Texture Number Based Brain Tumor Segmentation

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***Abstract*— This paper explores a simplest method for brain tumor segmentation. This method uses both intensity property and texture property of an Image. First, seed point is selected automatically based on intensity and texture number where texture number of a pixel depends on its eight neighbouring pixel values. Then the seed point is given to region growing algorithm. This is simulated in MATLAB. Here we use Magnetic resonance imaging (MRI) because it provides detailed information about brain tumor anatomy. The proposed algorithm is efficient in both selection of seed points and segmentation.**

Keywords—tumor; texture number; region growing; seed point;

I. INTRODUCTION

A brain tumor is an abnormal growth of tissues in brain. It affects proper functioning of brain. Brain tumors can grow to normal brain tissue if left untreated. Doctors refer a tumor based on where the tumor cells began and whether they are cancerous or not. Diagnosis of brain tumor helps to understand the type and grade, if it is cancerous or not, where the tumor is located and whether it is primary or secondary.

Main aim of image segmentation is to divide image in to homogeneous sub regions. Segmentation gives preeminent information than the original image. So segmentation plays a vital role in brain tumor detection. Segmentation of brain tumor is difficult task because of complex anatomy of image. Since tumors have irregular shape and inhomogeneous structure intensity based segmentation is inappropriate. Hence texture based segmentation is also needed.

The benefit of texture based approach over intensity or region based approach is the classification of intensity pattern and discrimination of different intensity pattern for different tumor types. This helps in increasing sensitivity and specificity of tumor detection.

In medical history biopsy and imaging studies are all important to reach a diagnosis of brain tumor. MRI is using for this segmentation method because it provides more detailed information about type, position and size. The research showed that MRI for intracranial tumor is better than CT [1][2].

One of the frequently used segmentation method is region growing. A correct seed selection is the basic requirement of region growing based segmentation. In this method selection seed point is based on intensity and texture number[3],[4][5].

Jun Xie, Yieng Jiang and Hung-tat Tsui [6] studies the segmentation of kidney from ultrasound images based on a novel texture and shape priors based method. Segmentation is implemented by calculating the parameters of the shape model to minimize a novel energy function. The goal of this energy function is to partition the test image into two regions, the inside one with high texture similarity and low texture variance, and the outside one with high texture variance.

Combination of two standard algorithm, mean shift and normalized cut is performed to detect the brain tumor surface area in [7] and the brain tumor is detected through component analysis. In [8] presents a novel technique for the detection of tumor in brain using segmentation and histogram thresholding. The concept behind this work is based mainly on three points: (i) the symmetrical structure of the brain, (ii) pixel intensity of image and (ii) binary image conversion.

R. Manikandan, G.S. Monolisa and K. Saranya [9] proposed a cluster based segmentation of MR Images for brain tumor detection. In this paper the MR Images are segmented through k-means clustering. The execution time of k-means is very less when compared to other algorithms. It provides robust and straight results.

In this project work our assumption is that the brain tumors have grown in considerable size and their structure may be of any type.

This paper is organized as follows: in section 2 we introduce proposed methodology. The experimental results are presented in section 3. The conclusion and future works are presented in section 4.

II. PROPOSED METHODOLOGY

Methodology of proposed algorithm consist of preprocessing stage, texture filtering which finds texture number of each pixel, seed point selection based on certain constrains and at the final stage region growing segmentation. The process flow of proposed method is shown in fig.1.

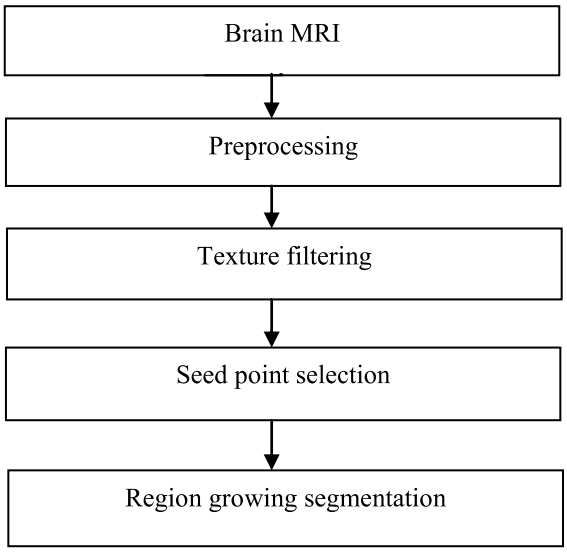

Fig. 1. Block diagram of proposed method.

A. Preprocessing

Preprocessing stage enhance the image and removes skull from MRI. Skull is eliminated using 'area' and 'solidity' property of an image.Fig.2 shows the image before and after preprocessing.

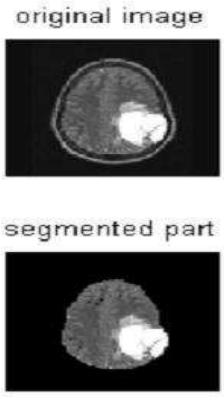

Fig. 2. Image after preprocessing.

