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Editorial

Advances in Artificial Intelligence, Machine Learning and Deep Learning Applications

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Recent advances in the field of artificial intelligence (AI) have been pivotal in enhancing the effectiveness and efficiency of many systems and in all fields of knowledge, including medical diagnosis [1,2], healthcare [3], the Internet of Things [4], power systems [5], etc. This includes the design and development of novel algorithms based on machine learning and deep learning to be applied to data acquired from recently adopted devices, sensors, and equipment for the automatic prediction and detection of patterns of interest. This also includes the implementation of novel AI and big data technologies for extracting relevant information from unstructured data with enhanced performance across different sectors [6]. The advances in the state-of-the-art methods addressing real-world AI applications vary from novel feature selection procedures [7] to the development of novel and application-based machine learning architectures [1,8]. In addition, some insights have been provided towards Generative AI [9].

This Special Issue's editorial review process accepted 38 high-quality manuscripts. Among them, significant fundamental methods applicable to action recognition in healthcare, surveillance, network security and transport sciences have been proposed and developed. One of those methods is based on a graph-driven attentional convolutional network (Contribution 1); another is based on a sequence segmentation attention network for skeleton-based action recognition (Contribution 2). In addition, a static gesture recognition algorithm has been introduced based on improved YOLOv5 (Contribution 3). Some fundamental methods have been proposed for generating and propagating features. One of the key methods proposed is a feature-pyramid-network-driven feature fusion single-shot detector to extract and propagate high-level multiscale semantic feature maps to enable real-time prostate capsule detection (Contribution 4). Another method developed a feature enhancement single-shot multibox detector for remote sensing image target detection (Contribution 5). Moreover, a real-time semantic segmentation, light-weight asymmetric spatial feature network has also been proposed (Contribution 6), as well as a feature trajectory clustering algorithm driven by deep learning for spatio-temporal features in cityscapes (Contribution 7). Another contribution proposes an image-style transfer learning approach based on a halo attention-driven deep neural network (Contribution 8). With the awareness of trustworthy AI and fairness, one contribution suggests the feature set extraction based on consistency of their explanation via different explainable AI methods (Contribution 9). Also, another research work suggests the use of least squares to improve piecewise linear approximation to control the change in absolute error in back propagation in neural networks (Contribution 10).

Significant advancements and breakthroughs in AI have been observed in the field of healthcare. New deep learning-driven techniques have been introduced for predicting labor based on time series electrohysterogram signals under low-cost settings (Contribution 11) and freehand 3D ultrasound reconstruction based on measuring the trajectory of conventional 2D ultrasound (Contribution 12). Application-driven traditional machine learning and deep learning methods have been developed for effective hospital management (Contribution 13), as well as for the early prediction of life-threatening infections, e.g., sepsis (Contribution 14), and for detecting granulation tissue to track chronic wound

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healing in diabetic foot ulcers (Contribution 15). Due to the bottlenecks associated with the availability and integrity of data, a novel study has been conducted to synthesize time series multivariate data, which can be acquired through the use of modern smart watches (Contribution 16). The study developed two techniques, i.e., a temporally correlated multimodal generative adversarial network and a document sequence generator, to synthetically generate the data obtainable from smart watches.

Some advancements have been made in the field of natural language processing and speech and time series signal processing, where the data are generally in encoded sequential fashion into embedding matrices. The NLP has many applications, especially in human–computer interaction, task-oriented dialogue systems, etc. A key advancement has been made towards dialogue state and context tracking via a transformer-based mechanism (Contribution 17). Another technology utilizes transformers with hierarchical frame-level networks for speech enhancement at the spectrogram level (Contribution 18). Another work developed a self-supervised contrast learning approach for the specific emitter identification of radio signals, which addressed the challenge associated with training deep learning models due to large unlabeled datasets (Contribution 19). Some advancements have been made towards hybrid models combining the sentence-based models from two transformer-based NLP models (BERT and USE) and an unsupervised LSTM autoencoder for sarcasm detection (Contribution 20). Another attempt developed a multimodal feature fusion approach by joining aggregation and propagation structures via bidirectional graph convolutional network and BERT model for detecting rumors in social media (Contribution 21), which can be compared with traditional machine learning and deep learning approaches (Contribution 22).

