A REVIEW AND PROPOSAL OF AN INNOVATIVE APPROACH FOR BRAIN TUMOR DETECTION AND SEGMENTATION FROM MRI IMAGES

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Abstract: In previous years, image processing had covered a large area over biomedical applications in diagnosis of several of diseases in medical images. Brain tumor detection is one of the most widely used applications by many researchers. In this review paper we treat a very important research subject that affects directly the human brain. Brain tumor detection techniques verify the presence the tumor in brain. Patients who is suffering by Brain tumor, often by suffer from the blood clot, movement of control loss, eye vision loss, behavioral-nature changes and hormone widely changes, etc. The location, type and size of the tumor have an effect on the normal functioning of the individual. MRI images help the doctors for identifying the Brain tumor size and shape of the tumor. But, it consumes the doctor's time. In order to save the time and burden of the doctor, there is a need for the automation of the brain tumor. Segmentation of images in MRI helps us to detect - tumor size, location and shape. Segmentation of MR images is more important and is an essential process in resolving the human tissues, especially at the time of clinical analysis. Brain tissue is explicitly complex and it consists of three normal main tissues named White Matter (WM), Gray Matter (GM) and Cerebral Spinal Fluid (CSF) and abnormal tissues like tumor and edema. These normal and abnormal tissues can be detected using segmentation of the brain MR image and are very important for surgical planning and in diagnosing neurological diseases. This paper presents a novel approach for the detection of normal and abnormal tissues.

Keywords – Brain tumor detection, Magnetic resonance imaging (MRI), Cerebral Spinal Fluid, Neurological Diseases, Edema, Tumor tissues.

I. INTRODUCTION

The human brain is the humans control center of nervous system. The brain nervous system consist a complex system, which has 50-100 billion neurons which constitute a giant nervous network. This brain only helps us to control, sustain and regulate different body functions in various environmental conditions. But under certain alter conditions-brain cells grow and multiply uncontrollably. This abnormal growth of the brain cells leads to increase in overall mass of nerve tissues of brain which increases pressure on neighboring tissues of brain. Due to this, surrounding brain tissues get shifted and pushed up against brain skull. Abnormal gain in mass of tissues is called tumor and if it's inside the brain, it is called as brain tumor. Brain tumor can be said as abnormal growth of neurons in brain. The growth of brain neurons can vary from person to person.

Brain tumors are categorized according to the shape and size of tumor into several types: noncancerous which include meningioma benign which does not spread to other regions, and cancerous which includes three types: Meningioma malignant, Gliomas. And Metastases. Various medical imaging are used for diagnosis such as Computed Tomography (CT), Positron Emission Tomography (PET), Ultrasound, and Magnetic Resonance Imaging (MRI). Detection and diagnoses of brain tumor comprises several stages; these are noise reduction, Feature extraction, Segmentation and classification. Tumors have even been graded for identifying and defining the growth rate of tumor. Grade ranges from Grade 1 which is less malignant to Grade 4 which is more malignant. *Grade I:* Tissues are benign and the brain cells grow gradually. This type of brain Tumors are rare in adults. *Grade II:* Tissues are relatively slower in growth, also nearby normal tissues get affected and become malignant. The cells look less like normal cells than do the cells in a Grade1 Tumor. *Grade III:* These are the malignant tissue and have cells that look very different from normal cell. The abnormal cell is actively growing. *Grade IV:* These cover the most malignant tissue and have cells that look abnormal and tend to grow quickly. Tumors have tendency to form new blood vessels for its growth and development. Now this tumor can only be treated if detected and diagnosed properly on time.

To detect and diagnose the brain tumor, computer technologies like image processing are put into use for proper detection and diagnosis. Image processing is basically a technique of processing those captured images into digital format for finer details, color and clarity. Using the principle of image processing, MRI (Magnetic Resonance Imaging)-a scan based imaging technique is used for detecting brain tumor.

Objective

We presented a novel method to classify a given MR brain image as normal or abnormal. The proposed method first employed wavelet transform to extract features from images, followed by applying principle component analysis (PCA) to reduce the dimensions of features. The reduced features were submitted to a kernel support vector machine (KSVM) for statistical and texture feature. We also works with DWT.

II. LITERATURE REVIEW

Segmentation is a pre-processing stage where images are divided into some separate regions and each is a set of pixels. Numerous image segmentation approaches were projected in the literature. On the other hand, a single technique may not be well-organized for a precise image class.

M. Ertdl1 etal[3], a new shape knowledge determined taxonomy for segmentation and registration algorithms is suggested by the authors. The classification is based on a continuum between two excesses: purely image based approaches and robust shape dependent approaches. Alamgir Nyma etal [4] proposed a hybrid medical image segmentation method. In the preprocessing stage, they used vector median filtering to

decrease the influence of noise. Then they produced rough-segmented images using the Otsu thresholding technique. To achieve well-segmented images, they finally used the improved repressed FCM algorithm.

