An efficient method for Segmentation and Detection of Brain Tumor in MRI images

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Abstract- *In this paper, a attempt has been made to summarize   segmentation techniques which are useful for separation of tumor region from brain tumor MRI images. By selecting a proper segmentation technique , it is possible to segment tumor region accurately, which helps in measuring the area of tumor region from brain tumor MRI image. This is possible by using digital image processing tool. Digital image processing is useful for   CT scan, MRI, and Ultrasound type of medical images. Digital image processing improves the quality of these medical images using various enhancement techniques. From this enhanced image the radiologist can easily identify infected region and its location. Digital image processing also able to separate out infected region from MRI or CT scan images easily which helps radiologist for diagnoses of the disease at earlier stage.*

1. INTRODUCTION

Brain is the center of human Central nervous system. It contains 50-100 billion neurons forming a gigantic neural network. The brain is a complex organ as it made up of many cells. These cells have their own special function. Most of the cells in the body grow and divide to form a new cell for proper functioning of the human body. When new normal cells grow, old or damaged cells die and new cells take their place. Sometimes new cells grow when the body doesn't need them and old or damaged cells don't die as they should. It gives rise to extra cells which forms a mass of tissue called   a tumor. The tumor may be embedded in the brain region that makes the sensitive functioning of the body to be disabled. Because of its location and spreading capacity it is very complex and risky for treatment. So Brain tumor is considered as the main cause of cancer death worldwide. Brain tumor can affect people at any age. Digital image processing technique is a tool by which it's become possible to identify the diseases location easily.

Digital image processing has advantages like reproducing original data again and again without any change; enhance an image which helps the radiologist for analysis. People are affected by tumor in India are near about 80271 (2007 estimates) [1]. The National Cancer Institute (NCI) estimated that 22,070cases of brain tumor and other Central Nervous System (CNS) cancer would be diagnosed in the United State in 2009.

There are basically two type of brain tumor Primary tumor and Secondary tumor.   Primary brain tumors are tumors that originates in the brain. Secondary tumor originated in other part of body and spread into the brain.

The primary tumor can be cancerous or noncancerous type of tumor. The noncancerous brain tumor is known as benign where as cancerous tumor is known as malignant tumor.   The benign type of tumor grows slowly and it rarely spread to other areas of the body. It has well-defined borders. This type of tumor can be removed completely by surgery and there are less chances to come back.

The Melignant type of tumor grows faster than benign type of tumor. This type of tumor affects healthy brain cells also. This tumor can come back even after surgery. It can spread to other parts of the brain or spinal cord.

Secondary type brain tumor begun in another part of the body such as in breast, in kidney etc. and that spreads to the brain. The scanning of brain can be done in different way by using different techniques like magnetic resonance imaging (MRI) and computer tomography (CT) scan in horizontal as well as vertical section and at different depth levels . In this proposed algorithm we have used MRI image taken in horizontal sections.

2. LETRATURE REVIEW

There are various algorithms proposed by different authors for detection of brain tumor. They have used different denoising, enhancing techniques for the implementation of algorithms. R. B. Debuy et at presented

an advanced gradient magnitude region growing algorithm using sobel operator to compute the gradient magnitude by considering homogeneity criteria. The gradient magnitude analyzing the boundaries of a region. These regions are enough contrast. Author measured the size of tumor based on labeled object, which are consecutive with no gaps between label numbers [2].

Gopal , N.N.Karnan, *et al* During past few years, brain tumor segmentation in magnetic resonance imaging (MRI) has become an emergent research area in the field of medical imaging system. Brain tumor detection helps in finding the exact size and location of tumor. An efficient algorithm is proposed in this paper for tumor detection based on segmentation and morphological operators. Firstly quality of scanned image is enhanced and then morphological operators are applied to detect the tumor in the scanned image [3].

Sudipta Roy *et al* proposed an algorithm for detection and quantification of brain tumor images. Magnetic Resonance Imaging plays an important role in Brain Tumor diagnosis in advanced stages. Segmentation process to extract suspicious region from complex medical images is very important. Brain image segmentation is a complex and challenging part in the Medical Image Processing. They worked on an algorithm that detect brain tumor using symmetry analysis method. Image segmentation is done using Watershed segmentation technique. Morphological operations are used to remove small object from segmented image to detect tumor [4].

Prachi *et al* extracted a affected region   from brain tumor MRI with the help of thesholding method of segmentation. Thresholding is one of the easiest and convenient ways of segmentation. It is based on different intensity values and colors [5].

