Akshar Chavan

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Summary

Innovative, impact-driven engineer with over 4 years of hands-on experience in energy-aware systems, edge computing, and battery state-of-health optimization. A multidisciplinary background spanning Electrical, Computer, Industrial, and Mechanical Engineering enables me to design, prototype, and deploy energy-efficient autonomous systems. Experienced in applying these skills to IoT devices and renewable energy projects. Proficient in robotics, high-performance computing, graph algorithms, energy-aware algorithms, and task scheduling for resource-constrained systems. Proven track record of extending battery lifespan, improving system scalability, and delivering research-driven, real-world solutions.

Technical Skills

Languages: Python, C, C++
Frameworks/Tools: ROS, Arduino, Gazebo, Git, Bash, Slurm, OpenMP, MPI
Data and Visualization: Pandas, NumPy, Matplotlib, Plotly
Machine Learning: TensorFlow, Keras, Reinforcement Learning
Systems: Embedded Systems, Autonomous Mobile Robots, Linux Scripting

Education

Ph.D. in Electrical and Computer Engineering - GPA: 3.7/4.0 — Jan 2024 - Dec 2025 (Expected)
The Ohio State University — Columbus, OH, USA

Ph.D. in Computer Science - GPA: 3.67/4.0 (*Transferred to OSU*) — Aug 2020 – Dec 2023
Wayne State University — Detroit, MI, USA

M.S. in Industrial Engineering - GPA: 3.51/4.0 — Aug 2018 – May 2020
Wayne State University — Detroit, MI, USA

B.E. in Mechanical Engineering - GPA: 3.27/4.0 — Aug 2011 – May 2014
University of Mumbai — Mumbai, India

Work/Research Experience

Safety Ensured Energy Management for Autonomous Mobile Robots (AMRs) — Aug 2023 – Present

- Investigated CPU frequency scaling in AMRs operating under variable environmental complexity, identifying key limitations and proposing control strategies to mitigate unsafe latency and unpredictable energy consumption.
- Built a fully functional AMR prototype using ROS with integrated LiDAR, cameras, and power sensors, enabling real-world testing of energy-aware control algorithms.
- Conducted real-world experiments showing that increasing speed from 0.4m/s to 2.4m/s led to a 222% increase in latency and an 1829% rise in reaction distance, motivating a need for coordinated control of motion and computation.
- Developed a linear regression model predicting reaction distance and power consumption from robot speed and CPU frequency, providing a mathematical foundation for safe, energy-aware decision-making.
- Designed and integrated a predictive energy management algorithm in ROS that adapts to dynamic obstacles and uncertain environments, ensuring reliable task completion within energy budgets.
- Currently validating system performance across diverse scenarios, targeting reduced task times, enhanced energy efficiency, and aiming for peer-reviewed publication in IEEE Transactions on Robotics (Aug 2025).

Speeding-up Graph Algorithms via Graph Restructuring — Aug 2022 – Jul 2025

- Developed novel graph restructuring techniques to tackle scalability bottlenecks in global-connectivity dependent graph algorithms such as matching and all-pairs shortest paths (APSP) by preserving complete path connectivity.
- Designed a deterministic sequential Clique Partition based Graph Restructuring (CPGR) algorithm and a Parallel Randomized Clique Partition based Graph Restructuring (PAR-CP), both restructuring graphs into tripartite forms and reducing edge count by $O(\log n)$ asymptotically.
- Implemented CPGR in C; achieved up to 59% edge reduction and 2.07× speedup for Dinitz's algorithm for matching, and 1.68× speedup for APSP on synthetic and real-world datasets.
- Implemented PAR-CP using MPI in C, optimized for multi-core architectures on the Pittsburgh Supercomputer with up to 128 cores; PAR-CP achieved up to 74.4% edge reduction and resulted in up to 2.06× speedup for Dinitz's algorithm, with APSP achieving a speedup up to 213.34×.

Battery Degradation-Aware Task Offloading in Edge-Assisted Mobile Computing — Jan 2025 – June 2025

- Designed and developed a novel task offloading algorithm for edge-assisted mobile computing to mitigate premature battery failure in mobile devices (e.g., delivery robots) by incorporating battery State of Health (SOH) awareness.
- Modeled the problem as a Binary Integer Program (BIP), optimizing task distribution with constraints on deadlines (e.g., robot navigation), transmission/processing times, energy usage, SOH, and edge resource limits.
- Developed a polynomial-time greedy algorithm with SOH estimation and adaptive scheduling, integrated into a Python simulator for dynamic edge environments.
- Executed 2-year simulations in an AMR-based food delivery scenario, demonstrating a 23% increase in battery lifespan (131-day extension) and 8% growth in projected revenue through SOH-aware, adaptive task offloading.

