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A Review on MRI Brain segmentation and classification techniques

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Abstract: MRI images plays important role in auxiliary radiologists approaches for diagnosis and treatment. It is an inventive classification technique to notice normal and abnormal MRI brain image. Medical image like ECG, MRI and CT-scan images are important way to diagnose disease of human being efficiently. The standard analysis of tumor based on visual check up by radiologist is the conjugative method, which may lead to wrong classification when a large number of MRIs are to be analysed. The prospect of endurance can be expanded if the tumor is observed perfectly at its recent stage. Magnetic resonance imaging (MRI) technique is used for the study of the human brain. Segmentation techniques locate tumor location. In this review, classification techniques based on Support Vector Machines (SVM) are suggested and tested to brain image classification with the help of segmentation. The main objective of this paper is to provide a magnificent result of MRI brain tumor classification using SVM. The different segmentation and classification techniques are described here. An efficient techniques are used for segmentation and classifications.

Keywords: Brain tumor, magnetic resonance imaging, support vector machine, ANN.

I. INTRODUCTION

A Brain detection and classification system has been invented and advanced. The system uses computer based strategy to observe tumor blocks and allocated the type of tumor. To avert the human error, an automated resourceful classification system is planed which provide the obligation for classification of image. The image processing techniques such as histogram equalization, image segmentation, image enhancement, morphological operations and feature extraction have been developed for detection of the brain tumor in the MRI images of the tumor afflicted patients. Curing cancer has been a major goal of medical researchers for decades, but development of new treatments takes time and money. Approximately 40 percent of all primary successfully treated with surgery [7].

Magnetic Resonance Imaging (MRI) has becomes a widely used method of high quality medical imaging, especially in brain imaging where MRI's soft tissue contrast and noninvasiveness is a clear advantage. MRI provides an unparalleled view inside the human body. The level of detail can be seen extraordinary compared with any other imaging modality. Reliable and fast detection and classification of brain cancer is of major technical and importance for the doctors. Common practices based on specialized technicians are slow, have low responsibility and possess a degree of subjectivity which is hard to quantify. There are many types of brain tumors but among various types of brain tumors the most prevalent and common is Astrocytoma. A brain tumor is a disease in which cells grow uncontrollably in the brain. MRI is an essential tool in the clinical and surgical environment, due to superior soft tissue differentiation, high spatial resolution, contrast and does not use any harmful ionizing radiation which may affect patients. Classifiers such as SVM, Artificial Neural Network (ANN), etc. are used for various applications [8].

The segmentation techniques also described here such as thresholding, region growing, clustering, soft computing, atlas-based etc. The halt paper is organized in the form of different sections such as: Section II describes the segmentation techniques. Section III presents the classification techniques. Section IV Proposed system. Section V describes conclusion.

II. SEGMENTATION TECHNQUES

Segmentation is nothing but the image is sub-divided in to regions that are meaningful. Segmentation depends at one level where problems under consideration. Also image segmentation is useful after surgery to track treatment progress.

Segmentation techniques are described below,

A) Manual
B) Semi-automatic
C) Fully Automatic

Manual brain tumor segmentation need to the authority of tumor must master the information presented in the brain tumor images. Also need of knowledge such as anatomy because manual brain tumor segmentation desire to manually draw the borderline of the brain tumor and cosmetic the field of anatomic arrangements with different design. The manual segmentation of the different territory

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of brain tumor will become a failure and time-exhausting task for the adroit and produces improvised results in a way. More advanced is semi-automatic [5].

Semi-automatic brain tumor segmentation chiefly subsist of the customer, synergy, and software figure out. In this methods, the user demand to consulate some parameters and is culpable for evaluate the optical information and providing assessment for the software computing. The software computing is design at the recognition of brain tumor segmentation algorithms. The cooperation is in charge of accommodate segmentation information between the customer and the software computing [9].

In fully automatic brain tumor segmentation computer regulate the segmentation of brain tumor without any human cooperation. This segmentation algorithm combines artificial brilliance and previous knowledge. The evolution of machine learning algorithms that can replicate the brilliance of humans to learn defiantly, the study of automatic brain tumor segmentation has become attractive research issue [1].
Some conventional methods are,
1) Thresholding
2) Region-growing
3) Clustering
4) Atlas-based.

1) Thresholding :
This technique extract the uniform regions of the images. This is easy image segmentation technique for separating images precisely into regions based on intensity standards with one or more thresholds. Thresholding will be categorized in to global or local. On the basis of intensity bright matters in the dark background are segmented out by choosing particular threshold value TH. Pixels that are above threshold are considered as 1 and those are under threshold are appointed to zero in image as compared to segmented image [2].

