ABSTRACT

Brain is the complex organ of the human body and associated with the essential functions such as planning, self-control, reasoning, emotions and abstract thought. Stroke is one of the principal causes of death, since it has limited treatments. Early detection of stroke at acute stage is essential for the emergency treatment to the stroke affected patients. Ischemic stroke occurs due to the blood clots which either wander or block the arteries. Stroke is the third leading cause of death, and most recovery occurs during the first few months following a stroke. Brain imaging such as MEG (Magneto Encephalography), Electro Encephalography (EEG), Positron Emission Tomography (PET), Magnetic Resonance Images (MRI) and Computerized Tomography (CT) are used for stroke detection.

Magnetic Resonance Image (MRI) is an advanced imaging modality than other modalities and used for diagnosing injuries, disorders and complications. MRI provides better visibility of soft tissues such as brain and heart with minimal bone artifact, because MR signal passes on bones. The analysis and recognizing the lesions from the brain images is an expensive, time consuming task and sometimes result in intra and inter observer variability. The accuracy of detection depends on the domain knowledge of the operator. An automated Computer Aided Diagnosis (CAD), analysis and classification will be helpful to assist the clinicians in the medical diagnostic process.

This work proposes an optimized feature selection and Hybrid Multi-Layer Perceptron (HMLP-NN) classifier to label the input brain Diffusion Weighted Imaging (DWI) into Stroke and Non-Stroke images. Pre-processing
and segmentation tasks are useful to maintain only the necessary details in the images and improve the accuracy of detection.

In the initial stage of investigation, a framework for classifying stroke images is presented. Local feature descriptors are identified and extracted using watershed segmentation and Gabor filter. A fused feature technique is proposed, where the features of the watershed segmentation and Gabor filter are normalized and feature fusion is achieved by concatenating the feature sets. The extracted features are ranked based on the information it provides with respect to the class labels. The ranked features are trained and classified using KNearest Neighbor (KNN) and MLPNN. Results show that the best classification performance is achieved by the MLPNN with fused features and achieves low root mean square error and high precision. The next step of the investigation aims to optimize the number of features to improve accuracy in classification.

Genetic Algorithm (GA) based feature selection with a novel fitness function is proposed. The learning parameters of MLPNN are tuned by the GA optimization. From the numerical results, it is observed that the classification accuracy of optimized MLP-NN increased 3.16% more than KNN and optimized MLP-NN increased 1.74% more than MLP-NN with fused features and GA feature selection.

A hybrid optimization approach is proposed to overcome the disadvantages of the GA. In this work, the GA is hybridized with local search to avoid local minima. Result showed that the accuracy of proposed MLPNN–Hybrid GA optimized with fused feature extraction with Hybrid GA based feature selection & proposed objective increases by 1.7026% more than MLPNN with fused feature extraction with Hybrid GA based feature selection and proposed objective. It is also seen that the proposed method reduces root mean square error and has high precision.