Detection and Estimation of Brain Tumor Parameters using Fuzzy C - Means Clustering

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***Abstract*:- Cancer is a disease caused due to uncontrolled division of abnormal cells in different parts of the body. In most of the cases the loss of lives of people who suffer from cancer is due to incorrect detection. The main aim of the proposed work is to separate structure of object of interest from background and other objects. This paper involves algorithm for detection of size and range of brain tumor using fuzzy c means clustering. The segmentation of tumor is more accurate and the results proved to be better compared to existing methods.**

Keywords - Brain tumor image, Pre-processing, Image segmentation Fuzzy C –means clustering technique.

INTRODUCTION

A group of cells or tissues (mass) which are under uncontrolled division and cannot be stopped by normal forces can be defined as Tumor. Now a days more well founded algorithms are developed for real time analysis and diagnosis of tumor. The main focus in latest development in medical imaging is to detect brain tumors in MR images and CT scan images. The separation of the cells and their nuclei from the rest of the image content is one of the main problems faced by most of the medical imagery diagnosis systems. Diagnose of the system output is main focused on segmentation. This paper deals with the concept for automatic brain tumor segmentation. The most features and objects of brain can be viewed reliably using MRI and CT scans. In this paper MRI scanned image is taken for the entire process. Since MRI is based on magnetic field and radio waves without any harmful radiations it does not affect human body. But they may have some drawback in segmentation. The MRI scan is more comfortable than CT scan for diagnosis. There are two stages of cancer primary stage and secondary stage. If its in origin then tumor is called as primary and tumor is well developed and spread over other region is called tumor is said to be in secondary stage. Normally secondary stage tumor affects CSF (Cerebral Spinal Fluid).further results in strokes. The main drawback here is physician gives treatment to stroke rather than giving treatment to tumor. Hence detection of tumor in right time plays an important role and may save life.

Fuzzy C-means (FCM) is a method of clustering which allows one pixel to belong to two or more clusters. The FCM algorithm attempts to partition a finite collection of pixels into a collection of "c" fuzzy clusters with respect to some given criterion. Depending on the data and the application, different types of similarity measures may be used to identify classes. Some examples of values that can be used as similarity measures include distance, connectivity, and intensity. In this work, the images are segmented into four clusters namely white matter, grey matter, CSF and the abnormal tumor region based on the feature values

Clustering can also be thought of as a form of data compression, where a large number of samples are converted into a small number of representative prototypes or clusters. High dimensional feature space based image segmentation is time intensive than in one dimensional feature spaces. The modified FCM algorithm is based on the concept of data compression where the dimensionality of the input is highly reduced. The data compression includes two steps: quantization and aggregation. The quantization of the feature space is performed by masking the lower '*m*' bits of the feature value. The quantized output will result in the common intensity values for more than one feature vector. In the process of aggregation, feature vectors which share common intensity values are grouped together. A representative feature vector is chosen from each group and they are given a sin put for the conventional FCM algorithm. Once the clustering is complete, the representative feature vector membership values are distributed identically to all members of the quantization level. Since the modified FCM algorithm uses a reduced dataset, the convergence rate is highly improved when compared with the conventional FCM.

OPERATIONS AND TYPES OF TUMORS:

In medical imaging, segmentation of images plays a vital role in stages which occur before implementing object recognition. Image segmentation helps in automated diagnosis of brain diseases and helps in qualitative and quantitative analysis of images such as measuring accurate size and volume of detected portion. Accurate measurements in brain diagnosis are quite difficult because of diverse shapes, sizes and appearances of tumors. Tumors can grow abruptly causing defects in neighboring tissues also, which gives an overall abnormal structure for healthy tissues as well. We will develop a technique of segmentation of a brain tumor by using segmentation in conjunction with morphological operations.

Tumors:

Some of the body's cells begin to divide without stopping and spread into surrounding tissues treated as tumor. Cancer can start almost anywhere in the human body, which is made up of trillions of cells. Normally, human cells grow and divide to form new cells as the body needs them. When cells grow old or become damaged, they die, and new cells take their place. When cancer develops, however, this orderly process breaks down. As cells become more and more abnormal, old or damaged cells survive when they should die, and new cells form when they are not needed. These extra cells can divide without stopping and may form growths called tumors.

