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Comparative Study of Efficient Methodology for Tumor Detection

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ABSTRACT

Tumor detection in human plays a vital role to be identified at an early stage and with more accuracy of the tumors. Tumors can be detected using many imaging techniques available. However, computer aided algorithms can be used on images for effective classification of tumors and it's stages. Using any one of the efficient computer aided technique, it is easy to segment abnormal tissues in the brain with more accuracy. With the help of these techniques the tumor in the brain can be detected. The MRI images are taken, preprocessed and fed into the algorithm for detection of tumors after segmentation process. From the segmented results, features are extracted and classified accordingly based on the classification techniques. For this purpose many algorithms to detect the tumor cells have been proposed. In this paper a comparative study was done to find out the efficient methodology to detect the tumor cells using MRI with more accuracy.

Keyword: Hybrid CNN, Segmentation, Tumor Detection

INTRODUCTION

Tumor is an abnormal tissue growth where in the cells gets divided enormously [1]. It can be located on any part of the body. The malignant tumors are very dangerous because they can cause cancer if persists without any care. So these tumors should be identified and treated at an early stage. Tumors are classified into many categories like Grade I, II, III … If the tumor is identified at an initial stage which means the cell division has just then started and not of a larger area then this comes under grade I brain **tumors.** If these tissues are completely removed by a surgery then this stage tumor can be cured. In the next level the tumor starts growing slowly and its spread is much lesser to other regions. This type of grade II tumors can be treated but not completely removed by surgery. Grade III and others -The spread is higher and rapid in the nearby tissues and there may be a chance of recurrence. Usuallythese typesof tumors cannot be **cured**. Detecting brain tumor is highly complicated task and needs more effort [4] Diagnosis of brain tumors in the early stages of the tumor's start is difficult because it cannot accurately measure the size and resolution of the tumor [5][18]. So, the detection and treatment of tumors at

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an early stage of tumor formation process may results in the patient's treatment and cure. Therefore, the treatment of tumor depends on the timely diagnosis of the tumor [6]. MRI images provide better results than other imaging techniques such as Computed Tomography (CT), due to their higher contrast in soft tissue in humans [7] [15].By inspecting the MRI the tumors can be differentiated and they can be treated. In the year 2016, a study says that brain tumor related death is increasing in children among the age group 0–14 in the United States and they are deadlier than Leukemia [8]

In earlier days where there was no machine intelligence[19][23][24] theses detection of brain tumor happened by Expert opinion with multiple persons discussion and suggestion, biopsy(which is also risky), Human inspection, etc.[9] [16]. After a suggestion given by an expert, the same will be considered by other experts to make decision, because human brain is always not correct and the chances of misconception is higher because human eyes cannot diagnose most of the tumors and miscalculation may lead to serious health problems in patients.. It is clearer that the manual procedures are time consuming to classify tumor correctly which further delays treatment of tumor. With the advancements in the field of machine intelligence (computer vision) computer-aided diagnosis are widely used in many biomedical fields for accuracy. So the need of a high resolution technique that can detect the presence of tumors in brain is needed for experts to proper diagnosis among patients.

The major objective of detection of Tumors in brain image is carried out by carefullyextracting the features and processing it for segmentation and identifying the tumorous tissues [10][22][25]. Various methods have been proposed for detecting tumors. So a fully automated methodology [17] [20][21] for detection of brain tumor is required. The ultimateaim is to understand various computer aided methods or approaches that are developed for the detection of Brain tumors and their accuracy. This are compared may help to identify the efficient technique and that methodology can be used in the medical field for better performance of detecting tumors.

METHODOLOGY

Various methods have already been proposed and their flow of work in the process of detection of tumors is as follows. Generally every methodology undergoes these stages for detecting tumors.

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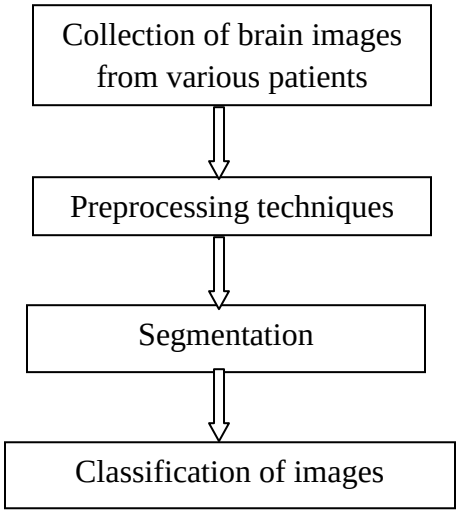

A. Acquisition of MRI

This step is the initial step that has to be done for classification of tumors. Without a proper data set collection, classification cannot be done effectively. So, for this purpose various images of brain are collected. Few dataset are collected from various hospitals and few others have collected from the universally accepted databases.

