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Brain Tumor Detection Using Standard Deviation and Area

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Abstract-Brain tumor is a perilous disease which causes brain damage. So detection and classification of brain tumor in early stage is necessary. Brain tumors can be basically categorized into normal, malignant or benign categories. There are two types of tumors-primary or secondary. Primary brain tumors originate in human brain and develop from growth of brain cells, membranes, nerve cells and glands. Secondary brain tumor originates in one part of the body and spreads into the brain or other part of the body. In the proposed work MRI brain images is converted into grayscale. Then the image is preprocessed using median filter for removing noises. Compute the standard deviation and by using canny edge detection, boundaries can be detected. Morphological operations such as dilation and erosion are applied for removing the unwanted disturbances after that tumor area is identified.

Keywords **-** *MRI of Brain Scans, Brain Tumor, standard deviation, Binarization, brain abnormalities*

1. Introduction

Magnetic resonance imaging (MRI) is considered now as an important tool for surgeons. It delivers high quality images of the inside of the human body. Detection of all infected tumor area from MRI images considered as a difficult and time consuming task done by radiologists or clinical experts. It is a challenging task, since the shape, structure, and location of these abnormalities are highly variable. Their accuracy depends on their experiences. The introduction of information technology in the medical field helps clinical, radiologist's experts to provide better health care and treatment to the patient. The tumor is basically an uncontrolled growth of cancerous cells in any part of the body, whereas a brain tumor is an uncontrolled growth of cancerous cells in the brain.

A brain tumor can be benign or malignant. The benign brain tumor has uniformity in structure and does not contain active cells, whereas malignant brain tumors have a non-uniformity in structure and contain active cells. The benign tumors are considered to be curative under complete surgical excursion, whereas malignant brain tumors can be treated by radiotherapy, chemotherapy, or a combination thereof. To detect infected tumor tissues from medical imaging modalities, segmentation is employed. Segmentation is necessary and important step in image analysis; it is a process of separating an image into different regions or blocks sharing common and identical properties, such as color, texture, contrast, brightness, boundaries, and gray level. The detection of a brain tumor at an early stage is a key issue for providing improved treatment. Once a brain tumor is clinically suspected, radiological evaluation is required to determine its location, its size, and impact on the surrounding areas. On the basis of this information the best therapy, surgery, radiation, or chemotherapy, is decided. It is evident that the chances of survival of a tumor-infected patient can be increased significantly if the tumor is detected accurately in its early stage. Thus the study of brain tumors using imaging modalities has gained importance in the radiology department.

2.Related Work

K means clustering algorithm applied to create segments of the image. Features extracted by applying, gray level co-occurrence matrix and histogram of oriented gradient. Mean, Standard deviation, skewness, root mean square and median attributes are derived from the process. All attributes are stored in a database which is treated as a training dataset for the machine learning process for further classification [1].

Gray-level pixel to a color-level pixelA luminosity layer L*, chromaticity-layer a* indicates color falls along the red-green axis, chromaticity-layer b* indicates color falls along the blue-yellow axis. Classifies colors in a*b* space using K-means clustering. After the clustering process, the cluster containing an area of interest is selected as the primary segment. To eliminate

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the pixels not related to the interest in the selected cluster, histogram clustering is applied [2].

Comparison of three different intensity based feature extraction methods for the abnormal patterns in brain tumor detection. Use of BRATS (Brain Tumor Segmentation) dataset is made for performance evaluation. The histogram is plotted by extracting smoothness, third moment, entropy and uniformity features. Texture feature is extracted using GLCM (Grey Level Co-occurrence Matrix) methodology. Intensity based feature is calculated using mean, median, mode and standard deviation [3].

Edges are commonly used for feature extraction so a study of edge detection schemes was done. Two edge detection algorithms are described. One is canny edge detection and other one is sobel edge detection which is used to extract edges from facial images to detect the face. Comparison of canny and sobel edge detection was done based on performance parameters that is speed and accuracy [4].

In segmentation image is segmented using canny edge detection. After that in level numbering stage segmented image is represented by certain level number. With the Canny edge detection, the image is represented in two levels black and white (binary image).Features are then extracted. Harris method is used because it gives good results with the test images. Two neural networks used. First neural network classify brains into healthy brain or brain with tumor second neural define tumor type. Each one is 3 layers simple feed forward network [5].

3. Design and Implementation

3.1 Image Acquisition

Images are obtained from MRI scan of the human brain where the gray-scale images are given as the input. The range of values for gray-scale image is from 0 (black) to 255 (white).

3.2 Pre-Processing

Preprocessing of MRI image improve the quality of the image, making it more suitable for further processing. It consists of Image enhancement, contrast improvement and image sharpening, noise removal. First the RGB image is converted into grayscale image.Grayscale images consist of only gray tones of colors, there are only 256 gray colors. Median filter is used to de-noising the MRI images. A 3x3 median filter is applied on brain MR image in order to remove the noise. Median filtering is a nonlinear method used to remove noise from images. It is widely used, as it is very effective at removing noise while preserving edges. It is effective at removing 'salt and pepper' type noise.

