Alzheimer's Detection By Using Neural Networks

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Abstract— *It is very important to get the diagnosis tools in early stage of Alzheimer as it will increase patient's chances of recovering and it enables the people attending the patient to take better care of him/her. Alzheimer's disease (shortly AD) is an acute disease with many number of the human deaths mostly people over 60 years. There are number of techniques like blood test, psychological analysis and neuroimaging, are available for the detection of Alzheimer's disease. Here we present details of work done in detection and classification of the Alzheimer's disease using neuroimaging techniques. MRI (magnetic resonance imaging) scans of brains are used for detection and classification purpose. First stage is to preprocess the MRI images and then we segment it. Next we do feature extraction from segmented image. These features are stored for the last stage which is classification and detection. Classification and detection is done using artificial neural network (ANN) which is very reliable and accurate technique. Neural network is trained using number of sample data and extracted feature. This leads to more accurate results which will aid in early diagnosis of Alzheimer's disease.*

Keywords— Alzheimer's disease, artificial neural network, classification, magnetic resonance imaging, neuroimaging, positron emission tomography.

I. INTRODUCTION

Alzheimer's disease is disorder in which person slowly starts to lose his/her memory, thinking ability and finally he/she is unable to do the simplistic day to day task. It is irreversible damage to the brain. It affects mostly the older people but can rarely be seen in people between 30 to 60 years. It was discovered by Dr. Alois Alzheimer in 1906. While examining he started noticing abnormalities in brain tissues of a dead woman. These abnormalities are now known as main features of the disease. The other significant finding was damage to interconnect between nerve cells. By studying these abnormalities we can detect the onset of the disease. The people affected by the disease can look normal in day to day life but steadily start having difficulties in day to day activities like reading, recognizing object, reasoning, driving and others. Eventually the brain damage is so much that its tissue shrunk. The disease is fatal and causes number of deaths every year. It is really necessary to diagnose the disease in early stages to take better care of the patient. Mild cognitive impairment (MCI) can be considered as the early stage of the Alzheimer. But not every person with MCI develops Alzheimer. Thus proper classification of the brain scans is necessary to segregate the affected person from non-affected one. There is pattern in brain damage as disease progresses. Hippocampus is one of the regions in the brain which first gets affected. This region is responsible for episodic and spatial memory and also provides interconnects between brain and body. Present day medicines only help to keep the symptoms in check. But they are not able to stop the progression of the disease. The disease is not curable and there is no treatment in current time to reverse the damage done to the brain. Computer based system for Alzheimer's disease focused on taking number of data samples and splitting them in training and testing samples. It uses morphological operations to separate normal brain scans from disease affected brain scans. Morphometry analysis is also used to study brain MRI images to classify them in normal or abnormal categories. It helps in computation of the structural differences throughout the brain tissues. Another form of Morphometry is voxel based Morphometry which allows to compare differences in local concentration of brain tissues using voxel wise comparison of multiple brain images. Study has been conducted to measure volumetric atrophy of the gray matter in the areas of the neocortex of the Alzheimer's patients and non-affected patients. In this method subject images are spatially normalized and then tissue classes are segmented using priori probability maps. Next step is to use denoising and remove distortions. The data is then tested using general linear model for residual variability and experimental results. This results in statistical parametric map which are thrsholded for required result. There are also experiments using machine learning techniques for classifying brain images into normal or specific neurodegenerative disease. In these experiments various forms of artificial neural network are used for classification. Some studies also show use of support vector machine with linear as well as non-linear kernels. Feature extraction can be done in different ways like using morphological operation, based on region of interest, or using grey level co-occurrence matrix on segmented image. Computer techniques are widely used in medical diagnosis mostly in cancer related cases. The research is done in detecting brain, liver and breast cancer detection using various image processing techniques using human organ photos or images. MRI scans are commonly used in neuroscience to study the brain tissues and any damage to them. These MRI images can be

processed to highlight the damages done to the brain tissues which can be used to detect the disease. A combination of the image processing techniques like denoising, segmentation, feature extraction and classification technique are applied to obtain affected region in the MRI image of the brain.

