SAAD AHMED

Curriculum Vitae

Technology Square Research Building
School of Interactive Computing, Atlanta, GA
(+1) 7738238029
✉ sahmed@gatech.edu
⌂ https://www.saadahmedch.com

Summary of Research Impact

I build a **sustainable** future for computing by enabling the **Internet of Batteryless Things**; a vision that liberates Internet of Things (IoT) devices from batteries thus allowing maintenance-free operation. I develop **system support** that cuts across the system stack to ensure **energy-efficient, reliable, and adaptive** program execution while making computational progress under frequent power failures. I actively look to apply my work in mobile health, education, smart cities, and environmental monitoring to unlock new **applications**.

15 publications including:

- **8** peer-reviewed conference papers
- **4** peer-reviewed journal papers
- **2** refereed poster abstracts

Citations: **191**   *numbers as of Nov. 12, 2023*

- h-index: **8**
- i10-index: **8**

My work has appeared in top computing conferences and journals, including **ACM IMWUT, ACM SenSys, ACM IPSN, ACM SIGOPS EuroSys, ACM TECS** and **ACM TCPS**, among others. Most of these venues are conferences with a very competitive acceptance rate of **14%-28%**. According to CORE 2020 conference rankings, I have **8** full peer-reviewed conference papers in A* or A international conferences. I released my work as open-source to enable other researchers and practitioners.

As of Nov. 2023, Google Scholar reports a total of **191** citations, **85%** of which have been obtained after my year of graduation—**8** papers having more than **10** citations (i10-index) with the top cited paper having more than **50** citations.

As a postdoctoral researcher, I have also solo advised/mentored multiple Ph.D. students who published in these venues. I have also taught graduate-level courses with over 25 students in each course at Northwestern as well as LUMS. My research work was nominated for the best paper award (EWSN), invited to the Communications of ACM, GetMobile magazine for the SIGMOBILE research highlight, named a finalist for Fast Company's Innovation by Design Award, and covered by top media outlets such ACM Tech News, Forbes, Tech Crunch, Gizmodo, and many more. I was selected for the prestigious Alexandar von Humboldt Postdoctoral fellowship in recognition of my work.

Professional Experience

Oct 2022 –
Present
Postdoctoral Researcher, Georgia Institute of Technology, USA.
Mentor: Dr. Josiah Hester

Dec 2020 –
Sep 2022
Postdoctoral Researcher, Northwestern University, USA.
Mentor: Dr. Josiah Hester

July 2016,
Aug 2017
Visting Researcher, RWTH Aachen, Germany.
Host: Dr. Klause Wehrle

Education

2016–2020
PhD, Computer Science, LUMS School of Science and Engineering, Pakistan.
Dissertation: *Fast and Energy-efficient Intermittent Computing*
Advisor: Dr. Muhammad Hamad Alizai

2014–2016
MS, Computer Science, LUMS School of Science and Engineering, Pakistan.
Advisor: Dr. Asim Karim

2009–2013
BS, Computer Science, National University of Computer and Emerging Sciences, Pakistan.
Project: *Compiler for PL/SQL to MySQL conversion*
Advisor: Dr. Fakhar-ul-Islam Lodhi
🏅Bronze Medal: Among top 2% in a batch of 200 students

Selected Publications

EuroSys'23
Efficient and Safe I/O Operations for Intermittent Systems.
Eren Yildiz, <u>Saad Ahmed</u>*, Bashima Islam, Josiah Hester, Kasim Sinan Yildirim
Published in European Conference on Computer Systems (EuroSys'23)
14.1% acceptance rate
* Lead advisor for the student

SenSys'22
Protean: Adaptive Battery-free Computing Platform.
Abu Bakar, Rishabh Goel, Jasper de Winkel, Jason Huang, <u>Saad Ahmed</u>, Bashima Islam, Przemysław Pawełczak, Kasım Sinan Yıldırım, Josiah Hester
ACM Conference on Embedded Networked Sensor Systems (SenSys'22)
ACM SIGMOBILE Research highlight

UbiComp'22
Battery-free MakeCode: Accessible Programming for Intermittent Computing.
Christopher Kraemer, Amy Guo, <u>Saad Ahmed</u>, Josiah Hester
ACM Conference on Pervasive and Ubiquitous Computing (UbiComp'22)
Published in PACM IMWUT, Volume 5, Issue 4
Covered by Microsoft Research, ACM Tech News, and Hackster.io and many more

UbiComp'22
FaceBit: Smart Facemask Platform.
Alexander Curtiss, Blaine Rothrock, Abu Bakar, Nivedita Arora, Jason Huang, Zachary Englehardt, Aaron-Patrick Empedrado, Chixiang Wang, <u>Saad Ahmed</u>, Yang Zhang, Nabil Alshurafa, Josiah Hester
ACM Conference on Pervasive and Ubiquitous Computing (UbiComp'22)
Published in PACM IMWUT, Volume 5, Issue 4
Fast Company's Innovation by Design Award Finalist
Covered by Top media outlets including Scientific American, TechCrunch, Forbes, Gizmodo and many more.