Significant advancements have been made in the field of artificial intelligence in anomaly detection for network security. Traditional machine learning models based on k-means and sequential minimal optimization methods (Contribution 23) and deep forest methods (Contribution 24) have been proposed for detecting anomalies and malicious traffic detection. In addition, deep learning architectures based on GRU have also been proposed for time series anomaly detection (Contribution 25). This is highly applicable in different fields such as the Internet of Vehicles, as trajectory analysis and traffic flow prediction require anomaly and malicious traffic prediction. A key advancement has been made in federated learning frameworks based on incremental weight and diversity selection for the incremental learning in the Internet of Vehicles (Contribution 26). Most of the learning has been based on real-time vehicular network trajectory analysis, such as via introducing digital twin network-based latency prediction (Contribution 27) and the identification of cyber attacks via deep learning approaches (Contribution 28). Apart from deep learning (Contribution 29), graph neural networks have been introduced to complex networks for traffic flow prediction (Contribution 30). Trajectory clustering and spatiotemporal feature networks have been extensively studied for aircraft trajectory prediction (Contribution 31).

Other advancements in machine learning and deep learning applications include improved multi-layer perceptron energy meter fault diagnosis based on a deep belief network (Contribution 32), an appearance defect detection method for cigarettes based on convolutional block attention mechanism (Contribution 33), power forecasting of regional wind farms via variational autoencoders and deep hybrid transfer learning (Contribution 34), and poisonous plant species prediction using a hybrid model composed of a convolutional neural network and a support vector machine (Contribution 35). Some applications of the YOLO model for object detection include photovoltaic panel defect detection (Contribution 36), stud leakage detection (Contribution 37), and surface defects detection in aluminum profiles (Contribution 38). The approaches discussed in this Special Issue offer readers a wide range of valuable paradigms that promote the use of fundamental and applied AI in different application domains and, at the same time, provide rich material for scientific thinking.

List of Contributions

1. S.-B. Zhou, R.-R. Chen, X.-Q. Jiang, and F. Pan, "2s-GATCN: Two-Stream Graph Attentional Convolutional Networks for Skeleton-Based Action Recognition"
2. Y. Zhang and H. Cai, "Sequence Segmentation Attention Network for Skeleton-Based Action Recognition"
3. S. Wu, Z. Li, S. Li, Q. Liu, and W. Wu, "Static Gesture Recognition Algorithm Based on Improved YOLOv5s"
4. S. Wu, X. Wang, and C. Guo, "Application of Feature Pyramid Network and Feature Fusion Single Shot Multibox Detector for Real-Time Prostate Capsule Detection"
5. J. Guo, Z. Wang, and S. Zhang, "FESSD: Feature Enhancement Single Shot MultiBox Detector Algorithm for Remote Sensing Image Target Detection"
6. Y. Chen, W. Zhan, Y. Jiang, D. Zhu, R. Guo, and X. Xu, "LASNet: A Light-Weight Asymmetric Spatial Feature Network for Real-Time Semantic Segmentation"
7. X. He, Q. Li, R. Wang, and K. Chen, "A Spatio-Temporal Feature Trajectory Clustering Algorithm Based on Deep Learning"
8. K. Li, D. Yang, and Y. Ma, "Image Style Transfer Based on Dynamic Convolutional Manifold Alignment of Halo Attention"
9. G. Elkhawaga, O. Elzeki, M. Abuelkheir, and M. Reichert, "Evaluating Explainable Artificial Intelligence Methods Based on Feature Elimination: A Functionality-Grounded Approach"
10. X. Liao, T. Zhou, L. Zhang, X. Hu, and Y. Peng, "A Method for Calculating the Derivative of Activation Functions Based on Piecewise Linear Approximation"
11. T. R. Jossou, Z. Tahori, G. Houdji, D. Medenou, A. Lasfar, F. Sanya, M. H. Ahouandjinou, S M. Pagliara, M. S. Haleem and A. Et-Tahir, "N-Beats as an EHG Signal Forecasting Method for Labour Prediction in Full Term Pregnancy"
12. X. Chen, H. Chen, Y. Peng, L. Liu, and C. Huang, "A Freehand 3D Ultrasound Reconstruction Method Based on Deep Learning"
13. E. Iadanza, G. Benincasa, I. Ventisette, and M. Gherardelli, "Automatic classification of hospital settings through artificial intelligence"
14. J. E. Camacho-Cogollo, I. Bonet, B. Gil, and E. Iadanza, "Machine Learning Models for Early Prediction of Sepsis on Large Healthcare Dataset"
15. A. S.-Y. Lien, C.-Y. Lai, J.-D. Wei, H.-M. Yang, J.-T. Yeh, and H.-C. Tai, "A Granulation Tissue Detection Model to Track Chronic Wound Healing in DM Foot Ulcers"
16. M. S. Haleem, A. Ekuban, A. Antonini, S. Pagliara, L. Pecchia, and C. Allocca, "Deep-Learning-Driven Techniques for Real-Time Multimodal Health and Physical Data Synthesis"
17. Q. Li, W. Zhang, M. Huang, S. Feng, and Y. Wu, "RSP-DST: Revisable State Prediction for Dialogue State Tracking"
18. W. Jiang, C. Sun, F. Chen, Y. Leng, Q. Guo, J. Sun and J. Peng, "Low Complexity Speech Enhancement Network Based on Frame-Level Swin Transformer"
19. B. Liu, H. Yu, J. Du, Y. Wu, Y. Li, Z. Zhu and Z. Wang, "Specific Emitter Identification Based on Self-Supervised Contrast Learning"
20. D. K. Sharma, B. Singh, S. Agarwal, H. Kim, and R. Sharma, "Sarcasm Detection over Social Media Platforms Using Hybrid Auto-Encoder-Based Model"
21. N. Zhong, G. Zhou, W. Ding, and J. Zhang, "A Rumor Detection Method Based on Multimodal Feature Fusion by a Joining Aggregation Structure"
22. H. Alhakami, W. Alhakami, A. Baz, M. Faizan, M. W. Khan, and A. Agrawal, "Evaluating Intelligent Methods for Detecting COVID-19 Fake News on Social Media Platforms"
23. S. Gadal, R. Mokhtar, M. Abdelhaq, R. Alsaqour, E. S. Ali, and R. Saeed, "Machine Learning-Based Anomaly Detection Using K-Mean Array and Sequential Minimal Optimization"
24. X. Zhang, M. Zhao, J. Wang, S. Li, Y. Zhou, and S. Zhu, "Deep-Forest-Based Encrypted Malicious Traffic Detectio"

