Editorial

Special Issue on “Intelligent Biomedical Data Analysis and Processing”

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Today the human lives in the age of information and technology. Information is the key, the power, and the engine that moves the world's economy. The world is moving with markets data, medical epidemiologic sets, Internet browsing records, geological surveys data, complex engineering models, and so on. Health sciences are fully embedded in information technology. Health science and biology are very complex fields and have made a long walk from the ancient times, but processes involved in biology, medicine, and physiology are much too intricate to be faithfully modeled. In the early eighties, AI in medicine was the main concern while developing medical expert systems in specialized medical domains aimed at supporting diagnostic decision making. The main problems addressed at this early stage of expert system research concerned knowledge acquisition, knowledge representation, reasoning, and explanation. Now there are many modern hospitals and healthcare institutions, which are well equipped with monitoring and other advanced data collection devices. The need of knowledge on the domain or on the data analysis process becomes essential in biomedical applications, as medical decision making needs to be supported by arguments based on basic medical and pharmacological knowledge. The new tool for analyses of biomedical applications is “Intelligent Data Analysis (IDA).” IDA can be defined as the use of specialized statistical, pattern recognition, machine learning, data

abstraction, and visualization tools for analysis of data and discovery of mechanisms that created the data. The main idea underlying in the concept of Intelligent Data Analysis is extracting knowledge from a very large amount of data, with a very large amount of variables, data that represent very complex, nonlinear, real-life problems. Moreover, IDA can help starting from the raw data, coping with prediction tasks without knowing the theoretical description of the underlying process, classification tasks of new events based off of past ones, or modeling the aforementioned unknown process. Classification, prediction, and modeling are the cornerstones that Intelligent Data Analysis can bring to us.

This special issue focuses on recent advances, challenges, and future perspectives about intelligent data analysis methods applied in biomedical studied in different domains of knowledge. From a total of around eighty submitted articles to this special section, nineteen papers were selected based on the reviews. Each paper was reviewed by at least three reviewers and went through at least two rounds of reviews. The brief contributions of these papers are discussed below.

The first paper by Shui-Hua Wang et al. proposes a 10-layer convolutional neural network for the diagnosis based on imaging, including three advanced techniques: parametric rectified linear unit (PReLU); batch normalization; and dropout. In total, 188 abstinent long-term chronic alcoholic participants and 191 non-alcoholic control participants (95 men and 96 women) were enrolled. Further, the performance of the proposed 10-layer CNN model outperforms the seven state-of-the-art approaches.

Ivanoe De Falco et al. propose a framework, which deals with the task of evaluating several artificial intelligence techniques to automatically distinguish between different activities of daily living (ADLs) and different types of falls. The performance of the proposed approach is better than those in the other papers in the literature that face this specific 17-class problem.

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In this paper, Mohd Khanapi Abd Ghani et al. present a new automatic classification of NPC tumor using machine learning techniques and feature-based decision-level fusion scheme from endoscopic images. Further, the results demonstrate that the majority rule for decision-based fusion is outperformed considerably by the single best-performing feature scheme (FFGF) for the SVM classifier, but for the ANN and KNN classifiers, it is significantly outperformed by each of the component features. The classifier approaches were listed a high accuracy of 94.07%, the sensitivity of 92.05%, and specificity of 93.07%.

The fourth paper by Rong Sun et al. has studied the coded caching scheme for the combination network. In the combination network, the server communicates with the users via multiple relays, and the relays, as well as the users, have cache memories. Using the maximum distance separable codes and placement delivery array (PDA) algorithm, the coded placement phase and delivery phase for combination networks are designed. The proposed scheme greatly reduces the subpacketization level with slightly increasing the transmission rate.

This paper by P. Mohamed Shakeel et al. introduces the effective and optimized neural computing and soft computing techniques to minimize the difficulties and issues in the feature set. The minimum repetition and Wolf heuristic features were subsequently selected to minimize the dimensionality and complexity of the features. The selected lung features were analyzed using discrete AdaBoost optimized ensemble learning generalized neural networks, which successfully analyzed the biomedical lung data and classified the normal and abnormal features with great effectiveness.

The authors Bo Li et al. propose a new approach to detect streaks effectively based on image analysis techniques. Furthermore, a marker-controlled watershed algorithm is then used to segment the streaks, and highly discriminating characteristics are used to identify candidate regions and reject false streaks. The proposed object detection method that is effective in complex backgrounds and low-contrast conditions is also helpful for object detection in other scenes.

The seventh paper by Xiaodong Yang et al. explores a novel approach to detect incognito hypopnea syndrome as well as provide a contactless alternative to traditional medical tests. Further, the proposed method is based on S-Band sensing technique, peak detection algorithm, and sine function fitting for the observation of breathing patterns and characterization of normal or disruptive breathing patterns for hypopnea syndrome detection. The experimental results show that this technique has the potential to open up new clinical opportunities for contactless and

accurate hypopnea syndrome monitoring in a patient-friendly and flexible environment.

The unsupervised Optimum-Path Forest (OPF) classifier for learning visual dictionaries in the context of Barrett's esophagus (BE) and automatic adenocarcinoma diagnosis has been introduced by Luis A. de Souza Jr. et al. Further, the proposed approach was validated in two datasets, i.e., MICCAI 2015 and Augsburg, using three different feature extractors, i.e., SIFT, SURF, and the not yet applied to the BE context A-KAZE.

Shizhou Dong et al. propose an end-to-end video SOD algorithm with an efficient representation of the objects' motion information for modeling the objects' motion information efficiently. Further, the proposed algorithm contains two major parts: a 3D convolution-based X-shape structure that directly represents the motion information in successive video frames efficiently, and 2D densely connected convolutional neural networks (DenseNet) with pyramid structure to extract the rich spatial contrast information in a single video frame. The results show that the proposed method achieves state-of-the-art performance compared with the other related methods.

