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Brain Tumor Detection and Area Calculation of Tumor in Brain MRI mages using Clustering Algorithms

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Abstract:*In biomedical field Medical image analysis is an important biomedical application, which is highly computational in nature and requires the help of the automated systems.In this paper, a simple algorithm for detecting the shape of tumor in brain MR Images is described. Brain tumor are created by an abnormal and uncontrolled cell division. It is an intracranial solid neoplasm. Magnetic resonance imaging (MRI) is another modern diagnostic imaging technique that produces cross-sectional images of brain. Unlike CT scans, MRI works without radiation. The MRI tool uses magnetic fields and a sophisticated computer to take high-resolution pictures of brain soft tissues. These images are visually examined by the physician for detection & diagnosis of brain tumor. So as assist to physician for calculate correct shape of tumor, this project uses computer aided method for detection of brain tumor.This method allows the segmentation of tumor tissue with accuracy using two algorithms. In addition, it also reduces the time for analysis. At the end gives result as tumor is extracted from the MR image and the shape also determined. The stage of the tumor is examined based on the amount of area calculated from the cluster.*

Keywords-*Cluster segmentation, Magnetic Resonance Imaging (MRI), Brain tumor, K-means, Fuzzy C means.*

I. Introduction

Any type of tumor is due to the uncontrolled growth of the tissues in any part of the body. Any type of brain tumor is inherently serious and life-threatening because of its attacking and infiltrative part in the limited space of the intracranial cavity. However, Brain tumors can be cancerous or non-cancerous; normally the anatomy of the Brain can be viewed by the MRI scan or CT scan. In this paper the MRI scanned image is taken for the entire process. The MRI scan is more comfortable than CT scan for diagnosis. And a sophisticated computer to take high-resolution pictures of brain soft tissues with tumor. 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 for segmentation were developed for brain tumor detection [1],[2]. But some of them may have drawback in detection and extraction. In this paper, two algorithms are used for segmentation. These algorithms gives the accurate result for tumor segmentation[6].The detection of tumor is important for getting proper treatment. The lifetime of the person who affected by the brain tumor will increase if it is detected at current stage. Normally tumor cells are of two types. They are Mass and Malignant.In this paper we focused on detection of mass tumor detection. The developing platform for the detection is mat lab. Because it is easy to develop and execute. At the end, There is detection of the tumor and its shape using this proposed method. There are some methods are used for segmentation such as thresholding and region growing. The thresholding method was ignored the spatial characteristics such as having only two values either black or white. But the bit map image contains 0 to 255 gray scale values. So sometimes it ignores the tumor cells also. In case of the region growing based segmentation there is need of the seed. Seed is nothing but the center of the tumor cells; it may cause intensity in homogeneity problem. And due to these drawbacks these segmentation systems will not provide the acceptable result for all brain tumor MRI images. In this proposed methode MRI image pre-processing done by Wavelet transform, then segmentation using K- means and Fuzzy C-means algorithms, Feature extraction done by thresholding and finally get tumor area.There are various types of segmentation algorithms are available but they are not give accurate segmentation as this proposed method gives. K- means and Fuzzy C-means algorithms give more segmentation accuracy than other segmentation methods.

II. Methodology Of Proposed Work

2.1 Image enhancement as preprocessing

Wavelet transform plays an important role in the image processing technique. This paper introduced an image de-noising algorithm based on interpolation of the high frequency sub band images obtained by discrete wavelet transform. DWT[4] is applied in order to decompose an input image into different sub bands. Then the high frequency sub bands as well as the input image are interpolated. The estimated high frequency sub bands are being modified by using high frequency sub band. Then all these sub bands are combined to generate a new

de-noised image by using inverse DWT. The quantitative and visual results show the superiority of image for image enhancement process.

2.2 Segmentation using Clustering Methods
Segmentation is carried out by Fuzzy C-means and K-means clustering algorithms.

