagnetics - ENE3005
- Physical electronics - ENE3006
- Electric energy systems - ELE3025
- Computer networks - ENE4019
- Data communications - ECE4005
- Signals and systems - ECE3008
- Introduction to digital signal processing - ELE3031
- Advanced computer programming - CUL0012
- Programming methodology - ELE2013
- Probability and statistics - MAT4015
- Engineering economy - CUL1013

CITIZENSHIP Republic of Korea (South Korea)

MORE
INFORMATION More information and auxiliary documents can be found at
<http://www.woosuklee.com>