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A Study of Image Segmentation Approaches

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Abstract— **One of the important technologies for image processing is image segmentation. The complexity of image content is still a big challenge for carrying out automatic image segmentation. A lot of work shows that the user guidance can help to define the desired content to be extracted and thus reduce the ambiguities produced by the automatic methods. A brief overview of some of the most common segmentation techniques, and a comparison between them comprise this literature review. It discusses the various segmentation techniques for pixel based image segmentation, region based image segmentation, edge based image segmentation, and graph based image segmentation. Among different segmentation techniques, interactive graph cuts have several good features in practical applications.**

Index Terms— **Boundary code, graph cut, image segmentation, threshold.**

I. Introduction

Image segmentation is an important process and its results are used in many image processing applications. It is a fundamental process in many images, videos, and computer vision applications. Generally image segmentation is defined as a process of partitioning an image into homogenous groups such that each region is homogenous but the union of no two adjacent regions is homogenous. Simply the segmentation subdivides an image into its constituent regions or objects and level to which the subdivision is carried depends on the problem being solved.

Computers have no means of intelligently recognizing objects, and so many different methods have been developed in order to segment images. Various features that are found in the image are the basis of segmentation process. Texture, shape, grey level intensity, and color are the common features used in image segmentation. However, there is no general way to successfully segment of all images. Many segmentation methods have been developed, but there is still no satisfactory performance measure, which makes it hard to compare different segmentation methods.

Color images have more information than gray scale images, and this information can be used to create higher quality segmentation. However it will increase the complexity of the problem. Segmentation of the non-trivial images is one of the most difficult tasks in image processing. Segmentation algorithms generally based on one of two basic properties of image intensity values: discontinuity and similarity. The success or failure of computerized analysis procedures is determined by the segmentation accuracy.

Some of the segmentation techniques are following:

Pixel based segmentation: Point based or pixel based segmentation [11], [12] is one of the simplest approaches used for segmentation. Pixel based classification, employing supervised or unsupervised classifiers that require no a priori information.

Region based segmentation: These methods focus attention on an important aspect of the segmentation process. Region based segmentation [6]-[8], [15] partition an image into regions that are similar in according to a set of predefined criteria. Thresholding, region growing, region splitting [10] and region merging [14], [15] are the main examples of techniques in this category.

Edge based segmentation: An edge based segmentation [1]-[3], [5] approach can be used to avoid a bias in the size of the segmented object without using a complex thresholding scheme. The fact that the position of an edge is given by an extreme of the first-order derivative or a zero crossing in the second-order derivative is the basis for edge based segmentation.

Graph based segmentation: Graph partitioning methods [16]-[19], [21], [24] can effectively be used for image segmentation. A weighted, undirected graph modelled image is obtained in this method. The (dis)similarity between the neighbourhood pixels is defined usually by a pixel or a group of pixels those are associated with nodes and edge weights. The criterion designed to model "good" clusters is the basis for partitioning the graph (image).

With the numerous developments of various technologies for segmentation, the categorization of these technologies based on their application is necessary. The objective is to classify different image segmentation techniques and to find out their merits and demerits. Also to determine the accuracy of segmentation by using various segmentation methods.

II. IMAGE SEGMENTATION METHODS

There are many algorithms used for image segmentation, segmentation of an image based on the regions or features, sharing similar characteristics are identified and grouped together. Now a days, no one can point out which is the optimal solution due to different constraints. The image segmentation algorithm is divided into different categories: Edge based segmentation, Region based segmentation, and Pixel based segmentation etc. In order to present an organized review on image segmentation techniques, a comparative study has been done. Because efficient image segmentation is one of the most critical tasks in image processing and image segmentation has been interpreted

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differently for different applications. This survey was conducted using base paper references, professional sources, journal articles, internet web sites and other sources as identified.

