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Detection of Brain Tumor from MRI images by using Segmentation &SVM

Swapnil R. Telrandhe[1]
Computer Science &Engineering
G.H.R.A.E.T,
Nagpur, India.
telrandheswapnil@yahoo.com

Amit Pimpalkar[2]
Computer Science & Engineering
G.H.R.A.E.T,
Nagpur, India.
amit.pimpalkar@raisoni.net

Ankita Kendhe[3]
Computer Science & Engineering
G.H.R.A.E.T,
Nagpur, India.
ankita.kendhe@raisoni.net

***Abstract*— In this paper we propose adaptive brain tumor detection, Image processing is used in the medical tools for detection of tumor, only MRI images are not able to identify the tumorous region in this paper we are using K-Means segmentation with preprocessing of image. Which contains de-noising by Median filter and skull masking is used. Also we are using object labeling for more detailed information of tumor region. To make this system an adaptive we are using SVM (Support Vector Machine), SVM is used in unsupervised manner which will use to create and maintain the pattern for future use. Also for patterns we have to find out the feature to train SVM. For that here we have find out the texture feature and color features. It is expected that the experimental results of the proposed system will give better result in comparison to other existing systems.**

***Index Terms*—K-Means algorithm, Object Labeling Algorithm, Image segmentation.**

I. INTRODUCTION

It is an important to find out tumor from MRI images but it is somewhat time-consuming and difficult task sometime performed manually by medical experts. Large amount of time was spent by radiologist and doctors for identification of tumor and segmenting it from other brain tissues. However, exact labeling brain tumors is a time-consuming task, and considerable variation is observed between doctors [2]. Subsequently, over the last decade, from various research results it is being observed that it is very time consuming method but it will get faster if we use image processing techniques [3]. 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 benign tumor is easier to identify than the malignant tumor. Also the first stage tumor may be malignant of benign but after first stage it will change to dangerous malignant tumor which is life threatening [12].

Different brain tumor detection algorithms have been developed in the past few years. Normally, the automatic segmentation problem is very challenging and it is yet to be fully and satisfactorily solved. The main aim of this system is to make an automated system for detecting and identifying the tumor from normal MRI. It takes into account the statistical features of the brain structure to represent it by significant feature points. Most of the early methods obtainable for tumor detection and segmentation may be largely divided into three groupings: region-based, edge-based and fusion of region and edge-based methods. Well known and broadly used segmentation techniques are K-Means clustering algorithm, unsupervised method based on neural network classifier [4]. Also, the time spent to segment the tumor is getting condensed due to the detailed demonstration of the medical image by withdrawal of feature points. Region-based techniques look for the regions satisfying a given homogeneity standards and edge based segmentation methods look for edges between regions with different characteristics [5].

II. LITRATURE SURVAY

R.Muthukrishnan, et.al [6] Proposed brain tumor detection in which Segmentation separates an image into its component regions or objects. Image segmentation it needs to segment the object from the background to read the image properly and classify the content of the image carefully. In this framework, edge detection was an important tool for image segmentation. In this paper their effort was made to study the performance of most commonly used edge detection techniques for image segmentation and also the comparison of these techniques was carried out with an experiment.

M.Saritha et.al, [7] Proposed approach by integrating wavelet entropy based spider web plots and probabilistic neural network for the classification of Brain MRI. The proposed technique uses two steps for classification i.e. Wavelet entropy based spider web plot for feature withdrawal and probabilistic neural network for classification. The obtained brain MRI, the feature extraction was done by wavelet transform and its entropy value was calculated and spider web plot area calculation was done. With the help of entropy value classification using probabilistic neural network was calculated. Probabilistic neural network provides a general solution for pattern classification problem and its classification accuracy is about 100%.

P.NandaGopal et.al, [8] in their paper they presented a combination of wavelet statistical features (WST) and co-occurrencewavelet texture feature (WCT) obtained from two level distinct wavelet transform was used for the organization of abnormal brain matters in to benign and malignant. The planned system was consists of four stages: segmentation of region of interest, discrete wavelet disintegration, feature abstraction, feature selection, organization and evaluation. The support vector machine was employed for brain tumor segmentation. A grouping of WST and WCT was used for feature extraction of tumor region extracted from two level discrete wavelet transform. Genetic algorithm was used to select the optimal texture features from the set of mined features. The probabilistic neural network was used to classify abnormal brain tissue in to benign and malignant and the performance evaluation was done by comparing the classification result of PNN with other neural network classifier. The classification accuracy of the proposed system is 97.5%.