Ch. Hima Bindu etal [1] proposed the Otsu thresholding method that has been medical image segmentation. This technique achieves better than the other local and worldwide thresholding approaches and produces appropriate binary images. Yuehao Pan etal[6] established classifying procedures based on CNN deep learning structure on brain tumor classification. The consequences display an extreme development of 18% on grading performance of CNN based on understanding and specificity associated to NN.

Alireza Norouzi1 etal[9] have classified the quantity of present image processing approaches which are broadly used in medical image investigation. The algorithms and their applications in medical image analysis are presented. Some of them have been useful in MRI images, particularly for the knee bone.

In [14], the M-L model is planned for medical image segmentation. Fuzzy clustering segmentation is one of the good approaches of segmentation of MR images. Conversely, in preparation, fuzzy clustering knowledge still occur some problems to be promote research. These problems alive in the high-quality, the constraints of the fuzzy clustering is how to select parameters in fuzzy clustering, select dissimilar constraint might not only result in different best dividing feature space, but also great effect on the clustering speed, they are from dissimilar features moving the speed and accuracy of clustering.

Divya Kaushik etal [6] presented the brief idea of numerous segmentation procedures practical for digital image processing. The revision also analyses the research on numerous methodologies for medical image segmentation and the issues encountered in this field. This revision can be measured as a modest direction to the researchers for those who want to carry out their research study in the medical image segmentation. Significance of these methods is the direct medical application for segmentation and edge detection.

Neeta S. Shirsat [17] suggested a segmentation of brain MRI image is complete using fuzzy clustering algorithm for segmentation. Then morphological filtering is used to evade the mis-clustered areas that can be designed after segmentation of the brain MRI image for recognition of tumor position.

Sun Yongqian etal [9] planned a new technique of image parallel segmentation merging support vector machine with regional growth. This technique chooses sample from the recognized segmentation result image and trained support vector machines is used for searching seed point, avoiding the physical seed selection. Associated with solo support vector machines segmentation, this technique also speeds up the segmentation.

Kishore Gunna [18] proposed brain image segmentation technique using the KMeans, Fuzzy C-Means, Otsu Thresholding and morphological closing and reconstruction. The performance of these algorithms are dignified using the Mean Square error, Peak Signal to noise ratio, Regularized Cross Correlation, Average Difference ,Structural Content and Normalized absolute error. The computational time taken by K-means is more than Fuzzy C-Means, making FCM better in the clustering method.

Comparative analysis

The following table presents a detailed survey on segmentation.

Techniques	Author & Ref	Year	Performance	Image	Quality measurement
Active contour based image segmentation					
Convex energy function	Wu and Yang [2]	2012	A convex optimization function with local Gaussian distributing fitting term with spatially variations of means and variances presented and the energy function formulated.	Synthetic and real images	Influence of Weight function\ Segmentation level
Constrained Active contour	Anh et al [5]	2012	Boundary refinement tool presented in constrained active contour has the capability to produce the smooth and accurate boundary contour.	Buddhist image	Accuracy Speed
Fuzzy clustering					
Adaptive FCM	D. Kaushik et al [6]	2012	Classical FCM employs the gain field model to correct the intensity in homogeneities by microscope imaging system. Gain field also regulates the center of cluster.	M-Fish dataset	Correct detection rate False detection
Kernel measure+ FCM	BingquanHuo et al [8]	2013	Kernel distance measure and trade off fuzzy weight factor estimates the extent of neighboring pixels. The objective function incorporates the kernel distance measure to improve the robustness to noise.	Brain image Salt & pepper corrupted image	Entropy based evaluation function Layout entropy
K-means clustering					
Graph based KMeans clustering	Sun Yongqian et al [9]	2012	The application Prim's algorithm and Lloyd algorithm constructs the Minimum Spanning Tree (MST) and generalized cluster centroids to determine the number of clusters and location	Mars hyper spectral image	Devis- Bouldin index

			of cluster centroids.		
Advanced K means	Himakshi Shekhawat et al [15]	2012	It detects the range and shape of Tumor in brain images and allows the accurate detection, reproducible and less execution time.	Brain MR image	Tumor shape Tumor position
Intensity based image segmentation					
MFLAAM	Seda Kazdal et al [16]	2012	It utilizes the accurate algorithm for identification of Image Derived Attributes (IDA) offers effective segmentation and incorporates the level set implementation to overcome limitation in the specification of landmark and location of object interest in image.	T2 weighted prostate MRI	Mean dice coefficient Accuracy
Maximum A Posteriori (MAP)	Kishore Gunna et al [18]	2013	The no smooth non-convex minimization problem investigated by MAP principle with relaxation in constraints of characteristic functions of partition regions.	Brain MRI	Jaccard Similarity Coefficient CPU time

TABLE I. Information about Different mage Segmentation Techniques

III. PROBLEM IDENTIFICATION

Real time diagnosis of tumors by using more reliable algorithms has been the main focus of the latest developments in medical imaging and detection of brain tumor in MR Mages and CT scan images has been an active research area. The separation of the cells and their nuclei from the rest of the image content is one of the main problems faced by most of the medical imagery diagnosis systems. The process of separation i.e. segmentation, is paid at most importance in the construction of a robust diagnosis system. Image segmentation is performed on the input images. This enables easier analysis of the image thereby leading to better tumor detection efficiency. Hence image segmentation is the fundamental problem in tumor detection.

