

# Detection of Brain Tumor using Image Processing Techniques



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**Abstract:** Image processing in biomedical field is being increasingly used for the detection and diagnosis of various abnormalities in the body parts. The detection of brain tumours using image processing on MRI images is one such field where better results are obtained as comparative to CT-scan and x-ray. Prior detection of the brain tumour is desirable and possible with the help of machine learning and image processing techniques. These techniques detect even a small abnormality in the human brain following a four-stage process which includes pre-processing, segmentation, feature extraction and optimization. Different parameters such as accuracy, PSNR, MSE are calculated to find out the efficiency of process and to compare it with other methods. This paper reviews about various different approaches which are used to detect the brain tumor using image processing techniques.

**Index Terms:** Types of tumors, feature extraction, classification, optimisation, image processing.

**Abbreviations:** Magnetic Resonance Imaging (MRI), Peak Signal to noise ratio (PSNR), Mean square error (MSE), Positron Emission Tomography (PET)

## I. INTRODUCTION

There are two types of tumor that can develop in brain; primary tumor and secondary tumor. The primary tumor in brain is classified as low grade or high grade. A low-grade tumor mostly grows very slowly; but with the pace of time, it can turn out to be of a high-grade tumor. High-grade tumor grows very rapidly and hits the brain. In adults, secondary brain tumors which are also called brain metastases, occurs more frequently in adults than the primary tumors.

### Types of primary brain tumor

- **Benign tumor.** This type of tumor is not taken as cancer. It grows very slowly (Ridhi, Salankar, & Babar, 2015) [1]. This type of brain tumors usually grows in isolated tissues so generally these are not dangerous, as once they are removed, tumor cells are finished so they don't emerges back in the brain. A benign tumor can give rise to symptoms like a malignant tumor depending where the tumor is located according to size and location.

- **Malignant tumor.** This type of tumor is treated as a cancer. In this tumor, cells grows very rapidly, and harm nearby tissue which is very difficult to remove partially they are operated. A malignant brain tumor may grow back after treatment.

### Types of brain tumors

There are nearly hundred types of brain tumors which include

- Gliomas
- Astrocytoma
- Pilocytic Astrocytoma (grade I)
- Diffuse Astrocytoma (grade II)
- Anaplastic Astrocytoma (grade III)
- Glioblastoma Multiforme (grade IV)
- Oligodendroglioma (grade II)
- Anaplastic Oligodendroglioma (grade III)
- Ependymoma (grade II)
- Anaplastic Ependymoma (grade III)

### The most common primary brain tumors

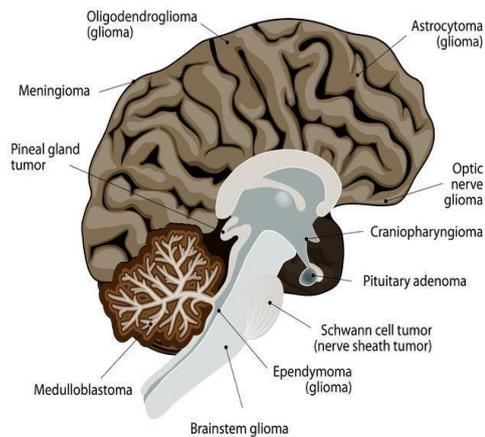


Figure 1: Types of Brain Tumor [1]

World Health Organization (WHO) categorized these tumors and developed a grade system for treatment, planning, standard communication and forecasting the results for brain tumors. Tumors are identified according to the cell type and grading system by viewing the cells, which are taken during a biopsy, under a microscope. Initially, it was very challenging to detect brain tumor for being a very time consuming process but with the growth of science, it's very easy to detect the tumour.

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Image processing techniques can help doctors to determine whether tumor is primary or secondary and whether it is cancerous or not and whether a patient can recover or not from brain tumor. The various processes which are followed in the diagnosing of a brain tumor are magnetic resonance imaging (MRI), CT Scanning, PET CT-SCAN, Cerebral arteriogram, also called a cerebral angiogram, Lumbar puncture or spinal tap [2]. A thorough literature survey is presented in the following section.