Types of tumor:

Depending upon weather tumor is cancerous or not tumors are broadly classified into two types.
1. Benign.
2. Malignant.

Benign:

These are non-cancerous tumors rarely cause serious problems or threaten of life unless they occur in vital organs or grow very large. Benign tumors are tend to grow slowly and stay in one place, not spreading into other parts of the body.

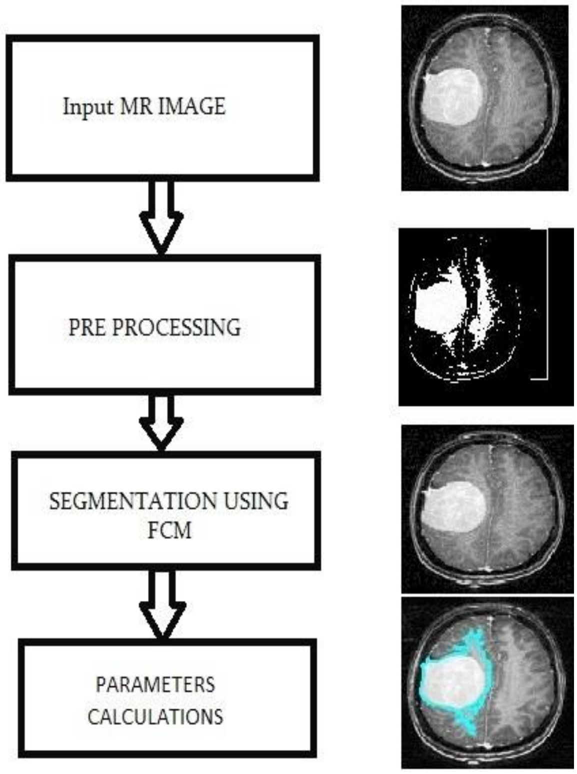
Malignant:

Malignant tumors are cancerous. Cancer can start in any one of the millions of cells in our bodies. Cancer cells have a larger nucleus that looks different from a normal cell's nucleus, and cancer cells behave, grow and function quite differently from normal cells. Malignant tumors vary in size and shape.

PROPOSED METHOD:

The proposed system has mainly four modules: preprocessing, segmentation, Feature extraction, and approximate reasoning. Preprocessing is done by filtering. Segmentation is carried out by advanced Fuzzy C-means algorithms. Feature extraction is by thresholding and finally, Approximate reasoning method to recognize the tumor shape and position in MRI image using edge detection method. The proposed method is a combination of two algorithms. In the literature Survey many algorithms ere developed for segmentation. But they are not good for all types of the MRI images

BLOCK DIAGRAM:



Magnetic resonance imaging (MRI):

MRI is basically used in the biomedical to detect and visualize finer details in the internal structure of the body. This technique is basically used to detect the differences in the tissues which have a far better technique as compared to computed tomography (CT). So this makes this technique a very special one for the brain tumor detection and cancer imaging.

PRE-PROCESSING:

In this phase image is enhanced in the way that finer details are improved and noise is removed from the image. Most commonly used enhancement and noise reduction techniques are implemented that can give best possible results. Enhancement will result in more prominent edges and a sharpened image is obtained, noise will be reduced thus reducing the blurring effect from the image. It performs filtering of noise and other artifacts in the image and sharpening the edges in the image. It includes median filter for noise removal. The possibilities of arrival of noise in modern MRI scan are very less. It may arrive due to the thermal effect. The main aim of this paper is to detect and segment the tumor cells. But for the complete system it needs the process of noise removal.