2.3 Feature extraction and calculation of tumor area
The feature extraction is extracting the cluster which shows the predicted tumor at the end FCM and KFCM output. The threshold process is applied on extracted cluster and binary mask is applied over the entire image [7]. This binarization method used for calculate tumor area in MRI brain images.

III. Implementation

Brain MR Images are having large size with some noise, to reduce noise wavelet transform technique is used and for reduce size of image reshaping takes place, Which generates sharper de-noised image.

3.1 Fuzzy c-means segmentation algorithm
Clustering is a method of data exploration which extracts the patterns from images according to interest. .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. There is no unpredicted transition between full membership and non-membership. The membership function defines the fuzziness of an image and also to definethe information contained in the image. In this paper, a centroid model such as fuzzy c means algorithm is used to detect tumor part from abnormal image. In fuzzy clustering, each point has a degree of belonging to clusters. The degree of belonging is inversely proportional to the center of cluster which is examined in previous pass of running code by operators. This method however finds local optimum and run over multiple times to find correct output.FCM is the clustering algorithm which allows one piece of data may be member of more than one clusters. It is based on reducing the following function

$$Y_m = \sum_{i=1}^{N}\sum_{j=1}^{C} M_{ij}^{m} \left\| x_i - c_j \right\|^2 \text{.....(1)}$$

$$M_{ij} = \frac{1}{\sum_{K=1}^{c}\left(\frac{\left\| x_i - c_j \right\|}{\left\| x_i - c_j \right\|}\right)^{\frac{2}{m-1}}} \text{.....(2)}$$

$$R_j = \frac{\sum_{i=1}^{N} x_i . M_{ij}^{m}}{\sum_{i=1}^{N} M_{ij}^{m}} \text{.....(3)}$$

The above process ends when,

$$\max_{ij}\left\{\left|M_{ij}^{k+1} - M_{ij}^{(k)}\right|\right\} < \delta \text{.....(4)}$$

Where,
m- Any real number greater than 1,
Mij- degree of membership of X; in the cluster j,
x- Data measured in d-dimensional,

Rj - d-dimension center of the cluster,
The update of membership Mij and the cluster centers R,
δ= termination value or constant between 0 and 1,
K= no of iteration steps.

3.2 Steps of Fuzzy c-means Algorithm

1. Initialize M= [Mij] matrix, M (0)
2. At k-step: calculate the centers vectors R (k) = [Rj] with M (k)
3. Update U (k), U (k+l)
4. If || M (k+1)) - M (k) || < δ then STOP, otherwise return to step 2.

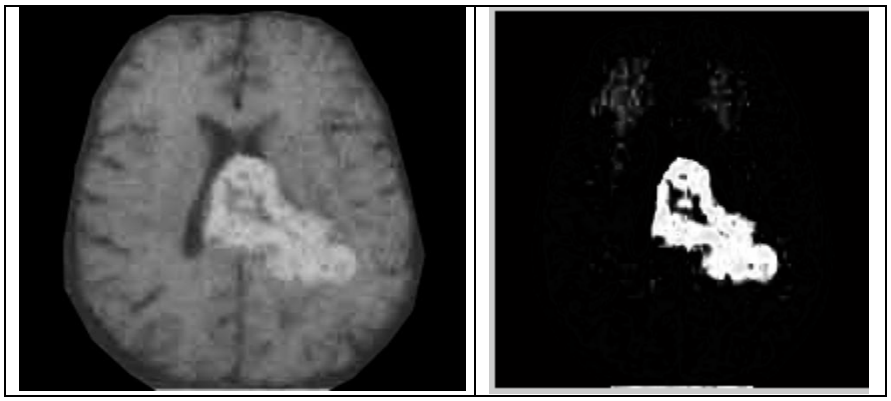

Fig. 3.1 (a) Input MRI Brain Image **(b)** FCM segmented image having tumor area.

