ABSTRACT

The abnormalities in brain cells are the main causes for forming lesions in brain. These abnormal lesions in brain lead to the formation of tumors in brain. Magnetic Resonance Imaging (MRI) and Computed Tomography (CT) are the two different brain image scanning methods. In this research work, MR images are used to scan the brain internal regions. Benign and Malignant are the type of abnormal lesions in brain in which, benign can be treated by radiation methods; whereas malignant lesions are treated through proper surgery by expert radiologist.

Tumor is defined as an uncontrolled growth of cancerous cells in any part of the body. Tumors are of different types and possess diverse characteristics and require different treatments. At present, brain tumors are classified into primary brain tumors and metastatic or malignant brain tumors. The primary tumors begin in the brain and are inclined to stay in the brain; the metastatic or malignant tumors begin as a cancer elsewhere in the body and then start to spread into the brain region. Due to the large amount of brain tumor images that are currently being generated in the clinics, it is not possible for physicians to manually annotate and segment these images in a practical time. Hence, the automatic tumor detection and segmentation technique has become inevitable. In conventional methods, brain tumors are detected and diagnosed manually by expert radiologist. It is time consuming and error probe process. Hence, it is not suitable for high population developing countries. Therefore, a computer aided automatic brain tumor detection and diagnosis methods are preferred.

In this thesis three brain tumor segmentation algorithms are proposed to classify and identify the tumor portions effectively. At first, a robust brain tumor segmentation approach is implemented by integrating Convolution Neural Network (CNN) and Multi Kernel K Means Clustering (MKKMC). In this proposed CNN-MKKMC approach, classification of MR images into normal

and abnormal is performed by CNN algorithm. At next, MKKMC algorithm is employed to segment the brain tumor from the abnormal brain image. The proposed CNN-MKKMC algorithm is evaluated both visually and objectively in terms of accuracy, sensitivity, and specificity with the existing segmentation methods. The experimental results demonstrate that the proposed CNN-MKKMC approach yields better accuracy in segmenting brain tumor with less time cost.

At next, a combined approach of convolutional neural network and support vector machine (CNN-SVM) is proposed. The proposed CNN-SVM method consists of the following stages; firstly, input MR brain image is subjected to pre-processing stage; in this stage unwanted noise and intensity in homogeneity components in the MR brain image is suppressed using anisotropic diffusion filter algorithm. Then, the features in MR brain image are extracted and based on the features input MR brain image is classified into normal or abnormal using deep CNN algorithm. In order to segment the tumor portions, gray scale morphological operation is adopted to the abnormal brain image. To analyse the efficacy of the proposed CNN-SVM approach, various tumor segmentation approaches are compared both visually and analytically. The test results show the convincing performance compared to the other existing methods.

Finally, brain tumor detection process using fuzzy logic-based enhancement and Co-Active Adaptive Neuro Fuzzy Inference System (CANFIS) and U-Net Convolutional Neural Network (CNN) classification methods is proposed. The proposed brain tumor detection process consists of the following stages such as, enhancement, feature extraction and classifications. The enhancement of the source brain image is done using fuzzy logic and then Dual Tree- Complex Wavelet Transform (DT-CWT) is applied on this enhanced image at different levels of scale. The features are computed from the decomposed sub band images and further these features are classified using CANFIS classification method which identifies the meningioma brain image

from non-meningioma brain image. In this work, the U-Net Convolutional Neural Networks are used for the detection and classification of meningioma brain tumor images. This proposed architecture consists of two separate modules as down sampling and up sampling. The proposed U-Net CNN architecture uses zero padding concepts in both down and up sampling in order to optimize the response from each layer, which is not available in general U-Net architecture. The proposed meningioma brain tumor detection method is applied on both publicly available open access dataset and clinical dataset. The performance of the proposed meningioma brain tumor detection and segmentation system is analyzed in terms of sensitivity, specificity, segmentation accuracy and Dice coefficient index with detection rate.

Although the research work has widely covered the topic subjective to various analysis and validations yielding fruitful conclusions, the scope of work in the field need not be limited to this part of the study. The work can be extended in terms of detection of abnormal tumor regions in thermogram brain images. There are possible connections in extending the scope of this research study, such that diagnosing of epilepsy disease basis the analysis of brain tissues is also possible. Earlier diagnosis of other brain related diseases such as the Parkinson disease can be one another area of interest to deep dive on same lines of the research work. Effectively all such works may lead to solve unsolvable problems in the advanced medical disciplines.