



## HIERARCHICAL FEATURE EXTRACTION FOR EARLY ALZHEIMER'S DISEASE DIAGNOSIS

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**Abstract** – There are one-of-a-kind ranges of Alzheimer's sickness. In our paper we've got proposed a way to locate the ones having slight cognitive impairment (MCI) that's on the early level of Alzheimer's sickness (AD). We have proposed a singular voxel-primarily based totally hierarchical characteristic extraction (VHFE) technique for the early alzheimer's sickness diagnosis. Firstly, we've got parcellate the complete mind into numerous areas of interest (ROIs). Then, the mind characteristic maps of every issue made from the fetched voxels and are fed into the convolutional neural network (CNN) to analyze the deeply hidden capabilities of the mind. Finally, to check the performance of our proposed technique, we take a look at it with the subset of the database.

**Keywords:** Alzheimer's, ADNI, fMRI, Deep-Learning, Featureextraction, Data Processing.

### I. INTRODUCTION

Alzheimer's disorder is a neurodegenerative disorder, it's miles very gradual withinside the starting however it catches tempo with time. Although Alzheimer's disorder is hard to stumble on withinside the preliminary ranges the use of MRI, groundbreaking improvements are completed the use of PET test images. Almost 1.60% of deaths in India arise because of Alzheimer's disorder. In the studies papers that we've got accumulated, the bulk of class is completed via way of means of searching at the buildup of amyloid beta protein withinside the hippocampus. There are many device algorithms used to categorise or stumble on the ranges. Some of them are Deep Learning which incorporates Back

propagation algorithm, Convolutional neural community of Inception V3 structure and so on.

In the USA of America about 5.eight million those who are sixty five years or older ail from Alzheimer's disorder. 60 % to 70 % of the overall international populace that is 50 million with dementia are stated to have Alzheimer's disorder.The onset of dementia is recognized via way of means of signs which encompass forgetting conversations and current events. As the disorder advances the man or woman with Alzheimers will lose the capacity to carry out each day duties and will broaden reminiscence impairment which may be excessive. Conditions of sufferers taking medicinal drugs may enhance barely or development of signs is probably slowed down. As a end result of this the affected person may have a experience of independence and their capabilities to carry out features may be maximized. There had been many camps and offerings and applications which might be being held everywhere in the international to offer a few consolation to the Alzheimer's sufferers. Currently no remedy for Alzheimer's disorder has been determined that could remedy Alzheimer's disorder or adjust the manner of disorder withinside the mind. Dehydration, contamination that could result in loss of life and malnutrition are a number of the headaches that could arise because of excessive lack of mind function.Functional magnetic resonance imaging (fMRI) measures the small adjustments in blood waft that arise with mind activity. It can be used to study the mind's purposeful anatomy, (decide which components of the mind are dealing with crucial features), examine the results of stroke or different disorder, or to manual mind remedy. fMRI can also additionally stumble on abnormalities withinside the mind that can't be determined with

different imaging techniques.

## II. PROBLEM DESCRIPTION

To develop software built using CNN to perform multi-class classification of the MRI images that will detect the presence and severity of Alzheimer's disease in the early stages of the entire diagnosis procedure."

- Input : MRI Scan
- Output : Diagnostic and Severity of Alzheimer's Disease

## III. RELATED WORK

[1] The Author visualized 3D Structural MR-Images in 3 perpendicular planes namely Axial, Coronal, Sagittal planes. They have done feature extraction based on first order statistics for gray matter and white matter of all three orthogonal images. After that they calculated Co-relation matrix for feature Extraction and for feature reduction they used PCA(Principal Component Analysis). Finally they did binary classification using SVM(Support Vector Machine), AdaBoost, Naïve Bayes and logistic Regression classifiers. They achieved accuracy of 99.9% on white matter using naïve bayes classifier.

