

Ganapati Bhat

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RESEARCH INTERESTS

Wearable IoT devices, heterogeneous mobile devices, energy harvesting and management, flexible hybrid electronics, health monitoring

EDUCATION

Ph.D., Computer Engineering **Aug. 2014 – Aug. 2020**
Arizona State University, Tempe, AZ
Thesis Title: Design, Optimization, and Applications of Wearable IoT Devices

B.Tech., Electronics & Communication Engineering **July 2008 – May 2012**
Indian Institute of Technology (ISM), Dhanbad, India

EXPERIENCE

Assistant Professor **August 2020 – present**
School of EECS, Washington State University

Graduate Research Associate **Aug. 2014 – July 2020**
Arizona State University

Senior Software Engineer **April 2014 – July 2014**
Samsung R&D Institute, Bengaluru, India

Software Engineer **July 2012 – March 2014**
Samsung R&D Institute, Bengaluru, India

ACHIEVEMENTS AND RECOGNITIONS

- Best paper award, ACM Transactions on Design Automation of Electronic Systems 2021
- Best paper award, CASES, Embedded Systems Week 2019
- Ferdinand A. Stanchi Fellowship, Arizona State University 2019
- ASU Graduate and Professional Student Association Outstanding Research Award 2019
- ASU Graduate and Professional Student Association Outstanding Mentor Award 2019
- Engineering Graduate Fellowship, Arizona State University 2019
- Engineering Graduate Fellowship, Arizona State University 2018
- Employee of the Month Award, Samsung R&D Institute 2013

PUBLICATIONS

Patents

IP1 S. Gumussoy, **G. Bhat**, U. Y. Ogras. “Systems and Methods for Power-Temperature Stability and Safety Analysis for Multiprocessor Systems.” (Provisional Patent)

Book Chapters

- B1 U. Y. Ogras, U. Gupta, J. Park, **G. Bhat**. “Designing Wearable Systems-on-Polymer using Flexible Hybrid Electronics.” Printed Electronics: Technologies, Applications and Challenges, Nova Science Publishers, Inc., 2017.

