

Rajeev Piyare

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Research Interests

My research interests lie in the field of energy-efficient decentralized and distributed systems, with an emphasis on energy-harvesting and radio-triggering techniques for cyber-physical systems. Specifically, my current work is focused on the following areas:

- Developing efficient wake-up radio MAC/routing protocols for energy constrained networked embedded systems, mainly for Wireless Sensor and Actuator Networks.
- Understanding the dynamics of complex systems through mathematical modeling and simulation-based techniques. The primary aim is to gain insights that can assist to design better energy-efficient wireless systems for the IoT.

Education

University of Trento

Trento, Italy

PH.D. CANDIDATE IN COMPUTER SCIENCE AND TELECOMMUNICATION

November 2014 - April 2019

- Thesis Title: Wake-up Radio based Approach to Low-Power and Low-Latency Communication in the Internet of Things
- Advisor: Dr. Amy Lynn Murphy

Mokpo National University

Jeonnam, South Korea

MASTERS IN ENGINEERING

August 2012 - June 2014

- Thesis Title: Human Activity and Context Recognition Using Smartphone Sensors: An Online Approach
- Advisor: Prof: Seong Ro Lee

University of The South Pacific

Suva, Fiji

POSTGRADUATE DIPLOMA IN ELECTRONIC ENGINEERING

August 2009 - April 2011

University of The South Pacific

Suva, Fiji

BACHELOR OF ENGINEERING TECHNOLOGY IN ELECTRICAL AND ELECTRONIC ENGINEERING

February 2006 - December 2008

Work & Research Experience

Bruno Kessler Foundation (E3DA Unit)

Trento, Italy

RESEARCHER IN THE INTERNET OF THINGS AND SENSOR NETWORKS

November 2014 - Present

- Development of a software stack for sensing and communication over ultra-low-power wake-up radios for short- and long-range networking.
- Development of energy efficient MAC and routing protocols for the wake-up radio-based systems.
- Development and integration of wake-up radio testbed.
- Development of mathematical models and simulation techniques for assessing and designing reliable and energy-efficient battery powered wireless systems.
- Mentored and supervised an undergraduate in LoRa and NB-IoT research project over 5 months.
- Maintenance and update of SoleLab, a 50-node WSN Testbed deployed in the facility.
- Deliverables: 2 journal publications, 4 international conferences.

Swiss Federal Institute of Technology (ETH)

Zürich, Switzerland

VISITING SCHOLAR AT IIS, LABORATORY OF PROF. LUCA BENINI

September 2017 - May 2018

- Design of a multi-radio multi-sensor platform comprising of LoRa and a wake-up receiver.
- Implementation of an On-demand TDMA communication protocol for improving both the energy efficiency and the latency of standard LoRa networks.
- Performance evaluation of the On-demand TDMA system in an indoor testbed under realistic network conditions, dynamics, and interference.
- Porting of ContikiOS for embedded networking with SX1276 LoRa chip and MSP430FR5969 platforms.
- Deliverables: 1 journal publication, 2 international conferences.

SpazioDati

Trento, Italy

GRANT REVIEW PANEL MEMBER

10th - 28th April 2017

- Project: United Nations Data for Climate Action Challenge (D4CA)
- Reviewing 50 grant applications towards solving global climate issues with the Big Data

- Developing lab instructions and course materials for the lab sessions.
- Instructed lab sessions that involved programming wireless sensor nodes (Tmote Sky/ Zolertia Z1) using ContikiOS and TinyOS for sensing and control.
- Assessment and grading of student projects for the course.

Fiji National University

Suva, Fiji

LECTURER IN ELECTRONICS, COLLEGE OF ENGINEERING SCIENCE & TECHNOLOGY (CEST)

April 2009 - October 2014

- Plan, prepare, and deliver lectures for Engineering Mathematics (MTH410) and Circuit Analysis (EED501) for Diploma in Electrical & Electronic Engineering and later degree levels.
- Student project management and lab supervision.
- Preparation and assessment of student exams and projects for the courses.
- Carrying out administrative work related to the course and the program.
- Engagement in training and professional development opportunities required by the faculty for enhancing research and teaching skills.
- Industrial collaboration, R&D.