A. Pixel Based Image Segmentation

It is the simplest approach used for segmentation. In which each of the pixels in a region are similar with respect to some characteristic or computed property, such as color, intensity, or texture. Pixel-based methods are the easiest to understand and to implement, but are also the least powerful and are particularly susceptible to noise. Thresholding is the straightest forward and common of the pixel based methods.

Biplab Banerjee, Tanusree Bhattacharjee &Nirmalya Chowdhury [11], does "natural grouping" of pixels to present color image segmentation technique. This is an unsupervised method for color image segmentation. To find out the clusters of the pixels having RGB values within a certain range present in the image. This approach first perform a Minimum Spanning Tree (MST) based "natural grouping" of the image pixels in this method. They propose an efficient algorithm for color image segmentation with automated seed selection. To perform natural grouping on the image pixels find out different color bands present in the image. Then the found out pixels nearest to the centers of those clusters are marked as the seeds and they are then used for region growing based image segmentation purpose. To eliminate the effect of over segmentation after the region merging based segmentation they select a suitable threshold. Segmentation of an image entails the division or separation of the image into regions of similar attributes. Also they define image segmentation is nothing but pixel classification. One of two basic properties of intensity values of the image pixels such as discontinuity and similarity are the basis of image segmentation algorithms. The experimental results show that the proposed method can find homogeneous regions present in a given image efficiently and this method can produce good result.

C Meurie, G Lebrun, O Lezoray, A Elmoataz, [12], presents a comparison of supervised pixel-based color image segmentation methods. To extract color regions accurately color pixel classification alone is not enough, so they suggest using a strategy based on four steps in different color spaces: simplification, pixel classification, marker extraction and color watershed growing. The quantitative analysis can only be performed from perfectly segmented objects. The supervised pixel classification brought improved results over a satisfactory unsupervised pixel classification. A simplification step to reduce the noise, a supervised pixel classification in different color spaces, a marker extraction by using an operation of mathematical morphology and a color watershed growing to segment correctly the objects are the basis to propose an automatic segmentation scheme. Image simplification consists of smoothing the initial image to reduce the importance of noise. This smoothed image is also used as input to the pixel classification. Pixel classification consists of determining each pixel of the image, in order to identify background and objects. The marker extraction is based on mathematical morphology operations which consist in a variable number of erosions according to the marker type. The watershed performs growing using image color information. The evaluation step is composed of two methods corresponding to an evaluation with or without ground truth reference image. This method is adapted to the segmentation of color objects in a noisy environment. The overall success rate of this method is 87%.

B. Region Based Image Segmentation

Regions are a group of connected pixels with similar properties. They can be found based on similarities between values of adjacent pixels. Region based approaches are based on pixel properties such as homogeneity and spatial proximity. According to the common image properties an attempt to partition or group region is carried out by the Region based segmentation methods. They are intensity values from original images, or computed values on an image operator and textures or patterns that are unique to each type of region.

Dr.S V Kasmir Raja, A.Shaik Abdul Khadir, Dr.S S RiazAhamed, [6], presents a study of region based image segmentation techniques, they compare the performances of the two commonly used region-based image segmentation methods namely the Watershed method and the Mean-shift method. One of the important problems in computer vision is the image segmentation and its performance evaluation. One of the image segmentation approach based on mathematical morphology is called watershed transform. A data-clustering method that groups all data to the clusters defined by local maximal density points which searches for the above points before grouping is called Mean-shift method. The fundamental conflict between generality and objectivity is a major challenge in segmentation evaluation. In which an image structure is represented by partitioning an image into a set of disjoint segments. The segmentation performance is usually evaluated by subjectively or objectively comparing with several sample images. The goal of this technique is to analyze the function performance of region-based segmentation methods such as watershed and mean-shift methods. The contextual and perceptual properties are the usual measure of segmentation performance. The performance of two region based segmentation methods is compared on the basis of important characteristics such as correctness, stability with respect to performance choice and stability with respect to image choice. They conclude that the Watershed image segmentation method has better performance than the Mean-Shift image segmentation method. It is clear that the Watershed Method is efficient for images with a small number of segments.

