Detection and Classification of Alzheimer's Disease Using Machine Learning

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***Abstract*- Alzheimer's disease is neurodegenerative disorder which will be caused by progressive death of brain cells. The identification of Alzheimer's disease (AD) has developed as the most challenging problem in medical area. This paper offers a new segmentation method which is called region masking for selecting the useful properties of affected parts in the human brain for improving the accuracy of diagnosis for Alzheimer's disease. Therefore, attributes of assembled data sets can make better correctness of classification and are selected by using region masking. The data set which contains more number of normal and Alzheimer's disease subjects is considered. The empirical results show that the proposed methods significantly increase the degree of correctness of the diagnosis of Alzheimer's disease in comparison with previous methods.**

***Index terms*- Alzheimer's disease, Region Masking, MRI, GLCM, LBP, ANN**

I.INTRODUCTION

The problems connected with growing population is becoming increasingly sincere as people live for longer period and the rate of fertility reduces in most countries. Moreover, because of greater part of individuals are elderly, more people are at high risk of developing dementia. Currently, nearly 47 million people worldwide live with dementia, and this count is adopted to rise above 131 million by 2050[11].Alzheimer's disease (AD) is the most common pattern of dementia examined in aging people and significantly reduces their quality of life. The precise and early diagnosis is essential for opportune treatment and risk reduction. Over the past decade, several imaging modalities have been used in Alzheimer's disease diagnosis, including diffusion tensor imaging (DTI) structural magnetic resonance imaging (MRI) and positron emission tomography (PET)[12]. MRI can detect brain abnormalities associated with mild cognitive impairment and can be used to predict which patients with mild cognitive impairment (MCI) eventually develop Alzheimer's disease. This study inquired machine learning perspective to use clinical data to predict the development of Alzheimer's disease in future years.

II. EXISTING METHOD

Alzheimer's disease classification done by using the modified subspace alignment algorithm. Alzheimer's disease classification duty using a small dataset can be efficiently estimated using the modified subspace alignment method. This method can efficiently improve the accuracy of the classification in small sample sets. Researchers can utilize this method to replace the provocation of extremely limited sample size, particularly when collecting neuroimaging data is complex and computer- aided diagnoses with restricted samples are required and the main disadvantage of this method is, it is suitable for only small datasets whereas the complex datasets are not applicable [17]. Classification based on multiple kernel learning algorithms seems to be less interpretable and much expensive [7]. Multivariate ROC provides improved classification than univariate ROC [8]. Compared to low pass filter used in preprocessing median filter is better in conserving sharp edges [9]. Multivariate statistical machine learning technique is used for classification [10].

III. PROPOSED METHOD

The proposed work includes four different phases. The first important phase is to read the input image

from dataset. The second step is the preprocessing in that median filter is used to remove noise and to enhance the contrast of the input image. The major step is the third step which is the segmentation process and here we use region masking segmentation process which gives the affected area. The fourth step is the feature extraction which comprises of LBP and GLCM. The final step is the classification using ANN method.

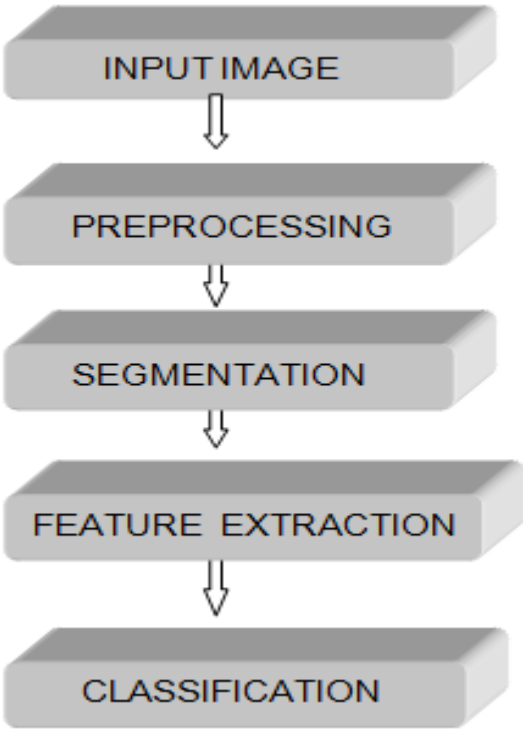

Fig. 1. Block diagram of proposed method

A. MEDIAN FILTERING

The first process in the preprocessing step is the median filtering. The median filter is a nonlinear technique, often used to remove noise from an image. Such noise reduction is a typical pre- processing step to improve the results of later process. It is useful in reducing impulsive or salt-and-pepper noise. The median filter is also used to conserve edge properties while reducing the noise. The median filter is widely used in digital image processing just because it preserves edge attributes the median filter accounts all pixels in the image and looks at nearby neighbors to decide whether or not it is typical of its surroundings. Instead of simply returning the pixel value with the average of neighboring pixel values, it replaces it with median of those values.

