RESEARCHERID
THOMSON REUTERS
[AIVESC-18]
IC™ Value: 3.00
ISSN: 2277-9655
Impact Factor: 5.164
CODEN: IJESS7

IJESRT
INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY

E - DIAGNOSIS

Mariya Jose K[*1], Skilva Paul[*2], Swathy T N [*3], Sweena Tony[*4], Walda Sidharthan P[*5] and Ms. Ambily Francis[6]

[*1,2,3,4,5]Department of Electronics & Communication, Sahrdaya College of Engineering & Technology, India,

[6]Assistant professor, Department of Electronics & Communication, Sahrdaya College of Engineering & Technology, India.

DOI: 10.5281/zenodo.1227214

ABSTRACT

Alzheimer's disease (AD) is a progressive degenerative disorder that attacks the brain nerve cells, which results in loss of memory, thinking, language skills and behavioral changes. Hence, the Alzheimer's early stage detection is one of the major challenges faced by the medical field. Therefore, to this problem we here by propose a project named "E -DIAGNOSIS" which means early diagnosis. The Proposed project uses the utility of image processing on the Magnetic Resonance Imaging (MRI) scans to estimate the possibility of an early detection of AD. The basic techniques used in proposed system are feature extraction and classification. It classifies the input Magnetic Resonance Imaging (MRI) scans in to Alzheimer's disease (AD), Cognitively Normal (CN) Or Mild Cognitive Impairment (MCI).

KEYWORDS: AD, MRI, CN, MCI

I. INTRODUCTION

Alzheimer's disease (AD), is one of the most common form of dementia. It is a degenerative disorder that eventually leads memory loss. However promising research and development for early detection and treatment is underway until now a perfect solution has not been found out or declared. Alzheimer's disease remains to be a dilemma with normal aging and dementia. Severe memory distortions, characteristic of AD, are not a symptom of normal aging process. Healthy aging may lead to the gradual loss of hair, weight, height and muscle mass. A problem in hearing and vision may occur, as well as a decrease in metabolic rate. It is usual to have a slight decline in memory, includes slower recall of information, however cognitive decline that impacts daily life to be miserable and not to be a normal aging process. AD progresses and thereafter gradually can last for decades. There are three main stages of this disease. Each of these three stages has its own challenges and symptoms. Physicians can predict its symptoms that can be expected in the future and possible courses of treatment, by identifying the current stage of the disease [1]. The early stage of Alzheimer's or another dementia is actually MCI. MCI may not always lead to dementia. MCI reverts to normal cognition or remains stable in some individuals. There are some exceptional cases. That is, when a medication causes cognitive impairment, MCI is mistakenly diagnosed. So, it is very important that people experiencing cognitive impairment seek help as soon as possible for diagnosis and possible treatment.

Most commonly, an individual's primary care physician is doing the diagnosis of Alzheimer's disease. There is no simple test exists to diagnose Alzheimer's disease. A variety of tools and approaches are available which help to make a diagnosis. They are as follows:

- A medical and family history from the individual is obtained, which contains the psychiatric history and history of cognitive and behavioral changes.
- To provide input about changes in thinking skills or behavior of the individual, by asking a family member close to him.
- Getting input from a specialist, such as a neurologist.

ISSN: 2277-9655
Impact Factor: 5.164
CODEN: IJESS7

- Conducting physical and neurologic examinations and cognitive tests.
- Having the individual undergo a magnetic resonance imaging (MRI) scan, which can help to identify brain changes, such as a tumor, that could explain the individual's symptoms [2].

II. MATERIALS AND METHODS

ADNI Database

ADNI is a global research effort that actively supports the investigation and development of treatments that slow or stop the progression of AD. This multisite, longitudinal study assesses clinical, imaging, genetic and bio specimen biomarkers through the process of normal aging to early mild cognitive impairment (EMCI), to late mild cognitive impairment (LMCI), to dementia or AD. With established, standardized methods for imaging and biomarker collection and analysis, ADNI facilitates a way for scientists to conduct cohesive research and share compatible data with other researchers around the world. The Alzheimer's disease Neuroimaging Initiative (ADNI) unites researchers with study data as they work to define the progression of Alzheimer's disease. ADNI researchers collect, validate and utilize data such as MRI and PET images, genetics, cognitive tests, CSF and blood biomarkers as predictors for the disease. Data from the North American ADNI's study participants, including Alzheimer's disease patients, mild cognitive impairment subjects and elderly controls, are available from this site. ADNI researchers collect several types of data from study volunteers throughout their participation in the study. Data collection is performed using a standard set of protocols and procedures to eliminate inconsistencies. This information is available for free to authorized investigators through the Image Data Archive (IDA) [5].

