NEW APPROACH FOR BRAIN TUMOR STAGE DETECTION AND AREA CALCULATION

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ABSTRACT
A tumor also known as neoplasm is a growth in the abnormal tissue which can be differentiated from the surrounding tissue by its structure. A tumor may lead to cancer, which is a major leading cause of death. Cancer incidence rate is growing at an alarming rate in the world. Great knowledge and experience on radiology are required for accurate tumor detection in medical imaging. Automation of tumor detection is required because there might be a shortage of skilled radiologists at a time of great need. We propose a new approach for brain tumor detection that can detect and localize brain tumor in magnetic resonance imaging. The proposed brain tumor detection and area calculation framework comprises image acquisition, pre-processing, segmentation, extraction, classification and area calculation and stage detection.

KEYWORDS: Brain tumor, K-means, Magnetic Resonance Imaging (MRI), Pre-processing, Support Vector Machine (SVM), Naïve bayes (NB).

INTRODUCTION
Tumor is an uncontrolled growth of tissues in any part of the body. Brain tumor is inherently serious and life-threatening. Huge numbers of deaths have been verified due to the fact of inaccurate detection. Magnetic Resonance images are examined visually for detection of brain tumor producing less accuracy while detecting the stage and size of tumor. Lot of work were done over brain tumor detection but they all are having some drawbacks. By taking this entire drawback in consideration, we propose a brain tumor detection technique to increase accuracy and reduce the noise and other artifacts in the image. The noise reduction is done by median filtering technique. The accuracy is improved in segmentation by k- means algorithm. GLCM is used extract features. In addition support vector machine and Naive bayes classification techniques are compared for more accurate results. And then area and stage of cancer is calculated.

RELATED WORK
In 2012, J. Selvakumar, A, Lakshmi and T. Arivoli [2] proposed a technique for brain tumor segmentation using k-means and fuzzy c-means algorithm. Its use preprocessing step for filtering noise and other artifacts in image and apply K-means and fuzzy c-mean algorithm. This purposed algorithm, fuzzy c-mean is slower than K-means in efficiency but gives accurate prediction of tumor cells which are not predicted by K-means algorithm. Authors: J.Vijay, J.Subhashini[11]: An Efficient Brain Tumor Detection Methodology Using K-means Clustering Algorithm, International conference on Communication and signal processing, April 3-5, 2013 In this K-means clustering is a key technique in pixel-based methods. In which pixel-based methods based on K-means clustering are simple and the computational complexity is relatively low compared with other region-based or edge-based methods, the application is more practicable. It is an unsupervised clustering algorithm that classifies the input data points into multiple classes based on their inherent distance from each other.

METHODOLOGY

IMAGE ACQUISITION
The purpose of these steps basically involves removing low-frequency background noise, normalizing the intensity of the individual particles images, removing reflections and masking portions of images. In this stage images are converted (RGB image in gray scale image if not already) to be displayed as a gray scale image of size 256*256.The size is important to reduce processing time or to be large enough to be considered for proper processing. The values of the gray scale image would range

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from 0 to 255, where 0 represents total black color and 255 shows pure white color. Anything in between shows a variety of values representing the intensities of gray color. Fig. 1 shows Color to gray conversion.

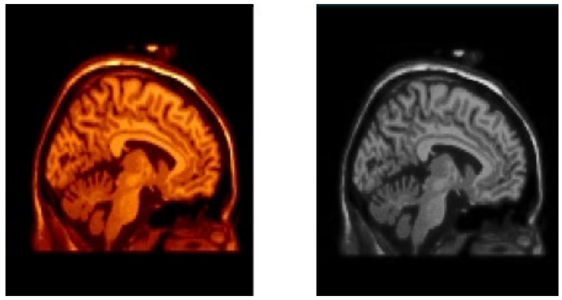

Fig.1 RGB to Gray conversion

A) PREPROCESSING

According to the need of next level that is to enhance the visual appearance of image and to improve the manipulation of dataset, preprocessing of image is required. The possibilities of arrival of noise in modern MRI scan are very less. It may arrive due to the thermal effect [1]. This performs filtering of noise and other artifacts present in image. Different techniques are present. We have compared median filter Gaussian filter for pre-processing. Noise reduced by median filter is better than Gaussian filter. Median filter acts as noise removal non-linear tool. In this filtering technique each image pixel is replaced by the neighborhood median pixel.

