

HARSH S. DESAI

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Research Interests

Brain-Computer Interfaces, Computer Architecture, Batteryless Computing, Ultra-low-power computing

Research Experience

Yale University, New Haven, CT.

March 2025 – Present

Post-doctoral Researcher Mentor: Abhishek Bhattacharjee

I am interested in building ultra-low-power, resource-constrained computers, which find applications in cutting-edge domains, such as Brain-Computer Interfaces (BCIs). Currently, I am building a framework to guide computer architects in designing BCIs that are efficient and relevant over the long timeframes of the medical community. My larger goal is to design efficient, adaptive and intelligent computers that enable futuristic applications, while pushing the boundaries of computer architecture innovation.

Carnegie Mellon University, Pittsburgh, PA.

August 2018 – February 2025

Ph.D. in Electrical & Computer Engineering

Advisor: Brandon Lucia

Clemson University, Clemson, SC.

Aug 2016 – Aug 2018

Master of Science in Computer Engineering

Advisor: Jacob Sorber

Mumbai University, Mumbai, India.

Aug 2011- Aug 2015

Bachelor of Engineering in Electronics Engineering

Awards

- Carnegie Mellon University Presidential Fellow 2019-20, sponsored by Tata Consultancy Services
- CONIX Annual Review Best Demo Award 2019 for Camaroptera

Publications

- **Quetzal: Energy-aware Scheduling and Input Buffer Overflow Prevention for Energy-harvesting Systems**
Harsh Desai, Xinye Wang, Brandon Lucia
ASPLOS 2025
- **Pipestitch: An Energy-Minimal Dataflow Architecture with Lightweight Threads**
Nathan Serafin, Souradip Ghosh, **Harsh Desai**, Brandon Lucia, Nathan Beckmann
MICRO 2023
- **An Architectural Charge Management Interface for Energy-Harvesting Systems**
Emily Ruppel, Milijana Surbatovich, **Harsh Desai**, Kiwan Maeng, Brandon Lucia
MICRO 2022
<https://ieeexplore.ieee.org/document/9923863>
- **Camaroptera: A Long-range Image Sensor with Local Inference for Remote Sensing Applications**
Harsh Desai, Matteo Nardello, Davide Brunelli, Brandon Lucia
IEEE Transactions on Embedded Computer Systems (TECS) (Volume 21, Issue 3, May 2022)
<https://dl.acm.org/doi/full/10.1145/3510850>

- **Computational nanosatellite constellations: Opportunities and challenges**
Brandon Lucia, Brad Denby, Zachary Manchester, **Harsh Desai**, Emily Ruppel, Alexei Colin
GetMobile: Mobile Computing and Communications (Volume 25, Issue 1, June 2021)
- **A Power-Aware Heterogeneous Architecture Scaling Model for Energy-Harvesting Computers**
Harsh Desai and Brandon Lucia
IEEE Computer Architecture Letters (Volume: 19 , Issue: 1 , Jan.-June 1 2020)
<https://ieeexplore.ieee.org/document/9078058>
- **Camaroptera: a Batteryless Long-Range Remote Visual Sensing System**
Matteo Nardello, **Harsh Desai**, Davide Brunelli, and Brandon Lucia
Energy Harvesting & Energy-Neutral Sensing Systems (ENSSys'19), New York, NY, USA.
<https://dl.acm.org/citation.cfm?id=3363491>
- **Powering Pipeline Monitoring Sensors Using Locally Available Energy**
Harshit Shukla, Kalyan R. Piratla, **Harsh Desai**, and Jacob Sorber
Pipelines 2019
<https://ascelibrary.org/doi/abs/10.1061/9780784482506.033>
- **Evaluation of Energy Harvesting Potential in Water Pipelines to Power Sustainable Monitoring Systems**
Harshit Shukla, **Harsh Desai**, Jacob Sorber, and Kalyan R. Piratla
Construction Research Congress 2018
<https://ascelibrary.org/doi/abs/10.1061/9780784481295.047>

Research Experience

Quetzal – Input Buffer Overflows in Energy-Harvesting Systems

August 2023 – January 2025

- Detecting and Preventing Input Buffer Overflows in Energy-harvesting systems
- Variable Input Power and Event Activity causes processing rate to dynamically vary, filling the input buffer
- We present a new scheduler and mechanism to detect and prevent the input buffer from filling

PHASE – Modeling Performance in Energy-Harvesting Systems

December 2019 – February 2025

- First Performance Model for Energy-harvesting systems
- Recharging energy causes variable delays in system performance, depending on environmental input power level
- We present a new architecture that adapts according to input power, maximizing end-to-end performance

Camaroptera – Batteryless Smart Image Sensing

August 2018 – February 2025

- Designed and developed a tiny smart camera that runs without batteries and sends images over kilometers
- Equipped with on-board machine learning for sophisticated image processing on the edge
- Ultra-low-power camera, LoRa radio for kilometer-scale communication

Batteryless Occupancy Monitoring with Reflected Ambient Light

January 2017-July 2018

- Monitoring the occupancy status of a room using Solar panels
- Ambient Light acts as a dual power-signal source
- Developed custom hardware and full software stack

Energy Harvesting in Pipelines

January 2017-July 2018

- Evaluating the energy harvesting potential of surface vibrations and flow turbulence caused by liquids flowing in pipelines using Piezoelectric crystals

Work Experience

Efficient Corporation , Systems Engineering Intern	Aug 2023 - Aug 2024, Pittsburgh, PA.
- Worked on novel research for ultra-energy-efficient dataflow CGRA chips	
Microsoft Research , Research Intern	May 2022 - Aug 2022, Seattle, WA.
- Explored integrating energy-harvesting techniques into Microsoft products	
Saaz Technologies , Intern	Dec 2016 – Jan 2017, Simi Valley, CA.
- Developed a Raspberry Pi-based smart camera platform for testing imaging algorithms	
Accenture , Associate Software Engineer	Aug 2015 – July 2016, Mumbai, India.
- Spearheaded maintenance of over 20 remote workstations for the Royal Mail Group, coordinating weekly team calls	

Technical Skills

Programming Languages	C, C++, Python, CUDA, Assembly-Level (8085/86)	Application Platforms, Tools & Softwares	ARM- and MSP430-based systems, gem5, McPAT, Ramulator, DRAMPower, Raspberry Pi, Circuit Design EDA (Eagle, Altium), Matlab
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