EWSN'20 **Intermittent Computing with Dynamic Voltage and Frequency Scaling**.
<u>Saad Ahmed</u>, Qurat-ul-Ain, Junaid Haroon Siddiqui, Luca Mottola, Muhammad Hamad Alizai
International Conference on Embedded Wireless Systems and Networks (EWSN'20)
🏆 **Best Paper Nominee**

Awards & Recognitions

2023	Nomination for the College of Computing Outstanding Postdoctoral Researcher Award
2023	Protean selected for the **ACM SIGMOBILE Research Highlight**
2022	FaceBit was the **Fast Company's Innovation by Design Award Finalist**
2021	Selection for the prestigious **Alexander von Humboldt** postdoctoral fellowship, Germany.
2020	D^2VFS nominated for **Best Paper Award** at EWSN
2017	**First place** in Intermittent Computing Hackathon at IDEA League Doctoral School
2013	🎖**Bronze Medal**, Faculty of Computing, NUCES, Pakistan
2009	🎖**Gold Medal** and Academic Roll of Honour, Govt. College University Lahore, Pakistan

Fellowships & Grants

2021	Alexander von Humboldt Research Fellowship (Selection), Germany
2020	National Data Center Travel Grant to attend EWSN, LUMS
2019	Student Travel Grant worth to attend LCTES, LUMS
2018	CPS Week Travel Grant to attend IPSN, CPS Week
2017	Travel Grant to attend Doctoral Colloquium at RWTH Aachen, DAAD
2016	Travel Grant to attend Doctoral Colloquium at RWTH Aachen, DAAD

Invited Talks

Nov-2020	Fast and Energy-efficient Intermittent Computing, University of Southampton, Host: Prof. Geoff Merrett, UK
Nov-2020	Fast and Energy-efficient Intermittent Computing, KTH Royal Institute of Technology, Host: Prof. György Dán, Sweden
Feb-2020	Intermittent Computing with Dynamic Voltage and Frequency Scaling, EWSN, Lyon, France
June-2019	Differential Checkpointing for Intermittent Programs, LCTES, Phoenix, USA
June-2019	Finding the Missing Joules of Transiently-powered Computers, LCTES, Phoenix, USA
Aug-2016	Incremental Checkpoints for Interruptible Computations, RWTH Aachen, Host: Prof. Klause Wehrle, Germany

Mentorship

Ph.D. students

2023-	Christopher Kraemer, Georgia Institute of Technology.
2022-2023	Eren Yildiz, Visiting Student, Northwestern University (now at Ege University, Turkey).
2021-2022	Abu Bakar, Georgia Institute of Technology
2021-2022	Alexander Curtiss, Northwestern University

Graduate students

2023	Shashank Holla, Research Assistant, Georgia Institute of Technology (now at NVIDIA).
2019-2020	Qurat-ul-Ain, MS-Thesis, LUMS.
2018-2019	Muhamamd Nawaz, Research Assistant, LUMS (currently at SIEMENS).
2016-2017	Hassan Ali Khan, MS-Thesis, LUMS (currently at NC State University).
2016-2017	Natasha Khan, MS-Thesis, LUMS (currently at CERN).

Undergraduate students

2021	Amy Guo, Undergraduate Research Assistant, Northwestern University (currently at Amazon)
2016-2017	Ans Fida, Undergraduate Research Assistant, LUMS (currently at SalesForce)
2016-2017	Kamran Khalil, Undergraduate Research Assistant, LUMS (currently at Purdue University).

Service

Peer Review

2023	IMWUT
	ACM Transactions on Internet of Things
	Ad Hoc Networks
2022	Journal of Systems Architecture
2021	Ad Hoc Networks
2020	IEEE Transactions on Mobile Computing
	ACM Transactions on Sensor Networks
2019	International Journal of Computer and Telecommunications Networking
	IEEE International Conference on Parallel and Distributed Systems (ICPADS)

Undergraduate Research

2022	Judge for the undergraduate research expo, Northwestern University

Open Source

My collaborators and I make research artifacts available as open source whenever possible.

