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Fast Image Segmentation Using Fixation Method

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Abstract: - Computer vision applications have come to rely increasingly on image segmentation in recent years, but it is not always clear what constitutes a good segmentation algorithm. Attention is an internal important subpart of the human visual system and has been largely studied in the visual attention techniques or literature. The human eyes fixes at important locations in the scene as early as possible, and every fixation point belongs to a particular region or part of arbitrary shape and size, which can either be an whole object or a part of the object. By using that fixation point or region or part as an identification marker on the object, we propose a operation to segmenting the object from image of interest by finding the “best or most favorable” closed contour around the fixation point or part in the polar space, avoiding the long time or continuously recurring problem of scale in the Cartesian space. The put forth segmentation process is carried out in two separate steps: First, all visual cues or regions are combined to generate the probabilistic boundary edge map of the scene; second, in this edge map, the “optimal” closed contour around a given fixation point is detected. Having two separate steps also makes it possible to establish a simple feedback between the mid-level regions and the low-level visual edges. In fact, we propose a segmentation sophistication process based on such a feedback. Finally, our experiments show the promise of the proposed method as an automatic segmentation framework for a general purpose visual system.

Keywords: - Visual Attention, Object Segmentation, Texture Effect, Cartesian to Polar space, Region Integration

I. INTRODUCTION

The human visual system perceives and makes sense of a dynamic scene or we can say a static scene by making a various different series of fixation at various different salient locations in the scene or picture. The eye movement between consecutive fixations in a particular manner is called a rapid movement of eye known as saccade. Even during a fixation, the human eye is regularly moving particular pattern. Such movement is called fixational movement or eye movement. The main difference between the fixational eye movements during a fixation and saccades between fixations is that the former is an involuntary movement whereas the latter is a voluntary movement. But the most important and main question is: Why does the human visual system make these eye movements? One obvious role of human eye or any other animals eye is the eye movements is capturing high resolution or can say high definition visual information from the noticeable or important locations in the scene or picture as the structure of the human retina has a high concentration of cones with fine resolution in the central fovea. For instance, during a change blindness experiment, the subjects or human were found to be unable to notice a change when their eyes were fixated at a particular location away from where the change had occurred in the scene or picture unless the change altered the gist or the meaning of the scene. However, psychophysics recommend a more vital and crucial role of fixations in visual perception so far. In contrast, the difference is detected and predicted quickly when the subjects and objects fixated on varying conditions or often close to it.

This clearly suggests a more basic objective of fixation in how we receive a image or picture. The role of fixational eye movements like the involuntary eye movement when a fixation is more of obscure. As a matter of fact, long period of time before, these eye movements were taken to be just a neural tick and not beneficial for visual perception. However, neuroscientists have recently gone through the debate related to the behavior of these eye movements and their effects and impacts on visual perception. While we do not claim to know the exact use of these eye movements, we certainly draw our inspiration and vision from the need of the human visual system to fixate at various places in order to perceive that part of scene. We think that fixation should be an vital and major component of any developed visual system. We conclude that, during a fixation, a visual system at least segments the territory it is at present fixating at in the scene or image. We also argue that culminating and introducing fixation into segmentation makes it well defined and exact. This method provide us a best mechanism for the segmenting the image or object.

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II. SUPERPIXEL GENERATION

Super-pixel algorithms group pixels into perceptually meaningful atomic regions, which can be used to replace the rigid structure of the pixel grid. They capture image redundancy, provide a convenient primitive from which to compute image features, and greatly reduce the complexity of subsequent image processing tasks. They have become key building blocks of many computer vision algorithms. Super-pixels are commonly used as a pre-processing step in segmentation algorithms. A good super-pixel algorithm should improve the performance of the segmentation algorithm that uses it.

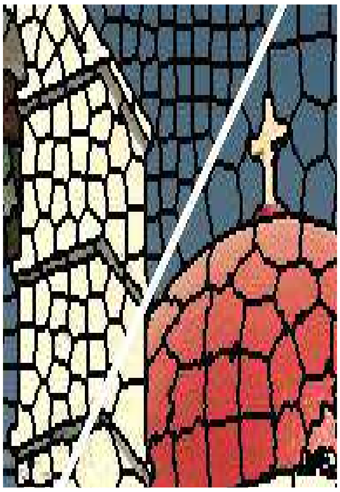

Fig.1. Image segmented using algorithm into super-pixels of (approximate) size 64, 256, and 1024 pixels. The super-pixels are compact, uniform in size, and adhere well to region boundaries.

