

Special Issue on Advances in Intelligent Systems

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1. Introduction

This Special Issue invites state-of-the-art research in intelligent systems. It also includes selected papers from the conference of the 22nd International Symposium on Advanced Intelligent Systems (ISIS 2021, <http://isis2021.org/>, accessed on 1 March 2023), which was held in Cheongju, Republic of Korea on 15–18 December 2021. The topics of the contributed papers include various intelligent techniques and their real-world applications.

A broad range of research fields is included in this Special Issue, including computational intelligence, machine and deep learning, fuzzy logic and reasoning, evolutionary algorithms, soft computing, data mining, big data analysis, probabilistic models and inference, robotics, image processing, and (bio)medical applications. The selected papers discuss how many valuable and cutting-edge technologies can solve real-world problems.

A total of 12 research or review papers were verified through a thorough review process. It is anticipated that the scope of the intelligent systems field will be even broader in the future.

2. Frontiers of Intelligent Systems

This Special Issue aims to collect the latest research on relevant topics, and more importantly, to address current practical and theoretical challenges. In the following, the papers are categorized into several subtopics: recognition and detection with deep learning, intelligent mobility, mobile robots, big data analysis, and brain–computer interface.

2.1. Recognition and Detection with Deep Learning

Recognition with deep learning has become an important topic for intelligent systems. In the first paper of this category, entitled ‘Effective Conversion of a Convolutional Neural Network into a Spiking Neural Network for Image Recognition Tasks’, Huynh Cong Viet Ngu and Keon Myung Lee [1] propose a conversion from a convolution neural network (CNN) to a spiking neural network (SNN). SNNs can be considered as an energy-efficient alternative to CNNs.

The paper ‘Weighted Averaging Federated Learning Based on Example Forgetting Events in Label Imbalanced Non-IID’ by Mannsoo Hong, Seok-Kyu Kang, and Jee-Hyong Lee [2] proposes a federated weighted averaging method to avoid the forgetting problem of federated learning. Federated learning is a data privacy-focused distributed learning method, highlighting the development of deep learning models.

One paper proposes a practical solution for a water supply enhancement project in the Republic of Korea. Sang Soo Lee, Ho-Hyun Lee, and Yun-Jung Lee [3], in their paper ‘Prediction of Minimum Night Flow for Enhancing Leakage Detection Capabilities in Water Distribution Networks’, constructed a model using multi-layer perceptron (MLP) and long short-term memory (LSTM) to predict minimum night flow in water distribution networks.



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The paper entitled ‘Error-Resistant Movement Detection Algorithm for the Elderly with Smart Mirror’ by Bo-Seung Yang, Tae-Won Kang, Yong-Sik Choi, and Jin-Woo Jung [4] proposes a movement detection algorithm incorporated in a smart mirror for the elderly. This study applies the pose estimation technique of the skeleton extracted from adjacent frame subtraction.

2.2. Intelligent Mobility

It is important for autonomous mobility to be able to perceive three-dimensional space in an unknown environment. The paper entitled ‘Growing Neural Gas with Different Topologies for 3D Space Perception’ by Yuichiro Toda, Akimasa Wada, Hikari Miyase, Koki Ozasa, Takayuki Matsuno, and Mamoru Minami [5] proposes a new topological structure learning method to reconstruct a structure from a 3D point cloud, based on growing neural gas.

According to reports, many maritime accidents occur in ports and adjacent waters. In the paper entitled ‘Development of Priority Index for Intelligent Vessel Traffic Monitoring System in Vessel Traffic Service Areas’, Lee-Na Lee and Joo-Sung Kim [6] propose a method to improve vessel traffic management by prioritizing vessel surveillance in high-density areas and predicting risks in advance.

Smart data analysis is beneficial for mobile computing devices. A new interval-clustering technology using symbolic data analysis (SDA) was proposed and implemented on smart phones in the paper entitled ‘Rough IPFCM Clustering Algorithm and Its Application on Smart Phones with Euclidean Distance’ by Chih-Ming Chen, Sheng-Chieh Chang, Chen-Chia Chuang, and Jin-Tsong Jeng [7].

2.3. Mobile Robots

Autonomous mobile robots are emerging in various fields. In the paper entitled ‘ROS-Based Unmanned Mobile Robot Platform for Agriculture’, Eu-Tteum Baek and Dae-Yeong Im [8] developed a mobile robot platform that can be used in greenhouses. The proposed mobile robot operates on a path and rail with two drive wheels and four casters.

The paper entitled ‘Improved Analytic Expansions in Hybrid A-Star Path Planning for Non-Holonomic Robots’ by Chien Van Dang, Heungju Ahn, Doo Seok Lee, and Sang C. Lee [9] improved the safety performance of the hybrid A-star algorithm for robots moving in indoor environments. A non-holonomic robot using the proposed algorithm can have multiple safe options for curvature and turning radius on pathways.

2.4. Big Data Analysis

Big data are characterized by the volume and heterogeneity of data. The use of quantitative analysis on patent big data is increasing along with the size of the dataset. In the paper entitled ‘Patent Analysis Using Bayesian Data Analysis and Network Modeling’ by Sangsung Park and Sunghae Jun [10], Bayesian additive regression trees are utilized for quantitative patent analysis.

The paper entitled ‘Logit Averaging: Capturing Global Relation for Session-Based Recommendation’ by Heeyoon Yang, Gahyung Kim, and Jee-Hyoung Lee [11] proposes a novel algorithm called logit average, which improves recommendation performance. With the rapid growth in internet commerce platforms, recommender systems now play an essential role in improving user experience and satisfaction.

2.5. Brain–Computer Interface

A brain–computer interface (BCI) is a promising technology by which a robot or computer can be controlled via brain signals. In the review paper entitled ‘Studies to Overcome Brain–Computer Interface Challenges’, Woo-Sung Choi and Hong-Gi Yeom [12] reviewed studies on overcoming the challenges of using BCIs in daily life.

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