

Abu Bakar

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Research Interests

I am interested in building battery-less sensors and enabling their large scale deployment in daily life applications—from smart cities to smart buildings, wildlife tracking and wearables. My goal is to develop new hardware designs, software techniques, and tools so that novice developers and hobbyists can easily design, debug, and deploy sustainable battery-less sensors for dynamic and constrained energy harvesting environments

Education

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| 2018-
Current | Northwestern University
Ph.D. in Computer Science, GPA: 3.83/4.0
Advisor: Josiah Hester
Focus: Adaptive Intermittent Computing | Evanston,
Illinois |
| 2016 | National University of Computer and Emerging Sciences (NUCES)
B.S. in Electrical Engineering, GPA: 3.59/4.0 | Islamabad,
Pakistan |

Publications

Conference Papers

- 2021 **BFree: Enabling Battery-free Sensor Prototyping with Python**
Vito Kortbeek, **Abu Bakar**, Stefany L. Cruz, Kasim Sinan Yildirim, Przemysław Pawełczak, Josiah Hester
To Appear in ACM Conference on Pervasive and Ubiquitous Computing (UbiComp'21)
- 2020 **Time-sensitive Intermittent Computing Meets Legacy Software**
Vito Kortbeek, Kasim Yildirim, **Abu Bakar**, Jacob Sorber, Josiah Hester, Przemysław Pawełczak
ACM Conference on Architectural Support for Programming Languages and Operating Systems (ASPLOS'20)
- 2019 **The Betrayal of Constant Power × Time: Finding the Missing Joules of Transiently-Powered Computers**
Saad Ahmed, **Abu Bakar**, Naveed Anwar Bhatti, M. Hamad Alizai, Junaid Haroon Siddiqui, Luca Mottola
ACM SIGPLAN/SIGBED Conference on Languages, Compilers, and Tools for Embedded Systems (LCTES'19)
- 2017 **Inverting HVAC for Energy Efficient Thermal Comfort in Populous Emerging Countries**
Khadija Hafeez, Yasra Chandio, **Abu Bakar**, Ayesha Ali, Affan A. Syed, Tariq M. Jadoon, M. Hamad Alizai
ACM Conference on Systems for Energy-Efficient Built Environments (BuildSys'17)

2016 **Design of a Laser Tracker Using 2-DOF Stepper Controlled Platform**
Abu Bakar, Neelam Nasir, Mukhtar Ullah, Zeashan Hameed Khan
IEEE Conference on Robotics and Artificial Intelligence (ICRA'16)

Journal Papers

2020 **Demystifying Energy Consumption Dynamics in Transiently Powered Computers**
Saad Ahmed, M. Nawaz **Abu Bakar**, Naveed A. Bhatti, M. Hamad Alizai, Junaid H. Siddiqui, Luca Mottola
ACM Transactions on Embedded Computing Systems (TECS), Volume 19 , Issue 6 October 2020

2018 **Inverted HVAC: Greenifying Older Buildings, One Room at a Time**
Samar Abbas, **Abu Bakar**, Yasra Chandio, Khadija Hafeez, Ayesha Ali, Tariq M. Jadoon, M. Hamad Alizai
ACM Transactions on Sensor Networks (TOSN), Volume 14 , Issue 3-4 December 2018

Workshop Papers

2018 **Making Sense of Intermittent Energy Harvesting**
Abu Bakar, Josiah Hester
6th International Workshop on Energy Harvesting & Energy-Neutral Sensing Systems (ENSys'18)

Posters and Demos

2018 **The Energy Harvesting Mode Abstraction**
Abu Bakar, Josiah Hester
ACM Conference on Embedded Networked Sensor Systems (SenSys'18)

Work Experience

2016-2018 **LUMS School of Science and Engineering — SysNet Lab** Lahore,
Pakistan
Research Assistant
Advisor: Muhammad Hamad Alizai, Junaid Haroon Siddiqui
Focus: Intermittent computing, Embedded systems, Building systems
Publications: BuildSys' 17, TOSN'18, LCTES' 19, TECS'20

Worked on developing: energy-efficient inverted HVAC system, hardware platform for evaluating a system that performs differential checkpointing, and mechanism for estimating dynamic energy consumption of batteryless devices at compile time

2014 **NUCES — SysNet Lab** Islamabad,
Pakistan
Undergraduate Research Intern
Advisor: Affan A. Syed
Focus: Wireless Sensor Networks, Wireless energy transference

Worked on decoupling energy from sensing activities by using a wireless energy distribution architecture using 808nm laser

Teaching Experience

Spring 2017	CS365: Data Communication & Networks Information Technology University	Lahore, Pakistan
Fall 2016	CS677: Internet of Things LUMS School of Science and Engineering	Lahore, Pakistan
Fall 2015	CS214: Programming Fundamentals National University of Computer and Emerging Sciences	Islamabad, Pakistan
Fall 2014	EE112: Programming for Engineers-II National University of Computer and Emerging Sciences	Islamabad, Pakistan
Spring 2014	EE110: Programming for Engineers-I National University of Computer and Emerging Sciences	Islamabad, Pakistan

Awards and Honors

2020	SIG Travel Grant: for attending ASPLOS'20
2018	NSF Travel Grant: for attending ACM SenSys'18
2017	People's Choice Award: for "Inverted HVAC" at ACM BuildSys'17
2017	ACM SIGMOBILE Travel Grant: for attending ACM BuildSys'17
2015	Dean's Honor List: for outstanding academic performance at NUCES
2014	Silver and Bronze medal: for outstanding semester performance at NUCES
2014	Best Intern Award: for completing internship tasks and going beyond at SysNet Lab

Other Projects

32-bit pipelined CPU based on MIPS architecture

Implemented CPU design in VHDL which supported 15 assembly instructions with full-forwarding and hazard detection capabilities

PID based autonomous line following mobile robot

Designed using IR sensors and implemented PID algorithm for efficient motion control. Won many competitions including zonal round of International Robotics Challenge (IRC) in Pakistan

Video Graphics Array (VGA) on FPGA

Implemented a Pac-Man like game and displayed it on a monitor directly from FPGA in real-time

Extracurricular Activities

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|---------------|---|------------------------|
| 2016 | Finance Secretary of National Student Convention (NaSCon) — NUCES
Responsible for managing the budget and expenses of 50+ social and technical events that included talks, workshops, seminars, and robotics and coding competitions. Also, served as a liaison between the university and the sponsors | Islamabad,
Pakistan |
| 2015-
2016 | Chairperson IEEE Student Branch — NUCES
Responsible for organizing workshops and seminars for students that focused on technology trends in industry | Islamabad,
Pakistan |
| 2015 | President IEEE Robotics Club — NUCES
Responsible for organizing workshops and maintaining a conducive learning environment that helped students learn and polish their skills in robotics | Islamabad,
Pakistan |

Skills

Communication

English: Fluent | Urdu: Native language

Platforms & Tools

Ekho, Flickr, MSP430, FPGA, Nucleo, mbed, Arduino, Atmel, Telosb, Z1 mote
TinyOS, Contiki, Modelsim, Microwind, Xilinx Spartan-3, MATLAB, Keil, Proteus

Programming

C, C++, Python, CircuitPython, VHDL, Verilog, Assembly, NesC

Last Updated: Nov 2, 2020