Battery Lifespan-Aware LPWAN Protocol Feb 2022 – Jul 2024

- Designed and implemented a Python-based task offloading scheduler for LoRaWAN IoT networks to mitigate battery limitations and high transmission failure rates.
- Integrated a semi-empirical model to estimate battery SOH from SOC profiles and developed a Bayesian time slot selection algorithm that used SOH and predicted solar energy to optimize offloading decisions, minimizing battery degradation and data loss.
- Validated the protocol through 2-year simulations, demonstrating a 69.7% increase in overall network lifespan. Further confirmed real-world effectiveness using a 10-node LoRaWAN testbed (Raspberry Pi 3 + Dragino), achieving up to an 80% reduction in battery cycle aging over 24 hours.

Joint Task and Charging Scheduler for High-Quality Battery Life Aug 2020 – Sept 2022

- Developed a Python-based Mixed Integer Non-Linear Programming (MINLP) model using Gurobi to jointly schedule tasks and charging for AMRs, reducing energy waste and preserving battery health by enforcing SOC thresholds.
- Designed a high-performance greedy algorithm (Task and Charging Schedule Manager – TCM) to approximate the MINLP model in real time (0.015s vs. 2837.6s), achieving a 1.15 approximation ratio for efficient fleet-level scheduling.
- Balanced battery longevity and task throughput, improving AMR fleet efficiency through optimized joint scheduling of charging and task assignments.
- Validated via simulation, showing a 99.3% reduction in SOC violations and 22.36% lower energy waste, significantly enhancing AMR battery reliability and lifespan.

Industrial Engineering Intern — Aerostar Manufacturing Aug 2019 – Aug 2020

- Streamlined production planning by implementing a continuous monitoring system for part availability, ensuring accurate order acceptance and improving on-time deliveries for enhanced customer satisfaction.
- Leveraged Kanban, 5S, and Lean Manufacturing principles to continuously identify opportunities for enhancing manufacturing time and cost, providing metrics that supported data-driven process improvements.
- Developed and implemented a Python-based inventory tracking system that provided real-time, accurate quantities of raw, finished, WIP, RTV, and scrap materials, significantly reducing manual counting time and providing precise data for production scheduling.

Predictive Maintenance for Connected Vehicles Feb 2019 – Aug 2019

- Contributed to a research initiative developing a predictive maintenance framework to reduce vehicle downtime by aligning component availability with scheduled service.
- Collaborated on a greedy algorithm integrating real-time sensor data, multi-vehicle routing, and predictive analytics to pre-position maintenance components ahead of service appointments.
- Modeled mixed-fleet DVRP with operational uncertainties (e.g., drone constraints) in Python, enabling analysis of disruption impacts on logistics efficiency.
- Enabled synchronized maintenance operations that eliminated part-order delays, significantly improving fleet availability and operational efficiency.

Teaching Experience

Instructor — Wayne State University, Detroit, MI, USA Aug 2023 – Dec 2023
Graduate Teaching Assistant — Wayne State University, Detroit, MI, USA Aug 2022 – Dec 2022
Lecturer — St. John College of Engineering and Management, Palghar, MH, India Jul 2015 – May 2018

Fellowship, Awards & Honors

- Thomas C. Rumble University Graduate Fellowship Award, Wayne State University. Aug 2023
- Overall First Place in Formula Kart Design Challenge (FKDC 2018) Mar 2018
- Overall Third Place in Formula Kart Design Challenge (FKDC 2017) Feb 2017

Leadership & Teamwork

- Team Guide for Formula Kart Design Challenge (FKDC), Palghar, MH, India. Jun 2016 - May 2018
- Team Manager for SAE INDIA Baja 2013 & Formula Student (Supra) 2014, MH, India. May 2012 - Feb 2014

PUBLICATIONS

[1] S. Fahmida, A. S. Chavan, P. V. Modekurthy, S. Abusayeed, and M. Brocanelli, "A Battery Lifespan-Aware Protocol for LPWAN," in *Proceedings of the IEEE 44th International Conference on Distributed Computing Systems (ICDCS)*, Jersey City, NJ, USA, July 2024, pp. 1050–1061.

[2] S. T. Atik, A. S. Chavan, D. Grosu, and M. Brocanelli, "A Maintenance-Aware Approach for Sustainable Autonomous Mobile Robot Fleet Management," *IEEE Transactions on Mobile Computing*, vol. 23, no. 6, pp. 7394–7407, June 2024.

[3] A. S. Chavan and M. Brocanelli, "Towards High-Quality Battery Life for Autonomous Mobile Robot Fleets," in *Proceedings of the IEEE 3rd International Conference on Autonomic Computing and Self-Organizing Systems (ACSOS)*, Virtual Conference, September 2022, pp. 61–70.