MATLAB

MATLAB (matrix laboratory) is a programming language developed by Math Works. It started out as a matrix programming language where linear algebra programming was simple. It can be run both under interactive sessions and as a batch job. MATLAB is a fourth-generation high-level programming language and interactive environment for numerical computation, visualization and programming. MATLAB is developed by Math Works. It allows matrix manipulations; plotting of functions and data; implementation of algorithms; creation of user interfaces; interfacing with programs written in other languages, including C, C++, and Java [6].

Statistical Parametric Mapping (SPM)

The brain image processing is done using the toolboxes VBM8 and SPM8 in MATLAB. VBM8 toolbox is supported by SPM8. SPM refers to the construction and assessment of spatially extended statistical processes used to test hypotheses about functional imaging data. These ideas have been instantiated in software that is called SPM. The SPM software package has been designed for the analysis of brain imaging data sequences. The sequences can be a series of images from different cohorts, or time-series from the same subject. The current release is designed for the analysis of fMRI, PET, SPECT, EEG and MEG.

Voxel-Based Morphometry (VBM)

It is a neuroimaging analysis technique that allows investigation of focal differences in brain anatomy, using the statistical approach of statistical parametric mapping. In traditional morphometry, volume of the whole brain or its subparts is measured by drawing regions of interest (ROIs) on images from brain scanning and calculating the volume enclosed. However, this is time consuming and can only provide measures of rather large areas. Smaller differences in volume may be overlooked. VBM registers every brain to a template, which gets rid of most of the large differences in brain anatomy among people. Then the brain images are smoothed so that each voxel represents the average of itself and its neighbors. Finally, the image volume is compared across brains at every voxel. However, VBM can be sensitive to various artifacts, which include misalignment of brain structures, misclassification of tissue types, differences in folding patterns and in cortical thickness. All these may confound the statistical analysis and either decrease the sensitivity to true volumetric effects, or increase the chance of false positives. For the cerebral cortex, it has been shown that volume differences identified with VBM may reflect mostly differences in surface area of the cortex, than in cortical thickness.

Proposed Algorithm

The main objective of our project is to detect the Alzheimer's disease at its earlier stage. The project uses the utility of image processing on the Magnetic Resonance Imaging (MRI) scans to estimate the possibility

ISSN: 2277-9655
Impact Factor: 5.164
CODEN: IJESS7

of an early detection of AD**.** Initially the data sets (T1 weighted MRI scans) are obtained from the ADNI and these MRI scans obtained are subjected to pre-processing using theVBM8 toolbox in MATLAB which helps for the voxel based morphometry of the MRI. The obtained pre-processed MRI is further subjected to feature extraction. The appropriate features are selected and further subjected to classification. The proposed approach uses feature extraction using DWT and PCA and the classification is further carried out using the SVM technique. And thus the early stage of Alzheimer's disease can be detected [3].

Pre-processing

The MRI images obtained from ADNI are subjected to pre-processing. The MRI images where undergone the pre-processing using VBM8 toolbox. They are segmented as grey matter and white matter. These images were further smoothed.

DWT

By using Discrete Wavelet Transform (DWT), it overcomes the negatives seen in the Fourier transform analysis and DWT also helps in finding and recognizing the discontinuity point that is present in an image. The local frequency information of the MRI image is obtained through DWT [3].

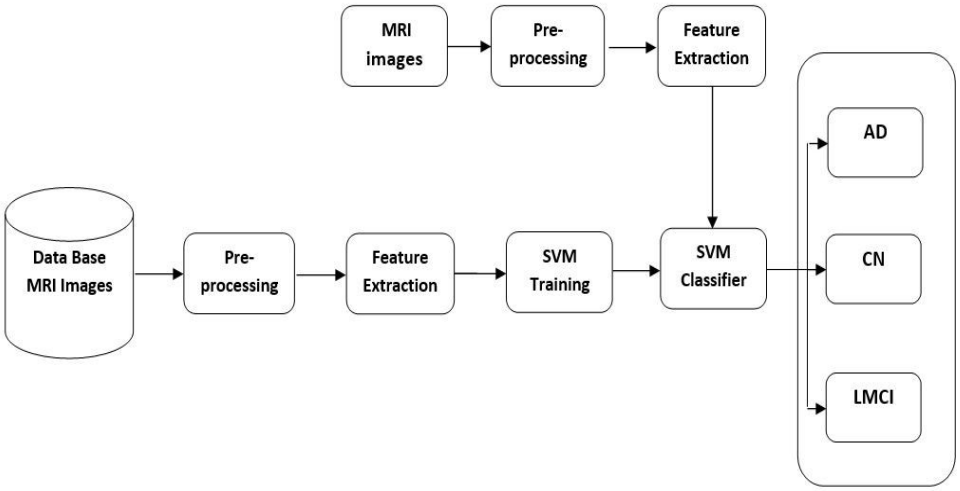
PCA

Principal Component Analysis (PCA) is a method used for feature extraction. It includes principal component and principal coefficients. PCA is carried out on the MRI image and the result is a set of principal components with non-zero Eigen values. Thus, the obtained principal components are sorted in descending order with respect to its variance [3].