B. REGION MASKING

Region masking exists as an algorithm for image segmentation. The region masking is the part of the image that we need to filter or accomplish some action on. region masking defined by the binary mask, and that is a binary image which is in a similar size as the image wants to progress with pixels that represent the region of interest put to 1 and all the rest pixels put to 0 many ROI can be defined in an image[13].

C. FEATURE EXTRACTION

In image processing, after pre-processing, preferred extent of segmentation has been attained, and then a certain feature extraction approach is employed to the segments to acquire features. It is a kind of dimensionality contraction that adequately constitutes interesting sectors of an image as a compressed feature vector. This technique is considerable when image dimension is large and compressed feature description is essential to quickly fulfill chores such as image matching and recovery. Features perhaps particular form in the image for example edges, objects, or points. GLCM and LBP are effective techniques in feature extraction. The GLCM points to Grey Level Co-occurrence matrix. GLCM is texture nature surface and this surface relate to touch i.e. smooth, silky and rough, etc. GLCM is qualified from grayscale esteem. It is taken into account how frequent a pixel with gray level values come either diagonally, vertically, and horizontally to leveled [14].

GLCM FEATURES

1. Contrast: In contrast measure, weight increases exponentially (0,1,4,9) as persists from the diagonal. Range=[0,size(GLCM,1)-1)^2]

The equation of contrast is

$$\sum_{I,J=0}^{N-1} Pi,j(i-J)\text{^}2$$

2. Correlation: Range=[-1,1] and the formula is

$$\sum_{I,J=0}^{N-1} Pi,j[\frac{(i-\mu i)(j-\mu j)}{\sqrt{(\sigma i^2)}(\sigma j^2)}$$

3. Energy: Its range is [0,1]. The equation of Energy is

$$\sum_{I,J=0} P(i,j)\text{^}2$$

4. Homogeneity: The equation of homogeneity is

$$\sum_{i,j=0}^{N-1} P(i,j)/R$$

LOCAL BINARY PATTERN

Local binary pattern is a uncomplicated besides well assembled texture. LBP characteristic vector, returned as a 1-by -N vector of length N significance the amount of features. LBP features encrypted local texture statistics. LBP which mark the pixels of an image by approaching the neighborhood of each pixel and considers the outcome as a binary number

D. CLASSIFICATION

Artificial neural networks (ANN) consider classification as one of the most effective research and application field. ANN is the branch of Artificial Intelligence. Artificial neural network (ANN) remains the estimated model depend on the structure and role of biological neural networks. ANNs are non-uniform statistical data modeling implementation in which the compound correlation between input and outputs are designed or samples are established [15]. An artificial neural network is a try to replicate the convolution of neurons in the human brain consequently the computer will be able to learn things and make decisions in a humanoid way [16]. ANNs are designed by organized systematic computers to act like they are interlinked neurons. ANN possess the control to study and represent irregular and complicated relationships, and that is certainly essential over in real life, some of the links within inputs and outputs are unpredictable inclusive of the compound. Artificial neural networks collect the input signal from the outer world in the model of pattern and image in the form of vector. All of the input is then increased by its comparable weights (these weights are the features given by the artificial neural networks to solve a definite issue).

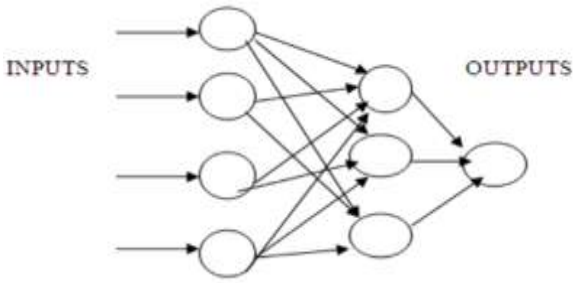

Fig. 2. Artificial neural network

IV. RESULT

ANN makes effective classification in Alzheimer's disease. The affected area that is to be identified is successfully obtained by applying pre- processing techniques to the input MRI brain scan followed by the region masking segmentation process. The output is given below according to the flow of the project.

