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Preface to Special Issue on Digital Twin Empowered Internet of Intelligent Things for Engineering Cyber-Physical Human Systems

This special issue entitled *Digital Twin Empowered Internet of Intelligent Things for Engineering Cyber-Physical Human Systems* contains a collection of selected papers all discussing the state-of-the-art cyber-physical human systems, artificial intelligence techniques, biomedical engineering and optimization algorithms. All the articles published in this special issue were accepted for publication after a careful peer-review process to fulfill the standard quality requirements and fall within the journal's scope.

Recently, numerous challenges have been encounter in cyber-physical human systems (CPHSs) when integrating with the internet of things (IoT). Appropriate digital twin configurations through advanced multi-sensors are used to overcome the limitations in the CPHSs. To produce high-performance, dependable, and low-cost CPHSs that serve humanity, several key problems need to be answered. This special issue offers a detailed view of the emerging internet of intelligent things (IoIT) field in engineering CPHSs.

This special issue includes selected papers from this new interdisciplinary research area. We received a number of submissions covering a wide variety of new optimization techniques and challenges, an initiative to expand the research opportunities in this newly emerging field. The research articles in this issue introduce new challenges, solutions, and advancements toward CPHSs integrated with IoT. The details of the selected papers are as follows.

A Deep Hybrid Model for Human-Computer Interaction Using Dynamic Hand Gesture Recognition. The first article discusses a dynamic hand gesture recognition system that helps to perform control operations in applications such as music players, video games, etc. The key motivation for this work is to provide a simple, touch-free system for effortless and faster human-computer interaction (HCI). The proposed model employs dynamic hand gestures, and HCI is achieved by building a model with a convolutional neural network (CNN) and long short-term memory (LSTM) networks [1].

A Novel Framework for Fetal Nuchal Translucency Abnormality Detection Using Hybrid Maxpool Matrix Histogram Analysis. In this research, a machine

learning-based nuchal translucency (NT) detection and measurement method is proposed to create and apply a new system for identifying NT fetal abnormalities. The performance of the proposed technique is analyzed in terms of error rate, sensitivity, Matthias correlation coefficient (MCC), accuracy, precision, recall, and F1 score. The proposed model is found to perform better when compared with the conventional approaches [2].

Congestive Heart Failure Detection Based on Electrocardiomatrix Method with ECG Signal. This research article aims to use electrocardiomatrix (ECM) technology to perform the task of detecting congestive heart failure (CHF) quickly and accurately, which converts 2D ECG data into a 3D-colored matrix. The approach was tested using ECG readings from the BIDMC CHF Database on the Internet (Physionet.org). The outcomes of the ECM were then compared to manual interpretations of ECG data. This research shows that the ECM approach is a good way for machines and practitioners to interpret long-term ECG readings without losing accuracy [3].

Brain Tumor Classification in MRI Images Using Genetic Algorithm Appended CNN. The research introduces a novel CNN model to help physicians and radiologists to validate initial screening for multiple brain tumor classifications. In this approach, an EfficientNet B3 pre-trained model is utilized to classify three types of brain tumors: glioma, meningioma, and pituitary tumor. Tensor flow 2 and Nesterov-accelerated adaptive moment estimation are employed to improve the model training process to be quicker and better [4].

Microfluidic Design for Continuous Separation of Blood Particles and Plasma Using Dielectrophoretic Force Principle. This research investigates various microchannel geometries, electrode shapes, electrode voltages, widths of plasma outlets, and flow velocities at the inlets to compute the blood cell isolation purity and efficacy, plasma segregation purity and efficiency and plasma flow velocity through simulation in COMSOL Multiphysics 5.4 software. It is found that the device is best suited for continuous separation of all the blood components when compared with existing designs. Moreover, the effectiveness of the device is that it not only separates the diluted plasma but is also able to separate distinct blood cells with various properties [5].

Enhanced Design and Analysis of Microcantilever-Based Bio-Sensor to Detect Carcinoembryonic Antigen Tumor Biomarkers. In this research article, a microcantilever-based biosensor design with an equivalent active area of 3200 μm^2 is proposed and tested. The proposed design acts as a biosensor to detect carcinoembryonic antigen (CEA) using a microcantilever beam. The simulation of proposed designs is constructed and experimented with the different materials to obtain better deflection results [6].

A Supervised Approach to Musculoskeletal Imaging Fracture Detection and Classification Using Deep Learning Algorithms. This research aims to build,

construct, and evaluate a deep-learning system for fracture identification and bone fracture classification (BFC). An image processing system is developed to identify bone fractures using X-rays. Images from the dataset are pre-processed, enhanced, and extracted. Then, DNN classifiers such as ResNetXt101, Xception, InceptionV3, and InceptionResNetV2 separate the images into the ones with unfractured and fractured bones [7].

We hope readers will enjoy this in-depth exploration of digital twin enabled IoIT for the advancements toward cyber-physical human systems.

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References

1. B. Ramalingam, G. Angappan, A deep hybrid model for human-computer interaction using dynamic hand gesture recognition, *Computer Assisted Methods in Engineering and Science*, **30**(3): 263–276, 2023, doi: 10.24423/cames.559.
2. D. Verma, S. Agrawal, A novel framework for fetal nuchal translucency abnormality detection using hybrid maxpool matrix histogram analysis, *Computer Assisted Methods in Engineering and Science*, **30**(3): 277–290, 2023, doi: 10.24423/cames.631.
3. B. Mohan Rao, A. Kumar, Congestive heart failure detection based on electrocardiomatrix method with ECG signal, *Computer Assisted Methods in Engineering and Science*, **30**(3): 291–304, 2023, doi: 10.24423/cames.644.

4. T. Balamurugan, E. Gnanamanoharan, Brain tumor classification in MRI images using genetic algorithm appended CNN, *Computer Assisted Methods in Engineering and Science*, **30**(3): 305–321, 2023, doi: 10.24423/cames.649.

5. W. Pakhira, R. Kumar, F.C. Panwala, K.M. Ibrahimi, Microfluidic design for continuous separation of blood particles and plasma using dielectrophoretic force principle, *Computer Assisted Methods in Engineering and Science*, **30**(3): 323–345, 2023, doi: 10.24423/cames.653.

6. K.M. Ibrahimi, R. Kumar, W. Pakhira, F.C. Panwala, Enhanced design and analysis of microcantilever-based bio-sensor to detect carcinoembryonic antigen tumor biomarkers, *Computer Assisted Methods in Engineering and Science*, **30**(3): 347–367, 2023, doi: 10.24423/cames.654.

7. S.R. Karanam, Y. Srinivas, S. Chakravarty, A supervised approach to musculoskeletal imaging fracture detection and classification using deep learning algorithms, *Computer Assisted Methods in Engineering and Science*, **30**(3): 369–385, 2023, doi: 10.24423/cames.682.