



Study of Region Base Segmentation Method

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Abstract— Segmentation refers to the process of partitioning a digital image into multiple segments (sets of pixels also known as super pixels). The goal of segmentation is to simplify /and or change the representation of an image into something i.e. more meaningful and easier to analyse. The goal of region base segmentation is to find regions that are correspond to objects as a person sees them. Objective of this paper is to study the performance of Split and Merge segmentation and marker controlled Watershed segmentation method. The watershed transform has intensity properties that make it useful for many different image segmentation applications. This method gives complete division of the image. Split and Merge method is highly lucrative now a days because of its simplicity and effectiveness in the area of image processing.

Keywords— Image Segmentation, Region Based Segmentation, Split and Merge, Watershed Segmentation, Marker controlled Watershed Segmentation,

I. INTRODUCTION

Segmentation is the process of partitioning a digital image into multiple segments. Segmentation subdivides an image into its constituent part or object. The main goal of image segmentation is domain independent partitioning of an image into a set of disjoint regions that are visually different, homogeneous and meaningful with respect to some characteristic or computed property such as gray level, texture or colour to enable easy image analysis. Image segmentation process in three stages. The first is image processing, in this stage remove useless information from the image. The second stage is initial object discrimination, where objects are grossly separated into groups with similar attributes. Third stage is object boundary clean up, where object boundaries are reduced to single pixel widths. [1][2]

Segmentation techniques roughly categorized into two broader approaches.

1. Boundary –based methods
2. Region based methods

The first approach is based on discontinuity and tends to partition an image by detecting isolated points, lines and edges according to abrupt changes and local properties. The regions are then deduced from their boundary. The second approach includes thresholding, clustering, region growing, region splitting and merging exploit the homogeneity of spatially dense information (e.g. intensity, colour, texture properties etc.) to produce the segmented results. [3]

II. BASIC IDEA OF AN REGION BASED SEGMENTATION

Region based segmentation is a procedure to subdivide an image into its constituent parts or objects called regions, using image attributes such as pixel intensity, spectral values and/ or textural properties.

Let R represents the entire image region. Segmentation may be viewed as a process that partitions R into n subregions $\{R_1, R_2, \dots, R_n\}$ such that [1]

- a) $\bigcup_{i=1}^n R_i = R$
- b) R_i is connected region, \forall_i
- c) $R_i \cap R_j = \emptyset, \forall_{ij}, i \neq j$
- d) $P(R_i) = \text{TRUE}$
- e) $P(R_i \cap R_j) = \text{FALSE}, i \neq j$

Where $P(R_i)$ is a logical predicate over the set of pixels in R_i and \emptyset is the empty set. Region growing is a general technique for image segmentation. The basic scheme consist of joining adjacent pixels to form regions followed by adjacent regions are then merged to obtain larger regions. Based on the used merge and split operators, region extraction techniques may be classified as

1. The bottom-up approach which leads to merging algorithms consisting in aggregating small regions into larger regions.
2. The top-down approach which leads to splitting algorithms consisting in recursively dividing an image into smaller and smaller regions.
3. The mixed approach which leads to splitting and combining splitting and merging.

All these methods partition original image by recursively splitting and / or merging its regions. [3]

III. RELATED WORK AND CONTRIBUTION

There has been large number of literature on image segmentation evaluation. Most of previous works are focused on developing better ways to measure the accuracy error of the segmentation. [5] Pure merging method is computationally expensive because they start from such a small initial region. We can make this more efficient by recursively splitting the image into smaller and smaller regions until all the individual regions are coherent then recursively merging these to produce larger coherent region. This paper presents the study of two region based image segmentation method on a large variety real images this paper presents the result of an objective evaluation of two popular segmentation techniques, split and merge segmentation and marker controlled watershed segmentation. For each of these algorithm we examine

1. *Minimum mean square error (MMSE)* - This is a cumulative squared error between segmented image and original image.

