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A New Approach of Classification of Alzheimer's Disease of MRI Images Using (Learning Vector Quantizer) Classifier

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ABSTRACT- Alzheimer's disease is the disease of the brain also referred as only Alzheimer's.Alzheimer's disease (AD) affects the central nervous system and begins in middle to late life, and results in severe dementia and ultimately death. Alzheimer's disease (AD) is the most common progressive neurodegenerative disorder. Therefore, early detection and evaluation of AD is an important issue in contemporary brain research. The demographic data show that presently there are about 18 million peoplewith dementia in the world. This technique helps to differentiate between the people with Alzheimer and its stages. The stages are mostly represented as normal stage, Mild Cognitive Impairment, and finally the Alzheimer's stage. The combination of principal component analysis and Independent Component Analysis helps to extract the useful features from the MRI scan. The Linear Vector quantizer is used to distinguish between the three stages of the disease. The results obtained are easy to interpret.

KEYWORDS: LVQ, Biomedical image processing; Statistical learning; Feature extraction; Classification algorithms; Independent component analysis; Support vector machines.

I. INTRODUCTION

Structural magnetic resonance imaging (s MRI) is a useful tool for detecting differences in brain morphometry. It has been used widely to study various mental illnesses such as schizophrenia and Alzheimer's disease. One commonapproach to study changes in brain structure using sMRI isto compute volume differences of the regions of interest (ROI) between groups; another is to find the features of the region of interest in the MRI. The features can be extracted using the following methods Principal Component Analysis, Independent Component Analysis methods. Recent advancements in imaging techniques have aided in accurate diagnosis of AD and also in identifying its early preclinical stages. Magnetic Resonance Imaging has been the most widely used imaging modality in differentiating AD from other brain related pathologies. MRI based measures of atrophy are regarded as predictive biomarkers of the disease state and its progression.

Independent component analysis (ICA) has emerged asa useful multivariate feature extraction tool to identify the naturally grouped sources in AD-related histopathology patterns by representing them as spatially unique and temporally coherent brain regions. A big advantage of using a multivariate technique such as ICA, is that it is capable of identifying and suppressing noise caused by low frequency physiologic artifacts thereby preserving interesting dynamics of the data.
A wavelet transform divides a function into different scale components. It is a time frequency transformation. In this methodology a wavelet transform and bilinear transform is used to reduce the noise contents.

Learning Vector Quantization (LVQ), different from Vector quantization (VQ) and Kohonen Self-Organizing Maps (KSOM), basically is a competitive network which uses supervised learning. We may define it as a process of classifying the patterns where each output unit represents a class. As it uses supervised learning, the network will be given a set of training patterns with known classification along with an initial distribution of the output class. After completing the training process, LVQ will classify an input vector by assigning it to the same class as that of the output unit.

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II. OBJECTIVES

(a) Study of brain MRI scans of individuals.

(b)To give proper care to AD patients, it is essential to measure the level of decay in thalamus, hippocampus, entorhinal cortex and neocortical territories in the early and later phases of the disease. Such kind of assessment is known as region of interest (ROI) based investigation and is typically centered on the examination of particular mind areas amid the sickness movement. And Study of the LVQ (Learning Vector Quantization) classifier.

(c) Early categorization of Alzheimer's disease. Classification into the disease stages which are Normal Controls (NC), Mild Cognitive Impairment (MCI) and Alzheimer's disease (AD

III. SYSTEM ARCHITECTURE

This method represents the new approach to distinguish between the various stages of Alzheimer's disease.

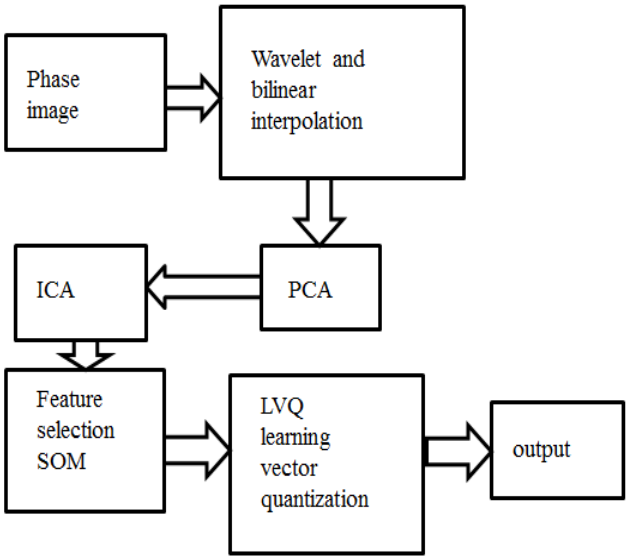

Figure 1: Block diagram of proposed system

A] sMRI DATA

The MRI scans of patients with Alzheimer's disease present and the stages of the disease are collected.
The MRI are used are of three different categories namely Normal Controls, Mild Cognitive Impairment and Alzheimer's disease. The patients are aged between 20 to 97 for comparisons.

