Survey On Image Segmentation Techniques Using Dynamic Region Merging

Abstract
In region merging the criterion of stopping and merging order are essential. In this paper this two issues are solved by SPRT and the minimal cost criterion. Starting from an over segmented image, neighbouring regions are progressively merged if there is an evidence for merging. The principle of dynamic programming used for merging. The final segmentation is based on the observed image. We are also satisfies the certain global properties of segmentation. In this algorithm region merging process become faster due to nearest neighbour graph in each iteration.

1. Introduction
Image segmentation plays an important role in image processing. To separation and analyse of image we need image segmentation. Image segmentation is actually the pre-processing of image. During 1970 various works started on this but there is no perfect solution, so we want to find better solution for this. To represents the information and process in solid and efficiently the image is the best solution. In image segmentation the process of identifying groups of similar image ancient Clustering is used. It is classified into supervised and unsupervised clustering. In supervised there is human interaction to perform clustering criterion includes hierarchical approaches. Vice versa in unsupervised [12] it is decides clustering criterion by itself includes density based methods. Image segmentation is a partitioning of digital image into sets of pixels of same texture or colour or intensity [1]. Applications of image segmentation are image processing, face reorganisation, medical...
imaging, digital libraries, image and video retrieval etc. Due to importance of image segmentation in image processing researches on this is still going on. Still some popular early & classical image segmentation ways like threshold-selection based image segmentation algorithm, area-based image segmentation algorithm and edge detection- based image segmentation algorithm [4-7] etc. are used. While problems with these traditional algorithms are that they are either confronting with feature extraction problem or disagreeing with a featured condition that there’re uncertainty and fuzziness with an image.

Now days image segmentation is mostly using in many applications like object recognition, target finding, image editing. In commercial and health image segmentation used for disease diagnosis, including localization of tumours and other pathologies, measuring tissue volumes, and computer-guided surgery, etc. It is also used in biometrics for security purpose. On the other hand, traffic control systems, such as brake light detection, is another application of automatic image segmentation in practice.

In region based methods regions carry more descriptive information about an object also due to less primitive region it speed up the process. Region merging algorithm based on statistical properties [16] [22], graph properties [17-19]. The recent region merging work based on region similarity.

This paper comprises survey of various segmentation techniques. The segmentation algorithm is applied in region merging style where similar neighbouring regions are merged according to the new predicate. As homogeneity criterion are essential to region merging process. In this paper we are not making complex model instead we are going with function of random variables. For this we are using Gestalt theory [26] based on grouping principle having consistent elements in same data set. In proposed algorithm we combine consistency as well as similarity measures. It is measured by two suggestions with respect to SPRT [28], $H_0$ and $H_1$ respectively tested data is consistent (null) or inconsistent (alternative). In a cycle region finds is nearest neighbour. If segmentation taken as a labelling problem [1], the label exchange to the nearest neighbour during cycle process result into a merging.

Image segmentation algorithms are generally based on one of two basic properties of intensity values of the image pixels: discontinuity and similarity. In the first category, the approach is to partition an image based on sudden changes in intensity values. Edge detection techniques fall in this category which is similar to edges removal. On the other hand, in the second category, the idea is to partition the image into different regions such that pixels belonging to a given region are similar with respect to a set of predefined criteria’s. Researchers have been working on these two directions for years and have proposed various methods keeping those region based properties in mind. It should be noted that there is no fixed approach for segmentation. Based on the similarity or discontinuity criteria, many image segmentation methods have been proposed which can be broadly subsequently.

2. Edge Detection

Edge detection is a well-developed field on its own within image processing. Region boundaries and edges are closely related, since there is often a sharp adjustment in intensity at the region boundaries. Edge detection techniques have therefore been used as the base of another segmentation technique.
L. Ugarriza et al. [31] suggest a new unsupervised colour image segmentation algorithm, which exploits the information obtained from detecting edges in colour images in the CIE L*a*b* colour space. To this effect, by using a colour gradient detection technique, pixels without edges are clustered and labelled individually to identify some initial portion of the input image content. The algorithm uses an edge-detection algorithm that provides the intensity of edges present in an image; these help to detect the individual regions into which an image is segmented and the direction in which the region growth procedure takes place. The algorithm consists of three different modules. The first module implements an edge-detection algorithm to produce an edge-map used in the generation of adaptive gradient thresholds, which in turn dynamically select regions of contiguous pixels that display similar gradient and colour values, producing an initial segmentation map. The second module creates a texture characterization channel by first quantizing the input image, followed by entropy based filtering of the quantized colours of the image. Finally, the last module utilizes the initial segmentation map and the texture channel to obtain our final segmentation map.