A. Laxami et.al, [9] 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 METHOD

The main purpose of this paper is to identify the region of tumor and to do the detailed diagnosis of that tumor which will used in treating the cancer patient the detailed about the proposed system is given below.

Threshold is a specific intensity value which contents 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 [13]. But it is detected that clustering methods followed by threshold cannot notice tumor correctly from MRI image, because the image consist of several non-brain tumor tissue. For this reason we express 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 [14].

A. *Preprocessing*

In the image processing the gray scale image is processed by using different techniques like brightness, threshold and Filtering, Brightness makes the image by which white objects are distinguished from gray and light items from dark objects. Hence by changing the brightness of the image the tumor detection in the MRI image is easier. Thresholding isolates objects, keeping those that interest us and removing those that do not. Also thresholding converts the image from a grayscale image, with pixel values ranging from 0 to 255, to a binary image, with pixel values of 0 or l. The processing window in vision assistant displays a preview of the threshold operation using the current set of parameters. The pixels showed in red have strengths that fall inside the threshold range. The threshold operator sets their values to 1. The pixels depicted in gray have values outside the threshold range. The threshold operator sets their values to 0 [9].

Filters can smooth, sharpen, transform, and remove noise from an image so that we can extract the information needed to sharpen edges, counting the edges of any holes inside a particle, and create contrast between the elements and the background.

When applied Convolution-Highlight Details with size 7x7 the image is as shown in Fig 4. Preprocessing of brain MR image is the first step in our projected technique. Preprocessing includes image filtering and skull masking for further processing. Our intention behind performing preprocessing is improvement of the image quality to get more surety and ease in spotting the tumor. 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 [1].

The addition of edge noticed image and the original image in order to obtain the enhanced image will give the resulted image.

Median filter should only change the intensity of corrupted pixels on the damaged image in order to preserve the local details of the image it has to be done. However, for fixed-valued impulse noise (i.e. salt-and-pepper noise) it is very difficult to detect the tainted pixels from this image correctly.

Skull Masking

Detection of skull is used to control the boundaries of the object. The edge information helps to find out the region of interest (ROI) i.e. the portion of the imagecovering the tumor. This work is done with the help of the calculating the centroid in the image [16]. Extraction of brain tissue from non-brain tissues in MR images which is referred to as skull stripping is an important step in many neuron imaging studies. In this, we used automatic threshold value selector to automatically choose threshold value. Then, mathematical morphology operations on a binaries image are applied stage by stage to achieve acceptable skull stripped brain images. The proposed skull stripping method comprises four steps. Initially image binarisation is completed using threshold value and narrow connections are removed from binarised image using morphological opening. Then, largest connected component from binarised image is selected by considering the fact that brain is the largest connected structure inside the head.

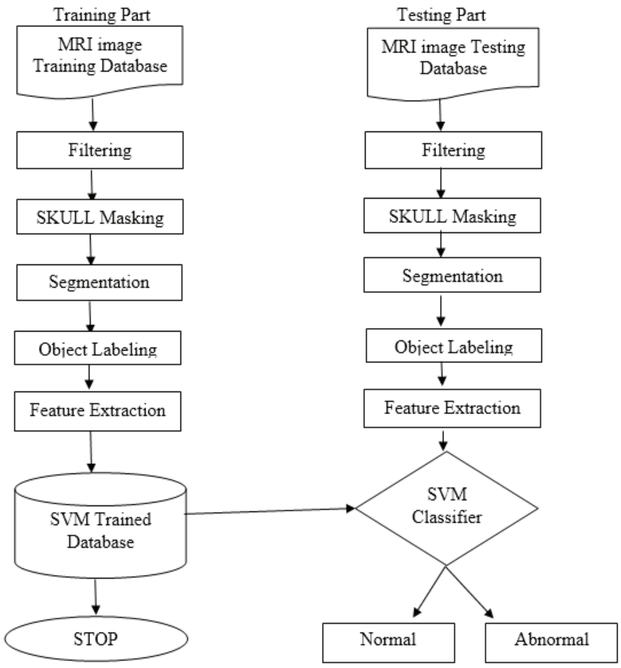


Figure 1: Flow diagram of proposed system

Thirdly, a mathematical morphology operation such as: filling holes and dilation is carried out on selected largest binarised image. Finally, we found skull stripped brain image.

