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A Review on Different Image Segmentation Techniques

KEYWORDS: mage segmentation, Watershed, Clustering, Thresholding

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ABSTRACT *This paper has presented a review on different image segmentation techniques. The image segmentation; segments a given image into separate regions and objects. It is widely used in various vision applications like face detections, motion detection etc. The overall objective of this paper is to review various techniques of image segmentation. The short comings of image segmentation techniques will also be evaluated. This paper ends up with the analytical solution to overcome the problems of the existing techniques.*

1. INTRODUCTION

The purpose of image segmentation is to partition an image into meaningful regions with respect to a particular application. The segmentation is based on quantities taken from the image and might be colour, texture, grey level, depth or motion.

Applications of image segmentation range from filtering of noisy images, medical imaging, locating objects in satellite images (roads, forests, etc.), automatic traffic controlling systems, machine vision to problems of feature extraction and recognition [8]. Image segmentation means assigning a label to each pixel in the image such that pixels with same labels share common visual appearances. It makes an image easier to analyze in the image processing tasks.

There are many different methods available to implement image segmentation. There are many approaches available for the image segmentation. Examples are, edge based segmentation, region based segmentation, threshold based segmentation, markov random field based segmentation, hybrid techniques and clustering based image segmentation [21]. These segmentation methods differ from their computation complexity and segmentation quality. Watershed based image segmentation algorithms provide good segmentation results.

2. IMAGE SEGMENTATION TECHNIQUES

Most segmentation techniques are either region-based or edge based.

1. Region-based techniques rely on common patterns in intensity values within a cluster of neighboring pixels. The cluster is referred to as the region, and the goal of the segmentation algorithm is to group regions according to their anatomical or functional roles [11].

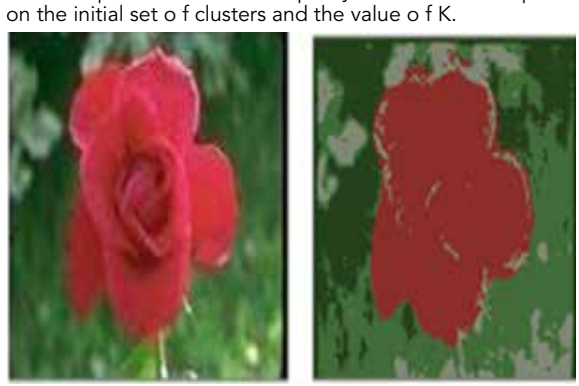
2. Edge-based techniques rely on discontinuities in image values between distinct regions, and the goal of the segmentation algorithm is to accurately demarcate the boundary separating these regions [11].

A. Clustering Methods

Clustering [2] [3] [4] is a process whereby a data set (pixels) is replaced by cluster; pixels may belong together because of the same color, texture etc. There are two natural algorithms for clustering: divisive clustering and agglomerative clustering. The difficulty in using either of the methods directly is that there are lots of pixels in an image.

Also, the methods are not explicit about the objective function that is being optimized. An alternative approach is to write down an objective function and then build an algorithm. The K- means algorithm is an iterative technique that is used to partition an image into K clusters, where each pixel in the image is assigned to the cluster that minimizes the variance between the pixel and the cluster center and is based on pixel color, intensity, texture, and location, or a weighted combination of these factors.

This algorithm is guaranteed to converge, but it may not return the optimal solution. The quality of the solution depends on the initial set o f clusters and the value o f K.



a) Original Image **b) Segmented Image**

Figure1.1 Cluster Method Segmentation ([4])

B. Thresholding Methods

Thresholding [1] [3] [6] [7] is the operation of converting a multilevel image into a binary image Le., it assigns the value of 0 (background) or 1 (objects or foreground) to each pixel of an image based on a comparison with some threshold value T (intensity or color value). When T is constant, the approach is called global thresholding; otherwise, it is called local thresholding.

Global thresholding methods can fail when the background illumination is uneven. Multiple thresholds are used to compensate for uneven illumination. Threshold selection is typically done interactively; however, it is possible to derive automatic threshold selection algorithms.

