Nurani Saoda

4213 Seibel Center for Computer Science, University of Illinois Urbana-Champaign, Urbana, IL 61801

+1-434-249-4853 nsaoda.github.io saoda@illinois.edu saodacynthia Google Scholar

Research Interest

Energy-harvesting and energy-efficient systems, Wireless and Passive sensing, Edge ML, Low power IoT, Sustainable computing

Education

- **University of Virginia** — Charlottesville, VA
  Ph.D. *in Computer Engineering* — Aug 2017 – Aug 2023
- **University of Virginia** — Charlottesville, VA
  M.S. *in Computer Engineering* — Aug 2017 – Aug 2020
- **Bangladesh University of Engineering and Technology (BUET)** — Dhaka, Bangladesh
  B.S. *in Electrical and Electronic Engineering* — Feb 2011 – Mar 2016

Professional Experience

- **Postdoctoral Research Fellow** — Urbana, IL
  University of Illinois Urbana-Champaign — Aug 2023 –Present
- **Graduate Research Assistant** — Charlottesville, VA
  University of Virginia — Aug 2017 – Aug 2023
- **Lecturer, EEE** — Dhaka, Bangladesh
  Uttara University — May 2016 – Jun 2017

  Courses: Electrical Properties of Materials, Energy Conversion I and II, Microprocessor and Interfacing Lab, Control Systems Lab, Wireless Communication Lab.

Technical Skills

- **Programming Language**: Python, C/C++/C#, Embedded C, MATLAB, Verilog, Java, Javascript (Node.js), Make, ARM Assembly Language
- **Hardware Platforms**: nRF51 and nRF52 SoCs, STM32, MSP430, Arduino, Xilinx Artix FPGA, Raspberry PI
- **Machine Learning tools**: TensorFlow, TensorFlow Lite, Scikit-learn
- **Real-time OS**: Zephyr RTOS
- **Embedded Development**: EAGLE, Altium Designer, Proteus, Keil uVision, STM32CubeIDE, SEGGER Embedded Studio, TI Code Composer Studio, Cadence, PSpice, Xillinx Vivado, Orcad, Quartus II
- **Communication Protocols**: UART, SPI, I2C, JTAG, DMA, USB, Bluetooth Low Energy (BLE), LoRa, UWB
- **Prototyping and Equipment**: Board bring-up, Board debug and validation, Oscilloscope, Source/Load Measure Units, Power Profiler, Spectrum Analyzer, Logic Analyzer

Selected Research Projects

Altair: A HW-SW co-designed architecture for energy management in energy-constraint systems

- Proposed and designed a new energy-harvesting power management architecture that offloads all energy management operations to a dedicated power supply co-processor, achieving modularity, flexibility, and better energy optimization for energy-harvesting sensors. The architecture can be adopted by any application that may benefit from efficient energy management.
- Proposed and developed an on-device duty cycle adaptation technique using reinforcement learning to ensure optimal energy utilization and device performance in post-deployment conditions.
- Microcontrollers: STM32L010R8, nRF52840 Tools: EAGLE CAD, GNU ARM Embedded toolchain Language: Embedded C, Node.js

RetroIoT: Using batteries to incorporate new sensing functionality

- Proposed and demonstrated an innovative technique that uses the reported battery voltage channel of an IoT sensor to transmit additional data such as sensor readings, metadata or tag-like information. The system builds on existing devices, gateway, and cloud application without completely replacing them.

