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A Novel Based Approach for Extraction of Brain Tumor in MRI Images Using Soft Computing Techniques

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Abstract: Brain tumor diagnosis is a very crucial task. Magnetic resonance imaging (MRI) scan can be used to produce image of any part of the body and it provides an efficient and fast way for diagnosis of the brain tumor. In the Existing Method, K-nearest neighbor is used to classify subject as normal or abnormal image. In the Proposed method an efficient detection of brain tumor region from cerebral image is done using Fuzzy C-means clustering and histogram .The histogram equalization calculates the intensity values of the grey level images and decomposition of image are extracted using principle component analysis is used to reduce dimensionality of the wavelet co-efficient. The Fuzzy C-means clustering algorithm finds the centroids of the cluster groups together the Brain tumor patterns obtained from MRI images. Segmentation result shows the extract suspicious tumor region.

Keywords: Magnetic resonance imaging (MRI), K-nearest neighbor, Fuzzy C-means clustering, Histogram equalization, Segmentation**.**

I. Introduction

Brain tumor is composed of cells that exhibit unstrained growth in the brain. Brain tumor nature is malignant since it takes up space and invades brain tissue which is required for vital body function. Due to the invading nature of brain tumor it affects one of most important in the body (5). Image of intensity in MRI depends upon four parameters. One is proton density (PD) which is determined by the relative concentration of water molecules. Other three parameters are T1, T2, and CSF, relaxation, which Reflect different features of the local environment of individual protons. Magnetic Resonance Imaging is a medical imaging technique. Radiologist used it for the visualization of the internal structure of the body. MRI provides rich information about human soft tissues anatomy.MRI helps for diagnosis of the brain tumor. Images obtained by the M Magnetic Resonance Imaging are used for analyzing and studying the behavior of the brain. Image intensity in magnetic Resonance Imaging depends upon four parameters. One is proton density (PD*)* which is determined by the relative concentration of water molecules. Ones the brain images acquired they are classified as normal and abnormal. The proposed method is composed of main 3 steps .The histogram equalization, the decomposition of Magnetic Resonance Imaging images suspect Zone or Tumor and extraction of location tumor .It improves contrast and goal of histogram equalization is obtain a uniform histogram. Segmentation method implements (14) the Fuzzy C-means clustering algorithm for detect tumor extract region from MRI image. Brain tumor is any mass that results from abnormal growths of cells in the brain. It may affect any person at almost any age. Brain tumor effects may not be the same for each person, and they may even change from one treatment session to the next. Brain tumors can have a variety of shapes and sizes; it can appear at any location and in different image intensities. Brain tumors can be benign or malignant. Benign brain tumors have a homogeneous structure and do not contain cancer cells. They may be either simply be monitored radiologically or surgically eradicated and they seldom grow back. Malignant brain tumors have a heterogeneous structure and contain cancer cells. They can be treated by radiotherapy, chemotherapy or a combination thereof and they are life threatening.

Many procedure and diagnostic imaging techniques can be performed for the early detection of any abnormal changes in tissues and organs such as Computed Tomography (CT) scan and Magnetic Resonance Imaging (MRI). Although MRI seems to be efficient in supplying the location and size of tumors, it is unable to classify tumor types, hence the application of biopsy. Biopsy is a painful process. This inability requires development of new analysis techniques that aim at improving diagnostic ability of MR images. This paper is organized as follows: Details of the overview are described in section II. Experimental results are reported in section III. Conclusion and Future work is presented in section IV.

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II. OVERVIEW OF METHODOLOGY USED

Mallet (6) shows that discrete wavelet transform is implemented by using two quadrature mirror filters H (low-pass) and G High pass filter . The Figure1 decomposition implemented by these two filters is applied at first line by line and then column by column.

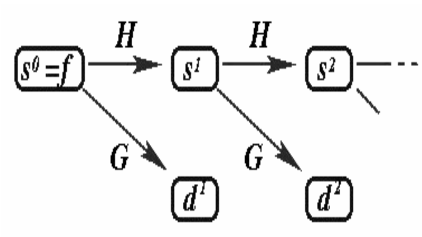

Fig 1: Wavelet decomposition

At each level, four sub-images are generated. Wavelet transform represents an image at different resolution levels. At resolution I_j, it provides an approximation of the original image I_j and three detail of image D_2^V, D_2^D,D_2^H Each of these details images privileges a particular orientation: horizontal, vertical and diagonal, and preserves the lost information .Figure 2 illustrated a decomposition of image at two level(16). Thus the set of all wavelet coefficients gives the wavelet domain representation of the image. Given a set of data, Principle component analysis finds the linear lower-dimensional representation of the data such that the variance of the reconstructed data is preserved .Using a system of feature reduction based on a combined principle component analysis on the feature vectors that calculated from the wavelets limiting the feature vectors to the component selected by the Principal Component Analysis should lead to an efficient classification algorithm utilizing supervised approach. So, the main idea behind using Principal Component Analysis in our approach is to coefficients. This leads to more efficient and accurate classifier reduce the dimensionality of the wavelet.

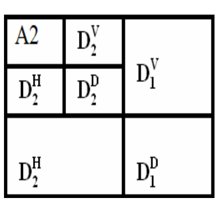

Fig 2: Sub Image generated at two levels

A. *K-nearest Neighbor*

The K-Nearest Neighbor is amongst the simplest pattern recognition algorithms. Existing method used k-nearest neighbor classifier for the classification of brain images as normal or timorous (3). In the training phase data points are given in an n-dimensional space. These training data points are given have labels associated with them that designate their class. A k-nearest neighbor algorithm based on the wavelet transform, which exploits the important information hiding in the transform coefficients to reduce the computational complexity. No more processing is required once the Magnetic Resonance Imaging image is determined as benign. The k-Nearest Neighbor has a slow running time.