[2] Optical Character Recognition system (OCR) can The Author have used 3D Structural MR-Images to get away from information loss which occur during 3D image slicing into 2D. For this research work they have used ADNI and OASIS both publicly available datasets they build 3D VGG variant CNN(Convolutional Neural Network).For binary classification of Alzheimer's and achieved accuracy of  $73.4\% \pm 0.04$ (mean, standard deviation) and  $69.9\% \pm 0.06$ (mean, standard deviation) on ADNI and OASIS dataset respectively. [3]The proposed method uses a deep learning algorithm to extract features from magnetic resonance imaging (MRI) scans of the brain. The features are then combined using a hierarchical approach to obtain a comprehensive representation of the brain. The authors evaluate the proposed method on a dataset of MRI scans from patients with Alzheimer's disease and healthy controls. The results show that the proposed method outperforms existing methods for Alzheimer's disease diagnosis, achieving an accuracy of over 90%. Overall, this paper presents a promising approach for early diagnosis of Alzheimer's disease using hierarchical feature extraction techniques. The proposed method has the potential to improve the accuracy and reliability of Alzheimer's disease diagnosis, and could ultimately lead to better treatment and management of this debilitating condition.[4] The Author have used 3D CNN to FDG and AV-45 PET images for classification of AD/NC. After training this network Author gave MCI subject images as input to predict whether MCI subject will develop a AD in future. This method achieve accuracy of 96% for AD/NC and 84.2% for MCI to AD converting subject.[5]The Author have proposed to combine transfer learning

on 2D CNN with LSTM (Long Short Term Memory) network. Pretrained CNN was used to extract feature for MR Images and LSTM is used to include spatial dependency across the MRI slices.[6]The Author used deep convolutional neural network (DCNN) to extract the most useful features of the structural magnetic resonance imaging (MRI). Firstly, the structural MRIs are pre-processed in a strict pipeline. Then, instead of parcellating regions of interest, we re-slice each volume, and put the resliced images into a DCNN directly. Finally, four stages of Alzheimer's are identified, and the average accuracy is 94.5% for NC versus LMCI, 96.9% for NC versus AD, 97.2% for LMCI and AD, 97.81% for EMCI versus AD, 94.8% for LMCI versus EMCI. The results show that the DCNN outperforms existing methods.[7]The proposed method is that the 3D images are given as input(axial Sagittal or Coronal) slices at a time, each slice is the like a pixel of an image (176x220) axial slice dimension. They applied PCA+TSNE for dimension reduction, as this becomes highly complex for classification. The reduced dimension now becomes into an  $609 \times 3 = 1827$  for single RAW MRI scan the above dimension are obtained by a generated CNN features. So the Output results will be 2 different working principles to be compared, Navies Bayes and KNN, whichever has the highest accuracy among them will be the output. In this case, the Trained CNN with the proposed idea has the highest accuracy with 88.2%. [8] DATASET is used for preprocessing. The data used consists of MRI images of the brain in DICOM format which is collected from (ADNI) database. The images are MRI, fMRI, PET, which is one of the functions used in the deep learning approach. This is used to insert non-linearity into the network to offer better performance. The pre-trained networks(softmax layer) is used for performance comparison are AlexNet(25 layered network which is 8 layers deep), ResNet-18(18 layers), and GoogLe Net(144layers). The satisfactory within a minimum span of time is the network which is selected. The training, testing, and Classification are carried out in GPU platform. The final output is compared and the true positive, true negative, false positive, false negative are the values obtained from the confusion charts used to find the other performance metrics like recall, specificity and prediction, and score. So the Final output is converted to RGB format. AlexNet being the smallest, Resnet-18 and GoogLe Net with the same performance but shows that has attained the optimum value of accuracy.[9]30 2D slices in the axial plane located above the eye is selected for each visit examination for every subject these images are directly given as input to CNN for feature extraction. After feature extraction, random forest, SVM, KNN where used for AD classification accuracy of this method is 0.88%, 0.95% and 0.85% for random forest, SVM and KNN respectively. Images used for this work was obtained from MIRIAD dataset.

