NOVEL SEGMENTATION METHOD FOR DETECTION OF TUMORS IN HUMAN BRAIN

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Abstract : ***Tumor is a rapid uncontrolled growth of cells. Now-a-days number of people suffering from brain tumor has increased rapidly. There are several types of tumors in which some are cancerous and some are non-cancerous. Tumor stage generally depends on the size and its growth rate. If the features of tumor in the brain are properly detected at an early stage, it can be treated or removed by the doctor effectively. Thus the life of the patient can be saved by proper detection of tumor cells in the brain.***

There are several fundamental segmentation approaches for the tumor cells detection like K-Means clustering, Threshold based segmentation, Morphological operations, Watershed segmentation, Edge detection methods etc. These methods are used in various sequences in the literature for segmenting out the tumor region. In this paper, we propose novel segmentation method by sequencing fundamental segmentation approaches effectively that segments out the tumor with better PSNR than the existing methods. Further, this method can segment tumors having low contrast in the MRI images. We superimpose this segmented region over the original MRI image for better identification of its structure. Finally we find various region parameters of the tumor like its Area, Diameter, Perimeter and Centroid.

Index Terms* - *Clustering, K-Means, Morphological, MRI Image, Segmentation, Watershed Transform.

I. INTRODUCTION

Image processing is a process where the input image is processed to get output image as per our requirement. Main aim of all image processing techniques is to identify the image or object under consideration easier visually. Image processing is a technique to translate an image into digital form and perform some operations on it, in order to get an enhanced image or to extract some useful information from it.

A Tumor [1], [2], [3], [4] can be defined as a mass which develops without any control of normal forces. Tumor type generally depends on the size and its growth rate. There are mainly two types of tumors. One is Benign Tumor and the other is Malignant. A Benign tumor is small in size and has slower growth rate. It is a non cancerous tumor. A Malignant tumor is large in size and has faster growth rate. It is a cancerous tumor. Various traditional methods available for diagnosis are an expert opinion, human inspection, biopsy etc. Some of the drawbacks of these methods are time consumption, incorrect inspection etc. So various techniques of image processing can be helpful to detect brain tumor.

General Flow of Brain Tumor Detection [2-6]:

Brain tumor detection general flowchart is depicted in Fig. 1

- **Image Acquisition:** Image is acquired by scanning the brain using any of the equipment like MRI (Magnetic Resonance Image), CT (Computed Tomography), Ultra Sound Scanning, X-Ray, PET (Positron Emission Tomography). Among these, MRI is commonly used in the medical field for detection and visualization of details in the internal structure of the body. It is most reliable and safe and does not involve exposing the body to any sort of radiations.
- **Preprocessing:** Images are often subtle by noise. In the very first step we get our input MRI image and apply preprocessing on it. We apply filtering technique on our input image. One of the key research fields in image processing is Image Enhancement. To highlight the essential part of interest, enhancement is done.
- **Segmentation:** Segmentation is necessary and important step in image analysis. It is a method that separates an image into variety of regions or blocks having common and identical properties, such as color, intensity, texture, contrast, brightness, boundaries, and gray level. It simplifies the image into something that is more meaningful and easier to analyze visually.

Various Fundamental Segmentation Methods:

- K-Means clustering method
- Threshold Based segmentation
- Using Morphological Operators
- Using Edge Detection.
- Watershed Segmentation

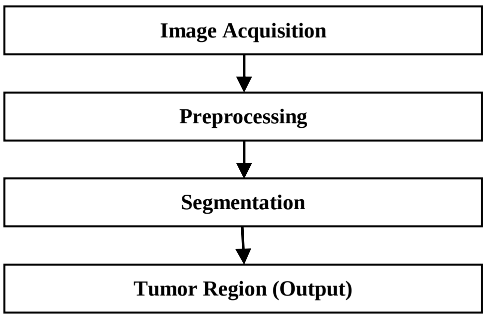


Fig.1: General Flow of Brain Tumor detection

By using the above methods we can segment the tumor part from the MRI image. Each method has its own merits and demerits when used individually. So these methods are combined in a particular sequence in literature to obtain the results accurately.

In the literature, there are many techniques and algorithms which were developed and implemented for image segmentation but still there is a necessity to identify and develop an efficient and fast technique for medical image segmentation, because all these techniques have their own advantages and limitations with reference to their suitability, applicability, performance and computational time.

A comparative study and analysis of various brain tumor detection methods for MRI images by using image processing are seen in [1]. Also comparison and review of different existing work of a variety of researchers in the field of MRI image processing are found in the literature.A new approach for brain tumor detection and classification is proposed in [2]. This new approach is developed to extract brain tumor based on enhanced image and segmentation using threshold and watershed techniques.

Survey of various techniques that are part of Medical Image Processing and prominently used in discovering brain tumors from MRI Images are proposed in [3]. In [4], tumor detection algorithm is divided into two parts: preprocessing and segmentation. For preprocessing the Brain MRI images used local binary pattern. For segmentation of the Brain MRI images it used different techniques like K-means, edge detection and Morphological operations like erosion and dilation. Further all these techniques are combined and observed for the segmentation results.

