MR IMAGE SEGMENTATION OF BRAIN TO DETECT BRAIN TUMOR AND ITS AREA CALCULATION USING K-MEANS CLUSTERING AND FUZZY C-MEANS ALGORITHM

Brundha B[1], Nagendra Kumar M[2]
[1]Signal processing, M .Tech, [2]Associate Professor, E&C dept
SJCIT, Chikkaballapur, India

Abstract: In most of the MR images we cannot be able to detect size and range of the tumor with respect to brain, the main goal of this paper involves algorithm for detection of size and range of the tumor. The main aim of the segmentation is to separate structure of interest object from background and other objects. Though there are various methods developed for segmentation of MR brain images among that k means and fuzzy c are widely used ones. Cancer is a disease caused due to uncontrolled division of abnormal cells in different part of the body. In most of the cases the loss of lives of people who were suffering from cancer is due to incorrect detections. Hence ultimate goal of this paper is to detect exact size and stages of brain tumor using combination of two algorithms namely k means and fuzzy c means clustering for more accuracy.
Keywords: image processing; kmeans; fuzzy c means; thresholding; MRI;

I. 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.

A. Operations and types of tumors.

In medical imaging, 3D segmentation of images plays avital role in stages which occur before implementing object recognition. 3D 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 3D segmentation of a brain tumor by using segmentation in conjunction with morphological operations.

B. 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.

C. 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.

D. 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.

E. Background works already existed.

1) Separation of Brain Tissues in MRI based on Multidimensional FCM and Spatial Information:

This technique was proposed by Jamal Ghasemi, Mohamad Reza Karami mollaei and Ali Hojjatoleslami. A novel method for brain MRI segmentation (BMS) based on multi-dimensional standard FCM has been proposed. Different features of neighboring pixels like mean, singular value, and standard deviation in combination with pixel intensity has been used for typical pixel segmentation. The results evaluation is done against manual segmentation on a publicly available dataset.

2) An Adaptive Spatial Fuzzy Clustering Algorithm for 3-D MR Image Segmentation:

This method was proposed by Alan Wee-Chung Liew and Hong Yan. In this paper an adaptive spatial fuzzy c-means clustering algorithm is used for the segmentation of three-dimensional (3-D) magnetic resonance (MR) images. The input images may be corrupted by noise and intensity non uniformity (INU) artifact. The efficacy of the proposed algorithm is demonstrated by extensive segmentation experiments using both simulated and real MR images and by comparison with other published algorithms. Some methods are based on the thresholding and region growing. The thresholding method was ignored the spatial characteristics. Normally spatial characteristics are important for the malignant tumor detection. In the thresholding based segmentation the image is considered 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 it needs more user interaction for the selection of the seed. Seed is nothing but the center of the tumor cells; it may cause intensity in homogeneity problem. And also it will not provide the acceptable result for all the images.

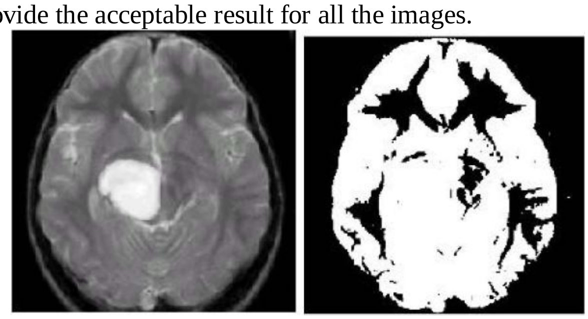

Figure 1: (left) Input for thresholding and (right)its output.

F. Problem statement

Now days, one of the main cause for increasing mortality among children and adults is brain tumor. It has been concluded from the research of most of the developed countries that number of people suffering and dying from brain tumors has been increased to 300 per year during past few decades. The National Brain Tumor Foundation (NBTF) for research in United States estimates the death of 13000 patients while 29,000 undergo primary brain tumor diagnosis. This high mortality rate of brain tumor greatly increases the importance of Brain Tumor detection. Real time diagnosis of tumors by using more reliable algorithms has been the main focus of the latest developments in medical imaging and detection of brain tumor in MR images and CT scan images has been an active research area. 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. The process of separation i.e. segmentation, is paid at most importance in the construction of a robust diagnosis system. Image segmentation is performed on the input images. This enables easier analysis of the image thereby leading to better tumor detection efficiency. Hence image segmentation is the fundamental problem in tumor detection.

