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Alzheimer Disease Detection System

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ABSTRACT: The paper endeavors to detect and diagnose Alzheimer's disease by analyzing brain images, taken from PET (Positron Emission Tomography) scan. Since the disease cannot be identified by their symptoms at an early stage, proper classification of the image should be performed. Finally, prognosis of the disease is performed with the help of classification results. The image databases used in the project are legally procured from the physician. Image pre-processing is used for the enhancement of the image, so that, it becomes quite clear and easier for the analysis in forecoming modules. Contrast limited adaptive histogram equalization is used in the case of image enhancement. Contrast limited adaptive histogram equalization brings out the hidden features of the brain image. Red channel is extracted to improve the luminance and thin findings in the image. For the noise removal module, morphological methods are used. In morphological technique, erosion is used to increase the size and for the maintenance of the shape of the image. As the final module, region growing is used to identify the region which is infected part that has the amyloid deposits. Finally prediction is performed with the help of validation results.

I.INTRODUCTION

Alzheimer's disease[2] majorly damages human brain, and affects memory, thinking, behaviour, problem solving, feeling, automatic functions like breathing etc. There is no cure for AD, and it worsens as it progresses, and eventually leads to death. AD is not a spreading disease from one person to another. A person gets Alzheimer's from their ancestors only. When a person is affected by AD means, somehow his or her ancestral parent would have been existed with this disease even with or without their knowledge. Even though this disease was identified before hundred years, effective therapies to cure Alzheimer disease, or to simply halt or slow its progression, are still lacking. As the disease gets advanced, the symptoms can include confusion, irritability and aggression, mood swings, trouble with language, and long-term memory loss. On a gradual increase bodily functions are lost, ultimately leading to death. Fig.1 shows that the difference between the healthy brain and diseased brain. Since the disease is different for each individual, predicting how it will affect the person is difficult.

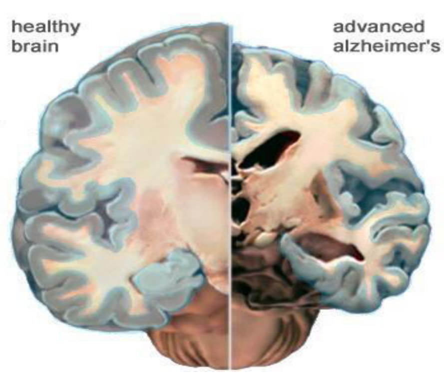

Fig.1 Difference between healthy and an Alzheimer's affected brain

Positron Emission Tomography (PET)[4] is a nuclear medical imaging technique that produces a three-dimensional image of functional processes in the body. The system detects the pairs of gamma rays emitted indirectly by a positron-emitting radionuclide or tracer, which is introduced into the body on a biologically active molecule. Three-dimensional images of tracer concentration within the body are constructed by computer analysis. PET measures the emissions from radioactively labeled metabolically active chemicals that have been

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injected into the bloodstream. Fig.2 shows the image for PET scan of human brain. The emitted data are computer-processed to produce multi-dimensional images of the distribution of chemicals throughout the brain.

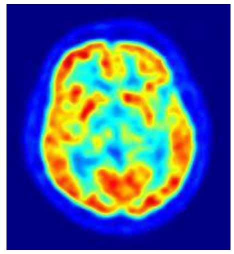

Fig.2 PET scan of human brain

II. SYSTEM ARCHITECTURE

This project work focuses on developing an automated method by applying digital image processing to the field of medical diagnosis in order to identify the presence of atrophy in the brain images, in order to reduce the time and stress undergone by the specialists and other members in the team in the diagnosis and prognosis of Alzheimer's disease[3]. Fig.3 shows the architecture diagram of the work. The algorithm proposed here is to determine the presence of atrophy which is one of the features associated with the disease by applying techniques of digital image processing on the brain image which is obtained in a legally from the hospital. The method attempts to detect the presence of Alzheimer's disease with the help of its features called atrophy

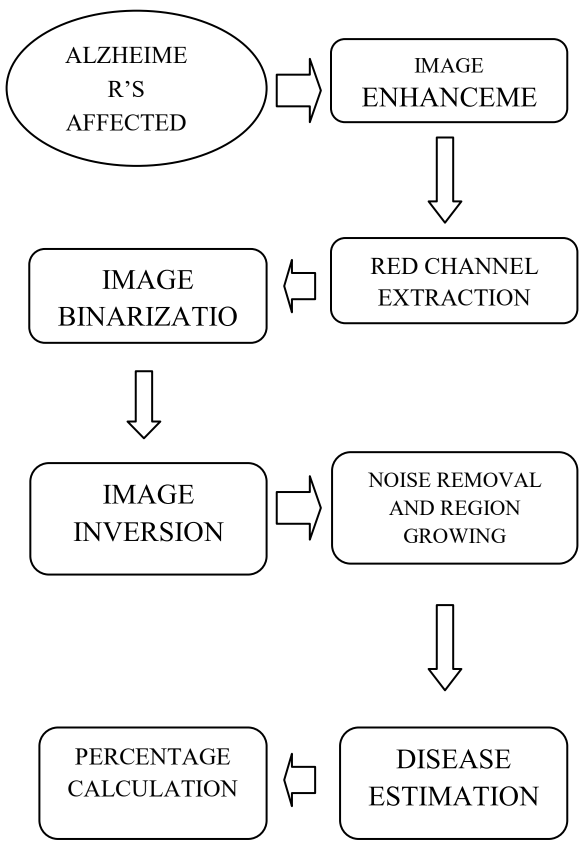

Fig. 3 Architecture Diagram

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III. METHODOLOGIES

Methodologies are the process of analyzing the principles or procedure of detection of Alzheimer's disease using PET scan brain image. The following are the 6 modules involved in detection of Alzheimer's disease using PET scan brain image.