II. METHODOLOGY

2.1 Reading MRI Images

First step is to read dataset of MRI images. We are also using positron emission topography (PET) images.

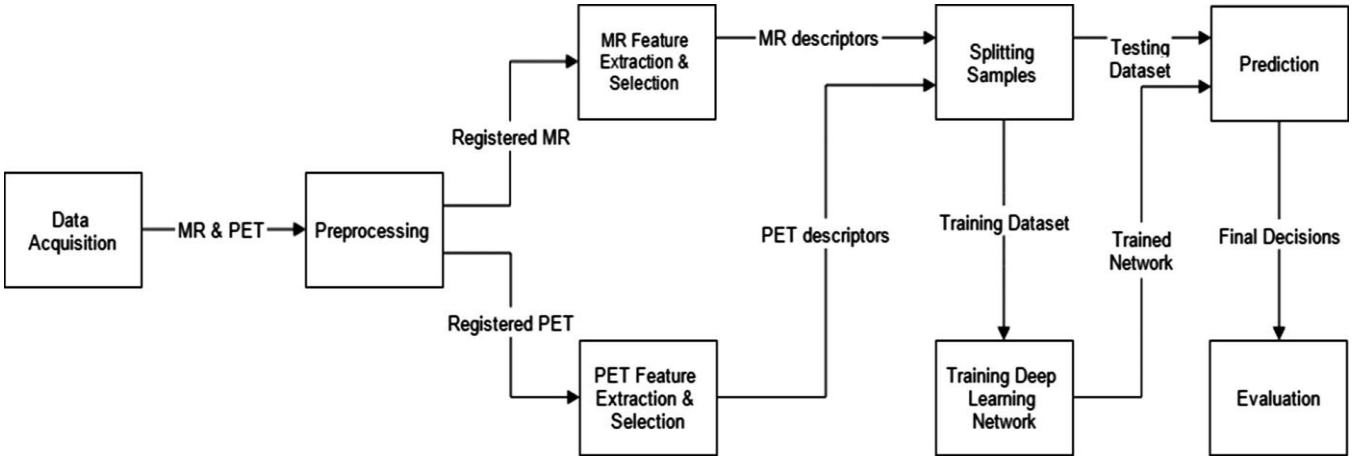

FIGURE 1: Block Diagram for Proposed System

2.2 Pre-processing & Enhancement

The collected MRI images first pre-processed and then segmented into some working parts. In pre-processing first we perform RGB to GRAY conversion in this conversion image is resize that is we actually convert 3D image into 2D image. Because 2D image take less time for detection. And then resize the image to reduce processing time. After pre-processing we enhance the image to find hide area. Because of enhancement hide area is visible and easily detects the node.

2.3 Segmentation of Pre-processed Image

After pre-processing and enhancement MRI image is segmented into no of working parts. Each working part has a feature which should be extracting. This dataset is first divided into training, testing and valuable purpose.

2.4 Feature Extraction

After segmentation we extract each working part feature. Feature extraction is a method of capturing visual content of an image. The feature extraction is the process to represent raw image in its reduced form to facilitate decision making such as pattern classification. Each feature is extracted in descriptor and statistically. Here mostly I used fourier descriptor and for statistical feature extraction I shall use standard deviation and variance. Each working part extracts the features like intensity, texture, shape etc.

2.5 Classification

In this study we are going to use artificial neural networks for classification. Artificial neural networks are computational model inspired by an animal's nervous systems in particular the brain which is capable of machine learning as well as pattern recognition. In artificial neural network use feed forward back propagation and because of that we can get accurate result. Here I shall use Levenberg learning algorithm as a learning method.