Journal Articles

- J1 **G. Bhat**, U. Gupta, Y. Tuncel, F. Karabacak, S. Ozev, and U. Y. Ogras. “Self-Powered Wearable IoT Devices for Health and Activity Monitoring.” *Foundations and Trends® in Electronic Design Automation*, 13, no. 3 (2020): 145-269.
- J2 **G. Bhat**, N. Tran, H. Shill, U. Y. Ogras. “w-HAR: An Activity Recognition Dataset and Framework Using Low-Power Wearable Devices.” *Sensors*, 20 (18), 5356, 2020.
- J3 Y. Tuncel, S. An, **G. Bhat**, N. Raja, H. G. Lee, U. Y. Ogras. “Voltage-Frequency Domain Optimization for Energy-Neutral Wearable Health Devices.” *Sensors* 20 (18), 5255, 2020.
- J4 S. K. Mandal, **G. Bhat**, J. R. Doppa, P. P. Pande, U. Y. Ogras. “An Energy-Aware Online Learning Framework for Resource Management in Heterogeneous Platforms.” *ACM Trans. Design Autom. Electron. Syst. (TODAES)*, 25.3 (2020): 1–26, 2020. **[Best Paper Award]**
- J5 **G. Bhat**, S. Gumussoy, U. Y. Ogras. “Analysis and Control of Power-Temperature Dynamics in Heterogeneous Multiprocessors.” *IEEE Trans. Control Systems Tech.*, 29(1), 329-341, 2020.
- J6 J. Park, **G. Bhat**, Anish NK, C. S. Geyik, U. Y. Ogras, and H. G. Lee. “Energy per Operation Optimization for Energy-Harvesting Wearable IoT Devices.” *Sensors*, 20(3):764, 2020.
- J7 **G. Bhat**, H. Gao, S. K. Mandal, U. Y. Ogras, and S. Ozev. “Determining Mechanical Stress Testing Parameters for FHE Designs with Low Computational Overhead.” *IEEE Design & Test*, 37(4), 35-41, 2020.
- J8 **G. Bhat**, Y. Tuncel, S. An, H. G. Lee, U. Y. Ogras. “An Ultra-Low Energy Human Activity Recognition Accelerator for Wearable Health Applications.” *ACM Trans. Embedd. Comput. Syst.*, 18(5s), p. 49, 2019. **[Best Paper Award]**
- J9 **G. Bhat**, R. Deb, and U. Y. Ogras. “OpenHealth: Open Source Platform for Wearable Health Monitoring.” *IEEE Design & Test* 36 (5), pp. 27–34, 2019.
- J10 S. K. Mandal, **G. Bhat**, C. A. Patil, J. R. Doppa, P. P. Pande, U. Y. Ogras. “Dynamic Resource Management of Heterogeneous Mobile Platforms via Imitation Learning.” *IEEE Trans. Very Large Scale Integr. (VLSI) Syst.* 27(12), pp. 2842–2854, 2019.
- J11 D. Chang, **G. Bhat**, U. Y. Ogras, B. Bakaloglu, S. Ozev. “Detection Mechanisms for Unauthorized Wireless Transmissions.” *ACM Trans. Design Autom. Electron. Syst. (TODAES)* 23 (6), pp. 70:1–70:21, 2018.
- J12 **G. Bhat**, G. Singla, A. K. Unver, U. Y. Ogras. “Algorithmic Optimization of Thermal and Power Management for Heterogeneous Mobile Platforms.” *IEEE Trans. Very Large Scale Integr. (VLSI) Syst.* 26 (3), pp. 544–557, 2018.
- J13 **G. Bhat**, S. Gumussoy, U. Y. Ogras. “Power-Temperature Stability and Safety Analysis for Multiprocessor Systems.” *ACM Trans. Embedd. Comput. Syst.* 16 (5s), pp. 145, 2017.
- J14 U. Gupta, C. A. Patil, **G. Bhat**, P. Mishra, U. Y. Ogras. “DyPO: Dynamic Pareto Optimal Configuration Selection for Heterogeneous MpSoCs.” *ACM Trans. Embedd. Comput. Syst.* 6 (5s), pp. 123, 2017.

