Enhancing Alzheimer's Disease Detection Through Advanced Image Processing Techniques

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Abstract— This study proposes a new method for Alzheimer's Disease detection using 3D brain MR images and first-order statistical features. Alzheimer's is a progressive neurodegenerative disorder affecting the elderly. The method focuses on extracting features from grey and white matter to predict AD using ensemble classifiers.

I.   INTRODUCTION

Alzheimer's Disease (AD) is a progressive neurodegenerative condition affecting primarily the elderly, with no known cure. Early detection is crucial for managing the disease. Computer-Aided Diagnostics utilizes advanced algorithms for identifying Features of Interest in MR images. As the global population ages, dementia cases, including AD, are expected to rise significantly. This review provides insights into AD and mild cognitive impairment (MCI), emphasizing clinical aspects, biomarkers for diagnosis, and ongoing therapeutic developments.

II.   LITERATURE SURVEY

2.1   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 summarize existing research on the advantages and potential obstacles of diagnosing AD in a timely manner. Early diagnosis, especially during the prodromal stage, could provide several benefits such as symptom management, avoiding harmful medications, and facilitating access to potential interventions. However, current evidence supporting these benefits is limited, highlighting the need for further studies to validate the feasibility and advantages of early diagnosis in AD.

2.2   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.

2.3   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 introduces a new CAD method for early Alzheimer's disease diagnosis, using NMF and SVM with confidence bounds. Functional brain images from SPECT and PET databases are analyzed with FDR and NMF for feature selection. The reduced feature sets are classified using SVM with high accuracy (up to 91%) and sensitivity/specificity rates (>90%), making it an effective tool for AD image classification.

2.4   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).

2.5   A Bayesian Framework Based on A Gaussian Mixture Model and Radial-Basis-Function Fisher Discriminant Analysis (Baygmmkda V1. 1) For Spatial Prediction of Floods

Bui DT, Hoang ND (2009)

In this study, BayGmmKda, a probabilistic model, is proposed for flood susceptibility assessment in central Vietnam. It combines GMM, RBFDA, and GIS data to generate a flood susceptibility index. Results show its superiority over other models, aiding land-use planning. A MATLAB software program, BayGmmKda, has been developed for implementation.

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.

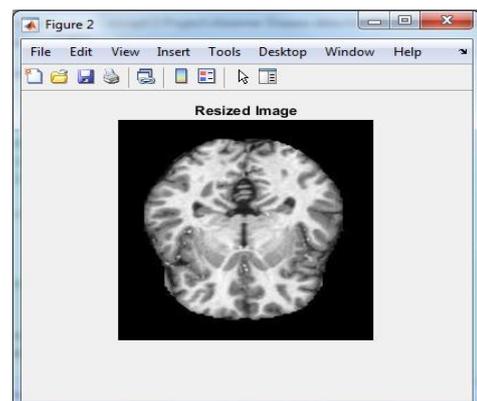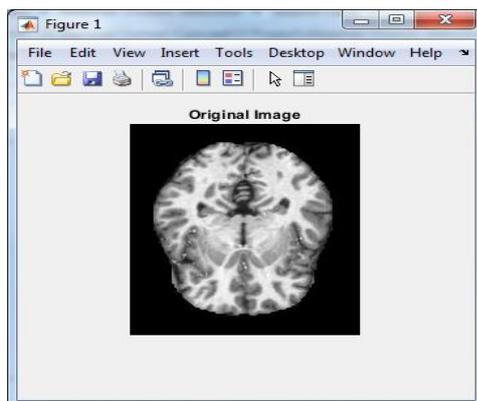- Experimental results obtained the better performance when compared to existing method.
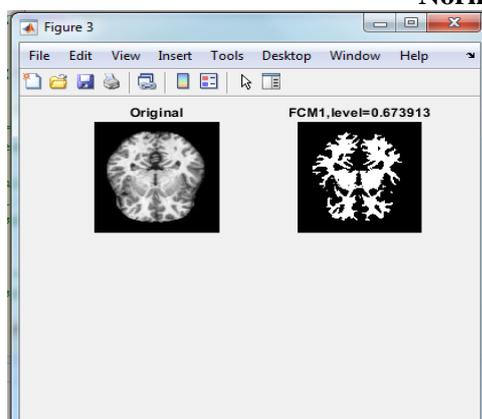
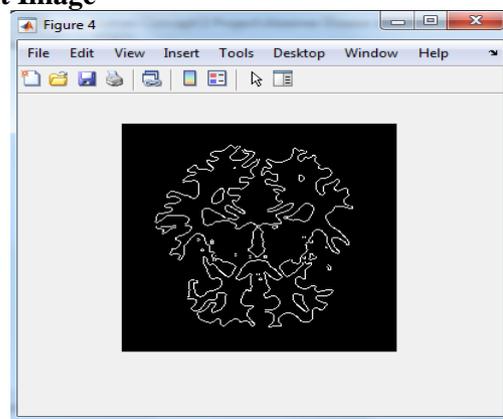**Advantages**

