

# Image Processing techniques in Alzheimer Disease Detection

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**Abstract**— This study proposes a new method for the detection of Alzheimer's Disease (AD) using first-order statistical features in 3D brain Magnetic Resonance (MR) images. Alzheimer's disease is a neurodegenerative disorder that affects elderly people. This is a progressive disease and early detection and classification of AD can majorly help in controlling the disease. Recent studies use voxel-based brain MR image feature extraction techniques along with machine learning algorithms for this purpose. Grey and white matter of the brain gets affected and damaged due to AD and so studying these both prove to be more effective in predicting the disease. In this article, this study proposes a new method for the detection of Alzheimer's Disease in brain Magnetic Resonance (MR) images. Alzheimer's disease is a neurodegenerative disorder that affects elderly people. A brain MR image feature extraction technique along with machine learning algorithms for this purpose. Grey and white matter of the brain gets affected and damaged due to AD. The proposed work uses 3D structural brain MR images to separate the white and grey matter MR images. In the classification phase, different classifiers take the selected features as its input to predict the classes AD. But here Ensemble method is used. (Alzheimer's Disease) or HC (Healthy Control) based on the observations in the validation set.

## I. INTRODUCTION

Alzheimer's Disease (AD) is a neurodegenerative disease affects primarily the elderly population. It is a progressive disease and the fact that there is no treatment to stop or reverse the progression of the disease. According to the reports from 2005 through 2030, there is a steady growth in the percentage estimate of the number of people affected by AD. Presently 40 million people suffer from AD worldwide. It is distinctly possible to reach 135 million by 2050 . However, an interesting feature of AD is, though incurable, early detection and appropriate treatment of the disease can control the degeneration of neurons. In the current context, Computer-Aided Diagnostics uses advanced computer programs and algorithms in the field of image processing and pattern recognition for identification of Features of Interest or Region of Interest (FOI / ROI) in the MR image under observation.

The world's population is rapidly aging, and the number of people with dementia is expected to grow from 35 million today to 65 million by the year 2030. In the United States alone, 5 million or 1 in 9 people over the age 65 are living with Alzheimer's disease (AD), the most common cause of dementia. For comparison, according to the Centers for Disease Control and Prevention (2009/2012 estimates), about 3 million older adults in the United States have asthma, 10 million have diabetes, 20 million have arthritis, and 25 million have hypertension. Primary care physicians and specialists alike will encounter older adults with dementia at an increasing frequency during their careers. As dementia carries significant implications for patients, their families, and our society, it is imperative for well-rounded physicians to have a solid understanding of this topic. The purpose of this review article is to provide a brief introduction to AD and the related concept of mild cognitive impairment (MCI). The article emphasizes clinical and neurobiological aspects of AD and MCI with which medical students should be familiar. In addition, the article describes advances in the use of biomarkers for diagnosis of AD and highlights ongoing efforts to develop novel therapies.

## II. LITERATURE SURVEY

### *Digital Timely Diagnosis for Alzheimer's Disease: A Literature Review on Benefits and Challenges*

*Dubois B, Padovani A, Scheltens P, Rossi A, Dellagnello G.*

To comprehensively review existing scientific evidence on the benefits and potential challenges of making a timely diagnosis of AD. We believe that timely diagnosis of AD at a time when people first seek for help being worried about changes in cognition, behavior, or functioning not necessarily resulting in dementia, has the potential to reduce the impact of no or delayed diagnosis or misdiagnosis. Timely diagnosis at the prodromal stage of the disease could offer many potential benefits to patients and caregivers, especially the opportunity to obtain treatment to control symptoms, avoid medications that may worsen symptoms, and, possibly in the future, access to interventions that slow or lessen the disease process. Patients could put into

place advance care planning and make end-of-life decisions, consider changing unhealthy lifestyles, and seek better medical care. The findings of this literature review show that, at the current time, these ideas are mainly based on expert opinion and perhaps belief; evidence is lacking, and further studies are needed to demonstrate not only that a timely diagnosis is feasible, but also that it has benefits. Such evidence would support the cultural shift towards diagnosis at the pre-dementia stage of AD.