Honors & Awards

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| 2017 | Student travel grant , to attend/present at 42nd IEEE Conference on Local Computer Networks | Singapore |
| 2014 | Scholarship recipient , University of Trento for Ph.D. research | Trento, Italy |
| 2012 | Scholarship recipient , Woosung Education and Culture Foundation | Seoul, South Korea |
| 2012 | Scholarship recipient , Global IT Talent Support Program for Masters research | Seoul, South Korea |
| 2006 | Scholarship recipient , Fiji Multi-Ethnic Affairs for Bachelors Degree | Suva, Fiji |

Publications

Journal Papers

- **R.Piyare**, A.L.Murphy, M.Magno and L.Benini, "On-Demand LoRa: Asynchronous TDMA for Energy Efficient and Low Latency Communication in IoT," MDPI Sensors, vol.18, no.11, pp.3718-3739, November, 2018. (Impact Factor: 2.475)
- **R.Piyare**, A.L.Murphy, C.Kiraly, P.Tosato and D.Brunelli, "Ultra Low Power Wake-Up Radios: A Hardware and Networking Survey," IEEE Communications Surveys & Tutorials, vol.19, no.4, pp.2117-2157, Fourthquarter 2017. (Impact Factor: 17.188)
- **R.Piyare** and S.R.Lee, "Activity Recognition of Workers and Passengers onboard Ships Using Multimodal Sensors in a Smartphone," The Journal of Korea Information and Communications Society, vol.39, Issue 9, pp.811-819, 2014.
- **R.Piyare** and S.R.Lee, "Towards Internet of Things (IOTs): Integration of Wireless Sensor Network to Cloud Services for Data Collection and Sharing," International Journal of Computer Networks and Communications, vol.5, No.5, September, 2013.
- **R.Piyare**, "Internet of Things: Ubiquitous Home Control and Monitoring System using Android based Smart Phone," International Journal of Internet of Things, vol.2, pp.5-11, 2013.
- **R.Piyare** and S.R.Lee, "Performance Analysis of Xbee ZB Module Based Wireless Sensor Networks," International Journal of Scientific and Engineering Research, vol.4, pp.1615-1621, 2013.

Peer Reviewed Conference and Workshop Papers

- **R.Piyare**, A.L. Murphy, M.Magno and L.Benini, "KRATOS: An Open Source Hardware-Software Platform for Rapid Research in LPWANs," In Proceedings of Wireless and Mobile Computing, Networking and Communications (WiMob), IEEE 14th International Conference on., 15th-17th October, Cyprus, 2018.
- **R.Piyare**, A.L. Murphy, M.Magno and L.Benini, "On-Demand TDMA for Energy Efficient Data Collection with LoRa and Wake-up Receiver," In Proceedings of Wireless and Mobile Computing, Networking and Communications (WiMob), IEEE 14th International Conference on., 15th-17th October, Cyprus, 2018.
- **R.Piyare**, A.L. Murphy, P.Tosato and D.Brunelli, "Plug into a Plant: Using a Plant Microbial Fuel Cell and a Wake-up Radio for an Energy Neutral Sensing System," In Proceedings of the Local Computer Networks Workshops (LCN Workshops), IEEE 42nd Conference on., 9th-12th October, Singapore, 2017.
- **R.Piyare**, T. Istomin and A. Murphy, "WaCo: A Wake-Up Radio COOJA Extension for Simulating Ultra Low Power Radios," In Proceedings of the 14th ACM International Conference on Embedded Wireless Systems and Networks (EWSN), 20th-22nd February, Uppsala, Sweden, 2017.
- **R.Piyare** and S.R.Lee, "Dynamic Activity Recognition using Smartphone Sensor Data," In Proceedings of International Electronic Conference on Sensors and Applications, 1-16th June, Multidisciplinary Digital Publishing Institute, Vol. 1, 2014.
- **R.Piyare** and S.R.Lee, "Utilizing Smartphone Sensors for Daily Physical Activity Recognition," In Proceedings of The 10th International Conference on Multimedia Information Technology and Applications (MITA 2014), 9th-10th July, Hong Kong University of Science and Technology, Hong Kong, 2014.

