International Journal of Innovative Technology and Exploring Engineering (IJITEE)
ISSN: 2278-3075, Volume-3 Issue-10, March 2014

# Analysis of Brain Images to Detect the Alzheimer's disease using Segmentation Approach

**R.Sampath, A.Saradha**

***Abstract- Brain image analysis is an important area under medical research. The brain image analysis results to detect brain diseases. A lot of researches are going on in medical image analysis along with this segmentation is also used in analysis of medical images. Alzheimer's disease is the most common type of senile dementia. Low brain activity and blood flow causes greater risks for strokes or Alzheimer's diseases. A lot of researches are going on for segmenting the medical images automatically. Hippocampus is the component of brain. It plays an important role in the normal behavior of human beings. It takes many hours for a specialist to segment the hippocampus manually. There are many techniques available for segmentation process. A modified approach based on the watershed algorithm for segmenting the hippocampus region. The brain images converted into binary form using two approaches. The first approach implements block mean, mask and labeling concepts and in the second approach tophat, mask and labeling concepts have been implemented. It is found that certain part of the image contains holes which interrupt the segmentation process. To overcome this image hole filling techniques are implemented and related components are grouped into connected components. The analysis of hippocampus structure and shape analysis will result in classifying the Alzheimer's disease.***

***Key Terms—*** **Alzheimer's disease, MRI, Segmentation, Hippocampus.**

## I. INTRODUCTION

Alzheimer's disease leads to nerve cell death and tissue loss throughout the brain. Overtime the brain shrinks dramatically, affecting nearly all its functions . Hippocampal structure plays an important role in the diagnosis of neuro degenerative diseases like Alzheimer's dementia and Evaluation of the course of disease. Analysis of Hippocampal

Structure helps for the diagnosis of Alzheimer's disease. Conventionally used the manual segmentation is a time consuming procedure so it is necessary for a segmentation method which will provide a realistic approach.

The location of the hippocampus is shown in the following MRI scan of brain which is marked by an arrow.

**Manuscript received March 2014.**

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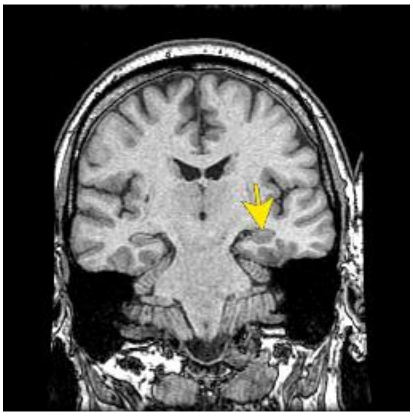

**Fig 1- Hippocampus**

### A. *Historical Analysis of Past Algorithms*

Segmentation of medical images is the task of partitioning data into contiguous regions representing individual anatomical objects. It is prerequisite further investigations in many computer-assisted medical applications these requires efficient robust and automatic methods. Some automated segmentation techniques have their own merits and demerits.

**(i)** ***Segmentation of the amygdale-hippocampal complex by Competitive region growing [MRI analysis]:***

In this method they have introduced a new method with Markovian region growing. They have not used the shape priors, but constrained the growth with relational and weak geometric priors. The major relational constraint is given by the simultaneous segmentation of hippocampus and amygdale. They ran the algorithm on basic workstation and has produced satisfactory results

**(ii)** ***Amygdala-hippocampal shape differences in schizophrenia the application of 3D shape models to volumetric MR data:***

In this method they have concentrated on the shape deformations in brain structure. They have used an active, flexible deformable shape model for the automatic segmentation of the amygdale-hippocampal complex from MR image data. Here volumetric binary segmentations of the amygdale-hippocampal complex of a training set of controls and schizophrenics were processed using a surface parameterization technique. The object surfaces of the training objects, in this case the manually segmented amygdale-hippocampal complex from the previous study, were converted into parametric surface nets and expanded into shape descriptions using spherical harmonic expansion.