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(a) Input image b) Segmentation Image (T=50)

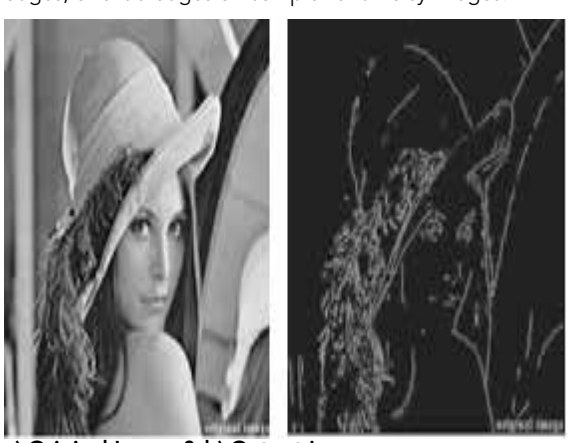


c) Segmentation Image (T-75)

Figure1.2 Thresholding Image Segmentation ([5])

C. Edge-Detection Methods

Edge detection methods [1] [2] locate the pixels in the image that correspond to the edges of the objects seen in the image. The result is a binary image with the detected edge pixels. Common algorithms used are Sobel, Prewitt and Laplacian operators. These algorithms are suitable for images that are simple and noise-free; and will often produce missing edges, or extra edges on complex and noisy images.

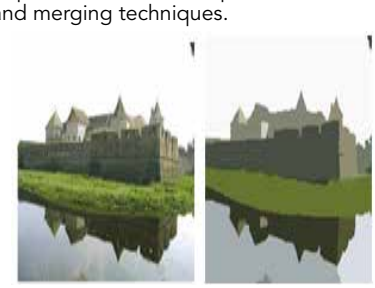


a) Original Image & b) Output Image

Figure1.3 Edge Detection Using Sobel Operator ([6])

D. Region-Based Methods

The goal of region-based [1] [3] [7] [8] [9] segmentation is to use image characteristics to map individual pixels in an input image to sets of pixels called regions that might correspond to an object or a meaningful part of one. The various techniques are: Local techniques, Global techniques and Splitting and merging techniques.



a) Original Image & b) Segmented Image
Figure1.1 Region Based Method Segmentation ([4])

The effectiveness of region growing algorithms depends on the application area and the input image. If the image is sufficiently simple, simple local techniques can be effective. However, on difficult scenes, even the most sophisticated techniques may not produce a satisfactory segmentation. Over-stringent criteria create fragmentation; lenient ones overlook blurred boundaries and over-merge. Hybrid techniques using a mix of the methods above are also popular.

3. WATERSHED TRANFORM

Watershed transform has concerned with great attention in recent years as an efficient morphological image segmentation tool. It is similar to region-based approach; it begins the growing process from every regional minimum point, each of which creates a single region after the transform. Watershed algorithm combines both the discontinuity and similarity properties successfully [5]. It performs well when it can distinguish the background location and the foreground object. It is based on grayscale mathematical morphology. The main drawback of watershed transform is over-segmentation, sensitive to noise and high computational complexity those make it unsuitable for real-time process [6].

4. LITERATURE SURVEY

Liu et al. (2008) [1] has discussed watershed transformation based on opening-closing operation and distance transform. Opening-closing operation is a kind of iterative calculation of erosion and dilation. It reflects the location feature of pixels in the image. It also overcame over-segmentation existed in traditional watershed segmentation preserving the original edges of the image.

Shan et al. (2010) [2] presented the improved watershed image segmentation method. The morphological opening/closing reconstruction filter is applied to remove the image noise. It keeps the information of object outlines when filtering the image. Multi-scale structure elements are used to calculate morphological gradient. It overcomes the short- comings of other traditional gradient operators and produces a gradient map appropriate for watershed segmentation.

Kumar et al. (2011) [3] has studied a color image segmentation method of automatic seed region growing on basis of the region with the grouping of the watershed algorithm. Firstly original image given as input to start the segmentation process. Modulated Intensity Gradient image is achieved by erosion and dilation operations; this image is used for the boundary extraction. Texture Gradient is used for the extraction of the connected components of the image. Final Gradient image is input for the watershed algorithm.

Bala et al. (2012) [4] has described paper a novel method of image segmentation that includes image enhancement and noise removal techniques with the Prewitt's edge detection operator. The Prewitt's operator to detect the edges instead of Sobel operator as in existing marker controlled watershed transformation. It effectively reduce the over segmentation effect and achieve more accurate segmentation results than the existing method.

