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Region Merging Based Image Segmentation Using Maximal Similarity Mechanism

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Abstract:- Image segmentation is the basic step in image Analysis and processing mechanism. The Image is partitioned into multiple segments so that a meaningful image is extracted out and then image is analyzed easily. Many techniques have been developed for the Image segmentation and there has been a constant growth in the research area of image segmentation and with this it has become more important to provide the readers with the growing research on image segmentation, it has become important to categorize the research outcomes and provide readers with an overview of the existing segmentation techniques in each category. In this paper, different image segmentation techniques are reviewed and presents a new region merging based interactive image segmentation method. A novel maximal similarity based region merging mechanism is used to guide the merging process with the help of markers and applying weighted sum method thatautomatically merges the regions that are initially segmented by mean shift segmentation, and then effectively extracts the object contour by labeling all the non-marker regions as either background or foreground and then to predict TPR and FPR for proposed algorithm.

Index Terms:- Image Segmentation,Region merging,MaximalSimilarity, Mean shift.

I. INTRODUCTION

Images are often considered as the most important medium of presenting information about an object. Image segmentation is a technique to separate the useful objects from the background of the image so that the desired information can be displayed about the image.It is an essential step for many applications such as object recognition, target tracking, content based image retrieval and medical image processing. Generally, the goal of image segmentation is to partition an image into a certain number of pieces which have similar features for example color, texture, etc. and at the same time grouping the meaningful pieces together for the convenience of getting the useful information out of the Image. The color and texture features in a natural image are very complex and it is very difficult to get the fully segmented image out of the natural and therefore semi automatic segmentation methods which include more of the user interactions have been proposed and are becoming more and more popular. There are many image segmentation techniques have been used now a days such as mean shift image segmentation, watershed Image Segmentation, level set and superpixel Image Segmentation. But they may have enforced over segmentation and because of that objective multilevel thresholding is required to be applied over the segmentation so that it can be used as a good measure for the region merging operations.The statistic features of each region which requires less over segmentation will be exploited by the proposed region merging method and hence can be more robustly calculated and then be used in guiding the region merging process. Image segmentation is performed by repeatedly merging the regions according to a statistical test performed. There two essential issues in a region merging algorithm are to measure the order of merging and the stop criteria of the merging. This is done by using weighted sum method for predicting most likely objects for internal merging of edges and then applying loop up to stopping criteria based upon number of remaining objects and mean difference.This formulates image segmentation as an inference problem, where the final segmentation is established based on the observed image. There are practical examples over which the image segmentation is applied over the variety of fields such as in medical application to locate the tumors, In Surgery, In diagnosis of tissues and can help in preparing the treatment plan. The image segmentation is used to locate the objects in the satellite images and also is helpful in Finger print and Face recognition.

II. TECHNIQUES FOR IMAGE SEGMENTATION

Mean Shift Image Segmentation -Mean shift was first proposed by Fukunaga and Hostetler and later adapted by Chengfor.The purpose of image analysis is more recently extended by Comaniciu, Meer and Ramesh tolow-level vision problems including segmentation, adaptive smoothing and tracking. The main idea behind mean shift is to treat the points in the d-dimensional feature space as an empirical probability density function where dense region in the feature space corresponds to the local maxima or modes of the underlying distribution. For the data point in the feature space one performs a gradient ascent procedure on the local estimated density until convergence. It estimates the gradient if the probability density function to detect modes

in an interactive fashion. Hence image segmentation that takes color / intensity similarity as well as local connectivity into account can be obtained by using the algorithm to the combined special range domain. As the mean shift algorithm partition the image into several segments rather than separating a foreground object from the background, typical evaluation features based on the well-known true/false positive negative notification cannot be used for the validation purpose.

Watershed Technique–Different watershed lines may be computed in the image processing. The watershed lines can be defined on the nodes, edges, hybrid lines on nodes. Watersheds may also be defined in the continuous domain. There are also many different algorithms to calculate the watersheds.The user can apply different approach to use the watershed principle for image segmentation.

- Local minima of the gradient of the image may be chosen as markers, in this case an over-segmentation is produced and a second step involves region merging.
- Marker based watershed transformation make use of specific marker positions which have been either explicitly defined by the user or determined automatically with morphological operators or other ways.

Thresholding Technique–It is defined as the simplest way for the image segmentation and is most widely used technique for image segmentation.A threshold value is used which can be selected using several methods in this method to turn a gray scale image into a binary image. The most common method is to set the threshold value in such a way that image can be segmented; the user manipulatingthe value and reviewing the thresholding result until a satisfying segmentation is achieved. Thresholding can be used to segment the image if bright objects are embedded in the darker images.The main point in this method is to select a particular threshold value or values when multiple levels are selected. There are many methods are used in the industry which includes k-means clustering, maximum variance called as Otsu's method or the maximum entropy method. Now certain methods have been developed by which the Computed Tomography images can be threshold which includes the thresholds derived from the radiographs rather then the reconstructed image.

