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EDITORIAL

Topical collection on machine learning for big data analytics in smart healthcare systems

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The advancements in communication and hardware technologies have enabled the wearable devices of smart healthcare systems (CSHS) to generate an enormous amount of data. However, it is not clear what information can be obtained from the collected data that can be used by practitioners in CSHS. Recently, various machine learning algorithms and big data analytic techniques have been used to investigate the effectiveness of CSHS. In CSHS, efficient machine learning and big data analytics are mandatory because the gathered data are in an unorganized form and in different volumes, velocities, and varieties. CSHS are persuasive global needs due to the growth of the world's population and a rapid increase in urbanization. As the urban population continuously increases, the need for improved quality of life, efficient delivery of health services to citizens becomes paramount. As CSHS continues to mature, specialized machine learning algorithms and big data analytic techniques are required to maintain the voluminous amount of medical data used in CSHS.

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This topical collection attracted a total of 89 papers. Upon rigorous review, only 15 high quality papers were selected for publication. Each paper received a minimum of three reviews and each paper underwent two to three round of revision. Each paper was substantially modified based on the comprehensive comments of independent reviewers and guest editors. The papers are diverse in nature with each paper strictly comply with the scope of the special issue in true spirit.

Pneumonia is an infectious disease that affects the lungs and need to be prevented at an early stage. The first paper of this topical collection is titled identification and classification of pneumonia disease using a deep learning-based intelligent computational framework, by Rong Yi et al. This paper proposed a scalable and interpretable deep convolutional neural network (DCNN) to identify pneumonia using chest x-ray images. The proposed modified DCNN model first extracts useful features from the images and then classifies them into normal and pneumonia classes. The experimental result shows that the proposed model's performance is greater compared to the other state-of-the-art methodologies used to identify pneumonia.

Hypertension risk prediction has always been the focus of attention of the research community. In this context, Min Fang et al. proposed a hybrid machine learning approach for hypertension risk prediction in the second paper of this topical collection. This paper addressed the risk prediction for hypertension in the next five years, and put forward a model merging KNN and LightGBM. The proposed approach allowed the researchers to predict the hypertension risk for a specific set of individuals using features, such as the age of the subject and blood indicators. Results shows that the proposed model is reliable and achieves accuracy and recall rate over 86% and 92%, respectively.

Parkinson disease is another disease that affect a large proportion of human race. Zainab Ayaz et al. proposed automated methods for diagnosis of Parkinson's disease and predicting severity level. This review paper aims to provide a comprehensive survey of the use of artificial

intelligence for Parkinson's disease diagnosis. Techniques, such as machine learning and deep learning have been used broadly and reported promising results. Different datasets including voice data samples, radiology images, and handwriting samples and gait specimens have been used for analysis and detection. Moreover, several key peculiarities and challenges are also provided based on the comprehensive literature review to diagnose a healthy or unhealthy person.

In this topical collection, the fourth paper is Segmentation of ultrasound image sequences by combing a novel deep siamese network with a deformable contour model. In this paper, a novel deformable contour model is proposed for segmenting ultrasound image sequences, which aims to utilize the powerful ability of deep learning network in learning of image features to help the deformable contour model resist weaknesses of ultrasound images. The deep learning network is designed as a densely connected Siamese architecture. It trains a contrastive loss that serves as a boundary searching metric of a deformable contour to segment ultrasound image.

The next paper is titled a machine learning enabled intelligent application for public health and safety. This article uses a machine learning approach to analyze and detect burst signals in a smart healthcare system to protect and safeguard the public health. They considered the time-series electrocardiogram (ECG) waveforms for the detection of burst signals.

The next paper is Internet of things enabled real-time health monitoring system using deep learning. The proposed system uses wearable medical devices to measure vital signs and apply various deep learning algorithms to extract valuable information. The deep learning algorithms help physicians properly analyze these athletes' conditions and offer the proper medications to them, even if the doctors are away. The performance of the proposed system is extensively evaluated using a cross-validation test by considering various statistical-based performance measurement metrics.

The seventh paper of this topical collection, i.e., an improved deep learning mechanism for EEG recognition in sports health informatics uses deep learning methods to analyze the EEG signals of athletes. It then proposes and designs a channel attention module connected to the input layer of the convolutional neural network (CNN). The proposed approach automatically learns the EEG signals of different channels for recognizing the contribution of the task. The experimental result shows that the proposed model improves the recognition accuracy from 82.58% of ResNet13 to 85.68% and attained excellent recognition accuracy of 91.05% by using CAMResNet13 + CRNN architecture.