II. 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 Kmeans and 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 were developed for segmentation. But they are not good for all types of the MRI images.

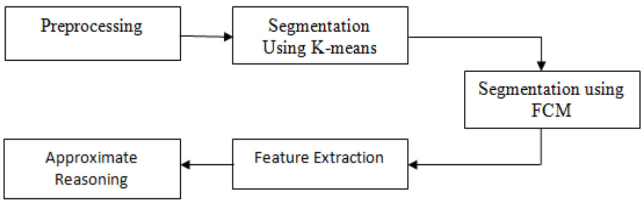

Figure2: Block diagram of the proposed algorithm

A. 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. RGB to grey conversion and Reshaping also takes place here. 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. For better understanding the function of median filter, we added the salt and pepper noise artificially and removing it using median filter.

B. KMEANSCLUSTERING

K-Means is the one of the unsupervised learning algorithm for clusters. Clustering the image is grouping the pixels according to some characteristics. In this project input image is converted into Standard format 512 X 512, then find the total no. of pixels using Length = Row X Column. Then covert 2D image into 1D and create no. of clusters depend on user. The k-means algorithm initially it has to define the number of clusters k. Then k-cluster Centre 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 Centre converges.

Algorithm

1. Give the no of cluster value as k.
2. Randomly choose the k cluster centers.
3. Calculate mean or center of the cluster.
4. Calculate the distance b/w 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.

C. SEGMENTATION USING FUZZY C MEANS.

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 isbasically 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.

D. 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. 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. The thresholding method is an adaptive method where only those coefficients whose magnitudes are above a threshold are retained within each block. Let us consider an image 'f that has the k gray level. An integer value of threshold T, which lies in the gray scale range of k. The thresholding process is a comparison. Each pixel in 'f 'is compared to T. Based on that, binary decision is made. That defines the value of the particular pixel in an output binary image 'g':

$$g(n) = \begin{cases} 0, & f(n) \geq T \\ 1, & f(n) < T \end{cases}$$

E. MATHEMATICAL REPRASENTATION

TO construct cluster means m, for a given image

$$M = \frac{\sum_{i:c(i)=k} x_i}{N_k} \quad (1)$$

To calculate distance between cluster center to each pixel

$$D(i)=\arg\min||x_i-M_k||^2 \ ,i=1,\ldots\ldots.,N \quad (2)$$

Repeat the above two steps until mean value convergence

For fuzzy c means

$$Y_m = \sum_{i=1}^{N} \sum_{j=1}^{C} M_{ij}^{m} ||x_i - c_j||^2 \quad (3)$$

Where

m-any real number greater than 1,

M_{ij}-degree of membership of x_i in the cluster j,

Xi-data measured in d-dimensional,

R_j-d-dimension center of the cluster.
Updates of membership Mij and R_f are given as

$$M_{ij} = \frac{1}{\sum_{k=1}^{c}\left[\frac{||x_i-c_j||}{||x_i-c_j||}\right]^{\frac{2}{m-1}}} \qquad (4)$$

$$R_j = \frac{\sum_{i=1}^{N} x_i M_{ij}^{m}}{\sum_{i=1}^{N} M_{ij}^{m}} \qquad (5)$$

The above process ends when,

$$\max_{ij}\{|M_{ij}^{(K+1)}-M_{ij}^{(k)}|\}<\delta \qquad (6)$$

where
δ=termination value or constant between 0 and 1,

E. APPROXIMATE REASONING

In the approximate reasoning step the tumor area is calculated using the binarization method. That is the image having only two values either black or white (0 or 1). Here 256x256 jpeg image is a maximum image size. The binary image can be represented as a summation of total number of white and black pixels. For Image I

$$I = \sum_{W=0}^{255}\sum_{H-0}^{255}[f_{WH}(0) + f_{WH}(1)] \qquad (7)$$

Where
Pixels=Width (W) height (H) =256x256
F (0) =white pixel (digit 0)
F (1) =black pixel (digit 1)

$$\text{No of white pixels, } P = \sum_{W=0}^{255}\sum_{H=0}^{255}[f_{HW}(0)] \qquad (8)$$

Where,
P=number of white pixels(width*height)
1 pixel=0.264mm

$$Size\ of\ tumor, S = [(\sqrt{p})0.264]mm^2 \qquad (9)$$

Where p=no of white pixels

III. 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 K- 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 K-means process. The noise free image is given as an input to the k-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. The experimental results are compared with other algorithms. The proposed method gives more accurate result. In future 3D assessment of brain using 3D slicers with Mat lab can be developed.