**(iii)** ***3D semi-interactive segmentation:***

Initially the random noise was removed using the anisotropic diffusion filter. The segmentation is done by the application of the immersion-based watershed-algorithm. Then a 2D merging was done to reduce the oversegmentation Scheme. For encoding of the interior region an entropy criterion was applied,


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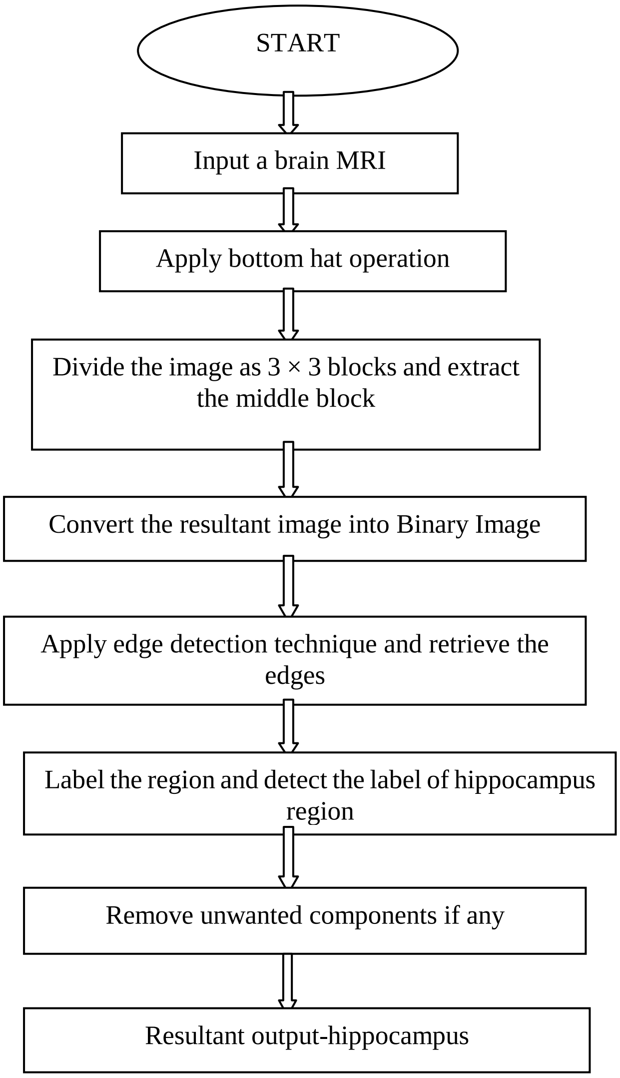
while the boundary was encoded by chain coding. Regions are merged when the total description length gain is positive.




### *B. Shape Analysis*

The below figure shows the image used for segmentation process.

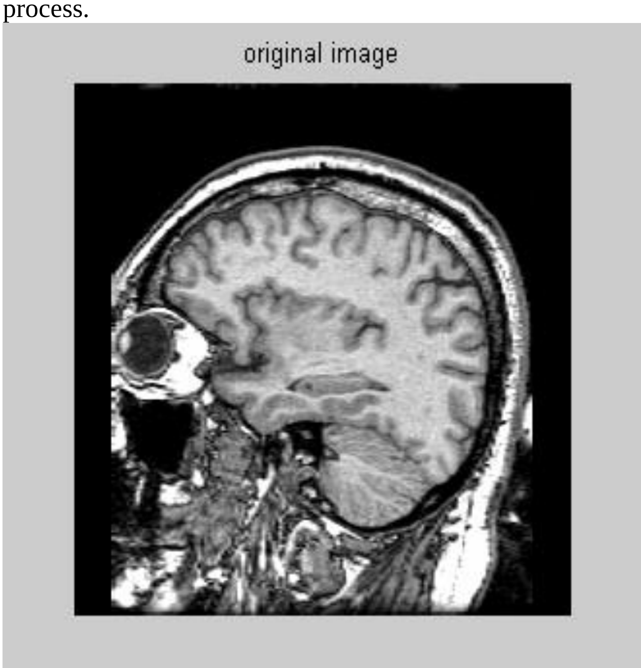



**Fig 2 – Normal brain image**

To do the segmentation process the image should be identified with the area of interest, any image should be converted in to binary form to make the process a easier one. Instead of using the direct image the image is first radically decomposed with a disc of radius 14.The formula for radial decomposition with a disc Dr of radius *r* is approximated by a cascade of Ne {2, 3, …, 8 } line structuring elements.

