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COLOR IMAGE SEGMENTATION WITH K MEANS CLUSTERING AND DYNAMIC REGION MERGING

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ABSTRACT

Image quality can be improved using different image enhancement techniques. It includes different types of operations like image segmentation, smoothing, filtering etc. Image segmentation is a process in which features having homogenous characteristics are identified and grouped together for further use. Here input is color image. The image gets converted into horizontal and vertical histogram. Hill climbing technique used for the peak detection, where number of peaks is equal to number of clusters. Then actual color clusters are formed using k means clustering. K Means clustering is the famous algorithm to form the clusters. Sequential probability ratio test is use to check similarity of regions.If This consistency test result is true then merge the region Merging of region follows the nearest neighbor graph and dynamic region merging algorithm. Depending on homogenous properties partitions are merged. dynamic region merging algorithm gives fine and efficient automatic image segmentation. This merging will give the enhanced segmented image which is the final output. Nearest neighbour graph is used before dynamic region merging algorithm to increase the speed and efficiency of above process. This improved image is useful in the field of medical and security purpose. This auto clustering based image segmentation is totally new method in the field of image processing.

Keywords: NNG; SPRT; DP; DRM; K means

INTRODUCTION

Image segmentation is basically to partition image into certain number of pieces [4] that have coherent features, and again group the meaningful pieces for the convenience of perceiving. Segmentation helps to modify the image into many regions which are basically larger representation of data, where region is group of connected pixels with similar properties. The goal of segmentation is to simplify the representation of an image into something that is more meaningful and easier to analyze. Image segmentation is typically used to locate objects and boundaries in images**.** In this paper plane color image is the input. The image is made of various colors. Considering various features of image, it gets converted into regions using hill climbing technique. Here color clusters are formed using K means clustering segmentation techniques, the last step is to recover the image. This is possible using Sequential probability ratio test, nearest neighbour and dynamic region merging algorithm here SPRT test assume some predicate to check the consistency. Once consistency is checked then nearest neighbor graph and dynamic region merging algorithm is used for better segmented output image. With the help of these algorithm the neighbouring regions are progressively merge. DRM algorithm gives automatic segmentation.

There are different image segmentation methods[10] like K-means (KM) [16] Clustering Methods, Histogram-Based Methods, Edge Detection Methods, Region Growing Methods, Model based, set level Methods, Graph Partitioning Methods, Watershed Transformation, Neural Networks Segmentation, and Multi-scale Segmentation. Relay Level set method [7], [14].

OBJECTIVE

The system operation follows the steps mention below:

1. Color image is input for this system. Then color clusters are formed using k means clustering method. We are using auto clustering approach. The plane color image is converted into horizontal and vertical histogram.
2. Then we apply hill climbing technique to detect the peak points, in short peak detection is possible using histogram and hill climbing technique. Then form the actual clusters using. K-means algorithm. Here clusters are made of various regions.
3. Check consistency between these regions. Consistency of the region is calculated by sequential probability ratio test, which depend on the two fix assumptions. Right assumption and wrong assumption. Then sort the data into two groups.

Finally apply principal of nearest neighbor graph it will allow better merging at the initial stage. Then use dynamic region merging which gives automatic image segmentation.at this step actual merging is possible, Output of the DRM algorithm is enhanced segmented image.

LITERATURE REVIEW

In the field of image segmentation much research work is published in last some which give following information. Image segmentation is partition of image into subparts which are divided according to certain standard, image segmentation, is sometime necessary step in image analysis .image segmentation is having wide variety of methods. Some of the methods discuss in detail as follows

A) Threshold segmentation: This is famous technique of image segmentation as it is easy to use. This divide the input image mainly into two different parts where one with segment value as positive and second is with the segment value as negative. In short first some dimension for the image regions are set, and then segment all regions according to the dimension. It may use horizontal and vertical Histogram techniques to segment the image. [12]

B) Edge segmentation: In this method the operation starts from outer part to inner part. First identify the edges of the image. Then process these outer edges so that only boundaries of the regions will remain. Finally identify the object with this technique considering edge as criteria. It is generally used to identify these objects. [8], [14], [11].