Ren et al. (2012) [5] has studied improved watershed segmentation method is used to raise the segmentation correctness of rock particles image. The new method used the qualities of mathematical morphology algorithm. Conventional watershed algorithm is too sensitive to noise. If it is use directly in the extraction of the rock particles, it often result is "over segment".

Chen et al. (2012) [6] authors discuss image reconstruction and segmentation in an improved watershed algorithm by using a plug-in function in flooding process. This method shows very low error rates compared with other approaches. Size filter is used to get the better result for image segmentation. It also can be considered as a binary mask used into the flooding process at each level. The marker-controlled water-

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shed transform method provides better segmentation result without preprocessing.

Zhang et al. (2012) [7] has demonstrated the adaptive marker extraction-based watershed algorithm is used to overcome the over-segmentation problem. It also analyzes the disadvantages of the classical watershed segmentation and presents a marked extraction based on adaptive color image segmentation algorithm to improve the watershed, the conventional marker for the lack of extraction methods, many consider the minimum characteristics of properties, and set the adaptive threshold.

Rahman et al. (2013) [8] has discussed object counting in an image is one of the main challenges in image processing. Image segmentation is used to separate similar particles, which help calculating estimated total number of particles. Thresholding technique is desirable for counting objects in an image. It used the marker controlled watershed segmentation along with thresholding technique provides suitable result. The shortcoming of the method is that when the particles are of different tones of colors, it takes bright objects as object and darks objects are considered as background.

Fu et al. (2012) [9] presented the fast two-step marker-controlled watershed image segmentation method in CIELAB color space to resolve the over-segmentation problem, which saves a lot of execution time. The watershed super pixels segmentation technique produces over-segmented regions efficiently which adhere well to the real object boundaries. This method is faster than many other segmentation algorithms and very appropriate for real-time applications.

Li et al. (2012) [10] has suggested new approach to reduce over-segmentation using both pre and post processing for watershed segmentation. A new watershed segmentation method that combines pre-processing of the image and post-processing of image objects to produce the final segmentation results. In the initial stage of the watershed transform, this not only generates a gradient image from the original image. It also introduces the texture gradient. The texture gradient can be obtained using a gray-level co-occurrence matrix.

Richhariya et al. (2013) [11] has studied the merging morphological watershed result with improved edge detection result obtain on degraded images. In post-processing step, to each of the segmented regions attained, color histogram algorithm is applied, improving the overall performance of the watershed algorithm. Image deblurring can be done with 2-D Gaussian function.

Acharjya et al. (2013) [12] has presented novel approach of Watershed Algorithm using Distance Transform is applied to Image Segmentation. The watershed algorithm with Laplacian of Gaussian (LoG) edge detector is used to detect the edges of the image and generate less over-segmented image.

Ghoshale et al. (2013) [13] has described the several edge sharpening filters and to find the effect on the output image using watershed algorithm. A spatial sharpening filter on the performance of the segmented images and mathematical morphology plays a very important role. Morphology is the special type of filtering and structuring elements used for shape smoothing and elimination of small holes.

Rahman et al. (2013) [14] present, a novel image segmentation method based on adaptive threshold and masking operation with watershed algorithm. Whose objective is to overcome over-segmentation problem of the traditional watershed algorithm.

5. GAPS IN EARILER WORK

By conducting the literature survey it has been found that the most of the existing literature has neglected one of the following:

1. The over-segmentation problem is ignored i.e. as over segmentation degrades the performance or accuracy of the segmentation results by a lot; so it become an critical issue to reduce the effect of the over-segmentation by introducing some pre-processing operations.

2. The effect of the noise, dust, haze etc. is also ignored by the most of the researchers. It also degrades the performance of the over segmentation.

3. The computation time is still an issue for the most of the cases. As any enhancement on the existing method comes up with some potential overheads so it is required to reduce this time.

6. CONCLUSION

The literature review has shown that the over-segmentation problem has been ignored in the most of existing work. The noise has also found to be critical issue for image segmentation techniques. So it is required to modify the existing methods in such a way that the modified technique will work better for noisy images as well and also overcome the problem of over segmentation. In near future we will extend this work to propose a new technique which will modify the image watershed based segmentation using switching median filter and dynamic thresholding.