A novel idea is proposed in [5] for successful identification of the brain tumor using normalized histogram and segmentation using K-means clustering algorithm. Using Naïve Bayes Classifier and Support Vector Machine (SVM), efficient classification of the MRIs is presented so as to provide precise prediction.For automatic brain tumor segmentation an efficient method is developed for the extraction of tumor tissues from MR images in [6]. Here K-means clustering algorithm is used for segmentation for better performance. This enhances and sharpens the tumor boundaries more and is very fast when compared to many other clustering methods. Here K-Means segmentation method and Morphological operators are used for brain tumor detection.

Various types of segmentation methods are used in [7] to segment brain tumors precisely. Also comparison of the result of these segmentation methods by using correlation and structural similarity index (SSIM) to analyses and see the best technique that could be applied to MRI image is presented here.Key interest is shown in [8] on comparative study of techniques for segmenting brain tumor from MRI images. The tumor area is recognized by using different algorithms like seeded region growing and merging, K-Means, KNN, fuzzy C-Means and a comparative study of all these methods is presented here.

Three segmentation methods, k-means clustering with watershed segmentation algorithm, optimized k-means clustering with genetic algorithm and optimized c- means clustering with genetic algorithm are compared in [9].Different aspects of medical imaging especially for the application of diagnosis of brain tumor using MRI is studied in [10]. A review of different brain image segmentation methods presented with their advantages and disadvantages as comparative analysis.

A novel scheme is presented in [11] which uses a two-step procedure; the k-means method and the Hierarchical Centroid Shape Descriptor (HCSD). The clustering stage is applied to discriminate structures based on pixel intensity while the HCSD allow selecting only those having a specific shape.In [12] a strategy for efficient detection of a brain tumor in MRI brain images. The methodology consists of the following steps: preprocessing by using sharpening and median filters, enhancement by histogram equalization; segmentation by thresholding. Then the further application of morphological operations is done. Finally by using the technique of image subtraction the tumor region can be obtained

A computer-based method for defining tumor region in the brain using MRI images is presented in [13].A comparative study of different methods for tumor detection is explained in [14]. Various numbers of methods for tumor detection in image processing such as Edge detection, segmentation (using Watershed transform) are studied. Here, after observing results watershed segmentation gives the exact results i.e. extracted tumor area is observed.

In [15] two filtering techniques (Gaussian, Median) have been applied for enhancement of MRI images. It is observed that,
Median filter removes the noise without eliminating the original details of the image with high accuracy. In this study, segmentation techniques like Otsu's thresholding and Fuzzy C-means are described and compared. An approach. for brain tumor detection and classification is proposed in [16]. This study was developed using agency system classification brain tumors. The suggested method developed to achieve the agency system requirements.

In [17], different edge detection segmentation techniques using MRI brain tumor image were compared with each other and analyzed and the most accurate was found using error measurement techniques. Also the comparative study of several techniques of edge detection segmentation on the brain tumor original image is presented. Watershed transformation technique with gradient magnitude and morphological open image is used in [18] for tumor detection. Here two important features are used as foreground and background to detect the tumor.

A robust segmentation algorithm is used in [19] in order to detect tumor in MRI brain images. For segmentation of primary tumors and its boundary automatically from brain MRIs using morphological filtering techniques, a novel framework is described in [20]. This method uses T2 weighted, T1weighted and FLAIR images.

Automatic segmentation by morphological operations is implemented in [21] and the result is compared with other segmentation techniques like Expectation maximization and Fuzzy C-Means with reference to performance measures and processing time.Illustration of the ability of watershed segmentation is presented in [22] to separate the abnormal tissue from the normal surrounding tissue to get a real identification of involved and noninvolved area that help the surgeon to distinguish the involved area precisely.

An automated method for detecting brain abnormalities and Tumor edema has been proposed in [23] using sobel edge detection method. In [24] a survey is carried out to find the best edge detection method for brain tumor detecting between Robert, Prewitt, and Sobel method. Among these three methods, it is found that Sobel method of edge detection works well for detection of brain tumors.

Noise elimination and image segmentation using edge detection operators is mainly focused in [25]. The edge detection using various edge detection methods like Sobel operator, Prewitt operator, Robert operator, Canny detection, LoG, Expectation-Maximization (EM) algorithm, OSTU and Genetic Algorithm is studied.

By going through different related works of this brain tumor detection, we learnt about various techniques of brain tumor detection. Also we learnt about various advantages and limitations of each technique. Among these papers we have chosen three different papers [6], [14], [23] that have segmented the tumor in a better way using the combination of fundamental segmentation methods .In this paper, we implement these existing methods and use the benefits of these methods to develop a better method than these methods. We develop a method that has better PSNR than these methods for a particular image. Also we find various region properties of the detected tumor like its Area, Perimeter, Centroid, diameter, Mean. Further we develop this method to detect tumors in the images having various contrasts. So this method can be able to identify the tumor in even the low contrasted (where all the pixels of the image are not clearly visible) image also.

