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Rappy Saha

Research Focus and Interest

- Implement an efficient quantization method on edge FPGAs for machine learning workloads.
- Analyze the impact of approximate computation on edge accelerator design for machine learning workloads.
- Investigate the effects of sparsity and quantization on edge accelerator design for machine learning workloads.

University Education

2022–2026(Expected) **PhD Degree in Computing Science**, *University of Glasgow*, United Kingdom.
Supervisor: Dr José Cano Reyes.
UKRI Research Project: *Framework to Optimize DNN Model Inference on FPGA.*

2016–2018 **MSc Degree in Electronics Engineering**, *Kookmin University*, South Korea.
Thesis: *Implementation of Image Sensor and Development of HDR Algorithm using HLS.*
Grade: *4.50 out of 4.50.*

2011–2015 **BSc Degree in Electrical and Electronic Engineering**, *Khulna University of Engineering & Technology*, Bangladesh.
Thesis: *Arduino based home automation System.*
Grade: *3.56 out of 4.00.*

Professional Experience

since May 2023 **Graduate Teaching Assistant**, *University of Glasgow*, United Kingdom.

- Coordinated lab sessions and graded exam papers.

2019–2022 **Researcher**, *Ronix Inc.*, South Korea.

- Design and development of industrial camera solution from the system design to each individual module/IP development.
- Configured multiple custom image sensors and developed custom bt1120 decoder-based IP.
- Gained experience of various embedded platforms – Arm CPU, FPGA (Xilinx/Altera), ASIC, Soc, Microcontrollers (STM/AVR).
- Handled communication protocol – UART, I2C, SPI.
- Experienced with memory controller – DRR3/4, flash.
- Worked with several display controllers – VGA, HDMI/DVI, SDI.

2018–2019 **Researcher**, *Kookmin University*, South Korea.

- Machine learning based application development in the field of optical wireless communication and medical image classification.

2016–2018 **Graduate Research Assistant**, *Kookmin University*, South Korea.

- Development and implementation of image processing algorithm for the high dynamic range (HDR) applications and image fusion technology.

Skills

Tools Vivado, Quartus Prime, Modelsim, STM IDE, Git, MATLAB

Language C, VHDL, Python, C++, Verilog

Misc Datacrunch, Technical Writing, Presentations, Team Communication

Notable Projects

Welding vision camera

Developed FPGA Design for the image sensor functionality.

- Special image sensor, suited for the welding vision application, configured using FPGA. Capture raw image data, process the image data using ISP pipeline.
- Develop basic on-screen display (OSD) engine for the application.

Welding vision Camera Controller.

Firmware development for the targeted micro-controller.

- Design the system firmware and the features of the DVI controller.
- Handled communication protocol, I2C, UART and SPI to communicate between micro-controllers, outside chips and to control the flash memory.
- Controlling different ASIC chips with micro-controller using two wire communication protocol.

Scholarships

- IEEE CAS Student Travel Grant 2024.
- EPSRC Scholarship for PhD (Full Tuition Fee and Stipend for 3.5 years), United Kingdom.
- Scholarship for outstanding overseas researcher($18,436) for MSc, South Korea.

Languages

Native Bengali.

Advanced English, IELTS 2017-6.5, IELTS 2020-7.5, IELTS 2022-7.0.

Basic Korean(Hangul).

Publications

Citation Statistics

Overall citations: 273, h-index: 7, i-index: 5

(from Google Scholar accessed on the 29th of September 2024)

Journal Articles

2020 [J1] P. P. Banik, **R. Saha**, and K.-D. Kim. "An Automatic Nucleus Segmentation and CNN Model based Classification Method of White Blood Cell". In: *Expert Systems with Applications* 149 (2020). SJR **Ranking: Q1, 146 citations on Google Scholar**.

[J2] **R. Saha**, P. P. Banik, S. S. Gupta, and K.-D. Kim. "Combining highlight removal and low-light image enhancement technique for HDR-like image generation". In: *IET Image Processing* 14.9 (Mar. 2020). SJR Ranking: Q2, 9 citations on Google Scholar.

2019 [J3] P. P. Banik, **R. Saha**, and K.-D. Kim. "LED color prediction using a boosting neural network model for a visual-MIMO system". In: *Optics Communications* 437 (Apr. 2019). SJR Ranking: Q2, 4 citations on Google Scholar.

2018 [J4] **R. Saha**, P. P. Banik, and K.-D. Kim. "HLS Based Approach to Develop an Implementable HDR Algorithm". In: *Electronics* 7.11 (Nov. 2018). SJR Ranking: Q2, 3 citations on Google Scholar.

[J5] P. P. Banik, **R. Saha**, and K.-D. Kim. "Regression analysis for LED color detection of visual-MIMO system". In: *Optics Communications* 413 (Apr. 2018). SJR Ranking: Q2, 14 citations on Google Scholar.

Conference Proceedings

2024 [C1] **R. Saha**, J. Haris, and J. Cano. "Accelerating PoT Quantization on Edge Devices". In: *Proceedings of the 31st IEEE International Conference on Electronics, Circuits and Systems*. Accepted for Publication, Conf Ranking: B1. Nancy, France, Nov. 2024.