EaseIO	**Efficient and Safe IO Operations for Intermittent Systems**. https://github.com/tinysystems/easeIO
SuperSensor	**Hardware Platform for rapid prototyping**. https://github.com/ka-moamoa/protean-hardware

Chameleon	**Adaptive runtime for developing batteryless Applications**. https://github.com/ka-moamoa/protean-firmware
Battery-free MakeCode	**Accessible Programming for Intermittent Computing**. https://github.com/ka-moamoa/makecode-ic
FaceBit	**Smart Face Masks Platform**. https://github.com/ka-moamoa/facebit-hardware

▬▬▬ Teaching Experience

Spring 2022	**Internet of Things**, Co-Instructor, Northwestern University. Lectures and in-class exercises with over 25 students.
Fall 2020	**Introduction to Internet of Things**, Co-Instructor, LUMS. Lectures, quizzes, and lab exercises with over 30 students.
Fall 2018	**Internet of Things**, Teaching Assistant, LUMS. Designed lab exercises and graded quizzes for over 30 students.
Fall 2014	**Operating Systems**, Teaching Assistant, NUCES. Designed and graded assignments for over 50 students.
Spring 2014	**Operating Systems**, Lab Instructor, NUCES. Designed and graded lab exercises for over 50 students.
Fall 2013	**Operating Systems**, Teaching Assistant, NUCES. Designed and graded in-class assignments for over 50 students.
Fall 2013	**Operating Systems**, Lab Instructor, NUCES. Designed and graded lab exercises and in-class assignments for over 50 students.

▬▬▬ Publications

In Conference Proceedings

C8   **Efficient and Safe I/O Operations for Intermittent Systems**.
Eren Yildiz, <u>Saad Ahmed</u>*, Bashima Islam, Josiah Hester, Kasim Sinan Yildirim
18th European Conference on Computer Systems (EuroSys'23)
14.1% acceptance rate
* Lead advisor for the student

C7   **Protean: Adaptive Battery-free Computing Platform**.
Abu Bakar, Rishabh Goel, Jasper de Winkel, Jason Huang, <u>Saad Ahmed</u>, Bashima Islam, Przemysław Pawełczak, Kasım Sinan Yıldırım, Josiah Hester
20th ACM Conference on Embedded Networked Sensor Systems (SenSys'22)
ACM SIGMOBILE Research highlight

C6   **Battery-free MakeCode: Accessible Programming for Intermittent Computing**.
Chris Kraemer, Amy Guo, <u>Saad Ahmed</u>, Josiah Hester
ACM Conference on Pervasive and Ubiquitous Computing (UbiComp'22)
Published in PACM IMWUT, Volume 5, Issue 4
Covered by Microsoft Research, ACM Tech News, and Hackster.io and many more

C5 FaceBit: Smart Facemask Platform.
Alexander Curtiss, Blaine Rothrock, Abu Bakar, Nivedita Arora, Jason Huang, Zachary Englehardt, Aaron-Patrick Empedrado, Chixiang Wang, Saad Ahmed, Yang Zhang, Nabil Alshurafa, Josiah Hester
ACM Conference on Pervasive and Ubiquitous Computing (UbiComp'22)
Published in PACM IMWUT, Volume 5, Issue 4
Fast Company's Innovation by Design Award Finalist
Covered by Top media outlets including Scientific American, Forbes, TechCrunch, Gizmodo and many more.

C4 No-frills Water Comfort for Developing Regions.
Samar Abbas, Ahmed Ehsan, Saad Ahmed, Sheraz Ali Khan, Tariq Muhammad Jadoon, Muhammad Hamad Alizai
19th ACM/IEEE International Conference on Information Processing in Sensor Networks (IPSN'20)

C3 Intermittent Computing with Dynamic Voltage and Frequency Scaling.
Saad Ahmed, Qurat-u-Ain, Junaid Haroon Siddiqui, Luca Mottola, Muhammad Hamad Alizai
2020 International Conference on Embedded Wireless Systems and Networks (EWSN'20)
🏆 **Best Paper Nominee**

