electronics

MDPI

Editorial

Deep Learning in Big Data, Image, and Signal Processing in the Modern Digital Age

Deepika Koundal [1,*], Yanhui Guo [2,*] and Rashid Amin [3]

[1] School of Computer Science, University of Petroleum & Energy Studies, Dehradun 248007, India
[2] Department of Computer Science, University of Illinois, Springfield, IL 62703, USA
[3] Department of Computer Sciences, University of Chakwal, Chakwal 48800, Pakistan; rashid.amin@uoc.edu.pk
* Correspondence: dkoundal@ddn.upes.ac.in (D.K.); yguo56@uis.edu (Y.G.)

1. Introduction

Data, such as images and signals, are constantly generated from various industries, including the internet [1,2]. As a result, new technologies have surfaced to track the origin of data and determine their potential for collection, quantification, decoding, and analysis. The analysis of big data, signals, and images has gained significance due to the vast amount of domain-specific and valuable information they contain. These data are crucial for addressing issues such as national intelligence, cyber security, marketing, medical informatics, and fraud detection [3]. Deep learning techniques are highly popular in today's modern digital age. They enable the analysis and learning of substantial quantities of unsupervised data, making them significant for information processing when raw data are mostly uncategorized and unlabeled [4]. Moreover, these applications can include working with medical images as well as signal processing for wellness devices, remote monitoring, and neural devices [5]. Industrial data may also be used for early warning alert systems in assembly lines, whereas big data can be derived from huge forms like electronic health records and hospital information systems [6,7]. This Special Issue aimed to delve into the application of deep learning for addressing significant challenges related to big data, images, and signals.

2. Brief Description of the Contributions

Aleem et al. discussed machine learning (ML) models for diagnosing depression in (Contribution 1). The depression diagnosis model was presented with data extraction, preprocessing, detection, classification, and evaluation. In (Contribution 2), four pre-trained models, MobileNetV2, VGG16, DenseNet121, and InceptionV3, were proposed for detecting Hurricane-Harvey-induced building destruction in the Greater Houston region (2017). Tahir et al. (Contribution 3) considered m7G-LSTM to predict N7-methylguanosine sites. The LSTM model demonstrated superior performance in identifying N7-methylguanosine sites compared to the CNN model. Wang et al. introduced a GAN-based data augmentation model for accurately segmenting ischemic stroke. Experimental evaluation showed superior performance and high-quality generated stroke images compared to alternative methods (Contribution 4). Albahli et al. introduced the sentiment lexicon and employed ELM and RNN for predicting the stock market. Its performance was evaluated using Twitter data and the Sentiment140 dataset across ten different brands (Contribution 5). In (Contribution 6), an innovative and robust vehicle detection system was proposed based on the DNN You Only Look Once (YOLOv2) with DenseNet-201 used for the feature extraction. In (Contribution 7), the authors analyzed cloud/sky image classification features. Advanced GAN technologies (KernelGAN, ESRGAN, PatchGAN, etc.) were utilized to estimate degradation kernel and inject noise for Super-Resolution (SR) of Sentinel-2 remote-sensing images (Contribution 8). In (Contribution 9), the processing of features

Citation: Koundal, D.; Guo, Y.; Amin, R. Deep Learning in Big Data, Image, and Signal Processing in the Modern Digital Age. *Electronics* **2023**, *12*, 3405. https://doi.org/10.3390/electronics12163405

Received: 8 August 2023
Accepted: 9 August 2023
Published: 10 August 2023

based on a gray-level co-occurrence matrix was presented. The method successfully detected COVID-19 pictures and produced favorable experimental results when it integrated the multi-head self-attention with Residual Neural Network (RNN) for recognizing X-ray images for testing.

The suggestion of a more straightforward bubble model and associated solver optimization technique addresses the problem of insufficient realistic simulation and convoluted solutions for bubble-motion behavior in water. First, the computation was made simpler by ignoring the internal bubble velocity and creating the bubble model by just considering the net flow of the intake and outflow bubbles (Contribution 10). Hamdi et al. (Contribution 11) developed a classification model to detect COVID-19 in X-rays images of the human chest. Unbalanced classes were addressed using preprocessing techniques, including conditional GANs for data generation. Transfer learning was used to fine-tune the VGG16 model after pre-training it on ImageNet. A fog-based anomaly detection system was introduced to demonstrate the effective utilization of fog nodes to decentralize cloud-based architectures for IoT networks (Contribution 12). In (Contribution 13), a Multi-Access Edge Computing (MEC) system was designed to minimize energy consumption by employing multiple Mobile Devices (MDs) and servers. For identifying low-resource malware families, the authors looked at cross-family knowledge transmission (Contribution 14). They assessed the knowledge transfer through supportive scores between families and presented the Sequential Family Selection algorithm to improve detection. For COVID-19 image classification, a BoT-ViTNet model based on ResNet50 was provided (Contribution 15). It incorporated a multi-scale self-attention block to enhance global information modeling and a two-resolution transformer-based vision transformer block for fusing local and global information in complex lesion regions.