Finally we superimpose the detected tumor over the original image with a colored boundary around the tumor for better identification of its structure and location of all its pixels.

II. PROPOSED METHOD

Let us see the process of detection of tumor in this proposed method. Fig. 2 shows the flowchart for proposed method.

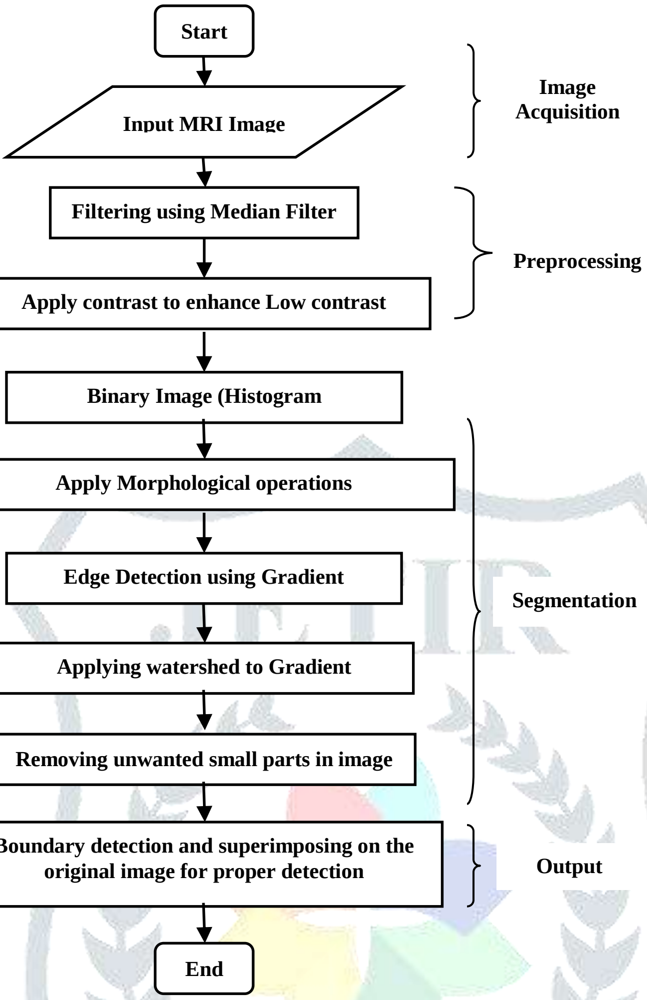


Fig.2: Flow chart for detection of tumor using proposed method

Here we used Histogram thresholding, morphological and watershed segmentation methods. Further this method has the advantage of detecting the low contrast MRI images having tumor. In such images the complete tumor part is not properly visible. This method helps in detecting such images.Also the detected image is given a colored boundary and superimposed on the original image for proper identification of location of every pixel of the complete tumor on the original image. Then the PSNR of the detected tumor is found and is compared with the PSNR of the existing methods. Then we found that the proposed method has better PSNR than the existing methods. Finally various parameters of the detected tumor (Area, Perimeter, Centroid and Diameter) are also calculated.

Here we used the following steps to extract the tumor region:

Step1: Initially the given MRI image into gray scale image.

Step2: Then the gray scale image is passed through the Median filter to remove noise and other spikes. Here, we use median filter [15] for better smoothing of images because it has excellent noise reduction features especially in case of salt and pepper noise. It lessens blurring and heightens perseverance of edges in the image.

Step3: Now some image enhancement techniques are applied to this filtered image so that the sharpened image is obtained.

This helps in improving the contrast of low contrast images for better appearance.

Step4: Then we apply canny edge detection to this enhanced image. The method uses two thresholds to detect strong and weak edges and includes the weak edges in the output only if they are connected to strong edges. This helps in removal of unwanted weak edges.

Step5: Then this image is converted into binary image by using Histogram threshold segmentation.

First the image is divided into two equal halves and the histograms of the two halves are plotted. Then the threshold value is chosen based on the difference between the two histograms. The main benefit of histogram thresholding is, as we select the threshold by difference between the thresholds

This difference gives the unwanted portion (Tumor) in the image. So proper detection of tumor is possible.

Step6: Then by using Morphological erosion and dilation bridges and holes are eliminated out.

Step7: Then the tumor is separated from the above segmented image by using watershed transform. This makes use of Gradient operator. Edges are detected out by using sobel gradient operator. This is given as input for watershed and this divides the images into watersheds and ridge lines. The idea of this technique is derived from a landscape submerged in water. The landscape image comprises different regions; each of which has a diverse intensity from other. The watershed segmentation separates the regions according to these diverse intensities. Different regions are filled with different colors .This separates out the tumor region.