$$MSE = \frac{1}{MN} \sum_{y=1}^M \sum_{x=1}^N [I(x,y) - S(x,y)]^2$$

Where $I(x,y)$ is the original image, $S(x,y)$ is the segmented image and M, N are the dimensions of the images. A lower value for MSE means lesser error

2. *Peak Signal to Noise Ratio (PSNR)* - It is the measure of peak error.

$$PSNR = 20 \log_{10} \left[\frac{255}{\sqrt{MSE}} \right]$$

Logically a higher value of PSNR is good because it means that the ratio of signal to noise is higher. Here the signal is original image and the noise is error in segmentation process so if high PSNR is found it indicates good quality segmentation. It defines image quality.

IV. METHODOLOGY

We evaluate the following two image segmentation methods.

1. Split and Merge method

An alternative to the region growing method consist of initially subdividing the image into a set of arbitrary, disjoint regions and to merge and/ or to split the regions in an attempt to satisfy 2(a) to 2(c) condition.

Let R and P be the entire image and predicate respectively. If R is a square image, an approach for segmenting R consist of successively subdividing it into smaller and smaller regions so that for any region $R_i \in R$, $P(R_i)=TRUE$ i.e. if $P(R_i)=FALSE$, R_i has to be newly subdivide and so on. To satisfy the constraints 2(a) to 2(c) only merging adjacent regions whose combined pixels satisfy the predicate P is required where two adjacent regions R_i and R_k will be merged if $P(R_i \cup R_k)=TRUE$.

The region splitting and merging may be summarized as

- a) Split any region R_i into four square regions where $P(R_i)=FALSE$
- b) Merge any adjacent regions R_j and R_k for which $P(R_j \cup R_k)=TRUE$.
- c) Stop when no further merging or splitting is possible. Otherwise repeat steps (a) and (b).

2. Watershed method

This method is also called watershed transform is an image segmentation approach based on gray scale mathematical morphology, to the case of color or more generally speaking multi component images [5]. In geography a watershed is the ridge that divides area drained by different river system. The watershed transform computes the catchment basins corresponding to image regions and ridge lines relating to region boundaries.

The watershed transform usually leads to over segmentation of images due to image noise and other local irregularities. To overcome this, researches have proposed many strategies such as marker controlled watershed segmentation, hierarchical segmentation and multiscale segmentation. Due to number of advantages watershed transform has been widely used in many fields of image processing. This method is the morphological based image segmentation. This method produce a complete division of the image in separated region even if the contrast is poor, thus avoiding the need for any kind of contour joining[10].

Different approaches may be employed to use the watershed principle for segmentation. Local minima of the gradient of the image may be chosen as markers, in this case an oversegmentation is produced. Marker based watershed transformation makes use of specific marker positions which have been either explicitly defined by the user or determined automatically with morphological operators or other ways.

The watershed transform finds “catchment basins” and “watershed ridge lines” in an image by treating it as a surface where light pixels are high and dark pixels are low.

Marker controlled watershed segmentation follows the following algorithm.

1. Compute the segmentation function. This is an image whose dark regions are the objects you are trying to segment.
2. Compute the foreground markers. These are connected blobs of pixels within each of the objects.
3. Compute background markers. These are pixels that are not part of any object.
4. Modify the segmentation function so that it only has minima at the foreground and background marker locations.
5. Compute the watershed transform of the modified function.

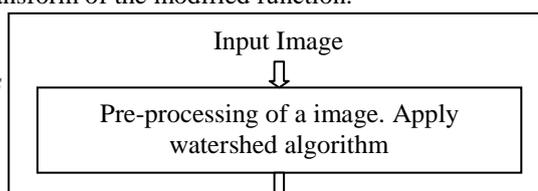


Fig.1 Process of marker controlled watershed segmentation

In this section work for processing real image segmentation is explained. Firstly we have applied split and merge segmentation algorithm and watershed segmentation algorithm on the images. In split and merge algorithm first the image is initially considered as a single region, and if considered nonhomogeneous by a dynamic range criterion, then it split into four regions (according to quadtree structure). The splitting algorithm is recursively applied to each of the resulting regions, until the homogeneous criterion is satisfied. In the second phase split and merge is region merging, in which pairs of adjacent regions are compared and merged, if their union satisfied the homogeneity criterion. In watershed algorithm we have first applied watershed segmentation on the image, but the result is not properly segmented. So mark the background object using marker. Now apply watershed segmentation algorithm.

