School of Engineering Seminar

SAN FRANCISCO STATE UNIVERSITY

Speaker:

Omiya Hassan

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Department of Electrical Engineering and Computer Science,
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Date:

Wednesday
Mar. 8, 2023
1:00-1:50 PM

Location:

Hensill Hall 803

Energy-Efficient AI/Machine-Learning-Based Hardware Architectures for Biomedical Applications

Abstract: The future of critical health will involve intelligent and smart devices that are low-cost, wearable, and lightweight requiring energy-efficient hardware platforms. Various AI/machine learning (ML) models, such as deep learning architectures, have been employed in the design of intelligent systems. However, deploying these sophisticated and smart devices in real-time embedded systems with limited hardware resources and power budget is complex due to the requirement of high computational power in achieving a high accuracy rate. As a result, this creates a significant gap between the advancement of computing technology and the associated device technologies for healthcare applications. This talk will emphasize the necessity of developing energy-efficient AI/ML models on edge, especially for biomedical applications, by introducing two digital hardware design techniques. An overview of ML-based digital architectures, such as "SABiNN" and "DeepSAC," will be presented, which were used in developing a compact design architecture for a real-time sleep apnea monitoring system. DeepSAC is a shift-accumulator-based technique, whereas SABiNN is a 2's complement-based binarized digital hardware technique. Various deep compression learning techniques were employed in creating the optimized architecture, such as pruning, n-bit (n= 8,16) integer quantization, and binarization on hyper-parameters. These models significantly reduced the power consumption rate by 5x, size by 13x, and improved model latency in contrast with traditional neural network models. Furthermore, these two design methods were used in developing various other applications, such as a diabetes prediction model among pregnant women and an RF energy harvester design for biomedical applications. The talk will conclude by introducing promising research opportunities in AI/ML on hardware, VLSI, and neuromorphic computing.

***Speaker Bio*:** Omiya Hassan is currently working as a graduate instructor and a Ph.D. candidate. in the Department of Electrical Engineering and Computer Science (EECS) at the University of Missouri. She received her Bachelor of Science degree in Electrical and Electronics Engineering (EEE) in 2017 from United International University, Bangladesh. She served as a lecturer at Presidency University, Bangladesh, in the Department of Electrical and Computer Engineering (ECE) in 2018. Her current research topic focuses on designing energy-efficient machine-learning (ML) model-based integrated circuits (IC) for biomedical applications. Her research interest includes Integrated Circuit Design, VLSI, Embedded Computing Systems, Biomedical Instrumentation, and Domain-Specific Hardware Architecture Design. Ms. Hassan received the IEEE Instrumentation and Measurement Society's Graduate Research Fellowship Award in 2021, achieved the Outstanding Doctoral Student Award of 2021 from the Department of EECS at the University of Missouri, received the prestigious Research in Excellence from The Graduate Professionals Council at the University of Missouri and was awarded the University of Missouri's Outstanding Undergraduate Research Mentor of the year 2022 for her teaching and mentorship. She is a fellow 2022 Rising Star of Electrical Engineering and Computer Science (EECS). Besides research and education, Ms. Hassan is a trained vocalist in South Asian Tagore Music and loves to indulge herself in Nature, Art, and Music.

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