### ***The Critical Need to Promote Research of Aging and Aging-Related Diseases to Improve Health and Longevity of The Elderly Population***

*Jin K, Simpkins JW, Ji X, Leis M, Stambler I (2015).*

Due to the aging of the global population and the derivative increase in aging-related non-communicable diseases and their economic burden, there is an urgent need to promote research on aging and aging-related diseases as a way to improve healthy and productive longevity for the elderly population. To accomplish this goal, we advocate the following policies:

- 1) Increasing funding for research and development specifically directed to ameliorate degenerative aging processes and to extend healthy and productive lifespan for the population;
- 2) Providing a set of incentives for commercial, academic, public and governmental organizations to foster engagement in such research and development; and
- 3) Establishing and expanding coordination and consultation structures, programs and institutions involved in aging-related research, development and education in academia, industry, public policy agencies and at governmental and supra-governmental levels.

### ***NMF-SVM based CAD Tool Applied to Functional Brain Images for The Diagnosis Of Alzheimer's Disease.***

*Padilla P, Lpez M, Grriz JM, Ramirez J, Salas-Gonzalez D, Alvarez I. 2011*

This paper presents a novel computer-aided diagnosis (CAD) technique for the early diagnosis of the Alzheimer's disease (AD) based on nonnegative matrix factorization (NMF) and support vector machines (SVM) with bounds of confidence. The CAD tool is designed for the study and classification of functional brain images. For this purpose, two different brain image databases are selected: a single photon emission computed tomography (SPECT) database and positron emission tomography (PET) images, both of them containing data for both Alzheimer's disease (AD) patients and healthy controls as a reference. These databases are analyzed by applying the Fisher discriminant ratio (FDR) and nonnegative matrix factorization (NMF) for feature selection and extraction of the most relevant features. The resulting NMF-transformed sets of data, which contain a reduced number of features, are classified by means of a SVM-based classifier with bounds of confidence for decision. The proposed NMF-SVM method yields up to 91% classification accuracy with high sensitivity and specificity rates (upper than 90%). This NMF-SVM CAD tool becomes an accurate method for SPECT and PET AD image classification.

### ***Automated Diagnosis of Alzheimer's Disease Using Gaussian Mixture Model Based On Cortical Thickness.***

*Song S, Lu H, Pan Z. (2012)*

Alzheimer disease (AD) is known as the most common form of dementia, which imposes a considerable burden on society. In this paper, we focus on the automated diagnosis of Alzheimer disease. Based on the researches on neuropathology, we adopt the thickness of cortex regions from the magnetic resonance imaging (MRI) to characterize the pathology of AD. 3D reconstruction technique is utilized to extract feature vectors from the structured MRI data. To improve the classification quality of our method, we proposed a new classification method which is Based on the combination of SVM and Adaboost. Experiment results show that our method performs well, and can reaches higher classification accuracy than classical classification methods such as k-Nearest Neighbor (KNN), Linear Discriminant Analysis (LDA), Support Vector Machine (SVM), and Gaussian mixture model (GMM).

### ***A Bayesian Framework Based on A Gaussian Mixture Model and Radial-Basis-Function Fisher Discriminant Analysis (Baygmmkda VI. 1) For Spatial Prediction of Floods***

*Bui DT, Hoang ND (2009)*

In this study, a probabilistic model, named as BayGmmKda, is proposed for flood susceptibility assessment in a study area in central Vietnam. The new model is a Bayesian framework constructed by a combination of a Gaussian mixture model (GMM),

radial-basis-function Fisher discriminant analysis (RBFDA), and a geographic information system (GIS) database. In the Bayesian framework, GMM is used for modeling the data distribution of flood-influencing factors in the GIS database, whereas RBFDA is utilized to construct a latent variable that aims at enhancing the model performance. As a result, the posterior probabilistic output of the BayGmmKda model is used as flood susceptibility index. Experiment results showed that the proposed hybrid framework is superior to other benchmark models, including the adaptive neuro-fuzzy inference system and the support vector machine. To facilitate the model implementation, a software program of BayGmmKda has been developed in MATLAB. The BayGmmKda program can accurately establish a flood susceptibility map for the study region. Accordingly, local authorities can overlay this susceptibility map onto various land-use maps for the purpose of land-use planning or management.

### **Problem Definition**

- In our Existing method, to detect the disease based on the Machine Learning techniques , some concept is implemented.
- All the three different views of slices ( Axial, Sagittal, and Coronal ) of gray matter and the white matter has been used for this study.
- Some Image processing Techniques is used to predict the disease not in accurate way.
- The experimental results show that minimum accuracy.