C) Region based segmentation: Here homogeneity between neighboring regions is observed. If neibhouring regions are maximum similar then merge these region. Likewise proceed further up to stop criteria. [3], [9], [13]

D) Clustering techniques: clustering is one of most usable techniques in segmentation. Clustering is nothing but group of similar type of elements. K-means algorithm is famous example of clustering. Clusters are formed by calculating the centroid and objects near to centroid. Clustering is mainly divided into two types top down approach and bottom up approach [6], [16].

E)Matching: In matching set the ideal object, and proceed for searching other object which having same feature as that of the ideal object. Locating the objects is possible with this type. This type of segmentation is known as matching.

METHODOLOGY

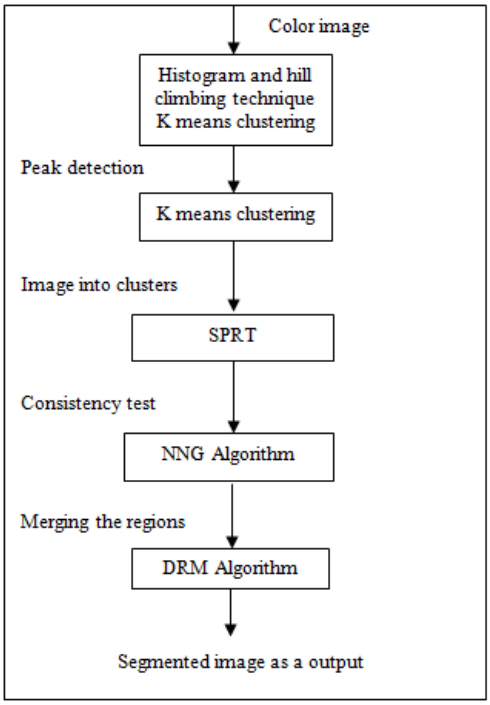


Fig 1.Flow of System

Interactive software is developed to do the reliable monitoring and management of segmentation process. The system software is made using MATLAB 10 .We are implementing hill climbing technique and k Means clustering first on the plane color image, and then applying consistency test using SPRT. Dynamic region merging algorithm and nearest neighbor graph on color image. This operation is totally software part. In the proposed DRM method, there are five parameters that control the consistency condition. While implementing the system there are four fix parameters, they are α, β, λ1, λ2.Here (α, β) represent the probability of accepting an "inconsistent" model as "consistent" and rejecting a "consistent" model as "inconsistent" .m is used to decide the amount of data selected for the random test. If we set λ2=1, then only λ1 is the user input which can be vary.

The algorithm of total working is as follows:

- Algorithm: color image segmentation
- Input: an color image
- Output: a set of visually coherent segmented image
- Compute the color histogram of the input color image
- detect the peaks using hill climbing techniques
- Consider number of peaks is equal to number of clusters.
- Form the clusters(group of regions) of input images using K means algorithm
- Check the consistency of neighboring regions using sequential probability ratio test.
- Divide the regions into two hypothesis as true (similar) and false (dissimilar).
- Merge the two regions if they find maximum similarity using nearest neighboring algorithm.
- Perform the automatic image segmentation using dynamic region merging algorithm.

- Continue the process up to stopping criteria.
- Obtain the segmented image at output.

Histogram and Hill Climbing Technique

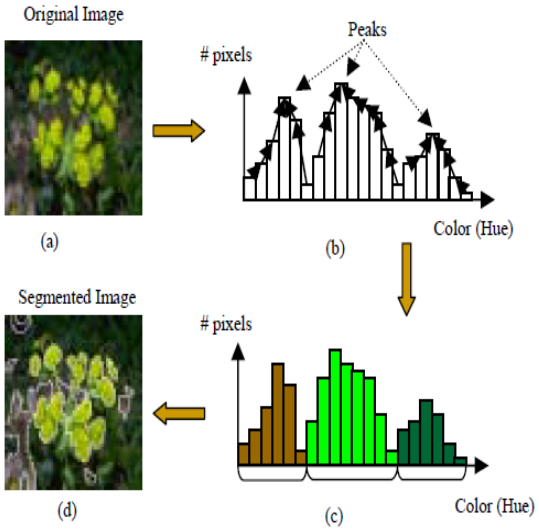
Hill-climbing based segmentation is a simple technique which is used to detect the peaks of clusters in the global histogram of an image. The hill-climbing based segmentation algorithm is as follows.

