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Brain Tumor Detection Using Clustering Method

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Abstract— In this paper, an algorithm about brain tumor detection using the K- means clustering and graphcut technique that uses the color based segmentation method to track tumor objects in magnetic resonance (MR) brain images.Magnetic resonance imaging (MRI) is a advanced medical imaging technique giving rich information about the human soft tissue anatomy.Magnetic Resonance Imaging has become a widely used method of high quality medical imaging..Tumor is an uncontrolled development of tissues in any part of the body. Brain tumor is intrinsically genuine and lifethreatening. Immense quantities of passings have been checked because of the reality of incorrect recognition. Brain tumor detection in magnetic resonance imaging (MRI) has become an emergent research area in the field of medical imaging system. Brain tumor detection helps in finding the correct size, shape, boundary extraction and area of tumor. A comparative study on clustering with K-Means algorithm and graphcut algorithm was also done with the MRI image dataset using MATLAB.

Keywords- Brain Tumor,Clustering,K-means,Magnetic Resonance Imaging (MRI),Thresholding, Histogram-Based method, Graphcut

I. INTRODUCTION

The brain is a soft, delicate, non-replaceable and spongy mass of tissue. It is a stable place for patterns to enter and stabilize among each other.Brain is one of the largest and most complex organs in the human body.Brain contains billions of nerve cells organized in designs that arrange thought, feeling, conduct, development and sensation. A confounded thruway arrangement of nerves interfaces your brain to whatever remains of your body, so correspondence can happen in split seconds. While every one of the parts of your brain cooperate, each part is in charge of a particular capacity controlling everything from your heart rate to your state of mood. A brain tumor happens when unusual cells form within the brain.“Tumor" in the first more extensive sense means any encircled increment in volume of a tissue (a swelling).

Benign brain tumors

Benign brain tumors are typically characterized as a gathering of comparable cells that don’t take after ordinary cell division and development designs and form into a mass of cells that microscopically do not have characteristic appearance of a cancer.

Malignant brain tumor

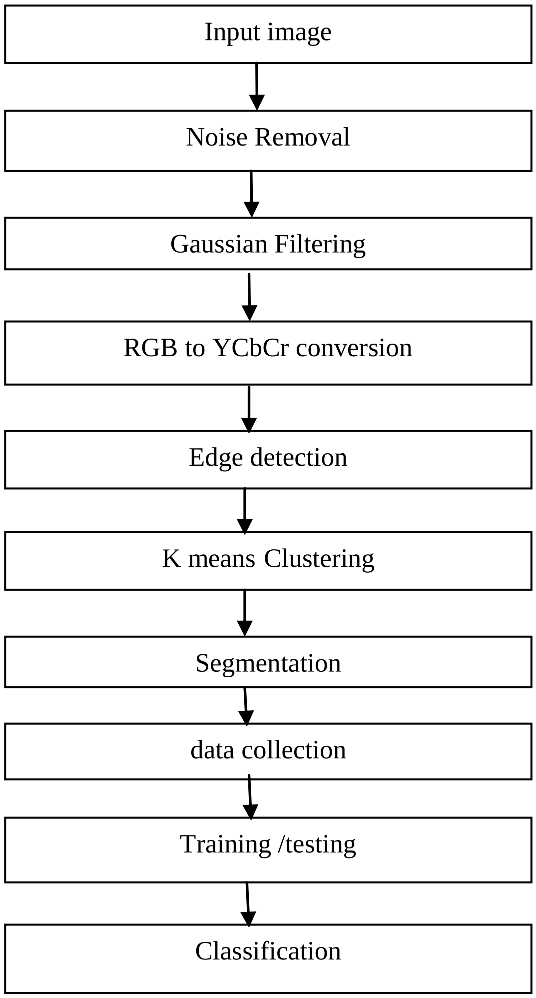
Malignant brain tumor is forceful in nature, started from the brain and can spread quick to other parts of the central nervous system. Malignant brain tumor is shaped because of unusual cancerous proliferation of the cells in the brain tissues.