SEGMENTATIM USING C-MEANS ALGORITHM:

Fuzzy C-Mean (FCM) is an unsupervised clustering algorithm that has been applied to wide range of problems involving feature analysis, clustering and classifier design. FCM has a wide domain of applications such as agricultural engineering, astronomy, chemistry, geology, image analysis, medical diagnosis, shape analysis, and target recognition. The fuzzy logic is a way to processing the data by giving the partial membership value to each pixel in the image. The membership value of the fuzzy set is ranges from 0 to 1. Fuzzy clustering is basically a multi valued logic that allows intermediate values i.e., member of one fuzzy set can also be member of other fuzzy sets in the same image. The clusters are formed according to the distance between data points and cluster centers are formed for each cluster. The Algorithm Fuzzy C-Means (FCM) is a method of clustering which allows one piece of data to belong to two or more clusters. This method is frequently used in pattern recognition. There is no abrupt transition between full membership and non-membership. Fuzzy c-means (FCM) is a data clustering technique in which a dataset is grouped into n clusters with every data point in the dataset belonging to every cluster to a certain degree. For example, a certain data point that lies close to the center of a cluster will have a high degree of belonging or membership to that cluster and another data point that lies far away from the center of a cluster will have a low degree of belonging or membership to that cluster. The Fuzzy Logic Toolbox™ function FCM performs FCM clustering. It starts with an initial guess for the cluster centers, which are intended to mark the mean location of each cluster. The initial guess for these cluster centers is most likely incorrect. Next, FCM assigns every data point a membership grade for each cluster. By iteratively updating the cluster centers and the membership grades for each data point, FCM iteratively moves the cluster centers to the right location within a data set. This iteration is based on minimizing an objective function that represents the distance from any given data point to a cluster center weighted by that data point's membership grade. The membership function defines the fuzziness of an image and also to define the information contained in the image. These are three main basic features involved in characterized by membership function. They are support, Boundary. The core is a fully member of the fuzzy set. The support is non-membership value of the set and boundary is the intermediate or partial membership with value between 0 and 1.

Algorithm

1. Give the no of cluster value as k.
2. Randomly choose the k cluster centers

$$M = \sum i : c(i) = k^{x_i} \big/ N_k$$

3. Calculate mean or center of the cluster.
4. Calculate the distance b/w each pixel to each cluster center.

D(i)=arg min

$$\|x_i - M_k\|^2, i = 1,2,........N$$

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.

$$Y_m = \sum_{i=1}^{N} \sum_{j=1}^{C} M_{ij}^{m} \|x_i - C_j\|^2$$

Where

m-any real number greater than 1,

Mij-degree of membership of xi in the cluster j,

Xi-data measured in d-dimensions

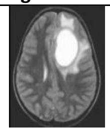
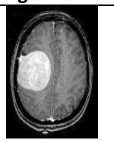
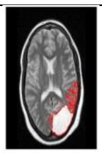
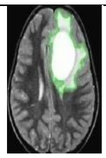
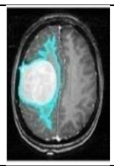
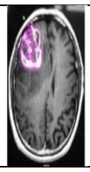
DISCUSSION ON RESULTS:

The algorithm namely Fuzzy C means clustering to performed calculating tumor shape and position calculation like *Tumor area, Centroid, Major axis, Major axis, Tumor perimeter.*

CONCLUSION:

There are different types of tumors are available. They may be as mass in brain or malignant over the brain. Suppose if it is a mass then c- means algorithm is enough to extract it from the brain cells. If there is any noise are present in the MR image it is removed before the c-means process.

The noise free image is given as an input to the c-means and tumor is extracted from the MRI image. And then segmentation using Fuzzy C means for accurate tumor shape extraction of malignant tumor and thresholding of output in feature extraction. Finally approximate reasoning for calculating tumor shape and position calculation. *Tumor area, Centroid, Major axis, Major axis, Tumor perimeter.* The experimental results are compared with other algorithms. The proposed method gives more accurate result. In future assessment of brain using slicers with Mat lab can be developed.

parameter	Fig-1	Fig-2	Fig-3	Fig-4
Original image				
Segmentation image				
Tumor area	3599	8184	7317	7384
Centroid	(191.01 , 233.06)	(157.8 ,100.3)	(158.9 , 87.05)	(75.74 ,132.46)
Major axis	116.3812	138.8210	126.5331	120.0748
Major axis	52.7690	82.3526	82.9020	88.7108
Tumor perimeter	694.1392	511.6295	535.1026	684.633

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