Deep learning enabled block scrambling algorithm for securing telemedicine data of table tennis players is the next paper of this topical collection. In this paper, the authors first presented a data block scrambling algorithm (without key management) for secured transmission and storage of ECG data of table tennis players at the cloud. A small piece of original data stored at the cloud is used for scrambling the massive amount of remaining ECG data. The secured telemedicine data is then imported into Hadoop Distributed File System for data management, which is read by Spark framework to form Resilient Distributed Datasets. Finally, a deep learning approach is used that extracts useful features, learns the related information, and weights and sums the feature vectors at different layers for classification.

The next paper is AI-enabled radiologist in the loop: novel AI-based framework to augment radiologist performance for COVID-19 chest CT medical image annotation and classification from pneumonia, proposed by Hemant Ghayvat et al. This work proposed an RILML framework for automated segmentation, where a radiologist is partially employed to annotate data for training sets, classification based on textural changes in CT, with clinical expandability via heat maps. A machine learning (ML)-based recognition and segmentation system was developed to spontaneously discover and compute infection areas in CT scans of COVID-19 patients. The computable assessment exhibited suitable performance for automatic infection region allocation.

Deep neural network correlation learning mechanism for CT brain tumor detection by Marcin Woźniak is the tenth paper in this topical collection. This paper proposed a novel correlation learning mechanism (CLM) for deep neural network architectures that combines convolutional neural network (CNN) with classic architecture. The support neural network helps CNN to find the most adequate filers for pooling and convolution layers. As a result, the main neural classifier learns faster and reaches higher efficiency. Results show that the proposed CLM model is able to reach about 96% accuracy, and about 95% precision and recall.

Analysis and design of dual-feature fusion neural network for sports injury estimation model is the next paper of this topical collection. This paper proposed a model to solve the problem of feature loss by using a 1×1 convolution and hyperlink to form a dual-fusion structure to enhance effective discrimination. Multiple experiments have been performed using different classification models. The performance of the utilized models, including the proposed model, has been evaluated with the help of numerous performance evaluation metrics. The proposed model attained an excellent classification accuracy of

97.0%, a sensitivity of 95.70%, and a specificity of 97.54%.

The next paper is aggregated decentralized down-sampling-based ResNet for smart healthcare systems. This paper proposed a new strategy of aggregation decentralized down-sampling to prevent the loss of feature information in healthcare data. The regions that are not involved in the convolution operation are re-convoluted and stacked onto depth information in the forward propagation layer and the short-circuit layer, ensuring gradual convergence of the feature map and avoiding the loss of feature information. The accuracy of the proposed residual network (ResNet) system for classification tasks showed an average improvement of 2.57% compared with the conventional ResNet strategies.

The next paper of this topical collection is arrhythmia diagnosis of young martial arts athletes based on deep learning for smart medical care by Jing Zhuang. This study proposes an intelligent system based on deep learning and machine learning methods to classify and diagnose ECG signals to improve their classification and recognition accuracy. It improves the detection ability of martial arts athletes' arrhythmia disease and obtains accurate arrhythmia diagnosis information. MIT-BIH arrhythmia dataset has been used for the experimental analysis. The performance of the proposed scheme is evaluated with the help of various performance measures.

Hamdi Altaheri et al. proposed deep learning techniques for classification of electroencephalogram (EEG) motor imagery (MI) signals: a review. In this work, we systematically review the DL-based research for MI-EEG classification from the past ten years. This article first explains the procedure for selecting the studies and then gives an overview of BCI, EEG, and MI systems. The DL-based techniques applied in MI classification are then analyzed and discussed from four main perspectives: preprocessing, input formulation, deep learning architecture, and performance evaluation. In the discussion section, three major questions about DL-based MI classification are addressed: (1) Is preprocessing required for DL-based techniques? (2) What input formulations are best for DL-based techniques? (3) What are the current trends in DL-based techniques? Moreover, this work summarizes MI-EEG-based applications, extensively explores public MI-EEG datasets, and gives an overall visualization of the performance attained for each dataset based on the reviewed articles. Finally, current challenges and future directions are discussed.

The final paper of this topical collection, i.e., an intelligent heart disease prediction system based on swarm-artificial neural network was proposed by Nandy et al. This study propose an intelligent healthcare framework for predicting cardiovascular heart disease based on Swarm-Artificial Neural Network (Swarm-ANN) strategy. Initially, the proposed Swarm-ANN strategy randomly generates predefined numbers of Neural Networks (NNs) for training and evaluating the framework based on their solution consistency. Additionally, the NN populations are trained by two stages of weight changes and their weight is adjusted by a newly designed heuristic formulation. Finally, the weight of the neurons is modified by sharing the global best weight with other neurons and predicts the accuracy of cardiovascular disease. The proposed Swarm-ANN strategy achieves 95.78% accuracy while predicting the cardiovascular disease of the patients from a benchmark dataset. The simulation results exhibit that the proposed Swarm-ANN strategy outperforms the standard learning techniques in terms of various performance matrices.