II. METHODOLOGY

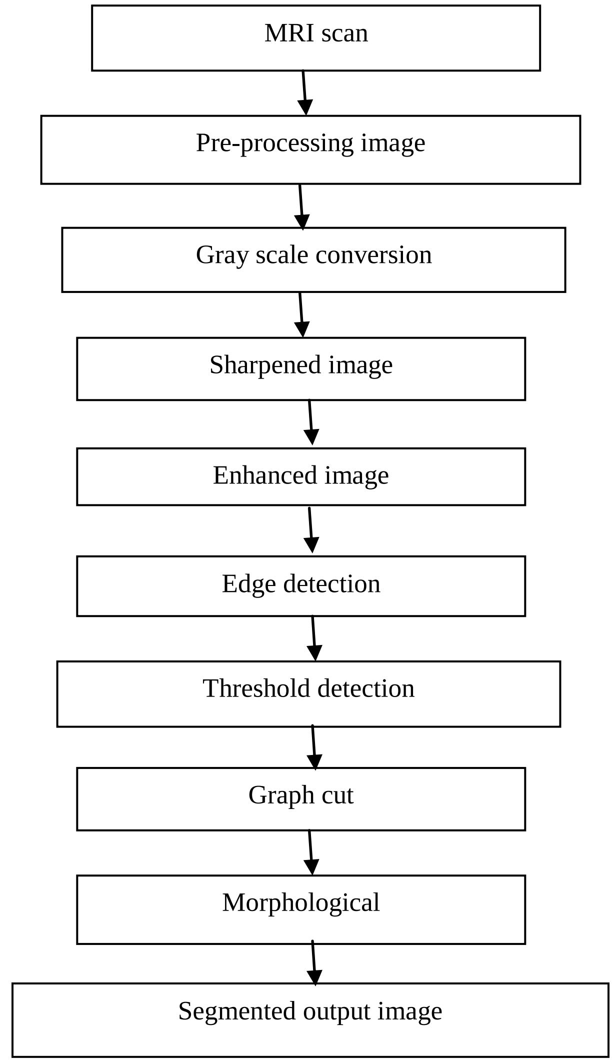
Brain tumor and program code will be written and modeled in MATLAb using image processing tool.The algorithm has two stages, first is K-mean clutering in MRI image shown fig(1) and second graph-cut is shown in fig(2).

III. PROPOSED METHOD

- Firstly,they started with Input Image.
- Apply Gaussian Filtering to enhance the quality of image.
- Then they converted to RGB to YCbCr conversion
- After edge detection is identified for tumor boundaries.
- Compute K-means process



Fig(1) : K-means Clustering



Fig(2) : Graphcut

The part of the image that has the tumor has greater force in that part and we can make our assumptions about the radius of the tumor in the image, these are the basic things considered in the C-Means algorithm . First of all some image enhancement and noise reduction techniques are utilized to enhance the image quality, after that some morphological tasks are applied to detect the tumor in the image. The morphological tasks are essentially connected on a few suppositions about the size and state of the tumor and at last the tumor is mapped onto the original gray scale image with 255 force to make obvious the tumor in the image. The algorithm has been attempted on various diverse images from various edges and has constantly given the right wanted outcome.

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- Give an Input image.
- Preprocessing methods removed for Noise Removal
- Then they converted to Gray scale conversion
- After edge detection is identified for tumor boundaries.
- Compute GraphCut method

Here Interactive division includes forcing both Hard Constraints (Indicate the pixels of the object region and thebackground region by the user) and soft constraints (Boundary and area properties of the sections).

Implemented algorithm will be tried on both the Synthetic therapeutic images (Brain MRI) and Non- medical images. The impact of adding commotion to the first image on the actual segmentation is considered. This approach is contrasted and the Existing.

K-Means Clustering

A cluster is a collection of objects which are similar are grouped together and are dissimilar to the objects belonging to other clusters. Clustering is an unsupervised learning method which manages finding a structure in a gathering of unlabeled data. Another meaning of clustering could be the way toward sorting out articles into groups whose individuals are comparative somehow.K-means clustering is an algorithm to group objects based on qualities/ features into k number of groups where k is a positive whole number. The grouping (clustering) is done based on the Euclidean distance between data and the corresponding cluster centroid. Thus the purpose of k-means clustering is to cluster the data.

