



BRAIN TUMOR DETECTION USING OBJECT LABELING ALGORITHM & SVM

Swapnil R. Telrandhe¹, Amit Pimpalkar², Ankita Kendhe³

¹G.H.R.A.E.T, Nagpur, ²G.H.R.A.E.T, Nagpur, ³G.H.R.A.E.T, Nagpur

¹telrandheswapnil@yahoo.com, ²amit.pimpalkar@raisoni.net, ³ankita.kendhe@raisoni.net

ABSTRACT:

In this paper, we propose an efficient brain tumor uncovering method, which can detect tumor and localize it in the brain MRI images. This method extracts the tumor by using K-means algorithm followed by Object labelling algorithm. For better result we can cluster the identified regions and apply object labelling there, also some preprocessing step (median filtering) is used for tumor detection purpose. At the end the training and testing by SVM will be perform, SVM find out the patterns of this to use in future and comparison purpose so it will enhance the efficiency of system and tumor detection will get easier task in medical field. It is expected that the experimental results of the proposed method will give better result in comparison to other existing techniques.

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

I. INTRODUCTION

Image segmentation holds an important position in the area of medical image processing [1]. Segmentation can be used to detect tumor from MRI image. Throughout the few years, different segmentation methods have been used for tumor recognition but it is time consuming process and

also gives inexact result. So, computer aided system can be planned for accurate brain tumor Recognition from MRI images. Brain tumor can be broadly classified as primary brain tumor (the tumor invents in the brain) and secondary brain tumor (spread to brain from somewhere else in the body through metastasis)[2].

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. For the accurate detection of the malignant tumor that needs a Different brain tumor detection algorithms have been developed in the past few years. M. Masroor Ahmed and Dzulkifti BinMohammad[1] proposed brain tumor detection method using K-means algorithm. It is observed that tumor is detected along with non-tumor region. Also, GregHamerly and Charles Elkan have presented an algorithm using K-means clustering [3]. This algorithm can be used for better result in image segmentation. Mangipudi Partha Sarathi et.al implemented a methodology for fully automated Brain Tumor segmentation from T1 weighted contrasts enhanced Magnetic Resonance Images. Feature point extraction algorithm has been designed to extract the visually significant feature

points. Feature points relating to Tumor are then identified and extracted as seeds for further region growing. Feature points are obtained by fusion of wavelet methods and image edge maps.

Robustness of feature points to geometrical transformations and scaling have been shown. Our method gives a sparse representation of the information (region of interest) in the medical image and thereby vastly improves upon the computational speed for tumor segmentation results. Significant feature points based approach for primary brain tumor segmentation is 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, implemented 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 is then employed to isolate the tumor region. Preliminary results show that our approach has achieved good segmentation results. Also, this approach reduces a large amount of computation. Future work will involve an investigation of the technique 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 [12].

An adaptive K-means algorithm is considered in [4] to detect micro calcifications in digital mammograms for breast cancer detection. FCM technique is used in [5] to extract WM, GM and CSF from MRI image. In [7] a technique called Cohesion Based Self Merging (CSM) is used to refine the detected tumor area. In addition, algorithm using threshold technique based segmentation has also been investigated in tumor detection problem in [8].

Threshold is a particular intensity value which satisfies a predefined intensity value, it is used to separate object or Region of Interest (ROI) from the image background, chosen in the range of 0 to 255. But it is observed that clustering methods followed by threshold cannot detect tumor properly from MRI image, because the image consist of several on-brain tumor tissue. For this reason we formulate the proposed method using K-means algorithm followed by Object labeling algorithm also, some preprocessing steps (median filtering and morphological operation) is used for tumor detection purpose.

II. PROPOSED METHOD

The basic purpose of this paper is to show only the tumor region. In this paper, we will implement the system for brain tumor detection from MRI images, the malignant tumor region we will find by this system. The complete procedure for the proposed algorithm is given below.

