



Brain Image Segmentation Using Chan-Vese algorithm using Active Contours and Level Set Functions

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Abstract: Region-based level set segmentation is a paradigm for the automatic segmentation of brain tumor image. Unfortunately, region-based segmentation, which is relied on the intensity difference of different regions, has been of limited used in presence of complex background. Algorithm based on calculating the variational energy of the Chan-Vese model without the length. The multiphase level set formulation is of interest on its own, by construction, it automatically avoids the problems of vacuum and overlap, it needs only $\log n$ level set functions form phases in the piecewise constant case. In this work, we specially solve the Chan-Vese active contour model by multiphase level set methods.

Keywords: Image Segmentation, Level Set Methods, Chan-Vese model, Energy minimization, multi-phase motion, image segmentation, active contours

1. Introduction

Image segmentation is arguably the most ubiquitous and is difficult in technical problem such as medical image processing. The problem of partitioning an image into meaningful pieces interest has proven to be as difficult as a host of other computational problems that attempt to mimic the capabilities of human intelligence or perception. The main difficulty which arrives in image segmentation is not from a lack of attention; thousands of papers and theses on image segmentation describe a wide variety of approaches ranging from statistics, differential geometry, and partial differential equations to discrete geometry, game theory, and computational mechanics. As a result, engineers designing clinical systems that require an image segmentation capability are left with wide range of possible approaches virtually all of which claim to be effective to some degree. To help with this, several researchers have proposed mechanisms for evaluating or validating the effectiveness of various segmentation algorithms [2]. However, quantifying the validity of segmentation has proven to be almost as difficult as the segmentation itself. The challenge stems from the fact that quantifying differences in shapes is also an important, open problem in computer vision and image processing. In the midst of these difficult challenges and proposed solutions one might ask, "How well are we doing?" This paper is a case study that looks at the effectiveness of a relatively simple, well-known segmentation paradigm, hierarchical watersheds with user interaction. In our experience, this method is moderately effective on a wide range of segmentation problems. We systematically study its effectiveness on two different types of data using several commonly cited validation metrics. This study is designed to address the question of whether or not one should use user-assisted watershed segmentation in lieu of hand contouring. The results, however, also provide some insight into the watershed algorithm itself as well as the methodology of validating segmentation algorithms against an expert defined ground truth. Image segmentation is useful in many applications [7]. It can identify the regions of interest in a scene or annotate the data. We categorize the existing segmentation algorithm into region-based segmentation, data clustering, and edge-base segmentation. Region-based segmentation includes the seeded and unseeded region growing algorithms, the JSEG, and the fast scanning algorithm. All of them expand each region pixel by pixel based on their pixel value or quantized value so that each cluster has high positional relation. For data clustering, the concept of them is based on the whole image and considers the distance between each data. The characteristic of data clustering is that each pixel of a cluster does not certainly connective. The basis method of data clustering can be divided into hierarchical and partitioned clustering [4]. Furthermore, we show the extension of data clustering called mean density estimation. The last classification of segmentation is edge-based segmentation. This type of the segmentations generally applies edge detection or the concept of edge. The typical one is the watershed algorithm, but it always has the over-segmentation problem, so that the use of markers was proposed to improve the watershed algorithm by smoothing and selecting markers. Finally, we show some applications applying segmentation technique in the preprocessing. Medical image segmentation is an essential step for most subsequent image analysis tasks. The segmentation of an atomic structure in the brain plays crucial role in Nero imaging analysis. Successful numerical algorithms can help researchers, physicians and neurosurgeons to investigate and diagnose the structure and function of the brain in both health and disease [10]. This has motivated the need for segmentation techniques that are robust in application involving abroad

range of anatomic structure, disease and image type .The process of partitioning a digital image into multiple regions or sets of pixels is called image segmentation. Actually, partitions are different objects in image which have the same texture or color. The result of image segmentation is a set of regions that collectively cover the entire image, or a set of contours extracted from the image. All of the pixels in a region are similar with respect to some characteristic or computed property, such as color, intensity, or texture. Adjacent regions are significantly different with respect to the same characteristics.

II. RELATED WORK

Sudipta Roy, Samir K. Bandyopadhyay, et al. (2012), says that segmentation of tumor from magnetic resonance imaging (MRI) data is an important but performing it manually by medical experts is time consuming task. It's a challenging task to automate it because there is high diversity in the appearance of tumor tissues among different patients and in many cases similarity with the normal tissues. There exist different methods to detect brain tumor and to segment a brain tumor from MRI images. They provide a brief review of different segmentation methods for detection of brain tumor from MRI of brain.

M. Usha, A. Sanyam, et al. (2013), performed denoising and segmentation of medical image is using morphological filters and watershed algorithm. A complete division of image is provided by Watershed Algorithm. This algorithm has low computational complexity but it suffers from over-segmentation. This technology has enhanced but still, noise may come into image during the acquisition of image. To denoise image authors used various morphological filters with the improved watershed segmentation. They applied proposed algorithm on different medical images like Ultrasound, X-Ray and MRI and evaluate the on the basis of MSE, MAE, PSNR and number of segments.