III. EXPERIMENT AND RESULT

We created the system based on the artificial and check the result with multiple images. We used different dataset for training and testing purposes. Feature was extracted from the MRI brain scans with Alzheimer in different stages and also with no Alzheimer. The neural network was trained using these features and then tested using test data samples. The image samples included scans from people of different age group and sex.

Following is the user interface created for the system and the steps to perform the classification of the Alzheimer's disease.

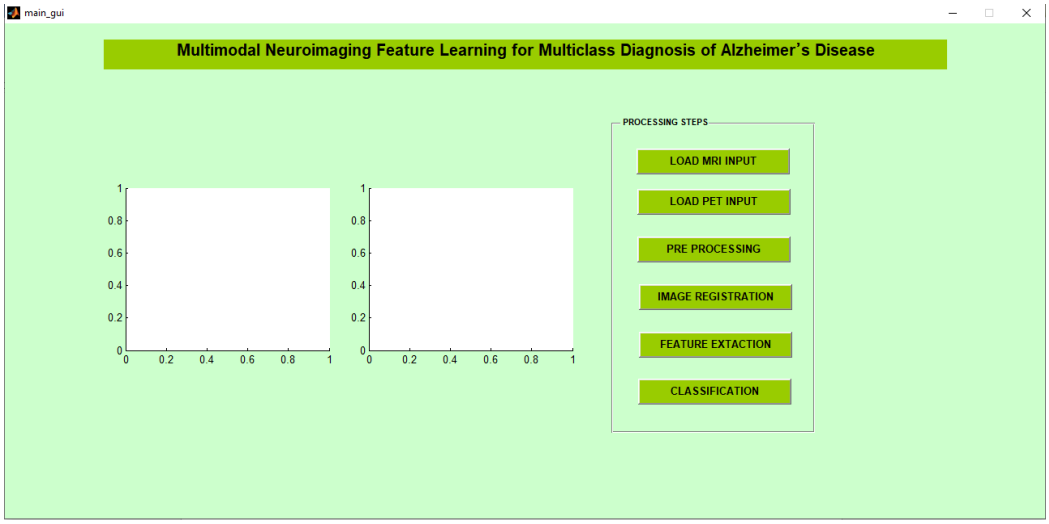

FIGURE 2: Main Window

When we click on first push button a window will appear containing number of test images. We then select one image from the set as an input image for the system. The input image is shown in the below figure.