Create images and masks:

In this, the region properties of an image are used. By using centroid property of an image, a line is drawn in the center of stripped skull. This divides the skull into two equal parts. One part is referred as a test image and other is referred as reference image.

Locating bounding box around tumor: In each input MR slice (axial view), there is a left–right axis of symmetry of the brain. A tumor, which is considered adeviation in the brain, typically perturbs this symmetry. Parallel rectangle on the left side that is very unlike from its replication about the axis of symmetry on the right side. i.e., the intensity histograms of two rectangles are most different, but the intensity histograms of the outside of the rectangles are comparatively similar [18]. We assume that one of the two rectangles will restrict the tumor appearing in one hemisphere of the brain.

B. Segmentation

Image Segmentation is the procedure of partition a digital image into numerous 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 whole image together and a set of contours extracted from the image [11]. All of the pixels in a region are similar with respect to some characteristics such as color, intensity, or texture. Neighboring regions are considerably different with respect to the same individuality.

The different approaches are

(i) By finding limits between regions based on discontinuities in intensity levels

(ii) Thresholds based on the distribution of pixel properties, such as intensity values

(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 split 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 [6].

Threshold is the simplest way of segmentation. Using thresholding technique regions can be classified on the basis range values, which is applied to the strength 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 [1].

K-Means based segmentation

A cluster is a collection of objects which are similar between them and are dissimilar to the objects belonging to other clusters. It deals with finding a structure in a collection of unlabeled data. A loose description of clustering could be the process of organizing objects into groups whose members are similar in some way. K-Means clustering is an algorithm to group objects based on attributes/features into k number of groups where k is a positive integer. The grouping (clustering) is done by minimizing the Euclidean distance between the data and the corresponding cluster centroid. Thus the function of K-Means clustering is to cluster the data. Commonly used initialization methods are Random Partition [20]. The Forgy method randomly chooses *k* observations from the data set and uses these as the initial means. The Random Partition method first randomly assigns a cluster to each observation and then proceeds to the update step, thus computing the initial mean to be the centroid of the cluster's randomly assigned points. The Forgy method tends to spread the initial means out, while Random Partition places all of them close to the center of the data set. According to Hamerly [10] the Random Partition method is generally preferable for algorithms such as the K-harmonic means and fuzzy *k*-means. For expectation maximization and standard *K-Means* algorithms, the Forgy method of initialization is preferable [17].

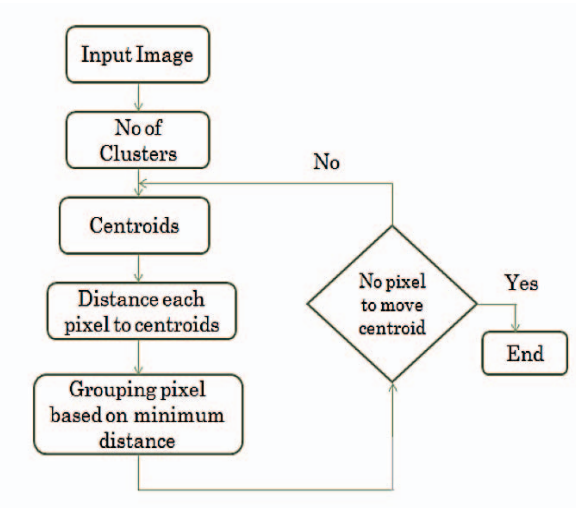


Figure 2: K-Means work flow

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.

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. Usually used initialization methods are Random Partition. The Forgy method arbitrarily chooses *k* annotations from the data set and uses these as the initial means. The Random divider method first arbitrarily assigns a cluster to each observation and then proceeds to the update step, thus computing the original mean to be the centroid of the cluster's randomly assigned points. The Forgy method tends to spread the initial means out, while Random divider places all of them close to the center of the data set. According to Hamerly[10] the Random divider method is generally preferable for algorithms such as the *k*-harmonic means and fuzzy *k*-means. For expectation maximization and standard *k*-means algorithms, the Forgy method of initialization is preferable.

