Implementation of Brain Tumor Detection using Segmentation Algorithm & SVM

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Abstract:

In this paper, we implemented an automated system for brain tumor detection, the main functionality of this system is divided in some parts are Segmentation, Object Labeling, HOG (Histogram Oriented Gradient), feature extraction and linear SVM implementation.

For Segmentation we are using K-means algorithm, for Object Labeling HOG is use, HOG also use to extract texture feature, shape context feature and color feature. Then we are implementing the SVM based on this feature we can train the SVM and further test is on other infected MRI images.

Keywords: K-means algorithm, Object Labeling Algorithm, Image segmentation.

I. INTRODUCTION

Tumor segmentation from MRI data is an important but time-consuming and difficult task often performed manually by medical experts. Radiologists and other medical experts spend a substantial amount of time segmenting medical images. However, accurately labelling brain tumour is a very time-consuming task, and considerable variation is observed between doctors [2].

Throughout the few years, different segmentation methods have been used for tumor detection but it is time consuming process and also gives inaccurate result. So, computer aided system can be designed for accurate brain tumor detection from MRI images. Brain tumor can be broadly classified as primary brain tumor(the tumor originates in the brain) and secondary brain tumor (spread to brain from somewhere else in the body through metastasis) Primary brain tumors do not spread to other body parts and can be malignant or benign and secondary brain tumors are always malignant. Malignant tumor is more dangerous and life threatening than benign tumor. The detection of malignant tumor is more difficult than benign tumor [3].

After the noise removing from the MRI images we have to focus on tumour only for that we need to extract the exact brain tissues for that we have performed the skull removing process in that we have used the horizontal, diagonal, anti-diagonal and vertical masks to perform the erosion and dilation which is results in to the skull masked image which further proceed to segmentation.

Labelling of connected components ('objects') is one of the most important tools of image processing. It is the basis for the generation of object features as Well as of some kind of filtering, *i.e.*, removing of noisy objects or holes in objects. The criteria for removing an object or a hole can be chosen extremely flexible based on the object features. The task of labelling (object filling, region detection) is to assign labels (mostly unsigned integers) to the pixels in such a way that all pixels belonging to a connected component of the image are assigned the same label, and pixels belonging to different components get different labels [5].

II. LITERATURE REVIEW

J.Vijay et.al [3], propose the work on automated brain tumor detection by using segmentation by k-means algorithm and object labeling algorithm. They identified that a well known segmentation problem within MRI is the task of labeling the tissue type which include White Matter (WM), Grey Matter (GM), Cerebrospinal Fluid (CSF) and sometimes pathological tissues like tumor.

S.Koley et.al [4], propose the efficient work on tumor detection and segmentation of brain MRI for the purpose of determining the exact location of brain tumor using CSM based partitioned K-means clustering algorithm. CSM has attracted much attention as it has given efficient result as a self merging algorithm compared to other merging processes and the effect of noise is also less and the probability of obtaining the exact location of tumor is more. Their approach is much simpler and computationally less complex and computation time is very less.

A. Laxami et.al, [5] proposed the work on information (region of interest) in the medical image and thereby vastly improve upon the computational speed for tumor segmentation results. Significant feature points based approach for primary brain tumor segmentation was proposed. Axial slices of T1-weighted Brain MR

Images with contrast enhancement have been analyzed. In order to extract significant feature points in the image, applied a feature point extraction algorithm based on a fusion of edge maps using morphological and wavelet methods. Evaluation of feature points thus obtained has been done for geometric transformations and image scaling. A region growing algorithm was then employed to isolate the tumor region. Preliminary results show that our approach has achieved good segmentation results. Also this approach was reduces a large amount of calculation. Future work will involve an investigation of the method in automatic 3D tumor segmentation, segmentation of ROI's in other medical images, as well as the importance of implemented technique in medical image retrieval applications.

III. PROPOSED SYSTEM

The basic purpose of this paper is to show the tumor region. In this paper, we are implementing the system for brain tumor detection from MRI images, the malignant or benign tumor region we will find by this system. The complete system includes preprocessing of MRI by using Median filtering, skull removing by morphological filtering, and segmentation by k-means algorithm; object labeling by HOG algorithm, also feature extracted by HOG, and linear SVM implementation by using extracted feature of the MRI.

In the testing part we are passing the parameter to the SVM that is the previously stored feature with class name and the extracted feature of new MRI image.

A. Preprocessing

Preprocessing of MRI images includes the de-noising the MRI image and also skull masking. The Median filter is used to de-noising the MRI images by converting first the RGB image to grayscale image so we can get one intensity scale.