- Proposed and implemented a digital data encoding-decoding technique in a programmable energy-harvesting power supply that replaces the device's battery with energy-harvesting.
- Development platforms used: STM32L0 LoraWan kit Tools: EAGLE CAD Language: Embedded C, Python

SolarWalk: Identifying humans in indoor spaces using pervasive photovoltaic harvesters

- Proposed a novel passive, unobtrusive, and low hardware overhead sensing technique to identify occupants in smart homes from their distinguished solar cell output voltage traces.
- Adopted event-triggered sensing and BLE to transmit time-series data in an energy-efficient manner and used supervised machine learning techniques to perform occupant identification.
- Development platforms used: Nordic nRF52840 DK, Raspberry Pi Language: Embedded C, Python

Selected Publications (**Google Scholar**)

1. RetroIoT: Retrofitting Internet of Things Deployments by Hiding Data in Underused Data Channels. **Nurani Saoda**, Victor Ariel Leal Sobral, Ruchir Shah, Wenpeng Wang, Bradford Campbell. **ACM MobiCom'22**
2. SolarWalk: Smart Home Occupant Identification using Unobtrusive Indoor Photovoltaic Harvesters. **Nurani Saoda**, Md Fazlay Rabbi Masum Billah, Victor Ariel Leal Sobral, Tushar Routh, Wenpeng Wang, Bradford Campbell. **ACM BuildSys'2022**
3. An Energy Supervisor Architecture for Energy-Harvesting Applications. **Nurani Saoda**, Wenpeng Wang, Md Fazlay Rabbi Masum Billah, Bradford Campbell. **ACM IPSN'22**
4. Low Cost Light Source Identification in Real World Settings. Tushar Routh, **Nurani Saoda**, Md Fazlay Rabbi Masum Billah, Brad Campbell. **IEEE SECON'22**
5. BLE Can See: A Reinforcement Learning Approach for Radio Frequency based Occupancy Detection. Md Fazlay Rabbi Mashum Billah, **Nurani Saoda**, Jiechao Gao, Bradford Campbell. **ACM IPSN'21**
6. UbiTrack: Enabling Scalable & Low-Cost Device Localization with Onboard WiFi. Wenpeng Wang, Zetian Liu, Jiechao Gao, **Nurani Saoda**, Bradford Campbell. **ACM BuildSys'21**
7. SolarWalk Dataset: Occupant Identification using Indoor Photovoltaic Harvester Output Voltage **Nurani Saoda**, Md Fazlay Rabbi Masum Billah, Victor Ariel Leal Sobral, Bradford Campbell. **ACM DATA Workshop with SenSys'22**
8. Developing a General Purpose Development Platform for Energy-harvesting Applications. **Nurani Saoda**, Md Fazlay Rabbi Masum Billah, Bradford Campbell. **ACM ENSsys Workshop with SenSys'21**
9. No Batteries Needed: Providing Physical Context with Energy-Harvesting Beacons. **Nurani Saoda**, Bradford Campbell. **ACM ENSsys Workshop with SenSys'19**

Invited Talks

- *Designing Energy-Harvesting Devices for Sustainable Internet-of-Things*
  Research for Industry Talk, Networking Research Group, Microsoft Mar 2023
- *Sustainable Internet-of-Things with Batteryless Energy-harvesting Sensors*
  Earth Systems Predictability & Resiliency Group, Pacific Northwest National Laboratory Jan 2023
- Presented my research on *Broadening the Capabilities of Self-Powered Energy-Harvesting Systems*
  UVA Link Lab Student Seminar Award Series Nov 2022
- *Making IoT Batteryless: Challenges and Opportunities*
  Embedded Systems Seminar, University of California San Diego Jan 2021

Awards and Scholarships

- UIUC Grainger Postdoctoral Fellow and Future Faculty Fellow 2023
- CPS Rising Star 2023
- UVA Link Lab Student Seminar Award 2022
- ACM SIGBED SRC Winner, Second Runner-up 2022
- ACM MobiCom'22 Travel Grant Scholarship 2022
- Finalist of NCWIT Collegiate Award 2022
- Grace Hopper Student Scholar, GHC 2019, 2021
- CRA-WP Grad Cohort for Women Workshop 2020
- N2Women Young Researcher Fellowship, SenSys'19 2019
- CRA-E Funding for CRA-E workshop on Academic Careers, FCRC'19 2019
- University of Virginia Graduate Engineering Travel Grant Award, Society of Women Engineers (SWE)'18 2018
- **Best paper award**, ICCIT'16 2016