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Guest Editorial

Sensing, decision-making and economic impact for next-generation technologies

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1. Introduction

In a rapidly evolving technological landscape, the integration of sensing and decision-making is increasingly critical to the development and deployment of next-generation technologies, which have a significant economic impact. These technologies, which can be applied to a wide range of smart systems and applications that aim to assist users in a non-intrusive way, such as intelligent environments [8], smart cities [14], Industry 4.0 [19], and advanced healthcare systems [6,13,21], are transforming how we live, work, and interact with the world around us. The aim of this thematic issue is to explore the current advancements in these fields and highlight their implications for both technology and society.

Sensing technology has advanced significantly in recent years, enabling the collection and preprocessing of large volumes of data in real time. This capability is essential for the development of intelligent environments that rely on diverse sensor types, including cameras, microphones, and biometric sensors, to monitor and interact with their surroundings. For example, wearable devices and mobile sensors are being increasingly used in enhanced living environments and healthcare applications to improve safety and efficiency [1,3,7,11,14,18,23]. The ability to process sensor data in real-time not only enhances the functionality of these systems but also opens up new opportunities for personalization and adaptability in various application domains [8,9,24].

Decision-making processes in intelligent environments have also become more sophisticated, leveraging advanced methods from artificial intelligence (AI), such as machine learning and deep learning. These methods allow systems to analyze complex datasets, identify patterns, and make informed decisions autonomously. The integration of AI in decision-making not only improves the accuracy of these systems but also enables them to learn and adapt over time, thereby enhancing their effectiveness in dynamic environments [4,20]. Recent studies have demonstrated the potential of AI-driven decision-making to optimize energy consumption and manage resources more efficiently in urban environments and industrial applications [2,17,22].

Furthermore, the economic impact of next-generation technologies cannot be understated. These technologies are reshaping industries and creating new economic opportunities by driving productivity and fostering innovation. For instance, the deployment of smart systems in manufacturing and logistics has been shown to reduce operational costs and enhance competitiveness [6,10,15]. Additionally, there is a growing recognition of the role of intelligent environments in promoting sustainable development by optimizing energy usage and reducing waste, which has significant economic and environmental benefits [5,12,16].

This thematic issue aims to bring together interdisciplinary perspectives on these pivotal topics, showcasing the latest research and innovations in sensing, decision-making, and economic impact as they relate to next-generation technologies. Through a collection of diverse contributions, we hope to provide a comprehensive overview of how these technologies are shaping the future of intelligent environments and driving societal transformation.

2. Contents of this issue

This thematic issue comprises the following five articles, each contributing unique insights into the applications of intelligent technologies across various domains, highlighting their potential to enhance efficiency, reduce costs, and optimize resource management.

The article "**Sensor event sequence prediction for proactive smart home: A GPT2-based autoregressive language model approach**" by N. Takeda, R. Legaspi, Y. Nishimura, K. Ikeda, A. Minamikawa, T. Plötz, and S. Chernova introduces a framework for predicting Sensor Event Sequences (SES) within smart homes. This framework aims to detect incomplete activities and provide timely assistance to users. The prediction process begins with recognizing an Ongoing Activity (OA) and subsequently forecasting future SES based on the recognized OA. This prediction aids in recognizing Activities of Daily Living (ADL), enabling smart homes to respond appropriately, such as turning off appliances, moving objects, or adjusting lighting. By employing an autoregressive model (specifically GPT-2), the authors demonstrate that this approach outperforms other prediction models, significantly enhancing the proactive assistance capabilities of smart homes.

In the paper "**Adaptive fuzzy-based node communication performance prediction with hybrid heuristic Cluster Head selection framework in WSN using enhanced K-means clustering mechanism**", A. Ayyappan, R. Arunachalam, and M. L. Kumar present an optimization-based Cluster Head (CH) selection mechanism for Wireless Sensor Networks (WSNs). This mechanism, called Hybrid Position of Heap and African Buffalo Optimization (HP-HABO), integrates an adaptive fuzzy logic-based communication performance prediction strategy to enhance communication among sensor nodes. The optimization process combines existing algorithms, including Heap-based Optimizer (HO) and African Buffalo Optimization (ABO), to fine-tune the fuzzy network parameters. Furthermore, this approach is coupled with an Optimal K-Means Clustering (OKMC) method for effective node clustering. The performance of the proposed approach was evaluated using various metrics, demonstrating that it outperforms traditional techniques in enhancing network communication.

The article "**Fuzzy automatic control of the irrigation process for the IoT-based smart farming systems**" by Y. Zheng, Z. Jiang, O. V. Kozlov, and Y. P. Kondratenko focuses on precision agriculture by introducing an advanced IoT-based fuzzy control system for irrigation management in smart farming. This system is designed around three main axes: hierarchical two-level IoT-based control, simple and reliable two-channel fuzzy controllers, and easy customization and adaptability. The study evaluates the effectiveness of these fuzzy controllers on two different crops, tomatoes and beets, through simulated experiments. The results demonstrate that the proposed system offers higher efficiency and improved quality indicators (such as speed and accuracy) compared to existing alternatives. Future work plans include testing the advanced control system in a real smart farming complex and comparing the results with the simulation experiments.

The paper "**An unsupervised anomaly detection framework for smart assisted living via growing neural gas networks**" by M. Ciprian, M. Gadaleta, and M. Rossi presents an innovative framework designed to identify anomalies in ADL within a smart home environment. The framework leverages Growing Neural Gas (GNG) networks to dynamically adapt to the evolving behaviors of individuals. The anomaly detection system operates through the phases of feature extraction, filtering, and classification. This system was evaluated using real-life data from tracking the activities of 17 elderly subjects over two years, demonstrating strong performance in terms of reliability and adaptability across various real-life scenarios, including monitoring around 16 homes during the same period.

Finally, the article "**GreenhouseGuard: Enabling real-time warning prediction for smart greenhouse management**" by J. Morales-García, D. Padilla-Quimbiulco, M. Cantabella, B. Ayuso, A. Muñoz, and J. Cecilia introduces an intelligent alert system for managing agricultural operations within a greenhouse setting. This system enhances productivity by optimizing crop growth and energy consumption through an interactive web application, called GreenhouseGuard, which monitors variables collected by IoT sensors strategically placed throughout the greenhouse. These sensors ensure precise real-time data readings, minimizing error margins. The system also employs a machine learning model (ARIMA) to predict temperature changes and detect abnormal conditions inside the greenhouse, providing real-time alerts to prevent potential incidents. Additionally, GreenhouseGuard offers diverse data visualization options, enabling comprehensive analysis of the acquired information and allowing greenhouse managers to proactively address abnormal situations that could threaten crop yields, ensuring optimal growth conditions and sustainable agricultural practices.

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