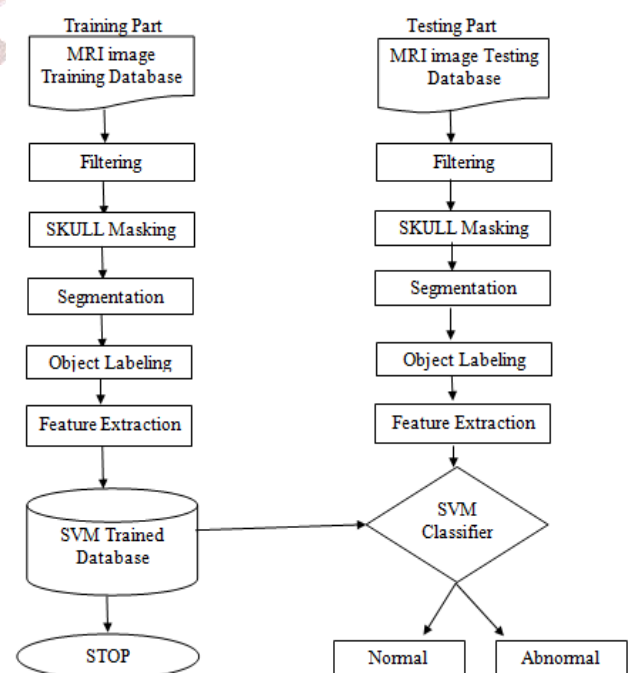


Figure 1: Flow diagram of proposed system

A. Preprocessing

Pre-processing of brain MR image is the first step in our proposed technique. Pre-processing includes image filtering and skull masking also. Pre-processing of an image is done to reduce the noise and to enhance the brain MR image for further processing. The purpose of these steps is basically to improve the image and the image quality to get more surety and ease in detecting the tumor. Steps for pre-processing 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 filters 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 change the intensity of corrupted pixels on the damaged image. However, it is very difficult to detect the corrupted pixels from this image correctly. Even for fixed-valued impulse noise (i.e. salt-and-pepper noise),

Where the noise only takes values 0 and $L-1$, simple thresholding method still cannot classify the pixels effectively. This is because some of the uncorrupted pixels are also had been presented by these two values. Thus, researches such as [13] incorporate fuzzy logic approach into median filtering process.

There are several ways on how fuzzy logic been used in median filtering process. Fuzzy logic can be used to grade how high a pixel has been corrupted by impulse noise. Normally, based on this fuzzy degradation measure, a proper correction will be applied. On the other hand, some of the methods use fuzzy logic as a decision maker that

selects a proper filter, from a filter bank, for a given input image.

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. 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.

Thus the choice of image segmentation technique is depends on the problem being considered. Region based methods 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.

Threshold is the simplest way of segmentation. Using thresholding technique regions can be classified on the basis range values, which is applied to the intensity values of the image pixels. Thresholding is the transformation of an input image to an output that is segmented binary image. Segmentation Methods based on finding the regions directly find for abrupt changes in the

intensity value. These methods are called as Edge or Boundary based methods. Edge detection is the problem of fundamental importance in image analysis. Edge detection techniques are generally used for finding discontinuities in gray level images. To detect consequential discontinuities in the gray level image is the important common approach in edge detection. Image segmentation methods for detecting discontinuities are boundary based methods.

In this paper we are using k-means segmentation algorithm of segmentation and segment the MRI images.

K-Means based segmentation

K means clustering is the most widely used and studied method among the clustering formulations that are based on minimizing a formal objective function. Modifications to the K-means clustering method that makes it faster and more efficient are proposed. 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. The main argument of the proposed modifications is on the reduction of intensive distance computation that takes place at each run (iteration) of K-means algorithm between each data point and all cluster centers.

