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IMAGE SEGMENTATION: REVIEW PAPER

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ABSTRACT

Image segmentation is a mid-level processing technique used to analyze the image and can be defined as a processing technique used to classify or cluster an image into several disjoint parts by grouping the pixels to form a region of homogeneity based on the pixel characteristics like gray level, color, texture, intensity and other features. The main purpose of the segmentation process is to get more information in the region of interest in an image which helps in annotation of the object scene [1]. Image segmentation aims at domain-independent partition of the image into a set of visually distinct and homogeneous regions with respect to certain properties [2].Here in this paper we are discussing various algorithms and methods of image segmentation.

KEYWORDS: Region, segmentation, pixel, image, texture

I. INTRODUCTION

Unsupervised image segmentation algorithms have matured to the point that they provide segmentations which agree to a large extent with human intuition. The time has arrived for these segmentations to play a larger role in object recognition. It is clear that unsupervised segmentation can be used to help cue and refine various recognition algorithms. However, one of the stumbling blocks that remain is that it is Unknown exactly how well these segmentation algorithms perform from an objective standpoint. Most presentations of segmentation algorithms contain superficial evaluations which merely display images of the segmentation results and appeal to the reader's intuition for evaluation. There is a consistent lack of numerical results, thus it is difficult to know which segmentation algorithms present useful results and in which situations they do so. Appealing to human intuition is convenient, however if the algorithm is going to be used in an automated system then objective results on large datasets are to be desired. In this paper we present the results of an objective evaluation of two popular segmentation techniques: mean shift segmentation [3], and the efficient graph-based segmentation algorithm presented in [4]. As well, we look at a hybrid variant that combines these algorithms.

For each of these algorithms [6], we examine three characteristics:

1. **Correctness:** the ability to produce segmentations which agree with human intuition. That is, neither segmentations which correctly identify structures in the image at neither too fine nor too coarse a level of detail.

2. **Stability with respect to parameter choice:** the ability to produce segmentations of consistent correctness for a range of parameter choices.

3. **Stability with respect to image choice:** the ability to produce segmentations of consistent correctness using the same parameter choice on a wide range of different images.

If a segmentation scheme satisfies these three characteristics, then it will give useful and predictable results which can be reliably incorporated into a larger system. The measure we use to evaluate these algorithms is the recently proposed Normalized Probabilistic Rand (NPR) index. We chose to use this measure as it allows a principled comparison between segmentation results on different images, with Differing numbers of regions, and generated by different algorithms with different parameters. Also, the NPR index of one segmentation is meaningful as an absolute score, not just in comparison with that of segmentation. These characteristics are all necessary for the comparison we wish to perform. Our dataset for this evaluation is the Berkeley Segmentation Database , which contains 300 natural images with multiple ground truth hand segmentations of each image.To ensure a valid comparison between algorithms, we compute the same features(pixel location and colour) for every image and every segmentation algorithm. This paper is organized as follows.

1.1 SEGMENTATION BY EDGE DETECTION

The edge-based methods make use of various edge operators to produce an "edginess" value at each pixel. The values are then threshed older to obtain the edges. The regions within connected edges can be considered as different segments because they lack continuity with adjacent regions. The Sobel operator was studied and implemented to find edges in images [8]. The edges thus found could also be used as aids by other image segmentation algorithms for refinement of segmentation results [9]. In simple terms, the operator calculates the gradient of the image intensity at each point, giving the direction of the largest possible increase from light to dark and the rate of change in that direction. The result therefore shows how "abruptly" or "smoothly" the image changes at that point and therefore how likely it is that that part of the image represents an edge, as well as how that edge is likely to be oriented. In practice, the
Magnitude (likelihood of an edge) calculation is more reliable and easier to interpret than the direction calculation. In theory at least, the operator consists of a pair of 3 Å~3 convolution masks as shown in Figure 1. One mask is simply the other rotated by 90degrees. This is very similar to the Roberts Cross operator. These masks are designed to respond maximally to edges running vertically and horizontally relative to the pixel
grid, one mask for each of the two perpendicular orientations. The masks can be applied separately to the input image, to produce separate measurements of the gradient component in each orientation (call these Gx and Gy). These can then be combined together to find the absolute magnitude of the gradient at each point and the orientation of that gradient. The gradient magnitude is given by:

$$|G| = \sqrt{{G_x}^2 + {G_y}^2}$$

Output values from the operator can easily overflow the maximum allowed pixel value for image types that only support smallish integer pixel values (e.g. 8-bit integer images). When this happens the standard practice is to simply set overflowing output pixels to the maximum allowed value. The problem can be avoided by using an image type that supports pixel values with a larger range. Natural edges in images often lead to lines in the output image that are several pixels wide due to the smoothing effect of the Sobel operator. Some thinning may be desirable to counter this. Some results of edges detected by the Sobel operator are shown in Figures 2, 3 and 4.

1.2 SEGMENTATION BY GROUPING

Image segmentation can be related to perceptual grouping and organization in vision and several key factors, such as similarity, proximity, and good continuation, lead to visual grouping [5]. However, many of the computational issues of perceptual grouping have remained unresolved. In this report,

-1	0	+1
-2	0	+2
-1	0	+1

Gx

+1	+2	+1
0	0	0
-1	-2	-1

Gy

Figure 1: Sobel convolution masks graph theoretic approach to this problem isadopted, focusing specifically on the case of image segmentation.

