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The Automated Brain Tumor Detection Based On Fuzzy Clustering Segmentation Approach

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Abstract—

This Brain tumors are the mechanisms to control normal cells randomly and uncontrolled multiplication of cells in which growth is an abnormal mass of tissue. A tumor growth takes place within the skull and interferes with normal brain activity. Therefore, the first step is very important in tumor detection. Various techniques have been developed to detect tumors in the brain. Most crucial task is brain diagnosis. Magnetic Resonance Imaging (MRI) plays a vital role in Brain Tumor diagnosis in advanced stages. Segmentation is challenging task in medical image processing.In present study we are going to present different aspects of brain segmentation and tumor detection. This research aims to develop an effective algorithm for brain diagnosis and segmentation of pre-processed membrane MRI images. Enhancement and Segmentation are deeply analyzed in this work. In the pre-processing Enhancement process the noise and high frequency components are removed using filters. In the Proposed method, an efficient detection of brain tumor region from cerebral image is done by region growing segmentation marking process and using Fuzzy C-means clustering to diagnose tumor.

Keuywords- NMR, MRI, ARM, KNN, MR, DICOM, MRI.

I. INTRODUCTION

In the past decades, we have carried out research into brain cancer diagnosis has seen dynamic growth in the number of tasks. Many university centres [1] because brain cancer is spreading among the population of the world that are focused on issues of fact. In the U. S. for example, approximately 3, 000 children are diagnosed with brain tumors. Almost half of the most deadly cancer among children, which die within five years [2]. It will neurological disabilities, retardation and psychological problems and is associated with increased risk of death. Most increases in incidence and death from brain cancer in the general population, despite the world; Africans dying from the disease is more likely than other patients. In Tunisia, for example, the cancer death rate of deaths among the elderly accounted for 14. 8 %. They represent the second leading cause of death after cardiovascular diseases [3]. For its negative effects on people affected by cancer diseases have a high burden on the national economy and society as well as a source of suffering for the family formed [3]. To identify a tumor, the patient will undergo several tests. Most computed tomography (CT) and magnetic resonance imaging (MRI) is used to detect brain tumors. The information obtained will influence treatment a patient will receive. Perhaps the most widely used clinical diagnostic and research technique is MRI. ARM...) is that part of the body of skilled medical imagery equipment, especially the brain. The nuclear magnetic resonance (NMR) is based on the principal.

Due to various scenes with high contrast in various tissues[4]. In analyzing image processing, segmentation, a pre-treatment step before the increase. In fact, dealt with low contrast enhancement step, since the majority of the images is needed to improve the quality of the images. Split phase also known as tumor clearance ensures that classification is followed by a post- treatment step. Classification of medical images, such as psychology, biology, medicine is a fundamental step in various applications.

Due to the high variability of medical image data classification process, it is important to use the appropriate model. In the past decade, machine learning -based classification is a major development, which may prove useful for biomedical image analysis, support vector machine these advances, kernel principal component analysis, and independent component analysis, bagging and boosting techniques? Supervised and unsupervised classification algorithms are classified; each class has its basic principles and properties, though Tumor detection and clearance of both categories that have a common purpose.

II. DIFFERENT REVIEWS

In computer vision, division multiple segments (sets of pixels) is refers to the process of dividing a digital image. The goal of the division is more meaningful and easier to analyze an image that represents something easy to make and / or change. Medical image segmentation especially magnetic / resonance (MR) images during diagnostic analysis, in view of human tissues is an inevitable process. Some split into no overlapping meaningful homogeneous regions or objects is a process of dividing an image space. An image analysis system success depends on the quality of the partition. Computer aided analysis of medical images for diagnosis and treatment, the division is often required as a preliminary step. Medical image segmentation because of the nature of the images is a complex and challenging task.

June Kong, et al. A technique proposed in 2006 [3]. A novel approach for segmenting brain tissue is proposed in this year. The algorithm is composed of four steps. In the first stage of image de-noising based on wavelet filter is used

versatile. In the next step, an initial segmentation method as watershed algorithm is applied to brain tissue. The next process is the process of merging fuzzy clustering algorithm is applied to access the partition. Finally, the division process is applied again. Are not completely separated, which is used for certain areas. The minimum covariance determinant estimator is used to detect regions and KNN classifier is used to divide them.