Jung An, Yunmei Chen [7], presents region based image segmentation using a Modified Mumford-Shah Algorithm. This method is introduced by using two new variational Partial Differential Equation (PDE) based image segmentation models. By minimizing energy function which gives the first model depends on a modified Mumford-Shah algorithm. The second model is acquired by utilizing prior shape information and region intensity values. One of the commonly used region based image segmentation model is based on the Mumford-Shah Algorithm. In this method an image is decomposed into a set of regions and these regions are separated by smooth edges. A quadratic integral of an edge signature function is used to measure the length of an

edge. But there are some limitations to obtain an efficient segmentation result, if images have strong noise, occlusion, or loss of information. The prior shape information has been incorporated into the segmentation process to overcome these problems. By using the modified Mumford-Shah model, the prior shape information is attained. The goal of this method is to develop region based image segmentation algorithms. Another advantage of this method is its effectiveness and robustness against to noise, artifact, and loss of information.

I Karoui, Fablet, J Boucher, J M Augustin [8], presents supervised region-based image segmentation using texture statistics and level-set methods. It is a novel multi-class method for texture segmentation. The proposed approach is implemented using level-set methods, and Partial Differential Equations (PDE) are expressed using shape derivative tools. In this approach the segmentation issue is stated as the minimization of a region-based functional that involves a weighted Kullback Leibler measure between distributions of local texture features and a regularization term that imposes smoothness and regularity of region boundaries. In image processing texture segmentation aims at segmenting a textured image into several regions with the same texture features. There are two main categories in image segmentation. Whereas pixel-based schemes, consider image segmentation as a labeling issue at the pixel level, region based approaches directly search for a relevant image partition. Region-based techniques are more adapted, because the texture characteristics are defined at the region level. Then, pixel-based texture segmentation generally relies on the use of local texture features computed within a predefined window around each pixel. Therefore, the texture features extracted for pixels close to region boundaries involve a mixture of texture characteristics, which may causes to a lack of accuracy in localizing the boundaries of the texture region. In contrast, region-based approaches, offers an efficient manner to cope with texture and geometrical features at the region level. Then the advantage of supervised image segmentation is the recovery of region boundaries are performed accurately.

Dr. P Raviraj, Angeline Lydia, Dr.M Y Sanavullah [10], presents an accurate image segmentation using region splitting technique, they use split and merge method which is an improvement over the Iterative Region Growing using Semantics (IRGS). Region splitting method provides the possibility of building a hierarchical representation of the image content. In the segmentation process it allows various region features and even domain knowledge to be incorporated. Pure merging methods are, computationally expensive because they start from such small initial regions (individual points). To make this approach more efficient by recursively splitting the image into smaller and smaller regions until all individual regions are coherent, then recursively merging these to produce larger coherent regions. The image is being split at first. And the entire image is considered as one region in the starting. The characteristics of the split and merge algorithm is based on the use of the segmentation tree, which is normally a quad tree. The merge-split algorithm due to its use of criteria based on the difference between the maximum and minimum pixel values within the region tends to act like an edge detection algorithm. By using split and merge method this approach obtains good accuracy in image segmentation. Then some of the most commonly used segmentation techniques include thresholding, region growing, clustering, classifier, neural network-based approaches, deformable models, MRF model based approaches. There are a lot of disadvantages occurring with these approaches. The proposed model overcoming the disadvantage of region growing is that it requires manual interaction to obtain the seed point. Initial segmentation is required for clustering algorithms and not training data. The main disadvantage of MRF-based methods is that the objective function associated with most nontrivial MRF problems and it is extremely non-convex and the minimization problem is computationally very taxing. Using merge splitting prior to region growing tends to result in sharper edges. On the other hand, the region growing techniques without merge-splitting will be generated images with blurry edges. This proposed method is an improvement over the method called the Iterative Region Growing using Semantics (IRGS).