(Contribution 16) presented a novel VPN traffic classification method by means of Packet Block images. The notion of Packet Block, which is the accumulation of continuous packets in the same direction, is suggested in a traffic categorization approach based on deep learning. The Packet Block's characteristics were taken from network traffic and converted into graphics. In (Contribution 17), a novel scoring function was proposed to rank Fermatean Fuzzy numbers, addressing Fermatean Fuzzy uncertainty within a precise setting. An integration of evolution-based GA and deep CNN VGG16 was presented (Contribution 18). VGG16 performed feature learning on an eight-vehicle class dataset, followed by feature selection using GA. Classification was then carried out using the SVM classifier. Furthermore, (Contribution 19) introduced the temporal and spatial-fusion-network-model-based human action recognition method. In (Contribution 20), to evaluate how well three deep learning (DL) approaches performed in predicting the individuals' eyes' state from the EEG information, EEG signals were gathered. It did this by using a DL framework to separate out the best vector quantization from the underlying VQ systems, introducing a discriminative approach to LVQ. In (Contribution 21), a new ensemble model with data mining techniques was presented to predict student performance. The datasets incorporated features like student behavior in parental involvement in academic performance, online classes, and demographic information, demonstrating a significant connection between student conduct and performance. (Contribution 22) Deep deformable was used to create an aesthetic font style transfer network. The stylistic components of an image were translated into the text of a text image, and the font distortion was controlled by adjusting the parameters to create a range of style migration. Furthermore, (Contribution 23) introduced FedTCM, a federated two-tier cache scheme that mitigated the impact of Non-IID (Non-Independent and Identically Distributed) data on user behavior modeling. A neural-network-based sign language recognition model was presented, utilizing an assistive glove to capture real-time data (Contribution 24). To collect signals for the alphabet and numbers, sensor-based assistive gloves are being developed. These symbols make up a very small but crucial portion of the ASL vocabulary since they are crucial to fingerspelling, a common technique for conveying emphasis, lexical gaps, personal names, and technical words. A self-assembled dataset of isolated static digit, alphabetic, and alphanumeric

character postures was utilized to train a fully connected neural network using a scaled-conjugate-gradient-based backpropagation technique. In conclusion, Contribution 25 presents a feature-guide conditional generative adversarial network (FG-CGAN). In order to reduce the identity difference between the input and output face images of the generator and maintain the identity of the input facial image during the generating process, a feature guide module introduces both perceptual loss and L2 loss.

3. Conclusions

This Editorial introduces 25 research articles focusing on the applications of deep learning in the modern digital age. The goal was to collect relevant contributions in the modern digital age such as industry, education, healthcare, and security. The innovative approaches presented in this Special Issue are expected to be regarded as interesting and constructive and achieve recognition from the scientific community and international industry. The research results showcased in this collection anticipate more active development and research in the realm of deep learning in the future. To achieve this, future approaches could involve leveraging deep learning models to improve prediction accuracy and enhance the reliability of prediction models.

Author Contributions: Conceptualization, D.K.; formal analysis, R.A. and D.K., writing-review and editing, D.K., R.A. and Y.G.; supervision, D.K. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Acknowledgments: We thank the writers for their important contributions to this Special Issue. We would like to express our gratitude to the hardworking reviewers for their thorough and prompt evaluations, which significantly raised the standard of this publication. Finally, we would like to express our gratitude to the editorial staff of *Electronics* for their continuous support in making this Special Issue possible.

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

List of Contributions

1. Aleem, S.; Huda, N.; Amin, R.; Khalid, S.; Alshamrani, S.; Alshehri, A. Machine Learning Algorithms for Depression: Diagnosis, Insights, and Research Directions.
2. Kaur, S.; Gupta, S.; Singh, S.; Hoang, V.; Almakdi, S.; Alelyani, T.; Shaikh, A. Transfer Learning-Based Automatic Hurricane Damage Detection Using Satellite Images.
3. Tahir, M.; Hayat, M.; Khan, R.; Chong, K. An Effective Deep Learning-Based Architecture for Prediction of N7-Methylguanosine Sites in Health Systems.
4. Wang, S.; Zhang, X.; Hui, H.; Li, F.; Wu, Z. Multimodal CT Image Synthesis Using Unsupervised Deep Generative Adversarial Networks for Stroke Lesion Segmentation.
5. Albahli, S.; Irtaza, A.; Nazir, T.; Mehmood, A.; Alkhalifah, A.; Albattah, W. A Machine Learning Method for Prediction of Stock Market Using Real-Time Twitter Data.
6. Akhtar, M.; Mahum, R.; Butt, F.; Amin, R.; El-Sherbeeny, A.; Lee, S.; Shaikh, S. A Robust Framework for Object Detection in a Traffic Surveillance System.
7. Tran-Trung, K.; Duong Thi Hong, H.; Truong Hoang, V. Weather Forecast Based on Color Cloud Image Recognition under the Combination of Local Image Descriptor and Histogram Selection.
8. Li, Y.; Wang, Y.; Li, B.; Wu, S. Super-Resolution of Remote Sensing Images for $\times 4$ Resolution without Reference Images.
9. Wang, Z.; Zhang, K.; Wang, B. Detection of COVID-19 Cases Based on Deep Learning with X-ray Images.
10. Guo, H.; Wang, H.; Zhao, J.; Tang, Y. Realistic Rendering Algorithm for Bubble Generation and Motion in Water.
11. Hamdi, M.; Ksibi, A.; Ayadi, M.; Elmannai, H.; Alzahrani, A. Machine-Learning-Based COVID-19 Detection with Enhanced cGAN Technique Using X-ray Images.