Clustering Method–An interactive technique that is used to partition an image into K clusters is named as the K-means. The Algorithm states

1. Either randomly or based on some experience based technique Pick K clusters.
2. To minimize the distance between the center of the cluster and pixel each pixel is assigned to a designated cluster.
3. The cluster centers are then re computed by averaging all the pixels in the cluster.

The steps 2 & 3 are repeated until there is no pixel change in the cluster and convergence is achieved. The distance is the absolute difference between the pixel and cluster center in this scenario. On the basis of the intensity, pixel color, location or the texture or the weighted combination of the above mentioned facts the difference is attained. Either randomly or based on some experience based technique the valueK can be selected.The algorithm may not result into the best solution but the coverage is guaranteed in this algorithm. The value of the K and the clusters selected initially determine the quality of the solution.Even though clustering is sometimes used as a synonym for segmentation techniques here is it used as a primary technique used in the data analysis of high dimensional measurement patterns. It can be said that clustering attempts to group together patterns that are similar to each other in some ways. This goal is very similar to that what are the efforts put in an image is segmented and some clustering techniques can easily be applied for the image segmentation.

Edge Detection Technique- Edge detection itself is a very well developed field that is used for the image segmentation. There is a short adjustment in the intensity at the boundaries of a region as the edges and the region boundaries are related very closely and hence Edge detection technique is hence used as a base of another segmentation technique. The edges which are detected by the edge detection technique are most of the times disconnected and to segment an image the closed boundaries of the region are required. An attempt is made to resolve the image segmentation by detecting the pixels or edges between different regions that have rapid transition in intensity which are extracted and linked to form closed object boundaries. This results in a binary image. There are two most widely used edge based segmentation methods which is derived from the above mentioned theory which are termed as the gray histogram method and the gradient based method. The edges that are derived from the edge detectors; segmentation methods can be applied on these as well. There is an integrated method developed by Li and Linderberg by which the edges are segmented into curved edge or straight edge segments based on the minimum described length also called as MDL criteria that was optimized by a split and merge method with candidate breakpoints are achieved from the complementary junction cues which are more likely to obtain points which are consider partition into different segments. The quality with which the result is attained depends on both the similarity measure used as part of this method and how the same

is implemented. The clustering algorithms are often classified as Fuzzy clustering, K Means clustering, hard clustering and many more

Level Set Method–The level set method was proposed by Osher and Sethian to track the moving interfaced in 1988 which in the nineties spread across various imaging domains. The problem related to the curve or surface can be addressed very efficiently in a well formed manner. The idea is to represent a sign function used evolving counter where the actual counter is represented by the zero level. After that one can easily derive the similar flow for the implicit source that when applied to the zerolevel will reflect the propagation of the counter which is in accordance to the motion equation of the counter. The level set method has various advantages as it is free of parameters, it is implicit, geometric properties can be provided in a direct way of the evolving structures and also topology can be changed using the technique.Also an optimization framework can also be defined using this technique is proposed my Osher, Merriman and Zhao in 1996. Hence it can be concluded that it is a very well defined as easy framework to handle various application of the medical image analysis and the application of computer vision. It also research into various level set data structures using which efficient implementation of this method can be.This technique has several advantages like it is very stable, irrelevance to the topology, curve breaking and combining and display great advantage to solve the problem at the corner point. Only the objects defined by the gradients can be segmented as the edge stopping function depends on the image segment. In this practice another disadvantage is that the edge stopping functions are never equal to zero at the edges so the curve eventually pass through the boundaries of the object.

Hybrid Image Segmentation–A commonly occurring problem in the segmentation is how to segment an image into different heterogeneous segments such that a heterogeneous segment is achieved after combining two neighboring segments. Many techniques are available for the error free image partitioning as histogram represents the simple probability distribution function of intensity value of an image. Many techniques are present for the error free image partition as simple probability distribution function of intensity value of the image is represented by histograms. The other technique called as Edge Based technique is also used to detect differential filters in an image which are in order of the image gradient or the Laplacian and then the same is grouped into contours which represent the surface. The image is set into homogenous regions in the region based segmentation technique and then the same is merged according to the decision rules. The true image is represented by a Markov or Gibbs random field with a function called as distribution function in the Markov random field based segmentation. Such edge based and region based techniques are combined to represent the Hybrid segmentation techniques. The image is firstly partitioned into regions as a part of this technique. The contours are then detected using the edge based technique.

III. MAXIMUM SIMILIARITY BASED REGION MERGING.

To Partition an image into homogeneous regions for merging an initial segmentation is required in this technique. It is very difficult to get a fully segmented image automatically from a natural image there are some interactive techniques with user inputs are observed to be good solutions. It's also called as Interactive Image segmentation. The region of the object and the background and the location of the object is determined by the user using the strokes which are also called as markers. With the help of the markers a region merging mechanism is proposed to guide the merging process called as Novel maximal similarity mechanism. If R has highest similarity with Q among all the Q's adjacent region the region R is merged with its adjunct Q region. The regions that are initially segmented by the mean shift method of segmentation are automatically merged as part of this proposed method and then the objectcontour is extracted effectivelyand all the labeling the non-marker regions either as background or objects.