An automatic bone cancer detection system to predict cancer in earlier state has been presented by Torki Al-tameem. Initially, the bone images are collected from the patient, and noise in the images is eliminated using the median filter. After eliminating the noise, affected tumor part is detected by applying the intuitionistic fuzzy rank correlation. The derived features are processed by applying the deep neural network layers that successfully examine each features using Levenberg–Marquardt learning algorithm. The proposed process predicts bone cancer-related features with an accuracy of 99.1%.

The eleventh paper by Mohamed Abdel-Basset et al. proposes an enhanced metaheuristic algorithm called multi-verse optimizer with overlapping detection phase (DMVO) for optimizing the area coverage percentage of WSN. Further, the proposed algorithm is tested on many datasets with different criterions and is compared with other algorithms including the original MVO, particle swarm optimization, and flower pollination algorithm. The experimental results and the statistical analysis prove the prosperity and consistency of the proposed algorithm.

In the next paper of this issue, the authors Gayathri Nagasubramanian et al. propose a system using the cloud that helps to ensure authentication and that also provides integrity to health records. The keyless signature infrastructure used in the proposed system for ensuring the secrecy of digital signatures also ensures aspects of authentication. Furthermore, data integrity is managed by the proposed blockchain technology. The results show that the response time of the proposed system with the blockchain technology is almost 50% shorter than the

conventional techniques. Also, they express the cost of storage is about 20% less for the system with blockchain in comparison with the existing techniques.

H. R. Boveiri et al. have proposed a novel adaptive cuckoo optimization algorithm named A-COA. The proposed algorithm has three novelties in egg-laying and migration phases, which makes the basic algorithm more efficient with faster convergence to solve continuous and discrete optimization problems. A comprehensive comparison study of A-COA versus the basic COA and other conventional metaheuristics like GA, PSO, ABC, and TLBO has been made on a variety of unimodal and multimodal numerical benchmark functions with different characteristics. The result shows an overall 25.85% of improvement in terms of performance with a faster convergence speed compared to the basic COA, where the statistical Wilcoxon rank-sum test certifies the conclusions.

Weilin Zang et al. have studied a joint scheduling and admission control problem with the objective of optimizing the energy efficiency of both intra- and beyond-WBAN link. Further, the problem has been formulated as constrained Markov decision processes, and the relative value iteration and Lagrange multiplier approach are used to derive the optimal intelligent algorithm. Simulation results show the proposed algorithm is capable of, in comparison with the greedy scheme, achieving nearly 100% throughput improvement in various power consumption budgets. Moreover, the proposed algorithm can achieve up to $5.5 \times$ power consumption saving for sensor node in comparison with other scheduling algorithms.

Priya Govindarajan et al. present a prototype to classify stroke that combines text mining tools and machine learning algorithms. The proposed idea is to mine patients' symptoms from the case sheets and train the system with the acquired data. Artificial neural networks trained with a stochastic gradient descent algorithm outperformed the other algorithms with a higher classification accuracy of 95% and a smaller standard deviation of 14.69.

In the next paper of this issue, the authors D. Jude Hemanth et al. propose an alternative, hybrid solution method for diagnosing diabetic retinopathy from retinal fundus images. The method proposed in this study includes employment of image processing with histogram equalization, and the contrast limited adaptive histogram equalization techniques. Further, the diagnosis is performed by the classification of a convolutional neural network. By employing the related image processing techniques and deep learning for diagnosing diabetic retinopathy, the proposed method and the research results are valuable contributions to the associated literature.

Mohammed Al-Maitah presents a system to reduce the complexity of the genetic disease prediction system by

using the associative decision tree-based learning and Hopfield dynamic neural networks (HDNN). The excellence of the system has been measured with the aid of the experimental outcomes that are corresponding to the forecasting methods such as greedy algorithm, rough set method, and artificial bee colony, and the comparison is made with the avail of the accuracy, sensitivity, and specificity.

The eighteenth paper by Ali Hassan Sodhro et al. proposes a method which contributes in three distinct ways. First, it proposes the novel adaptive QoS computation algorithm (AQCA) for fair and efficient monitoring of the performance indicators, i.e., transmission power, duty cycle, and route selection during medical data processing in healthcare applications. Second, the framework of QoS computation in medical applications is proposed at physical, medium access control (MAC) and network layers. Third, QoS computation mechanism with proposed AQCA and quality of experience (QoE) is developed. The experimental results indicate that QoS is computed at physical, MAC and network layers with transmission power (-15 dBm), delay (100 ms), jitter (40 ms), throughput (200 Bytes), duty cycle (10%), and route selection (optimal). Thus, it can be said that proposed AQCA is the potential candidate for QoS computation than baseline for medical healthcare applications.

In the final paper of this issue, the authors Amina Naseer et al. propose a PD identification with the help of handwriting images that help as one of the earliest indicators for PD. Further, a deep convolutional neural network classifier with transfer learning and data augmentation techniques has been proposed to improve the identification. Experimental results on benchmark dataset reveal that the proposed approach provides better detection of Parkinson's disease as compared to state-of-the-artwork.

To conclude, this special issue publishes nineteen papers out of the total of around eighty submitted papers. The guest editors hope that the research contributions and findings in this special issue would benefit the readers in terms of enhancing their knowledge and encouraging them to work on various aspects of Intelligent Biomedical Data Analysis and Processing.

We would like to express our sincere thanks to the editor in chief for allowing us to organize this special issue. The editorial office staffs are excellent and thanks for their support. We are also thankful to all the authors who made this special issue possible and to the reviewers for their thoughtful contributions.

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