C.Prema *et al*   proposed computer based diagnosis algorithm for detection of brain tumor from MRI images .This paper basically divided into two phases such as brain segmentation and tumor extraction. The brain segmentation has done using dual tree wavelet based watershed segmentation algorithm and the tumor region extraction done by using morphological operators [6].

Neha Tirpude , R. R. Welekar   presented a paper on Brain MRI images segmentation . In this paper author has segmented MRI images of brain, for detection of tumor with the help of image processing. In this paper author has also

mentioned the different techniques like thresholding, Region-growing, Clustering etc. for image segmentation of brain MRI images [7].

3.   PROPOSED METHODOLOGI

The proposed algorithm is designed to separate out the tumor region from brain tumor MRI images and to measure the tumor area. The brain tumor MRI image is as shown in figure1.
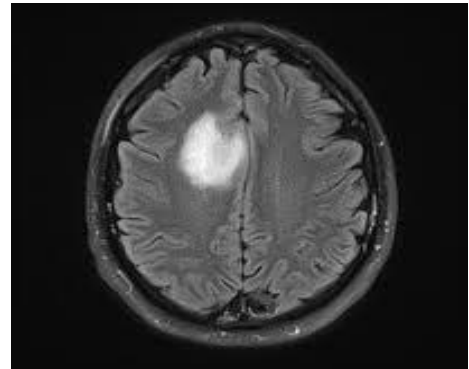

Figure 1 Brain Tumor MRI image

Figure 2 shows major stages that are followed during the segmentation and measurement of tumor from brain tumor MRI images. The major stages are

  i.   Preprocessing
  ii.   Segmentation
  iii.   Tumor area measurement

i. Preprocessing

The MRI image of brain tumor is an input for this proposed algorithm. The MRI image is a blur image. The noise is present in this image. Noise disturbances may cause because of electronic imaging sensors, sensor temperature, insufficient Light levels, film granularity, and channel noise. So preprocessing is essential for such images to remove blurriness from it and make it sharper. So at this stage initially the input image is filtered. There are linear and nonlinear types of filters. Linear filters like low pass filter, geometric mean filter and high pass filter replaces each pixel in the input image by a linear combination of neighboring pixels intensities. Linear filtering can
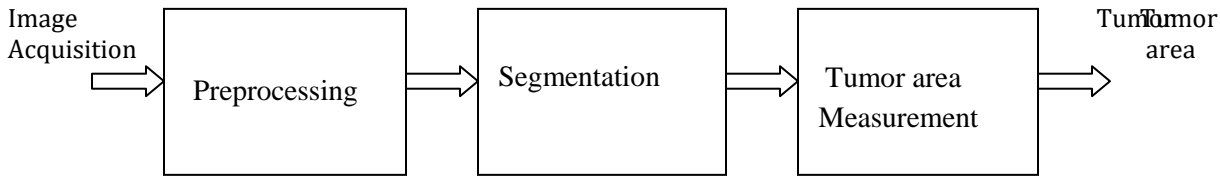
Figure 2 Block diagram of tumor segmentation

smooth as well as sharp an image. The nonlinear filters are median filter, max filter and min filter. Median filter smoothes the image just by replacing center pixel intensity by the median of the neighborhood. In this proposed algorithm median filter is used. Median filter removes the random noise from an image, also enhance the image and make it sharper. This give more contrast image. The median filter does not require convolution. the centre pixel replaced by the median of the pixel values under the filter region [8].

ii.   Segmentation

Segmentation technique is to separate out tumor region from MRI image. Using segmentation it is possible to identify objects, boundaries, location in an image. There are many applications of segmentation in medical field like identify the diseases in MRI or CT scan images, to locate tumor. There are number of segmentation techniques used by various author to segment the given image to extract the required object from an image. The segmentation can be done by edge detection method, by Region growing or by threshoding segmentation technique. The different segmentation techniques are like K-mean, region growing, region mearging, histogram technique etc. Otsu's thresholding method is one of the method where the pixels that either fall in foreground or background is decided by iterating through all the possible threshold values. Otsu's method measure of region homogeneity in terms of variance. It selects the threshold value by minimizing the within-class variance of the two groups of pixels separated by the thresholding value[6]. Ostu's method is minimum error method [9]. K-mean clustering is suitable for biomedical image segmentation as the number of clusters is known for images. The clustering is done by minimizing the Euclidean distance between centroid of cluster and data. In K-means clustering as the number of clusters are known.