B. Texture filtering.

Texture filtering is an operation that converts a pixel into its texture number. In this method the size of neighborhood is 3*3.If the intensity value of central pixel is and the eight neighboring pixels are, for i=1, 2, 3…8, as mentioned in [10]. Fig.3. shows a 3*3 texture unit.

$$\begin{matrix} V_1 & V_2 & V_3 \\ V_4 & V_0 & V_5 \\ V_6 & V_7 & V_8 \end{matrix}$$

Figure 3.Texture unit

In texture unit intensity of central pixel is compared with its eight neighboring pixels and the corresponding texture unit is defined by

$TU = \{E_1, E_2, .. E_8\}$ where,

$$E_i = \begin{cases} 0 & if\ V_i \\ 1\ if\ (V_0 - \Delta) < V_i \\ 2 & if\ V_i \end{cases} \qquad (1)$$

for i=1, 2,….8 and texture number T is defined as ,

$$T = \sum_{i=1}^{8} E_i \qquad (2)$$

C. Seed point selection and segmentation.

Seed point is selected by combining simple thresholding and texture number thresholding i.e. a point is considered as seed point if and only if its intensity value is above intensity threshold and its texture number lies in a certain interval.

Selected seed points are given to a region growing algorithm. The region is iteratively grown by comparing all unallocated neighbouring pixels to the region. The difference between a pixel's intensity value and the region's mean is used as a measure of similarity. The pixel with the smallest difference measured this way is allocated to the respective region. This process stops when the intensity difference between region mean and new pixel become larger than a certain threshold (t).

D. Proposed algorithm.

Input: Brain MRI.
Output: Tumor.

Step 1. Start.
Step 2. Find texture number of each pixels using (1) and (2).
Step 3. Find intensity threshold value I_t and texture threshold T_t
Step 4. Find seed points which is greater than and whose texture number lies in the interval $(0, T_t)$.
Step 5. For image I do,

a) Calculate mean of the region, m.
b) For pixels having intensity check for the intensity constraint $\|m - I_i\| \leq t$.
c) If the constraint is met region is grown to neighboring pixels. The region is not grown to neighboring pixel in the other case.

Step 6. Stop.

III. EXPERIMENTAL RESULTS

The proposed method is implemented in Matlab environment on dual core, processor speed 2GHz.The proposed system is tested on data available in the web[11]. Fig 4,5 shows the results of segmentation.

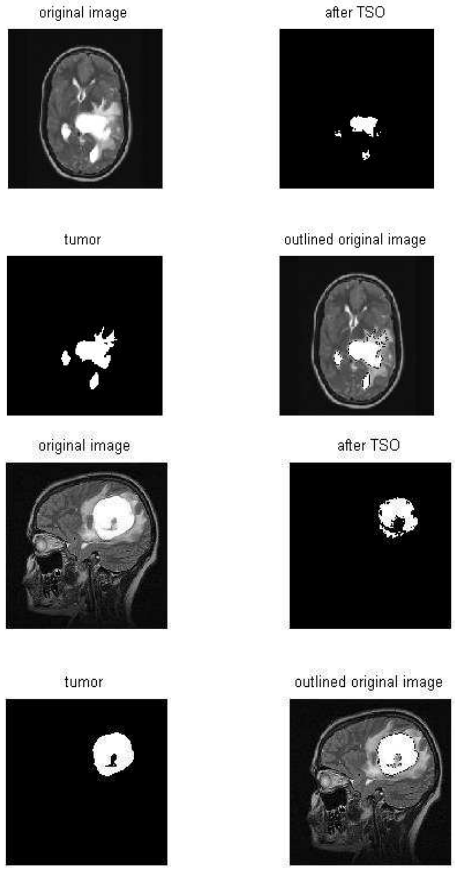

Fig.4. Segmentation result

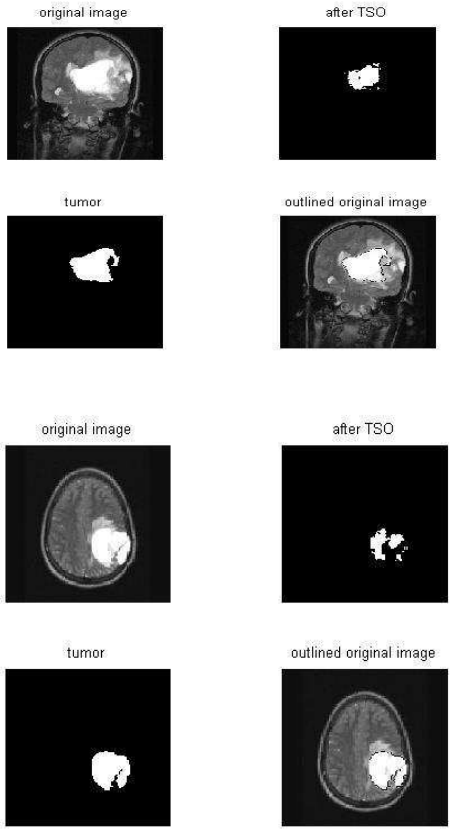

Fig. 5 Segmentation result

IV. CONCLUSION

Proposed system is developed for the detection and segmentation of brain tumor. Segmentation uses texture and intensity thresholding for the selection of seed point then seed points are given to a region growing algorithm. Experiments show that the proposed system gives good result and simpler compared to recent segmentation methods and is efficient in both selection of seed points and segmentation.

Future work of this research is to modify this to a fully automatic segmentation and classification algorithm.

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