Step 8: Only that part of the image having the tumor is selected with the part of the image having more Intensity and more area. Thus the tumor region is segmented out.
Step9: Now the edge or boundary of the tumor region is detected and given a color .This colored boundary is placed over the original image for proper identification of location of every pixel of the complete tumor on the original image.
Step10: Then PSNR of this method is calculated and compared with the existing methods.
Step11: Also various parameters (Area, Perimeter, Centroid and Diameter) of the tumor region are also calculated.

III. MATHEMATICAL ANALYSIS

3.1 Thresholding: [7], [10], [12], [13], [14], [15]

This image analysis technique is a type of image segmentation that isolates objects by converting grayscale images into binary images..Converts Grayscale image (0 to 255) into Binary image (0 or 1).

Pixel intensity < Threshold => Black (0) Pixel intensity > Threshold => White (1)

Fig. 3 shows the flowchart for choosing a threshold value for a given image.

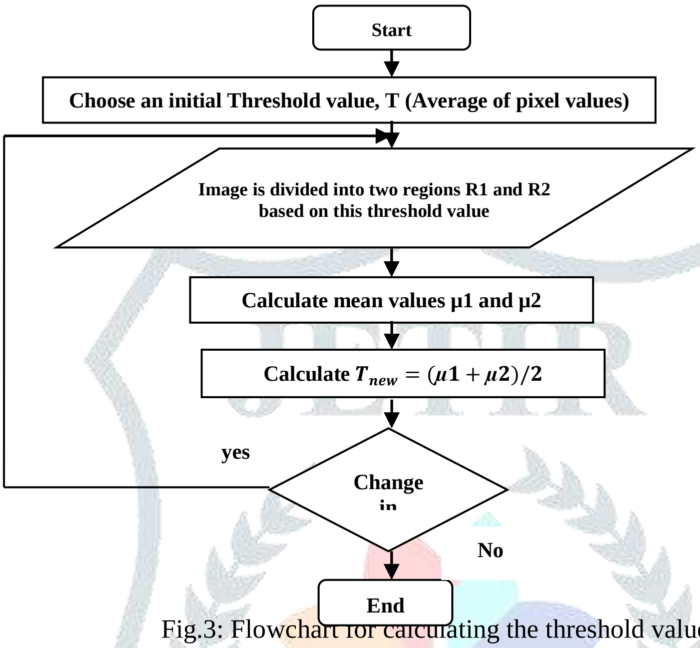


Fig.3: Flowchart for calculating the threshold value

- **Histogram Thresholding: [13]**
  Histogram is a plot between number of pixel and pixel intensity. To plot the histogram, bar graph can be used. The histogram code operates by first reading the grayscale value at the first entry and coming up with pixel intensity between 0 and 255. It increments the total number of pixels and then it will move on to the next row or column entry until it finishes reading all the raster data. However, while it is reading each entry, if it picks up pixel intensity value more than once it will increment that particular value.
- **Algorithm for Segmentation Through Histogram Thresholding:**
  Step 1: The MRI image of the brain is divided into two equal halves around its central axis and the histogram of each part is drawn. By this the infectious side of the brain is found.
  Step 2: Based on a comparison technique made among the two histograms, the threshold point of the histograms is calculated.
  Step 3: Then segmentation is done based on the threshold point.
  Step 4: To find out the physical dimension of the tumor the detected image is cropped along its contour.
  Step 5: Create an image of the original size, check the segmented images pixel value; if it's value is greater than threshold value, assign 255 else 0.
  Step 6: Segmented image is displayed.

3.2 Morphological Operations: [7], [14], [16], [18], [19], [20]

Morphing means changing an image from one form to another form required, by small gradual steps. Here we make use of some operators for segmenting the required part in the image. It is applied on Binary images. There are 4 types of morphological operators(Erosion, Dilation, Opening, Closing).
For all these operations we make use of a structural element.

- **Structural Element: [19], [20]** It is a mask containing pixels of 0 or 1.It's size varies from 3X3 to 21X21.This mask is moved over the image sequentially to add or eliminate pixels required. Shape of the mask can be disk or box or hexagonal etc.,
- **Erosion: [19], [20]** Shrinking of an image by removing unwanted pixels. An erosion of an image I by the structure element H is given by the set operation

$$I \Theta H = \{ p \in Z^2 \mid (p+q) \in I, q \in H \qquad \textbf{(1)}$$

Where Z indicates Sample Space of image

- **Dilation: [19], [20]** Expansion of image by adding pixels. A dilation of an image I by the structural element H is given by the set operation

$$I \oplus H = \{ (p+q) \mid p \in I, q \in H \} \qquad \textbf{(2)}$$

Dilation alone leads to additional boundaries in an image. Erosion alone leads to under segmentation. So we make use of both dilation and erosion to segment out the required part in an image accurately. There comes the concept of opening and closing.

