Brain Tumor Segmentation and Detection

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Abstract- ***Tumor is an uncontrolled growth of tissues in any part of the body and they have different characteristics and different treatments. As brain tumor is inherently serious and life threatening because number of individuals who died due to the fact of inaccurate detection. Generally, MRI produces complete image of brain. This image is visually examined for detection and diagnosis.***

This paper describes the computer aided method for segmentation of tumor using K-means clustering, PCA and SVM for classification of tumor. This method allows the detection of tumor tissue with accuracy comparable to manual segmentation. In addition, it also reduces time for analysis. At the end of the process the exact position and the shape of the tumor is determined.

Indexed Terms- Brain tumor, MRI, K-means, DWT, PCA, and SVM.

I. INTRODUCTION

In the past few years tumor is the major cause of deaths in both children and adults. A tumor is a mass of tissue that's formed by a growth of abnormal cells. Generally, cells grow and replace after they die but with cancer and other tumors this cycle will disturb. Tumor cells grow in the body even though the body does not need them. There are two general groups of brain tumor namely, Benign (non-cancerous) and Malignant (cancerous).

Benign tumors grow slowly and spread rarely. This tumor can be removed and rarely occur again [6].

Fig Benign tumor

Fig Malignant tumor

Growth of these cells varies and spread to other parts. These can't be removed.

There are many ways in diagnosing the brain tumor. Some of them are Computerized Tomography (CT), Positron Emission Tomography (PET), Magnetic Resonance Imaging (MRI) and Electroencephalography (EEG). Different angle images of brain is taken and combined together in all the scans. In MRI radio waves are used for getting digital images of brain.

Brain tumor is generally detected using MRI scan by the doctor. Magnetic resonance images (MRIs) has more information for brain tumor diagnosis and treatment. As deaths due to brain tumor is increasing because of time taken to identify the tumor. So an automated scheme is required for the identification of tumor.

Devasena [1] proposed a CAD system for the detection of abnormal parts in MRI images based on hybrid abnormality detection algorithm (HADA). The CAD system contains noise reduction, smoothing, feature extraction, feature reduction, and classification.

E. Dandil, M. Cakiroglu, Z. Eksi [2] developed computer aided diagnosis (CAD) system to classify brain tumor into benign and malign. For segmentation, Spatial- Fuzzy C-Means (FCM) method is used. SVM is used to classify them.

Arakeri [3] employed multiple filters in the preprocessing stage to remove noise, improve, construct, and enhance input images. In the segmentation process a combination of modified FCM (MFCM) clustering and wavelet decomposition technique is used. An amalgamation of three different classifiers: SVM, ANN, and K-NN are applied to distinguish between tumor types.

This paper presents the design of automated system for brain tumor detection and classify as either benign or malignant.

II. DESIGN PROCESS

The design of the proposed system is used for the detection and classification of tumor using MRI's. The flow chart explains the proposed system. Initially brain MRI is read by the system then pre-processing, processing and post processing is applied. Finally classification of the tumor will be done.

A. Pre-processing

This stage is employed to convert the image into more readable format by converting the MRI image into binary image using Otsu binarization technique. The algorithm assumes that the image contains two classes and then calculates the optimum threshold separating the two classes. The pixel value greater than the threshold is considered as background and the pixel value less than the threshold is considered as foreground.

B. Processing

In the processing stage, segmentation is done using K- means clustering. This procedure

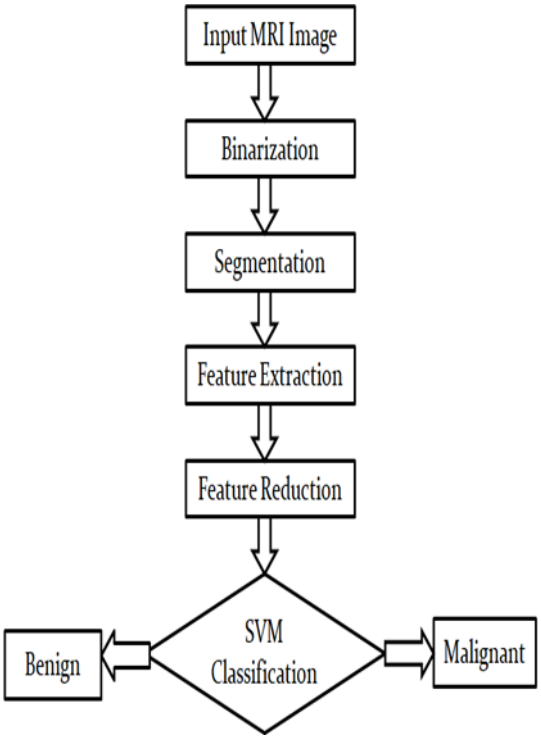

Fig1. Flow chart of proposed system

classifies a given data set through a given number of clusters (k clusters). This algorithm focuses at minimizing an objective function, in this case a squared error function [4]. The objective function:

$$L = \sum_{j=1} \sum_{i=1}^{K\,N} \left\| x_i^j - \rangle_j \right\|^2 \qquad (1)$$

Where $\left\| x_i^j - \rangle_j \right\|^2$ is a chosen distance measure between a data point x_i^j and cluster center $\rangle_j$. L is indicator of distance of N data points from their respective cluster centers.

C. Post processing

Post processing involves two methods namely Feature extraction and Feature reduction.

(i) DWT is used for Feature extraction. It transforms discrete time signals to discrete wavelet representation. DWT is preferable in comparisons with others as it capture both time and frequency information. Short-time wavelets allow information from high frequency components also. So this averages noise and elevates edges of the image. Thus edges in the image will be detected.

(ii) PCA is used for Feature reduction. It converts set of observations of correlated variables into set of values of uncorrelated variables. It is used for the

reduction of dimensions of image without much loss of information [7]. This is much advantageous for the image compression. Thus finds the features such as mean, entropy, kurtosis, skewness and these are used for the purpose of classification.

D. Classification

SVM classifier is used for the classification. It is the most popular data classification algorithm. It analyzes the data used for classification and regression analysis.

It classifies the two classes by finding a hyper-plane with low margin. It has two types of classifications namely, linear classification and non-linear classification.

In linear classification two classes are separated by a linear hyper-plane and in non-linear classification two classes are separated by using the operations like polynomial and quadratic.

III. RESULTS

For the proposed system the program is written in MATLAB window. After running the code, a window will open asking for the input MRI image. After taking the image, apply all the methods and detects the tumor. Finally, this tumor will be classified based on the shape as either benign or malignant.

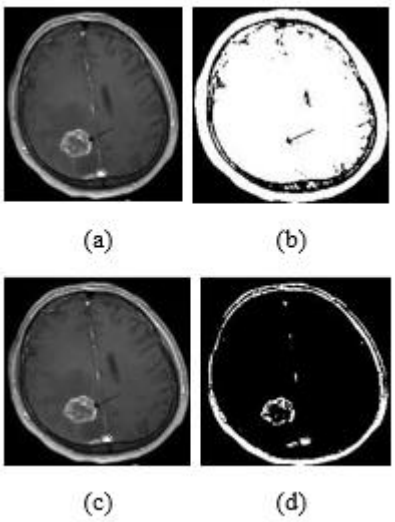

Fig2 Output images of benign tumor: (a) Brain MRI Image, (b) Otsu binary Image, (c) Objects in Cluster, (d) Detected tumor.

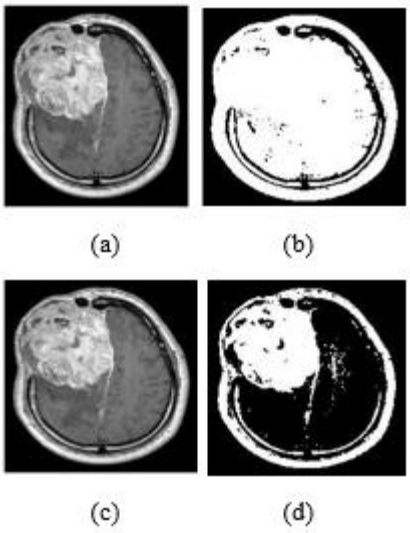

Fig3 Output images of malignant tumor: (a) Brain MRI Image, (b) Otsu binary Image, (c) Objects in Cluster, (d) Detected tumor.

CONCLUSION AND FUTURE SCOPE

Using MATLAB, benign and malignant tumor images are classified with higher accuracy. To distinguish these tumors we have employed segmentation, feature extraction, feature reduction and classification techniques.

By this system easy diagnosis of brain tumor will be done. This will be beneficial not only for the doctors and also for the patients for knowing their disease. Human interference will be reduced.

In future work by using other better techniques fir segmentation and classification the accuracy of segmentation and detection will increase.

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