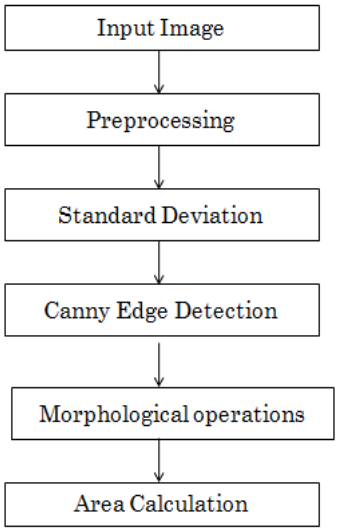

Fig 1: Proposed system

3.3 Standard Deviation

The standard deviation is much more informative, it indicates the variability of gray levels i.e, change in the contrast. The standard deviation is computed as follows. An image f(x,y) and mean intensity of an image is obtained by summing the values of all its pixels and dividing the sum by total number of pixels in the image, standard deviation is,

$$S_d = \sqrt{\frac{1}{MN}\sum_{x=0}^{M-1}\sum_{y=0}^{N-1}(f(x,y) - I_{mean})^2} \qquad (1)$$

The intensity value of the tumor and its surroundings are relatively high with respect to other tissue. Thus when standard deviation of the image is computed it give low standard deviation means they are clustered closely around the mean. Using this standard deviation it is impossible to segment the tumor section. Using this standard deviation intensity map is performed i.e. Intensity values greater than standard deviation set to 255 and less than set to 0.

$$L(x, y) = \begin{cases} 255 & if\ f(x,y) \geq S_d \\ 0 & if\ f(x,y) < S_d \end{cases} \qquad (2)$$

Then standard deviation of the processed image is recomputed. It gives large standard deviation, which indicates that the data points are far from the mean i.e. data points are spread out over the large range of values. Our aim is to set the threshold value in such a way that it is relatively close to the intensity values of the tumor

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boundaries. Using the newly computed standard deviation an average the standard deviation of the original image. The computed average intensity is taken as threshold value to process the entire original image to segment the tumor section from MRI.

$$I(x, y) = \begin{cases} 255 \; if \; f(x,y) \geq I_{average} \\ 0 \quad if \; f(x,y) < I_{average} \end{cases} \qquad (3)$$

border of tumor region canny edge filter is used and is given by canny edge detection method.

3.4 Canny edge detection algorithm

Edge detection is the approach used most frequently for segmenting images based on abrupt changes in intensity. The canny edge operator works in a multi stage process. canny's approach is based on three objectives i.e. low error rate, edge points should be well localized and single edge point response.

- Smooth the input image with a gaussian filter.
- Compute the gradient magnitude and angle image.
- Apply non maxima suppression to the gradient magnitude image.

Canny algorithm was the only procedure capable of yielding a totally unbroken edge for the posterior boundary of the brain.

3.5 Morphological Operators

Size and shape of the structuring element is been controlled by this operation. It consists of dilation operator which will grow or thickens the object. Structuring element plays an important role in both of the operations. Then apply the operations such as opening and closing formed from combining these two (dilation and erosion) operations. After applying all these operations, filling out the tumor (abnormal) region present in the brain.

3.6 Tumor Area Calculation

Number of white pixels (0) in the binary image is used to calculate the tumor area. Binarization method is used for this calculation. The image taken here is a binary image, so it has only black and white pixels. Zero is assigned to black pixel and one is assigned to white pixel. f (1) = white pixel ,f (0) = black pixel .The area calculation formula is ,size of tumor is S=[(√P)*0.264]mm2 Where, P = number of white pixels and value of 1 Pixel = 0.264 mm.

4. Results and Discussion

The proposed algorithm is used to detect the location of the abnormal regions, and border of the abnormal regions and the area of the detected abnormal regions. The output of segmented abnormal regions and border of the abnormal regions plays a vital role in the diagnosis and further treatment of brain abnormal regions.

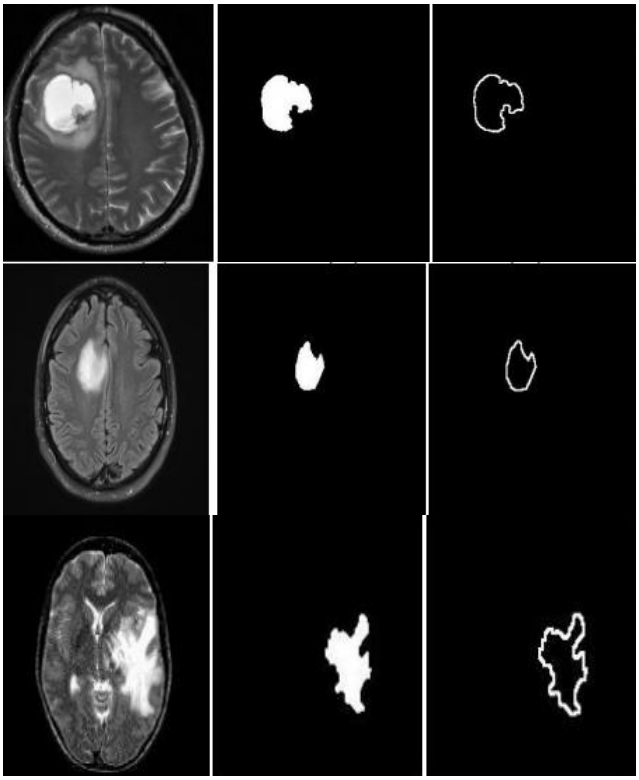

Fig 2: A in column1 is the input MRI Brain Image; B in column2 is the segmented output; C in the column3 are the border of the abnormal region.

5. Conclusion

The proposed algorithm shows an effective method for segmentation of the brain tumors from the 2D MRI images. Detect presence of brain tumor based on thresholding method. Experimental results on data sets show that the proposed method performed automatic detection of brain tumor from mri scans. It also find the area of the tumor portion, minimizing the computational procedure, minimize the manual interaction.

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