

PREFACE: EDGE INTELLIGENCE FOR PERVASIVE GREEN COMPUTING AND COMMUNICATIONS

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1 INTRODUCTION

The way data is created, processed, and used has changed dramatically due to the IoT, ubiquitous computing, and AI. Edge intelligence has become a crucial enabler for effective, low-latency, and sustainable systems by putting computation and decision-making closer to end devices. It has the capability for lowering energy usage, improving response times, and taking real-time decisions in various fields, such as smart grids, transportation, industrial automation, and HCI, when combined

with green computing. To solve problems in distributed, resource-constrained, and dynamic environments, this SI focuses on cutting-edge research that combines edge computing, AI, and sustainability techniques. Only 5 of the 69 submissions we received for this SI were chosen after careful consideration, yielding an acceptance ratio of about 7%. The collection reflects the influence of edge intelligence by bringing together cutting-edge research on algorithm design, data modeling, intelligent processing, security, and anomaly detection.

The papers included in this issue offer significant contributions. Collectively, these papers show how edge intelligence is becoming increasingly important in enabling safe, high-performance, and sustainable computing and communication systems. For researchers working to advance green and intelligent edge technologies, we believe this SI offers both theoretical insights and useful solutions. We would like to express our gratitude to all authors, editors, and reviewers who helped make this SI possible. We hope that this collection will inspire further research and innovation in the rapidly evolving field of edge intelligence for pervasive green computing and communications.

2 CONTRIBUTIONS

In [1], the authors present an iterative learning control protocol based on local data and a D-type iterative learning algorithm. The approach is designed for nonlinear time-varying multi-agent systems with communication interference under the premise that the initial state can be reset to zero. Simulation results show that the proposed algorithm can effectively solve the consistency problem and suppress any type of disturbance, which has strong theoretical and practical significance. This study provides a new perspective for the optimization of distributed iterative learning algorithms, and provides a theoretical basis and practical guidance for solving the problem of network data loss. Xiu [2] examines the characteristics of streaming data in edge computing environments, summarizes its volatility and changing trends in the real world, and deduces potential periodic patterns inherent in such data. A model for generating realistic streaming data in simulated edge computing environments is proposed to address these challenges. The model first preprocesses the original streaming data to extract time-related information (timestamps or precise time). Then, the NSA algorithm is applied to reduce the data volume, followed by the use of the PSD parallel algorithm to transmit the sampled data.

In [3], the authors present a systematic approach to automatically discover heap layout manipulation (HLM) primitives in the recent kernel heap vulnerabilities, with a design that can scale to edge environments for autonomous, real-time security. The key innovation of SyzPrime lies in combining dynamic analysis via fuzzing with static instrumentation, enabling a direct correlation between primitives and fuzzing seeds. The authors utilize object-driven instrumentation with a restricted mutation-based fuzzer targeting specific object or cache interactions, such as allocation, deallocation and usage. By enhancing ftrace for precise tracking, the work lays a foundation that

enables the identification and generation of exploitation paths without side effects, ensuring that the discovered primitives are both reliable and practical.

In [4], the authors focus on ChatGPT, an open-source large dialogue model based on OpenAI's GPT architecture. It is an emerging trend in the field of AI, which aims to expand the language model capabilities on powerful central servers to edge devices, thereby achieving more efficient and flexible applications. Utilizing a Transformer-based encoder-decoder framework with multi-head self-attention mechanisms, ChatGPT excels in generating natural, contextually-aware language responses, akin to human conversation. Edge intelligence combined with ChatGPT can provide more intelligent and personalized services. The authors propose enhancements in training methodologies, model architecture, and application domains to foster more intelligent and fluid dialogue systems. Despite its advancements, challenges remain regarding model complexity and data demands. The development of smart cities has made energy saving an important objective, and intelligent streetlight systems (ISLS) are an important part of the solution for saving energy. In [5] a LoRaWAN-based ISLS is proposed, in which a twisted Artificial Intelligence (AI) Model is embedded, that combines Convolutional Neural Networks (CNN) and Long Short-Term Memory (LSTM) networks, combining their best features to implement automatic brightness control and power consumption optimization. The CNN is used to accurately detect the current level of brightness and traffic flow, and the LSTM is employed to forecast the visibility changes in the future. With the combination, the system can be flexible in dynamic environments and cope with changes in severe weather by adjusting the streetlights' brightness in advance. The technique has been evaluated in a simulation environment which is based on the traffic road image dataset from the Kaggle platform.

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