Region based segmentation is a technique based on the similarities in the given image. This technique create regions by grouping pixels those are having common features. Region based segmentation works best when the region homogeneity criteria are easy to define [10].Here in this algorithm two segmentation methods are proposed, that are threshoding and watershed segmentation. Global thresholding is proposed in this algorithm, which gives a single threshod value to extract only tumor region from brain tumor MRI image. Thresholding converts grayscale image into binary image according the threshold point. As per the selection of thresholding value, two types of thresholding methods are in existence [11]. Watershed segmentation has done on the intensity bases. As every pixel has different intensities compared to each other [12**].** Watershed segmentation is one of the best methods that group up pixels on the basis of intensity from an image. Pixels having similar intensities are grouped together. It is a good segmentation technique for dividing an image to separate a tumor from brain MRI image. It separate out the region suffering from tumor from rest of brain [13]. Watershed is a mathematical morphological operating tool [14]. Here the pixels are grouped based on their intensities. This becomes a better way to separate the tumor from image.
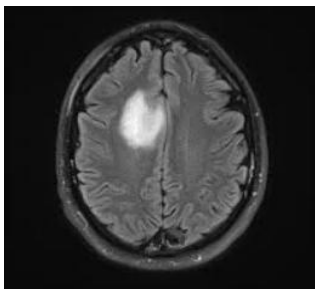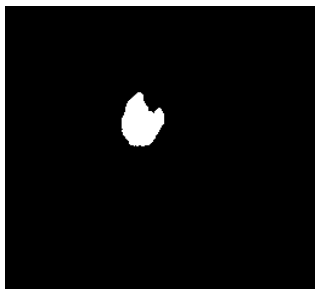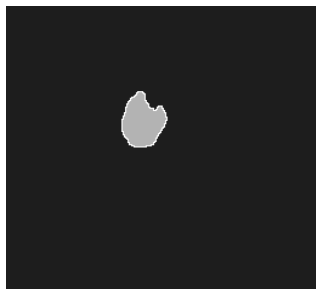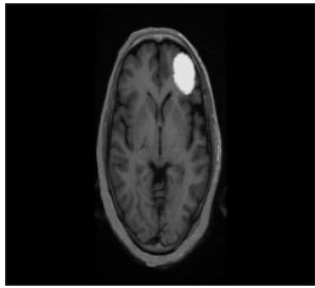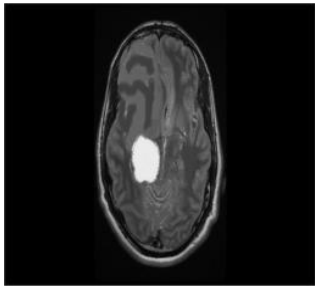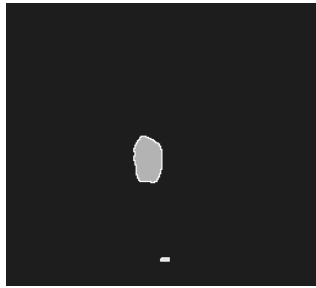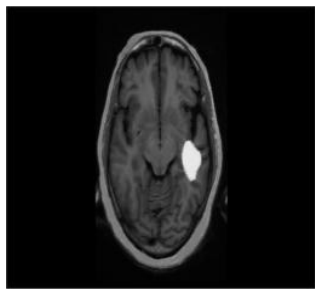
iii.   Tumor area measurement

Segmentation highlights only the tumor region from MRI image. Because of segmentation the tumor region looks like a white patch on MRI image . This region is highlighted by segmentation technique. To measure area of a tumor only this highlighted region is taken into consideration . The area of tumor is measured in terms of number of white pixels in that segmented image. The area is measured in terms of number of pixels.

4. RESULT

The result of segmented brain tumor images using thresholding and watershed segmentation techniques and its area is as shown in table 1.

Table 1 segmented brain tumor images

Original image	Thresholding	Watershed	Area
			1077 pixels
			479 pixels
			741 pixels
			373 pixels

5. CONCLUSION

The global thresholding and watershed segmentation are useful techniques in medical field for the segmentation of MRI or CT scan images. These segmentation techniques are applied to 75 MRI images. The segmentation results of some images are shown above. The global thresholding method separate out infected region with the help of single threshold point and converts gray scale image into binary image. Similarly watershed segmentation technique also separate out tumor region successfully from brain tumor MRI region. From these segmented images it is possible to get the detail information about the tumor location ,its shape and area of the extracted tumor region is measured in terms of number of white pixels in the segmented image.

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