Detection of Tumor in MRI Images of the Brain and its Classification using SVM

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Abstract— Brain tumor (tumor- British English, tumor- American English) is a group of cell that grows abnormally in the cell, nerves and other parts of the brain. Methods such as X-Ray, CT-Scan, MRI is available to detect the brain tumor. Many researchers have found that people die due to inaccurate detection of the affected brain tumor part. It is necessary to find the accurate part of the affected area of the brain tumor. Bio-medical image processing is the most challenging and upcoming field in the present world. By using MATLAB, the tumor present in the MRI brain image is segmented and the type of tumor is specified using SVM classifier (Support Vector Machine).

Key words: Brain Tumor, MRI Image, Segmentation, SVM Classifier, MATLAB

I. INTRODUCTION

Medical image processing is the most challenging and emerging field now-a-days. Processing of MRI images is one of the part of this field. MRI imaging technique is the best for detection of brain tumors due to its high resolution and ability to show clear brain structures, tumors size and location. MR Imaging is frequently used to obtain the images of the tumors, organs, joints and soft tissues. MR images provides such high resolution where we can obtain the detailed anatomical information to examine the brain tumor, and to detect the development and abnormalities inside the brain, if any. There are several methodologies for the classification of MR images include fuzzy methods, neural systems, atlas models, knowledge based techniques, shape methods and variation segmentation [1]. Preprocessing of MR images is the primary step in image analysis. Preprocessing steps include image resize, image enhancement and removal of noise as well as reduction techniques. There are some methods which are used to enhance the image quality, after which morphological operations basically applied on some assumptions about the size and shape of the tumor. In the end we mapped the tumor according to the original gray scale image with 255 intensity values. These values make it visible of the tumor in the image.

Image segmentation is the process of partitioning a digital image into multiple segments. Image segmentation is used to locate objects and boundaries in images. It is the process of assigning a label to every pixel in an image such that pixels with the same label share certain characteristics. The result of image segmentation is a set of segments that collectively cover the entire image, or set contours extracted from the image. Each of the pixels in a region is similar with respect to some characteristics such as color, intensity, texture. Some of the practical applications of image segmentation are as given below [1]

- Content based image retrieval
- Machine vision
- Medical imaging
- Object detection
- Recognition Tasks
- Traffic Control System

The disadvantage of the segmentation based on conventional techniques such as region growing, thresholding is stated as follows. In region growing, the choice of different seeds leads to different segmentation results. The seed lies at the edge of the image were the major problem in the segmentation result. The drawback of watershed transform technique was to fix the threshold value. The choice of different thresholding values leads to different segmented results. The disadvantage of these methods leads to the development of segmentation based on clustering techniques.

Image segmentation process is very close to the clustering problem. Clustering methods [3] have been successfully used to segment an image into a number of clusters (segments). Clustering-based segmentation techniques [5] have used several control parameters, e.g., the predefined number of clusters to be found or some tunable thresholds. These parameters are adjusted to obtain the best image segmentation. The parameters value is a nontrivial task.

II. PROPOSED SYSTEM

The proposed work performs processing of MRI brain images for detection and classification of tumor ad non tumor images by using a classifier. The image processing techniques like histogram equalization, image enhancement, image segmentation and then extracting the features for detection of tumor have been used. Extracted features are stored in the knowledge base. An appropriate classifier is developed to recognize the brain tumors by selecting various features [4]. The system is designed to be user friendly by using MATLAB tool based on following steps.

1) Input MRI images.
2) Image preprocessing is used to improve the quality of images. In preprocessing anisodiff filter is used.
3) Image segmentation is carried out by Fuzzy C Means clustering.
4) GLCM Features will be extracted from the segmented images.
5) The reduced features are submitted to a SVM classifier to identify tumor.

III. IMPLEMENTATION OF THE WORK

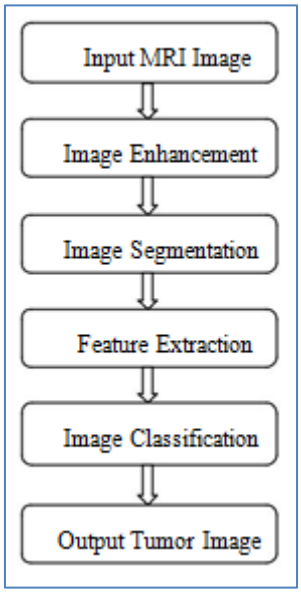


Fig. 1: Block diagram for Brain tumor detection using SVM classifier

A. Image enhancement

The preprocessing is done to de-noise the image and smoothing the edges using median filtering. After smoothing the image, the edges need to be isolated or extracted. The tumor needs to be isolated from its background. So the best suited segmentation methods like k-means, FCM has been used for this purpose.

B. Segmentation

Segmentation in medical imaging is challenging and complicating task for the exact recognition of brain tumor. A number of clinical investigation/ trials are performed for the recognition of pattern of brain tumor. The main purpose of segmentation is to partition the image into multiple segments which makes more meaningful and easy to analyze. Each pixel assigning a label to the image so that pixel having same label show similar characteristics and properties. For the anatomical detailed information of brain images, mapping and identification of tumor clustering algorithm has been very effective. Various methods for image segmentation are [9]

- Edge detection methods
- Region growing methods
- Watershed segmentation
- Clustering segmentation.

The best suited segmentation technique is clustering method for brain MRI scanned images; because, in other methods, the cancer cells near the surface of MRI image are very fat; thus, appear dark which is very confusing for the isolation of the edge or periphery for the tumor part and non-tumor part[11]. So Fuzzy C-means clustering has been used in this work in which every point has a degree of belongingness to cluster for a given dataset.