### **Drawbacks**

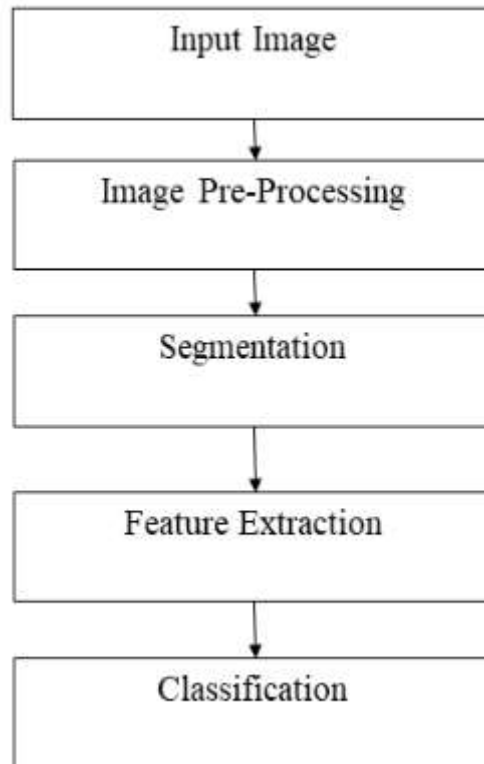
- Poor illumination condition.
- Noisy texture background.
- Inaccurate
- Segmentation not in proper way
- Low performance
- Inefficiency

## **III. PROPOSED WORK**

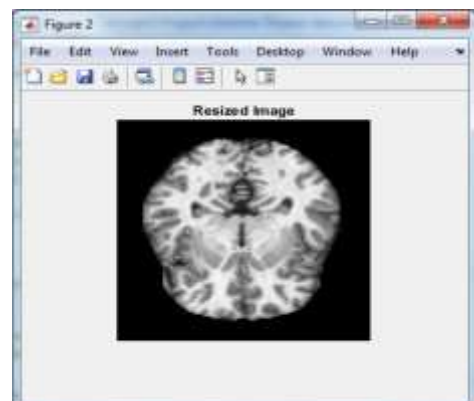
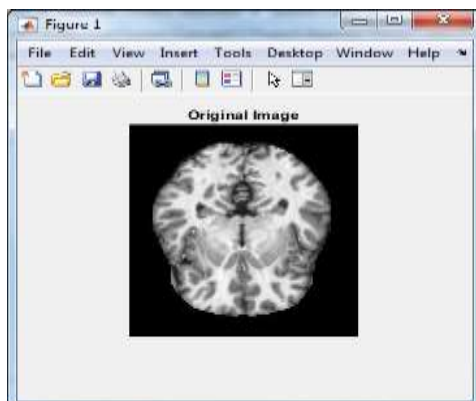
- In our Proposed method, the paper describes the based-on image processing techniques.
- Here, Machine Learning Techniques is used to predict the disease.
- In Preprocessing the, Gaussian filter is used.
- Segmentation, FCM techniques is used.
- An Ensemble model is used in the Classification part of the system.
- Some Technique is used to predict the disease. They are preprocessing, segmentation, Feature extraction, classification.
- Experimental results obtained the better performance when compared to existing method.

### **Advantages**

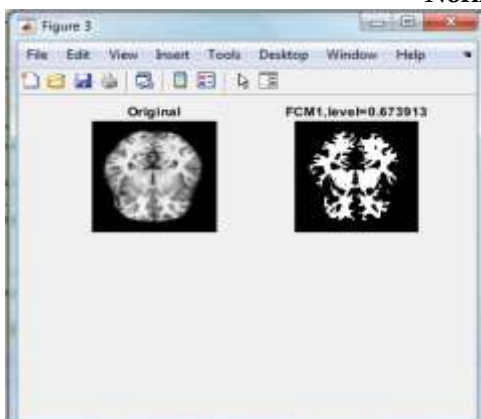
- Better Performance.
- Accuracy is more
- Precision is more



