Classification of alzheimer's disease using combination of each recognition method in MR scans

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Abstract - *Early accurate detection of Alzheimer disease (AD) and its prognostic stage, i.e., Mild Cognitive Impairment (MCI) is getting more and more vital. A novel approach is applied for the diagnosis of very mild (CDR- 0.5) to mild (CDR-1) Alzheimer disease patients from normal controls combining morphometric features along with MMSE (Mini Mental State Examination) score. The combined features are fed into recently proposed Self Adaptive Resource Allocation Network (SRAN) and Linear SVM classifier after getting rid of curse of dimensionality using principal component analysis.*

Keywords: Alzheimer disease, MMSE Score, and VBM features

1 Introduction

The statistical report depicts that by 2050 over 135 million people worldwide will have dementia, tripling the amount of people who have it now[1].The cost of AD patients care is likely to be yielded up to$220 billion per year in the USA and $605 billion globally. Effective early diagnosis of AD and its prodromal stage is always indispensable, can impair and prevent the disease to progress. Several noninvasive and efficient diagnosis techniques are being used like structural or functional magnetic Resonance Imaging (sMRI or fMRI), Position Emission Tomography (PET), and Single Photon Emission Computerized Tomography (SPECT). Many studies are based on automatic or semi-automatic measurement of various a priori brain Region of Interest (ROI) to compare and discriminate between healthy controls (HC), Mild Cognitive Impairment (MCI), and Alzheimer Disease (AD) patients. M. Chupin at al [2] studied that the AD patients suffer significant cerebral atrophy; several brain ROIs, especially the hippocampus and the entohinal cortex. The researchers unveiled the morphometric difference between subject groups by comparing regional volume of ROIs.P. Padillaet al [3] developed Computer aided design (CAD) tool for SPECT and PET images using NMF and SVM classifier for the diagnosis of AD patients from healthy controls yielding upto 91% accuracy with high sensitivity and specificity rates(above 90%). M. Lópezet al [4] developed tool for the diagnosis of AD patients from normal controls using PCA and Bayesian classification rules, and SPECT and PET image dataset classifying 98.3% accurately for SPECT and 88.6% accurately for PET dataset. RigelMahmood et al [5] developed an automatic detection tool using PCA and Artificial Neural Network to identify the CDR scale of entire 457 MR images in the OASIS dataset, and achieved 89.92% accuracy.

2 Material and methods

2.1 Overview of the experimental Data

All the sMRI imaging data is being taken from OASIS dataset which is an open access collection of cross sectional sMRI of 416 subjects covering the adult life span aged 18 to 96, right handed including both men and women. Longitudinal data consists of 150 subjects aged 60 to 96, right handed including men and women. The feature extraction technique is illustrated elaborately by Darya Chyzhyk et al [6]. Gender may affect morphometric differences and features. Thus 98 women MRI data has been selected to extract vbm features for training and testing strategy, 49 diagnosed patients with very mild to mild AD, and 49 non demented controls among 98 subjects.

2.2 Preprocessing and VBM Feature Extraction

The different steps of feature extraction process are depicted in Fig. 1. The averaged, registered images resampled with 1-mm isotropic image in atlas space and the bias field corrected [5] are already available in OASIS cross sectional data set. VBM toolbox has been used for preprocessing. The MRI images are manually realigned with template image, spatially normalized, segmented to get GM features. The GM segmented images are spatially smoothed with FWHM of the Gaussian kernel to 10mm isotropic prior to analyze voxel base statistics. A GM mask had been generated from the mean of GM segmentation volumes of the 98 subjects. The binary mask was built from thresholding the average GM segmented volumes consisting of all voxels with probability greater than 0.1. The statistical General Linear Model (GLM) created to analyze using two-sample t-test where the groups mapped to very mild to mild AD patients and Normal controls respectively.

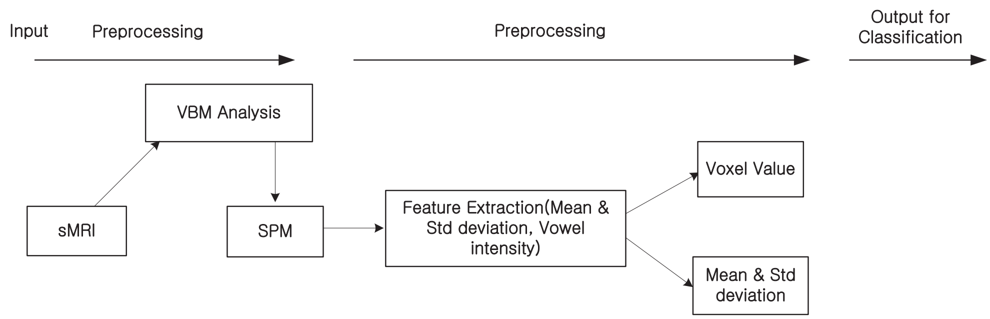

Figure 1. Block diagram of the feature extraction process from the subject s' GM segmentation volumes.

$$x_i = \{NMSE_i, vbmf_{i1}, vbmf_{i2}, ...vbmf_{iM}\}$$

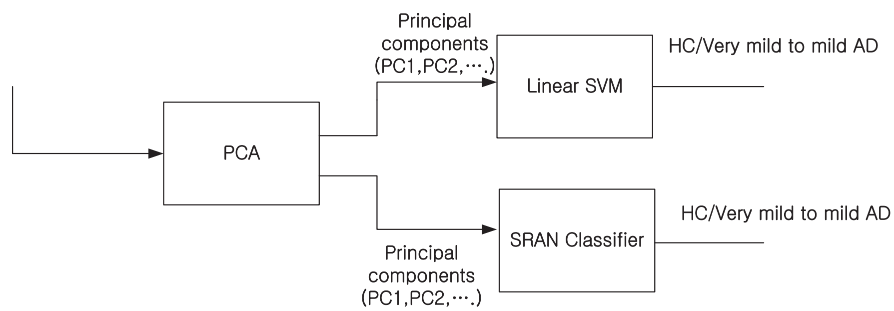

Figure 2. Schematic diagram proposed approach.

In SPM, the several functions have been set as follows: the contrast has been set to [-1 1], a right-tailed (groupN>groupAD), corrected FWE, p-value is 0.05. The feature has extracted from clusters detected by VBM for supervised learning purpose.

2.3 PCA-SRAN Classifier

A noble approach is applied combining VBM feature along, reducing the curse of dimensionality by using PCA, differentiating very mild AD to mild AD from healthy controls with SRAN classifier and linear SVM as shown in Fig. 2. Although linear SVM performs better, SRAN classifier performs efficiently for higher observations and multiclass classification problem in Table 1.

Table 1. Classification result.

Classifier	Accuracy	Sensivity	Specificity
PCA+Linear SVM	83.33%	83.33%	83.33%
PCA+ SRAN	79.17%	79.17%	79.17%

3 Conclusions

A diagnosis method for the early detection of very mild to mild AD is presented. The system was evolved by performing PCA, which drastically reduces the curse of dimensionality of the feature space. The most important components, the three principal components in terms of ability to discriminate are chosen for training and testing of Linear SVM and SRAN classifier for the diagnosis.

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