- Better Performance.
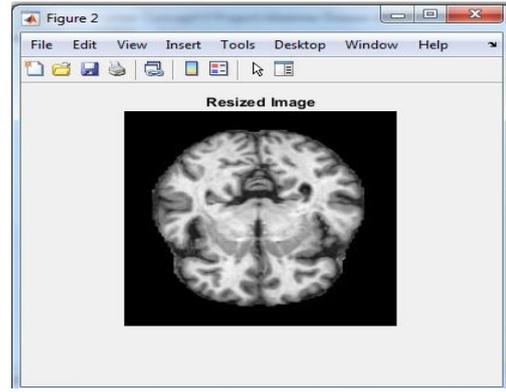
- Accuracy is more

- Precision is more
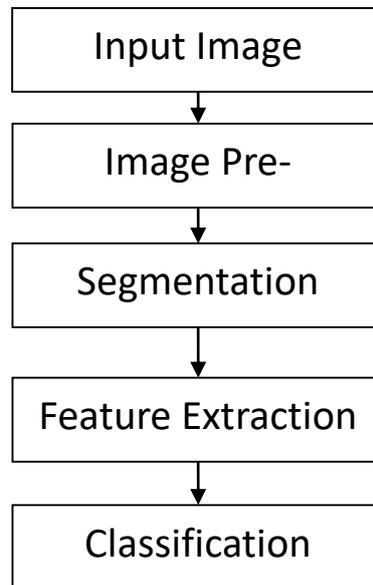
IV.   IMPLEMENTATION

Normal Case: Input Image

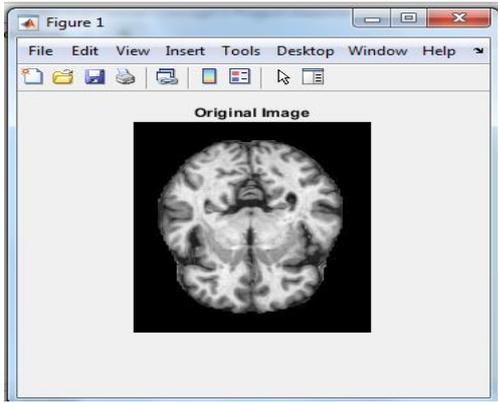**Segmentation**   **Edge Detection**
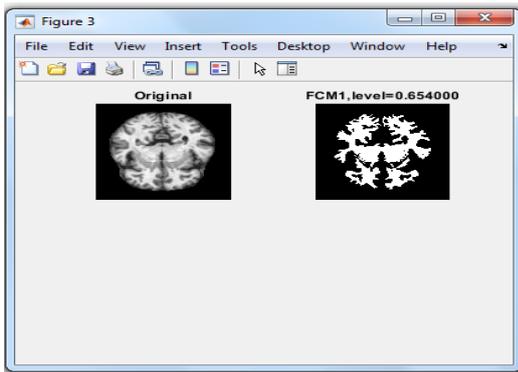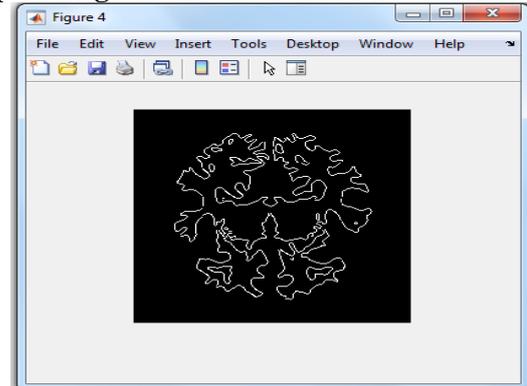
Abnormal Case: Input Image

Segmentation   **Edge Detection**

```
Normal

accuracy =

      1
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Abnormal

accuracy =

   0.9971
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V.   CONCLUSION

Alzheimer's Disease (AD) affects the elderly and lacks a cure. With cases set to rise, early detection is crucial. Our article proposes an image processing-based method using Machine Learning Techniques. Gaussian filtering is applied in preprocessing, FCM in segmentation, and an Ensemble model in classification. Results show improved performance compared to existing methods.

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