- **Opening:** Opening means Erosion followed by dilation.

$$I \circ H = (I \Theta H) \oplus H \quad \textbf{(3)}$$

This is also useful for removing the bridges between two parts in an image. Opening of an image I by the structural element H is given by the set operation

- **Closing:** Closing means Dilation followed by erosion. This is done in order to fill the holes in an image. Closing of an image I by the structural element H is given by the set operation

$$I \bullet H = (I \oplus H) \Theta H \quad \textbf{(4)}$$

3.3 K-Means Clustering: [5], [11]

Clustering means "Grouping of objects which are similar in certain characteristics". K-means clustering aims to partition **n observations** into **k clusters.** Each observation belongs to the cluster with the nearest mean. k clusters or groups and cluster center is selected randomly by the user for each group. Euclidean distance is calculated between the cluster center and every pixel of the given image. Pixels are assigned to those cluster centers having minimum distance from center. The position of the cluster center is re-calculated by taking the average of all pixel intensities of a cluster: The process is repeated until there is no change in the new cluster center values. This finally divides the image into k clusters .Finally we divide the brain MRI image into k number of clusters by which we can detect the tumor part.

- **Euclidean Distance:**

Let di indicates the total pixels in the image, Where $(1 \le i \le n)$, c_j indicates centroids ($1 \le j \le k$), centroid is C (c1, c2), pixel position is P (p1, p2)

Then Euclidean distance is given by,

$$D(C, P) = \sqrt{\left[(p1-c1)^2+(p2-c2)^2\right]} \quad \textbf{(5)}$$

3.4 Edge Detection: [9], [10], [14], [17], [22], [23], [24], [25]

The points where brightness of image alter sharply are generally organized into a bunch of curved line segments called *edges*. Edge detection operator is implemented with convolution masks. Here we use gradient operators to detect the edges. By this edges are segmented out effectively.. This method makes use of 'Masks'. Mask is a small square matrix of pixels. There are various Edge Detection methods of which we are using sobel Edge detection method.

Among these masks Sobel mask which can be seen in Fig. 5 gives the best results in detection of tumor part (edges are sharper than other methods.)

- **Sobel Edge Detector:** The sobel edge detector method uses the approach of calculating the gradient by utilizing the discrete differences between columns and rows of a 3X3 neighborhood. It uses the approach of convolution of the image with a minor, discrete, and numeral valued filter.

Masking Process: [24] To compute the values of Δx and Δy , the x and y masks of a particular operator are first convolved with the image. From these values, then the magnitude and angle of the edges are calculated. Then these are stored (usually) as two detach image frames. Thus we obtain the edge detected images. Mask is made to move over the image sequentially. When the mask is placed on the image, the central pixel value is replaced by the Response value obtained by convolving image pixel with mask pixel.

The edge detection process uses the most common type of a gradient operator, of which there have been numerous variations. Mathematically, for an image function, f(x,y), the gradient magnitude, g(x,y) is computed as

$$g(x,y) \cong \left(\Delta x^2 + \Delta y^2\right)^{\frac{1}{2}} \quad \textbf{(6)}$$

Where,
$$\Delta x = f(x+n, y) - f(x-n, y)$$
$$\Delta y = f(x, y+n) - f(x, y-n)$$

3.5 Watershed Segmentation: [9], [10], [14], [16], [18], [22]

It is a Complimentary approach for segmentation of objects. It works on binary image. It works good in case of weak edges. It uses intensity as a parameter to segment the whole image dataset. Considering image as a surface, by using watershed transformation image is converted into catchment basins (objects we need to detect) and watershed lines. The key behind using the watershed transform for segmentation is this: Convert your image into another image whose catchment basins are the objects you want to recognize.

- **Using Distance Transformation: [18]** For a given binary image,distance from every pixel to the nearest nonzero valued pixel is caluculated and the resultant image gives a distance transformed imageBinary image is converted into distance transformed image.Watershed is then applied to this distance transformed image that converts pixels with value '0' to watershed ridge lines and pixels with positive values to catchment basins.
- **Using Gradient Magnitude:** The gradient magnitude image has higher pixel values along object edges and lower pixel values otherwise. By using gradient magnitude operator edges are detected out by using the equ (6). Then it is provided as an input to watershed segmentation that divides the images into ridges and watershed regions.

3.6 PARAMETERS:

PSNR: [5], [8], [14], [19], [22] PSNR means "Peak Signal To Noise Ratio". It is mainly used for Quality measurement. Higher is the PSNR value better is the quality of the image detected.

$$PSNR = 10\log_{10}\left(\frac{MAX_I^2}{MSE}\right) \quad \textbf{(7)}$$

MAX_I^2 indicates the maximum pixel value in the image
MSE indicates Mean Square Error value.

$$MSE = \frac{1}{mn}\sum_{i=0}^{m-1}\sum_{j=0}^{n-1}\left[I(i,j) - K(i,j)\right]^2 \qquad (8)$$

m indicates number of rows, n indicates number of columns
I(i,j) indicates original input image, K(i,j) indicates output image.
Area: It is the actual number of pixels in the region. It helps in finding the physical dimension of the tumor, using the following algorithm.
Diameter: It indicates length of the major axis of the region. Diameter of a circle with the same area as the region, returned as a scalar. It is given by,