Jifeng Ning, Lei Zhang, David Zhang, Chengke Wu [15], presents interactive image segmentation by maximal similarity based region merging. The image is initially segmented by mean shift segmentation and the users only need to roughly indicate the location and region 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 similarly the background regions have high similarity to the marked background regions. Then a novel maximal-similarity based region merging mechanism is proposed to guide the merging process with the help of markers. In this proposed method the initial segmentation is performed by mean shift segmentation and it automatically merges the regions. When the merging process ends the object will then be extracted from the background and all the non-marker regions as either background or object. In general, the fully automatic segmentation of the object from the background is become very hard because color and texture features in a natural image are very complex. Therefore, semi-automatic segmentation methods incorporating user interactions have been proposed and are becoming more and more popular. The low level image segmentation methods provide the image into many small regions and it causes over segmentation. Subsequent high level operations called region merging is highly based on these low level segmentation methods. The static features of each region are exploited by the proposed region merging method due to less over segmentation. While the non-marker objects regions will be identified and avoided from being merged with background. Once all the non-marker regions are labeled, the object can be readily extracted from the background. The advantage of the proposed method is it will be easier to calculate the similarity of different regions and merge them and it can reliably extract the object from the complex background. This method is simple yet powerful and it is image content adaptive.

C. Edge Based Image Segmentation

Points, lines, and edges are the three basic types of gray level discontinuities in a digital image. A set of connected pixels that lie on the boundary between two regions is called an edge. Edges in an image are a significant local change in the image intensity. They are found based on differences between values of adjacent pixels. It is necessary to group edges in to chains that correspond to the sides of the structural units which in turn called as structural boundaries in order to move from edges to segments.

Y Ramadevi, T Sridevi, B Poornima, B Kalyani [1], presents segmentation and object recognition using edge detection techniques. Interaction between image segmentation and object recognition are determined. Image segmentation is defined as a process of partitioning an image into homogenous groups. Whereas object recognition is defined as the task of finding a given object in an image or video sequence. The relationship between the segmented images and object recognition is demonstrated by using Expectation-Maximization (EM) algorithm, OSTU and Genetic algorithms. A set of regions that collectively cover the entire image, or a set of contours extracted from the image is the result of image segmentation. For object recognition there are many 'features' which are considered as the interesting points on the object that can be used to extract object from the images. Before the application of segmentation and recognition methods the colored images are converted to gray scale image. An edge in an image is identified by local change in the image intensity, and it will be usually associated with the discontinuity in either the image intensity or the first derivative of the image intensity. The edge detection process is progressed through the following a) Filtering b) Enhancement and c) Detection. Some of the frequently used edge detection methods are Sobel, Prewitt, Roberts, Canny, LoG, EM algorithm, OSTU algorithm and Genetic Algorithm [1]. From these the stable segmentation effect is provided by the Expectation-Maximization algorithm and OTSU algorithm. The merits and demerits associated with this edge detection technique is smooth segmentation of the edges and boundaries formed not necessarily closed, no significant improvement for multi-spectral images, computation based on difference.

Takumi Uemura, Gou Koutaki, Keiichi Uchimura [2], presents image segmentation based on edge detection using boundary code. An important basic process in image analysis is image segmentation. Edge-detection techniques can be used to determine whether the pixels are an edge or not. By using this segmentation method thin areas are segmented continuously even if the images have a narrow elongated object, shading and blurring. This segmentation method is useful for images with few features such as gray scale images. The coding of images is known as image encryption. In this method Boundary Code (BC) is using image coding to segment images. The boundary code is the edge information of pixels and detected the edges as the virtual edges were set in a virtual space between pixels. Then by using BC the edges are detected and segmented the image in detail. The result of this process is affected by the accuracy of the results of segmentation significantly in the images that have shading, blurring and noise but this method is applied only to the gray scale images. The overall success rate of BC is minimum of 92.56%.

