Editorial

Intelligent systems and computational methods in medical and healthcare solutions with their challenges during COVID-19 pandemic

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This special issue of the *Journal of Intelligent Systems* focuses on recent advances and improvements in intelligent systems and computational methods in medical and healthcare solutions with their challenges during COVID-19 pandemic. Although intelligent systems and artificial intelligence (AI) and their applications are now the hottest research areas, in recent years, there have been more and more AI applications in the medical field. AI technology is promoting the development of the medical and health industries. In the medical domain, AI techniques can be used to develop clinical decision support systems to help with medical diagnostics. AI technologies can also be deployed in various medical devices, trackers, and information systems. A huge amount of patient data are recorded in the electronic medical record database, including diagnosis, medical history, medications, and lab results. Through the process of extraction, transformation, and loading, researchers can generate a patient dataset worthy of analysis by AI techniques. In addition to the data analysis using structure data, AI techniques are now used for medical image recognition, medical text and semantic recognition, and molecular biological testing. The analysis results can be used as a reference for the evaluation of patients by the medical team. Recently, AI, internet-of-things, big data analytics, machine learning, deep learning, Fog Computing, cloud computing, and block chain technologies have been intelligently applied with various applications in networking, Medical diagnosis and Healthcare Systems, shipping to build efficient, sustainable systems, and Intelligent Solutions to Medical and Healthcare Systems.

This special issue focuses on advanced techniques in signal processing, analysis, modelling, and classification, applied to a variety of medical diagnostic problems. Biomedical data play a fundamental role in many fields of research and clinical practice. Very often the complexity of these data and their large volume makes it necessary to develop advanced analysis techniques and systems. Furthermore, the introduction of new techniques and methodologies for diagnostic purposes, especially in the field of medical imaging, requires new signal processing and machine learning methods. The recent progress in machine learning techniques, and in particular deep learning, has revolutionized various fields of artificial vision, significantly pushing the state of the art of artificial vision systems into a wide range of high-level tasks. Such progress can help address problems in the analysis of biomedical data.

As advances in intelligent systems and computational methods in medical and healthcare solutions are becoming more powerful in terms of functionality and communicative capabilities, their contribution to the *Journal of Intelligent Systems* is becoming more significant. This special issue is organized to promote and publish the state-of-the-art research papers, which are organized as follows.

1 Intelligent systems and computational methods in medical and healthcare solutions with their challenges during COVID-19 pandemic

In the first paper under this category, Manal Mostafa Ali proposed an effective Arabic Sentiment Analysis about Online Learning to Mitigate Covid-19. Different classification algorithms including Naïve Bayes (NB), Multinomial Naïve Bayes (MNB), K Nearest Neighbor (KNN), Logistic Regression (LR), and Support Vector Machine (SVM) were examined. The experiments reveal that the proposed model performs well in analyzing the perception of people about coronavirus with a maximum accuracy of about 89.6% using SVM classifier.

In the second paper, Omar Adil Mahdi et al. presented a Void-hole Aware and Reliable Data Forwarding Strategy for Underwater Wireless Sensor Networks. This article proposes a void-holes aware and reliable data forwarding strategy (VHARD-FS) in a proactive mode to control data packet delivery from CH nodes to the sink in underwater wireless sensor networks (UWSNs). In the proposed strategy, each CH node is aware of its neighbor's performance ranking index to conduct a reliable packet transmission to the sink via the most energy-efficient route. Extensive simulation results indicate that the VHARD-FS outperforms existing routing approaches while comparing energy efficiency and network throughput. This study helps to effectively alleviate the resource limitations associated with UWSNs by extending network life and increasing service availability even in a harsh underwater environment.

In the third paper, Mustafa Kamal Pasha et al. have proposed an Identification of Efficient COVID-19 Diagnostic Test Through Artificial Neural Networks Approach – Substantiated by Modeling and Simulation. They utilized the approach of artificial neural networks (ANN) to acquire the relevant data on COVID-19 and its testing. The data were analyzed by using Machine Learning, and probabilistic algorithms were applied to obtain a statistically proven solution for COVID-19 testing. The results obtained through ANN indicated that sample pooling is not only an effective way but also regarded as a “Gold standard” for testing samples when the prevalence of the disease is low in the population and the chances of getting a positive result are less. Also, further demonstrated through algorithms that pooling samples from 16 individuals are better than pooling samples of 8 individuals when there is a high likelihood of getting negative test results. These findings provide ground to the fact that if sample pooling will be employed on a larger scale, testing capacity will be considerably increased within limited available resources without compromising the test specificity.

In the fourth paper, Firas Mohammed Aswad et al. presented An Optimization of Color Halftone Visual Cryptography Scheme based on Bat Algorithm. This study aims to enhance the visual quality and avoid the problems of cross-interference and pixel expansion of the share images. It introduces a novel optimization of color halftone visual cryptography (OCHVC) scheme by using two proposed techniques: hash codebook and construction techniques. The new techniques distribute the information pixels of a secret image into a halftone cover image randomly based on a bat optimization algorithm. The results show that these techniques have enhanced security levels and make the proposed OCHVC scheme more robust against different attacks. The OCHVC scheme achieves a mean squared error (MSE) of 95.0%, a peak signal-to-noise ratio (PSNR) of 28.3%, a normalized cross correlation (NCC) of 99.4%, and a universal quality index (UQI) of 99.3% on average for the six shares.

