Editorial

Sandeep Kumar

Department of Computer Science and Engineering,
Amity School of Engineering & Technology,
Amity University Rajasthan,
Jaipur, 303007, India
Email: sandpoonia@gmail.com

Janos Arpad Kosa

Department of Information Technology,
GAMF Faculty of Engineering and Computer Science,
Neumann Janos University,
Kecskemét, Izsáki út 10, 6000, Hungary
Email: Kosa.janosarpad@outlook.com

Ashish Kr. Luhach

Department of Electrical and Communication Engineering,
The Papua New Guinea University of Technology,
Lae 411 Lae, Papua New Guinea
Email: ashishluhach@gmail.com

Ramesh C. Poonia

Amity Institute of Information Technology,
Amity University Rajasthan,
Jaipur, 303007, India
Email: rameshcpoonia@gmail.com

Biographical notes: Sandeep Kumar has obtained his PhD in the field of Nature Inspired Computing. His area of interest is theoretical computer science, swarm intelligence, and evolutionary computing. He has published more than 50 research papers in refereed journals and international conferences and edited two books and two conference proceedings.

Janos Arpad Kosa received his PhD from Technical University of Budapest (TUB), Electrical Energy Department, Hungary. He developed the RL-I-SFCL and DC flux transfer and AC flux transfer between independent iron cores in a power system first in the world. He likes dealing with solutions to applications of superconductors in the electrical energy system. He is currently working as Professor at Neumann Janos University, GAMF Faculty of Engineering and Computer Science.

Ashish Kr. Luhach received a PhD in Computer Science from Banasthali University, India, and graduated from Latrobe University, Australia. Since April 2019, he is working as a Senior Lecturer at The Papua New Guinea

University of Technology, PNG. He has published more than 40 research papers in reputed journals and conferences. He is a member of CSI, ACM, and IACSIT.

Ramesh C. Poonia is a Postdoctoral Fellow at the Cyber-Physical Systems Laboratory, Department of ICT and Natural Sciences, Norwegian University of Science and Technology, Alesund. He is an Associate Editor of the *Journal of Sustainable Computing: Informatics and Systems*, Elsevier. He has authored/ co-authored over 65 research publications in refereed journals and international conferences.

1   Introduction

The computer reads an image in the form of a matrix. That contains an array of real numbers. Image processing refers to converting an image into digital format and some additional operations to improve its overall quality. An image may contain some unwanted information like noise. Image processing is targeted to extract useful information, visualise the objects that are not visible, restore the image, retrieve targeted image or portion of an image, measure different objects in an image, recognise a particular object, and many more. Processing of image includes digitisation of image, pre-processing, image improvement, segmentation, feature extraction, and classification. Image processing is essential in various filed like medical science, forensic science, material science, military, graphics and film industry, weather forecasting, agriculture, and many more. Machine learning and deep learning models are very efficient and very fast in detecting and predicting diseases with the help of the previous history of the patient. In the early times, medical experts used to analyse medical images manually. However, with the development of computer algorithms and an increase in computational power, modern machines are very efficient in diagnosing deadly diseases; after the 1990s, machines can train themselves with training datasets and replaced expert systems.

The image analysis approaches are proficient in distinguishing various images or image components. Thus, it is pertinent to a broader group of applications in the real world viz. bioinformatics, identification of document, medical imaging, and identification biometrics, and many more in the investigation area. Several review papers provide a thorough survey of image analysis techniques directly or indirectly connected with the recognition of different objects appearing in an image. Other important aspects of image analysis are image registration, image segmentation, and extraction of features from an image. Analysis of images is required various real-life problems such as criminal investigation, informative data indexing, and many other real-life problems. However, Image analysis has distinguished medical science applications and health care for disease diagnosis, prediction of diseases. This is achieved by a broad span of imaging devices (cameras, scanners, etc.) that are efficient in diagnosing/predicting. Hence, it is essential to develop systematic algorithms to assist in the analysis of medical images. These algorithms should provide accurate results with higher precision and robustness. Now a day's machine learning and deep learning techniques are successfully applied in medical imaging due to higher accuracy and timely diagnosis of chronic diseases.

Computational intelligence includes the development of biological and linguistic computational methods. The fuzzy system, neural network, and nature-inspired techniques are part of computational intelligence and used for knowledge representation, learning and adaption, and evolutionary computation. These techniques can deal with tolerance for approximation, uncertainty, imprecision, computing with words, and partial truth to achieve close resemblance with human-like decision making.

2 Introduction to special issue

This issue (Special Issue on: "Advances in Computational Intelligence for Machine Vision and Image Processing") collects several different contributions that extend selected works presented at the international conference on sustainable computing in science, technology, and management (SUSCOM-2020).