- **R.Piyare** and S.R.Lee, “*Activity Recognition using Smartphone low level sensor data,*” 2014 International Conference on Future Information and Communication Engineering (ICFICE 2014), 26th-28th June, Kowloon, Hong Kong, 2014.
- **R.Piyare** and S.R.Lee, “*Mobile Sensing Platform for Personal Health Management,*” 18th IEEE International Symposium on Consumer Electronics, 22nd-25th June, Jeju, South Korea, 2014.
- **R.Piyare** and S.R.Lee, “*Integrating Wireless Sensor Network into Cloud Services for Real-time Data Collection,*” in ICT Convergence (ICTC), 2013 International Conference on.IEEE, 14th-16th October, Jeju, South Korea, 2013.
- **R.Piyare** and S.R.Lee, “*Smart Home-Control and Monitoring System Using Smart Phone,*” International Conference, ICCA 2013, Korea University, Seoul Korea, July, 2013.
- **R.Piyare** and M.Tazil, “*Bluetooth Based Home Automation System using Cell Phone,*” Presented at 15th IEEE International Symposium on Consumer Electronics, 14th-17th June, Singapore, 2011.
- **R.Piyare** and R.Singh, “*Wireless Control of An Automated Guided Vehicle,*” Presented at 2011 International MultiConference of Engineers and Computer Scientists (IMECS), 16th-18th March, Hong Kong, 2011.

Professional Activities

Invited Reviewer:

- IEEE Transactions on Wireless Communications
- IEEE Sensors Journal
- IEEE Access Journal
- Elsevier Computer Networks Journal
- MDPI Sensors Journal
- MDPI Energy Journal
- MDPI Future Internet Journal
- IEEE World Forum on Internet of Things (2018, 2019)
- IEEE Global IoT Summit (GIoTS) (2017, 2018)
- 1st Workshop on Internet of Energy Neutral Things (IoENT 2017)
- 2nd International Conference on Informatics, Robotics, Networks, Control and Systems (IRONCONS 2016)
- NewNets 2019

Organization:

- Web Chair of the 17th ACM/IFIP/USENIX Middleware conference (Middleware 2016)
- Publicity Chair of the 1st Workshop on Internet of Energy Neutral Things (IoENT 2017)

Member:

- Institute of Electrical and Electronics Engineers (IEEE)
- International Association of Engineers (IAENG)
- International Association of Computer Science and Informational Technology (IACSIT)

Research Artifacts

Over the course of my research, I have developed various open-source software frameworks for low- power networking and analysis including:

WaCo

- An open source Wake-Up Radio COOJA Extension for Simulating Ultra Low Power Radios.
- <https://github.com/waco-sim>

KRATOS

- An open source hardware-software platform for prototyping in LPWANS
- ContikiOS port for Semtech LoRa radio chipset and TI MSP430FR5969 MCU.
- <https://contikios4lora.github.io/contikios-lora/>

Certifications

- 2014 **Machine Learning**, from Coursera.org
- 2014 **The Data Scientist’s Toolbox**, from Coursera.org
- 2014 **More Data Mining with Weka**, from The University of Waikato
- 2013 **Data Mining with Weka**, from The University of Waikato
- 2013 **Advanced Protocols for Wireless Ad-hoc Networks**, from IEEE
- 2012 **Wireless Sensor Networks and Applications**, from IEEE
- 2011 **Training on Programmable Logic Controllers**, from Omron Electronics Limited, Auckland
- 2010 **Training on Control and Instrumentation modules**, from Feedback Instruments, United Kingdom

Technical Skills

- Programming Languages: C/C++
- IoT Embedded Operating Systems: ContikiOS, TinyOS, TI-RTOS
- Network simulation: COOJA
- Statistical Analysis Tools: WEKA Data Mining, R, MATLAB
- Familiar with Python, Swift, Apple Xcode, Android Studio, Wireshark
- Intermediate knowledge of Programmable Logic Controller Programming
- Extensive knowledge of MS Office Package, LaTeX
- Operating Systems: Unix/Linux, Windows
- Version Control Tools: Git, GitHub, GitLab, SVN
- Wireless Technologies: ZigBee, BLE, LoRa, NB-IoT
- IoT Protocols: CTP, RPL, ContikiMAC, CSMA, RIME, 6LoWPAN, UDP, TCP, CoAP, HTTP
- Embedded Platforms: ARM Cortex, PIC, TI MSP430, Atmel AVR, Arduino, Raspberry Pi
- Communication Buses: SPI, I2C, UART, USB

Referees

Dr. Amy L. Murphy
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Bruno Kessler Foundation (FBK)
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