In the fifth paper, Mohammed et al. proposed a novel and adaptive intelligent learning approach based on visual anti-spam email model for multi-natural language. This study shows how the adaptive intelligent learning approach, based on the visual anti-spam model for multi-natural language, can be used to detect abnormal situations effectively. The application of this approach is for spam filtering. With adaptive intelligent learning, high performance is achieved alongside a low false detection rate. There are three main phases through which the approach functions intelligently to ascertain if an email is legitimate based on the knowledge that has been gathered previously during the course of training. The proposed approach includes two models to identify the phishing emails. The first model has proposed to identify the type of the

language. New trainable model based on Naive Bayes classifier has also been proposed. The proposed model is trained on three types of languages (Arabic, English, and Chinese) and the trained model has used to identify the language type and use the label for the next model. The second model has been built by using two classes (phishing and normal email for each language) as training data. The second trained model (Naive Bayes classifier) has been applied to identify the phishing emails as a final decision for the proposed approach. The proposed strategy is implemented using the Java environments and JADE agent platform. The testing of the performance of the AIA learning model involved the use of a dataset that is made up of 2,000 emails, and the results proved the efficiency of the model in accurately detecting and filtering a wide range of spam emails. The results of our study suggest that the Naive Bayes classifier performed ideally when tested on a database that has the biggest estimate (having a general accuracy of 98.4%, a false positive rate of 0.08%, and a false negative rate of 2.90%).

In the sixth paper, Fatmah Abdulrahman Baothman and Budoor Salem Edhah assessed the Toward Agent-Based LSB Image Steganography System. The study aims to investigate novel steganography techniques based on agent technology. It proposes a Framework of Steganography based on agent for secret communication using LSB. The most common image steganography databases are explored for training and testing. The methodology in this work is based on the statistical properties of the developed agent software using Matlab. The experiment design is based on six statistical feature measures, including histogram, mean, standard deviation, entropy, variance, and energy. For steganography, an Ensemble classifier is used to test two scenarios: embedding a single language message and inserting bilingual messages. ROC curve represents the evaluation metrics. The result shows that the designed agent-based system with 50% training/testing sample set and 0.2 Payload can pick out the best cover image for the provided hidden message size to avoid visual artifact.

In the seventh paper, Shafiza Ariffin Kashinath et al. introduced a General Framework of Multiple Coordinative Data Fusion Modules for Real-Time and Heterogeneous Data Sources. This paper proposes a general Multiple Coordinative Data Fusion Modules (MCDFM) framework for real-time and heterogeneous data sources. They develop the MCDFM framework to adapt various DF application domains requiring macro and micro perspectives of the observed problems. This framework consists of preprocessing, filtering, and decision as key DF processing phases. These three phases integrate specific purpose algorithms or methods such as data cleaning and windowing methods for preprocessing, extended Kalman filter (EKF) for filtering, fuzzy logic for local decision, and software agents for coordinative decision. These methods perform tasks that assist in achieving local and coordinative decisions for each node in the network of the framework application domain. They illustrate and discuss the proposed framework in detail by taking a stretch of road intersections controlled by a traffic light controller (TLC) as a case study. The case study provides a clearer view of the way the proposed framework solves traffic congestion as a domain problem. They identify the traffic features that include the average vehicle count, average vehicle speed (km/h), average density (%), interval (s), and timestamp. The framework uses these features to identify three congestion periods, which are the non-peak period with a congestion degree of 0.178 and a variance of 0.061, a medium peak period with a congestion degree of 0.588 and a variance of 0.0593, and a peak period with a congestion degree of 0.796 and a variance of 0.0296.

In the final paper in this category, Mohammed Kamal Nsaif et al. introduced an online COVID-19 self-assessment framework supported by internet of medical things (IoMT) technology. This study proposes an online COVID-19 self-assessment tool supported by the IoMT technology as a means to fight this pandemic and mitigate the burden on our nation's healthcare system. Advances in IoMT technology allow us to connect all medical tools, medical databases, and devices via the internet in one collaborative network, which conveys real-time data integration and analysis. The proposed IoMT framework-driven COVID-19 self-assessment tool will capture signs and symptoms through multiple probing questions, storing the data to our COVID-19 patient database, then analyze the data to determine whether a person needs to be tested for COVID-19 or other actions may require to be taken. Further to this, collected data can be integrated and analyzed collaboratively for developing a national health policy and help to manage healthcare resources more efficiently. The IoMT framework-driven online COVID-19 self-assessment tool has a big potential to

prevent our healthcare system from being overwhelmed using real-time data collection, COVID-19 databases, analysis, and management of people with COVID-19 concerns, plus providing proper guidance and course of action.

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