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SEGMENTATION OF TUMOURS IN MEDICAL IMAGES

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Abstract: Computerized image segmentation has played an increasingly important role in medical imaging. Image segmentation remains a difficult task, due to high diversity in appearance of tumor region and the variation in image quality. An efficient algorithm is used in this paper for tumor detection based on segmentation. The method uses level set based deformable models for segmenting the tumor image. Brain tumor detection helps in finding the exact size and location of tumor. This model can automatically handle changes in an image, allow for multiple simultaneous boundary estimations and identify the tumorous tissues.

Keywords: Segmentation; Level set; Speed function.

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INTRODUCTION

Medical images, such as Computed Tomography (CT), Magnetic Resonance Imaging (MRI), X-Ray and Ultrasound are often stored in Picture Archiving and Communication Systems (PACS). We have to process the medical image to extract meaningful information such as shape (boundary feature). Medical experts examine the patient by using CT scan and MRI. They spend a great amount of time in segmenting tumor in medical images. A challenging problem is to segment regions which have boundary insufficiencies due to missing edges, lack of texture contrast between regions of interest (ROIs) and background. Segmentation is the process of separating a digital image into different regions, find boundary between different regions and extracts the features of region of interest. So that image can be more understandable and helpful to analyzing. There are various methods which are used for segmentation.

Precise boundary location of brain Tumor in MRI is a challenging problem that depends on many factors. Indeed, there is a large class of tumor types which vary greatly in size and position, have a variety of shape and appearance properties, have intensities overlapping with normal brain tissue, may defect the surrounding structures giving an abnormal structure also for healthy tissue. Conventionally, it is difficult to segment a tumor by a simple technique like thresholding or classic edge- detection. This type of methods may not allow separation between non-enhancing tumor and normal tissue due to overlapping intensity distributions of healthy tissue with tumor and surrounding edema. Also, they are unable to exploit all information provided by MRI. Therefore, to solve the problem, advanced image analysis techniques are needed.

Deformable models are other popular methods that are widely used for a wide range of applications and have proved to be a successful segmentation technique. They have used for medical image processing and especially for brain segmentation, in the form of a level set function.

Level Set Method

Snake is parameterized curve or surface which iteratively evolves toward the desired locations according to the energy minimization criterion. The disadvantages of such kind of contour models are- They are sensitive to initial conditions and should be placed usually near to the boundary of objects of interest. The Level Set method was developed to study curve propagation and overcomes the drawback of snake function. This algorithm has been widely used image processing field for mage segmentation especially [9]. The speed of evolving curve is inversely proportional to the intensity gradient. The evolution finally stops to the instance where the intensity difference is highest in a local neighbourhood. Hence, the propagation of the curve in a level set help in finding an object boundary. Shape recovery problem solved by level set method [2].

Speed Function

The main parameter in the level set equation is the speed function, whose design is the most important step in the level set approach. The edge sensitive speed function-

$$F = k_I(F_A + F_G) \quad (1)$$

Where, F_A is independent of the geometry of the front, which controls the direction of movement of the moving front. $F_G$is depends on the geometry of the front, such as its local curvature.

The evolution of contour is coupled with the image data throughk_I, given as:

$$k_I = \frac{1}{1+[\nabla\{G_\sigma(x,y)*I\ (x,y)\}]^m} \quad (2)$$

Where, $\nabla\{G_\sigma(x,y) * I(x,y)\}$ is the gradient of the input image I(x, y) and m is a positive integer. For homogeneous regions, the term $\nabla\{G_\sigma(x,y) * I(x,y)\}$ will nearly equal to zero, so the effect of k_I on $F_A + F_G$ becomes negligible. If the boundary is clearly defined, at the boundaries the term $[\nabla\{G_\sigma(x,y) * I(x,y)\}]$ tends to infinity (*i.e.*, F → 0), which stops the evolving front at the desired region.

Image gradient is an indicator of object boundaries, if the object boundary is indistinct or has gaps, the traditional deformable contour may leak out because the multiplicative term k_I only slows down the curve near the boundary instead of completely stopping the curve.

