

AQEEL ANWAR

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OBJECTIVE

Motivated graduate research assistant working on hardware-algorithm co-design for energy efficient Machine Learning systems.

EDUCATION

- MAY 2021 **Ph.D. Electrical & Computer Engineering** - GEORGIA INSTITUTE OF TECHNOLOGY, ATLANTA, GA
(*Expected*) Focus: Machine Learning (ML) and ML System Design | Advisor: [Dr. Arijit Raychowdhury](#)
- MAY 2017 **M.Sc. Electrical & Computer Engineering** - GEORGIA INSTITUTE OF TECHNOLOGY, ATLANTA, GA
Focus: Digital Signal Processing | CGPA: 4.00/4.00
- AUG 2012 **B.Sc. Electrical Engineering** - UNIVERSITY OF ENGINEERING & TECHNOLOGY LAHORE, PAKISTAN
Dean's Honor List | Gold Medalist | CGPA: 3.93/4.00

WORK EXPERIENCE

- AUG 2017 **Graduate Research Assistant** - GEORGIA INSTITUTE OF TECHNOLOGY, ATLANTA GA
present Working towards enabling edge intelligence in resource constrained autonomous systems for Reinforcement Learning (RL) based applications.
- **Software tools:**
 - **PEDRA [1]**: A programmable engine for Drone Reinforcement Learning (RL) applications developed in Python and module-wise programmable. The engine interfaces with Unreal gaming engine using AirSim to create the complete platform which can be used to train and test various RL algorithms for their algorithmic and energy performance. <https://aqeelanwar.github.io/PEDRA/>
 - **MaskTheFace[3]**: Computer vision based script to create masked face dataset from face dataset that can be used to train neural network with masked face application such as masked face recognition, mask detection and correct mask application etc. The motivation for this tool is the current ongoing COVID19 pandemic. <https://aqeelanwar.github.io/MaskTheFace/>
 - **MultiTask RL [4]**: A decentralized policy gradient approach at learning a unified policy on multi-task RL problems. By combining consensus optimization with the policy gradient algorithm, we theoretically show that the convergence of multi-task algorithm achieves the same convergence rate as the single task algorithm within constants depending on the connectivity of the network
 - **Energy efficient RL [5]–[7]**: Transfer learning (TL) followed by reinforcement learning (RL) algorithm mapped onto a hierarchical embedded memory system to meet the stringent power budgets of autonomous drones. The power reduction is achieved by using transfer learning on meta-environments followed by online RL only on the last few layers of a deep convolutional neural network (CNN).
- MAY 2019 **Machine Learning System Intern** - SAMSUNG SEMICONDUCTOR INC. SAN JOSE, CA
- AUG 2019 Worked in the Advanced Logic Lab on a novel *STT-MRAM based analogue Processing-In-Memory modular DNN accelerator* providing end-to-end simulation framework that can be used to find a power-performance optimized solution for a given DNN topology. The simulator supports various layer types, logical to physical crossbar mapping schemes and crossbar configurations. A list of control parameters is used to overwrite DRAM read/write bandwidth, number of parallel inputs for pipe-lining and to select mapping scheme. Results show a significant improvement in energy and latency when compared with a digital DNN accelerator. [2]
- MAY 2017 **Machine Learning Engineer** - AIVSOL GERMANY
- JUL 2017 Worked remotely on a start-up working towards the algorithms for self-driving cars
- Worked on object localization and classification for the application towards self driving car using deep learning framework TensorFlow
 - Adapted and integrated state-of-the-art deep learning algorithm for accurate classification of pedestrians, cars and traffic signs
 - Carried out experiments, trained models, analyzed and documented results to make recommendations regarding the choice of algorithms, respective implementations and configurations

