ANALYSIS OF IMAGE SEGMENTATION TECHNIQUES FOR BRAIN TUMOR DETECTION

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Abstract—This paper deals with the implementation of Simple Algorithms for detection and range of tumor in brain MR images. Magnetic resonance imaging (MRI) is an important diagnostic imaging technique for the early detection of brain cancer. Tumor is an uncontrolled growth of tissues in any part of the body. Tumors are of different types and they have different Characteristics and different treatment. Using the different algorithms the current methodologies of image segmentation is reviewed so that user interaction is possible for images. In this paper, the review of image segmentation is explained by using different techniques.

Keywords—MRI, Brain tumor,Image segmentation.

I. INTRODUCTION

Image segmentation refers to the process of partitioning an image into groups of pixel which are homogeneous with respect to some criterion. The segmentation of magnetic resonance images plays a very important role in medical field because it extracts the required area from the image .For the segmentation of medical images we need different algorithms and different procedure to segment and classification of image. Image segmentation is the first step and also one of the most difficult tasks of image analysis, which has objective of extracting information which is represented in the form of data from image via image segmentation, feature measurement and object representation.

Image segmentation is the computer-aided so that the computerization of medical image segmentation plays an important role in medical imaging applications. Image segmentation process that subdivides an image into its constituent parts and extracts those parts of interest or objects. Automatic image segmentation also done but the most critical task is that the segmentation result affect all the subsequent processes of image analysis [10]. Normally the anatomy of the Brain can be viewed by the MRI scan or CT scan. The MRI scanned image is taken for the entire process.

The MRI scan is more comfortable than CT scan for diagnosis. It is not affect the human body. Because it doesn't use any radiation. It is based on the magnetic field and radio waves. There are different types of algorithm were developed for brain tumor detection. But they may have some drawback in detection and extraction. In this Paper, four algorithms are used for segmentation. So it gives the accurate result for tumor segmentation. Tumor is due to the uncontrolled growth of the tissues in any part of the body. The tumor may be primary or secondary. If it is an origin, then it is known as primary. If the part of the tumor is spread to another place and grown as its own then it is known as secondary. Normally brain tumor affects CSF (Cerebral Spinal Fluid). It causes for strokes. The physician gives the treatment for the strokes rather than the treatment for tumor. So detection of tumor is important for that treatment. The lifetime of the person who affected by the brain tumor will increase if it is detected at current stage. That will increase the lifetime about 1 to 2 years. Normally tumor cells are of two types. They are Mass and Malignant. The detection of the malignant tumor is somewhat difficult to mass tumor. For the accurate detection of the malignant tumor that needs a 3-D representation of brain and 3-D analyzer tool. In this Paper we focused on detection of tumor and its area using four algorithms.

II. CLASSIFICATION OF SEGMENTATION TECHNIQUES

Image segmentation can be broadly classified into two types:

1. Local segmentation
2. Global segmentation

Global segmentation is concerned with segmenting a whole image. Global segmentation deals mostly with segments consisting of relatively large number of pixels [7].This makes estimated parameter values for global segments most robust. Image segmentation can be approach from three different philosophical perspectives. They are as region approach, boundary approach and edge approach as illustrated in Figure1.

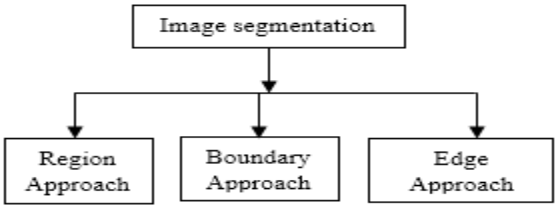


Figure 1. Image segmentation Approach

III. EDGE BASED SEGMENTATION DETECTION

The intensity data of an image only provides partial and uncertainly information about the location of edges. Edge detection technique [7] is finding pixel on the region boundary. This method attempts to resolve image segmentation by detecting the edges or pixels between different regions that have rapid transition in intensity are extracted [3] and linked to form closed object boundaries. The result is a binary image [6]. One source of uncertainly comes from the existence of noise introduced in the imaging process and later in the transmission and sampling process. The other source of uncertainly comes from fact that any measurement device is imperfect and their results are only partial observation. This means that edge detection methods are generally ill-posed, i.e. they are under-constrained and so may not have unique solutions. The easiest way to detect edges in an image is to look for places in the image where the intensity changes rapidly, using one of this criteria:

- Places where the first derivative of the intensity is larger in magnitude than some threshold.
- Places where the second derivative of the intensity has a zero crossing.