Line structuring elements

$D_r$ ˜ $La_1ka_1$ T $La_2ka_2$ T …… T $La_N$ $ka_N$ … (1)

$a_i$ = i? /n denotes the angle of each line and kai the length of each line (which increased with the radius r of the disc).

Then performed the morphological bottom-hat filtering on the grayscale or binary input image, IM, returning the filtered image. An structuring element is used in this function which is returned by the above function which performs the radial decomposition. These two functions are performed in order to make the boundary of the hippocampus more visible compared to the original image

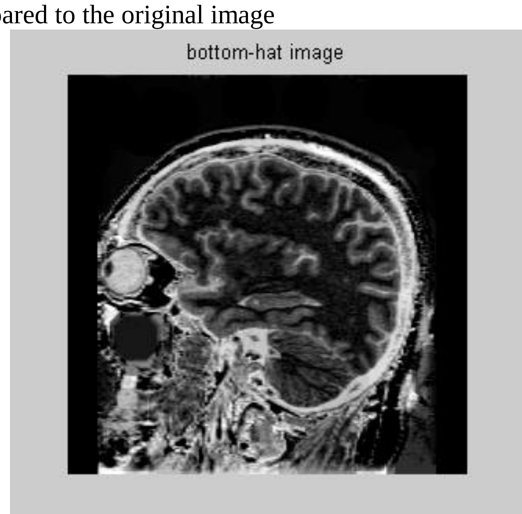



**Fig 3:Image after bottom hat operation**

It is found that the hippocampus is present only at the center, so in order to minimize the time complexity of the process the entire image is not converted into the binary form. It is enough to convert only the required area. For this purpose the image is divided into 3 × 3 blocks and the middle block consists of the hippocampus. The middle block is converted into a bilevel image using the block mean value. i.e the pixels that are having the intensity value greater than the block mean value are converted to zero and others to one. The resulting image is a bi level image having only 0's and 1's.

$$\text{Mean} = \frac{\sum_{i=1}^{n} ai}{n}$$

The image should be enhanced for better processing and result. Median filter is used to enhance the image it's based upon moving a window over an image (as in a convolution) and computing the output pixel as the median value of the bright nesses within the input window. If the window is *J* × *K* in size we can order the *J**K* pixels in brightness value from smallest to largest.



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If $J*K$ is odd then the median will be the $(J*K+1)/2$ entry in the list of ordered brightness. Note that the value selected will be exactly equal to one of the existing brightness so that no round off error will be involved if we want to work exclusively with integer brightness values. The algorithm as it is described above has a generic complexity per pixel of $O(J*K*\log(J*K))$.

*A. FIgures*

As said, to insert images in *Word*, position the cursor at the insertion point and either use Insert | Picture | From File or copy the image to the Windows clipboard and then Edit | Paste Special | Picture (with "Float over text" unchecked).

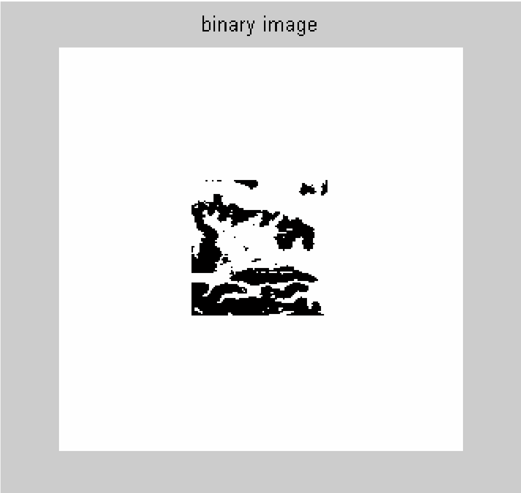


**Fig 4: Binary image of the middle block**

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## II. SEGMENTATION

The brain tissues in patients are compared with Alzheimer disease in order to perform elderly control subjects by using high-resolution MRI imaging and quantitative tissue-segmentation techniques. The brain MRI imaging was performed in patients with Alzheimer disease and Control subjects. The volumes of ventricular and sulcal cerebrospinal fluid (CSF), white matter, cortical gray matter, and white matter, signal hyper intensity are quantified using computerized segmentation program. Medical images mostly consist of complicated structure and unknown noise. Some segmentation algorithms consider intensity of image, homogeneous regions or complete object segmentation for identifying objects. Efficient image segmentation to detect lesion in brain images is usually driven by such morphological watershed approaches.