Algorithm: hill-climbing based segmentation

Input: an image

Output: a set of visually coherent segments

- Compute the color histogram of the image.
- Start at a non-zero bin of the color histogram and make uphill moves until reaching a peak
- Compare the number of pixels of the current histogram bin with the number of pixels of the neighboring (left and right) bins.
- If the neighboring bins have different numbers of pixels, the algorithm makes an uphill move towards the neighboring bin with larger number of pixels.
- If the immediate neighboring bins have the same numbers of pixels, the algorithm checks the next neighboring bins, and so on, until two neighboring bins with different numbers of pixels are found. Then, an uphill move is made towards the bin with larger number of pixels.
- The uphill climbing is continued until reaching a bin from where there is no possible uphill movement.
- The identified peaks represent the initial number of clusters of the input image; thus these peaks are saved.
- Finally, neighboring pixels that lead to the same peak are grouped together, that is associating every pixel With one of the identified peaks. Thus, forming the clusters of the input image.



Source: http://www.researchgate.net/publication/234838692_Hill-climbing_Algorithm_for_Efficient_Color-based_Image_Segmentation

Fig.2. An example showing the segmentation process: (a) Original image (b) Hill-climbing process color histogram (hue component only) (c) The result of the hill climbing Process, where 3 clusters are identified (d) The segmented image.

K Means Clustering

K means clustering is generally used to form the color clusters. As mention above once the peaks are detected then actual clustering starts. Here number of peaks= number of clusters.

K-Means Algorithm Properties are as follows

- There are always K clusters.
- There is always at least one item in each cluster.
- The clusters are non-hierarchical and they do not overlap.
- Every member of a cluster is closer to its cluster than any other cluster because closeness does not always involve the 'center' of clusters.

The K means clustering algorithm works as follows. Construct a partition of n documents into a set of K clusters.

- Input: An image and the number K.
- Output: A partition of K clusters where K IS number of peaks.
- Select K random docs {S1,S2,…..SK} as peaks
- Form Clusters based on centroids and its distance to neighboring objects.
- Reassign clusters, which are based on distance to the current cluster centroids.
- This process is continuing up to stopping criteria.

Consistency Test (SPRT)

- This property used to check homogenous features in the image. Consistency property deals with two conditions: true condition and false condition. The condition in which similarity of the adjacent region is considered, it is known as true condition and condition considering the dissimilarity is known as the false condition. For true condition combine the regions. This is explaining as follows:
- Here consider two assumptions [1] to check if the regions are homogenous or not.
- Result=true, if neighboring regions are similar in desired features, then we merge the regions easily. It is also called as valid hypothesis.
- Result=false, if neighboring regions are not similar .or very contradictory features are present then hypothesis is known as alternative hypotheses.
- The algorithm for consistency test is as below
- Set λ_1
- Choose $\lambda_2=1$, $\alpha=0.05$, $\beta=0.05$
- $A = \log(1-\beta/\alpha)$, $B = \log\beta(1-\alpha)$
- Choose the k pixels of neighboring regions.
- The predicate cue x is calculated which require $P0(x/\theta_0)$, $P1(x/\theta_1)$
- This value is calculated as