B. *Proposed method*

In this proposed method k-means clustering is implemented with histogram equalization method. The K-Means clustering technique is a well-known approach that has been applied to solve low-level image segmentation tasks. Image segmentation covers this objective by extracting the abnormal portion from the image which is useful for analyzing the shape of the abnormal region.A brain Image consists of cluster(18) i.e. gray matter (GM), white matter (WM), cerebrospinal fluid (CSF) and tumor region. Experimental results on region segmentation verify the effectiveness of the proposed algorithm. The fig 3 shows proposed segmentation Method.

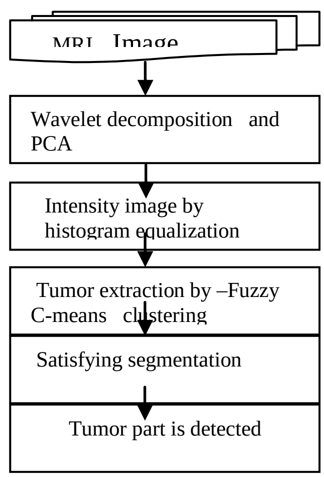

Fig3: Proposed method

C. *Histogram Equalization*

Histogram equalization is the technique by which the dynamic range of the histogram of an image is increased. Histogram equalization assigns the intensity values of pixels in the input image such that the output image contains a figure 4 show the uniform distribution of intensities (20). If the histogram of any image has many peaks and valleys, it will have peaks and valley after equalization, but peaks and valley will be shifted. Because of this, "spreading" is a better term than "flattening" to describe histogram equalization.

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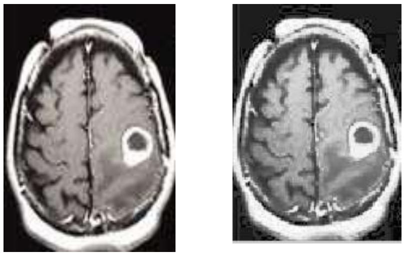

Fig4:(a)Original image (b)Histogram Equalization

Algorithm Fuzzy-C-means:

Fuzzy C-means is a clustering method which allows a piece of data to belong to two or more cluster, which is frequently used in computer vision, pattern recognition and image processing. The FCM algorithm obtains segmentation results by fuzzy. Color based classification methods which group a pixel belong exclusively to one class.FCM approach is quite effective for color based image segmentation. [10]Several segmentation algorithms are based on fuzzy set theory. Fuzzy C-means is a clustering algorithm that used membership degree to determine each data point belongs to a certain cluster. FCM divided the n vectors X_i(i=1,2,3…..n) into C fuzzy group and computing the cluster center of each group making value function of non-similarity index to achieve the minimum.[6] Fuzzy c-means (FCM) is a method of clustering which allows one piece of data to belong to two or more clusters. where m is any real number greater than 1, u_{ij} is the degree of membership of x_i in the cluster j, x_i is the ith of d-dimensional measured data, c_j is the d-dimension center of the cluster, and ||*|| is any norm expressing the similarity between any measured data and the center.[11] Fuzzy partitioning is carried out through an iterative optimization of the objective function shown above, with the update of membership u_{ij} and the cluster centers c_j by:

$$u_{ij} = \frac{1}{\sum_{k-1}^{c}\left(\frac{||xi-cj||}{||xi-cj||}\right)2/m-1}$$

Step1 : Initialize U=[u_{ij}] matrix, $U^{(0)}$
Step2: At k-step: calculate the centers vectors $C^{(k)}$=[c_j] with $U^{(k)}$

$$c_j = \frac{\sum_{i-1}^{N} u_{ij}^{m} \cdot xi}{\sum_{i-1}^{N} u_{ij}^{m}}$$

Step:3 Update $U^{(k)}$, $U^{(k+1)}$

$$u_{ij} = \frac{1}{\sum_{k-1}^{c}\left(\frac{||xi-cj||}{||xi-cj||}\right)2/m-1}$$

Step4: If || $U^{(k+1)}$ - $U^{(k)}$ ||< ε then STOP; otherwise return to step 2.

III. EXPERIMENTAL RESULTS

The proposed segmentation technique have been implemented using Matlab 7.0.The performance of various brain tumor image is analyzed and each Magnetic Resonance image shows different location. The RMSE and PSNR are used to evaluate the segmentation of medical image (6).

Table 1:PSNR and RMSE values for different MRI

S.NO	K-NN		FCM	
	PSNR	RMSE	PSNR	RMSE
1.	22.1659	102.206	32.1041	115.2132
2.	27.3142	107.241	35.6745	117.2143
3.	30.6634	125.253	37.6745	132.5871

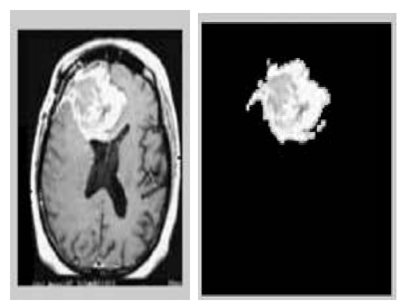

Fig 5: a) Original image b) Tumor region

The result is given in Figure (5). 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. PSNR is defined as

$$PSNR=10.\log_{10}\left(\frac{MAX_1^2}{\sqrt{MSE}}\right)$$

$$=20.\log_{10}\left(\frac{MAX_1}{\sqrt{MSE}}\right)$$

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

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 set of pixel value of MSE and PSNR is calculated of MRI images are tabulated below.

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IV. CONCLUSION

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. By using this technique centroid point can be located easy and will give more accurate and high resolution result. This work was successful in detecting the tumor region extracted; hence this work can be extended for more abnormality condition in the brain.

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