### *A. Watershed Algorithm*

After the segmentation is carried out, resulting segments features could be extracted and subsequently classified. Classification could be carried out based on features such as gray, white, and cerebrospinal fluid (CSF) anatomically regions in brain. Most de-blurring approaches rely on old de-convolution techniques such as the Lucy Watershed transformation is an efficient morphological based tool for segmentation image. An efficient watershed algorithm is preceded by using a marker image. A marker image defines the included zero marker values of watershed line pixels. For efficient Watershed segmentation a marker image needs to be accurately calculated. The markers are classified into two, internal and external markers. Internal markers are imposed inside the objects to be identified; external markers are imposed outside the objects. Markers can be composed by various methods such as linear filtering, nonlinear filtering, or morphological processing. The choice usually is determined by the nature of the processed image. Watershed algorithms are extremely vulnerable to noise. Watershed should present correct contours and may show other erroneous contours due to noise, therefore it may produce an over segmentation of the image.

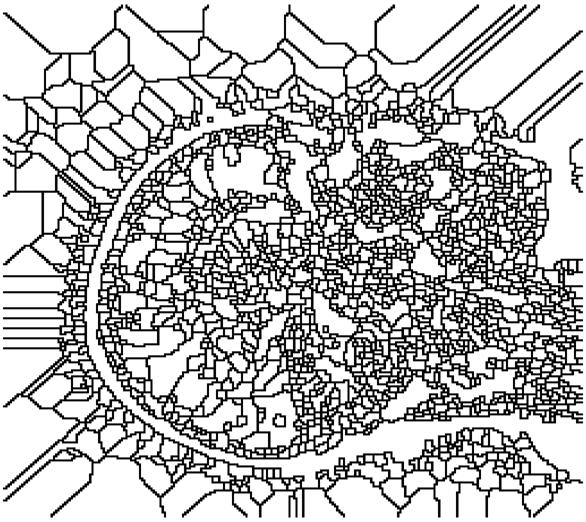

**Fig 5a: Before Applying Watershed Algorithm for normal controls**

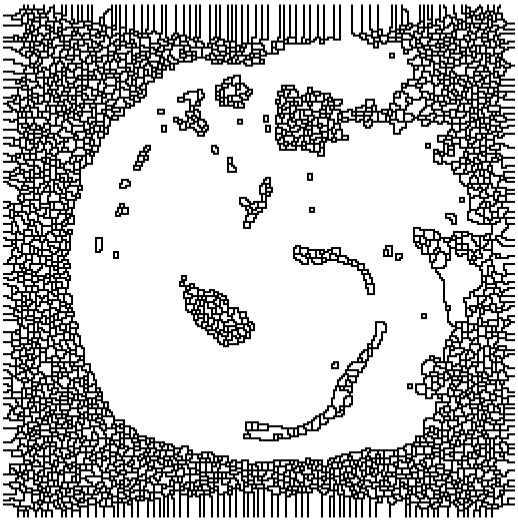

**Fig 5b: After Applying Watershed Algorithm for AD controls**

## III. CONCLUSION

The MRI image which is collected from the database is used to do the segmentation process. In segmentation process we are using a highly sophisticated called watershed algorithm to find the diseased area in the scanned image.

The results of this watershed algorithm are already submitted and the project is completed till this level. After this the image of the brain scan is analyzed and the diseased area is analyzed using the Shape analysis techniques. The classification technique is also using SVM algorithm for further classification of the image. The main advantage of using SVM technique for classification is because of its accurate results. So using these accurate results of this SVM algorithm the Stage of the Alzheimer's disease can be identified. And at the end the final results of this algorithm will be stored in the database.

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