IV. PROPOSED ALGORITHM

As in the figure 4.1 we have some of the steps to detect brain tumor and classify that tumor.

MRI Acquisition

We load the MRI data which is store in our system. We collect the number of sample data from the radiologist and test this data in our system. We collect the high resolution structural and functional MRI data in normal and abnormal patient with different types of brain tumors.

Preprocessing

Preprocessing steps in used to removing the background noise, normalization the intensity of the each and individual parts of images, reflection removing and masking images portion. We have Anisotropic filter to removing the background data noise and it is preserve the images edge points. In the anisotropic filter choose the appreciate value of threshold to smoothing the background noise and diffusion constant to the gradient of noise. This reason we choose higher constant value diffusion for compare with fixed value of the noise gradient in its edge.
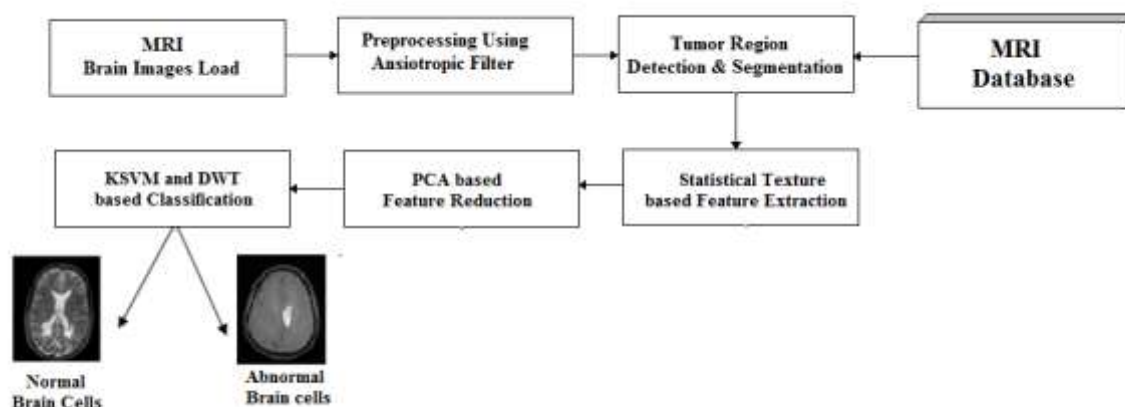

Figure 4.1: Schematic block diagram of the proposed system

Tumor Detection and Segmentation

In the image processing techniques, image segmentation is the process of separating the digital image data into numerous regions where each of the pixels in a region is comparable to particular feature or calculated properties, like as color, intensity of image or texture feature. In the biomedical image processing, the result of image segmentation is a data of contours extracted from the MRI images after edge detection. Each of the data pixels in a region having the similar property with respect to some characteristic or be a computed property.

Feature Extraction

The most conventional tool of signal analysis is Fourier transform (FT), which breaks down a time domain signal into constituent sinusoids of different frequencies, thus, transforming the signal from time domain to frequency domain. However, FT has a serious drawback as discarding the time information of the signal. For example, analyst cannot tell when a particular event took place from a Fourier spectrum. Thus, the quality of the classification decreases as time information is lost. Gabor adapted the FT to analyze only a small section of the signal at a time. The technique is called windowing or short time Fourier transform (STFT). It adds a window of particular shape to the signal. STFT can be regarded as a compromise between the time information and frequency information. It provides some information about both time and frequency domain.

Feature Reduction

PCA is an efficient tool to reduce the dimension of a data set consisting of a large number of interrelated variables while retaining most of the variations. It is achieved by transforming the data set to a new set of ordered variables according to their variances or importance. This technique has three effects: it orthogonalizes the components of the input vectors so that uncorrelated with each other, it orders the resulting orthogonal components so that those with the largest variation come first, and eliminates those components contributing the least to the variation in the data set.

Classification

In-order to detect the tumor in the input MRI images after the feature extraction process. In this paper we used kernel based SVM (Support Vector Machine) and DWT to classify the image into tumorous or not. It have effectively supervised classifier and accurate learning technique.

V. CONCLUSION

In this study we goes to develop an automated brain MRI diagnostic system with normal and abnormal classes. The medical decision making system was designed with the statistical texture features that we have built gave very promising results in classifying the healthy and brain patient having lesion. The benefit of the system is to assist the physician to be make the final decision without hesitation.

VI. EXPECTED OUTCOME

This research was conducted to be detect brain tumor using medical imaging techniques. The main technique will be used segmentation, which will be using a method based on threshold segmentation, watershed segmentation and morphological operators. The proposed segmentation method is experiment with MRI scanned images of human brains: thus locating tumor in the images. Samples of human brains were taken, scanned using MRI process and then were processed through segmentation methods for giving efficient end results.

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