K-means Clustering Algorithm:

K-Means algorithm is an unsupervised clustering algorithm that orders the input data points into multiple classes in view on their inherent separation from each other. The algorithm expect that the data features form a vector space and attempts to find natural clustering in them. The points are clustered around centroids

$$\mu i \forall i = 1 \ldots k$$

which are obtained by minimizing the objective

$$V = \sum_{i=1}^{k} \sum_{zj \in Si} (xj - \mu i)^2$$

Where there are k clusters Si, i=1,2,..., k and µi is the centroind or mean point of all the points xi ε Si

As a piece of this endeavor, an iterative variation of the algorithm was executed. The algorithm takes a 2 dimensional image as input. Diverse walks in the algorithm are according to the accompanying:

1. First they Process the power distribution(also called the histogram) of the forces.
2. After Initialize the centroids with k random intensities.
3. Then Repeat the accompanying strides until the point when the cluster marks of the image does not change any longer.
4. The Cluster the concentrations in perspective of partition of their forces from the centroid powers.

$$c^{(i)} := \arg\min \| x^{(i)} - \mu j \|^2$$

5. Compute the new centroid for each of the clusters.

Steps of the K-Means clustering algorithm

Initialization – define the number of clusters and randomly select the position of the centers for each cluster or directly create k seed points as cluster centers.

1. Assign each data point to the nearest cluster center.
2. Calculate the new cluster centers for clusters receiving new data points and for clusters losing data points.
3. Repeat the steps 2 and 3 until a convergence criterion is met (when there is no exchange of data points between the k clusters). The aim of the K-Means is the minimization of an objective Function.

It is the distance measure (usually Euclidian metric) between a data point $x_i^{(j)}$ and the cluster center c j (this is an indicator of the distance of the n data points from the cluster centers). There are situations when the K-Means algorithm doesn't find the optimal solution corresponding to the global objective function J and in addition is sensitive to the initialisation process that selects the initial cluster centers that are usually randomly picked from input data.

The main advantages of this algorithm are its effortlessness and low computational cost, which allows it to run efficiently on large datasets.The main drawback is the fact that it does not systematically yield the same result each time the algorithm is executed and the resulting clusters depend on the initial assignments. The K-Means algorithm maximizes inter-cluster (or minimizes intra-cluster) variance, but does not ensure that the algorithm will not converge to local minima due to an improper starting condition (initialization of the cluster centers).K- means is a widely used clustering algorithm to partition data into k clusters.Clusteing this the process for grouping data points with similar feature vectors into a single cluster and for grouping data points with dissimilar feature vectors into different clusters. Let the feature vectors derived from l clustered data be X-{Xi/i=1,2---------l} .

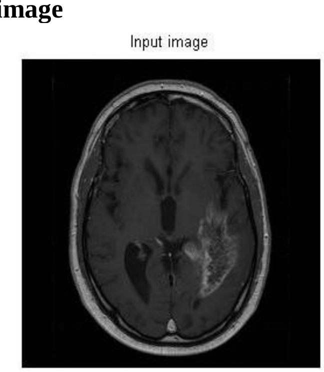
The generalized algorithem initiates k cluster centroids C={Cj/j=1,2,--------k} by randomly selecting k feature vectors from X. Later the feature vectors are grouped are grouped into k clusters using a selected distance measure such Euclidean distance so that

d=mod(Xi-Cj).

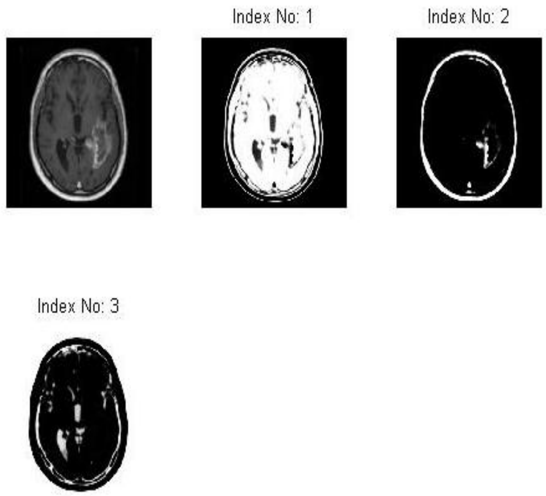
Detection of Brain Tumor using K-means

Using MATLAB program we got the following images as results in brain tumour detection

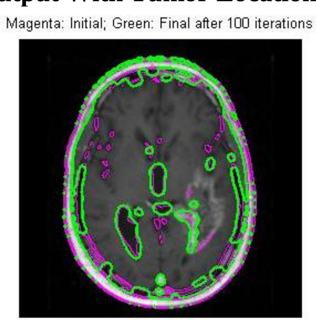
Step 1:Input image



Step 2: Clustering image



Step 3: Output With Tumor Location



Thresholding

Gray level thresholding is the simplest segmentation process. Many objects or image regions are characterized by consistent reflectivity or light assimilation of their surface. Thresholding is computationally inexpensive and fast and should effortlessly be done in real time utilizing specialized hardware.