Edge detection is one of the structural technique of the image segmentation. There are two main edge based segmentation methods- Gray histogram and Gradient based method [5]. In the edge approach, the edges are identified first, and then they are linked together to form required boundaries.

IV. REGION BASED SEGMENTATION METHOD

A region denoted by R of an image is defined as a connected homogenous subset of the image with respect to some criterion such as gray level or texture.

Regions in an image are a group of connected pixels with similar properties. In the region approach, each pixel is assigned to a particular object or region.

Compared to edge detection method, segmentation algorithms based on region are relatively simple and more immune to noise [5]. Edge based methods partition an image based on rapid changes in intensity near edges whereas region based methods, partition an image into regions that are similar according to a set of predefined criteria [6][8]. In the region-based segmentation, pixels corresponding to an object are grouped together and marked. Region-based segmentation also requires the use of appropriate thresholding techniques. The important principles are value similarity (which includes gray value differences and gray value variance) and spatial proximity (which consists of Euclidean distance and compactness of a region).Segmentation algorithms based on region mainly include following method:

A. Region Growing

Region growing [10] is a technique for extracting a region of the image that is connected based on some predefined criteria. This criteria based on intensity information. Region growing is an approach to image segmentation in which neighbouring pixels are examined and added to a region class of no edges are detected. This process is iterated for each boundary pixel in the region. If adjacent regions are found, a region-merging algorithm is used in which weak edges are dissolved and strong edges are left intact. A new region growing algorithm is proposed in this paper based on the vector angle color similarity measure. The region growing algorithm as-

1. Select seed pixels within the image
2. From each seed pixel grow a region:
   2.1 Set the region prototype to be seed pixel;
   2.2 Calculate the similarity between the region prototypes
   And the candidate pixel;
   2.3 Calculate the similarity between the candidate and its
   Nearest neighbour in the region;
   2.4 Include the candidate pixel if both similarity measures
   Are higher than experiment all set thresholds;
   2.5 Update the region prototype by calculating the new
   Principal component;
   2.6 Go to the next pixel to be examined.

This algorithm presents several advantages over other color image segmentation algorithms. Region growing approach is simple. The border of regions found by region growing are perfectly thin and connected. The algorithm is also very stable with respect to noise. Limitation is that, it requires a seed point, which generally means manual interaction. Thus, each region to be segmented, a seed point is needed.

V. NORMAL BASED SEGMENTATION

A technique for the segmentation i.e. segmentation using morphological operations in morphological operations there is the study of the shape and form of objects. Morphological image analysis can be used to perform object extraction, Image filtering operations, such as removal of small objects or noise from an image, Image segmentation operations, such as separating connected objects, Measurement operations such as texture analysis and shape description. The Video and Image Processing Block set software contains blocks that perform morphological operations such as erosion, dilation, opening, and closing. Often need to use a combination of these blocks to perform your morphological image analysis.

Morphological image analysis can be used to perform image filtering, image segmentation, and

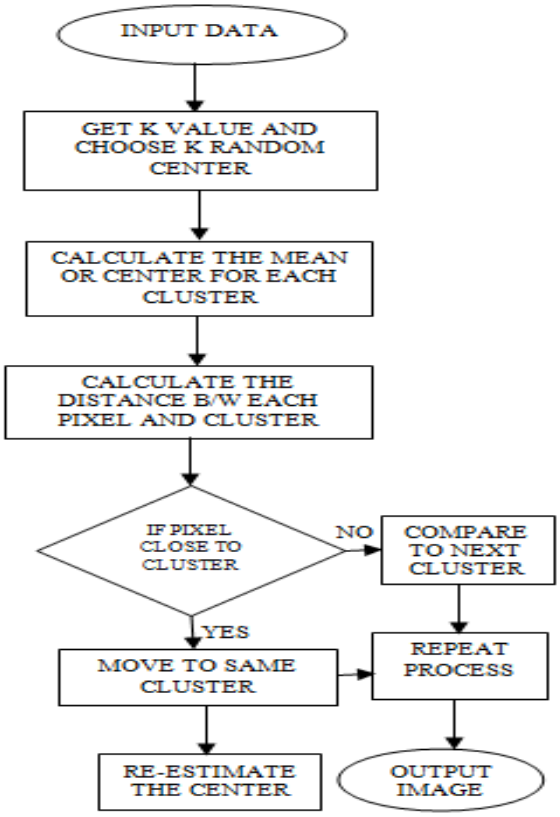
measurement operations. After the sobel edge detection operator applied, different morphological operations like opening, closing, dilation etc. were applied gradient component of image because it provides better segmentation image.