II. LITERATURE SURVEY

Table 1: Literature Survey

Author and year	Findings
Umit Ilhan et al., 2017[3]	Proposed new threshold technique with better accuracy to detect tumor. There is one limitation that this approach is not an automatic procedure
B. Devkota et al. 2018[5]	Suggested a new method which detects brain tumor in its initial stage with the help of MRI images which is being executed for pre-processing by median filter and Fuzzy C-Means for segmentation. The proposed method has not been tested or compared with current best solution upto evaluation stage
Nilesh.L.Shimpi et al. 2017 [6]	Proposed an algorithm which is based on segmentation and extract the tumor region automatically.
Amruta Pramod Hebli et al. 2016 [7]	This paper showed that machine learning can have a vital role in brain tumor detection and categorized according to proper segmentation approach. In this paper, GA and PSO, K-means and fuzzy-c approaches have been compared for segmentation.
Tian Xia et al. 2018[8]	Suggested a method for automatic segmentation and classification of MRI brain image with tumor. In this tumor region is extracted using Ostu's thresholding and morphological operations with 86% accuracy
Aby Elsa Babu et al. 2018[10]	Proposed a bilateral transformation method which is proved to be a good method for tumor detection in brain using image processing techniques
Luxit Kapoor et al.2017 [11]	In this paper he suggested about the numerous steps that are indulge in the detection of tumors, and prove that Segmentation is the most significant and propitious
Miss.Shrutika Santosh et al 2017 [12]	Proposed that brain tumor detection method and find extraction of boundaries of tumor by Sobel edge detection operator. Stage and size of tumor is depicted in this paper-proved that MRI images are best fit for brain tumor detection.
Geert Litjens et al., 2017[13]	This paper presented the review of using deep learning for registration, object detection, segmentation, image classification and other tasks.
Olfa Limam et al.2016[14]	Suggested a Multi objective fuzzy clustering approach that produces a set of Pareto solutions, which are based on I-index validation measure and is chosen to be the final clustering solution. -This method is applied only to CT images

	with 97.5% accuracy.
Nilesh Bhaskarrao Bahadure et al. 2017[15]	In this paper new approach has been proposed which can provide help in the quick, accurate and time saving detection of tumor in brain and also provide the exact location where the tumor is originated with good accuracy.
G Rajesh Chandra et al.2016[16]	The developed method uses the nature inspired algorithm that is GA which helps to solve optimization problems via a large search space.
P.Shanthakumar et al.2015 [18]	-propose a method that transparently compare brain abnormalities from normal brain tissue. tumor de-segmentation results are calculated based on similarity indexed, the overlap fraction and positive predicted value whose obtained values are 0.817%, 0.817%,0.812%..
Munmun Saha et al.,2018 [20]	This paper reviewed and summarised some existing method of segmentation for tumor detection in brain using MRI images
Alexander Zotin et al., 2018 [21]	The paper present brain tumor edge detection using MRI images which are based on FCM clustering. in biomedical image.
Iván Cabria et al. 2017 [22]	Suggested a segmentation technique called PFS has been proposed which shows that performance is good as comparatively to other segmentation methods.
Amin et al.2018[17]	Proposed that DNN architecture is explained and it is being evaluated on 8 challenges data sets and 5 MRI modalities such as flair, DWI., T1,T2 and T1-contrast respectively which provide average time of CNN model is 5.502 sec.

