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BRAIN NEOPLASM CLASSIFICATION & DETECTION OF ACCURACY ON MRI IMAGES

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Abstract— The abnormal uncontrolled cell growth in the brain, commonly known n as a brain tumor, can lead to immense pressure on the various nerves and blood vessels causing irreversible harm to the body. Early detection of brain tumor is the key to avoid such compilations. Tumor detection can be done through various advanced Machine Learning and Image Processing algorithm. The various stages of brain tumor detection are image pre-processing, segmentation and feature extraction. Preprocessing includes enhancing the image by using various fitters and removing noise. Segmentation includes methods like thresholding, region growing etc. Features like lucunar infarct, meningioma, and vestibular schwannoma are calculated for the extruded tumor. Different classifiers like Artificial Neural Network, Naive Bayer are used to classify the tumor as benign or malignant.

Keywords—Component, Detection, Diagnosis, , MRI

I. INTRODUCTION

The advancing technology has had a profound effect on the field of medical imaging. The building blocks of the body are the various cells, which make up the organs. A tumor is a disease arising out of these cells. Tumors can be either benign (primary) or malignant (metastatic or secondary). A benign tumor is static, continuing to grow in size, applying enormous pressure on the surrounding tissues of the brain causing problems. On the other hand, malignant tumors can originate somewhere else in the body as a mass of cancerous cells and migrate to the brain [1].

Expert opinion, Human Inspection and Biopsy are few of the methods that are available to diagnose tumors. Some of the drawbacks of these methods are excessive time consumption, inaccurate inspection etc. Hence, image-processing techniques are very helpful in the detection of brain tumors. Some of the current imaging techniques are - Computed Tomography, Positron Emission Tomography and Magnetic Resonance Imaging.

The most common imaging technique used to detect and clearly visualize the brain tumor formation, is the magnetic resonance imaging. It gives us a detailed analysis of the unaffected or healthy tissues of the brain and the affected tissues [2]. Computer aided diagnosis is based on the study of the various cerebral tissues of the brain white matter, gray matter and cerebrospinal fluid. Careful analysis if these scans helps in planning an effective treatment for every patient.

II. SURVEY OF EXISTING METHODOLOGY

Existing methodology segmentation and classification, have been surveyed and the results have been tabulated in Table I, given below. The methodology used in the past by various researchers for segmentation of the brain tumor and then extracting the features have some flaws which give low accuracy in the results. The most common segmentation methods used are K-means segmentation and watershed segmentation, which lead to over-segmentation of the tumor. The commonly used classifier SVM has been found to give inferior results as compared to the newer classification algorithms based on neural networks

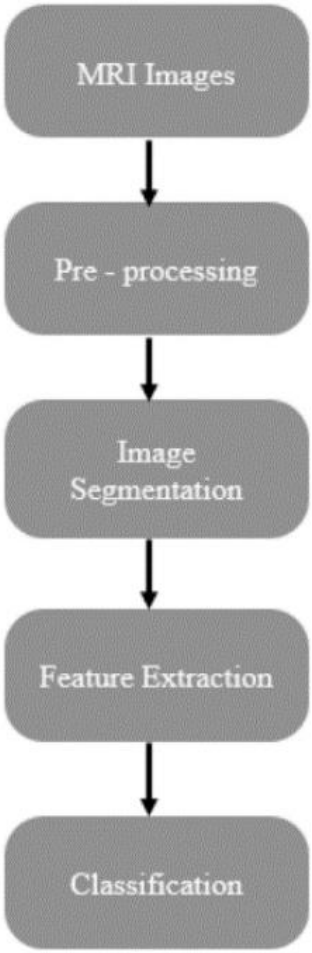
Table 1. Various methodologies studied

YEAR	METHOD	REMARK	REF
2010 2012	Watershed Segmentation	A simplified algorithm, very accurate and has low computational overhead	[9] [10] [11]
2012	Bayesian HMM,SVM	Using tumor probability map with SVM classifier or hidden Markov chain	[12] [13]
2013	Neural network based	Supervised and unsupervised learning for tumor detection. accuracy is dependent on feature selection and inputs given.	[14]

2013 2012	Support vector machine	SVM accuracy depends on the dataset and the application	[15] [16] [17]
2015	K-means clustering, SVM	Better segmentation effect for low SNR brain MR Images	[18]
2016	Convolution Neural Network	More accurate results and reliable information for clininc treatments	[19]

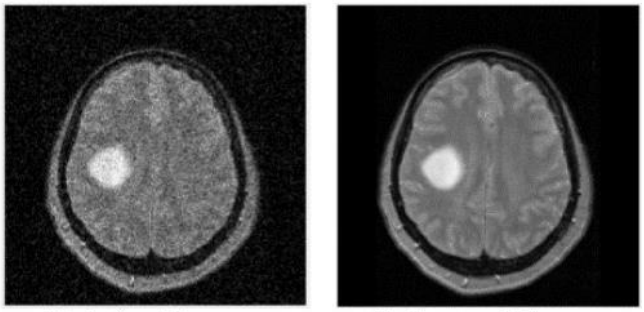
III. PROPOSED METHODOLOGY

The major steps followed in the detection of a tumor from a MRI Scan are as follows: Pre-processing,, Segmentation, Feature Extraction and finally the classification. The flowchart in Figure 1 shows the major steps with snapshots of the output at each stage. The process begins with the accumulation of a clean data set of either T-1 weighted or T-2 weighted MRI scans.