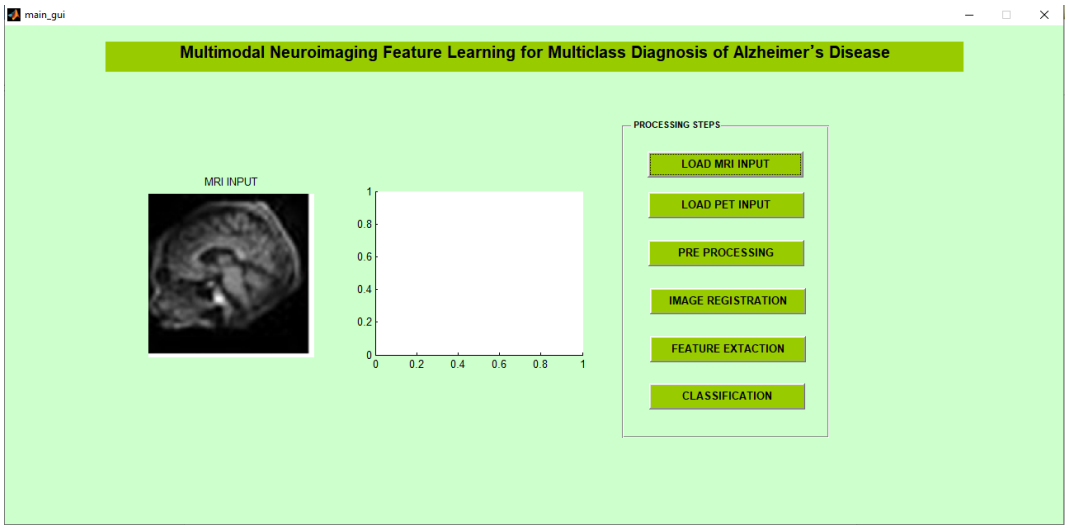

FIGURE 3: Taking MRI image as input

Next we will input the PET images from the sample set same as MRI images. This image will be shown in box next to the MRI image. The PET images were aligned with MRI image to give better biomarkers for the classification function.

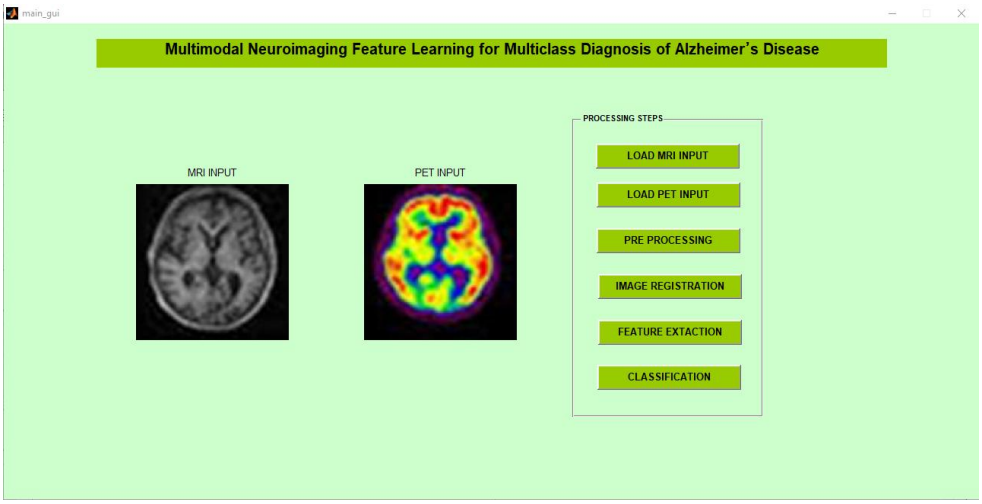

FIGURE 4: Pre-processing of input images

Next step is to pre-process the MRI and PET images. Pre-processing include denoising the images using filtering methods here we are using median filtering and convert the image in grey.

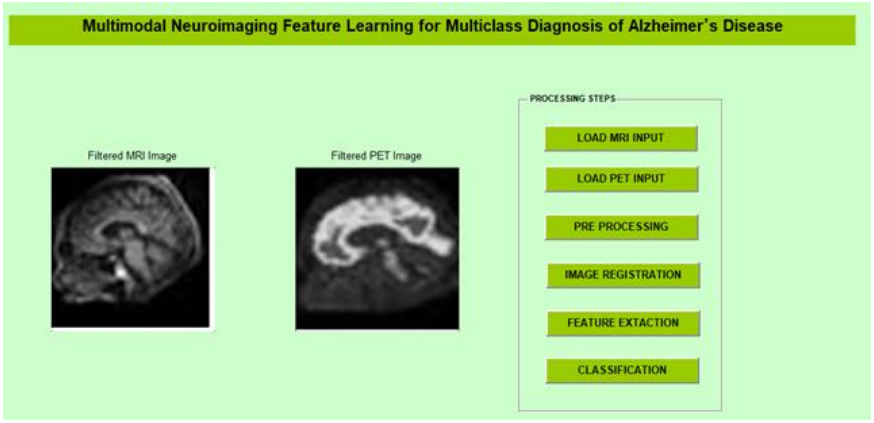

FIGURE 5: Pre-processing of both the images

Next process is image registration which includes image registration based on the intensities. This process will align the PET and MRI images using matched intensities of the two images. This will transform the various biomarkers from MRI and PET images into single coordinate system which will be easier to access when classifying the images in disease affected and non-affected set. Figure below shows registered images.