3.3 K-FCM Segmentation algorithm

K-means algorithm is one of the popular partitionalgorithm in cluster analysis is the one ofthe unsupervised learning algorithm for clusters. Clustering the image is grouping the pixels according to the same characteristics. K-means clustering is an algorithm to group objects based on attributes/features into k number of groups where k is a positive integer. The grouping (clustering) is done by minimizing the Euclidean distance between data and the corresponding cluster centroid. Thus the purpose of k-means clustering is to cluster the data.

$$M = \frac{\sum_{i;c(i)=k} x_i}{N_k} \text{.....(5)}$$

3.4 K-FCM Segmentation Algorithm steps

1. Take image data.
2. Give the no of cluster value as k.
3. Randomly choose the k cluster centers.
4. Calculate mean or center of the cluster.
5. Calculate the distance between each pixel to each cluster center.
6. If the distance is near to the center then move to that cluster.
7. Otherwise move to next cluster.
8. Re-estimate the center.

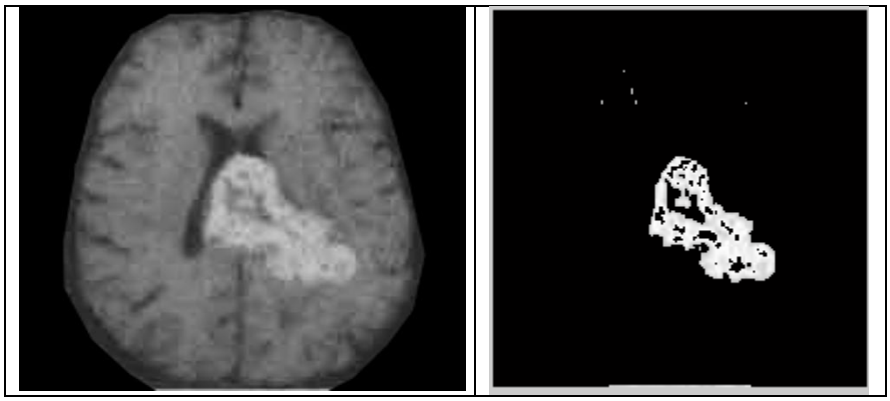

Fig. 3.2 (a) Input MRI Brain Image **(b)**K-FCM segmented image having tumor are

3.5. Feature Extraction

The feature extraction is extracting the cluster which shows the predicted tumor at the FCM output. The extracted cluster is given to the thresholding process. It applies binary mask over the entire image[8]. It makes the dark pixel become darker and white become brighter. In threshold coding, each transform coefficient is compared with a threshold. If it is less than the threshold value then it is considered as zero. If it is larger than the threshold, it will be considered as one.

$$g(n) = \begin{Bmatrix} '0' if\ f(n) \geq T \\ '1' if\ f(n) < T \end{Bmatrix} .....(6)$$

IV. Performance analysis

For Performance evaluation various parameters are used given below.

$$I = \sum_{W=0}^{255} \sum_{H=0}^{255} [f(0) + f(1)] .....(7)$$

Where,
W = Width of image
H= Height of image
f (0) = white pixel (digit 0)
f (1) = black pixel (digit 1)

$$No.of\ white pixels, P = \sum_{W=0}^{255} \sum_{H=0}^{255} [f(0)] .....(8)$$

Where,
P = number of white pixels

The area calculation formula is

$$Area\ of\ tumor, S = \left[\left(\sqrt{P} \right) '0.264 \right] mm^2 .....(9)$$

P=no-of white pixels;

Table I: Parametric analysis.

Parameters	FCM	KFCM
Processing time	32.15 sec.	3.63 sec.
Area in mm^2	18.99	13.19
No. of White pixels	5177	2497

V. Conclusion

MRI Brain image segmentation should strive toward improving the accuracy, precision, and computation speed which is given by KFCM segmentation algorithm than FCM. The noise free image is given as a input to the k-means and tumor is extracted from the brain MRI image using DWT as de-nosier. Also segmentation using Fuzzy C means for accurate tumor shape extraction of tumor and Binarization is used for feature extraction. Finally approximate reasoning for calculating tumor size which decides stage of that tumor.

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