- SEP 2013 **Research Assistant** - AL-KHAWARAZMI INSTITUTE OF COMPUTER SCIENCES LAHORE, PAKISTAN
AUG 2015 Proposed a self-calibration mechanism for the application of gunshot detection, achieving localization and orientation for wireless acoustic sensor network using a single moving beacon equipped with RF and acoustic sources reporting localization and orientation accuracy of 11cm and 1.7° respectively on a custom-built hardware prototype. [8], [9]

SKILLS

Python, TensorFlow, Keras, PyCaffe, Unreal Engine, ROS, MATLAB, L^AT_EX

AWARDS AND CERTIFICATES

- NOV 2018 Best Paper Award at 2018 IEEE Mechatronics and Machine Vision in Practice (M2VIP) Stuttgart, Germany
AUG 2015 Recipient of the US Fulbright Scholarship for Masters program at Georgia Institute of Technology
MAR 2013 Gold Medalist - Best performance in Telecom & Electronics subjects in B.Sc Electrical Engineering at 20th convocation of University of Engineering & Technology Lahore, Pakistan

WORKSHOPS AND INVITED TALKS

- OCT 2019 “Real Time Reinforcement Learning in Hierarchical Memory Sub-systems” presented in C-BRIC (Centre for Brain Inspired Computing) annual review at Purdue University.
APR 2019 “Shifting ML training from cloud to edge nodes” presented in The Physics of AI organized by New York state section of American Physical Society (APS) at T. J. Watson Research Center New York on behalf of Dr. Arijit Raychowdhury

PUBLICATIONS

- [1] A. Anwar and A. Raychowdhury, “Autonomous navigation via deep reinforcement learning for resource constraint edge nodes using transfer learning,” *IEEE Access*, vol. 8, pp. 26 549–26 560, 2020.
- [2] A. Anwar, A. Raychowdhury, R. Hatcher, and T. Rakshit, “Xbaropt - enabling ultra-pipelined, novel stt mram based processing-in-memory dnn accelerator,” in *2020 2nd IEEE International Conference on Artificial Intelligence Circuits and Systems (AICAS)*, 2020, pp. 36–40.
- [3] A. Anwar and A. Raychowdhury, *Masked face recognition for secure authentication*, 2020. arXiv: [2008.11104](https://arxiv.org/abs/2008.11104) [cs.CV].
- [4] S. Zeng, A. Anwar, T. Doan, J. Romberg, and A. Raychowdhury, *A decentralized policy gradient approach to multi-task reinforcement learning*, 2020. arXiv: [2006.04338](https://arxiv.org/abs/2006.04338) [cs.LG].
- [5] I. Yoon, A. Anwar, T. Rakshit, and A. Raychowdhury, “Transfer and online reinforcement learning in stt-mram based embedded systems for autonomous drones,” in *2019 Design, Automation & Test in Europe Conference & Exhibition (DATE)*, IEEE, 2019, pp. 1489–1494.
- [6] I. Yoon, M. A. Anwar, R. V. Joshi, T. Rakshit, and A. Raychowdhury, “Hierarchical memory system with stt-mram and sram to support transfer and real-time reinforcement learning in autonomous drones,” *IEEE Journal on Emerging and Selected Topics in Circuits and Systems*, 2019.
- [7] M. A. Anwar and A. Raychowdhury, “Navren-rl: Learning to fly in real environment via end-to-end deep reinforcement learning using monocular images,” in *2018 25th International Conference on Mechatronics and Machine Vision in Practice (M2VIP)*, IEEE, 2018, pp. 1–6.
- [8] M. A. Anwar, A. B. Siddique, and M. Tahir, “Relative self-calibration of wireless acoustic sensor networks using dual positioning mobile beacon,” *IEEE Systems Journal*, vol. 12, no. 1, pp. 862–870, 2016.
- [9] M. A. Anwar, H. Hassan, H. Maqbool, A. Rehman, and M. Tahir, “Acoustic sensor network relative self-calibration using joint tdoa and doa with unknown beacon positions,” in *2014 IEEE Wireless Communications and Networking Conference (WCNC)*, IEEE, 2014, pp. 3064–3069.