ABSTRACT

Alzheimer’s disease (AD) is a complex progressive brain disorder. It is a devastating illness characterized by progressive memory loss, impaired cognition, personality change, and inability to perform routine tasks of daily living. Mild Cognitive impairment (MCI) is believed to be the preclinical stages of AD. MCI is considered as a subtle but measurable disorder that is greater than the normal aging controls. The first AD related neuropathological changes appear in the medial temporal lobe (MTL) substructures already decades prior to the manifestation of clinical oblivious dementia. Hence, the early recognition of AD allows time to plan for the future and to treat patients before marked deterioration occurs. Neuroimaging technique is a particularly useful tool in the diagnostic and prognostic process of early AD. Among the various neuroimaging techniques, Magnetic Resonance Imaging (MRI) is now recognized as an important tool for the preclinical detection of early AD. Computer Aided Diagnosis (CAD) could be almost as effective as double reading by providing a “second opinion” to the radiologist, and help in increasing the sensitivity and accuracy of detection. In order to find the appropriate CAD technique for the early detection and severity of AD is important to develop the early treatment of the disease.

In this proposed study, analyze the performance of Voxel Based Morphometry (VBM) and different classification algorithms to discriminate between AD patients and healthy control subjects, and hence to predict conversion from No Cognitive Impairment (NCI) to MCI and MCI to AD. The proposed AD detection algorithms are composed of three stages: Skull stripping based on mathematical morphology, extracting the texture features from the pixels of the preprocessed MR images using 2D Gabor filters. These features are used for segmentation of GM, WM and CSF in MRI using unsupervised classifier like K-Means clustering and supervised classifiers like Radial Basis Function Neural network (RBFNN), Generalized Regression Neural Networks (GRNN), Probabilistic Neural Network (PNN), Back Propagation Neural Network (BPNN), Multi Support Vector Machine (MSVM) and Bacterial Foraging Optimization tuned ANN (BFOANN) based classifiers for the early diagnosis of AD. This longitudinal study also examined the correlation of voxel based methods and different classifier techniques to map the progression of GM loss in MCI patients over time and compared progressive MCI
(PMCI) to stable MCI (SMCI). The rational for this study is that early and preclinical diagnosis will assist in early intervention and perhaps allow for the prevention of AD.

The proposed study describes several approaches to segmenting MR images of the brain. The results analysis of the proposed methods was successful in early and accurate diagnosis of AD. The classification approaches and the VBM method revealed the vast majority of the brain atrophy in the Gray Matter (GM) structures of the MTL regions in the AD patients compared to the control subjects. In these results we report a statistically significant trend towards accelerated volume loss in the MCI follow up group compared to the MCI baseline group. The observed changes at an individual level were small, and within the accuracy range of measurements.

In summary, the results demonstrate that the VBM method and the supervised classification algorithms could get higher sensitivity and accuracy of classification than unsupervised clustering techniques. The BFOANN has yielded the best performance in the classification algorithm. The supervised BFOANN classifier proved as a biomarker for early diagnosis and tracking the progression of MCI to AD based on the volumetric analysis of GM and Cerebro-spinal fluid (CSF) structures in MRI by reducing the misclassification rate compared to other CAD systems.