IV. FUTURE ENHANCEMENT

After the brain tumor is located and location is found out, the stage of the tumor is located based on area of the tumor. Based on stage, drugs are injected to patient. This drug detection is done through the Nano-bio sensor. After the detection for the particular stage is determined then drugs may be injected to patient treatment.

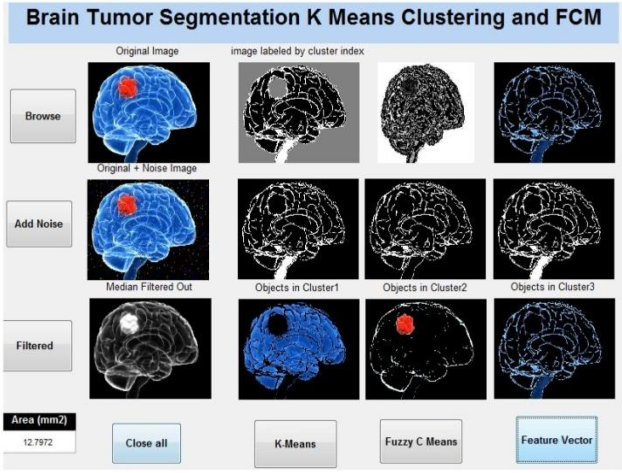

Figure 3: overall output of paper with area calculation

REFERENCES

[1] J.selvakumar, A.Lakshmi, T.Arivoli, "Brain Tumor Segmentation and Its Area Calculation in Brain MR Images using K-Mean Clustering and Fuzzy C-Mean Algorithm" IEEE-International Conference On Advances In Engineering, Science And Management (ICAESM -2012)

[2] Alan Jose, S.Ravi, M.Sambath, "Brain Tumor Segmentation Using K-Means Clustering And Fuzzy C-Means Algorithms And Its Area Calculation" Vol. 2, Issue 3, March 2014

[3] Archana Lala1, Jitendra Kumar Gupta 2, Mrinalini Shringirishi3 "Implementation of k-means clustering and fuzzy c-means algorithm for brain tumor segmentation" International Journal of Computer Engineering & Science, Sept 2013.

[4] Mr.Rohit S. Kabade, Dr. M. S. Gaikwad " Segmentation of Brain Tumour and Its Area Calculation in Brain MR Images using K-Mean Clustering and Fuzzy C-Mean Algorithm" International Journal of Computer Science & Engineering Technology (IJCSET)

[5] Ms. Pritee Gupta, MsMrinaliniShringirishi, ,Dr.yashpalsingh, "Implementation of Brain Tumor Segmentation in brain MR Images using KMeans Clustering and Fuzzy C-Means Algorithm"International Journal of Computers & Technology Volume 5, No. 1, May -June, 2013, ISSN 2277-3061

[6] Jude hemanth.D, D.Selvathi and J.Anitha," Effective Fuzzy Clustering Algorithm for Abnormal MR Brain Image Segmentation ",Page Number 609-614, International/Advance Computing Conference (IACC 2009), IEEE,2009.

[7] S.M. Ali1, LoayKadom Abood2, and RababSaadoon Abdoon3"Brain Tumor Extraction

in MRI images using Clustering and Morphological Operations Techniques”

[8] R. Karuppathal1 and v. Palanisamy2” fuzzy based automatic detection and classification Approach for mri-brain tumor” ARPN Journal of Engineering and Applied Sciences, VOL. 9, NO. 12, DECEMBER 2014

[9] S.MaryPraveena, Dr.IlaVennila “Optimization Fusion Approach for Image Segmentation using K-Means Algorithm” International Journal of Computer Applications (0975 – 8887) Volume 2 – No.7, June 2010