complete segmentation of image *R* is a finite set of regions *R1, . . .RS,*

$$g(i,j) = 1 \text{ for } f(i,j) \geq T$$
$$\quad\;\; = 0 \text{ for } f(i,j) < T$$

For binary images, there is a single threshold

$$R = \bigcup_{i=1}^{s} R_i \qquad R_i \cap R_j = \theta \quad i \neq j$$

Search all the pixels *f(i,j)* of the image *f*. An image element *g(i,j)* of the segmented image is an object pixel if *f(i,j) >=T*, and is a background pixel otherwise.In many vision applications.Thresholding frequently gives a simple and advantageous approach to play out this division based on the distinctive powers or hues in the closer view and foundation districts of a image. In addition, it is often useful to be able to see what areas of an image consist of pixels whose values lie within a specified range, or *band* of intensities (or colors). Thresholding can be used for this as well.

Image Segmentation By Thresholding

Characterizing a region of enthusiasm before image segmentation will confine the preparing the characterized locale so no figuring asset is squandered for other unimportant territories. This likewise lessens the measure of altering required after image segmentation since protest limits are produced inside the characterized regions. image segmentation by thresholding is a simple however great approach for pictures containing strong articles which are discernable from the foundation or different questions as far as pixel force esteems. The pixel limits are typically balanced intuitively and shown continuously on screen. At the point when the qualities are characterized appropriately, the limits are followed for all pixels inside the range in the image. Greyscale thresholding functions admirably when a image that has uniform locales and differentiating foundation. Following area examines a portion of the image segmentation methods actualized in the product.

Histogram-based methods

Histogram-based methods are exceptionally effective when contrasted with other image segmentation methods since they normally require just a single go through the pixels. In this technique, a histogram is processed from the majority of the pixels in the image, and the pinnacles and valleys in the histogram are utilized to find the clusters in the image. Color or intensity can be utilized as the measure.

A refinement of this procedure is to recursively apply the histogram-seeking method to clusters in the image with a specific end goal to separate them into smaller clusters. This is rehashed with smaller and smaller clusters until the point that no more clusters are shaped.

One detriment of the histogram- seeking method is that it might be hard to recognize critical pinnacles and valleys in the image. In this method of image classification distance metric and incorporated district coordinating are recognizable.

Pixel-Based Segmentation using Region-Growing

Region-based methods are complementary to the edge-based methods. In this method the region-growing is performed as a preprocessing stage. Unsupervised clustering is performed on the image, resulting in isolated regions of similarity, which are then used in the subsequent segmentation. The presence of anomalous pixels in a region can then be used as evidence for the region belonging to the foreground, and region models can be developed as before.

A conceivable favorable position to this method is that comparable pixels are spatially connected preceding any preparing being done, which ought to empower network of portioned areas. This would require high affectability on the parameters of the underlying clustering.Region developing is a way to deal with image segmentation in which neighboring pixels are analyzed and added to a district class if no edges are recognized. This procedure is iterated for every limit pixel in the locale. In the event that adjoining areas are discovered, a locale combining calculation is utilized as a part of which powerless edges are broken down and solid edges are left in judgment.

An example of how a region is grown

a. The seeds are found using specific criteria

b . The seeds are selected as the starting point of a region.

c. All neighbouring pixels of the seeds with similar characteristics are included in the region.

d. All other pixels surrounding the region which also have similar characteristics to the region are included into the region.

e & f Repeat section (d) until all pixels have been grown.

Color Image Segmentation Using a Region Growing Method

Normal methodologies for color image segmentation are clustering algorithms, for example, k-means or Mixture of Principal Components , anyway these algorithms don't consider spatial data. Moreover, clustering algorithms require earlier data with respect to number of clusters, which is a troublesome or equivocal errand, requiring the affirmation of some measure on the plain idea of the clusters being formed. Some advance has been made on this issue, anyway much experimentation still should be finished.

