DOI: doi.org/10.47363/JAICC/ICAIC2025/2025(4)6

International Conference on
Artificial Intelligence and Cybersecurity (ICAIC 2025)

Conference Proceedings

November 27-28, 2025 - Japan

Driving Sustainable Computing: Architectures and Systems for Efficient Energy Management with EVs and Renewable Resources

Zhishang Wang

Assistant Professor, The University of Aizu, Aizu Wakamatsu, Japan

Abstract

The rapidly advancing field of computing technology necessitates continuous innovation to cater to society's evolving needs while ensuring sustainability and energy efficiency. Electric vehicles (EVs) and the integration of renewable resources are key components of this transition, offering promising solutions to reduce carbon emissions. However, sustainable computing systems that support these technologies face critical challenges in balancing security, efficiency, and environmental impact. From a security perspective, robust measures are essential to protect data and ensure model integrity. From an efficiency standpoint, system designs must minimize energy consumption, optimize computational performance, and reduce communication overhead. To address these challenges, a novel framework is proposed, integrating collaborative learning for qualified local model selection, a blockchain-based approach to ensure model integrity, and a hybrid cluster-blockchain mechanism to minimize overhead in distributed networks. This framework aligns with the principles of sustainable computing systems and green computing, aiming to reduce the ecological footprint while maintaining high performance. This method has been deployed to two major projects. The first is an AI-enabled blockchain approach for electric vehicle integration that combines collaborative learning for electric vehicle energy consumption prediction with AI-driven solar energy forecasting to improve resource planning. The second project focuses on vehicle-to grid networks, enabling secure and efficient energy trading between vehicles and the power grid. Additional works extend these concepts to other areas, demonstrating the versatility of sustainable computing solutions. Future work will refine these sustainable computing architectures for more complex vehicular networks and investigate strategies for low-power, resource-efficient computing. By prioritizing sustainability and energy efficiency, this research aims to provide robust, scalable solutions that adapt to evolving requirements in the energy and automotive sectors, with the potential for broader application across diverse industries and domains. Furthermore, the development of prototypes and collaboration with related companies through a collaborative and multidisciplinary approach will ensure practical and impactful outcomes.