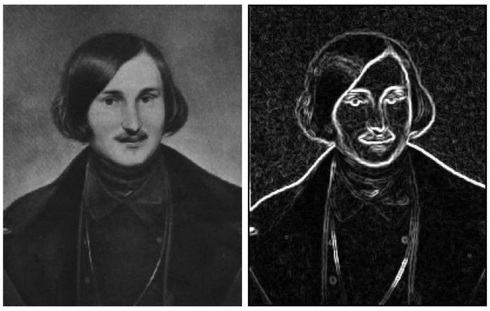
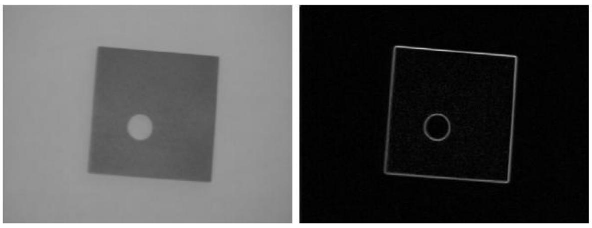


Figure 2 : Edge detection of a man's image

Figure 3: Edge detection of a clown image



F

I. Figure 4: Edge detection of a wedge image

II. IMAGE SEGMENTAT ION ALGORITHMS AND METHODS

I. INTENSITY BASED SEGMENTATION

One of the simplest approaches to segment an image is based on the intensity levels [7] and is called as threshold based approach. Threshold based techniques classifies the image into two classes and works on the postulate that pixels belonging to certain range of intensity values represents one class and the rest of the pixels in the image represents the other class. The algorithm [10] followed for adaptive three sholding can be stated in general as:

1. Divide the image into sub image.
2. Choose a local threshold for sub image considered.
3. Compare the pixels in that sub image and segment the region.
4. Consider all sub images individually and choose corresponding threshold values
5. Stop segmentation when all the sub images are processed.

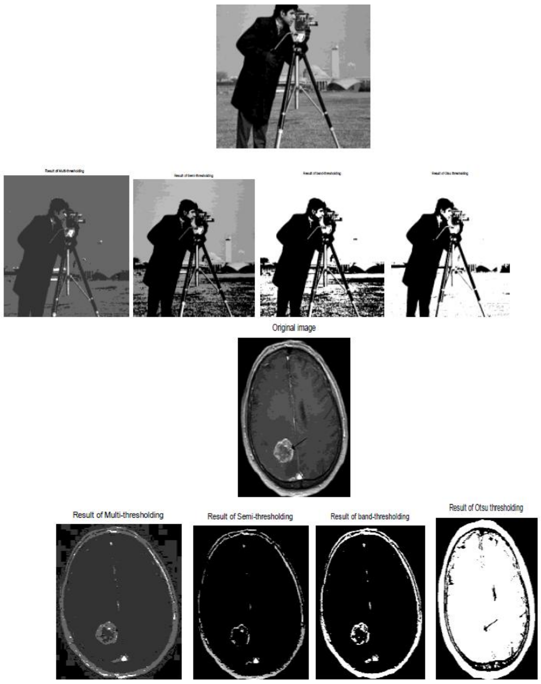


Figure 5: Images classified by using intensity based segmentation

III. DISCONTINUITY BASED METHODS

These methods are based on the principle of intensity variations among the pixels. If the image consists two or more objects boundaries exists and hence can be applied to segment the image. The boundaries of the objects lead to formation of edges. The significant abrupt changes in the intensity levels among neighboring pixels in certainirection are termed as edges and results in the discontinuity in the pixels. Edge detection basically involves the following steps: smoothing the image, edge detection and edge localization. There are four different edge types that may be present in the image (a) step-edge (b) ramp edge (c) ridge edge and (d) ramp edge

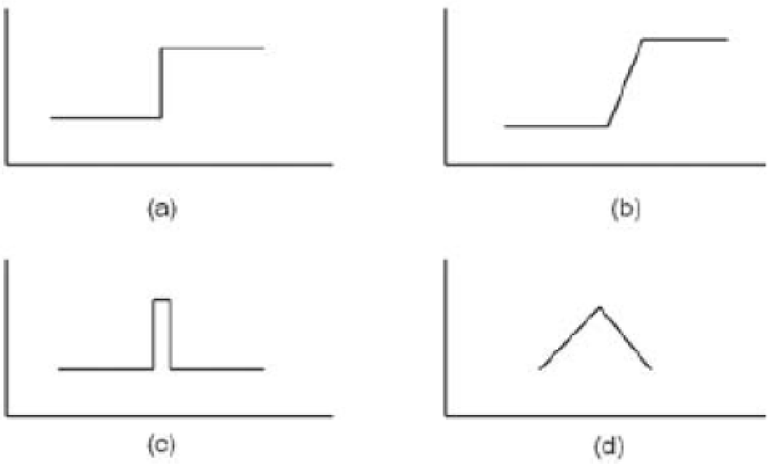


Figure 6: Different types of edges

IV. REGION BASED SEGMENTATION

This method works on the principle of homogeneity by considering the fact that the neighboring pixels inside a region possess similar characteristics and are dissimilar to the pixels in other regions. The objective of region based segmentation is to produce a homogeneous region which is bigger in size and results in very few regions in the image. The regions though treated as homogeneous in nature but there is provision to note any considerable changes in the characteristic of the neighboring pixels.

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Region based methods are fundamentally divided as
1. Region growing methods
2. Region split and merge methods

Figure 7: Results of region growing algorithms for segmenting images

V. CONCLUSION

The normalized cut formulation can be seen to give quite good results for image segmentation. Segmentation is an inherently subjective problem and quantitatively measuring performance of different segmentation algorithms is extremely tricky since there is no real "correct" answer to be compared with. Thus, the user should be able to parametrically control the segmentation that is achieved and this is provided for in the parameters of the weight function in all the graph theoretic formulations. Additionally, by setting a threshold on the normalized cut value, the number of groups segmented can also be controlled.

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