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# A Survey of Segmentation Methods for Brain Tumor Detection

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**ABSTRACT:** Brain tumor is an abnormal growth of cells in the brain. MRI is an advanced medical imaging technique used to produce high quality images of different part of human body. It gives detailed information to analyze the diseases. Medical image processing plays important role to give information in more extent for such advanced images. MRI Imaging play an important role in brain tumor for analysis, diagnosis and treatment planning. The input image is preprocessed and high intensity values are removed from the image. Histogram equalization technique is used for enhancing the contrast of the image as MRI images generally have low contrast. In this paper, different segmentation techniques are discussed with their corresponding merits and demerits.

**KEYWORDS:** Tumor detection, Contrast enhancement, Histogram Equalization, Segmentation of Image

## I. INTRODUCTION

Human body is made up of several types of cells. Brain is a highly specialized and sensitive organ of human body. Brain tumor is a very harmful disease for human being. The brain tumor is intracranial mass made up by abnormal growth of tissue in the brain or around the brain. Brain tumor can be detected by benign or malignant type. The benign being non-cancerous and malignant is cancerous. Malignant tumor is classified into two types; primary and secondary tumor. Benign tumor is less harmful than malignant. The malignant tumor spreads rapidly entering other tissues of the brain therefore, worsening condition of patients. Brain tumor detection is very challenging problem due to complex structure of brain [1]. Brain tumor diagnosis is quite difficult because of diverse shape, size, location and appearance of tumor in brain. Brain Tumor detection is very hard in beginning stage because it can't find the accurate measurement of tumor. But once it gets identified the brain tumor it gives to start the proper treatment and it may be curable. Therefore, the treatments depend on tumor like; chemotherapy, radiotherapy and surgery [2]. Medical imaging is useful to diagnose the noninvasive possibilities. The various types of medical imaging technologies based on noninvasive approach like; MRI, CT scan, Ultrasound, SPECT, PET and X-ray. In the field of medical diagnosis systems (MDS), Magnetic resonance Imaging (MRI), gives the better results rather than Computed Tomography (CT), because Magnetic resonance Imaging provides greater contrast between different soft tissues of human body [3]. In MRI-scan, a powerful magnetic field component is used to determine the radio frequency pulses and to produce the detailed pictures of organs, soft tissues, bone and other internal structures of human body. The MRI-Technique is most effective for brain tumor detection. The brain tumor detection can be done through MRI images. In image processing and image enhancement, tools are used for medical image processing to improve the quality of images. The contrast adjustment and threshold techniques are used for highlighting the features of MRI images. The Edge detection, Histogram, Segmentation and Morphological operations play a vital role for classification and detecting the tumor of brain.

*Brain tumor* is an abnormal growth of cells inside the skull. Normally the tumor will grow from the cells of the brain, blood vessels, nerves that emerge from the brain. There are two types of tumor which are benign (non-cancerous) and malignant (cancerous) tumors. The former is described as slow growing tumors that will exert potentially damaging pressure but it will not spread into surrounding brain tissue. However, the latter is described as rapid growing tumor and it is able to spread into surrounding brain. Tumors can damage the normal brain cells by producing inflammation, exerting pressure on parts of brain and increasing pressure within the skull. Radiologists examine the patient physically by using Computed Tomography (CT scan) and Magnetic Resonance Imaging (MRI). MRI images showed the brain structures, tumor's size and location. From the MRI images the information such as tumors location provided radiologists, an easy way to diagnose the tumor.



## II. TUMOR DETECTION

The various steps of MR imaging like preprocessing, feature extraction, segmentation, post-processing, etc. which is used for finding the tumor area of MRI images.

### 1. INPUT IMAGE (MRI)

Magnetic resonance imaging (MRI) of the brain is a secure and easy test that uses a magnetic field and radio waves to generate detailed images of the brain and the brain stem. MRI machines have better openings and supportive for patients with claustrophobia. MRI of the brain can be helpful in estimate problems such as persistent headaches, dizziness, weakness, and blurry vision or seizures, and it can help to notice certain chronic diseases of the nervous system, such as multiple sclerosis.

### 2. PREPROCESSING

This paper presents an integrated method of the adaptive enhancement of brain tissues in two-dimensional (2-D) MRI images. The MRI brain image consists of film artifacts or label on the MRI such as patient name, age and marks. film artifacts that are removed using tracking algorithm. Here, starting from the first row and first column, the intensity value of the pixels are analyzed and the threshold value of the film artifacts are found. The intensity value greater than that of the threshold value is removed from MRI. The high intensity values of film artifacts are removed from MRI brain image. The following figures 1 explain the process of preprocessing stage.