K. Gurpreet, K. Sumit, et al. (2013), examined the effect of image gradients as initial step for "watershed segmentation". They studied effects of gradients in the presence of different operators and then these operators are used by watershed transformation to segment the image. Convolution is performed using different mask operations. Reason behind doing this is to identify the operator which provides better results as initial step for watershed approach. The effect is studied in terms of time and peak signal to noise ratio.

Y. Hongzhe, Z. Lihui and T. Songyuan, (2014), proposed a hybrid technique for brain tumor segmentation, which is based on the approach of global intensity difference, curve evolution, local edge properties and level set method. By combining the edge information into the region-based framework, the images with intensity in homogeneity and complex background can be efficiently segmented. In addition, a penalizing energy is used for avoiding the time-consuming re-initialization step of the level set method.

Then they took some synthetic and real images to perform experiments and demonstrate that proposed method take few iterations to segment tumor.

III. METHODOLOGY

A. Flow chart for Chan-Vese Algorithm

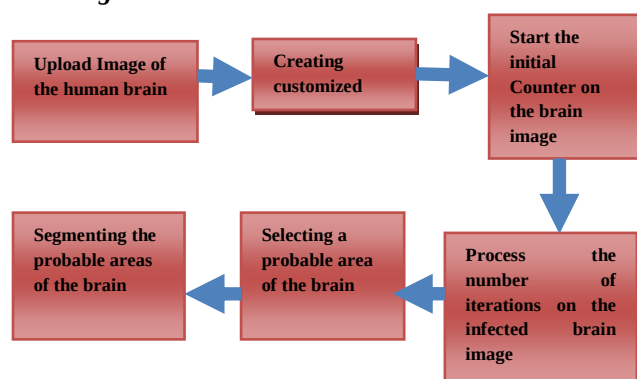


Figure 1: Flow chart for Chan-Vese Algorithm

B. Steps for Algorithm:

Step 1: Upload the image and dicom images.

Step 2: Create the active counter for segmentation with the help of mask.

Step 3: Start the initial counter manual and automatically on the image and dicom.

Step 4: Process the number of iterations in square and elliptic form.

Step5: Chan-Vese approach is used for segmentation is discussed above.

Step6. Finally we get the image part which is affected from a selected portion if extra part is encounter as affected that is also selected by region based approach i.e Chan- Vese.

IV. RESULT & DISCUSSION

In proposed work, an approach is used which is derived from initializing small curves inside the region part which we are selecting; it grows until it encounters the affected part.

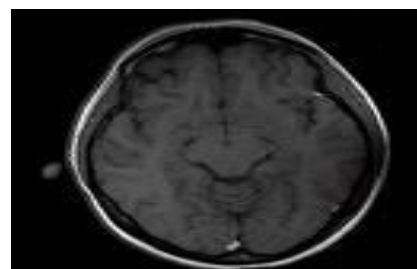
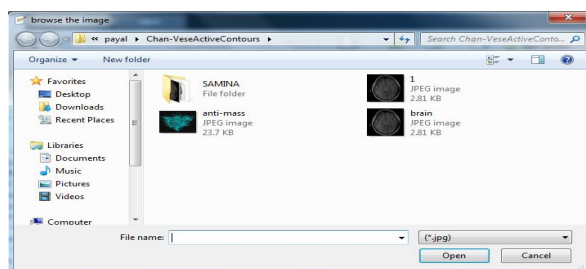


Figure 2(b): Original image

Figure 2(a): Original image Browsing window

Above said image represents the original image, from which we select the some region or boundary of a region. After this Chan-Vese approach is used with initialize point with iteration for mask to be performed.



Figure 3: Selected Region with 60 iterations

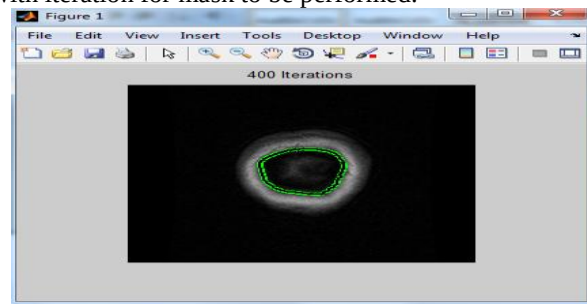


Figure 4: Selected Region with 400 iterations



Figure 3(b) Selected Region with 300 iterations

In Above figure 2, 3 and 4 iteration process works to have complete boundary region which is affected.