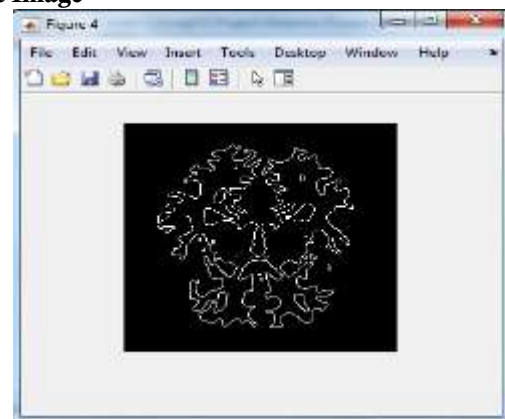
#### IV. IMPLEMENTATION



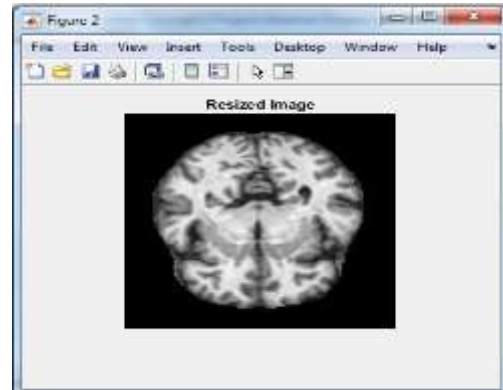
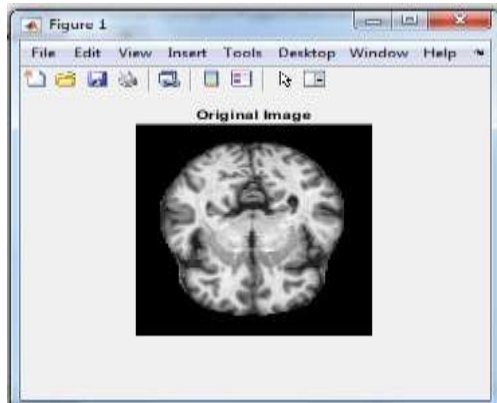
Normal Case: Input Image



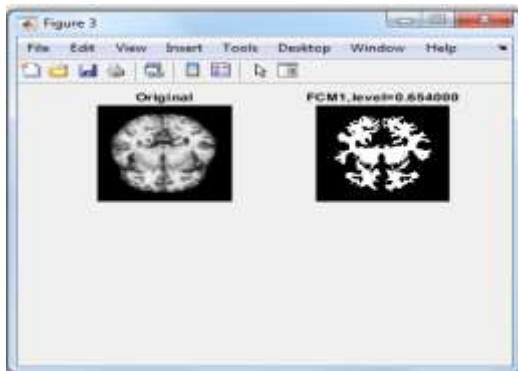
Segmentation



Edge Detection

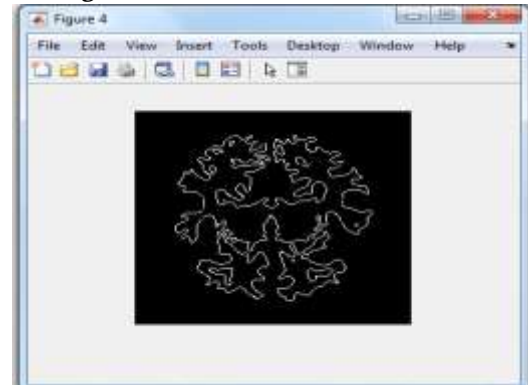


**Abnormal Case: Input Image**



**Segmentation**

```
Normal
accuracy =
1
```



**Edge Detection**

```
Abnormal
accuracy =
0.9971
```

## V. CONCLUSION

Alzheimer’s Disease (AD) is a neurodegenerative disease affects primarily the elderly population. It is a progressive disease and the fact that there is no treatment to stop or reverse the progression of the disease. According to the reports from 2005 through 2030, there is a steady growth in the percentage estimate of the number of people affected by AD. Presently 40 million people suffer from AD worldwide. It is distinctly possible to reach 135 million by 2050. However, an interesting feature of AD is, though incurable, early detection and appropriate treatment of the disease can control the degeneration of neurons. In our article method, the paper describes the based-on image processing techniques. Here, Machine Learning Techniques is used to predict the disease. In Preprocessing the, Gaussian filter is used. Segmentation, FCM techniques is used. An Ensemble model is used in the Classification part of the system. Some Technique is used to predict the disease. They are preprocessing, segmentation, Feature extraction, classification. Experimental results obtained the better performance when compared to existing method.

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