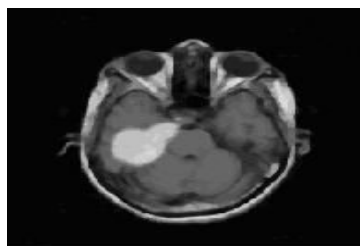


Fig.1 Preprocessed Image

### 3. FEATURE EXTRACTION

Poor contrast is one of the defects found in acquired image. The effect of that defect has great impact on the contrast of image. When contrast is poor, the contrast enhancement method plays an important role. The gray level of each pixel is scaled to improve the contrast. Image enhancement is among the simplest and most appealing areas of digital image processing. Basically, the idea behind enhancement techniques is to highlight certain features of interest in an image. Improvement in quality of these degraded images can be achieved by using application of enhancement techniques. Image Enhancement techniques are used to develop the image feature for human perception. It is defined as a method of an image processing such that the result is much more appropriate than the original image. Histogram equalization is a fundamental tool in image Enhancement. It is likely to aid in perceptible of how they function on digital images [2]. The intensity level equalization method is an image with increased dynamic range, which will tend to have high contrast. The increased in contrast is due to the significant spread of the histogram over the entire intensity scale. In overall the increase intensity is due to the fact that the average intensity level in the histogram of the equalized image is better than the original. Its function is to increase the dynamic range of intensity levels in an image [3].

Contrast enhancements improve the visualization of the MRI images [8]. Contrast enhancement technique is used for enhance the MRI image is shown in figure 2.

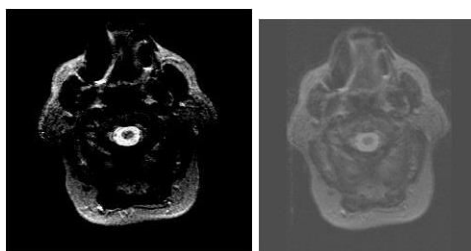


Fig 2(a) Reduced Contrast (b) Increased contrast

### 3.1 Edge Detection

Edge detection is an image processing technique for finding the boundaries of objects within images. It works by detecting discontinuities in brightness. Edge detection is used for image segmentation and data extraction in areas such as image processing, computer vision, and machine vision. Common edge detection algorithms include methods like Sobel, Canny, Prewitt. Edge detection methods are used for finding object boundaries from MRI images and the results are shown in figure 3

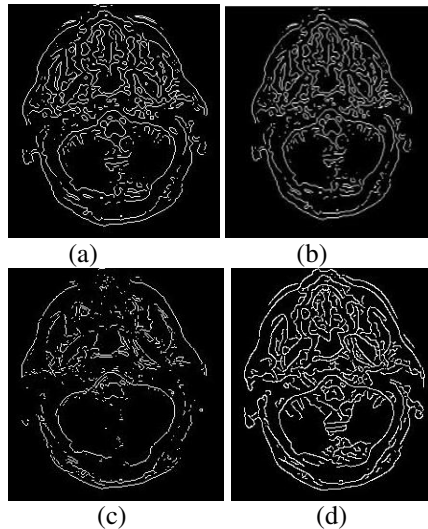


Fig. 3(a) Log operator (b) Sobel operator (c) Canny operator (d) Prewitt operator

### 3.2 Threshold

Image threshold is a simple and effective way of partitioning an image into a foreground and background. This image analysis technique is a type of image segmentation that isolates objects by converting gray scale images into binary images. Image threshold is most effective in images with high levels of contrast. Threshold technique is applied on input MRI image by changing the threshold value and the result shown in figure.4



Fig.4 Threshold applied image

## III. SEGMENTATION

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.

### 1. Region Growing Method

Region growing method extracts regions with similar pixels. The process begins with seed selection of the given image. Automatic or manual seeds selection is performed. Neighbors of the seeds are added to the region if it is similar to the seed. The process is repeated until seeds cannot be added to the region. Fuzzy Knowledge Based Seeded Region Growing for multispectral MR images is proposed. Taking into account the advantages of spatial information

and correlation from multispectral images, fuzzy edge and similarity are used for defining initial seed in modified seeded region. The texture based region growing is used. In the proposed method, local texture information of neighborhood pixel is extracted. Both intensity threshold and texture threshold for a pixel are considered for region growing to extract the brain tumour in MRI. The main advantage of region growing is that the regions with similar pixels are generated. The major limitations of region growing method are the initial seed point selection and are more sensitive to noise.

## 2. Watershed Algorithm

The watershed algorithm can be described with the help of the behavior of water on the landscape. The landscape is divided into various disjoint regions by dams. The dam is built at the point where water from different basins flow together. The process of building the dam is stopped, when water reaches the highest level in the landscape. Thus, each region in the landscape belongs to one dam. It leads to the production of a complete contour of the images, and no joining by contour is required. The main limitation of watershed segmentation is over segmentation. To overcome such limitation, pre and postprocessing is done to remove noise and to improve the reasonable segmentation. Marker Controlled Watershed Segmentation used markers and floods. The gradient of image starting from these markers instead of regional minima is used. The proposed method produced the better result for larger image. The advantage of the watershed algorithm is that it can segment accurately multiple regions at the same time. Another benefit of this method is that contour joining is not required, as it produces complete contour of the segments. The major drawback of the method is over segmentation.