C. Feature extraction

GLCM is the algorithm used to extract features from the gray image. The features were extracted from the image and it is selected by forward selection and backward elimination process [7]

- The fourteen features are enlisted below
- These features are extracted from image and feed input to the classifier.

D. SVM Classifier

This classifier is a part of machine learning that gives computers the ability to learn. It is a set of learning methods that analyze data pattern which is used for classification. SVM classifier has been used to determine whether it is normal or abnormal. SVM is a binary classification method in which two classes for input data has been fixed. For normal case, symbol '0' has been taken; whereas, for abnormal '1' has been taken. The parameters from feature extraction have been used for classification [6] [19].

Support vector machine is the linear learning algorithm. It is a supervised algorithm. The process of classification forward through training and testing [10].The linear function is given by

$$f(x) = w^T X + b \quad (1)$$

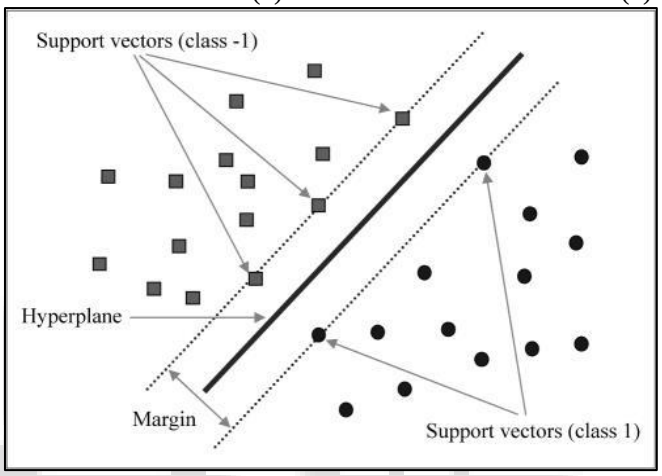
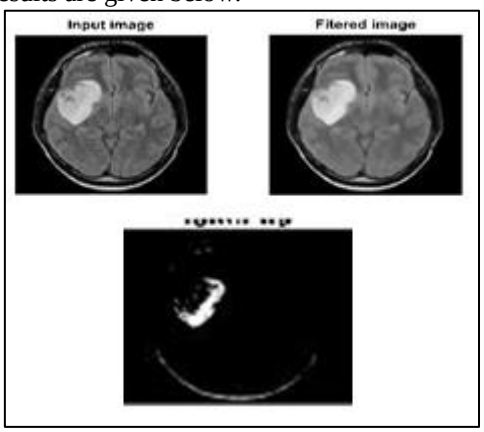


Fig. 2: SVM Classifier

IV. RESULTS & DISCUSSION

The execution of proposed system is one after another. Firstly, database images are used to preprocessing and after that preprocessed data used for segmentation. The preprocessing such as resize, gray scale conversion and use of LPF for noise removal. Second part is, the segmented results used for feature extraction. Extracted features are used for classification. Before classification database is trained in to the system and after that class is predicated. Finally, the browsed image from database is compared with trained data and the classification is done. The different stages results are given below.



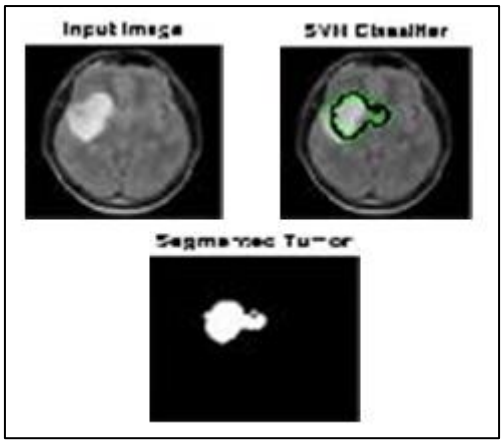


Fig. 3: (i) Input image and segmentation results (ii) SVM classifier and segmented tumor results

V. PERFORMANCE MEASURE

Classification is the process where a given test sample is assigned a class by the classifier during training.

A. Performance measures: Classification, the sensitivity, specificity and accuracy were calculated using below formulas:

- True Positive (TP): Abnormal brain correctly identified as abnormal.
- True Negative (TN): Normal brain correctly identified as normal.
- False Positive (FP): Normal brain incorrectly identified as abnormal.
- False Negative (FN): Abnormal brain incorrectly identified as normal.

1) Sensitivity = TP/ (TP+FN) *100% 2)
2) Specificity = TN/ (TN+FP) * 100% 3)
3) Accuracy = (TP+ TN)/ (TP+ TN+FP+FN)*100%

All these three parameters are used to check the classifiers performance

S.No	Classifier	Sensitivity	Specificity	
1	SVM (Linear)	100	1	1
2	SVM (Polynomial)	80	0.8	0.8
3	SVM (radial Basis function)	80	0.6	1

Table 2: Shows the various parameters for different classifier

VI. CONCLUSION

Brain tumors are caused by abnormal and uncontrolled growing of the cells inside the brain. Treatment of a brain tumor depends on its size and location. Although benign tumors do not tend to spread, they can cause damage by pressing on areas of the brain if they are not treated early. To avoid manual errors, an automated intelligent classification technique is proposed which caters the need for classification of image. In this paper classification techniques based on Support Vector Machines (SVM) are proposed and applied to brain image classification. This automated intelligent system results in the improvement of accuracy rate and reduces the error rate of MRI brain tumor.

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