I. Improved Speed Function

There are two approaches for boundary localization- Edge based and region based. Ideal solution would be performing segmentation with combining both. The improved speed function is combination of region as well as boundary information.

A. *The New Speed Function*

A good speed function has to put the zero level set 0 faster at the homogeneous regions, has to maintain the smoothness of the zero level set, and has to stop the moving front at the boundaries that is heterogeneous region. So the new speed function which satisfies all these requirements is defined as-

$$F = F_S . g(I)(1 - \varepsilon k) \quad (3)$$

Where, ε is a constant, and the k is the local curvature of the moving front. The term F_S is same as term F_A used in the equation (1), but here, it controls the evolving speed based on the regional information. We use the same k_I from the equation (1) for $g(I)$ and m is chosen as 1. [10]

Experimental Results

In this section the results of the experiments conducted on the data set (image) are presented and discussed. Code is written and using MATLAB the desired results are obtained. One of the images from the collected images, applied as the input to the algorithm and segmented tumour output are shown below-

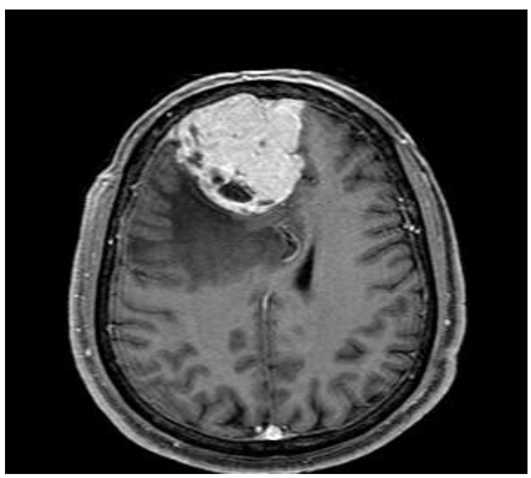

Figure 1. Input image

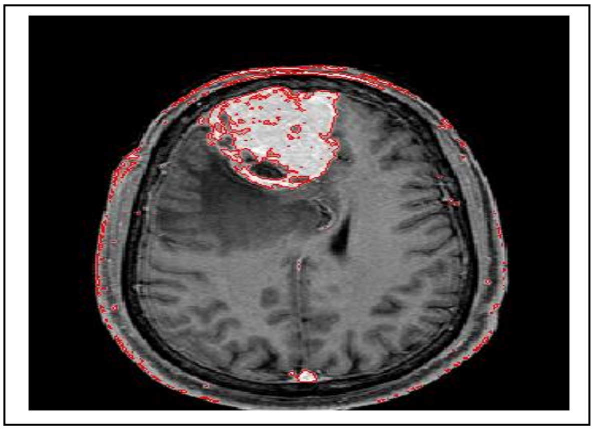

Fig. 2. At starting Iteration

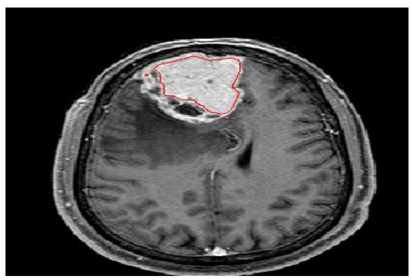

Fig. 3. At Last Iteration

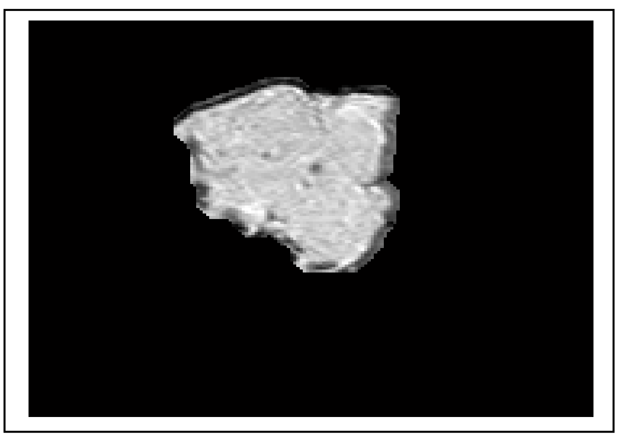

Figure 4. Segmented Image

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