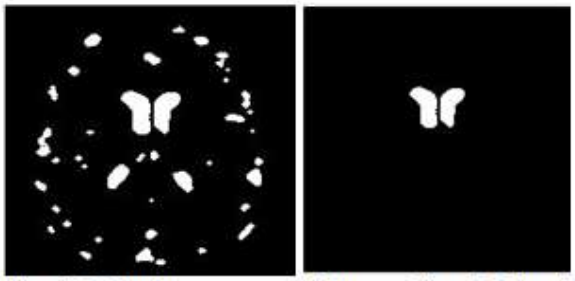

Fig. 3.I Border corrected image Fig. 3.J Small objects removed image

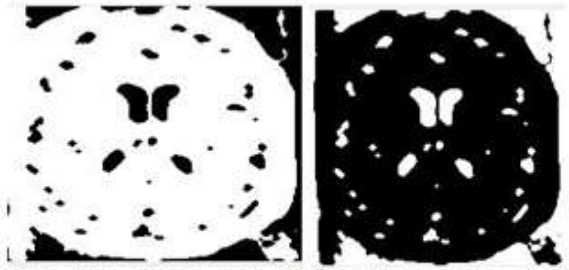

Fig. 3.G Black and White image Fig. 3.H Complement image

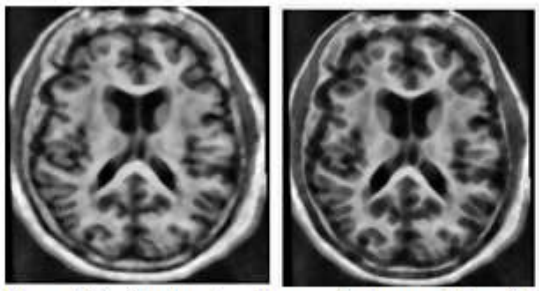

Fig. 3.E Contrast enhanced image Fig. 3.F Skull masked image

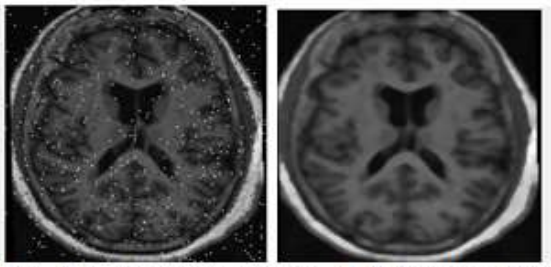

Fig. 3.C Noise image Fig. 3.D Median filter image

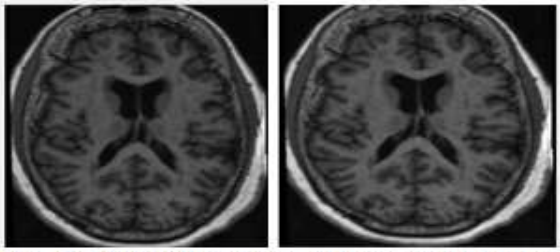

Fig. 3.A Input image Fig. 3.B Gray scale image

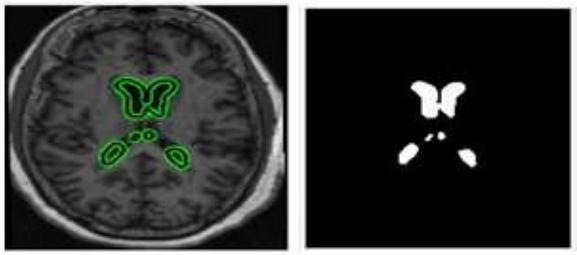

Fig. 3.K Disease area Segmentation Fig. 3.L Holes filled image

Fig. 3.M Dilated image

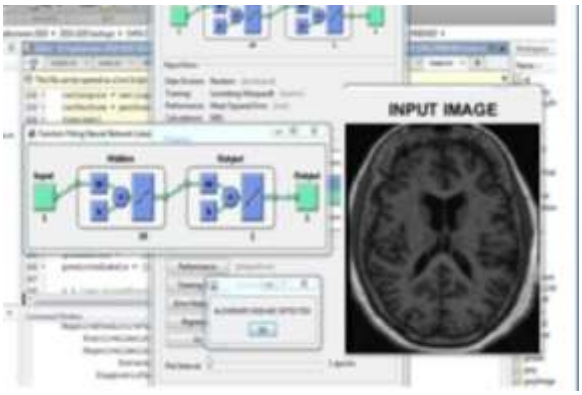

Fig. 3.N Final output image of Alzheimer disease

Fig. 3. It includes all figures from Fig. 3.A to Fig. 3.N(Magnetic Resonance Imaging uses a strong force field to develop the detailed picture of alzheimer's detection by scaling, filtering, segmenting the regions of human brain)

V. CONCLUSION

The Alzheimer's disease detection and classification mission utilizing a dataset perhaps better resolved by employing different image processing techniques with machine learning concepts. This procedure can successfully improve the exactness of the classification in selected sets.

To upgrade perfection in a diagnosis of Alzheimer's disease, a new segmentation method uses region masking for selecting the useful properties of affected parts in the human brain. Robust and accurate segmentation are the main advantages of this method. The Local binary pattern used for feature extraction is a significant texture operator. Artificial neural networks, which are a failure tolerance and allow us to classify well for new unlearned data.

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