2) Region-growing :
Region-based segmentation approach audit pixels in an image and form dislocate regions by blending neighbourhood pixels with identity properties based on a predefined identity criterion. The region growing and the watershed segmentation methods are sector of the region-based methods. These are broadly used in the operation of brain tumor segmentation.
Compared to edge detection method, segmentation algorithms based on region are comparatively easy and more unaffected to noise. Edge based methods partition depends on an image based on accelerated advance in intensity near edges whereas region based methods considered, separation an image into parts that are identical according to a set of predefined principle. Region growing depends on splitting and merging of image [10].

3) Clustering :
It is most useful technique in the segmentation, it classifies pixels in to different classes without knowing any information regarding region. Mainly it depends on pixel values.

It also consist of k-means algorithm. It is unsupervised learning algorithm. In K-means, for each cluster 'K' centres are defined. These clusters can be placed so much away from each another. Now next step is to consider a point under a given data set and correlated it to the closest centre. When no point is awaiting, the first step is completed and newly grouping is done. Then re-calculate 'k' new centroids as barycentre of the clusters outcomes from the previous step. After having 'K' new centroids a new mandatory has to be done between the similar data set points and the closest new centre. A loop has been generated. The result becomes, the k centres change their area step by step before centres do not move any more [4].
Also the Fuzzy C-Means clustering is an unsupervised method. It is used for the data analysis. This algorithm allowing participation to every data point comparable to each cluster centre depending on distance between the cluster centre and the data point.

4) Atlas-based :
The method attempt excuse in atlas-based segmentation of tumor-carrying brain images and also for upgraded patient-definite reproduction and diagnosis of tumor evolution. It has used three steps for brain atlas dislocation in the existence of large-space covering tumor, based on a previous model of constitution expansion that conclude radial enlargement of the constitution from its opening point; results show that automatic segmentation can be achieved and that the method can be tested to automatic segmentation of architecture and sub architecture in brains [1].

III. CLASSIFICATION TECHNQUES

Classifier related to segmentation and preprocessing methods. Segmentation is mainly depends on gray level pixel values. Correctly extracted area is given by segmentation algorithm. Classification is the labeling of a pixel or a group of pixels. Multiple features are used for a set of pixels i.e. many images of a particular object are needed. Image classification refers to the labeling of images into one of a number of predefined categories.

Image classification is more important as it is a critical step for high-level processing such as brain tumor classification. Classification is the last step in the process of brain tumor detection used to classify the image into normal or abnormal type. This study evaluates various techniques which are used in tumor detection from brain MRI.

In the present review, we are focusing primarily on the SVM classifier for MRI. MRI is a dynamic and flexible technology that allows achieving variable image contrast by using different pulse sequences and by changing the imaging parameters. SVM also belongs to kernel methods. The classifiers are SVM, ANN.

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A) ANN : (Artificial Neural Network)

An Artificial Neural Network is a adaptive, most often nonlinear system that enrols to act a function from data. Adaptive means that the arrangement of frameworks are changed at the same time of operation, normally called the Learning/Training aspect. After the training aspect the ANN parameters are fixed and the arrangement is expanded to solve the problem at hand (The Recognition/Testing phase). Back-propagation ANN's used in this study consist of one input layer, one or two hidden layers, and one output layer.

With black section input data is continuously presented to the Artificial Neural Network, with each presentation the output of the neural network is compared to the desired output and an error is gauged. This error is then fed back (back-propagated) to the Artificial Neural Network and used to adjust the weights such that the error decreases with each emphasis and the neural model gets closer and closer to producing the desired output. This process is known as Training. The Training of these networks consists in finding a mapping between a set of input values and a set of output values. This mapping is accomplished by adjusting the value of the weights, using a learning algorithm, the most popular of which is the generalized delta rule. After the weights are adjusted on the training set, their value is fixed and the ANN's are used to classify unknown input images.

B) SVM : (Support Vector Machine)

SVM algorithm was first developed in 1963 by Vapnik and Lerner [3]. It gives low error and consume very less time with higher precision. SVM is alternative for ANN. SVM is a binary classifier based on supervised learning which gives better result than other classifiers. SVM classifies between two classes by constructing a hyper plane in high-dimensional feature space which can be used for classification. SVM is a classification algorithm, which is based on different kernel methods. SVM is classified in two groups.

a)Linear SVM :

It is the simplest one, in which the training patterns are linearly separable. A linear function of the form is given below,

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

Such that for each training sample x_i the function yields $f(x_i) \geq 0$ for $y_i = +1$, and $f(x_i) < 0$ for $y_i = -1$. In other words, training samples of two different classes are separated by the hyper plane $f(x) = w^T x + b = 0$, where w is weight vector and normal to hyper plane, b is bias or threshold and x, is the data point [17].

