

## International Journal of Innovative Research in Science, Engineering and Technology

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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 a progressive disease that destroys memory and other important mental functions. At first, someone with Alzheimer's disease may notice mild confusion and difficulty remembering. Eventually, people with the disease may even forget important people in their lives and undergo dramatic personality changes. Alzheimer's disease is the most common cause of dementia a group of brain disorders that cause the loss of intellectual and social skills. In Alzheimer's disease, the brain cells degenerate and die, causing a steady decline in memory and mental function. This method gives a novel solution for classifying the initial stages of Alzheimer's disease. This includes the LVQ (Learning Vector Quantizer) classifier for classification purpose. PCA & ICA are used for feature extraction using the MRI scans.

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

## I. INTRODUCTION

Magnetic resonance imaging is a medical imaging technique used in radiology to form pictures of the anatomy and the physiological processes of the body in both health and disease. MRI scanners use strong magnetic fields, radio waves, and field gradients to generate images of the organs in the body. MRI does not involve x-rays, which distinguishes it from CT or CAT scans. Magnetic resonance imaging is a form of nuclear magnetic resonance (NMR). NMR can also be used for imaging in other NMR applications such as NMR spectroscopy. sMRI is used to 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 useful features are extracted using the following methods Principal Component Analysis, Independent Component Analysis methods, identifying its early preclinical stages. The early stages are Normal Stage, Mild Cognitive Impairment and the last stage that is Alzheimer's disease stage. MRI based measures of atrophy are regarded as predictive biomarkers of the disease state and its progression.

Independent component analysis (ICA) has a useful multivariate feature extraction tool to identify the naturally grouped sources like a "cocktail party effect." Which separates the uncorrelated data and gives the separate result. A big advantage of using a multivariate technique such as ICA is that it is capable of identifying the differences and suppressing noise. The fundamental idea of wavelet transforms is that the transformation should allow only changes in time extension, but not shape. Changes in the time extension are expected to conform to the corresponding analysis frequency of the basis function. Based on the uncertainty principle of signal processing, 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.

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Self Organizing Map (SOM) is a type of artificial neural network (ANN) that is trained using unsupervised learning algorithm to produce a low dimensional view of high dimensional data called as maps. And is a method to do dimensionality reduction. Like most artificial neural networks SOM operates in two modes: training and mapping.

“Training” builds the map using input examples; “Mapping” automatically classifies the new input vector.

LVQ can be understood as a special case of an artificial neural network, more precisely, it applies a winner-take-all Hebbian learning-based approach. It is a precursor to self-organizing maps (SOM) and related to neural gas, and to the k-nearest neighbour algorithm (k-NN). LVQ was invented by TeuvoKohonen. An LVQ system is represented by prototypes which are defined in the feature space of observed data. In winner-take-all training algorithms one determines, for each data point, the prototype which is closest to the input according to a given distance measure. The position of this so-called winner prototype is then adapted, i.e. the winner is moved closer if it correctly classifies the data point or moved away if it classifies the data point incorrectly. In this method the LVQ classifier classifies the initial stages of the disease.

## 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. Such kind of assessment is known as region of interest (ROI) based investigation and feature extraction by (The combination of PCA & ICA) is typically centered on the examination of particular mind areas. 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

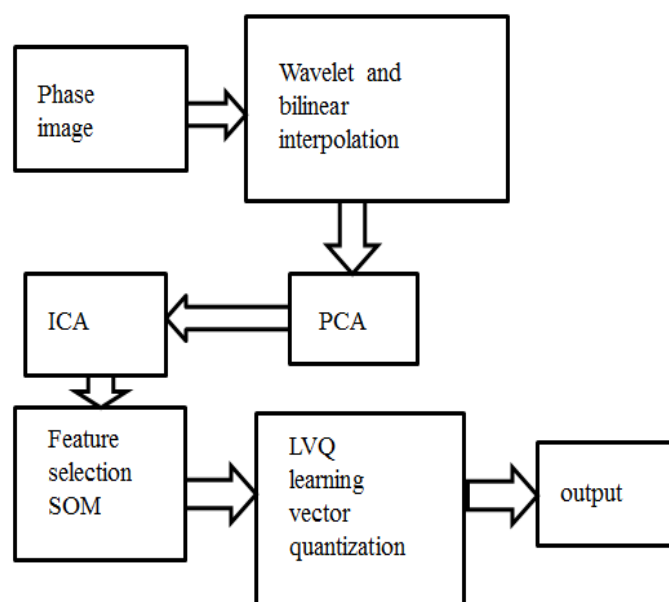


Figure 1: Block diagram of proposed system for classification of the initial stages.

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## 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 structural MRI are helpful in defining the structural behavior of brain tissues. Also MRI images of head provide excellent anatomical and strong grey/white matter contrast. The advantage of the structural MRI is normal and abnormal tissues are clearer than in CT scans. MRI is preferred over the CT scan because MRI doesn't use the x-rays which are quit harmful for the human body. Here the 1.5 T MRI scans are used for classification.

## 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 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 wavelet transform and bilinear interpolation are applied to reduce the size of the image for convenience but keeping the resolution same. The dimensionality reduction is done by PCA technique. The singular value decomposition is used to find out the how much data is spread. Then ICA is applied for feature extraction such as texture, region of interest, area, diameter and shape etc.

## D] Feature extraction

Feature extraction involves reducing the amount of resources required to describe a large set of data. When performing analysis of complex data one of the major problems stems from the number of variables involved. Analysis with a large number of variables generally requires a large amount of memory and computation power; also it may cause a classification algorithm to over fit to training samples and generalize poorly to new samples. Feature extraction is a general term for methods of constructing combinations of the variables to get around these problems while still describing the data with sufficient accuracy. 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.