A. *preprocessing of the MRI Images*

Preprocessing is the stage where noise is removed and any minute details are ameliorated. Clinical MRI scans riddled with noise reduce the accuracy of the segmentation algorithm output [3]. Multiple filters are used to eliminate the various kinds of noise. Median filters are used to eliminate salt and pepper noise while anisotropic filters are used to preserve the edges. To procure segmentation without any noise, this module is necessary. This refinement revamps the overall image quality. shows the contrast of a noise riddled image and a preprocessed image.



Original Image Enhanced Image

B. *Segementation Methods*

1. Boundary Approach

Thresholding is one of the most basic methods of segmentation that is used to isolate the tumor. All the pixels are allocated to a category based on the range that they lie in. That is for a certain threshold value t, the pixel located at position (i, j) with a grayscale value as shown in equation (1)

$$\text{Pixel}(i, j) = \begin{cases} 0, fij \le t \\ 1, fij > t \end{cases} \qquad (1)$$

2. Edge-Based Approach

In the edge based segmentation approach, the detected edges are assumed to be the representative boundaries of objects. Obtaining a closed distinct edge from this approach is highly unlikely. Additionally it is imperative to implement edge linking to join partial edges to gain a complete closed distinct edge of an object.

3. Region Based Approach or Clustering

Region based segmentation or Clustering based segmentation is based on the pixel connectivity. A pixel can be four, six or eight connected in a 2-D image. It implies that all the pixels in a certain region are congruent to each other or have a somewhat similar value. The focus is more on finding pixels that satisfy the connectivity criteria than the edges of the object. Clusters are made up of congruent pixels. The various clustering algorithms used are:

a. Particle Swarm Optimization

Particle swarm optimization is an optimization algorithm modelled after the simulation of the social

behavior of birds in a flock. It is a population-based algorithm. A group of random particles or solutions forms the initial solution of the algorithm. This initial solution then searches for the optima by subsequently updating the generations [6]. Every swarm particle traverses the search space constantly adjusting its position basis the distance from its own personal best position in the swarm and from that of the best particle of the swarm. A fitness function measures the fitness value of every particle in the swarm.

b. Feature Extraction

The complexity of the brain makes the isolation of the tumor a difficult task Various parameters are taken into consideration for feature extraction of the segmented tumors from the MRI scans. The main parameters for the area of interest are the expressions of the Gray-Level Co-Occurrence Matrix (GLCM) descriptors — Autocorrelation, Contrast, Correlation, Cluster Prominence, Cluster Shade, Dissimilarity, Energy, Entropy, Homogeneity and Maximum Probability [20]. The results of feature extraction are used to further classify the tumor as benign or malignant

c. Classification

Classification is done basis the results of the feature extraction. Various patters are mapped according to the extracted features and then a classification is made for the extracted tumor. Various algorithms used for the classification are Artificial Neural Networks, Tree J84, Naive Bayes and the Lazy IBK [8].

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IV. COMPARISION OF SEGMENTATION ALGORITHMS

From the above surveyed methodology, theoretically, the best segmentation methods are Genetic Algorithms and Particle Swarm Optimization giving increased accuracy and efficiency as compared to the above described segmentation methods. Table II gives a brief comparison between the two methods. Theoretically, using either of these two method for segmentation of the tumor should give better efficiency and accuracy.

TABLE I. COMPARISION BETWEEN GENETIC ALGORITHMS AND PARTICLE SWARM OPTIMIZATION

Genetic Algorithms	***Particle swarm optimization***
Genetic algorithm operates on populations of strings coded to represent the parameter set	Particle swarm optimization is initialized with a group of random solutions (particles)and optimizes it iteratively
Genetic Algorithms can implements three main operations i.e Selection, crossover and mutation	Analogies exist in PSO though they do not label its operations like genetic algorithms

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V CONCLUSION

This paper gives a brief overview brain tumor segmentation and classification techniques. A comprehensive analysis of the various stages of image processing are presented. Various segmentation methodologies are elaborated. It can be concluded that the algorithms and the parameters used in the proposed system are all meant to increase the efficiency of the system by achieving better results. The boundary approach and the edge based approach for segmentation are very common but the region growing approach gives better results.
Result is further classified with medical parameters for better classification are metastasis(10.25-12)% with aneurysm level of stages .Accuracy and reliability are of utmost importance in tumor diagnosis, as a patient's life depends on the results predicted by the system. Thus, the proposed methodology helps in increasing the accuracy and obtaining the desired results.

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