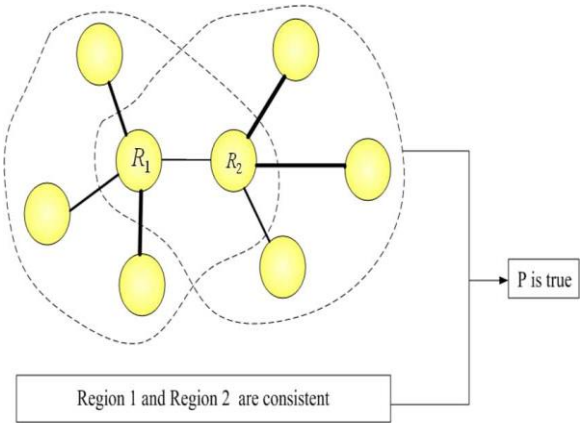
$$P_0 (x|\theta_0) = \lambda_1 \exp (-(I_b - I_{a+b})^T S_I^{-1}(I_b - I_{a+b}))$$

$$P_1 (x|\theta_1) = 1 - \lambda_2 \exp (-(I_b - I_a)^T S_I^{-1}(I_b - I_a))$$

- Calculate $\delta = \delta + \log (P_0(x|\theta_0)/(P_1(x|\theta_1)$

  If $\delta >= A$, then regions are consistent.

  If $\delta >= B$, then regions are not consistent



Source: from paper Automatic Image Segmentation by Dynamic Region Merging By Bo Peng, Lei Zhang, Member, IEEE, and David Zhang, Fellow, IEEE

Fig 3. Consistency test

Nearest Neighbor Graph

Here actual merging is possible. Once the consistency of the regions is check, start grouping the color clusters .instead of scanning whole image it scan very small part of image, so it becomes very fast and efficient[11].Then apply DRM algorithm.

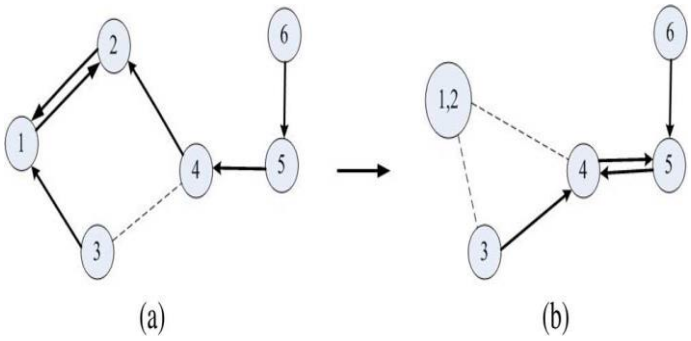


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Fig 4. NNG Process

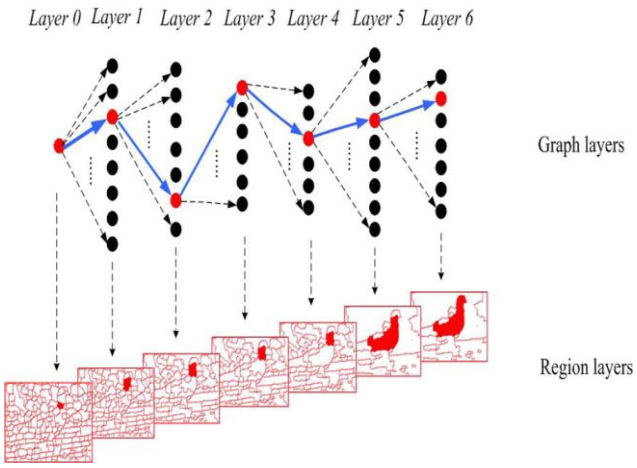
- Most similar pair of regions is connected by an edge with the minimum weight.
- Consider minimum weight=minimum dissimilarity=maximum similarity
- Along any directed edge in NNG, the weights are non-increasing.
- The maximum length of a cycle is two.
- The NNG contains at least one cycle.
- The maximum number of cycles is half of number of edges.

Dynamic Region Merging Algorithm

There are different algorithms to merge the data. Though NNG is used at the initial stage, DRM is use at final step to merge the data because with the help of DRM we get better, fine and automatic segmentation. A region predicate is compared with the description of adjacent region; if both are same; merge them into a larger region. Otherwise regions are mention as different regions. We cannot combine such regions. This process will be continuing for all the regions in the image. If any region cannot merge with any of its adjacent neighbor, then at that point we have to stop as all the possible regions are already merged This algorithm is conducted like discrete system. The segmentation in this algorithm is not overflow and not underflow. It is optimum. The DRM algorithm works as follows:

- Start with input image and give each region separate name.
- Likewise we can consider such k names.
- Give first name as B0 and proceed like the same
- Give last name to last region as B k.
- We have to start with first name up to last name.
- Obtain optimal solution for combining the regions
- Optimum solution can be obtain by dynamic programming
- Depending on the above solution we can calculate the similarity weight between neighbor regions
- Minimum dissimilarity =maximum similarity is the only criteria we have to follow. Likewise go on combining the regions up to stopping criteria

The DRM algorithm diagrammatic representation is as below:



Source: from paper Automatic Image Segmentation by Dynamic Region Merging By Bo Peng, Lei Zhang, Member, IEEE, and David Zhang, Fellow, IEEE

Fig 5. Dynamic region merging process

Dynamic region merging process works on the principal of the shortest path the corresponding image regions of each label layer. Starting from lower layer 0, (which is in red) we can obtain new label from (in red) its closest neighbor. If the region is merged with its neighbor, they will obtain to the same name of label.

DRM algorithm is very simple than rest of the merging algorithms. it gives better efficiency than any other algorithm. So it is better to use the DRM from efficiency point of view .The output of the DRM

algorithm is segmented image. These output images are very useful as they give us detail and enlarge explanation of data; especially in military and medical applications. The alternative to the DRM algorithm are mean shift algorithm [6] as well as graph based algorithm [13]

Application

Automatic image segmentation can be applied in object recognition, image compression, image editing, image searching and other tasks of machine vision. In industry and daily life, the applications of image segmentation lie in different aspects such as disease diagnosis, including localization of tumors and other pathologies, measuring tissue volumes, and computer-guided surgery, etc. In remote sensing interpretation image segmentation is being used to locate objects in satellite images (roads, forests, etc.). In order to maintain security, face recognition fingerprint recognition technique can be helpful. On the other hand, traffic control systems, such as brake light detection.

Advantage

- Better computational efficiency.
- More convenient to control the performance.
- Can tolerate variation of grouping
- Can be easily automated.
- Can be apply to discrete regions
- More computational efficiency than mean shift algorithm.
- The speed is very fast

The result of segmentation will be intact with good connectivity

RESULT

Following images are used to represent results

Source: paper Automatic Image Segmentation by Dynamic Region Merging by Bo Peng, Lei Zhang, Member, IEEE, and David Zhang, Fellow, IEEE

Input color image

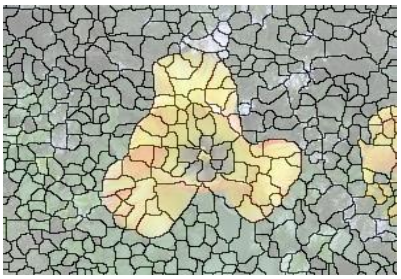
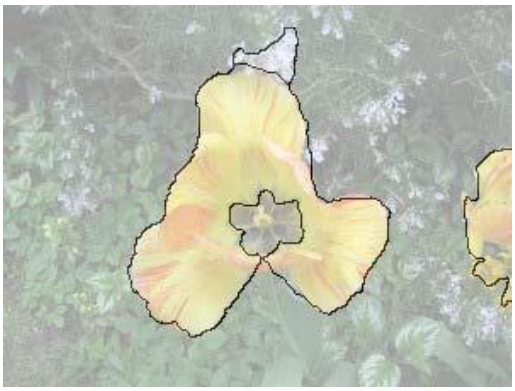


Image into regions



Output segmented image

CONCLUSION

Thus in this paper we studied the image improvement technique with the help of different algorithms such as hill climbing technique ,K means clustering, consistency test, dynamic region merging algorithm, nearest neighbor graph at different stages. We also studied how to check the consistency of the regions according to the predefined criteria. These image improvement techniques have great future in medical and electronics. The extension to above mention paper is to increase the efficiency and also increase in tolerance. We can also increase the speed of the operation using advance algorithms.

FUTURE SCOPE

- Improvement in efficiency
- Increase the tolerance
- Addition of global refinement: This is to correct the misclassified regions due to local decisions
- User interaction
- Interactive DRM algorithm

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