To reduce the intensive distance computation, a simple mechanism by which, at each iteration, the distance between each data point and the cluster nearest to it is computed and recorded in a data structure is suggested. Thus, on the following iterations the distance between each data point and its previous nearest cluster is recomputed. In the proposed method, we combine segmentation and the K-means clustering. A brain

Image consists of four regions i.e. gray matter (GM), white matter (WM), cerebra spinal fluid (CSF) and background. Therefore, an input image needs to be divided into these four classes. In order to avoid the chances of misclassification, the outer elliptical shaped object should be removed. After the enhancement of image morphological process is carried out to extract the required region. The Next step is by implementing K-means with clusters exact result is produced [12].

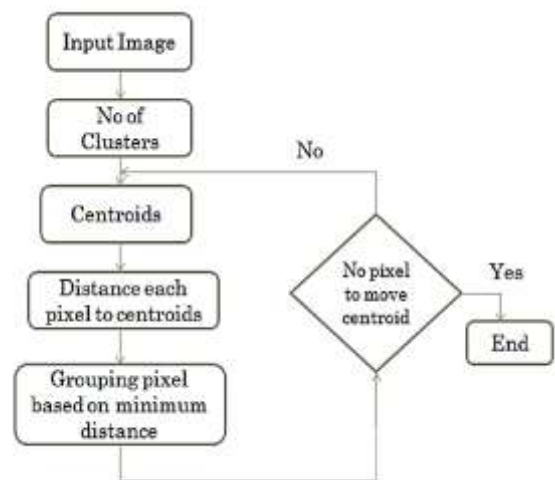


Figure 2: K-means work flow

In above figure we are showing K-means segmentation algorithm work flow. The first block shows the input image then it will convert that image into numbers of clusters, then it will find out the cluster centroid and find out the distance of each pixel from the centroid, then it will continue to grouping of pixels till it will reached the last pixel and stop.

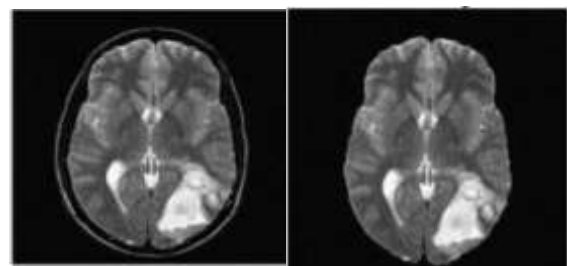


Fig.3:Image with skull (outer ring)

Fig. 4: Removing skull tissues

In figure 3 this is one of the MRI image with skull in next figure 4 the result showing after skull masking. Figure 5 shows the noisy image and the result of whole preprocessing is shown in figure 6.

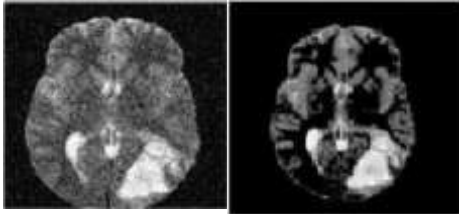


Fig.5: Noisy image Fig.6:Enhanced image

C. Object Labeling

The object labeling will performed after segmentation of an image, actually for fine result we are using both segmentation as well as object labeling for tumor detection. an input image, our system first extracts dense HOG (histogram of oriented gradients) and LBP (local binary pattern) local descriptors. Both features have been proven successful in various vision tasks such as object classification, texture analysis and face recognition, etc. HOG and LBP are complementary in the sense that HOG focuses more on shape information while LBP emphasizes texture information within each patch. The advantage of such combination was also reported for tumor detection task. For images with large size, we downsize them to no more than 500 pixels at either side. Such normalization not only considerably reduces computational cost, but more importantly, makes the representation more robust to scale difference.

We used three scales of patch size for computing HOG and LBP, namely, 16×16 , 24×24 and 32×32 . The multiple patch sizes provide richer coverage of different scales and make the features more invariant to scale changes.