Region Representation–After the initial segmentation there are many small regions available and based on their boundaries various approaches are apple died on it to represent the region. A descriptor is used to define the rule for merging to guide the process of region merging. The region can be described with the help of descriptor in terms of shape, size, color, texture. More information about the region is observed in the color based segmentation where pixels are compared to the gray scale images.To represent the statistical features of the color objects color histogram is used as a descriptor and is most often used in object tracking and the pattern recognition as small regions which are segmented initially from the object can differ a lot in the size or shape whereas the color of the object can be similar and hence the color histogram is used to represent each region in this paper.

Similarity Measure–In order to have the useful information about the object the regions should be related to the describing object. The uniformity or non-uniformity of pixels to form a connected region is represented by a uniformity predicate, i.e. a logical statement, or condition being true if pixels in the regions are

similar with respect to color histogram.In the interactive image segmentation users will mark some regions.as object and background regions. The key issue in region merging is how to determine the similarity between the unmarked regions with the marked regions so that the similar regions can be merged with some logic control. Therefore, we need to define a similarity measure (R, Q) between two regions R and Q to accommodate the comparison between various regions. There are some well-known goodness-of-fit statistical metrics such as the Euclidean distance, Bhattacharyya coefficient and the log-likelihood ratio statistic.

Marking Foreground and Background Objects - In the interactive image segmentation, the users need to specify the object and background conceptually. The users can input interactive information by drawing markers, which could be lines, curves and strokes on the image. The regions that have pixels inside the object markers are thus called object marker regions, while the regions that have pixels inside the background markers are called background marker regions. After object marking, each region will be labeled as one of three kinds of regions: the marker object region, the marker background region and the non-marker region. To completely extract the object contour, we need to automatically assign each non-marker region with a correct label of either object region or background region.

The figure shows the segmentation of the picture of tiger using two groups of markers. In this, aim is to separate a tiger from the complex background with two groups of markers, and also the MSRM with more markers performs better than with few markers. Even though, it extracts the rough contour of tiger with fewer markers. In general, the proposed MSRM algorithm could reliably extract the object contour from different backgrounds if the user input markers cover the main features of object and background.

Merging process-The whole MSRM process can be divided into two stages, which are repeatedly executed until no new merging occurs. Our strategy is to merge background regions as many as possible while keep object regions from being merged. Once we merge all the background regions, it is equivalent to extracting the desired object. Some two step strategies have been used in for image pyramid construction.Different from, the proposed strategy aims for image segmentation and it is guided by the Markers input by users. The proposed MSRM algorithm is an iterative method .It will progressively assign the non-marker background regions in N to M_B, and then all the left regions in N are assigned to M_O. It can be easily seen that the proposed method converge. The procedure is iteratively implemented, such that in each iteration, the sets M_b and N will be updated. Specifically, M_B expands and N shrinks. The iteration stops when the entire marker background regions MB will not find new merging regions. The iteration stops when the entire non-marker region set N will not find new merging regions. The region merging algorithm starts with an initial segmentation. This can be a trivial segmentation with each image pixel forming a region of its own, or it can be an output of the preceding segmentation step.

TPR AND FPR

As the accuracy (the ratio of the correctly segmented area over the ground truth) is not enough and segmentation may also cover the area that is not in the ground truth.Following measures should be evaluated your segmentation result.

1.True Positive Rate(TPR)-The correctly segmentation area over all the area you segmented and is defined as the ratio of the number of correctly classified object pixels to the number of total object pixels in the ground truth

2. FalsePositive Rate (FPR)- The area that is not in the ground truth but that is in your result over all the area you segmented and is the ratio of the number of background pixels but classified as object pixels to the number of background pixels in the ground truth.

Obviously, the higher the TPR is and the lower the FPR is, the better the method is and implies that the best segmentation performance is achieved.

IV. CONCLUSIONS

Image segmentation has a promising future as the universal segmentation algorithm and has become the focusof contemporary research.In spite of several decades of research up to now to the knowledge of authors, there isno universally accepted method for image segmentation, as the result of image segmentation is affected by lots of factors,such as: homogeneity of images, spatial characteristics of the image continuity, texture, imagecontent. The image is initially segmented by mean shift segmentation and the users only need to roughly indicate the main features of the object and background by using some strokes, which are called markers. Since the object regions will have high similarity to the marked object regions and so do the background regions, a novel maximal similarity based region merging mechanism may be used to extract the object. This scheme is simple yet powerful and it is image content adaptive. With the similarity based merging rule, a two stage iterative merging algorithm was presented to gradually label each non-marker region as either

object or background. This method provides a general region merging frame- work. It does not depend essentially on mean shift segmentation and other color image segmentation methods can also be used for initial segmentation. Although some marker based interactive image segmentation methods (e.g. graph cut and marker based watershed have been proposed), this algorithm firstly exploits a novel adaptive maximal similarity based region merging mechanism.

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