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Review of Detection of Brain Tumor Segmentation using MATLAB

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Abstract - *The aim of this survey is to provide an outline for those who are new to the field of image processing, and also to provide a reference for those searching for literature in this application. Tumor is because of an abnormal development of cells (tissues) inside the brain. Magnetic Resonance Imaging (MRI), Computer Tomography (CT) imaging techniques are used for early detection of abnormal changes in tumor tissues or cells. Its correct detection and identification at an early stage is the only way to get cure. Brain tumor tissues may become malignant (cancerous) if not diagnosed at right time. Different methodologies are proposed by different researchers. The MRI scan image considers as a high quality input for experiments as compared to other scans. In the future, we will develop a deep learning based automated brain tumor detection system and will compare with the existing state of the art techniques for better and more accurate results.*

Key Words: **Brain Tumor, MRI, Machine Learning**

1. INTRODUCTION

Brain is the central main part of the human body that controls their nervous system. Brain controls many functions like heart, breathing, talking, walking, thinking ability, consciousness and unconsciousness balance, etc. Therefore, it plays vital and central role of the nervous system of humans. Brain tumor is the irregular growth of cells in human brain. A brain tumor has two types, benign which is noncancerous and malignant which is cancerous. Malignant brain tumor has two categories such as primary tumor and secondary tumor. Primary brain tumor arises in the brain and secondary brain tumor arises in the other parts of body and spreads to brain and affect them.

The automatic brain tumor system may consist of step stages as shown in Fig. 1. The image acquisition step consists of capturing scanned images (MRI, CT, PET etc.) and some free datasets are BraTS, IBSR or BrainWeb. The pre-processing step composes of different techniques of digitization of images, noise removal, image enhancement and sharpening. Likewise, different techniques use for isolation and separation of the region of interest in segmentation step and some free tools for segmentation are available at. Statistics, structured or global features are extracted in the step of features extraction. Finally, different kinds of machine learning models use for classification or clustering for grouping the affected and non-affected parts of the brain and output image display to the physician or expert in diagnosing and making final medical decision.[20]

1.1 Workflow chart

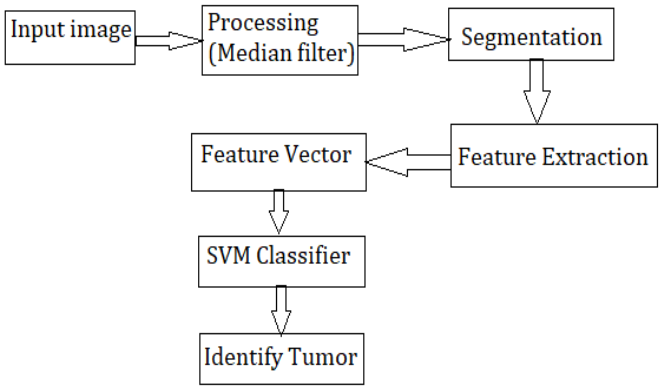

Fig-1: Flow of Classification Brain Tumor System

This review paper is providing sufficient and quick review of the current state of the art techniques for brain tumor segmentation and detection. We investigate different techniques for segmentation of the tumor and will develop automatic detection of brain tumor. We investigate different techniques for segmentation of the tumor and will develop automatic detection of brain tumor [20].

The motivations of the work area:

- High speed to diagnose bugs
- High accurate results
- Take small period to diagnose
- helping medical specialist to identify and cure disease in early stages
- Time and life savage

1.2 RELATED WORK

Kharrat et al.[1] have developed a methodology, where the brain tumor has been detected from the cerebral MRI images. The methodology includes three stages: Enhancement, segmentation and classification. An enhancement process has been performed to enhance the quality of images as well as to reduce the risk of distinct regions fusion in the segmentation stage. Also, a mathematical morphology has been used to increase the contrast in MRI images. Then, the MRI images have been

decomposed by applying a wavelet transform in the segmentation process. Finally, the suspicious regions or tumors have been extracted by using a k-means algorithm. The feasibility and the performance of the proposed technique have been revealed from their experimental results on brain images.

Mishra [2] has developed an efficient system, where the brain tumor has been diagnosed with higher accuracy using artificial NN. After the extraction of features from MRI data by means of the wavelet packets, an artificial NN has been employed to find out the normal and abnormal spectra. Normally, the benefit of wavelet packets is that it gives richest analysis when compared with the wavelet transforms and thus adding more advantages to the performance of their proposed system. Moreover, two cancer detection approaches have been discussed. The NN system has been trained using the Error Back Propagation Training Learning rule.

P. S. Mukambika et al. [3] have advocated an image processing scheme that essentially consists of i) Pre-processing, ii) Segmentation, iii) Feature extraction and iv) Classification phases. In pre-processing stage, the morphology scheme is adopted where double thresholding approach is implemented to detach the skull image from the MRI brain images. This current work has put forth a comparative study between two techniques that have been devised for tumor detection purpose. Both the schemes have been briefly described here: first is based on the Level set approach that exploit advantages of the non-parametric distorted models having active contours that are used to segment brain tumors from the MRI brain scans; the second approach uses the K-means segmentation algorithm. Once the segmentation stage terminates, decision making is adopted in two stages: i) Feature extraction adopting DWT (Discrete Wavelet Transform) and Gray Level Co-occurrence Matrix, and ii) Classification using the Support Vector Machine (SVM). Here the dataset consisted of MRI brain tumor cans that included T2 weighted 17 benign and 24 malignant tumor images of multiple patients. The achieved results were as follows: SVM having Level Set approach and K-Means segmentation scheme had classified brain scans into normal, benign or malignant tumor categories with 94.12% and 82.35% accuracy respectively. Obviously as evident, the Level Set methodology gave better results as compared to its k-means segmentation counterpart.