After extracting dense local image descriptors, we perform the 'coding' and 'pooling'

steps, where the coding step encodes each local descriptor z via a nonlinear feature mapping into a new space, then the pooling step aggregates the coding results fallen in a local region into a single vector. We apply two state-of-the-art 'coding + pooling' pipelines in our system,

one is based on local coordinate coding (LCC), and the other is based on super-vector coding (SVC) . For simplicity, we assume the pooling is global. But spatial pyramid pooling is simply implemented by applying the same operation independently within each partitioned block of images.

D. SVM

The SVM is support vector machine which will use for pattern mapping and pattern matching artificial neural networks have proven themselves as proficient classifiers and are particularly well suited for tumor classification [7]. The back propagation algorithm is the centre tool of this research work. Giving the image as input to the network is not feasible due to fact that the weight matrix is huge size [8]. Only the key features extracted from the image are used for training the network. The back propagation algorithm [9] is a product learning rule for a feed forward, multi-layer neural network that uses tan sigmoid with fixed step size to achieve training or learning by error correction is used in this work. The neural network is trained for either continuous or discrete valued features to analyze the efficiency of the network for varying inputs to identify the tumor detection. The algorithm involves initialization of weights, back propagation of errors and updating of the weights and biases. There is sequential or pre-pattern learning and batch or pre-epoch learning. In sequential learning a given input pattern is propagated forward, the error is determined and back propagated and weights are

updated. In batch learning the weights are updated only after the entire set of training network has been presented to the network. Thus the weights update is only performed after every epoch.

This algorithm first initializes all neuron weights in the network [10]. Inputs are applied to the network and the input vector is propagated or feed forwarded to determine neuron outputs. The neuron responses are compared in the output layer with the desired or target response [11]. An error can be computed, propagated through the network, and this measure is used as the weight correction. The overall error is minimized at each stage through neuron weight adjustments [12]. Usually the learning rate determines what amount of the calculated error Gradients will be used for the weight correction. The best value of learning rate depends on the error values. Some indication may be given by error calculation and observed the previous weight corrections.

To increase the accuracy in the above approach, speed up the training of the network. Neural network training algorithm is judged by a set of conflicting requirements such as simplicity, flexibility, and efficiency. Simplicity is a measure of the effort required to apply the algorithm including computational complexity. The structure of Back Propagation Network (BPN) is shown in figure 2. Flexibility relates the extendibility of the algorithm to train different architectures and efficiency which relates the computational requirements for training and the success of the training phase. Since the matrix problem solution is considered as a byproduct of the training process it is performed successfully.

A pattern recognition network, which is a feed-backward network with tan sigmoid transfer functions in both the hidden layer and the output layer, is used. The network has only one output neuron, as there are 24 input vectors. The hidden

layer neurons are 100 and the learning rate is 0.1. The momentum factor is 0.9 and total numbers of epochs are 500. The error is minimized by 0.001 and the performance of the classifier is evaluated by calculating accuracy.

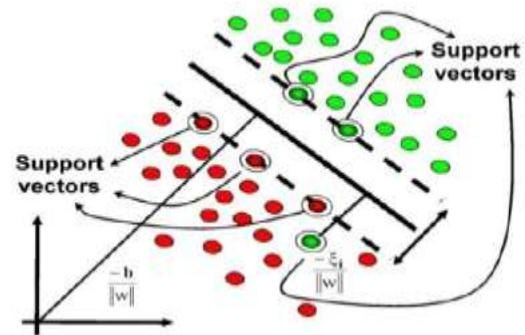


Figure 7: The classification process of SVM

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.

III. CONCLUSION

Segmentation of brain image is imperative in surgical planning and treatment planning in the field of medicine. In this work, we have proposed a computer aided system for brain MR image segmentation for detection of tumor location using K-means clustering algorithm followed by HOG object labeling algorithm. We were able to segment tumor from different brain MRI images from our

database. Also by this system we will be able to train and test the pattern which are made by the SVM by using textural feature we can find out the interested object from the image, at first in preprocessing we are doing skull masking and to reduce noise we are using median filter, morphological filter and wavelet transform as per condition requirement.

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