For a given tanning set, while there may exist many hyper plane that maximize the separating margin between the two classes, it is based on the hyper plane that maximizes the separating margin between the two classes. SVM classification with a hyper plane that minimizes the separating margin between the two classes are indicated by data points by black square's and black circle's. Support vectors are elements of the training set that lie on the boundary hyper plane of the two classes.

b) Non-Linear SVM :

In linear SVM straight line or hyper plane is used to distinguish between two classes. But data sets or data points are separated by drawing a straight line between two classes is not possible. In a nonlinear SVM classifier, a nonlinear operator is used to map the input pattern x into a higher dimensional space H. The nonlinear SVM classifier is defined as,

$$f(x) = W^T \phi(X) + b$$

The data with linear dissociable may be investigated with a hyper plane, and the continuously in separable data are investigated with different kernel functions like more advanced order polynomials and Quadratic [17].

IV. PROPOSED SYSTEM

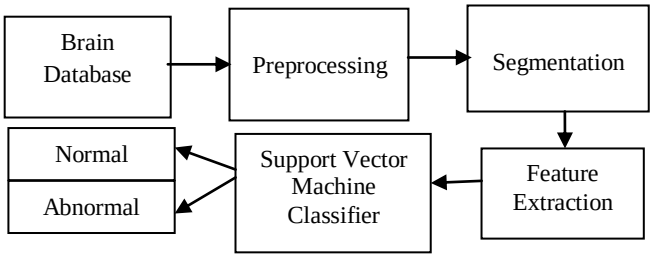

Figure 1. Block diagram of proposed system

Figure 1 Shows the block diagram of proposed system consist of diffrent preprocessing, segmentation method and classification gives outcome as normal or abnormal images.

Clinical image data consist of multi-contrasts MRI scan from different patients. In this study dataset having no of images in which some images are abnormal having tumor and remaining images are normal. MRI uses magnetic radiations, shows real time view and 3D view of or soft tissues. A digital image always contains fixed number of elements into it. Every elements has position and associated value is also carrying. That value is nothing but intensity of element & every same element is nothing but pixel. Database has different sizes, for equal size using resize operation in this system.

a) Overview of proposal:

The segmentation includes gradient, grade vector, splitting image in to grids with intensity threshold. The proposed region growing algorithm for image segmentation conains image read, preprocessing i.e. resizing, LPF, segmentation and finaly classification on the basis of extacted features. Tumor location is identified by using segmentation. For segmentation process region based level set method is used. Levelset having accuracy of 0.85- 0.93.

In the segmentation framework need to provide only database of MRI brain tumor. The segmentation results are obtained after the region analysis of the image. The level set method need to topological changes for description of curves which are considered in to the region growing field. By edge stopping and minimization of energy function the segmentation process is stopped at object boundary. More than two regions are segmented in the segmentation process of level set method [7].

Gray images are used in segmentation process. The purpose of segmentation is extraction of important feature from MRI images and easily perceived. Also the support vector machine classifier has been used for classification of tumor. Also the SVM classifier gives accuracy of 97.3% [6]. SVM is supervised classifier and used for MRI brain tumor classification because of computational efficiency and good performance. Working of structure risk reduction from the static learning theory. The support vector machine algorithm based of hyper plane. The SVM based on two steps such as training and testing. The SVM is better as compare to another methods regarding performance of algorithm [14].

V. CONCLUSION

The review gives idea to use which segmentation method is better and shows that SVM classifier is efficient for classification of tumor as per study. Image plays important role for diagnosis and treatment of brain tumor. The proposed technique shows usefulness and effectiveness for detection of tumor location. The segmentation technique is simulated on MATLAB and getting results with the help of classifier as a normal and abnormal. Due to segmentation the location of tumor part is located. So with the help of segmentation we can specify the location of the tumor. Segmentation process helps to radiologist for the location of tumor and helps for treatment. The proposed segmentation technique gives satisfactory results i.e. able see the location of tumor region. At primary stage brain tumor classify and treatment will be done within final stage and patient will be survive. A brain tumor consist of malignant i.e. tending to be severe and become progressively worse cells with different stages of cellular differentiation. Also with the help of SVM the brain tumor is classified as a normal and abnormal.

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