Classification

Classification is performed to identify the classes. Based on the decision plane, Support Vector Machine (SVM) classifies the data into two classes. The classification is carried out to classify different groups that are labeled in binary. The two sets of classes are separated using the decision boundary. The operation of the hyperplane is to give the consideration of the largest minimal distance that can possibly exist between the two different classes. SVM uses a linearly separable classifier to classify the data [3].

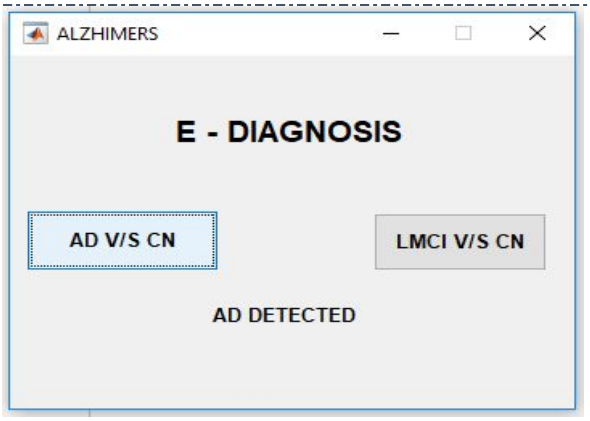
Figure: **1**



Block diagram of the proposed algorithm

Figure: **2**

ISSN: 2277-9655
Impact Factor: 5.164
CODEN: IJESS7



Output shown in GUI

III. RESULTS AND DISCUSSION

An approach for early detection of AD has been proposed based on image processing techniques such as preprocessing, feature extraction & classification based on grey matter volume which is considered as strong diagnostic test for AD. The use of linear classifier has made the classification more accurate. The dataset is trained to form the base of classifier and the different stages of Alzheimer's disease are identified. To make this system more user friendly it is implemented on Graphical User Interface (GUI). The use of image processing for medicinal diagnosis and research is extensively growing and thus improving the lives of aged people.

Tables:

Table 1: Data of the Participants Use

SL.NO.	GROUP TYPE	NO. OF SUBJECTS	AGE MEAN	MMSE SCORE MEAN
1.	CN	10	72.69	28.5
2.	LMCI	10	78.44	22.6
3.	AD	11	77.89	28.5

IV. CONCLUSION

Thus the early diagnosis of Alzheimer's disease is one of the aiding tools which open a wide scope in medical field for the better development & progress in the diagnostic approach of Alzheimer's disease. So that, along with welfare enhancement of patients both the medical field also could be enriched. This proposed system helps the individuals to aware about the disease and take possible measurements at the earliest. As well as make use of MRI image and undergo a series of preprocessing using VBM8 Toolbox and feature is extracted using DWT coupled with PCA and classified using SVM. Therefore, this algorithm provides a good classification between AD vs. CN and LMCI vs. CN classification.

V. ACKNOWLEDGEMENT

The authors would like to thank everyone who had come forward with their valuable suggestions. They would also like to thank all the tutors who helped and guided in the successful completion of the project and improving the clarity of this article.

VI. REFERENCES

[1] Bethune, Kelly. "Thesis: Diagnosis and Treatment of Alzheimer's Disease: Current Challenges." (2010): 1

[2] Alzheimer's, Association. "2015 Alzheimer's disease facts and figures. "Alzheimer's & dementia: the journal of the Alzheimer's Association 11, no. 3 (2015): 332

[3] *Jesia Mathew, Lasitha Mekkayil, Hariharan Ramasangu, B.Ramaswamy Karthikeyan, Aditya G Manjunath "Robust Algorithm for Early Detection of Alzheimer's Disease using Multiple Feature Extractions"*

[4] *Salvatore, Christian, Antonio Cerasa, Petronilla Battista, Maria C. Gilardi, Aldo Quattrone, Isabella Castiglioni, and Alzheimer's Disease Neuroimaging Initiative. "Magnetic resonance imaging biomarkers for the early diagnosis of Alzheimer's disease: a machine learning approach." Frontiers in neuroscience 9 (2015).*

[5] *http://adni.loni.usc.edu/*

[6] *http://mayankagr.in/images/matlab_tutorial.pdf*