The skull masking is the process which will perform on the de-noised image. The purpose of this process is to remove fatty tissue, skull part and hair part in the MRI so we can process with purely brain tissues only and the ambiguity in identification of tumor get reduce.

For morphological filtering we are using different masks on MRI image horizontal, diagonal, anti-diagonal and vertical masks are used to process the skull masking.

Steps for preprocessing are as follows:

1) Image is converted to gray scale.
2) A 3x3 median filter is applied on brain MR image in order to remove the noise.
3) The obtained image is then passed through a high pass filter to detect edges. The high pass filter mask is used.

The edge detected image is added to the original image in order to obtain the enhanced image.

In order to preserve the local details of the image, median filter should only modify the intensity of ruined pixels on the damaged image. However, it is very difficult to detect the ruined pixels from this image correctly. Even for fixed-valued impulse noise (i.e. salt-and-pepper noise)

B. Segmentation

Image Segmentation is the process of partitioning a digital image into multiple regions or sets of pixels. Essentially, in image partitions are different objects which have the same texture or color. The image segmentation results are a set of regions that cover the entire image together and a set of contours extracted from the image. All of the pixels in a region are similar with respect to some characteristics such as color, intensity, or texture. Adjacent regions are considerably different with respect to the same individuality.

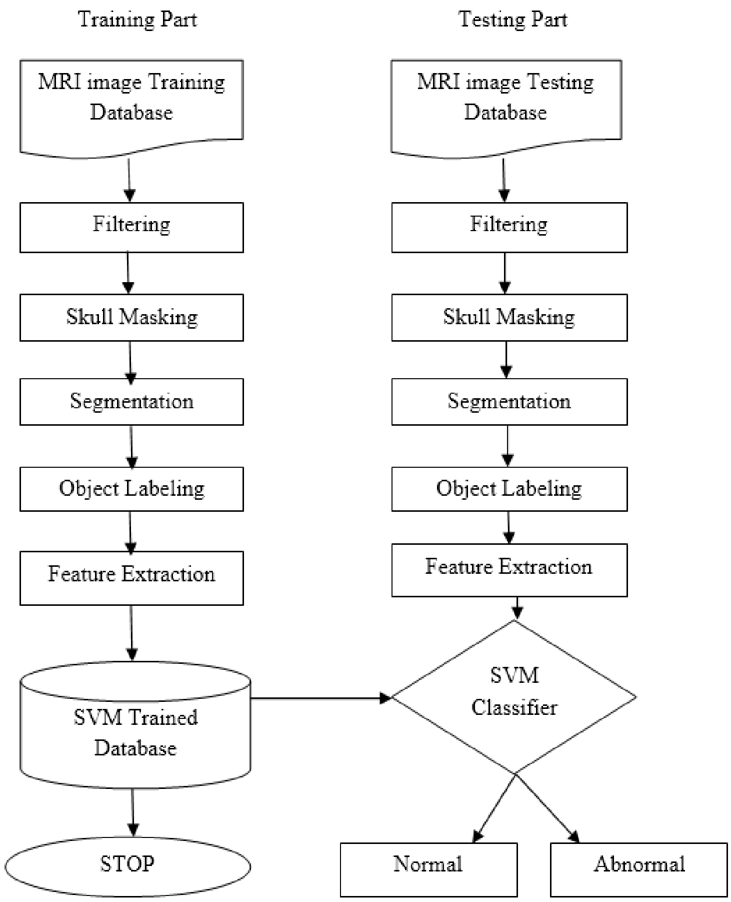


Figure 1: Flow diagram of proposed system

The different approaches are (i) by finding boundaries between regions based on discontinuities in intensity levels, (ii) thresholds based on the distribution of pixel properties, such as intensity values, and (iii) based on finding the regions directly.

Here we are implementing region based methods which are based on continuity. These techniques divide the entire image into sub regions depending on some rules like all the pixels in one region must have the same gray level. Region-based techniques rely on common patterns in intensity values within a cluster of neighboring pixels. The cluster is referred to as the region in addition to group the regions according to their anatomical or functional roles are the goal of the image segmentation.

C. Object Labeling

Object Labeling is used in this system for identifying the region of interest (ROI), here in this system the Histogram Oriented Gradient (HOG) algorithm is used for object labeling the additional benefit to use this algorithm is that it will help to extract the features of an image. This will further help to train and test the SVM.

The HOG extracts the color feature, texture feature and shape context feature. This features are stored in .mat file and it is use to train the SVM

D. SVM

Here we are using texture feature and color feature to train SVM. For texture feature we have taken the edge width as a parameter and for color feature we have taken RGB as a parameter.