D=sqrt (4*Area/pi) **(9)**

1	2	1
0	0	0
-1	-2	-1

-1	0	1
-2	0	2
-1	0	1

Fig.5: Masks for Sobel Operator along X-axis and Y-axis
Centroid: Centroid is the center of mass of the region. It is returned as a 1-by-Q vector. Here horizontal coordinate (or x-coordinate) is the first element and vertical coordinate (or y-coordinate) is the second element of the center of mass.
For a binary region centroid is the arithmetic mean of all (x,y) coordinates in that region

$$\bar{x} = \frac{1}{|R|}\sum_{(u,v)\in R} u \qquad \textbf{(10)}$$

$$\bar{y} = \frac{1}{|R|}\sum_{(u,v)\in R} v \qquad \textbf{(11)}$$

Perimeter: Distance around the boundary of the region is termed as its perimeter. It is a scalar quantity. It is computed by calculating the distance between each adjoining pair of pixels around the border of the region.

IV. RESULTS AND DISCUSSION.

Here we have implemented three different existing methods of brain tumor detection for a particular image and obtained the results of these methods for comparing the PSNR of these methods with the proposed method of the same particular image.

4.1 Existing Methods:

Method1: Here we have implemented the methodology proposed in [6]. Fig. 6 shows the results of sequence of operations proposed in [6] for detecting the tumor.

Method2: Here we have implemented the methodology proposed in [23]. Fig. 7 shows the results of sequence of operations proposed in [23] for detecting the tumor.

Method3: Here we have implemented the methodology proposed in [14]. Fig. 8 shows the outputs of sequence of operations proposed in [14] for detecting the tumor.

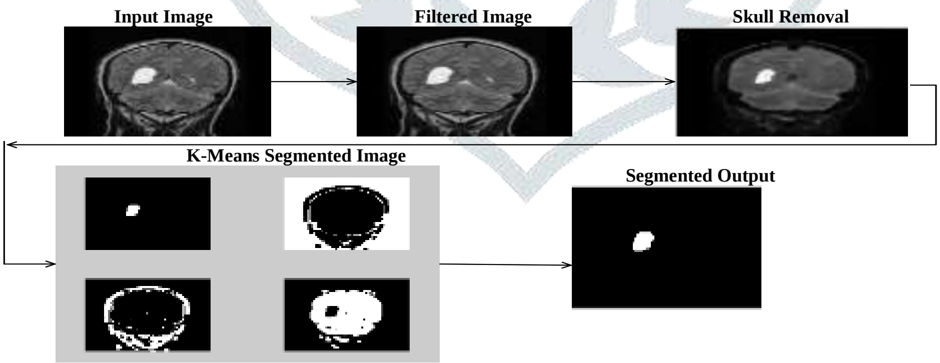


Fig.6: Output results of Method1 [6]

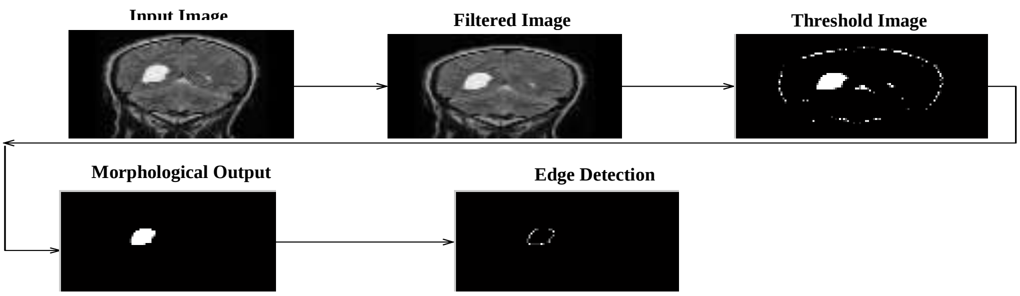


Fig.7: Output results of Method2 [23]

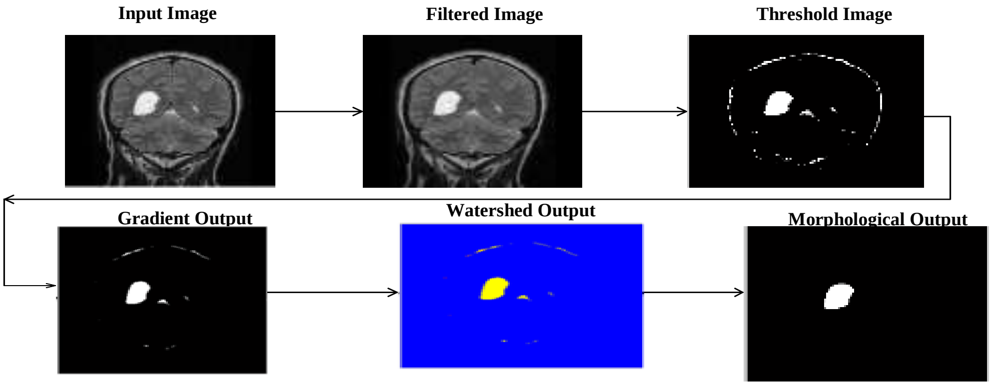


Fig.8: Output results of Method3 [14]