VI. K-MEANS CLUSTERING

K-Means is the one of the unsupervised learning algorithm for clusters. Clustering the image is grouping the pixels according to the some characteristics. In the k-means algorithm initially we have to define the number of clusters k. Then k-cluster [11] center are chosen randomly. The distance between the each pixel to each cluster centers are calculated. The distance may be of simple Euclidean function.

Single pixel is compared to all cluster centers using the distance formula. The pixel is moved to particular cluster which has shortest distance among all. Then the centroid is re-estimated. Again each pixel is compared to all centroids. The process continuous until the center converges.

B. Flowchart of k-means algorithm



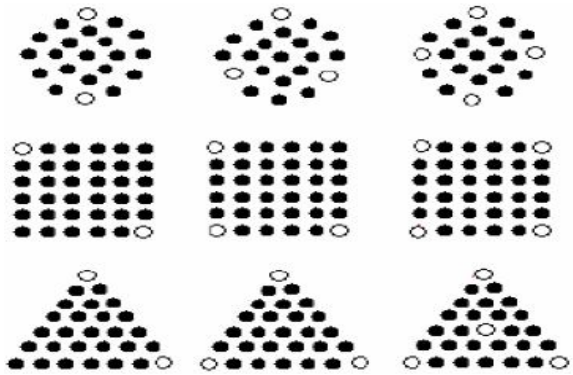
C. Algorithm

1. Give the no of cluster value as k.
2. Randomly choose the k cluster centers3. Calculate mean or
   Center of the cluster
4. Calculate the distance between each pixel to each cluster
   Center.
5. If the distance is near to the center then move to that cluster.
6. Otherwise move to next cluster.
7. Re-estimate the center.
8. Repeat the process until the center doesn't move.

VII. PILLAR ALGORITHM

The system uses the real size of the image in order to perform high quality of the image segmentation. It causes high-resolution image data points to be clustered. The K-means algorithm for clustering image data considering that its ability to cluster huge data, and also outliers, quickly and efficiently. However, Because of initial starting points generated randomly, K-means algorithm is difficult to reach global optimum, but only to one of local minima which it will lead to incorrect clustering results. Barak bah and Helen performed that the error ratio of K-means is more than 60% for well-separated datasets. To avoid this phenomenon in this project uses our previous work regarding initial clusters optimization for K-means using Pillar algorithm.

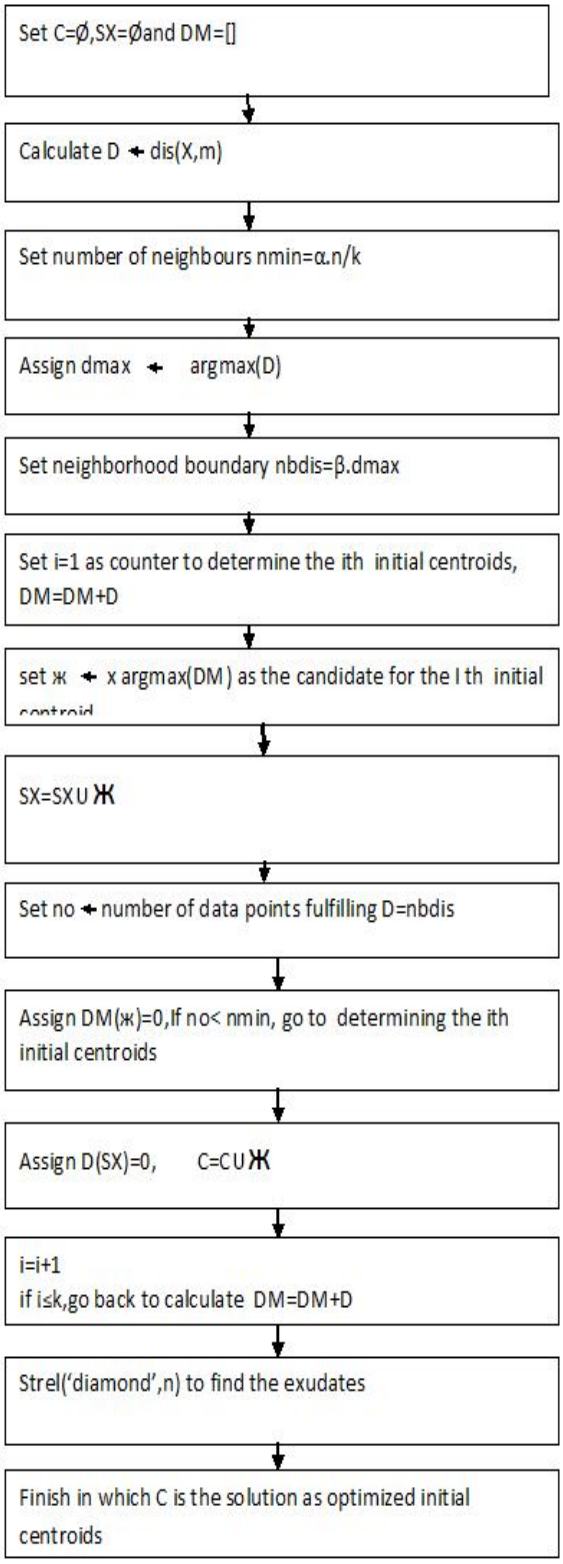
The Pillar algorithm is very robust and superior for initial centroids optimization for K-means by positioning all centroids far separately among them in the data distribution. This algorithm is inspired by the thought process of determining a set of pillars' locations in order to make a stable house or building. Fig. 2 illustrates the locating of two, three, and four pillars, in order to withstand the pressure distributions of several different roof structures composed of discrete points. It is inspiring that by distributing the pillars as far as possible from each other within the pressure distribution of a roof, the pillars can withstand the roof's pressure and stabilize a house or building. It considers the pillars which should be located as far as possible from each other to withstand against the pressure distribution of a roof, as number of centroids among the gravity weight of data distribution in the vector space. Therefore, this algorithm designates positions of initial centroids in the farthest accumulated distance between them in the data distribution.