## 3. Morphological Based Method

Morphology operation is based on the morphology of features of the image. It is mainly used for extraction of information from the image based on the representation of the shape. Dilation and erosion are two basic operations. Dilation is used for dilating the size of the image. Images are shrunk by erosion. The proposed method is able to segment tumour even in low intensity images. The method involves several steps to extract tumour from the image, which includes enhancement of image, resampling of image, color plane extraction, histogram application, an advanced morphological operation to extract tumour region. In the proposed method, morphological operations are mainly used as the filter to remove low frequency pixels and boundary pixels. Area of tumour, length, and other parameters of the tumour are identified effectively for treatment and diagnosis of the tumour.

## 4. Genetic Algorithm

Genetic algorithm (GA) is based on natural evolution. The natural evolution in GA is based on search process that optimizes the structure that it generates. In GA, chromosomes are used for describing the population of individuals. The population of individuals is updated using mutation, cross over, and selection operator. The population of individuals is updated iteratively. Fitness function used for evaluating each population is to be optimised. GA algorithm is used for optimizing the segmentation results of brain tumour from MRI image, through evaluation criteria. In the proposed method, clusters of K means algorithm is used as initial population. Centers that are clustered are evaluated by a fitness function. The weaker chromosomes are then replaced by better one, using various selection criteria such as crossover and mutation. The main advantage of GA is its high efficiency in difficult search problem.

## 5. Fuzzy Clustering

In fuzzy clustering, each pixel is allocated a membership function value to the available classes based on its attributes. Fuzzy membership function takes the value range of 0 to 1. This value gives the similarity between the pixel and its centroid. If the value is 1, then the pixel is close to the centroid. Thus clustering is done based on membership values. The neighborhood attraction, based on location and relation to neighboring pixels is introduced to increase the performance of Fuzzy C Means (FCM). The segmentation result depends on neighbors and their location. The intensity of the pixels and their neighbors' spatial position is used for determining the degree of the optimum value and degree of attraction is found using the combination. In multistage system, there are two stages namely, brain tumour diagnosis and tumour region extraction. In brain tumour diagnosis stage, texture features are extracted from the noise free brain MR images.



Ensemble based Support Vector Machine (SVM) classification is used to classify tumours. In tumour region extraction stage, skull removal, brain region extraction and brain tumour extraction are done to extract the brain tumour. The splitting techniques of Discrete Curve Evolution (DCE) techniques are used to find cluster for T1, T2 and PD MR Brain image segmentation. Adaptive scale FLGMM (ASFLGMM) algorithm for brain MR image segmentation developed a local scale estimation method to estimate the variances of the local Gaussian mixture model. This is combined with FCM for segmentation. The initialisation of FCM is improved by the rough set based intuitionistic fuzzy clustering is proposed. The initialisation of cluster centre is performed using intuitionistic rough set based measure. Membership of cluster center is updated using intuitionistic rough set similarity measure. The method used to segment an image into the CSF, WM, and GM, which is very useful for the diagnosis of brain diseases. The advantage of fuzzy clustering is that it converges to tumour boundary correctly. Many authors have developed the methods to overcome the drawbacks of FCM like reducing computation time, incorporating spatial information into clustering task to segment correctly, correlating neighbouring pixels for clustering to reduce noise effect and incorporated additional knowledge into clustering task to get better result.

### 6. K-Means Clustering

K-means is the easiest and the simplest way to cluster data. Initially k groups are identified to the cluster the data k groups. Then, k initial centres are identified randomly. The object is assigned to the centres that are close to them. The mean of all objects in each centre is identified and labelled as new centres. The process is repeated until all objects are converged. The evaluation of K-means and FCM have been modelled on T1 contrast axial plane MR images for segmentation of brain tumour with histogram guided initialization of cluster. K-means is able to cluster the regions comparatively better than FCM. FCM identifies only three tissue classes, whereas K-means identifies all the six classes. Table 1 shows the comparison of various segmentation techniques .

| Various Techniques    | Advantages  | Disadvantages  |
|-----------------------|---|--|
| Active contour method | <ul style="list-style-type: none"> <li>• Use active contour Models.</li> <li>• Preserves global line shapes efficiently.</li> </ul> | <ul style="list-style-type: none"> <li>• Should find strong image gradients to drive the contour.</li> <li>• Lacking accuracy with weak image boundaries and image noise.</li> </ul> |
| Watersheds Method     | <ul style="list-style-type: none"> <li>•Based on mathematical morphology</li> <li>• Helps to improve the capture range</li> </ul>   | <ul style="list-style-type: none"> <li>• Over segmentation</li> </ul>  |
| Threshold method      | <ul style="list-style-type: none"> <li>• Try to find edge pixels</li> </ul>   | <ul style="list-style-type: none"> <li>• The detected edges are consisted</li> </ul>   |

**Table 1:** Various Image Segmentation Techniques

### IV. CONCLUSION

The input brain image is preprocessed and the preprocessing techniques include different methods like Filtering, Contrast enhancement, Edge detection is used for image smoothing. The preprocessed images are used for threshold, histogram, segmentation and morphological, which is used to enhance the images. Histogram equalization is a image-processing technique often used to achieve better quality images in black and white scales in medical applications such as digital x-rays, MRIs and CT Scans. The enhanced image is then segmented. The performance of segmented image was evaluated for different segmentation techniques.

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