4.2 Proposed Method:

Fig. 9 shows the outputs of sequence of operations of our proposed method. Here initially the original input image is filtered using the median filter. Then image contrasting is applied to highlight the low contrast images. Then we apply histogram thresholding by dividing the image into two halves and convert the image into a binary image. Then the bridges and holes are removed using the morphological operators (erosion and dilation). Then the edges are detected using the sobel edge gradient operator. This is provided as input for watershed segmentation. By using this watershed segmentation the image region is divided into ridges and watersheds. Subsequently, the unwanted small particles around the tumor are removed. Finally this tumor detected region is given a colored boundary and superimposed on the original image to have clear identification of its exact location.

4.2.1 For Low Contrast Images:

Our proposed method also works in case of low contrast images where the complete tumor region is not clearly visible. In Fig. 10, we can see the tumor detection process for a low contrast image.

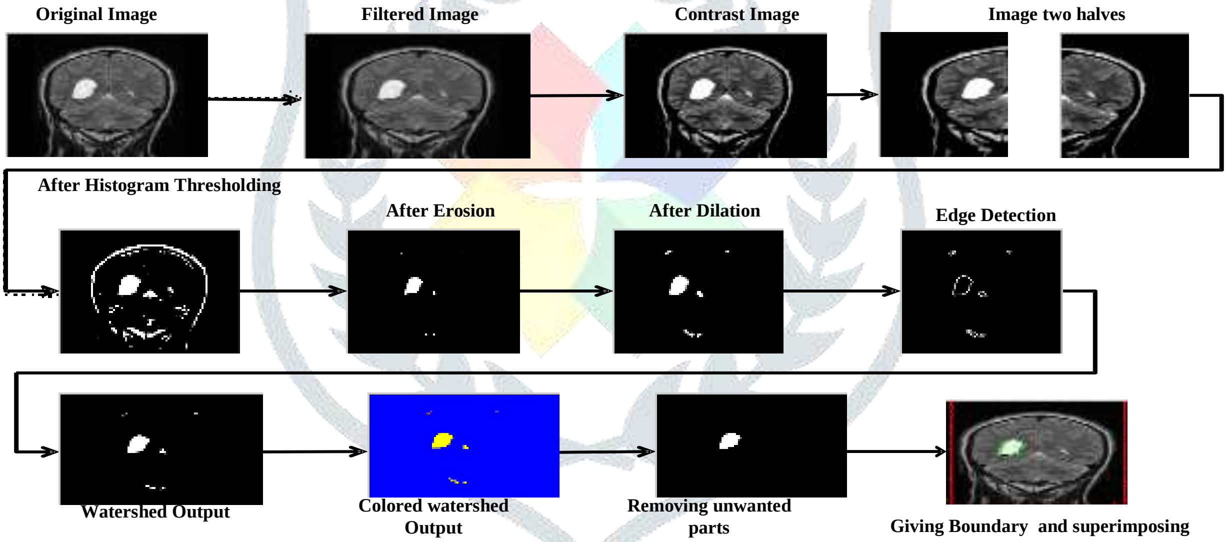


Fig.9: Output results of proposed method

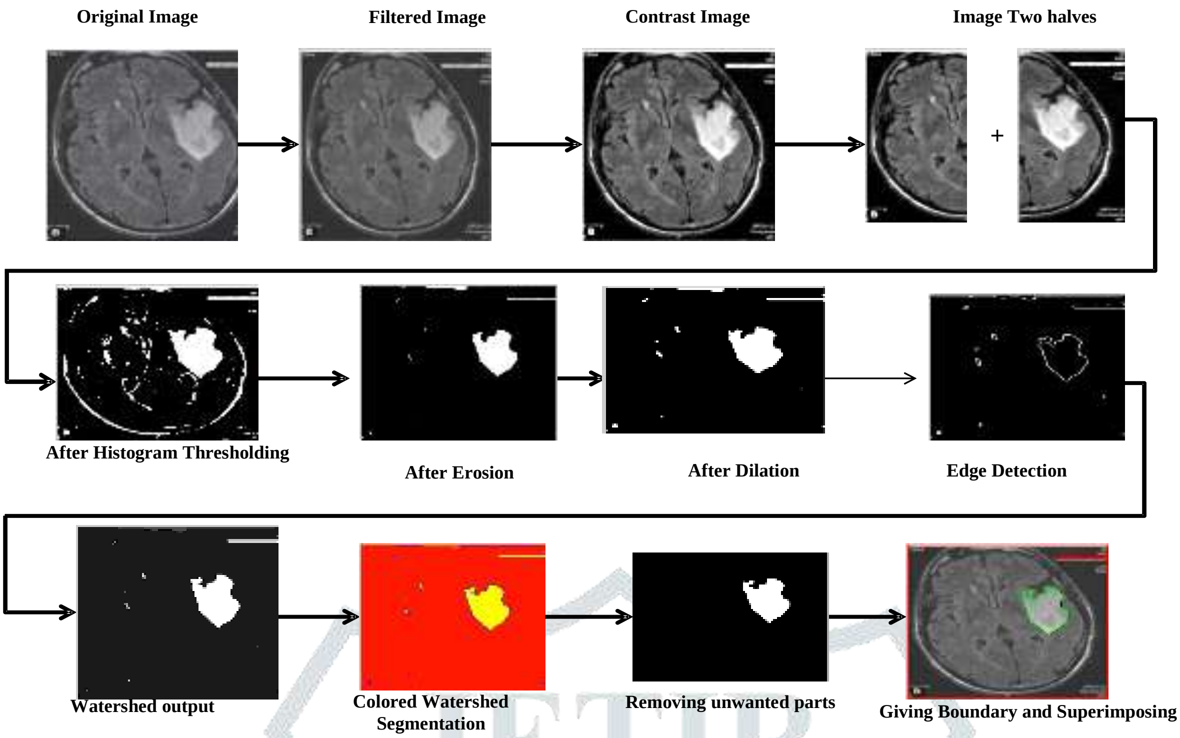


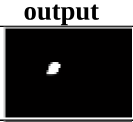
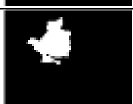
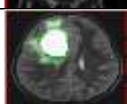
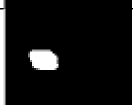
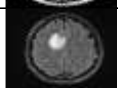
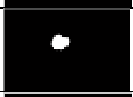
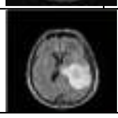
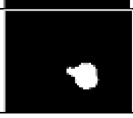
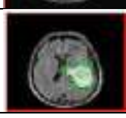
Fig.10: Output results of implementing proposed method for Low Contrast images

Comparison of PSNR values of existing methods and proposed method is depicted in Table 1. In Table 2, Detected tumor output and superimposed output on input image can be seen for various brain tumor input images. Images at shown at S. No. 1, 2, and 3 are of High Contrast, S. No. 4 and 5 are of Medium Contrast and S. No. 6 and 7 are of Low contrast types. Table 3 shows the tumor region properties of various detected images for a given input image.

Table1: Comparison of PSNR values of existing methods and proposed method.