REFERENCE

[1] Yuqian Zhao, Jianxin Liu, Huifen Li, and Guiyuan Li,"Improved watershed algorithm for dowels image segmentation," 7th IEEE World Congress on Intelligent Control and Automation, Year 2008. pp. 7644-7648. | | [2] Xiaoyan Zhang, Yong Shan, Wei Wei, and Zijian Zhu, "An image segmentation method based on improved watershed algorithm," IEEE International Conference on Compu- tational and Information Sciences (ICCIS),Year 2010,pp.258-261. | | [3] Ashwin Kumar and Pradeep Kumar, "A New Framework for Color Image Segmentation Using Watershed Algorithm", Computer Engineering and Intelligent Systems, Vol. 2, No.3 pp.41-46, 2011. | | [4] Anju Bala, "An Improved Watershed Image Segmentation Technique using MATLAB," International Journal of Scientific & Engineering Research Vol.3, No.6, pp.1-4, June 2012. | | [5] Yuncai Zhou and Hui Ren,"Segmentation Method for Rock Particles Image Based on Improved Watershed Algorithm," IEEE International Conference on Computer Science & Service System (CSSS), Year 2012, pp.347-349. | | [6] Jie Chen, Meng Lei, Yao Fan, and Yi Gao,"Research on an improved watershed algo- rithm to image segmentation," 7th International Conference on Computer Science & Education (ICCSE), Year 2012, pp.1917-1919. | | [7] Changmin Zhang, Shuaiqi Zhang, Junxia Wu and Shaoxiong Han, "An improved wa- tershed algorithm for color image segmentation," 2012 International Conference on Computer Science and Electronics Engineering (ICCSEE),Year 2012, pp.69-72. | | [8] Md. Sharifur Rahman and Md. Rafiqual Islam, "Counting objects in an image by marker controlled watershed segmentation and thresholding," 3rd IEEE International on Ad- vance Computing Conference (IACC),Year 2013, pp.1251-1256. | | [9] Xianwei Han, Yili Fu and Haifeng Zhang,"A fast two-step marker-controlled watershed image segmentation method,"International Conference on Mechatronics and Automa- tion (ICMA), Year 2012, pp.1375-1380. | | [10] Boren Li, Mao Pan, and Zixing Wu, "An improved segmentation of high spatial res- olution remote sensing image using Marker-based Watershed Algorithm," 20th IEEE International Conference onGeoinformatics , Year 2012, pp.1-5. | | [11] Farheen K. Siddiqui and Vineet Richhariya,"An Efficient Image Segmentation Ap- proach through Enhanced Watershed Algorithm," Computer Engineering and Intel- ligent Systems, Vol.4,No.6, pp 1-7,2013. | | [12] P.P. Acharjya, A. Sinha, S. Sarkar, S. Dey and S. Ghosh,"A New Approach Of Watershed Algorithm Using Distance Transform Applied To Image Segmenta- tion,"International Journal of Innovative Research in Computer and Communication Engineering, Vol.1,No.2, pp 185-189, April 2013. | | [13] Dibyendu Ghoshal and Pinaki Pratim Acharjya,"Effect of Various Spatial Sharpening Filters on the Performance of the Segmented Images using Watershed Approach based on Image Gradient Magnitude and Direction," International Journal of Computer Ap- plications, Vol. 82, No.6, pp 19-25, November 2013. | | [14] Md.Habibur Rahman and Md.Rafiqual Islam,"Segmentation of color image using adaptive thresholding and masking with watershed algorithm," IEEE International Conference onInformatics, Electronics & Vision (ICIEV), Year 2013, pp.1-6. | | [15] Rabul H Laskar, Kalyan Banerjee and Debajit Basak,"Removal of High Density Salt and Pepper Noise from Color Images through Variable Window Size," IEEE Interna- tional Conference on Circuits, Power and Computing Technologies, Year 2013, pp. 1132-1136. | | [16] S. Beucher, F. Meyer,"The morphological approach to segmentation: The water- shed transformation, Mathematical Morphology in Image processing, Marcel Dekker Inc",New York, pp.433-481, 1993. | | [17] M.Sonka, V.Hlavac, and R.Boyle, Image Processing, Analysis, and Machine Vision, PWS Publishing, 1999. |