B) SEGMENTATION

The main idea of the image segmentation is to group pixels in homogeneous regions and the usual approach to do this is by common feature. Features can be represented by the space of color, texture and gray levels, each exploring similarities between pixels of a region. Segmentation [1] refers to the process of partitioning a digital image into multiple regions (sets of pixels).For segmentation purpose K-means and fuzzy c-means algorithms are used. The noise free image is given as a 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. Fuzzy c-means (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. Fig. 2 shows segmentation.

- Mathematical Representation for K-means:

For a given image, compute the cluster means m

$$M = \frac{\sum_{i:C(i)=K} x_i}{N_k} \quad ,k=1,\ldots,K \qquad \text{---------------------(1)}$$

Calculate the distance between the cluster centers to each pixel

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

Repeat the above two steps until mean value convergence.

- Mathematical Representation for Fuzzy c-means

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

Where

m- any real number greater than 1,

M_{ij}_ degree of membership of X_i in the cluster j,

X_i_ data measured in d-dimensional,

R_j - d-dimension center of the cluster,

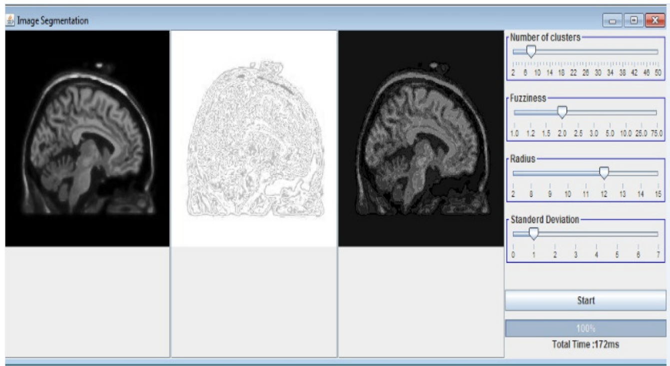

Fig. 2 Image Segmentation

C) FEATURE EXTRACTION USING GLCM

Gray-level co-occurrence matrix (GLCM) is the statistical method of examining the textures that considers the spatial relationship of the pixels. The GLCM functions characterize the texture of an image by calculating how often pairs of pixel with specific values and in a specified spatial relationship that present in an image, forms GLCM. This forms the extraction of statistical measures from this matrix. In this the features such as angular second moment, contrast, correlation, entropy, and inverse difference moment are extracted as shown in Fig. 3.

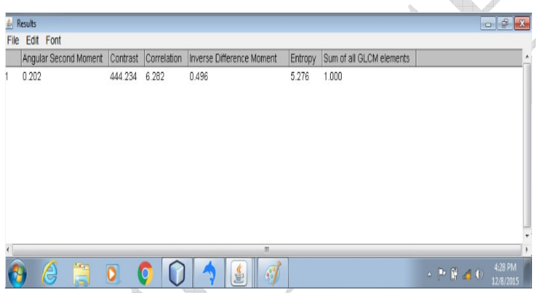

Fig. 3 Extracted features

D) CLASSIFICATION

Classification analyses the numerical properties of image features and organize the data into different categories. Super Vector Machine classifier is used to classify of normal and abnormal patients.

E) AREA CALCULATION

Using the binarization method in the stage detection step the area of the tumor is calculated. That means the image having two values either white or black (1 or 0). Here maximum image size is 256x256 jpeg image. We can represent a binary image as a summation of total number of black and white pixels.