Fig. S. No.	Existing Methods PSNR(dB)			Proposed Method (dB)
	Method1 [6]	Method2 [23]	Method3 [14]	
1	27.0330	27.0201	31.4090	34.3006
2	26.7279	26.7110	32.4074	35.2321
3	21.1408	21.6964	26.4216	37.6215
4	18.1716	18.1516	21.9871	24.8842
5	24.1430	24.1143	28.2673	32.0663
6	21.6688	21.6534	26.0627	29.3363
7	19.1438	19.1274	24.3752	26.3589

Table2: Output Tumor region and superimposed images of various input MRI images using proposed method.

S. No.	Input Image	Detected Tumor output	Superimposed Image
1			
2			
3			
4			
5			

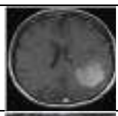
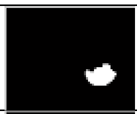
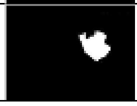
6			
7			

Table3: Region parameters of Tumor region detected

Fig. S.No.	Area (mm^2)	Perimeter (mm)	Centroid		Diameter (mm)	Mean
			X	Y		
1	771	104.8	98.1	115.1	31.3	41.9433
2	1521	153	115.2	105.2	44.0	47.1929
3	6472	390	98.3	87.8	90.8	67.7656
4	1586	146.9	71.5	113.5	44.9	78.9663
5	826	110.6	88.3	86.8	32.4	42.6318
6	1420	151.7	139.7	144.5	42.5	63.6782
7	4879	338.6	212.1	146.5	78.8	86.6274

V. CONCLUSION

Normal MRI brain images are not much suitable for proper tumor detection. We made further processing on these images by preprocessing and segmenting to detect the tumor part effectively. There are several fundamental segmentation approaches for the tumor cells detection out of which K-Means clustering method is mostly used because of the dimensionality reduction. Further there are methods like threshold based segmentation, using morphological operations, watershed segmentation, edge detection methods. These methods are used in various sequences in the literature for segmenting out the tumor region. In this paper, we developed a novel method by effectively sequencing the existing fundamental approaches to segment out the tumor with better PSNR than existing methods. We also segmented tumors having low contrast by using our proposed method. We superimposed this segmented tumor part with colored boundary over the original MRI image for better identification of its structure and location. Finally we found various region parameters of the tumor like it's Area, Diameter, Perimeter and Centroid.

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