An elective set of algorithms exists which utilizes color similarity and a region-growing approach to deal with spatial data . Locale developing depends on the accompanying standards. The algorithm begins with a seed pixel, looks at neighborhood pixels around it, decides the most comparable one, which is then incorporated into the locale on the off chance that it meets certain criteria. This procedure is taken after until the point when no more pixels can be included. The meaning of similitude might be set in any number of various ways.

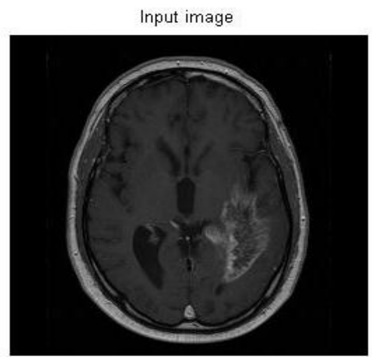
The Region growing algorithms have been utilized generally in the examination of the grayscale images; in any case, some huge work has been finished in the color realm by Tremeau et al. They talk about the segmentation of color regions which are homogeneous in color (i.e., no light impacts are considered) consequently limiting the application area. They utilize a set of thresholds when calculating whether a color pixel is a piece of a region or not, and the Euclidean distance is utilized an as the measure of comparability between two color vectors.

Region Growing Algorithm

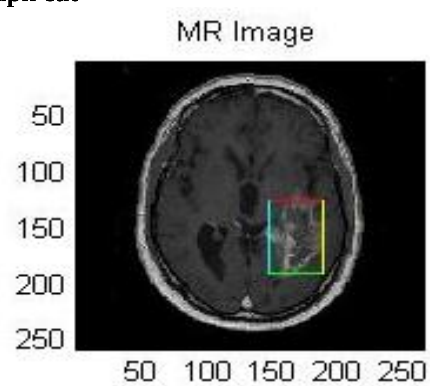
A region growing algorithm is proposed in this paper in light of the vector angle color similarity measure and the utilization of the vital segment of the covariance matrix as the " characteristic " color of the region, with the objective of a region-based segmentation which is perceptually-based.