FIGURE 6: Registration of the pet and MRI images

Features are then extracted from the registered images. It is done using grey level co-occurrence matrix. This matrix will provide texture information based on number of times specific value pixels repeated in specific special location. These values will create a map showing abnormal growth in the scans using texture features of the images. Once the features are extracted it will show message box as in the figure below.

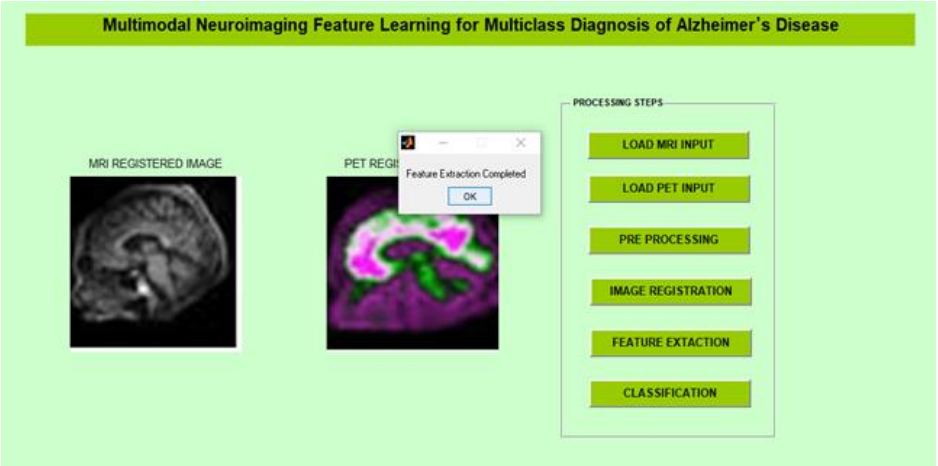

FIGURE 7: Feature extraction from pet and MRI images

Lastly we are doing classification using artificial neural network. The classifier matches extracted features from the dataset with features from test sample and provides result as Alzheimer's affected or Normal in the message box as shown in the below figures.