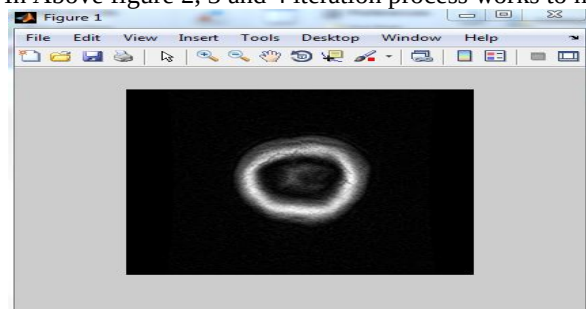


Figure 5: Affected Region part as output

Above window, we used to select the input image for boundary selection with circle or elliptical region finding as an affected part.

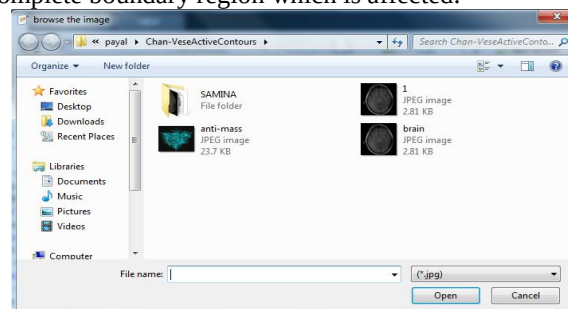


Figure 6: Browsing window input image

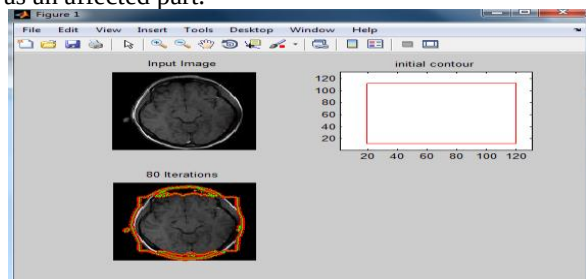


Figure 7: Elliptical region based counter iteration

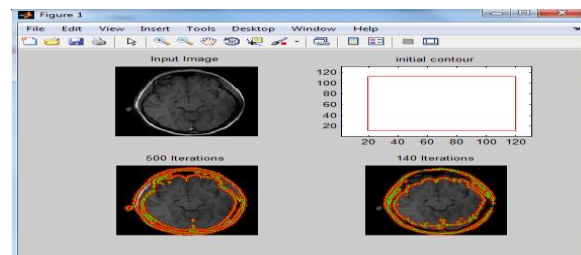


Figure 8: Elliptical region selected part with affected part as output

Above said image shows us the results with elliptical iteration using Chan-Vese approach.

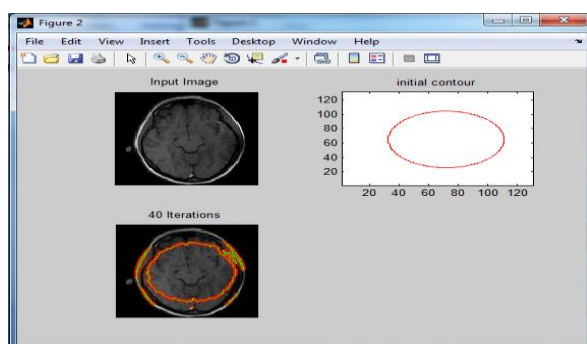


Figure 9: Circle region based counter iteration

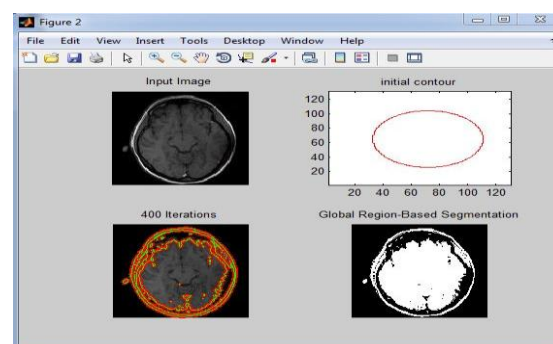


Figure 10: Circle region selected part with affected part as output

Above said image shows us the results with elliptical iteration using Chan-Vese approach.

The result in above all said figures is example to test our work, where we segment and superimpose accurate edges for other different images with good results of image segmentation and edge detection. Also it is easy to calculate region area and boundary length. Our results show the accuracy for edge position and region segmentation compared with other segmentation techniques.

V. CONCLUSION & FUTURE SCOPE

An active contours based on curves, Chan-Vese approach is good and best in edge and segmentation for detecting object and region boundaries, it isolate and extract individual parts from an image with accuracy. In this paper we have can detected objects whose boundaries are not necessarily defined by gradient or for which the classical active contour models are not applicable. Finally, we can automatically detect interior contours starting with only one initial curve. Initial curve can lie anywhere in the image, and it does not necessarily surround the objects to be detected. We validated our model by various numerical results. The energy functional for the proposed model consists of global term of the region intensity difference, local term of the geodesic length and regularization term.

Further improvements of the method could be incorporating more information into the scalar image, such as space correlation of adjacent slices, symmetry of the brain, and the multi- spectral data. From segmentation to image in painting and denoising problems and beyond, such methods will no doubt play an important role in future image analysis research.

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