Jie Yang, Ran Yang, Shigao Li, S Shoujing Yin, Qianqing Qin [3], presents a novel edge detection based segmentation algorithm for polarimetric SAR images and the algorithm to segment image is applied PolSAR data. Most recently used classification works have concentrated on point-based classification of SAR data and they are mainly based on spectral characteristic of pixels. But due to the high resolution of images, there may be some problems with those methods. Also there is a low level understanding of image features, then consideration of single pixel characteristic in isolation neglects some important and complex information of images. In such cases the result may contain a little amount of salt-pepper noise. To avoid these problems they introduced object-oriented classifications. Object-oriented classification of high resolution images is based on the image segmentation which is the precondition and foundation of this classification and the quality of image segmentation greatly influences/affects the accuracy of processing. By this method, after a series of pre-processing including edge enhancement and edge detection, the initial segmented small regions are merged according to the region distance defined by distance of coherence matrix of PolSAR data, and discrete points are merged into regions according to Wishart distance. The compressed Stokes matrixes or Muller matrixes M is the form in which the PolSAR image is stored. Then it is necessary to convert Stokes matrixes M to coherence matrixes before applying the edge detection algorithm. Some of the edge detection methods performed in this process: Preprocessing is implemented to eliminate the influence of speckles, edge enhancing templates construction, edge enhancement and edge detection. By this method it will overcome the disadvantages of RGW method and make it applicable to PolSAR data classification. It also avoid over segmentation such as a large number of small regions in the segmentation result.

Mahinda P Pathegama [4], presents Edge-end Pixel Extraction for Edge-based Image Segmentation. It is an important method for the edge linking process to achieve edge-based image segmentation. They present an algorithm to extract edge-end pixels together with their directional sensitivities. Due to the presence of broken boundaries in the image the edge-based approaches can yield inaccurate results. Therefore such boundaries need to be linked for reliable results. To reliably extract the edge-end pixels for use in edge-based image segmentation in image processing they introduce an algorithm. The algorithm aims at performing two tasks: extraction of edge-end pixels and recognition of the associated directions. The algorithm reads all the pixels in a 2-D image row by row by a speedy process. Then it first identifies each pixel located at edge-ends by considering the neighboring pixel values. If the target pixel is found it records the coordinates of the recognized pixel to complete the extraction. The extracted pixels can then be drawn into one of the several techniques available in image processing. Edge-linking technique is one of these several techniques. To perform the task of recognition, the numeric schemes are available. One method is the so-called Chain Coding [23], which traces a pixel-wide line and the direction of each of the detected pixels takes into account the known alignment of

neighboring pixels. The simplicity of this algorithm should make it an attractive tool for edge-based image segmentation.

Baris Sumengen, B S Manjunath [5], presents novel multi-scale edge detection and image segmentation. It is a vector field design scheme. The edge detection and segmentation quality on natural images can be improved significantly by using multiscale techniques. Therefore the need for explicit scale selection and edge tracking can be avoided. This method identifies edges that exist at a wide range of scales and localize these edges at finer scales. The edge detection algorithms specify a spatial scale at which the edges are detected. This method is based on first finding an edge representation at each scale and then combining them using certain heuristics. Some edge detectors utilize local operators and the effective area of these local operators defines the spatial scale. The spatial scale usually corresponds to the level of smoothing of the image. The edges at the small scale corresponding to finer image details, whereas the edges at the larger scale corresponding to coarser image details. On elimination of the most noises and clutter in the detected edges by the scale increase gives the differences such that the edges at the large scales are not well localized as the edges at small scales. Therefore to achieve good localization and good detection of edges, a multi-scale approach is needed. The main advantage of this method is that there is no need to estimate local scales at each pixel. Also this approach is able to localize edges with no extra and external effort such as tracking edges.

D. Graph Based Image Segmentation

A node in a graph is same as each pixel in an image. The similarities between adjacent pixels are represented by Arcs. Goal of graph cuts is to partition the graph into sets of vertices (regions), such that the similarity within the region is high and similarity across the regions is low. The two disjoint subsets obtained by the partition of the vertices in the graph define the cut of a graph.