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

Pixels = Height (H) *Width(W) = 256*256

f(1) = black pixel (digit 1)

f(0) = black pixel (digit 0)

$$\text{No\_of\_white\_pixel,P} = \sum_{W=0}^{255}\sum_{H=0}^{255} [f(0)]$$

Where,

P=Total number of white pixels (height*width)

1 Pixel = 0.264mm

The formula for area calculation is,

$$\text{Size\_of\_tumor, S} = [(\sqrt{P}) * 0.264]\ mm^2 \quad (3)$$

P = Number of white pixels;

H = height

W = width

F) SIMULATION RESULTS

The simulation studies involve conversion of MRI image into grayscale image as shown in Fig.1. The proposed algorithms are implemented with JAVA. A grayscale image is given as input to the preprocessing module. Fig. 4 shows that Median filter removes noise more efficiently than Gaussian filter. Fig.2 shows Segmentation. SVM classifier is used to classify normal and abnormal patients. It also finds the type of tumor for abnormal patient. It can be TYPE-1, TYPE-2 and TYPE-3. In this case TYPE-2 tumor with 27.85 mm area is detected. Shown in Fig. 6. Area of the tumor is calculated using binarization method.

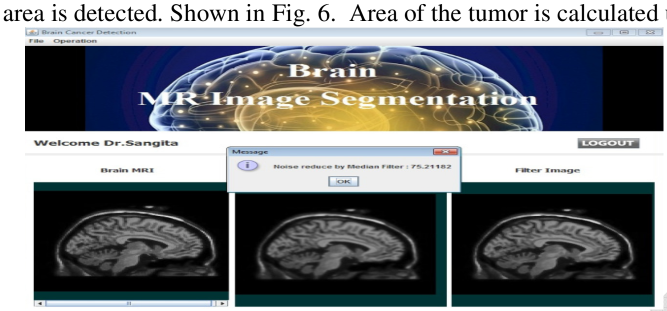

Fig. 4 Noised reduced by Median filter

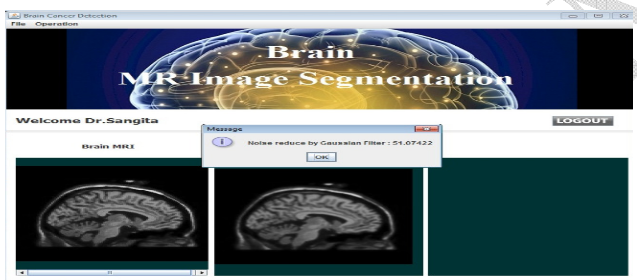

Fig. 5 Noised reduced by Gaussian filter

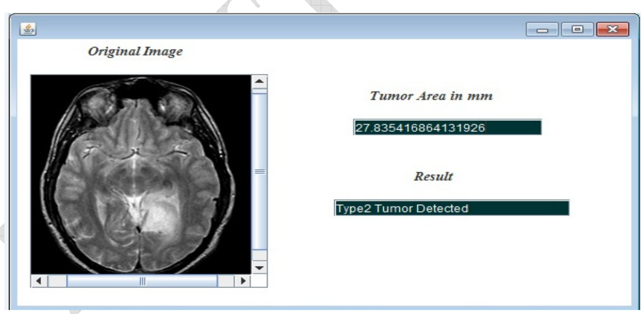

Fig. 6 Type and Area of tumor

CONCLUSION

There are different types of tumors available. They may be mass in the brain or malignant over the brain. Median filter removes noise more efficiently than gaussian filter. The thresholding method ignores spatial characteristics. Normally spatial characteristics are important for the malignant tumor detection. Hence by using GLCM different features are extracted and used to train classifier. Which further classify the normal and abnormal patients with their type such as TYPE-1, TYPE-2 and TYPE-3. Finally area is calculated using binarization method.

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