B] Proposed Method

Figure 1 shows the block diagram of proposed system. Phase images are formed (containing white and grey matter) and given to wavelet and bilinear interpolation, which is used for the size reduction, noise removal etc. PCA and ICA used to extract the features, energy content, texture, area, region of interest etc. the output of PCA and ICA is given to SOM, which is used for the feature selection and weight calculation. LVQ classifier is used to classify the stages of the Alzheimer's disease. In this proposed work, the LVQ classifier is used to classify the stages of the AD with the help of

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MRI scans. Learning vectored quantizer used for the classification of the initial stages of the Alzheimer's disease which are normal controls (NC), mild cognitive impairment (MCI), Alzheimer's disease (AD).

C] Pre-processing

This stage involves the study of MRI scans of individuals to classify between the three initial stages of the Alzheimer's disease. The bilinear interpolation and PCA are applied to reduce the size of the image for convenience but keeping the resolution same. The dimensionality reduction is done by PCA technique. It is based on singular value decomposition.

D] Feature extraction

In machine learning, pattern recognition and in image processing, feature extraction starts from an initial set of measured data and builds derived values (features) intended to be informative and non-redundant, facilitating the subsequent learning and generalization steps, and in some cases leading to better human interpretations. Feature extraction is related to dimensionality reduction. The ICA (Independent component analysis) technique is used for the feature extraction of related MRI phase image. The necessary features are namely, energy content, area, texture etc. This technique separates the data into independent components. Like for example. "Cocktail party effect". And confusion matrix is calculated.

E] Feature selection and Visualization

SOM (Self Organizing Map) technique is used. SOM is used to see the natural groupings of the data. It is use to have a low dimensional view of high dimensional data.

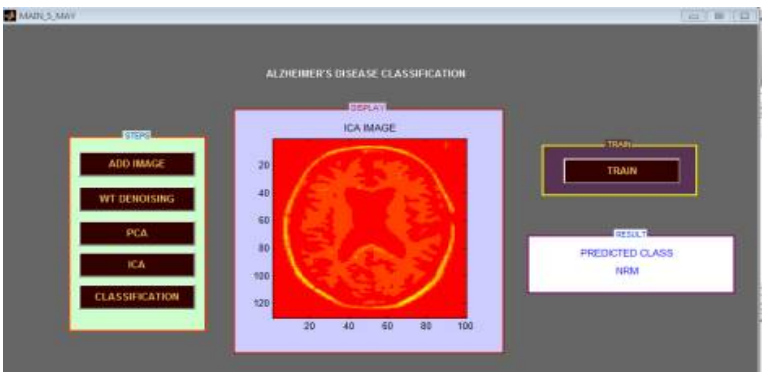
F] Classification

For classification purpose, the LVQ (Learning Vector Quantizer) is used which classifies the MRI into initial stages of the disease. Which are normal controls (NC), Mild cognitive impairment (MCI), Alzheimer's disease (AD) respectively; LVQ uses the k nearest neighbor. It creates prototype hence easy to interpret for experts in respective domains.

IV.RESULTS

Classification results:

Classification of Normal stage



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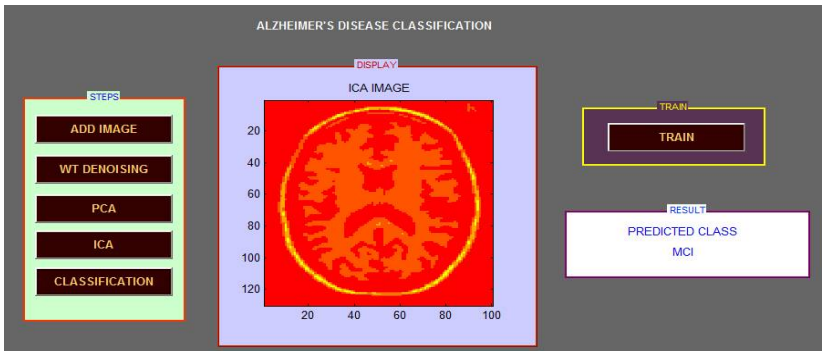
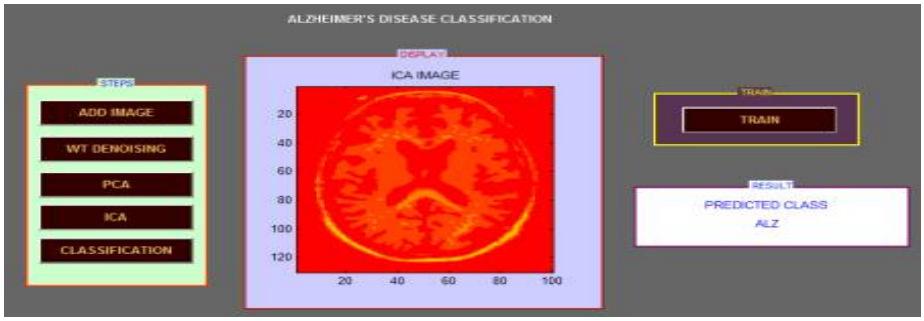
Classification of MCI stage



Classification of Alzheimer's disease



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