The Pillar algorithm is described as follows. Let $X=\{xi \mid i=1,\ldots,n\}$ be data, k be number of clusters, $C=\{ci \mid i=1,\ldots,k\}$ be initial centroids, SX _ X be

identification for X which are already selected in the sequence of process, $DM=\{xi \mid i=1,\ldots,n\}$ be accumulated distance metric, $D=\{xi \mid i=1,\ldots,n\}$ be distance metric for each iteration, and m be the grand mean of X. The following execution steps of the proposed algorithm are described as:

D. Flowchart of pillar k-means algorithm



VIII. EXPERIMENTAL RESULTS

The following figure 2 shows the Edge based segmentation result.

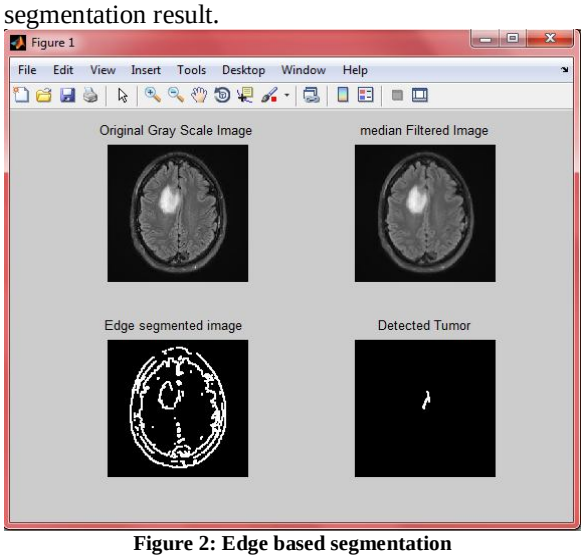


Figure 2: Edge based segmentation

Figure 3 shows the result of Segmentation using Region growing Approach.

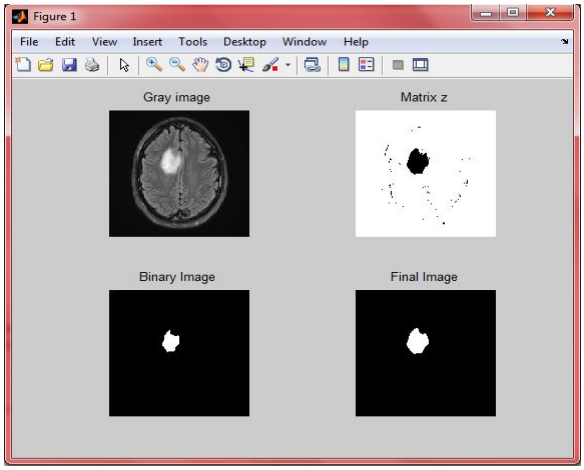


Figure 3: Segmentation using Region growing Approach

Figure 4 shows the result of Normal based segmentation.