## IV. IMPLEMENTATION

Implementation is the process of converting a new system design into an operational one. It is the key stage in achieving a successful new system. It must therefore be carefully planned and controlled. The implementation of a system is done after the development effort is completed.

### Modules

- Image Collection
- Image Preprocessing
- Image Segmentation
- Featur Extraction
- Training
- Classification

### Modules description

- **Image Collection**

The dataset that we have used in this project is available publicly on the internet (<https://www.kaggle.com/datasets>). The website has images of various types of Alzheimer's disease while we use Alzheimer's dataset. Input to proposed system is Classification of Scan images, MRI brain images are images taken. It is kind of magnifier used to take pictures of MRI brain Images.

- **Image Preprocessing**

Goal of pre-processing is an improvement of image data that reduces unwanted distortions and enhances some image features important for further image processing. Image pre-processing involves three main things

- a) Gray scale conversion
- b) Noise removal
- c) Image enhancement

a) Grayscale conversion:

Grayscale image contains only brightness information. Each pixel value in grayscale image corresponds to an amount or quantity of light. The brightness graduation can be differentiated in grayscale image. Grayscale image measures only light intensity 8 bit image will have brightness variation from 0 to 255 where '0' represents black and '255' represent white. In grayscale conversion color image is converted into grayscale image

shows. Grayscale images are easier and faster to process than colored images. All image processing technique are applied on grayscale image.

### b) Noise Removal

The objective of noise removal is to detect and remove unwanted noise from digital image. The difficulty is in deciding which features of an image are real and which are caused by noise. Noise is random variations in pixel values.

We are using median filter to remove unwanted noise. Median filter is nonlinear filter, it leaves edges invariant. Median filter is implemented by sliding window of odd length. Each sample value is sorted by magnitude, the centermost value is median of sample within the window, is a filter output.

### c) Image Enhancement:

The objective of image enhancement is to process an image to increase visibility of feature of interest. Here contrast enhancement is used to get better quality result.

- **Image Segmentation**

The next step after image pre-processing was to segment the Alzheimer's disease area from the surrounding MRI Images. A black and white image was produced with its contrast adjusted to provide better segmentation. situations.

- **Feature Extraction**

TensorFlow is a popular machine learning Feature extraction plays an important role in extracting information present in given image. are using GLCM for texture image analysis. GLCM is used to capture spatial dependency between image pixels. GLCM works on gray level image matrix to capture most common feature such as contrast, entropy, energy, homogeneity, correlation, ASM.

- **Training**

Training dataset was created from images of known Alzheimer's stages. Classifiers are trained on the created training dataset. Testing dataset is placed in a temporary folder. Predicted results from the test case, Plots classifiers graphs and add feature-sets to test case file, to make image processing models more accurate.

- **Classification**

The binary classifier which makes use of the hyper-plane which is also called as the decision boundary between two of the classes is called as Convolution Neural Network. Some of the problems are pattern recognition like texture classification makes use of CNN. Mapping of nonlinear input data to the linear data provides good classification in high dimensional

space in CNN. The marginal distance is maximized between different classes by CNN. Different Kernels are used to divide the classes. CNN is basically binary classifier which determines hyper plane in dividing two classes. The boundary is maximized between the hyper plane and two classes. The samples that are nearest to the margin will be selected in determining the hyper plane is called support vectors.

## V. CONCLUSION

In this project, we have proposed software to detect Alzheimer's from MRI scans and differentiate between different levels of severity of Alzheimer's to assist doctors in early diagnosis. An automated machine learning tool for the prediction of Alzheimer's disease using a deep learning algorithm has been successfully designed and implemented by this work. The performance levels of CNN models were also examined. Deep learning shows high accuracy level of about 80-90% in Alzheimer's disease prediction.

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