Conference Papers

- C1 N. Yamin and **G. Bhat**. “Online Solar Energy Prediction for Energy-Harvesting Internet of Things Devices.” *Proc. of Int. Symp. on Low Power Electronics Design*, 2021 (Accepted, to appear)
- C2 A. Deshwal, S. Belakaria, **G. Bhat**, J. R. Doppa, P. P. Pande. “Learning Pareto-Frontier Resource Management Policies for Heterogeneous SoCs: A Information-Theoretic Approach.” *Proc. of Design Autom. Conf. (DAC)*, (Accepted, to appear)
- C3 Y. Tuncel, **G. Bhat**, U. Y. Ogras. “Special Session: Physically Flexible Devices for Health and Activity Monitoring: Challenges from Design to Test.” *2020 IEEE VLSI Test Symp. (VTS)*, 2020.
- C4 **G. Bhat**, K. Bagewadi, H. G. Lee, U. Y. Ogras. “REAP: Runtime Energy-Accuracy Management for Energy Harvesting IoT Devices.” *Proc. of Design Automation Conf. (DAC)*, pp. 171:1–171:6, June 2019.
- C5 **G. Bhat**, Y. Tuncel, S. An, U. Y. Ogras. “Wearable IoT Devices for Health Monitoring.” *TechConnect Briefs*, pp. 357-360, June 2019.
- C6 Anish NK, **G. Bhat**, J. Park, H. G. Lee, U. Y. Ogras. “Sensor-Classifer Co-Optimization for Wearable Human Activity Recognition Applications.” *Proc. of Int. Conf. on Embedd. Software and Syst. (ICISS)*, pp. 1-4, June 2019. [Invited paper]
- C7 **G. Bhat**, S. Gumussoy, U. Y. Ogras. “Power and Thermal Analysis of Commercial Mobile Platforms: Experiments and Case Studies.” *Proc. Design, Automation & Test in Europe Conf. & Exhibition (DATE)*, March 2019. [Special Session]
- C8 H. Gao, **G. Bhat**, U. Y. Ogras, S. Ozev. “Optimized Stress Testing for Flexible Hybrid Electronics Designs.” *IEEE VLSI Test Symp. (VTS)*, March 2019. **[Best Paper Candidate]**
- C9 **G. Bhat**, R. Deb, V. V. Chaurasia, H. Shill, U. Y. Ogras. “Online Human Activity Recognition using Low-Power Wearable Devices.” *Proc. of Int. Conf. on Computer-Aided Design (ICCAD)*, pp. 72:1–72:8, November 2018.
- C10 **G. Bhat**, S. K. Mandal, U. Gupta, U. Y. Ogras. “Online Learning for Adaptive Optimization of Heterogeneous SoCs.” *Proc. of Int. Conf. on Computer-Aided Design (ICCAD)*, pp. 61:1–61:8, November 2018. [Special Session]
- C11 J. Park, **G. Bhat**, C. Geyik, H. G. Lee, U. Y. Ogras. “Energy-Optimal Gesture Recognition using Self-Powered Wearable Devices.” *Proc. of Biomedical Circuits and Syst. Conf.*, pp. 1–4, October 2018.
- C12 **G. Bhat**, J. Park, U. Y. Ogras. “Near-Optimal Energy Allocation for Self-Powered Wearable Systems.” *Proc. of Int. Conf. on Computer-Aided Design (ICCAD)*, pp. 368–375, November 2017.
- C13 **G. Bhat** et al. “Fluid Wireless Protocols: Energy-Efficient Design and Implementation.” *Proc. of Symp. on Embedded Systems for Real-Time Multimedia*, pp. 22–31, October 2017.
- C14 **G. Bhat**, U. Gupta, N. Tran, J. Park, S. Ozev, U. Y. Ogras. “Multi-Objective Design Optimization for Flexible Hybrid Electronics.” *Proc. of Int. Conf. on Computer-Aided Design (ICCAD)*, 1-8, November 2016.

Other Papers, Preprints, and Reports

1. R. Deb, **G. Bhat**, S. An, U. Y. Ogras, and Holly Shill. “Trends in Technology Usage for Parkinson’s Disease Assessment: A Systematic Review.” *medRxiv* (2021).

2. S. An, **G. Bhat**, S. Gumussoy, U. Y. Ogras. “Transfer Learning for Human Activity Recognition using Representational Analysis of Neural Networks.” arXiv preprint arXiv:2012.04479 (2020).
3. **G. Bhat**, S. Gumussoy, U. Y. Ogras. “Analysis and Control of Power-Temperature Dynamics in Heterogeneous Multiprocessors.” *SRC Techcon*, 2019.
4. J. Park, **G. Bhat**, C. Geyik, H. G. Lee, U. Y. Ogras. “Optimizing Operations per Joule for Energy Harvesting IoT Devices.” *Technical Report, Arizona State University*, 2018.

Posters

- P1 **G. Bhat**, U. Y. Ogras. “An Online Learning Framework for Activity Recognition on Wearable IoT Devices.” *ACM Student Research Competition at ICCAD*, 2019.
- P2 **G. Bhat**, S. Gumussoy, U. Y. Ogras. “Analysis and Control of Power-Temperature Dynamics in Heterogeneous Multiprocessors.” *SRC System-Level Design Review*, 2019.
- P3 **G. Bhat**. “Wearable IoT Devices for Health Monitoring.” *Ph.D. Forum at Design Automation Conference (DAC)*, 2019.
- P4 **G. Bhat**. “Wearable IoT Devices for Health Monitoring.” *Ph.D. Forum at Int. Conf. on Information Processing in Sensor Networks (IPSN)*, 2019.
- P5 U. Gupta, **G. Bhat**, J. Park, C. Geyik, U. Y. Ogras. “Energy Harvesting Wearable Devices for Movement Disorder Analysis.” *AZ Wellbeing Commons*, 2017.
- P6 G. Singla, **G. Bhat**, G. Kaur, N. Matturu, A. K. Unver, U. Y. Ogras. “Predictive Dynamic Thermal and Power Management of Heterogeneous Mobile Platforms.” *Connection One (C1) Annual Meeting*, 2015.

