

### 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 as ACM Tech News, Forbes, Tech Crunch, Gizmodo, and many more. I was selected for the prestigious Alexander von Humboldt Postdoctoral fellowship in recognition of my work.

## Professional Experience


- Oct 2022 – **Postdoctoral Researcher**, Georgia Institute of Technology, USA.  
Present Mentor: Dr. Josiah Hester
- Dec 2020 – **Postdoctoral Researcher**, Northwestern University, USA.  
Sep 2022 Mentor: Dr. Josiah Hester
- July 2016, **Visiting Researcher**, RWTH Aachen, Germany.  
Aug 2017 Host: Dr. Klaus 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, Saad Ahmed\*, 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, Saad Ahmed, Bashima Islam, Przemysław Pawełczak, Kasim Sinan Yildirim, 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, Saad Ahmed, 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, 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, TechCrunch, Forbes, Gizmodo and many more.

EWSN'20 **Intermittent Computing with Dynamic Voltage and Frequency Scaling.**  
Saad Ahmed, 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<sup>2</sup>VFS 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. Klaus 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 **Accessible Programming for Intermittent Computing.**

MakeCode <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, [Saad Ahmed\\*](#), 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, [Saad Ahmed](#), Bashima Islam, Przemysław Pawełczak, Kasim Sinan Yildirim, 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, [Saad Ahmed](#), 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.**

Saad Ahmed, 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, Przemysław Pawełczak, 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.**

Saad Ahmed, 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.**

Saad Ahmed  
Doctoral School on Transiently Powered Computing-Collocated with SenSys'17

### W1 **Incremental checkpointing for interruptible computations.**

Saad Ahmed, Muhammad Hamad Alizai, Junaid Haroon Siddiqui, Naveed Anwar Bhatti, Luca Mottola  
14th ACM Conference on Embedded Network Sensor Systems (SenSys'16)

## References

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