- Gray Scale Conversion
- Image enhancement
- Red channel extraction
- Image Binarization
- Image Inversion
- Noise removal
- Region Growing

3.1 Gray Scale Conversions

The diseased image is an RGB image, and in-order to calculate the grey level it is converted into grey scale image. A grayscale digital image is an image in which the value of each pixel is a single sample, and it carries only intensity information. Grayscale images are often the result of measuring the intensity of light at each pixel in a single band of the electromagnetic spectrum and in such cases they are monochromatic proper when only a given frequency is captured.Fig.4 is the conversion of color image to gray scale image.

3.2 Image Enhancement

Image enhancement is the process of adjusting digital images so that the results are more suitable for display or further analysis. [2]To remove noise or brighten an image, image enhancement makes it easier to identify key features. Contrast enhancements improve the perceptibility of objects in the scene by enhancing the brightness difference between objects and their backgrounds. A contrast stretch improves the brightness differences uniformly across the dynamic range of the image, whereas tonal enhancements improve the brightness differences in the shadow (dark), midtone (grays), or highlight (bright) regions at the expense of the brightness differences in the other regions.

3.3 Red Channel Extraction

RED channel extraction from a gray scale image will brighten the image slice. Luminance of the image is improved and it is an indicator of how bright the surface will appear. When compared to Green channel and Blue channel, Red channel provides improved and better results.In the RGB color model, a color image can be represented by the intensity function.

$$I_{RGB} = (F_R, F_G, F_B)$$

where $F_R(x,y)$ is the intensity of the pixel (x,y) in the red channel, $F_G(x,y)$ is the intensity of pixel (x,y) in the green channel, and $F_B(x,y)$ is the intensity of pixel (x,y) in the blue channel.

3.4 Image Binarization

Image binarization is performed to convert 255 intensity levels to 2 intensity level. Basically, a gray scale image consists of 255 intensity levels. When a gray scale image is converted into a binary image, only 0 levels and 1 level are present.A binarization method is binarizing an image by extracting lightness (brightness, density) as a feature amount from the image. When a pixel is selected in an image, sensitivity is added to subtracted from the value concerning the Y value of the selected pixel to set a threshold value range. Next, when another pixel is selected, the sensitivity is added to or subtracted from the value concerning the Y value of the selected pixel and a new threshold value range is set containing the calculation result and the already setup threshold value range. The pixel with the value concerning the Y value of any pixel in the image within the threshold value range is extracted as the same brightness as the selected pixel and the extraction result is displayed. A binary image is a digital image that has only two possible values for each pixel. Typically the two colors used for a binary image are black and white. The color used for the object in the image is the foreground color while the rest of the image is the

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background color. To make a complete differentiation in an image with the foreground color and background color, image binarization is performed.

3.5 Image Inversion

Image inversion performs the conversion of black pixel into white pixel and white pixel into black pixel. This is performed because; the MATLAB simulation considers the white pixels may contain the useful information than black pixel. Since, white pixels can be performed any sort of computation rather than black pixel.

3.6 Noise Removal

In the image which is obtained from the red channel extraction contains some artifacts, noise and amplified information which are invisible to human eyes after computation. These noises may hide the feature information and valid data through which valid information might be lost. So, morphological operation is performed to remove noise. Morphological operations apply a structuring element to an input image, creating an output image of the same size. In this, the value of each pixel in the output image is based on a comparison of the corresponding pixel in the input image with its neighbors. By choosing the size and shape of the neighborhood, we can construct a morphological operation that is sensitive to specific shapes in the input image. Generally, morphological operations are dilation, erosion, opening, closing, hit-or-miss transformation. In our work erosion is being performed.In erosion, every object pixel that is touching a background pixel is changed into a background pixel. Erosion makes the object smaller, and can break a single object into multiple objects. On considering a pixel as a black, it will be completely surrounded by black pixel with the iteration performed.

3.7 Region Growing

Region growing is a simple region-based image segmentation method. It is also classified as a pixel-based image segmentation method since it involves the selection of initial seed points. This approach to segmentation examines neighboring pixels of initial "seed points" and determines whether the pixel neighbors should be added to the region. The process is iterated, till the region is grown completely. The first step in region growing is to select a set of seed points. Seed point selection is based on some user criterion, such as pixels in a certain gray-level range, pixels evenly spaced on a grid, etc. The initial region begins as the exact location of these seeds. The regions are then grown from these seed points to adjacent points depending on a region membership criterion. The criterion could be as pixel intensity, gray level texture, or color[1]. Since the regions are grown on the basis of the criterion, the image information itself is important. For example, if the criterion were a pixel intensity threshold value, knowledge of the histogram of the image would be of use, as it could be used it to determine a suitable threshold value for the region membership criterion.

V. CONCLUSION

The goal of this work is to develop an algorithm for the automated diagnosis of Alzheimer's disease. The algorithm is implemented on the input image which is obtained legally from the physician. Image Pre-processing were the initial steps undergone in the diseased input image. Morphological methods are used for the noise removal techniques. Image enhancement is used for the process of image brightness. The luminance of the image is improved with the help of contrast limited adaptive histogram equalization. Image binarization is performed after the red channel extraction, to improve the contrastness. Image inversion is performed to identify the infected part of the diseased image. Finally, noise removal can be used for the region growing technique. In region growing, the methodology to enhance the region is performed.

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