RESEARCH GRANTS

A. Funded

1. **G. Bhat** (Sole PI), “Transforming Digital Healthcare with Self-Powered Wearable Devices.” WSU Office of Research, New Faculty Seed Grant, \$25,000, 5/17/2021 – 8/15/2022.

B. Submitted/Pending

1. S. Gupta (PI), **G. Bhat** (Co-PI), A. Du (Co-PI), “SCH: AI-enabled Integration of Nanomaterials Amplified Biosensor and Monitoring Devices for Cardiac Biomarker Detection.” National Science Foundation, \$1,200,000, 8/16/2021 – 8/15/2025.

GRADUATE STUDENT ADVISING

Nuzhat Yamin, PhD Student	WSU, Fall 2020 - present
Dina Hussein, PhD Student	WSU, Spring 2021 - present

TEACHING

CptS 260 Intro to Computer Architecture (undergraduate)	WSU, Spring 2021
EE 524/Cpts 561 Advanced Computer Architecture (graduate)	WSU, Fall 2020

- Primary instructor for the graduate level computer architecture class at Washington State University

- Revamped the course material by developing a new set of lecture slides that follow top computer architecture programs. The streamlined set of lecture slides were useful in having a coherent flow of material to the students.
- Introduced the gem5 simulator to the class so that students can get exposure to state-of-the-art architectural simulators.

System-level Design for Multicore Architectures

ASU, Fall 2017, Fall 2018

- Introduced possible research projects to classes of 30 and 40 students, respectively
- Mentored student groups in their research projects in the class. The projects involved applications of flexible wearable devices, dynamic power management, and instrumentation of mobile SoCs.

MENTORING EXPERIENCE

Doctoral Students Mentored

- **Sumit K. Mandal:** Mentored Sumit in a project on dynamic management of heterogeneous system-on-chips. The project resulted in a joint paper publication with Sumit [J10].
- **Sizhe An:** Mentored Sizhe on software development for the wearable IoT devices used in the research group. Using this knowledge, he developed an algorithm for step length detection.

Masters Students Mentored

- **Vatika Chaurasia:** Mentored Vatika in implementing neural network training algorithms in Python for a human activity recognition project. The work done by Vatika with the neural networks resulted in a joint paper publication [C9].
- **Ranadeep Deb:** Mentored Ranadeep in the human activity recognition framework and data collection for the same. This work resulted in the publication of a joint paper [C9].
- **Chetan A. Patil:** Mentored Chetan in enabling the performance counter unit on the Samsung Exynos 5422 system-on-a-chip. As a result of this, Chetan was able to collect a large amount of data on the platform. The data was used in at least two papers from the group [J10, J14].

Undergraduate Students Mentored

- **Nicholas Tran:** Mentored Nicholas in the implementation of a multi-objective optimization algorithm for flexible hybrid electronics. Nicholas implemented some key parts of the algorithm, which led to a joint paper with him [C14].
- **Pragathi Gopal and Abrahm Coury:** Mentored Pragathi and Abrahm in their research experience for undergraduates program. Helped them learn how data processing and machine learning is performed for human activity recognition.
- **Audrey Mendez:** Mentoring Audrey in her research experience for undergraduates program. I am guiding her in data collection for human activity recognition and gait analysis applications.

High School Student Mentored

- **Bhavya Sharma:** Mentored Bhavya in wearable devices when she was visiting our lab as a high school researcher. She is currently an undergraduate student at ASU.

PRESENTATIONS AND OUTREACH

A. Technical Presentations

1. "Special Session: Physically Flexible Devices for Health and Activity Monitoring: Challenges from Design to Test." *2020 IEEE VLSI Test Symp. (VTS)*, 2020.