Mayuresh Kulkarni, Fred Nicolls [16], presents interactive image segmentation using graph cuts. This method presents an accurate interactive image segmentation tool using graph cuts and image properties. To performing binary segmentation graph cuts is a fast algorithm, it is used to find the global optimum of a cost function based on the region and boundary properties of the image. To differentiate between the object and background regions the user marks certain pixels as background and foreground. By using the color and texture features of corresponding pixels they built Gaussian Mixture Models (GMM). This model can be used to classify and segment images and GMMs are used for image retrieval from databases. Image color and texture properties are used to build probabilistic models of foreground and background and to globally optimize the cost function the graph cut method is used. To calculate the relative probability of each pixel being foreground or background, based on the GMMs a simple ratio is used. The automatic segmentation is less easier problem compared to interactive image segmentation. A good segmentation can be derived for any image based on color and texture parameters, using GMMs and graph cuts. The fast and effective algorithm is the graph cuts algorithm. Accuracy is the ratio of misclassified pixels to the total number of pixels. The average accuracy of the algorithm was 92% over a set of 20 images and the best accuracy was 99.5%.

Bo Peng, Lei Zhang, Jian Yang [17], presents iterated graph cuts for image segmentation. This starts from the sub-graph. The extraction of foreground object from a complex background is obtained by graph cuts based interactive segmentation. This approach contains user labeled foreground/background regions and works iteratively to label the surrounding unsegmented regions. In order to reduce the interference from the far unknown regions, only the local neighboring regions to the labeled regions are involved in the optimization during each iteration. To partition the image into homogenous regions and to improve the segmentation efficiency and robustness, the mean shift method [6] is used. For high-resolution data the graph cuts are used. In this method, they explore the graph cuts algorithm by extending it to a region merging scheme. The mean shift algorithm is performed on the original image for an initial segmentation, which partitions the image in to many homogenous regions and the iterated graph cuts algorithm taking each region as the graph node for segmentation. It has many advantages. First, using sub-graph it can reduce significantly the complexity of background content in the image. Second, the background interference can be much reduced. Third, the computational cost is significantly less. Finally this method gives much better segmentation results than the standard graph cuts and the Grab Cut methods in both qualitative and quantitative evaluation. One of the important advantages in optimization is the insensitivity to the parameter λ.

Daniel Freedman, G Funka Lea [19], presents interactive graph cut based segmentation with shape priors. The useful alternative for pure automatic segmentation in many applications is interactive or semi-automatic segmentation. The interactive segmentation by using traditional graph cut approaches are may fail in cases where there are diffuse edges or multiple similar objects in close proximity to one another. The manual segmentation and fully automatic segmentation are both problematic. A small amount of user input can often use to resolve ambiguous decisions on the part of the algorithm. The manual segmentation is very time-consuming. The proposed method is a very effective method for interactive segmentation based on graph cuts. The user input is minimal, consisting of a few mouse-clicks indicating some pixels which are inside the object of interest, and some which are outside. Sometimes there is a failure is occurs because the absence of strong boundaries and the presence of a number of objects with similar intensity profiles. The solution to this problem is to include shape priors in a graph cut based formulation.

Abraham Duarte, Angel Sanchez a, Felipe Fernandez b, Antonio S Montemayor [14], presents improving image segmentation quality through effective region merging using a hierarchical social metaheuristic. They introduced a new evolutionary region merging method in order to efficiently improve segmentation quality results. This approach starts from an over-segmented image, which is obtained by applying a standard morphological watershed transformation on the original image. Next, the associated Modified Region Adjacency Graph (MRAG) structure is built to model the