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 [19].

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 area 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 comprehensive. But spatial pyramid pooling is simply implemented by applying the same operation independently within each partitioned block of images.

D. SVM

The SVM is a supervised learning method. It is a good tool for data analysis and classification. SVM classifier has a fast learning speed even in large data. SVM is used for two or more class classification problems. Support Vector Machine is based on the conception of decision planes. A decision plane is one that separates between a set of items having dissimilar class memberships**.** The Classification and detection of brain tumor was done by using the Support Vector Machine technique. Classification is done to identify the tumor class present in the image. The use of SVM involves two basic steps of training and testing.

Linear SVM:

The training patterns are linearly divisible. That is, there exists a linear function of the form f(x) = w T x + b (1) such that for each training example xi, the function yields (f(x)) ≥ 0 if x for =+1, y and f (xi) <0 for yi=-1.

In other words, training examples from the two different classes are separated by the hyper plane

F(x) = w T x + b =0, where w is the unit vector and b is a invariable. For a given training set, while there may exist many hyper planes that maximize the separating margin between the two classes, the SVM classifier is based on the hyper plane that maximizes the separating margin between the two classes In other words, SVM finds the hyper plane that causes the largest separation between the decision function values for the “borderline” examples from the two classes. SVM classification with a hyper plane that minimizes the separating margin between the two classes. Support vectors are elements of the training set that lie on the boundary hyper planes of the two classes.

Non-Linear SVM

In the above discussed cases of SVM classifier also shown in figure 7. Straight line or hyper plane is used to distinguish between two classes. But datasets or data points are always not separated by drawing a straight line between two classes. For example the data points in the below figure 7. It can’t be separable by using above SVMs discussed. So, Kernel functions are used with SVM classifier. Kernel function provides the bridge between from nonlinear to linear. Basic idea behind using kernel function is to map the low dimensional data into the high dimensional feature space where data points are linearly separable [15].

A pattern gratitude 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.

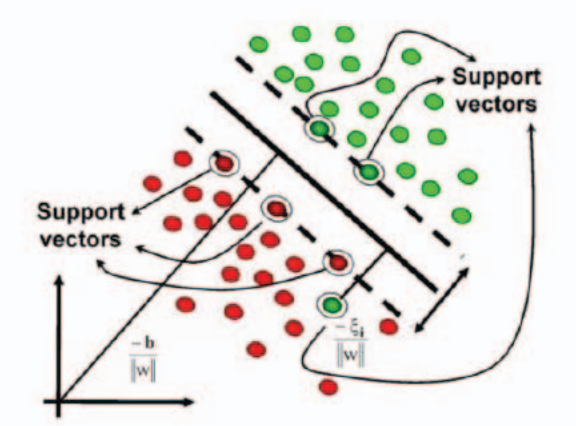
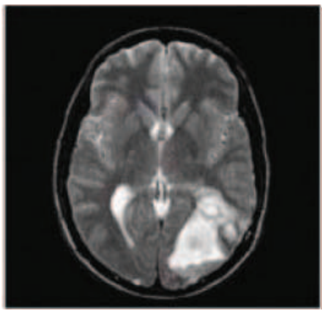


Figure 7: The classification process of SVM

SVM are based on optimal hyper plane for linearly pair able patterns but can be complete to patterns that are not linearly divisible by transformations of unique data to map into new space. They are clearly based on a abstract model of learning and come with theoretical guarantees about their performance. They also have a modular design that allows one to separately apply and design their components and are not affected by local minima. Support vectors are the elements of the training set that would change the location of the dividing hyper plane if removed[19]. Support vectors are the grave elements of the training set. The problem of discovering the best hyperplane is an optimization problem and can be solved by optimization techniques.

IV. RESULTS AND DISCUSSION

The test of projected technique to discover and segment brain tumor is performed using MR images of diverse long-suffering. Each test image has brain tumor of diverse size, shape and intensity. Manual examination is used to check the correctness of automated segmented tumor area. The experimental result for different MR images containing tumor of different shapes, sizes and intensities.