C2 The betrayal of constant power× time: Finding the missing joules of transiently-powered computers.
Saad Ahmed, Abu Bakar, Naveed Anwar Bhatti, Muhammad Hamad Alizai, Junaid Haroon Siddiqui, Luca Mottola
20th ACM SIGPLAN/SIGBED International Conference on Languages, Compilers, and Tools for Embedded Systems (LCTES'19)

C1 Efficient intermittent computing with differential checkpointing.
Saad Ahmed, Naveed Anwar Bhatti, Muhammad Hamad Alizai, Junaid Haroon Siddiqui, Luca Mottola
20th ACM SIGPLAN/SIGBED International Conference on Languages, Compilers, and Tools for Embedded Systems (LCTES'19)

Journal Articles

J4 ASHRAY: Enhancing Water-usage Comfort in Developing Regions using Data-driven IoT Retrofits.
Samar Abbas, Ahmed Ehsan, Saad Ahmed, Sheraz Ali Khan, Tariq Muhammad Jadoon, Muhammad Hamad Alizai
ACM Transactions on Cyber-Physical Systems (TCPS)

J3 A survey on program-state retention for transiently-powered systems.
Saad Ahmed, Naveed Anwar Bhatti, Martina Brachmann, Muhammad Hamad Alizai
Journal of Systems Architecture (JSA)

J2 Fast and Energy-efficient State Checkpointing for Intermittent Computing.
Saad Ahmed, Naveed Anwar Bhatti, Muhammad Hamad Alizai, Junaid Haroon Siddiqui, Luca Mottola
ACM Transactions on Embedded Computing Systems (TECS)

J1 Demystifying Energy Consumption Dynamics in Transiently-powered Computers.
Saad Ahmed, Muhammad Nawaz, Abu Bakar, Naveed Anwar Bhatti, Muhammad Hamad Alizai, Junaid Haroon Siddiqui, Luca Mottola
ACM Transactions on Embedded Computing Systems (TECS)

Opinions and Viewpoints

R2   **The Internet of Batteryless Things**.
<u>Saad Ahmed</u>, Bashima Islam, Kasim Sinan Yildirim, Marco Zimmerling, Przemysław Pawełczak, Muhammad Hamad Alizai, Brandon Lucia, Luca Mottola, Jacob Sorber, Josiah Hester
To appear in the Communications of ACM (CACM)

R1   **Protean: Adaptive Hardware-Accelerated Intermittent Computing**.
Abu Bakar, Rishabh Goel, Jasper de Winkel, Jason Huang, Saad Ahmed, Bashima Islam, Przemyslaw Pawelczak, Kasim Sinan, Josiah Hester
GetMobile: Mobile Computing and Communications. March 2023, Vol. 27 Iss. 1. pp 5-10
Selected as Research Highlight 2023

Workshops & Posters

W3   **Towards smaller checkpoints for better intermittent computing**.
<u>Saad Ahmed</u>, Muhammad Hamad Alizai, Junaid Haroon Siddiqui, Naveed Anwar Bhatti, Luca Mottola
17th ACM/IEEE International Conference on Information Processing in Sensor Networks (IPSN'18)

W2   **Incremental Checkpointing Techniques for Transiently Powered Computers**.
<u>Saad Ahmed</u>
Doctoral School on Transiently Powered Computing-Collocated with SenSys'17

W1   **Incremental checkpointing for interruptible computations**.
<u>Saad Ahmed</u>, Muhammad Hamad Alizai, Junaid Haroon Siddiqui, Naveed Anwar Bhatti, Luca Mottola
14th ACM Conference on Embedded Network Sensor Systems (SenSys'16)

References

Dr. Muhammad Hamad Alizai
Associate Professor,
Department of Computer Science
LUMS, Pakistan
✉ hamad.alizai@lums.edu.pk

Dr. Junaid Haroon Siddiqui
Associate Professor,
Department of Computer Science
LUMS, Pakistan
✉ junaid.siddiqui@lums.edu.pk

Dr. Luca Mottola
Professor,
Dipartimento di Elettronica,
Politecnico di Milano, Italy
✉ luca.mottola@polimi.it

Dr. Bashima Islam
Assistant Professor,
School of Science and Engineering
Worcester Polytechnic Institute
✉ bislam@wpi.edu

Dr. Kasim Sinan
Associate Professor,
Department of Computer Science
University of Trento, Italy
✉ kasimsinan.yildirim@unitn.it

Dr. Josiah Hester
Associate Professor,
School of Interactive Computing
Georgia Institute of Technology, Atlanta, USA
✉ josiah@gatech.edu

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