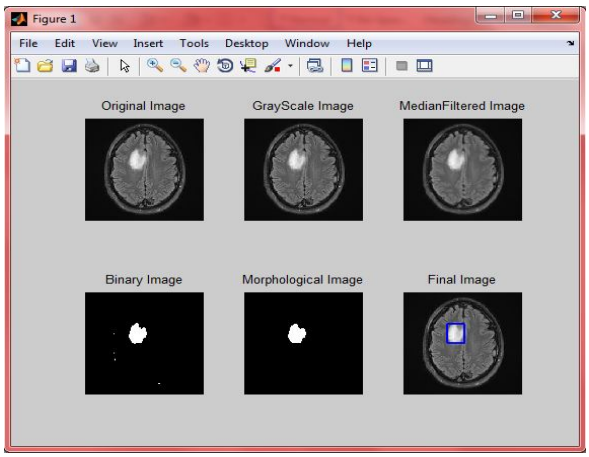


Figure 4: Normal based Segmentation.

Figure 5 shows the result of Segmentation using k-means clustering (cluster=3).

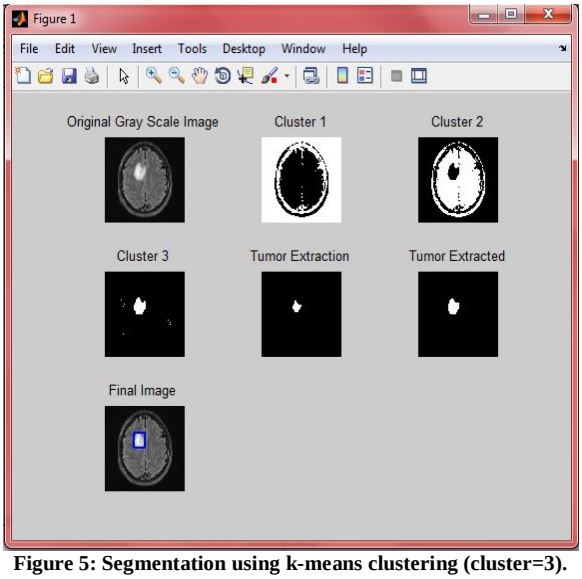


Figure 5: Segmentation using k-means clustering (cluster=3).

Figure 6 shows the result of Segmentation using Pillar k-means Algorithm.

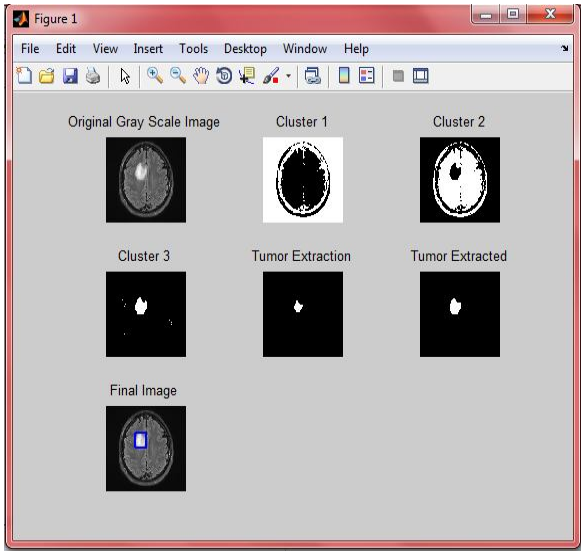


Figure 6 : Pillar k-means.

1: Comparison of Area of Tumor

Table Types of Segmentation	Area of the Tumor (pixels)
Edge based segmentation	878 Pixels
Region growing Approach.	897 Pixels
Normal based segmentation	867 Pixels
k-means clustering (cluster=3)	789 Pixels
Pillar k-means	755 Pixels

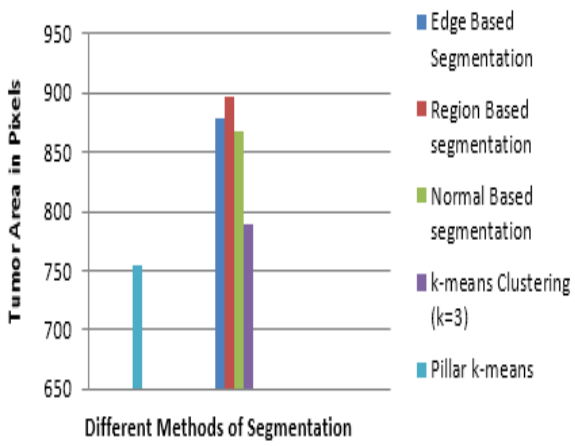


Figure 7: Graphical representation for table 1

CONCLUSION

In this Analysis of image segmentation, the overview of various segmentation methodologies applied for digital image processing is explained briefly. By using the different algorithms the current methodologies of image segmentation is reviewed so that user interaction is possible for images. In this paper, the review of image segmentation is explained by using different techniques. Using all these techniques observed that pillar k-means is the best solution for the detection of brain tumor.

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