25. G. Li, Z. Yang, H. Wan, and M. Li, "Anomaly-PTG: A Time Series Data-Anomaly-Detection Transformer Framework in Multiple Scenarios"
26. Y. Lei, S. L. Wang, M. Zhong, M. Wang, and T. F. Ng, "A Federated Learning Framework Based on Incremental Weighting and Diversity Selection for Internet of Vehicles"
27. Y. Fu, D. Guo, Q. Li, L. Liu, S. Qu, and W. Xiang, "Digital Twin Based Network Latency Prediction in Vehicular Networks"
28. H.-C. Lin, P. Wang, K.-M. Chao, W.-H. Lin, and J.-H. Chen, "Using Deep Learning Networks to Identify Cyber Attacks on Intrusion Detection for In-Vehicle Networks"
29. S. Safavi, M. Jalali, and M. Houshmand, "Toward Point-of-Interest Recommendation Systems: A Critical Review on Deep-Learning Approaches"
30. Z. Hu, F. Shao, and R. Sun, "A New Perspective on Traffic Flow Prediction: A Graph Spatial-Temporal Network with Complex Network Information"
31. Y. Wu, H. Yu, J. Du, B. Liu, and W. Yu, "An Aircraft Trajectory Prediction Method Based on Trajectory Clustering and a Spatiotemporal Feature Network".
32. C. Zhong, Y. Jiang, L. Wang, J. Chen, J. Zhou, T. Hong and F. Zheng, "Improved MLP Energy Meter Fault Diagnosis Method Based on DBN"
33. H. Liu, G. Yuan, L. Yang, K. Liu, and H. Zhou, "An Appearance Defect Detection Method for Cigarettes Based on C-CenterNet"
34. M. Khan, M. R. Naeem, E. A. Al-Ammar, W. Ko, H. Vettikalladi, and I. Ahmad, "Power Forecasting of Regional Wind Farms via Variational Auto-Encoder and Deep Hybrid Transfer Learning"
35. T. H. Noor, A. Noor, and M. Elmezain, "Poisonous Plants Species Prediction Using a Convolutional Neural Network and Support Vector Machine Hybrid Model"
36. L. Li, Z. Wang, and T. Zhang, "GBH-YOLOv5: Ghost Convolution with BottleneckCSP and Tiny Target Prediction Head Incorporating YOLOv5 for PV Panel Defect Detection"
37. P. Cong, K. Lv, H. Feng, and J. Zhou, "Improved YOLOv3 Model for Workpiece Stud Leakage Detection"
38. T. Wang, J. Su, C. Xu, and Y. Zhang, "An Intelligent Method for Detecting Surface Defects in Aluminium Profiles Based on the Improved YOLOv5 Algorithm"

Conflicts of Interest: The authors declare no conflict of interest.

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