segmentation problem as a graph. MRAG may consider as neighbor regions those ones that are not adjacent. Each resulting region is represented by its centroid. The over-segmented image is described by a simplified undirected weighted graph, where each node represents one region and weighted edges measure the dissimilarity between pairs of regions according to their intensities, spatial locations and original sizes. Finally, the resulting graph is iteratively partitioned in a hierarchical fashion into two sub graphs, corresponding to the two most significant components of the actual image, until a termination condition is met. This graph-partitioning task is solved by a variant of the min-cut problem using a Hierarchical Social (HS) metaheuristic. The problem consists of partitioning an image into its constituent regions, objects or labels. This partition is accomplished in such a way that the pixels belonging to homogeneous regions, regarding to one or more features, share the same label, and regions of pixels with significantly different features have different labels. There must be considered four objectives for developing an efficient generalized segmentation algorithm: continuous closed contours, non-over segmentation, independence of threshold setting and short computation time. Metaheuristic search algorithms are high-level general strategies for finding high quality solutions.

Bo Peng, Lei Zhang, and Jian Yang [18], presents image segmentation by iterated region merging with localized graph cuts. This graph cuts algorithm is performed by extending it to a region merging scheme. Specifically, we perform watershed segmentation [6] algorithm on the original image for an initial segmentation, which partitions the image into many homogenous regions. Starting from seeds regions given by the user, the iterated region merging is performed. Instead of the pixels in the original image, regions are regarded as the nodes of the graph. It has many advantages and merits. First, the complexity of background content in the image is significantly reduced by using sub graph. The many unlabeled background regions in the image may have unpredictable negative effect on graph cuts optimization. This is why the global optimum obtained by graph cuts often does not lead to the most desirable result. However, by using a sub-graph and blocking those unknown regions far from the labeled regions, the background interference can be much reduced, and hence better results can be obtained under the same amount of user interaction. Second, the computational cost is significantly less than running graph cuts on the whole graph which is based on image pixels. Third, as a graph cuts based region merging algorithm [13]-[15], this approach obtains the optimal segmentation on each sub-graph in the iteration. Forth, the object and background color models are updated after the segmentation on each sub-graph. Thus they can provide more informative guide for the next round of segmentation.

The following table compares the different segmentation techniques. And thus identifying which approach provides the best segmentation result of the given images. The comparison is given in Table I.

III. CONCLUSION

With the numerous amounts of image segmentation techniques presented, the following are the main categories: pixel based segmentation, region based segmentation, edge based segmentation and pixel based segmentation. The selection of segmentation approach depends on what quality of segmentation is required. Then this approach can extract the foreground from background with less user guidance. The approach starts from the user labeled sub-graph and works iteratively to label the surrounding un-segmented regions. It can reduce the interference of unknown background regions far from the labeled regions so that more robust segmentation can be obtained. With the same amount of user input, this approach can achieve better segmentation results than the standard graph cuts with less computational cost.

TABLE I

COMPARISON OF VARIOUS IMAGE SEGMENTATION METHODS

Segmentation Technique	**Advantages**	**Disadvantages**
Edge Based Approaches	1) Edge detection technique is the way in which human perceives objects. 2) Works well for images having good contrast between regions.	1) Does not work well with images in which the edges are not defined clearly or there are too many edges. 2) It is not a trivial job to produce a closed curve or boundary. 3) Less immune to noise.
Region Based Approaches	1) Work best when the region homogeneity criterion is easy to define. 2) They are also more noise immune than edge detection approach.	1) Are by nature sequential and quite expensive both in computational time and memory. 2) Region growing has inherent dependence on the selection of seed region.
Pixel Based Approaches	1) Perform well in automatic image segmentation. 2) Reduce noise. 3) Pixels nearest to the centers are marked as the seeds.	1) Computational cost will be high. 2) Takes much computational time. 3) Very sensitive to noise. 4) over segmentation occurs.
Graph Based Approaches	1) The boundaries of each region are continuous. 2) Segment unique boundaries from an image. 3) Easier approach to perform.	1) Each pixel will be a node in the graph so that the computational cost will be high. 2) Segmentation result may not be smooth.

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