Riries Rulaningtyasand Khusnul in 2009[4], analyzed between the three algorithms for the detection of brain tumors, studying the best way to get it. Those three techniques Prewitt, Sobel and Robert study [4]. Three methods for edge detection, the Sobel edge detection method more suitable for brain tumor is found. This method is a little mean and standard deviation value. A pair of 3x3 convolution masks, X- direction (columns) and the Y- direction of the gradient estimate (rows) is used to assess the shield. Manipulating a square of pixels at a time mask is slid over the image. In this way the efficient edge detection is obtained by this method.

A novel brain tumor segmentation scheme [9], the image is obtained by thresholding segmentation technique where Rajasvaran Logeswaran, Chikkannan Eswaran is addressed. In this paper, 2D MRCP images a plan for early detection of tumors was proposed. Ages of different implementations of the scheme were presented. In tests carried out, the schemes correctly classify tumors and normal MRCP images were found to achieve high success rates. Planning ahead can be improved and some recommendations are presented here. During the division of the existing scheme uses Gaussian filtering. The Euclidean shortening flow (ESF) as Anisotropic filtering algorithm may be better to try to maintain Image structure. Threshold values in different parts of the algorithm used to recover a large number of test images can be tuned through better statistical analysis. Dynamic thresholding algorithms can be used.

In 2010 Alexandra Constantine, [13], presented an unsupervised, automated technique for brain tissue segmentation based on multivariate magnetic resonance (MR) and spectroscopy images, for patients with gliomas. The algorithm uses spectroscopy data for coarse detection of the tumor region. Once the tumor area is identified, further processing is done on the FLAIR image in the neighborhood of the tumor to determine the hyper-intense abnormality in this region. Areas of contrast enhancement and necrosis are then identified by analyzing the FLAIR abnormality in gadolinium-enhanced T1-weighted images. The healthy brain tissue is then segmented into white matter, gray matter, and cerebrospinal fluid (CSF) using a hierarchical graphical model whose parameters are estimated using the EM algorithm.

III. PROPOSED METHOD

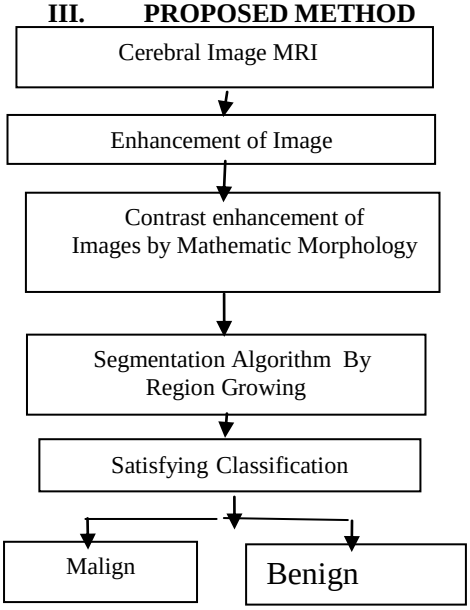

Fig 1 Flowchart For Brain Segmentation And Tumor Detection

1. ENHANCEMENT: Enhancement aims at improving the quality of a given image. It can be accomplished by removing noise, enhancing contrast, emphasizing edges and modifying shapes. Contrast enhancement of Images by Mathematic Morphology, morphology are the special enhancement by mathematical computation applied on medical images. It might be dilation or epsilon.

2. SEGEMENTATION: After pre-processing phase, a segmentation algorithm is adopted. The basic aim of segmentation is the partitioning of an image into homogeneous regions (spatially connected groups of pixels called classes, or subsets) with respect to one or more characteristics or features; such that the union of any two neighs boring regions yields a heterogeneous.

Medical image segmentation is a promising field and imposes constraints related to the concept of time, the great number of implied data and the richness of image concerning the complexity of the organ's anatomy, the patient's position of catching image. All these medical images characteristics add more difficulties to the problem of image segmentation and make the construction of a general model more complex.This explains the variety of segmentation methods appeared in the last years. In literature there exist two major classes of segmentation techniques: edge based segmentation approach and region based segmentation approach.

Region based methods

The goal of region based segmentation is to use image characteristics to map individual pixels in an input image to set of pixels called regions that might correspond to an object or a meaningful part of one. The various techniques are local techniques. Global techniques are splitting and merging. The performance of this algorithm depends on the application area and input image.