Ketan Machhale et al. [4] have adopted an intellectual classification system to categorize normal and abnormal MRI brain scans where the scan undergoes three phases namely; i) image pre-processing, ii) feature extraction and subsequent iii) classification. During the pre-processing stage, first the RGB components of the brain scans are transformed into grey scale format. Next, the Median Filter is applied to de-noise the MRI scans. Finally Skull Masking approach is used to separate non-brain tissues from MRT brain images. Dilation and Erosion are two fundamental morphological operations that are used for implementing the skull masking technique. In the second stage of feature extraction the texture features of the scan like symmetrical, gray scale components are extracted. Finally in the classification phase, varied machine learning techniques like Support Vector Machine (SVM), K- Nearest Neighbor (KNN) and Hybrid Classifier (SVM-KNN) have been adopted and a comparative study among them is facilitated. The dataset comprised 50 images and it was concluded that the Hybrid classifier SVM-KNN scheme offered the highest accuracy rate of 98% as compared to its counterparts.

Sumitra et al. [5] in this work have presented a neural network technique for the classification of MRI brain images. The proposed scheme encompasses 3 stages namely: i) feature extraction, ii) dimensionality reduction and iii) classification. The feature extraction was implemented using PCA from MRI scans and essential traits such as mean, median, variance, correlation values of maximum and minimum intensity were extracted. The classifier in the classification stage was based on back propagation and neural networks have been developed. This classifier classified the scan as either normal, benign and malignant. The result reveals that the BPN classifier gave fast and accurate classification as compared to any other neural network counterparts. The classification accuracy was 73%. Its future work might improve the performance of devised scheme by expanding the data set.

Researchers Nandagopal et al. [6], in their work have presented a combined approach of wavelet statistical features (WST) and wavelet co-occurrence texture feature (WCT) that has been attained from two level discrete wavelet transform which is eventually used for classification of abnormal brain scans into benign and malignant categories. The designed scheme encompasses four phases: i) segmentation of region under investigation, ii) discrete wavelet decomposition, iii) feature extraction and feature selection and iv) classification and evaluation. The support vector machine (SVM) approach is exploited for conducting brain tumor segmentation. For feature extraction of tumor zone, a merged approach of WST and WCT is employed that has been primarily extracted from two level discrete wavelet transform. Genetic algorithm was utilized to select set of optimal texture features from among extracted feature set. The probabilistic neural network (PNN) was adopted for classifying aberrant brain tissues into benign and malignant variants and finally the performance evaluation was facilitated by conducting a comparative study between the PNN with its other variants. The attained accuracy was 97.5%.However one fundamental limitation of this scheme lies with the requirement of new training for Gaussian SVM classifier whenever a change is encountered in image data set and this method can only be applied to CT images. Future work scope of this devised methodology might be extended to other types of imaging such as liver CT imaging, MRI imaging, ultrasound imaging etc.

Trung Le et al. (2010) [7] proposed the new help vector machine method for the two-class medical picture classification. The principle thought of the technique is to build an ideal hypersphere with the end goal that both the inside edge between the surface of this circle, the typical information, and the outside edge between this surface and the anomalous information are as substantial as could be expected under the circumstances. The proposed strategy is executed effortlessly and can diminish both the false positive and furthermore false negative mistake rates to acquire great order comes about. The Support Vector Machine (SVM) classifier is a decent classifier that functions admirably on the extensive variety of order issues, even issues in the high measurements and the cases that are not straightly distinct. Maybe the most concerning issue with the support vector approach is in decision of the piece.

2. PREPROCESSING AND SEGMENTATION METHODS

Preprocessing and enhancement techniques are used to improve the detection of the suspicious region from Magnetic Resonance Image (MRI).This section presents the gradient-based image enhancement method for brain MR images which is based on the first derivative and local statistics. The preprocessing and enhancement method consists of two steps; first the removal of film artifacts such as labels and X-ray marks are removed from the MRI using tracking algorithm. [21]Second, the removal of high frequency components using weighted median filtering technique. It gives high resolution MRI compare than median filter, Adaptive filter and spatial filter. The performance of the proposed method is also evaluated by means of peak single-to noise-ratio (PSNR), Average Signal-to-Noise Ratio (ASNR).[22]

Image segmentation is the process of partitioning a digital image into multiple segments. Image Segmentation is typically used to locate objects and boundaries in image, image segmentation is the process of assigning a label to every pixel in an image such that pixels with the same label share certain visual characteristics. [23]

Table -1: Various Image Segmentation Techniques

Various Techniques	Advantages	Disadvantages
Active contour method	• Use active contour Models. • Preserves global line shapes efficiently.	•Should find strong image gradients to drive the contour. •Lacking accuracy with weak image boundaries and image noise.
Watersheds method	•Based on mathematical morphology	•Over segmentation
	• Helps to improve the capture range	
Threshold method	• Try to find edge pixels while eliminate the noise influence. •Use gradient magnitude to find the potential edge pixels.	•The detected edges are consisted of discrete pixels and may be Incomplete or discontinuous. • Computationally Expensive
Seed region growing	• Correctly separate the regions that have the same properties • Determine the seed points	•It requires manual interaction to obtain seed point
Marker based Watershed	• It remove the over segmentation problem, which occur in watershed segmentation	

3. CONCLUSION

Research in the field of medical imaging in recent years a great effort has been focused on segmentation of brain tumors. In this paper, we have proposed different techniques to detect and segment Brain tumor from MRI images. To extract and segment the tumor we used different techniques such as SOM Clustering, k-mean clustering, Fuzzy C-mean technique, curvelet transform. It can be seen that detection of Brain tumor from MRI images is done by various methods, also in future work different automatic methods achieve more accuracy and more efficiency.

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