III. METHODOLOGY

Brain tumor can be detected using image processing techniques by the following process:

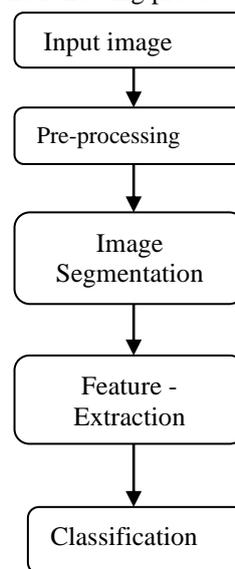


Figure 2: Steps for image processing[2]

**Pre-processing:** Basically pre-processing means converts the RGB image into Greyscale image.

It helps to enhance the quality of the MR images so that it can be easily recognised by human beings or machines [9]. It helps to diagnose many aspects of MR images like, removing the irrelevant noise from the image, fixing the strength of signal-to-noise ratio, improve the quality of the visual appearance of MRI images, and parts which are not required in the background, smooth and sharpen the inner part of the region, and help in maintaining its edges. Numerous filters are used to identify and remove the noise from image that includes low pass filters and high pass filters.

**Image Segmentation methods:** Image segmentation means technique of dividing a digital image into distinct sections. Which are based on similar attributes? It is mostly used to detect boundaries and objects in an image It is a technique of drafting a label to each pixel in the image so that pixels that are having the same label can share common visual attributes.

**Table 2: Different Techniques**

Various Techniques	Advantages	Disadvantages
Active contour method[28][29]	•It Uses active contour techniques and keep line shapes accurately and globally	•find strong image gradients for the contour. •it is inaccurate with image having noises.
Watersheds Method[29]	•it uses mathematical morphology •It is used to improve the capture range	•Over segmentation
Threshold method	It Uses gradient magnitude method to find out the edge pixels [26].	It fails in images having poor contrast.
Region Based	Correctly separate regions according to the similarity of properties [26].	Noise may lead to quality of final result
Fuzzy C Means, & K Means	This Technique is helpful in large images which are having poor contrast.	In this Sample which are to be selected and provide fuzzy sets may be hard to apply [27].
Seed region growing	It accurately differentiate the regions having matching properties which Are used to detect the seed points	It Requires manual not automatic interaction to obtain seed point

**Feature Extraction:** When segmentation phase is completed next step is to extract features from image which means to extract the relevant information from image to study the effective results. The features which are extracted will give the characteristics of the input category to the classifier by allowing for the description of the applicable properties of the image into feature vectors like area, shape, texture contrast and entropy Feature extraction include

- Histogram of oriented gradients (HOG)

- SIFT
- Color histograms
- SURF
- MSE
- Speeded-up robust features (SURF)
- Haar wavelets
- Local binary patterns (LBP)

**Classification:** Image classification plays an vital role and in various application domains like robot navigation biomedical field, biometry, vehicle navigation, industrial inspection for visual purposes and remote sensing surveillance and videos. It comprises of following steps:

**Table 3: Classification Techniques**

Techniques	Uses
Multi-Classification Support Vector Machine[21]	MCSVM segregate the boundary feature of 7 kinds of encephalic tissues properly and successfully and with good accuracy
PCA and PNN assisted automated brain classification tumor [22]	It is used to provide more scientific and quick solution than the previous implemented 1 methods of brain tumor.
k-nearest neighbour classifier, k-means clustering and Discrete wavelet Transform (DWT),PCA [23].	Segmentation approach that using k-means Clustering, skewness, Kurtosis, Specificity etc., are measured and contrasted
Genetic Algorithm (GA) and SVM, Spatial gray level dependence method [24]	A combination of these methods which are SGLDM for Feature extraction, SVM classifier and GA which is nature inspired algorithm for Feature Reduction proved to be high statistical measures
Modified Probabilistic Neural Network (PNN) model [25].	PNN Model which is based on Learning Vector Quantization (LVQ) provides performance which is proved to be 100% accurate.

#### IV. CONCLUSION

In this paper survey of brain tumor detection has described along with comparative study of different techniques used in different phases of tumor detection. The numerous methods, that are being studied these days in bio medical image processing were generously . Segmentation proved to be the best method among all and further research can be carried by using different optimization techniques which are inspired from nature .

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