L. Ugarriza et al. [32] presents a novel unsupervised colour image segmentation algorithm that utilizes colour gradients, dynamic Thresholding and texture modelling algorithms in a split and merge framework. To this effect, pixels without edges are clustered and labelled individually to identify the preliminary image content. Pixels that contain higher gradients are further classified by utilizing an iterative dynamic threshold generation technique and an appropriate entropy based texture model. The mentioned algorithm was demonstrated successfully on an extensive database of images and benchmarked favourably against prior art. [4]

J. Canny et al. [5] develop a mathematical form for these two criteria which can be used to design detectors for arbitrary edges. We will also discover that the first two criteria are not "tight" enough, and that it is necessary to add a third criterion to circumvent the possibility of multiple responses to a single edge. Using numerical optimization, we derive optimal operators for ridge and roof edges. We will then specialize the criteria for step edges and give a parametric closed form for the solution. In the process we will discover that there is an uncertainty principle relating detection and localization of noisy step edges, and that there is a direct trade-off between the two. One consequence of this relationship is that there is a single unique "shape" of impulse response for an optimal step edge detector, and that the trade-off between detection and localization can be varied by changing the spatial width of the detector.

3. Region Based Methods (Region Growing, Region Splitting & Merging)

In region based methods we examine neighbouring pixels and detect whether the neighbour pixel should be added or not. This technique attempts to group the pixels with similar characteristics into regions. There are two approaches in region-based methods

- Region growing
- Region splitting and merging

In the region growing process the Seed region is expanded to include all homogeneous Neighbours and the process is repeated. The process ends when there is no pixel to be classified. In region splitting method the process starts with the entire image as a seed. If the seed is in homogeneous then it splits into predetermined number of sub regions, typically four. The region splitting process is then repeated using each sub region as a seed. The process ends when all sub regions are homogeneous. In Region Merging Method merge any adjacent regions that are similar enough.
F. Calderero et al. [23] presented a new statistical approach to region merging where regions are modelled as arbitrary discrete distributions, directly estimated from the pixel values. Under this framework, two region merging criteria are obtained from two different perspectives; leading to information theory statically measures: the Kullback-Leibler divergence and the Bhattacharya coefficient. The developed methods were size-dependent, which assures the size consistency of the partitions but reduces their size resolution. Thus, a size independent extension of the previous methods, combined with the modified merging order, was also proposed. 

Lei et al. [34] addresses the automatic image segmentation problem in a region merging style. With an initially over segmented image, in which many regions (or super pixels) with homogeneous colour are detected, an image segmentation is performed by iteratively merging the regions according to a statistical test.

H. Liu et al. [24] is treated the image segmentation problem as region merging procedure. To solve the problem, an initial over segmentation is performed on the image and a k-Nearest Neighbour (k-NN) Graph whose vertexes denote regions is built. A new region similarity measure function is also proposed and the region similarity is assigned to the edge as its weight, which can make use of pixel intensity, edge feature, texture and so forth in a unit form. In k-NN graph, each vertex chooses exactly k nearest neighbours to connect. With it, the computation complexity of merging process can be reduced to O (tNlogN); here, t denotes the number of nearest neighbour updates required at each iteration while N denotes the number of the initial regions. Implementation of the proposed algorithm is introduced, and some experiment results are given to prove our method’s robustness and efficiency.

