Brain Image Segmentation using Bounding Box Method
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Abstract— The most challenging and emerging field now days is the Medical Image Processing. For safe and appropriate treatment of the tumor, proper diagnosing of the brain tumor is very important. The growth of tumor interrupts the normal brain activity and takes up a significant amount of space within the skull. So detecting the tumor at an early stage is essential. This paper reviews an automated way to detect the brain tumor. Firstly, image preprocessing is done to remove any noise and sharpen the image. Then the bounding box method is used for detecting the tumor. In the end, thresholding is done to segment the tumor portion from the brain image.

Key words: Brain tumor, MRI image, bounding box, thresholding

I. INTRODUCTION
The abnormal growth of cells in brain causes the brain tumor. Normally the brain cells, blood vessels or nerves that are present in the brain makes up the brain tumor. As the death rate is higher among humans having brain tumor, the early detection of the tumor is essential [1]. Due to the complex structure of the brain, the tumor segmentation is a very difficult task.

The images are subjected to some kind of noise and disturbances when it is acquired by a computer [2]. The cause for the poor illumination of the image can be the disturbance of electronic devices, environmental factor or human error [2]. The visibility of tumor is reduced by the image containing noise components. The first step should be filtering the noise and then detecting the tumor.

Noise removal, brain tumor detection and brain tumor extraction are the phases for the complete diagnosis system. The bounding box method proposed is an automated method used only for the detection of the brain tumor location and for further segmentation thresholding technique is used. The symmetry approach has an advantage that it does not require intensity normalization, human work etc. The symmetry axis detection is the only step that needs to be done.

In this paper, Part II is the literature survey briefing about the related work in this field. Part III gives the proposed method and steps involved for brain tumor detection and segmentation. Part IV gives the results of the application of the proposed method and Part V is the conclusion.

II. LITERATURE SURVEY
Many researchers have done detection and segmentation of brain tumor from MRI images by implementing various techniques. In this paper, we will discuss a number of approaches to the segmentation. The related works that have been mentioned are:

Rohan Kandwal and Ashok Kumar [3] introduced an easy and completely automated method for the detection and segmentation of tumor with a good accuracy. The bounding box method is used for locating the tumor. The results of enhancing, detecting and segmenting the brain tumor from an MRI image obtained from the methodology are good.

Mandeep Kaur and Dr. V. K. Banga [4] proposed a technique which locates a bounding box across the brain tumor. This is an automated and a fast method for locating the tumor. The left and right half of the brain is searched for any dissimilarity. After the bounding box method, segmentation is done by using thresholding and level set method. The advantage of the method is that it is independent of the intensity variations in the MRI image.

P. Dvorak, K. Bartusek and W. G. Kropatsch paper [5] briefly about the segmentation of edema in FLAIR images. The manifestation and visibility of edema in this image type was good so this is that’s the reason for choosing the image type. The brain is symmetrical, so this is used to locate the edema in the brain image. The approach which is multi dimensional is used for the detection. The hyper intense area in FLAIR images are the edema, thresholding is used for its extraction. The Otsu's algorithm is used for the automatic determination of the threshold.

Baidya Nath Saha, Nilanjan Ray, Russell Greiner, Albert Murtha and Hong Zhang paper [6] proposes a segmentation technique which is novel automated, fast, and approximate. The method used is based on the principle of detection of change that searches the most dissimilarity region between the left and the right halves of a brain in an axial view MR slice. This method uses score function based on Bhattacharya coefficient and computes the gray level intensity histograms.

Sahil J Prajapati and Kalpesh R Jadhav paper [7] proposes the technique Nonnegative Matrix Factorization to reduce the data's dimensionality. The methods of image processing to which NMF has been applied are text mining and pattern analysis. For the detection of the tumor, it is mainly used as decomposition approach which is uninterruptable. It is also for feature extraction and for classification into various type. Here the product of two non-negative matrices should closely approximate the original matrix.