12. Alzahrani, A.; Al-Rasheed, A.; Ksibi, A.; Ayadi, M.; Asiri, M.; Zakariah, M. Anomaly Detection in Fog Computing Architectures Using Custom Tab Transformer for Internet of Things.
13. Husham Almukhtar, F.; Abbas Ajwad, A.; Kamil, A.; Jaleel, R.; Adil Kamil, R.; Jalal Mosa, S. Deep Learning Techniques for Pattern Recognition in EEG Audio Signal-Processing-Based Eye-Closed and Eye-Open Cases.
14. Ma, L.; Wang, P.; Du, C.; Li, Y. Energy-Efficient Edge Caching and Task Deployment Algorithm Enabled by Deep Q-Learning for MEC.
15. Lin, Y.; Xu, G.; Du, C.; Xu, G.; Liu, S. Low-Resource Malware Family Detection by Cross-Family Knowledge Transfer.
16. Chen, H.; Zhang, T.; Chen, R.; Zhu, Z.; Wang, X. A Novel COVID-19 Image Classification Method Based on the Improved Residual Network.
17. Sun, W.; Zhang, Y.; Li, J.; Sun, C.; Zhang, S. A Deep Learning-Based Encrypted VPN Traffic Classification Method Using Packet Block Image.
18. Sharma, M.; Kamini; Dhaka, A.; Nandal, A.; Rosales, H.; Monteagudo, F.; Hernández, A.; Hoang, V. Fermatean Fuzzy Programming with New Score Function: A New Methodology to Multi-Objective Transportation Problems.
19. Alghamdi, A.; Saeed, A.; Kamran, M.; Mursi, K.; Almukadi, W. Vehicle Classification Using Deep Feature Fusion and Genetic Algorithms.
20. Zhang, Y.; Guo, Q.; Du, Z.; Wu, A. Human Action Recognition for Dynamic Scenes of Emergency Rescue Based on Spatial-Temporal Fusion Network.
21. Alsulami, A.; AL-Ghamdi, A.; Ragab, M. Enhancement of E-Learning Student's Performance Based on Ensemble Techniques.
22. Zhu, X.; Lin, M.; Wen, K.; Zhao, H.; Sun, X. Deep Deformable Artistic Font Style Transfer.
23. Zhang, J.; Li, Z. A Clustered Federated Learning Method of User Behavior Analysis Based on Non-IID Data.
24. Amin, M.; Rizvi, S.; Mazzei, A.; Anselma, L. Assistive Data Glove for Isolated Static Postures Recognition in American Sign Language Using Neural Network.
25. Li, C.; Li, Y.; Weng, Z.; Lei, X.; Yang, G. Face Aging with Feature-Guide Conditional Generative Adversarial Network.

References

1. Dash, S.; Shakyawar, S.K.; Sharma, M.; Kaushik, S. Big data in healthcare: Management, analysis and future prospects. *J. Big Data* **2019**, *6*, 54. [CrossRef]
2. Sharifani, K.; Amini, M. Machine Learning and Deep Learning: A Review of Methods and Applications. *World Inf. Technol. Eng. J.* **2023**, *10*, 3897–3904.
3. Butt, U.A.; Amin, R.; Aldabbas, H.; Mohan, S.; Alouffi, B.; Ahmadian, A. Cloud-based email phishing attack using machine and deep learning algorithm. *Complex Intell. Syst.* **2023**, *9*, 3043–3070. [CrossRef] [PubMed]
4. Zhou, X.; Hu, Y.; Liang, W.; Ma, J.; Jin, Q. Variational LSTM enhanced anomaly detection for industrial big data. *IEEE Trans. Ind. Inform.* **2020**, *17*, 3469–3477. [CrossRef]
5. Scataglini, S.; Kandappu, T.; Ghose, A.; Sinha, A. Wearable sensors role in promoting health and wellness via reliable and longitudinal monitoring. *Front. Physiol.* **2023**, *14*, 1201847. [CrossRef] [PubMed]
6. Keikhosrokiani, P. *Big Data Analytics for Healthcare: Datasets, Techniques, Life Cycles, Management, and Applications*; Academic Press: Cambridge, MA, USA, 2022.
7. Kawu, A.A.; Hederman, L.; O'Sullivan, D.; Doyle, J. Patient generated health data and electronic health record integration, governance and socio-technical issues: A narrative review. *Inform. Med. Unlocked* **2023**, *37*, 101153. [CrossRef]