B. Pre-Processing

The very first step that has to be done in all methodology is pre-processing of the images. This stage helps to remove the unwanted noises, bias field distortion and motion heterogeneityetc. In this stage the images get enhanced and the results produced from these images will be better than these images that are not undergone this stage.

Even if the image was taken from a high resolution devices or any perfect database set , they have to be preprocessed in order to enhance contrast for better segmentation. Noises are removed using filters like low pass, Gaussian filter, median filter etc accordingly. A main concern in preprocessing of MRI is that it should be done carefully so as to maintain the standard or else poor result production will occur due to increased noise or important details being eliminated during the noise reduction.

C. Extraction of Features

The process of getting the useful information from a larger data is called Feature Extraction. By doing this the results can also be improved. Various features like colour, texture and geometric features which are more relevant for the detection of tumors are obtained from the feature extraction stage from themedical images. This help to reduce the number of dimensions needed for processing where the loss of relevant information does not occur.In this section the region of interest is extracted from the image using any of the segmentation technique. Energy,

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Entropy, Correlation, contrast are the characteristics obtained from the image using the technique.

$$\text{Energy} = \sum_{i,j} I(i,j)^2 \quad \rightarrow(1)$$

$$\text{Entropy} = \sum_{i,j} I(i,j)\log(i-j) \quad \rightarrow(2)$$

$$\text{Correlation} = \sum_{i,j} \frac{I(i,j)(i-\mu i)(i-\mu)}{\sigma i \sigma j} \quad \rightarrow(3)$$

Region based segmentation, Segmentation using thresholding, watershed segmentation, Convolutional Neural Network (CNN) is used for learning how to segment images. CNN extracts features directly from pixel images with minimal preprocessing. CNN with softmax, RPF, Two layer CNN, CNN with region growing based segmentation are also used for feature extraction.

D. Classification

From the extracted features classifiers are used to classify the type of tumor and its level can be identified from the results. Various methods are proposed and their results have been discussed at the end of this paper.

E. Performance Evaluation

The parameters used to measure the performance of the classifiers are accuracy, sensitivity and specificity. Global performance can be identified using Accuracy. Reliability of the system is measured using Sensitivity and specificity measures the reliability of the system at making negative identifications.

$$\text{Accuracy} = \frac{TP+TN}{TP+FP+FN+TN} \quad \rightarrow(4)$$

$$\text{Sensitivity} = \frac{TP}{TP+FN} \quad \rightarrow(5)$$

$$\text{Specificity} = \frac{TN}{FP+TN} \quad \rightarrow(6)$$

Where,

TP, TN, FP, FN represents True Positive, True Negative, False Positive and False Negative respectively

E. Process flow

Step 1: Input images are collected from various resources

Step 2: Pre processing technique are applied and enhanced using enhancement technique.

Step 3: Edge detection or background feature extraction are done

Step 4: Classifiers are used to classify the type of tumor

Step 5: Finally the tumors are detected and send with tags mentioning their types

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RESULTS AND DISCUSSION

The results produced by various methodologies are discussed here and tabulated for better convenience.

Segementation			
Methodology	Results		
	Precision	Specificity	Sensitivity
Hybrid	83%	89%	98%
CNN+ Softmax	97.34%	94.64%	100%
CNN+ RBF	94.24%	89.28%	100%
2 layer CNN	98.51%	84.19%	100%
CNN without any feature extraction methods	98.67%	96.42%	100%
Patchbasedapproach	-	90%	94%

Classification	
Methodology	Accuracy
Segmentation using Thresholding	91.34%
CNN+ Softmax	98.67%
CNN+ RBF	97.34%
Region based Segmentation	87.48%
2 layer CNN	94.68%
CNN without any feature extraction methods	99.12%
Patchbasedapproach	98.99%
Watershed Segmentation	92.76%

CONCLUSION

Automated classification system became an important technique in computer-aided diagnosis for effective tumor detection among patients. Instead of going into a single approach a hybrid can be used for improved efficiency and efficacy for brain tumor segmentation. The accuracy of various methodsare discussed and the results can be seen in the above table. Considering the value of diagnosis the medical accuracy of the method should be considerably high using the fully automatic computer aided methodologies.

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