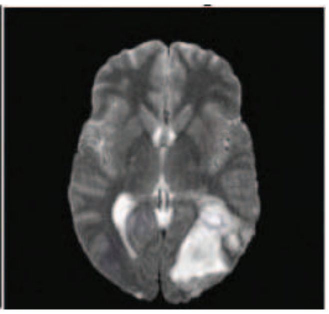
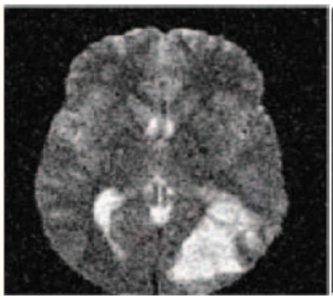


Figure 3: Image with skull (outer ring) Figure 4: Removing skull tissues

In figure 3 this is one of the MRI image with skull in next figure 4 the result showing after skull masking. In skull masking we have generated some horizontal, vertical, diagonal and anti-diagonal mask and after dividing image in small segments we have applied this masks over image sub parts and result image get combined is given this resultant image.

Figure 5 shows the noisy image and the result of whole preprocessing is shown in figure 6



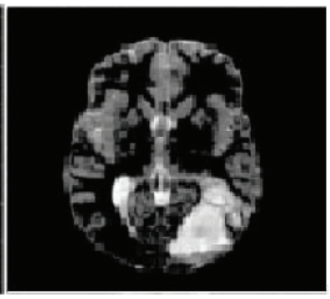
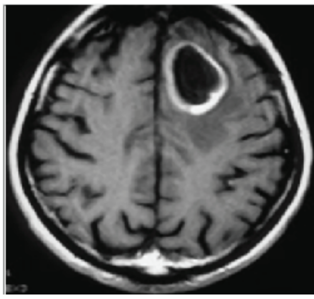


Figure 5: Noisy image Figure 6: Enhanced image

In figure 7 de-noising is done and in figure 8 skull masking is done the combining result of both will give result of preprocessing module.



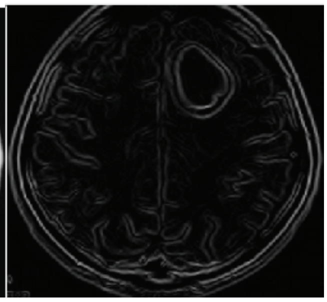


Figure 7: Enhanced Image Figure 8: Skull MaskingImage

In figure 9 the segmentation by using K-Means algorithm is done here. Segmentation is done by using some colors in preprocessed image on the basis of intensity we have divided brain MRI in to 3 colors as shown in resulted image.

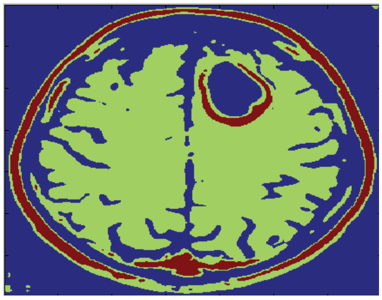


Figure 9: Segmentation resulted image

The reason behind using various colors in segmentation is to identify an area of interest from the MRI images; human eyes are more sensitive to color images than the grey scale images. So here we are using the intensities of MRI images to place different color on the image the resultant image of this process will give the idea of tumor region.

V. CONCLUSION

Brain tumor detection is done by preprocessing which is first step in that median filter and by using diagonal, anti-diagonal masks segmented images get preprocessed and skull masking is done here. After skull masking fatty tissues and other unwanted details get smoothen.

Preprocessed image is segmented with the K-Mean segmentation and Object Labeling with HOG, HOG is friendly with feature extraction. So the texture feature and color feature are extracted here in the system which is use to find out the region of interest and SVM is use for pattern mapping and pattern matching process. Also use to learn Neural Network.

Image processing has become a very important task in today's world. Today applications of image processing can be originate in number of areas like medical, remote sensing, electronics and so on. If we focus on medical applications, and image segmentation is widely used for diagnosis purpose.

In this paper, we have proposed a system that can be used for segmentation of brain MR Images for Detection and identification of brain tumor. We find area of tumor and its type of tumor. Future scope for detection and segmentation of brain tumor is that if we obtained the three dimensional image of brain with tumor then we can also find out its tumor size and also can evaluate its tumor type and also its stage of tumor.

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