3. TUMOR DETECTION: In recent years a great effort of the research in field of medical imaging was focused on brain tumors segmentation. The automatic segmentation has great potential in clinical medicine by freeing physicians from the burden of manual labeling; whereas only a quantitative measurement allows to track and modeling precisely the disease. MR is generally more sensitive in detecting brain abnormalities during the early stages of disease, and is excellent in early detection of cases of cerebral infarction, brain tumors, or infections. MR is particularly useful in detecting white matter disease, such as multiple sclerosis, progressive multifocal leukoencephalopathy, leukodystrophy, and post-infectious encephalitis. After scanning of brain, detection of the Brain tumor from the brain scanned images (MRI Scan) is performed. This detection helps to obtain the location and size of the tumor.

CLUSTERING METHOD:

In this technique data set is replaced by cluster pixels may belong together because of the some color, texture etc. K-means, C-means and hierarchical clustering are the classes of cluster based methods. These are iterative technique that is used to partition an image into clusters that minimizes the variance between the pixel and the cluster center. This algorithm is guaranteed to converge. The quality of solution depends on the initial set of clusters.

Fuzzy Clustering: Fuzzy C-means segmentation is over hard segmentation method because they could retain much more information from the original image. Fuzzy C-means (FCM) is a method of clustering which allows one piece of data to belong to two or more clusters. It works by assigning membership to each data point corresponding to each cluster center on the basis of distance between the cluster center and data point.

More the data is near to the cluster center more is its membership towards the cluster center. Clearly summation of membership of each data point should be equal to one after each iteration membership and clusters are updated according to formula.

$$U_{ij} = \frac{1}{\sum_{k=1}^{c} \left(\frac{d_{ij}}{d_{ik}}\right)^{\frac{2}{m}-1}}$$

$$V_j = \frac{\sum_{i=1}^{n} {U_{ij}}^m \, x_i}{\sum_{i=1}^{n} {U_{ij}}^m} \qquad \forall = 1,2,3,\ldots . C$$

n- Number of data points. $V_j - jth$ cluster Center. c -Number of cluster centers.

U_{ij} –Euclidean distance between ith and jth cluster center, m = fuzziness index.

With fuzzy C-means, the centroid of a cluster is computed as being the mean of all points. Weighted by their degree of belong to the cluster. The degree of being in a certain cluster (degree of membership) related to the inverse of the distance to the 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 data set.

IV. EXPERIMENTAL RESULTS

The proposed segmentation technique have been implemented, using Matlab 7.8.0.The performance of various brain tumor image is analyzed and each Magnetic Resonance image shows different location. The MSE, Entropy (E), Standard Deviation and PSNR are used to evaluate the segmentation of medical image . The measures are defined as:

$$E = -\sum (p * \log_2 p)$$

$$PSNR = 20 \log_{10} \frac{MAX}{\sqrt{MSE}}$$

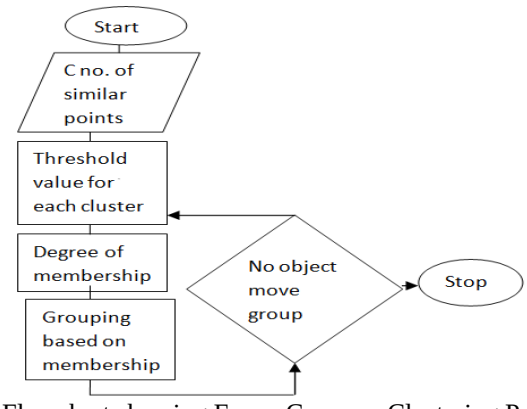

Fig 2 Flowchart showing Fuzzy C-means Clustering Process.

$$MSE = \frac{1}{mn}\sum_{i=1}^{m-1}\sum_{j=0}^{n-1}[I(i,j)-K(i,j)]^2$$

It is most easily defined by means MSE where m×n is no of pixel in the image and I (i, j) is the input image K (i, j) is the output image.

The Clustering algorithms Fuzzy C means clustering were applied on the database of 60 brain tumour images in non-medical format (.jpg, .png, .bmp etc.) as well as Images in DICOM format yielding the following efficiencies on the basis of four parameters.The result is given in Figure (3) shows the original MRI image as well tumor extracted through fuzzy clustering approach. The extraction of the tumor region is made by Fuzzy C-means clustering method. The MRI is compared for brain both existing and proposed where the PSNR ratio is exceeding around 10% which yield a better quality of image.

V. PERFORMANCE EVALUATION

The performance of brain tumor segmentation is evaluated based on Fuzzy C-means clustering. Dataset consists of Magnetic Resonance Imaging (MRI) size of 181 X 272. The MRI image dataset that we have utilized in image segmentation technique is taken from the publicly available sources. This image dataset consists of 40 brain MRI images in which 20 brain images with tumor and remaining brain images without tumor. Table 1 shows Analysed Parameters obtained from finally Segmented Image.