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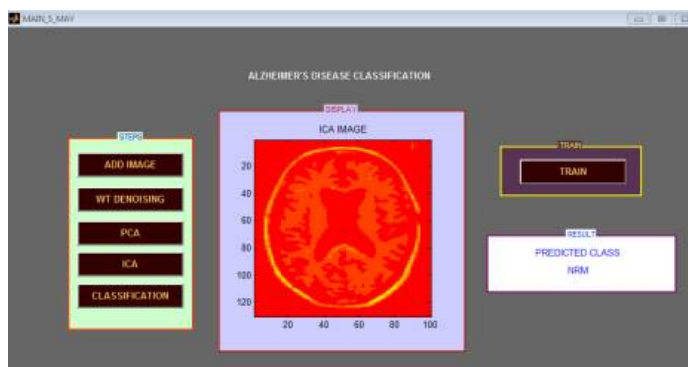
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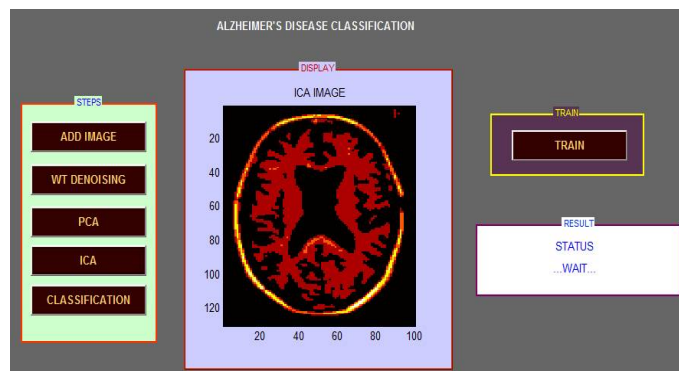
## IV.RESULTS

### Classification results:

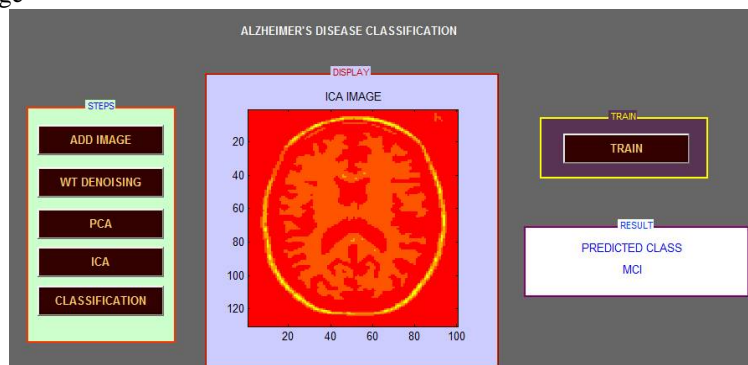
#### 1.Classification of Normal stage



#### ICA output of Normal stage



#### 2. Classification of MCI stage



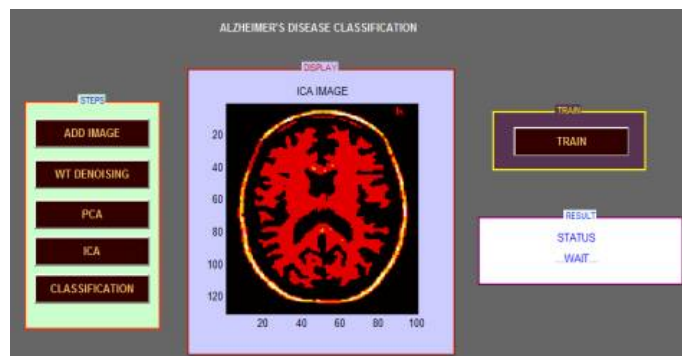
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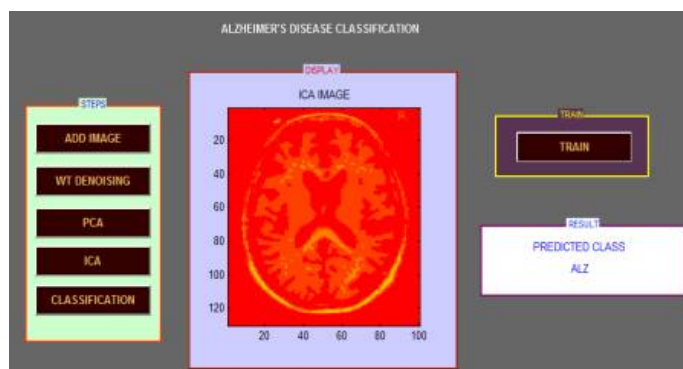
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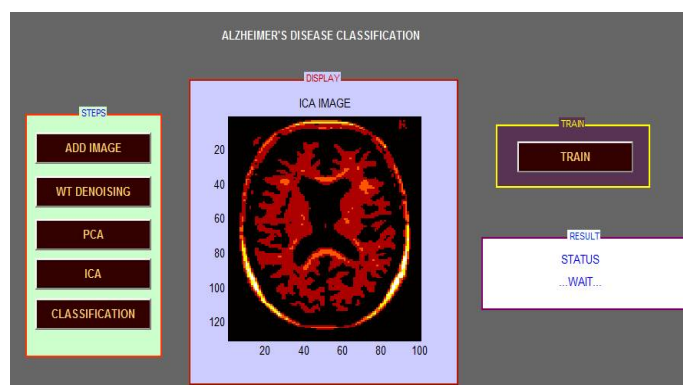
ICA output of MCI stage



3. Classification of Alzheimer's disease



ICA output of Alzheimer's disease Stage.



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