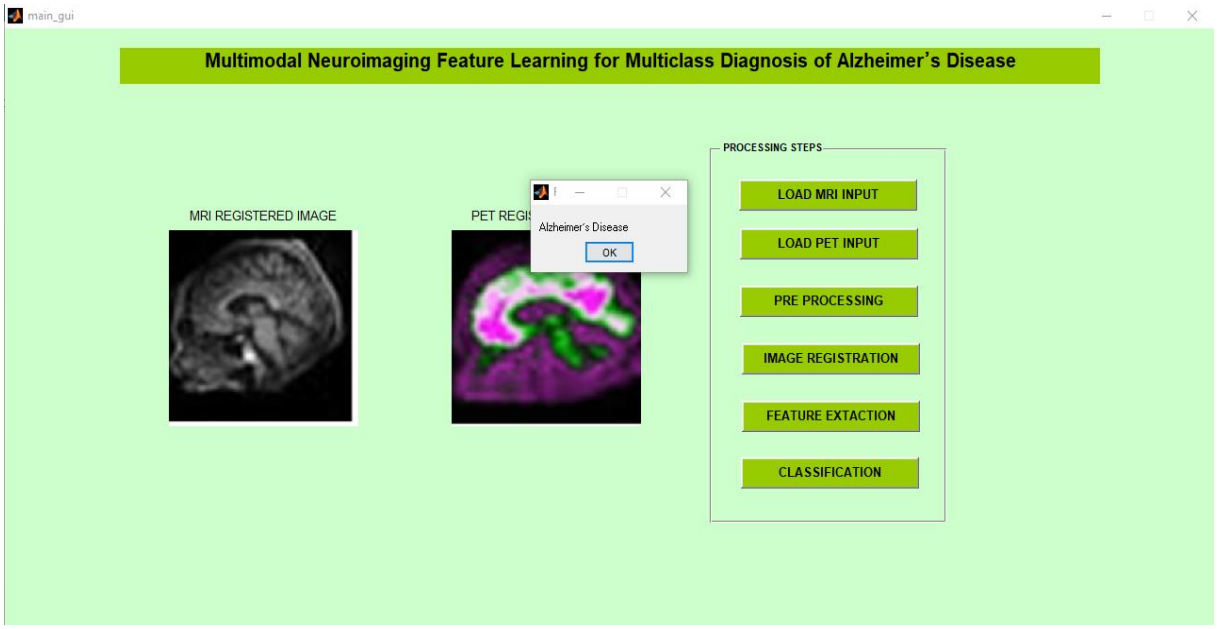

FIGURE 8: Alzheimer's disease scans

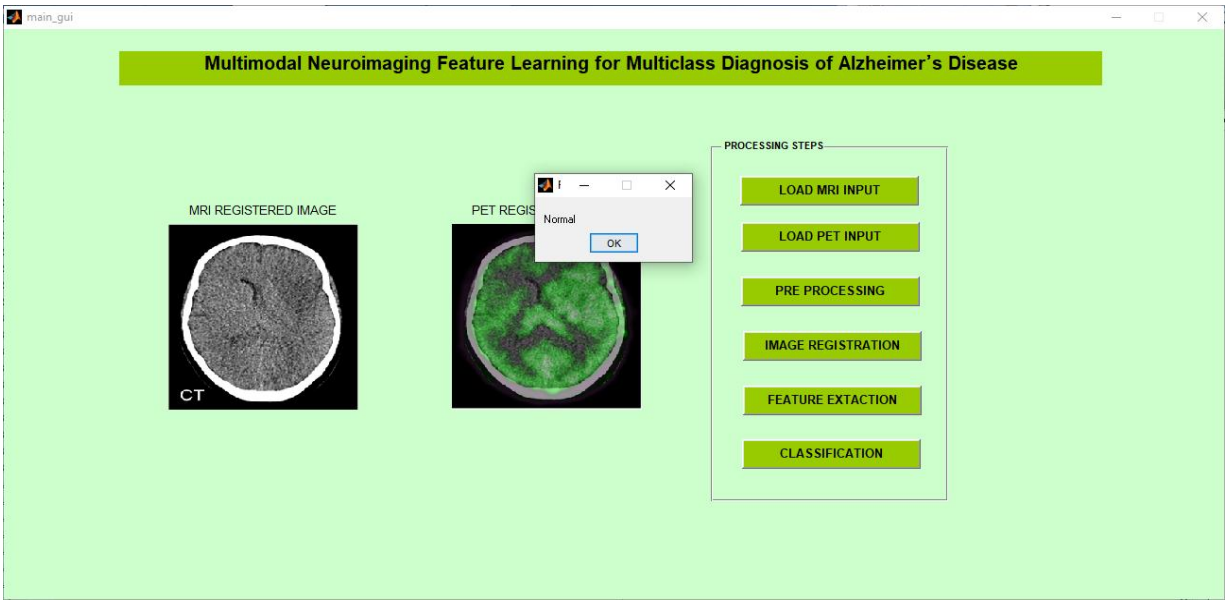

FIGURE 9: Image classified as normal scan

IV. CONCLUSION

We have experimented a system for Alzheimer's disease diagnosis and classification. The system can distinguish between normal and disease affected MRI scans with better accuracy. We can also extend this system to label more unlabeled data in the future. Grey level co-occurrence matrix used for feature extraction provides good feature bank for classification purpose. Neural network is best suited for these kinds of the classification and it gets better with more training samples comprising of different types of datasets. Proposed system is a powerful method to represent multimodal neuroimaging biomarkers.

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