The first paper, 'Dung beetle inspired local search in artificial bee colony algorithm for unconstrained and constrained numerical optimisation', proposed an effective local search strategy inspired by dung beetle's orientation behaviour, titled a dung beetle local search (DBLS) strategy. The developed DBLS strategy is incorporated with an artificial bee colony algorithm (ABCA) to improve the algorithm's exploitation behaviour. Thus the modified strategy is titled as dung beetle inspired ABC (DBABC) algorithm. To prove the proposed approach's authenticity, the authors analysed it using three different sets of benchmark functions consisting of 32 unconstrained standard benchmark optimisation test problems, 18 constrained optimisation test problems, and three engineering design constrained problems. Further, the statistical analysis is also carried out using Mann Whitney U Rank Sum test, and the obtained outcomes are compared with state-of-art approaches available in the literature. The obtained outcomes validate that the proposed approach is far better in terms of accuracy, reliability, and efficiency. It can be stated that DBABC is a competent variant in the arena of swarm intelligence cantered techniques.

The second paper, 'Low-level features based 2D face recognition using machine learning', evaluated three different low-level feature extraction techniques viz. HOG features, SURF features, and LBP features over two-dimensional face recognition. In terms of feature extraction techniques by deep learning, it offers in-depth features in hidden layers. In contrast to that, machine learning works on low-level features, which are faster to extract. A total of 22 variations of machine learning models have been evaluated in the presented work. Two publicly available datasets, namely, Bosphorus and UMBDB, are reviewed for the experimentations. The HOG features have outperformed the other two features based facial recognition system. There are five experimentations performed for the performance comparison. The effect of feature extraction techniques, discretisation, feature variation, visual verification, and noise effect on face recognition has been studied in the experimentation. Various experimentations have revealed that the subspace discriminant based ensemble model outperforms all the different machine learning models for both the datasets.

The third paper in this special issue is 'Artificial intelligence based watermarking in hybrid DDS domain for security of colour images'. This paper proposed a hybrid watermarking for solving a challenging problem of multimedia data security. The watermark information is first converted into different blocks; then, it was embedded into singular values of each sub-band coefficient of DWT-DCT. The scaling factor used is

optimised using an artificial bee colony optimisation to provide the watermark's maximum robustness and invisibility into the host/cover image. A new fitness function is proposed by considering the imperceptibility and robustness characteristics. Colour host/cover images are taken in the proposed watermarking scheme rather than the conventional greyscale image used in most of the previous approaches. Extra security is provided by encrypting the original image into some other form using a watermark. The experimental result obtained proves the robust nature of the proposed scheme towards various image manipulation attacks. Simultaneously, the proportional analysis of the proposed scheme by other related schemes depicts the approach's effectiveness.

The fourth paper is related to the segmentation of medical images with the title 'Medical image segmentation based on fuzzy 2-partition Kapur entropy using fast recursive algorithm'. This paper introduced a medical image segmentation approach using a selection of threshold method based on fuzzy 2-partition Kapur entropy along with the motive of comparing the performance of Fast Recursive based approach, GA based approach, BEA based approach, and DE based approach towards the segmentation of medical images. The proposed recursive algorithm scales down the need for computing resources by getting rid of repeated calculations. The proposed approach reduces the basic algorithm's complexity from $O(L^3)$ to $O(L^2)$. The processing time is also reduced for each medical image. Since the concept of fuzzy 2-partition using Kapur entropy and the fast-recursive approach for the segmentation of medical images has been neglect earlier, in this paper, an attempt is made to explore the medical images approach also. This paper's considerable contribution is the application of Kapur entropy based on a fast-recursive algorithm for medical image segmentation. Experiments are performed in MATLAB 2019b, and results are evaluated based on popular parameters like PSNR, Uniformity, SSIM, and computation time. The first four parameters are used to analyse the segmented image's quality, and the last parameter is used to record the time complexity. The overall experimental results indicate that the fuzzy 2-partition entropy approach is better against the Basic Exhaustive Search algorithm, Genetic Algorithm (GA) based approach, and Differential Evolution (DE) based approach.

The fifth paper in this issue is the 'Hybrid ANFIS-genetic algorithm based forecasting model for predicting Cholera-waterborne disease'. Here authors proposed a new model to predict the cholera disease. The authors used NSGA to tune the hyper-parameters of ANFIS instead of GA and PSO, as it is multi-objective. Also, NSGA does not stick from local optimal and pre-mature convergence issues. Initially, the required parameters of the ANFIS model are computed by using the NSGA. After that, the designed NSGA-ANFIS model is trained on the cholera dataset. To handle the over fitting problem, 20-fold cross-validation is also implemented. Cholera's testing data is then used to evaluate the performance of the designed NSGA-ANFIS model.

3   Conclusion

Authors of this issue have provided many different contributions that extend the selected works presented at the SUSCOM 2020. These contributions in this special issue represent several different approaches related to image processing using machine learning and deep learning. This issue also includes a new algorithm for feature selection to improve classification accuracy.

The guest editors of the special issue "Advances in Computational Intelligence for Machine Vision and Image Processing" would like to thank all the authors for submitting their valuable research in this special issue and acknowledge the reviewers for their appreciated helps in reviewing the papers and providing positive and valuable observations to the authors. Finally, the guest editors would like to personally thank the Editor-in-Chief of *International Journal of Intelligent Engineering Informatics (IJIEI)*, Professor Ahmad Taher Azar (Prince Sultan University, Kingdom of Saudi Arabia and Benha University, Egypt) for his continuous support and help in systematising and coordinating the publication of this special issue.