Detection of Brain Tumor using GraphCut

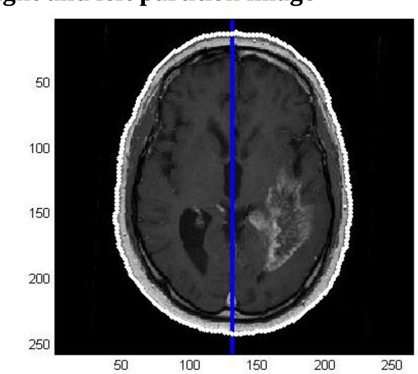
Step 1:Input image



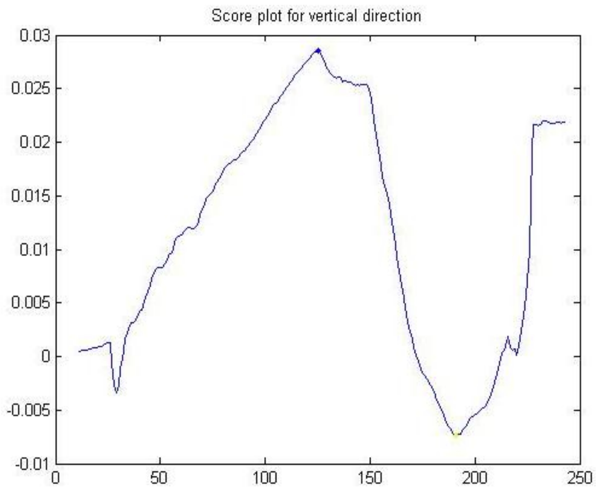
Step 2:Graph cut

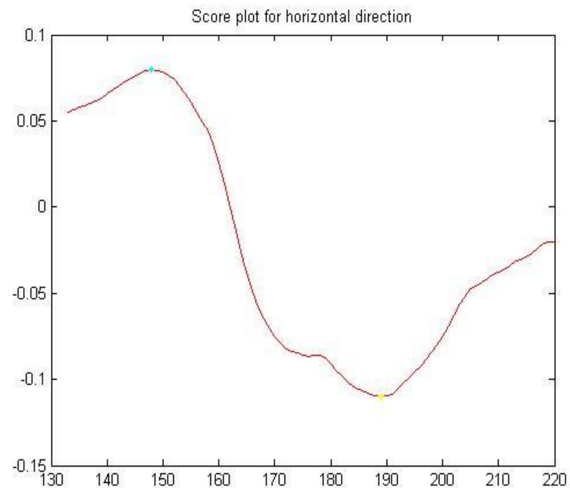


Step 3: Right and left partition image

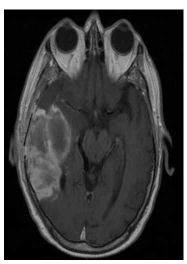
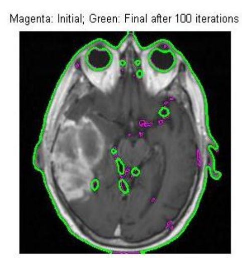
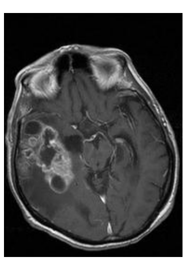
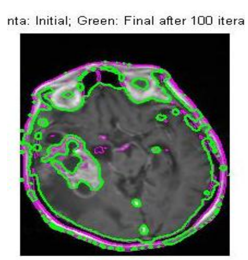
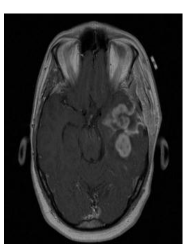
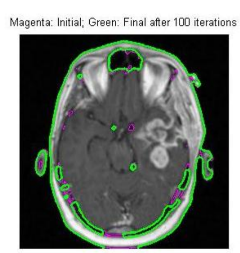


Step 4 : Tumor occur in vertical direction graph and horizontal direction graph

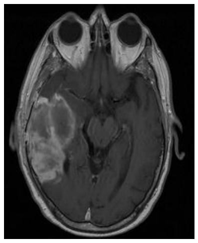
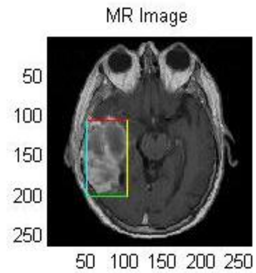
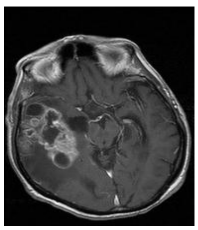
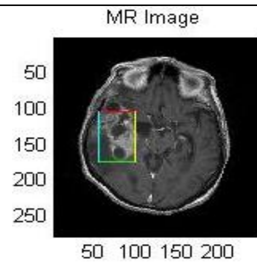
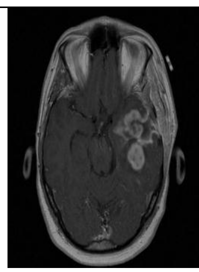
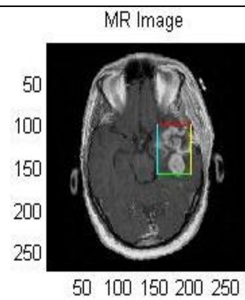




Output from K-means method

Name	Input	Output	Type	
Aa			Benign	Area 6402.0 Perimeter 1110.8 Centroid 77.3 149.1 Diameter 90.3
Bb			Malignant	Area 23795.0 Perimeter 971.0 Centroid 95.9 150.5 Diameter 174.1
Cc			Malignant	Area 9.0 Perimeter 7.7 Centroid 29.1 143.3 Diameter 3.4

Output from GraphCut method

Name	Input	Output	Type	
Aa			Benign	Area 41692.0 Perimeter 861.6 Centroid 132.7 130.6 Diameter 230.4
Bb			Malignant	Area 32247.0 Perimeter 710.0 Centroid 124.6 138.7 Diameter 202.6
Cc			Malignant	Area 38515.0 Perimeter 904.1 Centroid 138.4 134.7 Diameter 221.4

IV. CONCLUSION AND FUTURE WORK

This paper describes Brain tumor detection, Segmentation by using K-means and thresholding algorithm and describes the comparative study about the tumor detection.There are different types of tumours are available. They may be as mass in brain or malignant over the brain. Suppose if it is a mass then K- means algorithm is sufficient to extricate it from the brain cells.If there is any noise are present in the MR image it is removed before the K-means process. The noise free image is given as a input to the k-means and tumor is extracted from the MRI image.Finally inexact thinking for calculating tumor shape and position calculation. The experimental results are compared with other algorithms. The proposed method gives more accurate result. In future 3D assessment of brain using 3D slicers and optimization method with Matlab can be developed.

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