AI and ML techniques in various fields of Infocommunications – in the autumn issue of ICJ

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WELCOME to the September 2024 issue of the Infocommunications Journal. Let's have an brief overview of the papers.

The paper by A. S. Jagmagji and his co-authors presents the application of machine learning models to predict network performance metrics for the Self-Clocked Rate Adaptation for Multimedia (SCReAM) congestion control algorithm. By employing a systematic approach, including regression models, hyperparameter tuning, and ensemble learning, the study achieved high accuracy in predicting key metrics such as network throughput, queue delay, and smoothed Round Trip Time (sRTT). The LightGBM and CatBoost models outperformed others in predicting these metrics, demonstrating the effectiveness of the applied techniques. The study also highlights areas for improvement, including more advanced hyperparameter tuning and ensemble methods, and calls for rigorous statistical testing to validate minor performance differences.

A. Huszák and his co-authors introduce CityAI in their paper. CityAI is a scalable, AI-driven Intelligent Transportation System (ITS) designed to manage urban traffic on a city-wide scale. The system collects data from various sensing infrastructures and uses machine learning to predict traffic patterns, providing real-time solutions like adaptive traffic light control and V2X-based interventions. CityAI was successfully implemented as a proof-of-concept in Pécs, Hungary, demonstrating its ability to enable proactive traffic management.

The systematic review by R. Al-Shabandar et al. surveys the implications – benefits and challenges – of generative AI in higher education. It highlights how generative AI can provide personalized learning experiences, automate tasks, and support diverse student groups, while also emphasizing ethical and privacy concerns. The review discusses successful applications of generative AI in fields like sports management and surgery, but notes limitations in areas like patient education in radiology, stressing the need for context-specific use. Overall, the paper calls for responsible implementation, transparency, and safeguards to maximize the potential of AI while addressing its risks in educational environments.

The paper by N. A. A. Khleel and K. Nehéz investigates the impact of data balancing methods on optimizing LSTM models for code smell detection. By integrating techniques like random oversampling and SMOTE, the proposed approach enhances the accuracy of the LSTM model, addressing the challenges of imbalanced code smell distributions. The experiments on four code smell datasets demonstrated an average accuracy improvement of 5% when applying data balancing, reaching up to 97% accuracy. The proposed method out-performs the existing approaches, proving more effective in accurately detecting code smells across various datasets.

In their paper, M. A. Lone, Sz. Kovacs and O. M. Khanday present a method for implementing animal aggression behavior models in robotic systems using a Fuzzy Behaviour Description Language and fuzzy logic. By integrating ethologically inspired behavior, such as aggression, robots can adapt more effectively to dynamic environments, enhancing human-robot interaction and promoting safety in uncertain situations. The study also demonstrates the use of ROS tools, like Gazebo and RViz, to simulate and visualize these behaviors, improving robot decision-making and autonomy. Their findings have practical implications for robotics in fields such as collaborative manufacturing, search and rescue, and surveillance, promoting more intelligent and adaptable robotic systems.

In their paper, A. El Hanjri, I. Ben Abdel Ouhab and A. Haqiq survey various handover techniques for heterogeneous mobile networks, focusing on mobility management and decision-making approaches. They identifiy key issues such as frequent disconnections and increased handover failures caused by ineffective seamless handovers. The paper highlights the need for optimization methods that improve vertical handovers, focusing on bandwidth allocation, reduced failure rates, and improved Quality of Service (QoS). It also emphasizes the importance of incorporating user preferences, network coverage updates, and energy efficiency in the handover process to ensure a more reliable and efficient system.

In his paper, L. Nagy presents the design and analysis of a dielectric lens antenna for industrial radar applications, specifically for tank-level measurement systems. The antenna achieves high gain, low sidelobe levels, and improved distance resolution, making it ideal for minimizing side reflections and maximizing performance in extreme conditions. A key con- tribution is the development of an optimized air-to-dielectric waveguide transition, which improved matching by 5dB.

T. E. Ali and his co-authors introduce a Blockchain-Based Deep Reinforcement Learning (BDRL) system designed to optimize healthcare operations in a multi-cloud environment. The system enhances security and decision-making in healthcare by integrating blockchain for secure datamanagement and deep reinforcement learning for adaptive scheduling. The BDRL framework successfully addresses security, privacy, and efficiency challenges in distributed healthcare networks, but faces limitations such as high resource utilization and energy consumption as data size increases.

Pal Varga is the Head of Department of Telecommunications and Artificial Intelligence at the Budapest University of Technology and Economics. His main research interests include communication systems, Cyber-Physical Systems and Industrial IoT, network traffic analysis, end-to-end QoS and SLA issues – for which he is keen to apply hardware acceleration and AI/ML techniques as well. Besides being a member of HTE, he is a senior member of IEEE (both in ComSoc and IES). He is Editorial Board member in many journals, Associate Editor in IEEE TNSM, and the Editor-in-Chief of the Infocommunications Journal.