The Simple Linear Iterative Clustering (SLIC) algorithm generates super-pixels by clustering pixels based on their color similarity and proximity in the image plane. Our algorithm takes as input a desired number of approximately equally-sized super-pixels K. For an image with N pixels, the approximate size of each super-pixel is therefore N/K pixels.

Operating on super-pixels instead of pixels can speed up existing pixel-based algorithms, and even improve results in some cases. For instance, certain graph-based algorithms can see a speed increase using super-pixels. Of course, the super-pixel generation itself is fast for this to be practical. Using this super-pixel generation algorithm we can segment image in to its constituent parts and detect the object from an images by fixating the regions in the segmented image. Using the super-pixel image the segmentation speed is greatly increases and we are able to get the output very fast.

III. SEGMENTING THE FIXATED REGIONS

Segmenting a fixated region is equal to or we can say equivalent to finding the „best or most favorable‟ closed contour around the fixation point. This closed contour should communicate with a set of boundary cues or edge pixels in the edge map. However the edge map contains two different types of edges, these are nothing but boundary and internal edges. In order to trace the boundary edge parts or fragments through the edge map to form the contour enclosing the fixation point, it is very important to be able to differentiate between the boundary edges from the non-boundary edges.
There are two specific categories of visual cues on the basis of how they are calculated:
1) static monocular regions, that come from just a single image;
2) stereo and motion regions that need more than one image to be computed.
The main goal of image is to partition an image into certain number of parts or segments which has features like color texture etc. and they are group the meaningful segments to combine and form a region. The first region

combined gives the more information and is used for getting more regions and it continues until it get a fix region.

IV. RELATIONSHIP BETWEEN FIXATING AND SEGMENTING AN IMAGE

When the fixation point is inside a homogeneous region with no firm internal textures, the exact and precise place of the fixation with respect to the region boundary does not affect the segmentation result. It is the same closed contour for any fixation point inside the region. However, there are scenarios when change in fixation inside the region changes the segmentation output. It happens generally when only static monocular regional color and texture are used to generate the probabilistic boundary edge map as it leaves behind strong internal edges in the edge map. There are basically three such scenarios:

1) When smaller regions are fully contained in the original region;
2) In the presence of dominant internal textures and complex lighting effects;
3) When the fixated region (or object) are extremely concave and has long and thin structures extremely concave and has long and thin structures.

V. FUTURE WORK

A very essential benefit of segregating cue processing from segmentation step is that these two steps form a feedback loop between them. The forward essential process of generation of a closed contour given a point inside the probabilistic boundary edge map is a bottom-up step, whereas using the resulting region to either modify the probabilistic edge map, say, using shape information, or to consider the further fixation point using that information reserved and stored in the region is a top-down process. The multiple fixation based refinement of initial stage segmentation described is an example of an interaction between the bottom-up and the top-down process.

The top-down process can be more elaborate and exact. In addition to using the part of an object segmented using the first fixation point to predict and visualize the fixation point inside the other part of that object, the shape of that part can modify the probabilistic boundary map such that the edge pixels along the expected contour is strengthened at a certain point. A similar strategy to combine the top-down with bottom-up process has been employed wherein the authors first concentrate on a component of a face and use the prior knowledge about the shape of that component to segment it in a exact better way.

VI. CONCLUSION

We put forth here a novel formulation of segmentation in conjunction and association with fixation. The framework culminates static cues with motion and/or stereo to differentiate between the internal and the boundary edges. The approach is significant and relevant by biological vision and thinking, and it may have associations to neural models made for the problem of border ownership in segmentation. Although the framework was developed and organized for an active observer, it works with image databases as well, where the idea of fixation yields to selecting an image point which becomes the middle of the polar transformation. Our contribution here was to formulate and assemble an old problem segmentation in a completely different way and show that existing computational mechanisms in the state-of-the-art computer vision are sufficient to command everyone to promising automatic solutions. Our approach can be complemented in a number of ways, for example, by introducing a multitude of regions. An interesting avenue has to do with learning models of the world. For example, if we had a prototype model of a "horse," we could segment the horses more precisely. This interaction amongst low-level bottom-up processing and high-level top-down attention processing and analyzing, is a fruitful research and study direction.

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