VI. CONCLUSION & FUTURE SCOPE

The accurate results of Fuzzy C-means clustering algorithm effectively extract the tumor region from brain MRI brain images. The Fuzzy C--means algorithm is used because of its simplicity and it is also preferred for faster clustering. Image segmentation is a significant issue in digital image processing and finds extensive application in many fields. This work was successful in detecting the tumor region extracted; hence this work can be extended for more abnormality condition in the brain.

Thus in proposed method from earlier work K-means and fuzzy C-means are compared and after simulation we can see that results of both algorithms are same but as already mentioned Fuzzy C-means and K-means are comparative in terms of time. The elapsed time for K-means is 0.302351 seconds and for fuzzy C-means it is 4.40076 seconds. The execution time is less for K – means due to less no. of iterations. That's why K-means is more efficient than Fuzzy C-means.

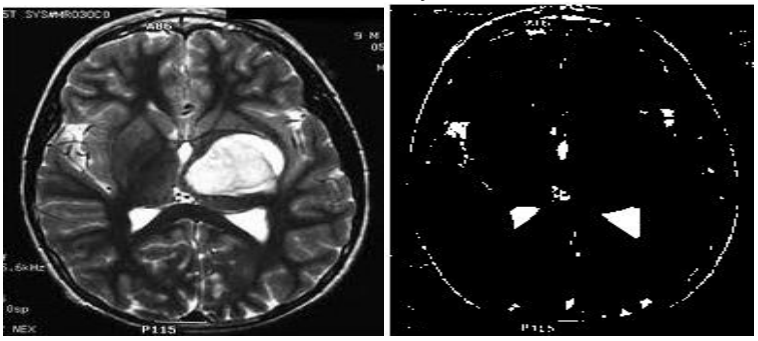

Fig 3 Comparing both Original Image as well as Tumor Image.

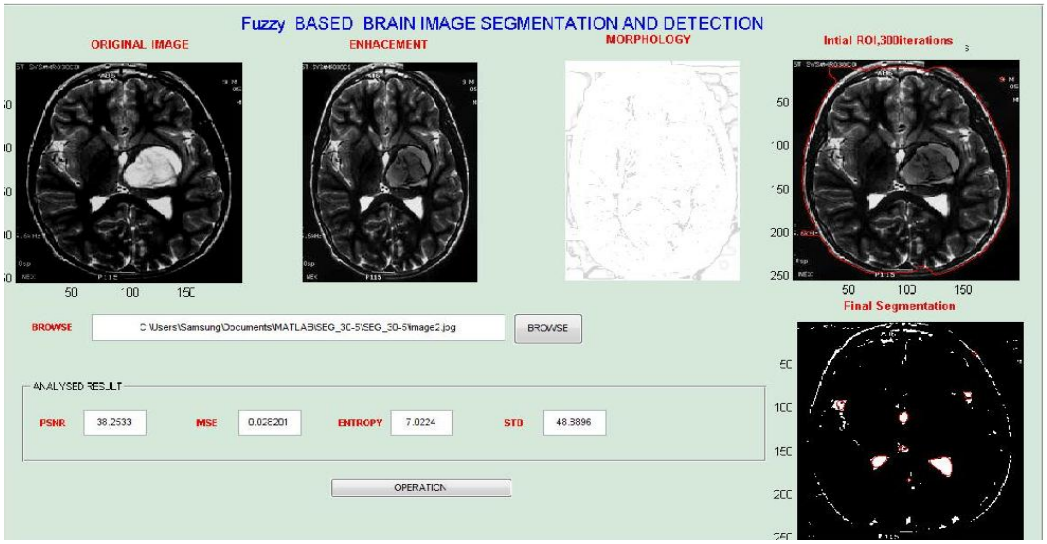

Fig 4 GUI Implementation

But in proposed current methodology, using current approach, the elapsed time for fuzzy C-means it is .88 seconds, which is highly improved with 300 maximum iterations, and less computational complexity, easy and fast approach.

TABLE I
Analysed Parameters obtained from finally Segmented Image.

Parameters	**Value obtained**
PSNR (Peak Signal To Noise Ratio)	38.2533
MSE(Mean Signal Error)	.02821
Entropy	7.0224
Standard Deviation(Std)	48.896

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