V. RESULT

These algorithms are implemented in MATLAB 7.7.0. and tested on three images. The result of segmented image is shown below.

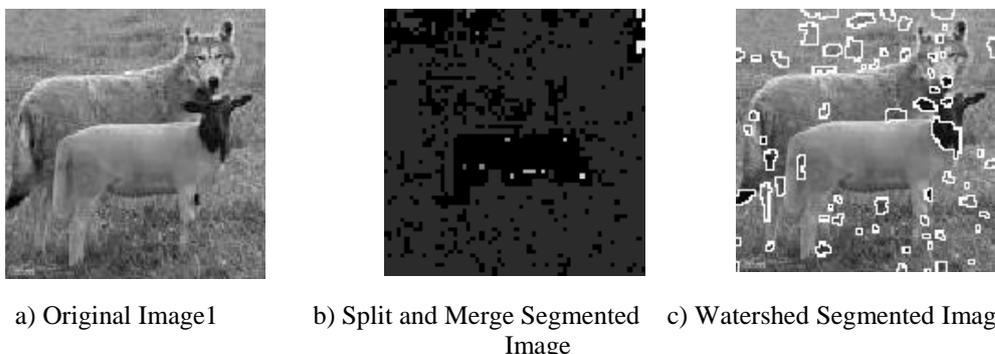


Fig. 2 Original and segmented image for image1

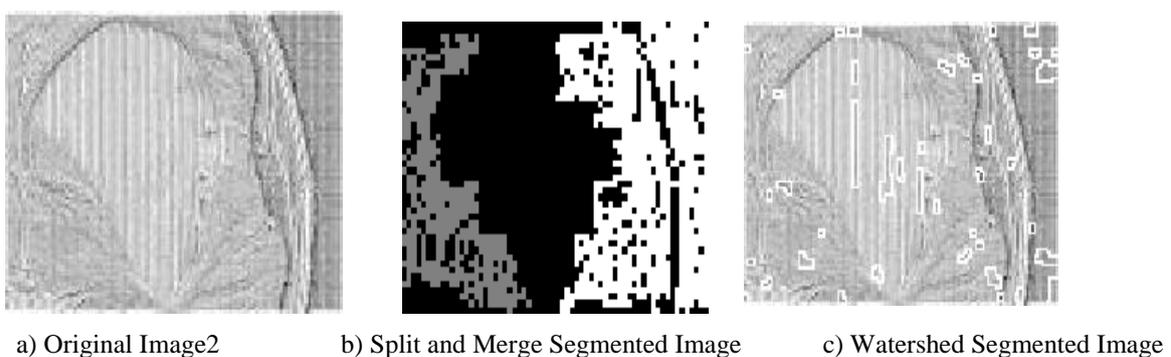


Fig. 3 Original and segmented image for image2

Table1

RESULT OF MMSE AND PSNR FOR IMAGE1 AND IMAGE2

IMAGE	PARAMETERS	SPLIT AND MERGE	MARKER CONTROLLED WATERSHED SEGMENTATION
IMG1	MMSE	0.53880DB	0.00008878DB
	PSNR	25.41DB	44.32DB
IMG2	MMSE	0.26479 DB	0.00006944DB
	PSNR	26.95DB	44.86DB

VI. CONCLUSION

Hence we conclude that watershed segmentation algorithm gives better result than split and merge segmentation algorithm. Mean Square Error of watershed segmentation algorithm is less than Split and Merge algorithm. PSNR of Watershed Segmentation algorithm is greater than Split and Merge algorithm. Marker Controlled Watershed Segmentation method is efficient for segmentation of the images.

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