2. "An Ultra-Low Energy Human Activity Recognition Accelerator for Wearable Health Applications." *Embedded Systems Week*, 2019.
3. "REAP: Runtime Energy-Accuracy Management for Energy Harvesting IoT Devices." *Proc. of Design Automation Conf. (DAC)*, June 2019.
4. "Wearable IoT Devices for Health Monitoring." *TechConnect Briefs*, June 2019.
5. "Online Human Activity Recognition using Low-Power Wearable Devices." *Int. Conf. on Computer-Aided Design (ICCAD)*, November 2018.
6. "Near Optimal Energy Allocation for Self-Powered Wearable Systems." *Int. Conf. on Computer-Aided Design (ICCAD)*, November 2017.
7. "Power-Temperature Stability and Safety Analysis for Multiprocessor Systems." *Embedded Systems Week*, October 2017.
8. "DyPO: Dynamic Pareto Optimal Configuration Selection for Heterogeneous MpSoCs." *Embedded Systems Week*, October 2017.
9. "Fluid Wireless Protocols: Energy-Efficient Design and Implementation." *Symp. on Embedded Systems for Real-Time Multimedia*, October 2017.
10. "Multi-Objective Design Optimization for Flexible Hybrid Electronics." *Int. Conf. on Computer-Aided Design (ICCAD)*, November 2016.

B. Invited Talks

1. "Evolution of Computing from Mobile Systems to Self-Powered Wearable Devices." *Washington State University*, 2020.
2. "Design, Optimization, and Applications of Wearable IoT Devices." *University of Kansas*, 2020.
3. "Evolution of Computing from Mobile Systems to Self-Powered Wearable Devices." *University of North Texas*, 2020.
4. "Design, Optimization, and Applications of Wearable IoT Devices." *Villanova University*, 2020.
5. "Evolution of Computing from Mobile Systems to Self-Powered Wearable Devices." *University of Texas at Dallas*, 2020.
6. "Evolution of Computing from Mobile Systems to Self-Powered Wearable Devices." *University of Maryland, College Park*, 2020.
7. "Design, Optimization, and Applications of Wearable IoT Devices." *Indian Institute of Science*, 2020.

SERVICE

Conference Committee Membership and Session Chair

- Program committee member, IEEE PerCom International workshop on Pervasive Health Technologies (PerHealth 2021)
- Program committee member, Embedded Systems Week, 2021
- Session chair, Design Automation and Test in Europe, 2021
- Session chair, Embedded Systems Week, 2020
- Member of reviewer board, MDPI Journal of Low Power Electronics and Applications

Peer-Reviewing

- Reviewer, IEEE Transactions on Very Large Integration (VLSI) Systems
- Reviewer, IEEE Transactions on Computer-Aided Design of Integrated Circuits and Systems
- Reviewer, IEEE Design & Test Magazine
- Reviewer, IEEE Transactions on Mobile Computing
- Reviewer, ACM Transactions on Design Automation of Electronic Systems (TODAES)
- Reviewer, Journal of Computer Science and Technology
- Reviewer, ACM Journal of Emerging Technologies in Computing Systems
- Reviewer, ACM Transactions on Embedded Computing Systems
- Reviewer, ACM Transactions on Sensor Networks
- Reviewer, IET Computers & Digital Techniques
- Reviewer, MDPI Sensors
- Reviewer, MDPI Journal of Low Power Electronics and Applications
- Reviewer, Elsevier Neurocomputing
- Reviewer, Elsevier Machine Learning and Applications
- Reviewer, Elsevier Journal of Sustainable Computing

Washington State University

- Faculty advisor, Palouse Robosub

Arizona State University

- Reviewer, GPSA Outstanding Research Award (Spring 2017, Fall 2019)
- Reviewer, GPSA Teaching Excellence Award (Spring and Fall 2017)

PROFESSIONAL MEMBERSHIPS

Student Member, Institute of Electrical and Electronics Engineers

Member, Association for Computing Machinery