Bo Peng et al. [19] suggested the automatic image segmentation problem in a region merging style. With an initially over-segmented image, in which the many regions (or super-pixels) with homogeneous colour are detected, image segmentation is performed by iteratively merging the regions according to a statistical test. There are two essential issues in a region merging algorithm: order of merging and the stopping criterion. In the proposed algorithm, these two issues are solved by a novel predicate, which is defined by the sequential probability ratio test (SPRT) and the maximum likelihood criterion. Starting from an over-segmented image, neighbouring regions are progressively merged if there is an evidence for merging according to this predicate. He showed that the merging order follows the principle of dynamic programming. This formulates image segmentation as an inference problem, where the final segmentation is established based on the observed image. He also proved that the produced segmentation satisfies certain global properties. In addition, a faster algorithm is developed to accelerate the region merging process, which maintains a nearest neighbour graph in each iteration.

4. Thresholding

Thresholding is an old, simple and popular technique for image segmentation. Image segmentation by Thresholding is a simple but powerful approach for segmenting images having light objects on dark background. Thresholding operation converts a multilevel image into a binary image. Salem Saleh Al-amri et al. [35] undertake the study of segmentation image techniques by using five threshold methods as Mean method, P-tile method; Histogram Dependent Technique (HDT), Edge Maximization Technique (EMT) and visual Technique and they are compared with one another so as to choose the best technique for threshold segmentation techniques Image.

Fari Muhammad Abubakar [36] attempts to study Image Segmentation using Thresholding Technique on an image corrupted by Gaussian Noise as well as Salt and Pepper Noise which is
implemented using MATLAB software and the results obtained are studied and thereby discussed, highlighting the techniques performance. The study made use of the Iterative algorithm for the purpose of Image Thresholding on an image with pixel size 500 x 699 and the results obtained in the experiment were studied thereby highlight the performance of this image segmentation technique.

5. Clustering (K-Means clustering, Fuzzy C-means clustering)

Principle of clustering is maximizing the intra class similarity and minimizing the interclass similarity. Clustering is done based on different attributes of an image such as size, colour, texture etc. The purpose of clustering is to get meaningful result.

K-mean Clustering
K-Means algorithm is an unsupervised clustering algorithm that classifies the input data points into multiple classes based on their inherent distance from each other effective storage and fast retrieval in various areas.

Fuzzy Clustering
Fuzzy c-means (fcm) is that clustering technique in which a dataset is grouped into n clusters with every data point in the dataset belonging to every cluster to a certain degree.

A.Mavrinac [34] proposed a colour image segmentation using a competitive learning clustering scheme. Two fundamental improvements are made to increase the speed performance. i) Initialization of the system with two units rather than one ii) Reducing the number of iterations with no adverse effect and random selection among winning vectors in case of a tie. A very high number of clusters lead to over segmentation which is reduced using threshold and rival personalization.

Z.Wu. et al. [10] presents the clustering technique which is based on network flow theory. Here minimum cuts in an undirected adjacency graph are used for partitioning the data into clusters. The data to be clustered are represented by an undirected adjacency graph G with arc capacities assigned to reflect the similarity between the linked vertices. Clustering is achieved by removing arcs of G to form mutually exclusive sub graphs such that the largest inter-sub graph maximum flow is minimized. However for larger graphs this approach is impractical. New theorems for sub graph condensation are derived and are then used to develop a fast algorithm which hierarchically constructs and partitions a partially equivalent tree of much reduced size. This algorithm results in an optimal solution equivalent to that obtained by partitioning the complete equivalent tree and is able to handle very large graphs with several hundred thousand vertices. The new clustering algorithm is applied to the image segmentation problem. The segmentation is achieved by effectively searching for closed contours of edge elements (equivalent to minimum cuts in G), which consist mostly of strong edges, while rejecting contours containing isolated strong edges. This method is able to accurately locate region boundaries and at the same time guarantees the formation of closed edge contours.

6. Conclusion

In this survey of image segmentation technique, we study many techniques which are developed, not all types are useful for all types of images. It is found that there is no perfect method for image segmentation because the result of image segmentation is depends on many factors, i.e., colour, pixel, intensity. Therefore, it is not possible to consider a single method for all type of images. All methods can perform well for a particular type of image like edge detection use for natural images where region based are for real time images.
7. References


Archana G. Mahajan, P. M. Mahajan:: Survey On Image Segmentation Techniques Using Dynamic Region Merging