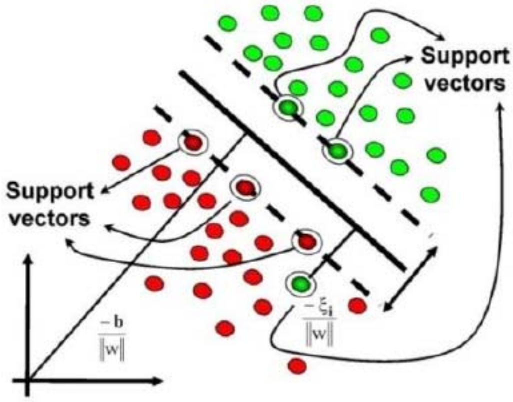


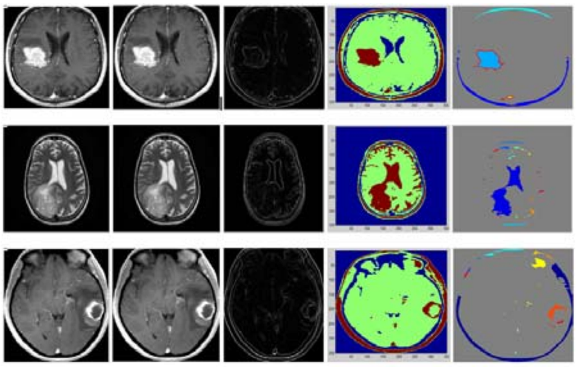
Figure 2: The classification process of SVM

SVM are based on optimal hyper plane for linearly pair able patterns but can be extended to patterns that are not linearly separable by transformations of original data to map into new space. They are explicitly based on a theoretical model of Learning and come with theoretical guarantees about their performance. They also have a modular design that allows one to separately implement and design their components and are not affected by local minima. Support vectors are the elements of the training set that would change the position of the dividing hyper plane if removed. Support vectors are the critical elements of the training set. The problem of finding the optimal hyper plane is an optimization problem and can be solved by optimization techniques.

IV. EXPERIMENTAL RESULT AND DISSCUSSION

Proposed Brain tumor detection system is improve with segmentation of preprocessed image then resulted image goes with object labeling and feature extraction.

Extracted features used to train SVM and the database of feature is use for pattern matching and test the system.



(A) (B) (C) (D) (E)

Figure 3: Result of proposed system (A) MRI image, (B) Preprocessed image, (C) Skull removed image, (D) Segmented image, (E) Object labeled image

In above figure 3 the result of proposed system is explain there, the first is original MRI image which is having some noise in it. The noise is removed with median filter the result of median filter is shown in (B) image. Then the morphological filtering is used on the preprocessed image and the masks are used to remove the fatty tissues and skull bone.

Then the resulted image is go under the segmentation with thresholding, here we have used three colors to show regions according to the intensity slices. After that the resulted image of segmentation goes under object labeling with HOG algorithm and also does the extraction of texture, color and shape context feature.

The resulted image of segmentation and object labeling goes under SVM learning, for SVM the linear classifier algorithm is used here and another features that are Mean, Standard deviation, Entropy, RMS, Varience, Smoothness, Kurtosis, Skiwness, IDM, Contrast, Corelation, Energy, Homogenety extracted and stored on the .mat file.

This all features are stored in database and that are use for making patterns of the classes that are benign tumor or malignant tumor.

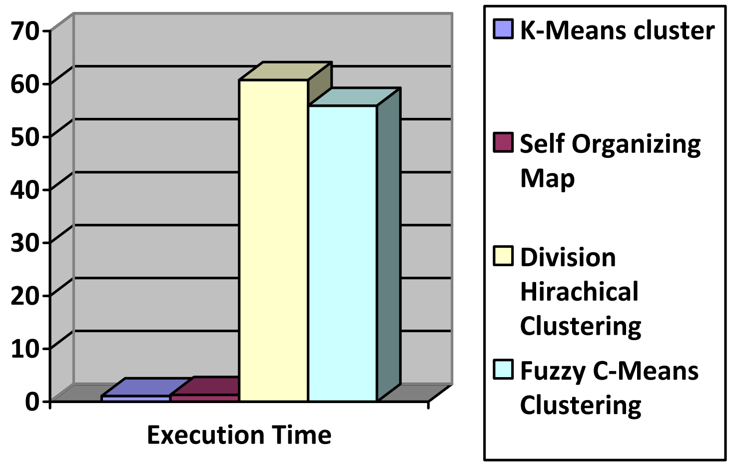


Figure 4: Result analysis of Execution time of various Segmentation methods

The above figure 4 shows the result analysis of Execution time of various Segmentation methods. In that the k-means clustering gives fine result than the other methods that's why here in improved system K-Means clustering is used for segmentation.