K.R. Yasodha and Dr. V. Thiagarasu paper [8] explained that the most important method in medical image mining is the Brain tumor detection. The white matter (WM), gray matter (GM) and cerebrospinal fluid (CSF) tissues of brain are correctly segmented in a shorter span of time. An automated method is used for segmentation of the brain tumor. The various algorithms in medical image mining based on MRI and imaging modalities are mentioned. The reduction of noise and segmentation methods are briefly explained.
III. PROPOSED METHOD

The various steps for detection of the tumor when an MRI image is given as an input:

A. Pre Processing:

The pre-processing phase is essential in the applications of image processing and especially in the segmentation. The aim is to remove the noise from the images in the pre-processing phase. The errors of the computation in components in the image. The various methods to remove noise are Histogram equalization, using Unsharp mask, Median filter, Mean filter and Gaussian filter. The salt and pepper noise is removed by the Median filter and the median of the neighboring pixels is used to determine the value of the pixel. The edges, clarity and quality of the image should not be destroyed by automatic or semiautomatic image analyzing methods are caused by the presence of the noise.

B. Bounding Box Method[6]:

There is a left–right axis of symmetry of the brain in each axial view of input MR slice. This symmetry is disturbed by a tumor. So if a tumor is present in the brain, the left part about the symmetry axis is very dissimilar from the right part of the brain which means the intensity histograms of two rectangles are not similar, but outside of the rectangles the intensity histograms are relatively similar.

The basic principle of fast bounding box (FBB) is change detection principle, where a region of change (D) is detected on a test image (I), when compared with a reference image (R). The left image taken as test image and the right taken as the reference image. Mostly the detection of change is associated with local pixel to pixel changes but here the change is related to a region based global change. We use a score function $E(l)$ that detects the region of change (D) by searching in two directions – horizontal and vertical.

![Fig. 1: Steps for the detection of tumor](image1)

![Fig. 2: Image enhancement using Gaussian filter](image2)

![Fig. 3: (a): Finding anomaly D from test image I using reference image R. (b): Energy function plot](image3)

![Fig. 4: (a): Vertical line represents geometric axis of symmetry. Horizontal line divides the skull into four quadrants. Horizontal line is moved from top to bottom of the image and equation (1) is computed for each position of the horizontal line. Similarly, a vertical line is also moved and equation (1) is computed accordingly and thus tumor is located by a bounding box.](image4)

Where $P_{I}^{T}(l)$ denotes the normalized intensity histogram of image I within the region $T(l)$, $P_{R}^{T}(l)$,$P_{I}^{B}(l)$ & $P_{R}^{B}(l)$ are defined respectively. $BC(a,b) = \sum_{i=0}^{1} a(i)b(i)$ denotes the Bhattacharya coefficient between two normalized histograms $a(i)$ and $b(i)$, with $i$ indicating the histogram bin. The similarity between two normalized intensity histograms measured by the Bhattacharya coefficient (BC). When two normalized histograms are the same, the value of BC between them is 1 and when two normalized histograms are not similar, the BC value is 0.
and the bottom regions $B(l)$ are dissimilar. Since tumor locates at Bottom–Right quadrant of the image shown in Fig 4, value of $BC(P_{B(l)}^{T1}, P_{B(l)}^{T2})$ will be high and of $BC(P_{B(l)}^{B1}, P_{B(l)}^{B2})$ is low which leads the value of $E(l)$ as high

C. Segmentation of the Tumor Region:
The simplest segmentation technique is the thresholding. The input image is converted into a binary image in this method. The selection of a threshold value is the main logic. The thresholding is performed on the whole image. The threshold is compared to each pixel: if its value is higher than the threshold, the pixel is considered to be the foreground and is set to white, and if it is less than or equal to the threshold it is considered to be the background and set to black. Now the bounding box containing threshold result is checked. The tumor output is shown as the white pixels within bounding box. The tumor region is changed to color image for a better visualization.

IV. RESULTS
The input image of the brain with tumor is shown below:

![Input Image](image)

Fig. 5: Input Image

The bounding box is created around the tumor by the comparison of test image with the reference image. Bhattacharya coefficient is used for creation of the bounding box. The score function is calculated in the horizontal and vertical direction. The graphs for both are shown in the result.

![Graphs](image)

Fig. 6: The output is bounding box created around the tumor.

V. CONCLUSION
FBB is a technique that uses symmetry to enclose abnormality by a bounding box within an axial brain MR image. It is a fast and novel technique the advantage of this approach is that it avoids the challenge of dealing with the variation of intensities among different MR image slices. Moreover, the method does not need image registration and is completely unsupervised. This is an efficient method.

REFERENCES