2022 [C2] C. Gao, S. Saha, Y. Lu, **R. Saha**, K. D. McDonald-Maier, and X. Zhai. "Deep Learning on FPGAs with Multiple Service Levels for Edge Computing". In: *Proceedings of the 27th International Conference on Automation and Computing (ICAC)*. Core Ranking 2023: B. Birmingham, UK, Sept. 2022.

[C3] Y. Lu, C. Gao, **R. Saha**, S. Saha, K. D. McDonald-Maier, and X. Zhai. "FPGA-Based Dynamic Deep Learning Acceleration for Real-Time Video Analytics". In: *Architecture of Computing Systems (ARCS) 2022, Lecture Notes in Computer Science, vol 13642*. Ed. by M. Schulz, C. Trinitis, N. Papadopoulou, and T. Pionteck. Conf Ranking: B2. Munich, Germany: Springer, Cham, Apr. 2022.

2019 [C4] P. P. Banik, **R. Saha**, T.-H. Kwon, and K.-D. Kim. "Fusing Reflectance based LDR Images to Generate HDR Image". In: *Proceedings of the 2019 25th Asia-Pacific Conference on Communications (APCC)*. Core Ranking 2018: B. Ho Chi Minh City, Vietnam, Nov. 2019.

[C5] **R. Saha**, P. P. Banik, and K.-D. Kim. "Low Dynamic Range Image Set Generation from Single Image". In: *Proceedings of the 2019 International Conference on Electronics, Information, and Communication (ICEIC)*. Auckland, New Zealand, Jan. 2019.

2018 [C6] P. P. Banik, **R. Saha**, T.-H. Kwon, and K.-D. Kim. "LED Color Detection of Visual-MIMO System Using Boosting Neural Network Algorithm". In: *Proceedings of the 2018 Tenth International Conference on Ubiquitous and Future Networks (ICUFN)*. Conf Ranking: B. Prague, Czech Republic, July 2018.

[C7] P. P. Banik, **R. Saha**, and K.-D. Kim. "Contrast Enhancement of Low-Light Image Using Histogram Equalization and Illumination Adjustment". In: *Proceedings of the 2018 International Conference on Electronics, Information, and Communication (ICEIC)*. Honolulu, HI, USA, Jan. 2018.

[C8] P. P. Banik, **R. Saha**, and K.-D. Kim. "HDR Image from Single LDR Image after Removing Highlight". In: *Proceedings of the 2018 IEEE International Conference on Consumer Electronics (ICCE)*. Las Vegas, NV, USA, Jan. 2018.

[C9] **R. Saha**, P. P. Banik, and K.-D. Kim. "Conversion of LDR Image to HDR-like Image through High-Level Synthesis Tool for FPGA Implementation". In: *Proceedings of the 2018 IEEE International Conference on Consumer Electronics (ICCE)*. Las Vegas, NV, USA, Jan. 2018.

2017 [C10] **R. Saha** and K.-D. Kim. "Add Weighted Algorithm Based on the PICA and RBF Neural Network for Image Fusion". In: *Proceedings of the 2017 International Conference on Electrical, Computer and Communication Engineering (ECCE)*. Cox's Bazar, Bangladesh, Feb. 2017.

[C11] **R. Saha**, J.-E. Kim, and K.-D. Kim. "Determination of Threshold for IR Image by Using PICA with RBF Neural Network". In: *Proceedings of the 2017 IEEE International Conference on Consumer Electronics (ICCE)*. Conf Ranking: B1. Las Vegas, NV, USA, Jan. 2017.

Workshop Proceedings

2024 [W1] J. Haris, **R. Saha**, W. Hu, and J. Cano. "Designing Efficient LLM Accelerators for Edge Devices". In: *New Approaches for Addressing the Computing Requirements of LLMs and GNNs (ARC-LG) Workshop in ISCA*. Buenos Aires, Argentina, June 2024. URL: https://arxiv.org/abs/2408.00462.

2017 [W2] P. P. Banik, **R. Saha**, and K.-D. Kim. "Improvement of Color Detection by Regression Analysis of Visual-MIMO System". In: *Proceedings of the 2017 IEEE Globecom Workshops (GC Wkshps)*. Singapore, Dec. 2017.

Research Community Activities

External reviewer

I regularly act as reviewer for journals and sub-reviewer conferences.

Reviewer for journals:

- IEEE Access. Review Record: Orcid ID

External reviewer for conferences and workshops:

- International Conference on Electronics Circuits and Systems (ICECS).
- International European Conference on Parallel and Distributed Computing (Euro-Par).
- Euromicro Conference Series on Digital System Design (DSD).
- Workshop on New Approaches for Addressing the Computing Requirements of LLMs and GNNs (ARC-LG).
- Workshop on Machine Learning and Systems (EuroMLSys).
- Workshop on IoT, Edge, and Mobile for Embedded Machine Learning (ITEM).