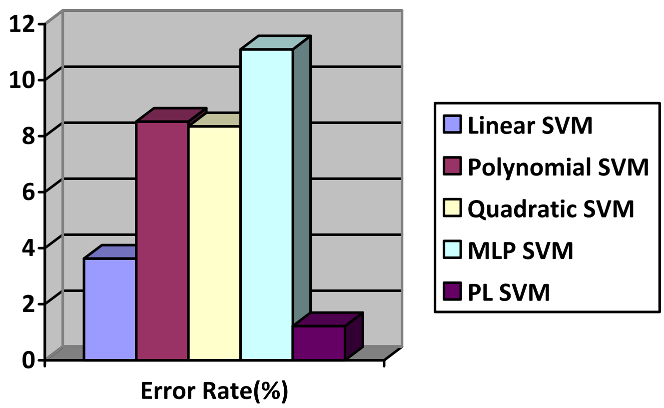


Figure 5: Result analysis of Error rate of various Classification Methods

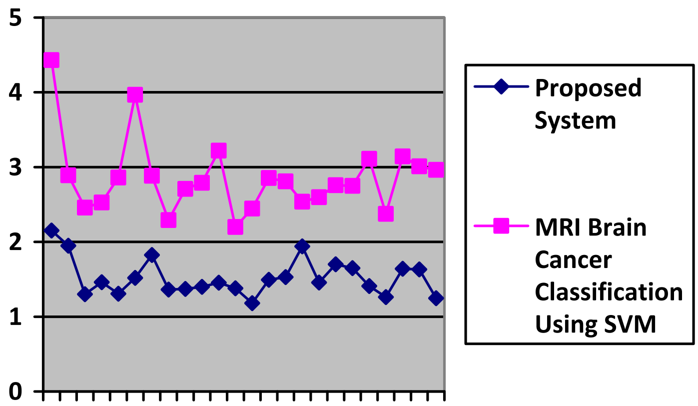


Figure 4: Result analysis of Execution time of Proposed system and Existing system

The proposed system gives a faire result for the input that is MRI images. The proposed method includes the k-means for segmentation HOG for segmentation and the SVM for pattern mapping and pattern matching process.

Before this system there exist the other methods to identify the brain tumor one of them is FCM mean and only simple k-means is used for tumor detection.

In above number of images verses accuracy graph the red line shows the graph of proposed algorithm, the green is FCM mean and the blue is k-means algorithm performance according to the accuracy towards the tumor detection.

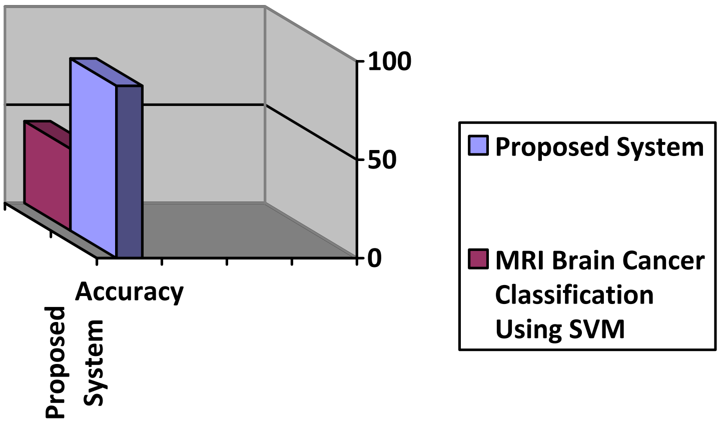


Figure 5: Result analysis of Accuracy of Proposed system and Existing system

The proposed system is also very sensitive to the errors, because the small error will take the situation in ambiguous state which is not good for diagnosis of tumor so here we are taking a resulted graph of number of images verses overall error in system.

Again same FCM mean and k means algorithms are use to compare individual performance with the proposed method and the result of all are compared and we found that the proposed system having less errors in the system.

V. CONCLUSION

The proposed system is the combinations of some technologies like k-means for segmentation, HOG for object labeling, median filter, morphological filter and wavelet transform for the preprocessing and skull masking. So the result of this all combination is very faire than the individual of them or the some other combinations.

The linear SVM and HOG are work with coordination because the HOG extracts the feature and SVM use that data for learning the SVM, so the SVM will able to make the patterns and after training in testing it will work for the test the pattern and gives the conclusion.

Here we are dividing the tumor images in Malignant or Benign classes. Also after identification the image and the feature of it are added into the database of the SVM so we can increase the accuracy of the proposed system.

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